



Consumer preferences for simultaneous presentation of nutrition and environmental labelling: Evidence from a discrete choice experiment at UK scale

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ABSTRACT

Labels that simultaneously present environmental and nutritional information are proposed as interventions to drive consumer demand towards a more environmentally sustainable and healthy food system. Understanding how consumers respond to this simultaneous labelling approach is crucial for determining its feasibility and potential impact of implementation. We conducted a discrete choice experiment ($N = 1970$) in UK to analyse consumer preferences for a simultaneous label, and its relationship with taxes/subsidies and priming (environment, nutrition, combined, and no priming). We also considered how these preferences varied using different foods (beef burger and salad meal) and purchasing contexts (where choices were made within restaurants, retail, and via delivery apps). The results suggest that UK consumers prioritised health score over environmental score in relation to food choices. Simultaneous labelling synergistically amplified the effects of both scores for beef burgers. For salad meals, the environmental score increased willingness to pay when combined with the health score, demonstrating a conditional effect of the simultaneous labelling. Taxes significantly affected consumer choices while subsidies had no significant effect. The effectiveness of priming information was found to be highly dependent on the purchasing contexts, with greater effectiveness observed in retail and delivery app contexts. These findings offer valuable insights for the design of simultaneous labelling schemes and highlight the importance of context and priming strategies in promoting environmentally sustainable and healthy food choices.

1. Introduction

The global food system is associated with multiple negative impacts with respect to human health and environmental sustainability (den Boer et al., 2021; Rockström et al., 2020). Diet-related diseases such as obesity and cardiovascular diseases, contribute significantly to mortality rates and disability-adjusted life years in the UK (Schmidt et al., 2020). Further, current agri-food production practices have negative impacts

on both terrestrial and aquatic ecological systems (Crippa et al., 2021; Poore & Nemecek, 2018). Thus, to ensure equality of access to nutritious foods which are produced from nature positive production systems, transformation within the food system must simultaneously address both nutritional and environmental drivers and the demand for healthy and sustainably produced foods (Fanzo et al., 2021; Gaupp et al., 2021; Gibson et al., 2025). Various international and national policy initiatives, such as: Food and Agriculture Organization of the United Nations

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(FAO) / World Health Organization (WHO) guiding principles for sustainable healthy diets (FAO & WHO, 2019), the EU's Farm to Fork strategy (European Union, 2020; Schebesta & Candel, 2020), and the UK's Government Food Strategy (Department for Environment Food, and Rural Affairs, 2022), have moved beyond food production alone to focus on consumers' food-related behaviours, particularly those associated with sustainable and healthy consumption, in order to address both health outcomes and environmental sustainability simultaneously. This focus reflects the view that consumers' transition towards healthier and more sustainably produced food choices can drive wider systemic changes, including increased adoption of sustainable procurement practices by food wholesalers and retailers, strengthened regulations related to sustainable food systems, and the promotion of healthier and more environmentally friendly diets, thereby reshaping agri-food systems (Biswas et al., 2023; Garcia-Torres et al., 2019). In this context, effective communication through food labelling can facilitate such transitions by guiding consumer choice towards foods that are nutritious and environmentally sustainable (Morren et al., 2021; Poore & Nemecek, 2018) through reinforcing credence values and informing consumers about nutritional quality (Applegate et al., 2025; Heeremans et al., 2025; Yamim & Werle, 2025) and environmental impacts of food production and transportation (Fretes et al., 2025; Hughes et al., 2024). This is particularly relevant to the food industry, as insights into consumers' responses to food labelling provide strategic value by enabling firms to align labelling practices with consumer preferences and facilitate the transition towards more sustainable production and consumption systems (Mehrabi et al., 2022; Vittersø & Tangeland, 2015).

Despite existing studies suggest that both nutrition and environmental labels can capture British consumers' attention and may positively influence healthier or more sustainable food choices (Bou Fakhreddine et al., 2025; Hughes et al., 2024; Klotz et al., 2025), relatively few studies have examined the effects of presenting nutrition and environmental labels simultaneously. Jürkenbeck et al. (2024) found that simultaneous exposure to nutritional and environmental labels can lead to “spillover” or “halo” effects, where positive environmental sustainability labelling enhances perceived healthiness, and positive nutritional labels improve perceived environmental friendliness of production systems and products. However, in the context of food choice, simultaneous exposure to nutritional and environmental labels tends to increase healthier selections, while effects on sustainable choices are less consistent (De Bauw et al., 2022, 2021).

To support the simultaneous communication of environment and health information, tools such as the Dashboard for Improving Sustainable Healthy (DISH), food choices and the food compass scoring system, have been developed to capture both nutritional quality and environmental impact of foods (Agyemang et al., 2024; Aidoo et al., 2023). The “Sus-Health Index” is such a combined index, which uses a composite indicator methodology to integrate nutritional and environmental indices into various label presentations tailored to the UK context. It includes the use of Nutritics software for nutritional metrics and life cycle assessment methodology to evaluate environmental impacts (Grigoriadis et al., 2025). While these models provide a crucial evidence base for industry reformulation and product development, they have not examined how simultaneous presenting environmental and nutritional information should be communicated to consumers via labels, nor how these labels influence purchasing decisions (Collins et al., 2025). This leaves significant knowledge gaps for industry and policymakers.

Consumers process food labelling information through dual cognitive pathways (Sanjari et al., 2017), making decisions based on experiential (System 1) thinking or analytical (System 2) processing (Kahneman, 2011; Maubach et al., 2014). Reliance on these cognitive pathways may also be affected by choice environments. For example, experiential cues such as front-of-package nutrition labelling improved food choices under time pressure compared to traditional nutrition facts table (Hafner et al., 2026). Some researchers have employed physical,

verbal, or sensory cues within the environment to activate automatic mental associations that unconsciously influence consumers' food-related decisions, a process commonly referred to as “priming” (Ge et al., 2025). For example, Chen et al. (2024) used word search tasks to activate consumers' awareness of the health and environmental benefits of sustainable diets, which increased their sustainable food choices. Therefore, consumers' exposure to a general introduction about the healthiness and environmental sustainability of foods may act as a stimulus, affecting how they process subsequent nutritional and environmental labelling information on specific products and, in turn, influencing their food choices (Ferrari et al., 2019; Wilson et al., 2016). Priming may be adopted by food businesses as a useful strategy to amplify and accelerate the effects of simultaneous nutrition and environmental labelling on consumers' healthy and sustainable choices. However, to date, research examining the impact of simultaneous labelling within specific priming contexts about nutritional and environmental information remains limited.

Additionally, fiscal measures, such as taxes or subsidies, are designed to encourage the consumption of environmentally friendly and healthy foods, while discouraging those that are environmentally unsustainable, or which may harm human health (Fearne et al., 2022; Gutiérrez et al., 2025; Siegerink et al., 2024). Consumers' responses to taxation can be product specific. For instance, the reduction in consumption following the introduction of a red meat tax may be more pronounced for ground beef than for ribeye (Kilders et al., 2025), and greater for steak and ribs compared to beef burgers (Kilders et al., 2023). The effects of such a tax may also vary by consumption context and socio-economic status, with potentially stronger impacts in delivery settings than in dine-in restaurants, and among lower-income consumers (Kilders et al., 2023). However, despite the taxation reducing purchases of targeted unhealthy products and nutrients, consumers may “switch” to unhealthy untaxed equivalent products (Sacks et al., 2021). Empirical and theoretical analyses also caution that the introduction of such taxes does not inherently equate to an enhancement of overall consumer welfare (Lusk & Schroeter, 2012). In contrast, subsidizing healthy and/or sustainable foods, such as fruits and vegetables, can increase consumers' consumption of more nutritious and environmentally friendly products (An, 2013; Andreyeva et al., 2022; Osman et al., 2021). However, these positive effects may diminish once the subsidy is withdrawn (Comini et al., 2025). Given the distinct impacts of taxes and subsidies on consumption and their respective limitations in sustaining long-term behavioural change, some researchers have called for the exploration of combining these two strategies within specific cultural and consumption contexts (Osman et al., 2021).

Using a discrete choice experiment (DCE), this research aims to examine whether simultaneous presentation of nutrition and environment labelling (hereafter referred to as “simultaneous labelling”) can influence consumer preferences and food choice decisions for healthy and environmentally sustainable products. The “Sus-Health Index” label design adopted in this study integrates both nutritional and environmental dimensions within a single labelling system. It represents one of the design options tailored to the UK context under the Sus-health project (<https://www.ncl.ac.uk/nes/our-research/social-science/sushhealth/>). In addition, real-world strategies that may be adopted to influence food choices—namely priming and fiscal measures—are incorporated into the experimental design. Product categories (a beef burger and a salad meal) and purchase settings (retail, restaurant, and delivery app) are also systematically controlled, given evidence that the effects of food labelling on consumption are context specific. This research makes novel contributions to the literature on food labelling effectiveness by evaluating a simultaneous label across various conditions and provides evidence-based policy recommendations for promoting environmentally sustainable and nutritional dietary transitions through priming and fiscal measures.

2. Materials and methods

2.1. Experimental design

DCE is a choice-based experiment which has been widely used to examine consumer preferences regarding environmental or nutritional attributes in food products (Ornelas Herrera et al., 2025; Ren et al., 2025). A DCE presents respondents with multiple alternatives in several choice sets that differ across key characteristics, called attributes. By selecting their preferred alternative, respondents reveal their implicit trade-offs between different attribute levels (Lusk & Schroeder, 2004). Each choice set requires selection of exactly one option, with the number of sets per respondent determined within the experimental design. This methodology closely approximates real-world decision-making scenarios, while allowing for controlled attribute variation (Louviere et al., 2000).

Our online DCE was structured in two parts, with each part presenting a single virtual meal by a description (a beef burger or a salad meal) to account for a range of dietary preferences. Vegetarian and vegan respondents participated only in the salad meal experiment, while other respondents were involved in both meal experiments. To ensure that all participants were evaluating the same meal, identical pictures were used to represent each option (see Fig. 1). Consumers perceive different food products to have varying levels of healthiness and/or environmental impact even prior to receiving information about these attributes (Laguna-Camacho & Booth, 2015; Mertens et al., 2019). This selection of two meals allows examination of how labelling effects may vary across food categories with distinct nutritional and environmental sustainability benefits (Chaudhary et al., 2024; de Alcantara et al., 2025).

The alternatives in each choice set are characterized by three attributes: 1) price, 2) label and 3) tax/subsidy (see Table 1). The attributes selected were based on our research objective and the exploratory analysis (Collins et al., 2025). The first attribute, price, was based on actual prices in restaurants and grocery stores in May 2024 for salad and beef burger meals.² It is important to note that the price vector in both purchasing contexts is identical to avoid confounding effects from price vector variation, allowing for comparison of results across contexts (Glenk et al., 2019).

The second attribute was a simultaneous label providing information on both environmental sustainability and health aspects, represented as an environmental score (E-score) and a health score (H-score). Each dimension was classified into three levels: low, medium, and high. Participants were informed that a low E-score indicates the meal has a high negative environmental sustainability impact, while a high E-score suggests a low impact. Conversely, a low H-score implies the meal provides low nutritional value, whereas a high H-score indicates high nutritional value. These scores were visualized using a “doughnut” chart, with distinct colours representing each level (see Fig. 1). To ensure accessibility for individuals with colour vision deficiencies, we deliberately selected colour combinations recognized for their inclusivity.

The third attribute was the application of taxes and subsidies to the meal. Participants were informed that some meals were subsidized because they were healthier, more nutritious, or had a lower environmental impact related to agriculture and transport. Conversely, some meals were taxed because they were less healthy, less nutritious, or had a greater environmental sustainability impact from agricultural production and transportation. They were also informed that the price

² The prices were based on the actual prices for salad and beef burger meals found in grocery stores (Tesco, Marks & Spencer, Sainsbury's) and restaurants (McDonald's, Burger King, Smashburger, Fat Hippo, Five Guys, Pret A Manger, Subway, Nando's, PizzaExpress, Zizzi, and local restaurants). The average of these prices was set as the medium price.

displayed in the choice set was the final price, inclusive of any taxation or subsidy. Explanations of the attributes used in the survey are provided in Supplementary Table A. Our experimental design presenting tax and subsidy as explicit labelled attributes, distinct from the final price. This method is grounded in a key theoretical objective: to isolate and measure the signalling effect of the fiscal policy label itself, separate from the pure price change. This allows us to test whether the mere presence of a “tax” or “subsidy” label influences consumer utility independently. Moreover, our design enhances behavioural realism. In a real-world policy implementation, consumers are typically aware that a tax or subsidy is in effect, but they may not precisely calculate its full monetary amount at the point of purchase. This approach is used in behavioural economics for examining fiscal policies (e.g., (Dieteren et al., 2023)) and for implementing symmetric cost/reward attributes in choice experiments (e.g., (Ewing & Sarigöllü, 2000)). While some attribute combinations may appear implausible, research indicates that their inclusion does not necessarily have a significant negative effect on the consistency of preference information (Vetschera et al., 2014).

This DCE was unlabelled (the alternatives presented in each choice set were generic) with each choice set having four alternatives and a “None of these” opt-out option. The DCE was generated using SAS software employing a modified candidate-set-search algorithm to optimize the variance-covariance matrix of the choice model (Cook & Nachrheim, 1980; Fedorov, 2013). A full-factorial design of attribute levels was first generated to form the candidate set. From this candidate set, the algorithm systematically evaluated potential swaps between design alternatives and candidate alternatives to enhance overall design efficiency. This approach identifies efficient experimental designs by minimizing the variances of the parameter estimates, given an assumed parameter vector β . The resulting design treats generic attributes, such as price, consistently across alternatives. It ensured an unbiased estimation of main effects and interactions, and the statistical information provided by each choice set is maximized, while maintaining a manageable number of tasks for respondents and facilitating the identification of meaningful trade-offs between attributes (Kuhfeld, 2001). The final design included eighteen choice sets and was blocked into two sets of nine choice sets, with a relative D-efficiency of 87.3%. The design was drawn from a candidate set with a D-efficiency of 99.77%. An example of a choice set is provided in Fig. 1.

The experimental manipulations were designed to (1) prime participants with either environmental information, nutritional information, both, or no information, and (2) simulate different purchasing contexts: retail, restaurant, or using a food delivery app. These contexts were included given that certain food or purchasing contexts are often associated with less healthy (Ziauddeen et al., 2018) or less environmentally sustainable food choices (Biermann & Rau, 2020). Incorporating these purchasing contexts therefore allows the analysis to capture how the effectiveness of nutrition and environmental labelling may vary across real-world decision environments. Participants were first randomly assigned to one of the three purchasing contexts through an introduction and one corresponding image to ensure they all had the same understanding of their assigned context. The retail context represented a traditional shopping experience such as a supermarket, the restaurant context was shown as a dine-in setting, and the food delivery app was presented as a digital platform for purchasing meals (see Supplementary Table B). After this initial context-setting, participants were randomly allocated to one of the four priming conditions. The priming text emphasised the consequences of food choices for personal health and/or environmental sustainability (see Supplementary Table C). This design allowed measurement of the extent to which the different priming and purchasing contexts influenced participants' choice behaviour.

The survey started with participant information sheet and consent form, which briefly introduced the Sus-Health project and the aims of the survey, as well as providing information about the ethical approval (approval number 49492/2023) and data management. Using a cheap-talk script before the choice experiment, respondents were reminded



Fig. 1. Example choice cards for beef burger and salad meal.

Table 1
Attribute levels in choice experiment.

Attribute	Levels	
Price	Beef burger	Salad meal
	£4.95	£3.5
	£7.95	£5.5
	£10.95	£7.5
	£13.95	£9.5
Label	Environment high	
	Environment medium	
	Environment low	
	Health high	
	Health medium	
Tax/ Subsidy	Health low	
	Tax	
	Subsidy	
	None	

to consider their budget when choosing among alternatives and to make the choice as realistic as possible (Cummings & Taylor, 1999). This was followed by a brief explanation of the experiment and the attributes. The online survey was programmed and distributed in Qualtrics.³ A soft launch commenced in October 2024, followed by a full launch from November 2024 to January 2025. We selected respondents from a UK consumer panel and aimed for a representative sample of the UK population on age (aged above 18 years old), and gender.

³ Qualtrics. (2024). Qualtrics XM. Retrieved from: Qualtrics XM: The Leading Experience Management Software

2.2. Econometric approach and model estimation

The analysis of the DCE was grounded in random utility theory (McFadden, 1972), which assumes that the utility U of an individual i derives from selecting alternative j in choice situation t and can be expressed as:

$$U_{ijt} = \beta_i' X_{ijt} + \varepsilon_{ijt} \tag{1}$$

where X_{ijt} is a vector of alternative-specific attribute levels, β_i is the parameter vector to each attribute level, and ε_{ijt} is the unobservable error term. The use of individual-specific coefficients β_i captures preference heterogeneity across respondents.

The models were estimated using a mixed logit model (also known as a random parameter logit), which allows the parameter associated with each observed variable (e.g., its coefficient) to vary randomly across respondents (Revelt & Train, 1998). In this framework, a person's probability of choosing a given alternative depends on parameters that enter the person's utility function and a specification of the distribution (Train, 2016). Common distribution includes the normal distribution usually for general attributes and lognormal distribution typically used for price coefficients to ensure a negative sign consistent with economic theory (Barbera et al., 1998).

To avoid counter-intuitive distributions of marginal willingness to pay (WTP), the model is parameterized in WTP space where the WTP is specified to be jointly normal and the price/scale coefficient σ is lognormal. The utility is specified as separable in price, $Price$, and a vector of nonprice attributes, X :

$$U_{ijt} = -\alpha_i \cdot Price_{jt} + \theta_i' X_{kjt} + \varepsilon_{ijt} \tag{2}$$

where α_i is the individual-specific marginal utility of price and θ_i is a vector of individual-specific coefficients for non-price attributes. Both α_i

and θ_i vary randomly over respondents (Scarpa et al., 2008). The WTP for a given attribute is then calculated as the ratio of the attribute coefficient to the price coefficient:

$$w_i = \theta_i / \alpha_i \tag{3}$$

Substituting into the utility function, utility in WTP space is expressed as:

$$U_{ijt} = -\lambda_i Price_{ijt} + (\lambda_i w_i)' X_{ijt} + \varepsilon_{ijt} \tag{4}$$

where $\lambda_i = (\alpha_i / \mu_i)$ is the scaled price coefficient and w_i represents the vector of WTPs. Estimating the model directly in WTP space avoids potential biases and facilitates a more stable estimation of individual-level WTP (Train & Weeks, 2005). In our DCE, the utility function for individual i , selecting alternative j , in choice situation t , is defined as follow:

$$U_{ijt} = \beta_{Price} Price_{ijt} + \beta_{Hscore} H_{scoreijt} + \beta_{Escore} E_{scoreijt} + \beta_{Tax} Tax_{ijt} + \beta_{Subsidy} Subsidy_{ijt} + \beta_{inter} (H_{scoreijt} * E_{scoreijt}) + \varepsilon_{ijt} \tag{5}$$

Model estimation was performed in WTP space using 1000 Halton draws for simulated maximum likelihood estimation, with covariances computed numerically (Train, 2009). All analyses were conducted using R (Apollo package).

3. Results

3.1. Sample characteristics

2006 respondents fully completed the survey. Responses were excluded from participants who failed internal validity checks, such as providing the same answer across all questions (straightlining), or who completed the survey in an unreasonably short or long time (Börger, 2016; Zhang & Conrad, 2014). This resulted in 1970 valid responses. The Random Response Share (RRS), used to identify random responding within the sample (Malone & Lusk, 2018), was estimated at 23%, indicating that the majority of respondents exhibited systematic and attentive choice behaviour. The sample was representative of the UK population in terms of gender and age (Table 2). The following results describe respondents' preferences for simultaneous labelling and other attributes, their mean WTP, and their preferences heterogeneity across food categories and priming/purchasing contexts.

3.2. Preference for attributes

A mixed logit model in WTP space was estimated to assess the effects of attributes including price, E-score, H-score, and tax/subsidy. Since the model was estimated in WTP space, the price parameter does not directly influence WTP interpretation. The alternative-specific constant (ASC) was coded as 0 for the opt-out alternative ("None of these" option) and 1 for all other alternatives, meaning a positive coefficient indicates higher utility for meal purchases when all attribute levels were zero, following standard practice in discrete choice experiments (Arbiol et al., 2015; Bazzani et al., 2025). The means and standard deviations of the non-price parameters reflect average preference and preference heterogeneity respectively. Robust standard errors were reported.

We first outlined the results based on the total 1970 respondents (Table 3). Most estimated parameters were statistically significant. The price coefficients were significantly negative across all meals, which is consistent with previous findings that price generally reduces utility in consumer choice models (Ben-Akiva & Lerman, 1985). The positive coefficients of H-score and E-score suggested that respondents valued burger beef and salad meals with high nutritional value and low environmental impact. However, they placed a higher premium on nutritional gains than on environmental benefits. For beef burger, the H-score had the strongest positive effect on choice followed by the E-score,

Table 2
Descriptive statistics (in %).

Variable	Sample (N = 1970)	Population
Gender		
Female	51.02	51.55
Male	48.73	48.44
Prefer not to say	0.05	–
Non-binary	0.20	–
Age		
18–24	12.03	10.49
25–34	20.20	17.06
35–44	18.68	16.43
45–54	17.36	16.81
55–65	14.57	15.92
Over 65	17.16	23.29
Education		
No formal qualifications	2.69	18.20
High school level or equivalent	36.50	16.90
Undergraduate degree level or equivalent	38.58	–
Postgraduate degree or higher	22.23	33.80
Annual household income (£)		
Up to 15,599	12.59	–
15,600 to 25,999	16.60	–
26,000 to 36,399	15.79	–
36,400 to 51,999	17.26	–
52,000 to 69,999	12.23	–
70,000 to 89,999	9.04	–
90,000 and above	16.50	–
Current diet		
Include animal products (e.g. meat, fish, dairy, and eggs)	94.77	–
Vegetarian (I do not eat any meat, poultry, fish, or shellfish, but eat dairy and/or eggs)	4.06	7.00
Vegan (I do not eat dairy products, eggs, or any other animal products)	1.17	3.00

Notes: All population statistics are taken from 2021 Census (Office for National Statistics, 2023). These datasets classify usual residents aged 16 years and over in England and Wales. The dietary statistics are from Statista Research Department (2024).

indicating that both health and environmental scores positively influenced participants' choices. The interaction between the two scores (E-score × H-score) was statistically significant, suggesting that the simultaneous label may reinforce positive evaluations when health and environmental attributes align (e.g. for healthy and environmentally sustainable meals). Fiscal policy instruments had a marked effect where tax significantly reduced utility in consumer choice, while subsidies significantly increased it. All the included attributes had a significant impact on beef burger choices, but their influence was less strong for salad meals. The H-score remained a significant predictor of choice for salad meals, whereas the E-score was statistically insignificant. The interaction term showed a significant effect, which implied the E-score still influenced participants' choices, but primarily when combined with the H-score. Taxes also reduced respondents' utility, though the effect was smaller compared to beef burger, while subsidies had no significant influence. A positive and statistically significant ASC indicates that respondents have higher utility from selecting one of the offered meal options than from choosing the opt-out alternative. Respondents showed a general preference for making a choice among the four meal alternatives rather than selecting "None of these."

Table 3 also shows that the role of nutrition and environmental labelling varies by the type of meal (burger or salad). The results suggest that nutrition and environmental scores are relatively more important for what could be perceived as less healthy and environmentally sustainable meals, such as beef burgers, than for meals perceived as more healthy and environmentally friendly, such as salads. In addition, results also suggest that the role of economic incentives such as taxes and subsidies is more relevant for meals that may be seen as less healthy and more environmentally sustainable than for meals perceived as healthy and environmentally friendly. Results show that respondents are

Table 3
Mixed logit model results in WTP space.

Beef burger			Salad meal		
	Coef	S.D.		Coef	S.D.
H-score	1.645*** (0.057)	-1.661*** (0.093)	H-score	0.945*** (0.045)	1.156*** (0.073)
E-score	0.420*** (0.051)	0.933*** (0.051)	E-score	0.078 (0.054)	0.682*** (0.061)
E-score* H-score	0.122*** (0.018)	0.387*** (0.016)	E-score* H-score	0.175*** (0.014)	0.370*** (0.014)
Tax	-0.884*** (0.099)	0.173 (0.139)	Tax	-0.446*** (0.051)	0.153 (0.106)
Subsidy	0.264*** (0.078)	-0.107 (0.128)	Subsidy	-0.008 (0.049)	0.086 (0.065)
Price	-2.125*** (0.052)		Price	-0.825*** (0.040)	
ASC	2.209*** (0.085)		ASC	3.868*** (0.156)	
Number of Respondents	1818		Number of Respondents	1970	
Log Likelihood (Converged)	-21,751.48		Log Likelihood (Converged)	-20,064.69	
AIC	43,528.97		AIC	40,155.38	
BIC	43,629.1		BIC	40,256.56	

Notes: ASC denotes the alternative-specific constant. Estimated mean coefficients (Coef) and standard deviations (S.D.) from a mixed logit model. Standard errors in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Negative standard deviation values result from the model coding ($\beta = \mu + \sigma \times draws$) where draws are random variate (Hess and Palma, 2025).

relatively more sensitive to price changes for burger than salad meals. As shown in Table 4, the mean WTP for both beef burger and salad

Table 4
Mean WTP and 95% confidence intervals for beef burger and salad meals by E-score and H-score levels.

	Beef burger			Salad		
	Low E	Medium E	High E	Low E	Medium E	High E
No tax nor subsidy						
	£2.07 (£1.93, £2.22)	£2.32 (£2.13, £2.52)	£2.58 (£2.33, £2.84)	£6.14 (£5.47, £6.92)	£6.45 (£5.69, £7.33)	£6.75 (£5.88, £7.56)
Low H	£2.90 (£2.72, £3.08)	£3.21 (£2.99, £3.45)	£3.53 (£3.24, £3.82)	£7.49 (£6.73, £8.41)	£8.02 (£7.14, £9.04)	£8.54 (£7.53, £9.70)
Medium H	£3.73 (£3.53, £3.95)	£4.10 (£3.84, £4.38)	£4.47 (£4.14, £4.82)	£8.85 (£7.98, £9.90)	£9.59 (£8.59, £10.76)	£10.32 (£9.17, £11.65)
Tax; no subsidy						
	£1.65 (£1.50, £1.81)	£1.91 (£1.71, £2.12)	£2.16 (£1.91, £2.43)	£5.60 (£4.96, £6.35)	£5.90 (£5.17, £6.75)	£6.21 (£5.36, £7.18)
Low H	£2.48 (£2.30, £2.68)	£2.80 (£2.57, £3.04)	£3.11 (£2.82, £3.41)	£6.95 (£6.22, £7.83)	£7.48 (£6.63, £8.46)	£8.00 (£7.02, £9.12)
Medium H	£3.32 (£3.11, £3.54)	£3.69 (£3.42, £3.97)	£4.06 (£3.72, £4.40)	£8.31 (£7.47, £9.31)	£9.05 (£8.08, £10.18)	£9.78 (£8.66, £11.07)
No Tax; subsidy						
	£2.19 (£2.03, £2.36)	£2.45 (£2.24, £2.66)	£2.70 (£2.44, £2.98)	£6.13 (£5.45, £6.92)	£6.43 (£5.67, £7.32)	£6.74 (£5.86, £7.75)
Low H	£3.02 (£2.84, £3.23)	£3.34 (£3.10, £3.59)	£3.65 (£3.36, £3.96)	£7.48 (£6.71, £8.40)	£8.00 (£7.13, £9.03)	£8.53 (£7.52, £9.69)
Medium H	£3.86 (£3.63, £4.09)	£4.23 (£3.95, £4.52)	£4.60 (£4.25, £4.96)	£8.84 (£7.96, £9.89)	£9.58 (£8.57, £10.76)	£10.31 (£9.16, £11.65)
Tax; subsidy						
	£1.78 (£1.60, £1.96)	£2.03 (£1.82, £2.26)	£2.29 (£2.02, £2.57)	£5.59 (£4.94, £6.35)	£5.89 (£5.15, £6.75)	£6.20 (£5.34, £7.18)
Low H	£2.61 (£2.41, £2.82)	£2.92 (£2.68, £3.18)	£3.23 (£2.93, £3.55)	£6.94 (£6.20, £7.82)	£7.46 (£6.62, £8.45)	£7.99 (£7.00, £9.11)
Medium H	£3.44 (£3.21, £3.68)	£3.81 (£3.53, £4.10)	£4.18 (£3.84, £4.54)	£8.30 (£7.45, £9.31)	£9.03 (£8.07, £10.17)	£9.77 (£8.65, £11.07)

Notes: “E” refers to the E-score and “H” refers to the H-score. Low E (Medium E/High E) indicates a low (medium/high) E-score level, and Low H (Medium H/High H) indicates a low (medium/high) H-score level. 95% confidence intervals in parentheses.

meals increased with higher H-score and E-score. This indicated that respondents were willing to pay a premium for products with better scores on both attributes. Furthermore, the results consistently showed that the application of a tax reduced WTP across all combinations of H-score and E-score. These findings align with the utility coefficients presented in the Table 3, where both H-score and E-score were significant positive drivers of choice, while taxes had a negative effect on consumer utility.

3.3. Preference heterogeneity

The heterogeneity of effects across priming information and purchasing contexts was further assessed. In terms of beef burger (Table 5), the H-score consistently exhibited the strongest and most significantly positive effect on choices across all contexts. For the E-score, significant effects were observed in retail contexts, when participants were primed with nutrition information (nutrition priming and combined priming). In contrast, in restaurant contexts, the E-score was only significant in decision-making regarding food choices when environmental information was not provided. Under the app delivery condition, the E-score significantly influenced decision-making when environment priming was included. These findings suggested that the effect of priming on the E-score was highly context-dependent and varied across purchasing contexts. Notably, the interaction terms between E-score and H-score were significant under both no priming and nutrition priming when the E-score alone was not significant. This indicated that the E-score influenced choice through its interaction with nutrition information. In restaurant contexts, the E-score became insignificant when participants were primed with environmental information, suggesting a potential diluting of E-score influence under this condition.

The interaction term was consistently significant in most app delivery contexts for beef burgers particularly under no priming and nutrition priming, suggesting a positive interaction effect in the app delivery context. The restaurant context showed limited evidence of interaction effects, with significance observed only when nutrition priming was provided, indicating the effectiveness of this priming strategy for the simultaneous label in that context.

Tax had a significantly negative effect on respondents' choices of beef burgers under nutrition priming across different contexts, suggesting that the presence of nutrition information may enhance the effect of the tax. Respondents who were only primed with nutrition information were less likely to make unhealthy choices when the meals were taxed. The subsidy was insignificant under most contexts, indicating that subsidization had a limited effect on incentivizing consumer behaviour.

In terms of participant responses to the salad meals (Table 6), the H-scores remained significant predictors of choices. The E-score had a non-

Table 5
Mixed logit model in WTP space under different priming and purchasing contexts on beef burger.

	No Priming			Nutrition Priming			Environment Priming			Nutrition+Environment Priming		
	Delivery	Retail	Restaurant	Delivery	Retail	Restaurant	Delivery	Retail	Restaurant	Delivery	Retail	Restaurant
Mean												
H-score	1.743*** (0.100)	1.704*** (0.190)	2.430*** (0.179)	1.068*** (0.156)	1.784*** (0.173)	2.020*** (0.137)	1.978*** (0.076)	1.714*** (0.202)	1.344*** (0.315)	1.590*** (0.144)	1.824*** (0.168)	1.740*** (0.117)
E-score	0.223 (0.159)	0.055 (0.302)	1.020*** (0.144)	0.031 (0.193)	0.898*** (0.249)	0.940*** (0.082)	0.637*** (0.131)	0.044 (0.317)	0.294 (0.209)	0.355* (0.173)	0.674*** (0.098)	0.534 (0.377)
E-score* H-score	0.295*** (0.069)	0.249*** (0.040)	0.029 (0.031)	0.304*** (0.068)	0.052 (0.054)	0.104*** (0.024)	0.172** (0.064)	0.184* (0.082)	0.241 (0.124)	0.178* (0.076)	0.113** (0.041)	0.144 (0.265)
Tax	-0.495 (0.299)	-0.684 (2.178)	-1.229** (0.468)	-1.071*** (0.266)	-1.586*** (0.395)	-1.664*** (0.216)	-1.278*** (0.314)	-1.301** (0.434)	-1.181* (0.471)	-0.358 (0.446)	-1.174*** (0.257)	-0.858* (0.346)
Subsidy	0.459 (0.274)	0.038 (0.543)	0.403 (0.296)	-0.117 (0.259)	0.111 (0.291)	-0.105 (0.234)	0.188 (0.254)	0.594* (0.342)	0.262 (0.806)	0.622** (0.223)	0.115 (0.327)	0.612 (0.423)
Price	-1.998*** (0.167)	-2.370*** (0.262)	-2.189*** (0.342)	-2.229*** (0.195)	-2.360*** (0.196)	-2.402*** (0.234)	-2.555*** (0.271)	-2.070*** (0.193)	-1.855*** (0.187)	-2.334** (0.183)	-2.248*** (0.220)	-2.134*** (0.380)
ASC	2.746*** (0.408)	2.670*** (0.350)	1.733*** (0.272)	2.509*** (0.330)	1.397*** (0.214)	2.118*** (0.302)	1.951*** (0.235)	2.537*** (0.398)	3.171*** (0.384)	2.160*** (0.291)	1.961*** (0.248)	1.830*** (0.282)
S.D.												
H-score	-1.225*** (0.116)	-1.880*** (0.144)	-1.507*** (0.143)	1.238*** (0.161)	1.073*** (0.196)	-1.162*** (0.144)	-1.206*** (0.100)	-1.334*** (0.234)	-1.462* (0.630)	2.400*** (0.328)	-0.943*** (0.220)	-1.501*** (0.277)
E-score	-0.653*** (0.092)	1.127*** (0.079)	1.295** (0.419)	1.024*** (0.118)	-0.505*** (0.165)	-0.813*** (0.041)	1.454*** (0.248)	0.778*** (0.149)	-0.972*** (0.202)	-1.073*** (0.119)	-0.486*** (0.064)	-0.640** (0.199)
E-score* H-score	0.549*** (0.093)	-0.442*** (0.079)	-0.486*** (0.058)	0.303*** (0.052)	0.349*** (0.070)	-0.376*** (0.029)	0.452*** (0.041)	-0.435*** (0.041)	-0.634*** (0.160)	-0.431*** (0.053)	-0.404*** (0.049)	-0.395 (0.492)
Tax	-0.486 (0.331)	-0.065 (3.709)	-1.563*** (0.435)	-0.487* (0.205)	-1.330*** (0.251)	1.210*** (0.148)	-1.215*** (0.205)	1.656*** (0.416)	0.899* (0.390)	1.249*** (0.307)	-0.675* (0.286)	-0.522 (1.197)
Subsidy	0.202 (0.246)	-1.272 (0.653)	0.231 (0.444)	-0.195 (0.219)	0.178 (0.176)	0.998*** (0.213)	0.200 (0.425)	-0.784 (0.412)	-0.479 (1.441)	1.460*** (0.224)	-0.692 (0.427)	-0.688 (1.380)
Number of Respondents	152	147	142	173	145	134	162	135	152	155	158	163
Log Likelihood (Converged)	-1743.01	-1731.52	-1679.58	-2095.18	-1811.37	-1589.25	-1953.42	-1583.67	-1717.72	-1852.46	-1892.34	-1977.66
AIC	3512.03	3489.04	3385.17	4216.37	3648.74	3204.5	3932.85	3193.34	3461.44	3730.91	3810.67	3981.33
BIC	3579.9	3556.48	3452.16	4285.92	3716	3270.73	4001.55	3259.67	3529.32	3799.04	3879.05	4050.11

Notes: ASC denotes the alternative-specific constant. S.D. denotes the standard deviations. Standard errors in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Negative standard deviation values result from the model coding ($\beta = \mu + \sigma \times \text{draws}$) where draws are random variate.

Table 6
Mixed logit model in WTP space under different priming and purchasing contexts on salad meal.

	No Priming			Nutrition Priming			Environment Priming			Nutrition+Environment Priming		
	Delivery	Retail	Restaurant	Delivery	Retail	Restaurant	Delivery	Retail	Restaurant	Delivery	Retail	Restaurant
Mean												
H-score	1.027*** (0.093)	0.922*** (0.079)	1.183*** (0.078)	0.649*** (0.180)	1.180*** (0.137)	0.915*** (0.094)	1.310*** (0.090)	0.929*** (0.051)	0.916*** (0.039)	1.100*** (0.048)	1.108*** (0.055)	0.991*** (0.146)
E-score	0.138 (0.073)	-0.110 (0.106)	0.182 (0.139)	-0.031 (0.204)	0.193 (0.121)	-0.123 (0.155)	0.296** (0.093)	0.089 (0.155)	-0.049 (0.060)	0.077 (0.058)	0.149** (0.054)	-0.164 (0.096)
E-score* H-score	0.253*** (0.029)	0.132*** (0.031)	0.148*** (0.041)	0.202*** (0.043)	0.131*** (0.033)	0.236*** (0.041)	0.146*** (0.028)	0.127* (0.059)	0.333*** (0.020)	0.105*** (0.017)	0.167*** (0.019)	0.200*** (0.038)
Tax	-0.642*** (0.174)	-0.364* (0.151)	-0.440* (0.183)	-0.455* (0.187)	-0.759*** (0.166)	-0.344* (0.174)	-0.490*** (0.129)	-0.430** (0.149)	-0.396** (0.127)	-0.403** (0.136)	-0.341* (0.134)	-0.767 (0.619)
Subsidy	0.119 (0.119)	0.045 (0.128)	0.101 (0.239)	-0.037 (0.162)	0.011 (0.145)	-0.201 (0.155)	0.022 (0.146)	-0.175 (0.128)	0.089 (0.098)	-0.130 (0.106)	-0.104 (0.088)	-0.181 (0.180)
Price	-0.875*** (0.115)	-0.702*** (0.120)	-1.004*** (0.124)	-0.738*** (0.119)	-0.922*** (0.125)	-0.945*** (0.125)	-0.798*** (0.113)	-0.824*** (0.144)	-0.761*** (0.131)	-0.574*** (0.118)	-0.640*** (0.112)	-1.057*** (0.143)
ASC	4.223*** (0.533)	5.077*** (0.626)	4.024*** (0.669)	3.584*** (0.459)	3.013*** (0.474)	3.960*** (0.590)	3.417*** (0.468)	4.022*** (0.508)	5.290*** (0.747)	4.786*** (0.607)	4.680*** (0.556)	3.943*** (0.487)
S.D.												
H-score	-1.091*** (0.149)	1.116*** (0.067)	-1.308*** (0.121)	1.334*** (0.239)	-0.853*** (0.111)	-1.174*** (0.121)	1.185*** (0.091)	0.584*** (0.099)	0.908*** (0.060)	-0.984*** (0.051)	-1.439*** (0.102)	1.377*** (0.118)
E-score	-0.638*** (0.063)	-0.731*** (0.082)	-0.905*** (0.084)	0.688** (0.257)	-0.733*** (0.095)	-0.828*** (0.109)	-0.613*** (0.061)	-1.063*** (0.126)	-0.499*** (0.023)	-0.872*** (0.014)	-0.698*** (0.057)	0.907*** (0.200)
E-score* H-score	-0.423*** (0.036)	-0.338*** (0.014)	0.443*** (0.045)	0.352*** (0.080)	-0.364*** (0.027)	0.383*** (0.038)	-0.288*** (0.015)	-0.262*** (0.022)	-0.396*** (0.013)	-0.257*** (0.014)	-0.330*** (0.022)	0.477*** (0.048)
Tax	0.389 (0.369)	-0.393* (0.196)	0.537*** (0.126)	0.660*** (0.166)	-0.207 (0.176)	0.499* (0.229)	0.189 (0.102)	0.038 (0.420)	0.632*** (0.112)	0.422*** (0.101)	-0.319** (0.120)	-0.074 (1.202)
Subsidy	0.377*** (0.114)	0.296 (0.180)	-0.694** (0.225)	0.148 (0.146)	-0.063 (0.088)	0.172 (0.191)	0.076 (0.166)	0.125 (0.127)	-0.205*** (0.027)	0.168* (0.078)	0.120* (0.047)	-0.692 (0.581)
Number of Respondents	165	163	155	182	161	145	176	146	168	165	167	174
Log Likelihood (Converged)	-1665.47	-1609.63	-1562.18	-1884.3	-1667.91	-1507.73	-1773.3	-1501.38	-1645.88	-1598.07	-1644.18	-1812.18
AIC	3356.94	3245.26	3150.36	3794.6	3361.81	3041.46	3572.61	3028.76	3317.75	3222.14	3314.35	3650.35
BIC	3425.88	3314.04	3218.49	3864.82	3430.44	3108.72	3642.39	3096.11	3386.93	3291.09	3383.45	3719.98

Notes: ASC denotes the alternative-specific constant. S.D. denotes the standard deviations. Standard errors in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Negative standard deviation values result from the model coding ($\beta = \mu + \sigma \times draws$) where draws are random variate.

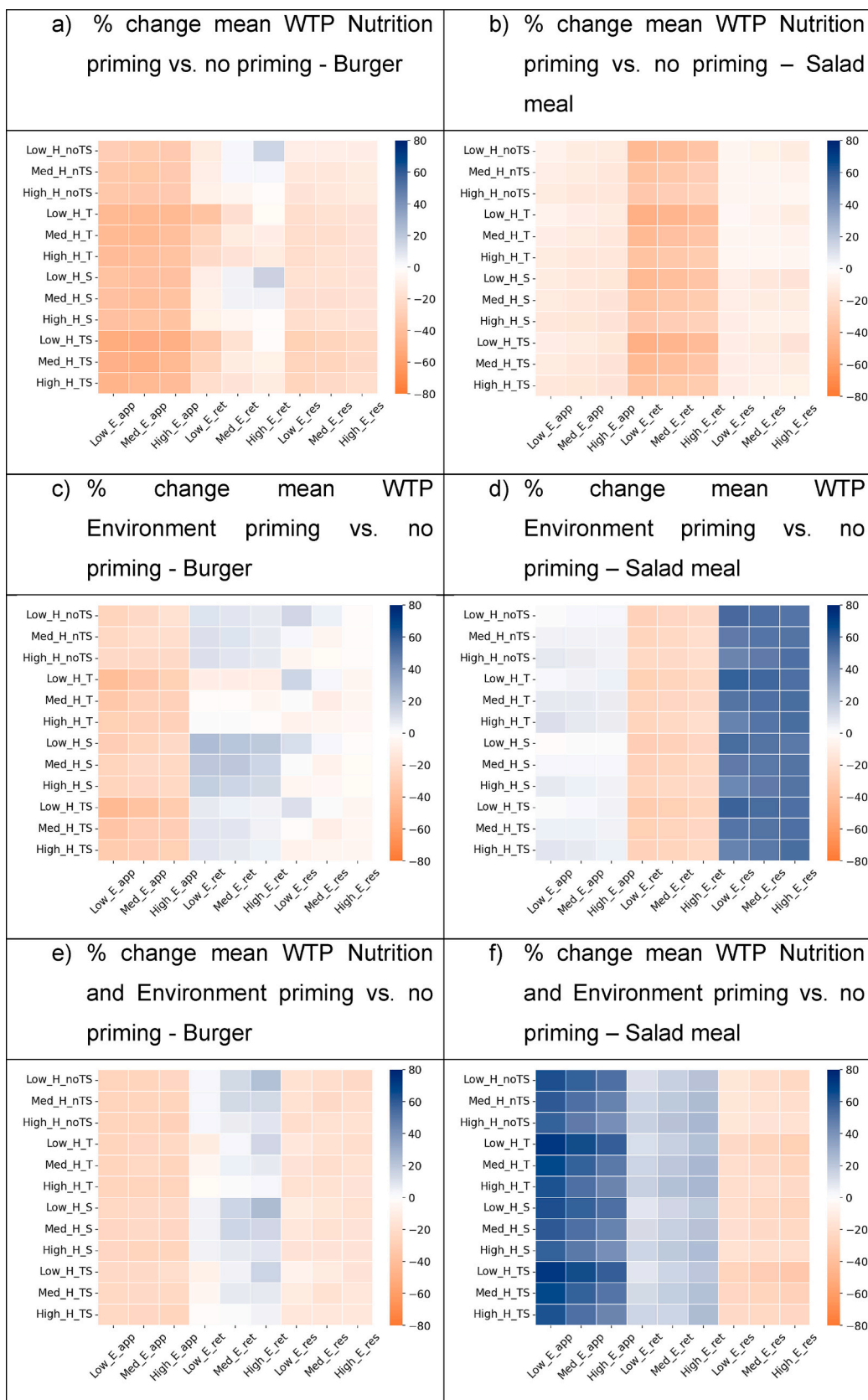


Fig. 2. Mean WTP percentage change under different priming /purchasing contexts, meals, health and environmental score combinations and policy treatments. Notes: Blue cells imply positive willingness-to-pay (WTP) differences between priming and no priming, the darker blue cell indicates priming is more effective. Orange cells imply negative WTP differences between priming and no priming, the darker orange cells indicate priming is more ineffective. The x-axis represents three distinct purchasing contexts (app: delivery app; ret.: retail; res: restaurant), each with three different environmental score levels (Low_E, Med_E, High_E). The y-axis represents the different combinations of health score levels (Low_H, Med_H, High_H) and tax/subsidy (TS).

significant effect indicating its limited influence, except under specific conditions such as environment priming in the app delivery context ($p < 0.01$) and combined priming in the retail context ($p < 0.01$). Across all priming contexts, the interaction between environmental and health scores was positive and statistically significant, indicating a synergistic effect. The strong interaction effects and insignificant E-score effects imply E-score's effect is highly related to H-score for the salad meals. A less significant interaction effect was observed under environment priming in retail; the E-score appeared to play an insignificant role in the retail context when environment priming was provided.

The effects of the tax on the salad meal were significant in most contexts. In retail contexts with nutrition priming, the absolute value of the tax coefficient was the largest, suggesting that tax had a stronger influence on consumer behaviour in retail context when nutrition priming is provided. In contrast, the subsidy remained insignificant across all contexts, indicating its limited ability to influence consumer behaviour in relation to food choices.

3.4. Priming effectiveness

Fig. 2 summarises the percentage change of individual's mean WTP under a range of combinations of health and environmental levels with different tax/subsidy policies for different information priming versus no priming. These figures suggest a more complex picture than that provided in Table 4. Focusing on the positive WTP differences between priming and no priming (blue cells), the darker blue cell indicates where priming increases the likelihood of purchasing a burger/salad. For negative WTP differences between priming and no priming (orange cells) the darker orange cells indicate that priming decreases the likelihood of purchasing a burger/salad. The impact of priming is not consistently positive or negative across all segments and attributes. Some priming lead to increased WTP (blue cells), while others result in decreased WTP (orange cells) compared to no priming. Environment priming and combined priming show more consistently positive effects on WTP for salad meals as darker blue cells are prevalent across various segments.

The effect of priming varied across purchasing contexts, taxation/subsidy, and meals. Priming was found to increase the likelihood of purchasing salad meals, and to decrease the purchasing of beef burger meals which suggested the effects of priming on the whole WTP vary according to how healthy or environmentally sustainable the food choice being initially considered to be. For salad meals, environment priming and combined priming show more consistently positive effects on WTP for salad meals as darker blue cells are prevalent across various segments. Environment priming was most effective in restaurants, followed by delivery apps, while it was ineffective in retail context. A combined environment and nutrition priming strategy would be comparatively more effective for consumers using delivery apps and in retail contexts, than if applied in a restaurant context. For beef burgers, priming reduces the likelihood of purchasing burgers in delivery contexts but increasing their likelihood of purchase in retail environments.

4. Discussion

The effects of a simultaneous presentation of nutrition and environment label on consumers' food choices in various meal, priming and purchasing contexts were investigated. The results indicated consistent positive effects of the H-score on WTP for both beef burger and salad meals across all contexts (Alsubhi et al., 2023; Dubois et al., 2021; van den Akker et al., 2022). This can be attributed to health-related motivations being a primary driver of consumers' food selection in the UK (Cheikh Ismail et al., 2025; Markovina et al., 2015), specifically due to higher nutrition self-efficacy and a stronger internal health locus of control (Stewart-Knox et al., 2025). In contrast, the effects of E-score on WTP were smaller than those of H-score across all contexts. This aligns with previous findings that UK consumers consider the environmental

impacts of foods to be a less important motive in food choice compared to health and tend to prioritize nutritional information over environmental information in food labelling as a determinant of decisions (Markovina et al., 2015; Yue et al., 2024). The results of exploratory focus group research in relation to the Sus-health index further support this, as the environmental impacts of foods were considered as less important compared to health concerns in relation to consumer food choices (Collins et al., 2025). This is potentially because immediate negative impacts on personal health appear psychologically close, whereas systemic risks to the environment are perceived to be psychologically distant and uncontrollable (Braga et al., 2015; Dowd & Artistic, 2016).

These results showed that the E-score tended to have greater direct positive effects for the beef burger compared to the salad meals, overall and across priming and purchasing contexts. This suggests that environmental sustainability evaluations consistently influence consumers' decisions regarding foods generally perceived as environmentally unfriendly, such as a beef burger, implying a willingness to pay more for "greener" options within this category. This supports previous research which has shown that consumers exhibit stronger preferences for environmental sustainability information when evaluating beef and chicken products in comparison to vegetable products as they may already perceive themselves as engaging in environmentally sustainable consumption by choosing vegetables over meat (Osawe et al., 2023). Thus, in addition to reducing the consumption of food categories known to have a high environmental burden (e.g. beef and dairy products) (The Climate Change Committee, 2025), it is possible to guide consumers choosing products from these categories using the simultaneous labelling, which have been produced through processes and systems that are relatively perceived as more environmentally friendly, such as organic farming and locally produced (Ditlevsen et al., 2020; Hughner et al., 2007). However, there is a risk that consumers may choose high environmental burden products with relatively good E-scores as a way to reduce the cognitive dissonance caused by the conflict between their belief in the need to reduce consumption of environmentally unsustainable foods and their desire to continue consuming these foods (Bandura, 1990). This may undermine strategies aimed at reducing consumption within these food categories. For a more accurate understanding of the actual impacts of the simultaneous labelling on consumption patterns and the environment, perhaps a long-term assessment conducted at regional or larger scales is needed.

While the interaction between the H-score and the E-score had a significant positive effect on consumers' WTP for both the beef burger and the salad meals, the underlying cognitive mechanisms may differ, reflecting the distinct roles that healthiness and environmental sustainability play in consumers' choices across different food types. In the case of the beef burger, both the H-score and the E-score had direct positive effects on consumers' WTP, suggesting that healthiness and environmental sustainability are both key considerations in consumer decision-making. When the H-score and E-score are presented simultaneously, the significant positive interaction effect can be interpreted as a synergistic effect. This synergy may arise from the complementarity of the two attributes, whereby their combination enhances perceived utility beyond the sum of their individual effects (Barbera et al., 1998). Alternatively, it may reflect "spillover" or "halo" effects, where positive environmental sustainability labelling enhances perceived healthiness, or favourable nutritional information improves perceptions of the environmental sustainability attributes of foods (Apolaza et al., 2017; Besson et al., 2019; Büttner et al., 2024). In contrast, for the salad meal, the E-score increases WTP only when it is paired with a sufficiently good H-score, highlighting the importance of simultaneous labelling in activating such a conditional effect. Thus, for food categories that are already perceived as environmentally sustainable, such as salad meals, simultaneous labelling is likely necessary to generate a positive impact of the E-score on consumer choices.

The use of priming to enhance consumers' simultaneous

consideration of nutritional and environmental information provided by simultaneous labelling differs across purchasing contexts. Environment priming was more likely to enhance the effects of both the H-score and E-score on purchase decisions in an app delivery context, whereas combined priming appeared to be more effective in influencing food choices in a retail context. In contrast, none of the three types of priming tended to simultaneously enhance the effects of both the H-score and E-score in a restaurant context. This divergence may reflect differences in cognitive processing demands across contexts. Due to consumers tend to prioritize enjoyment, budget, or habitual choices due to hedonistic motives when dining out (Babakhani et al., 2020; Greene et al., 2024), additional information priming at restaurants might be less effective. As factual, non-sensory information is significant for online choices (Degeratu et al., 2000), it's beneficial for delivery apps to provide more environmental sustainability information to prime consumers for more environmentally friendly and healthier options. Moreover, the effect of priming information can be negative compared to no priming, indicating information overload where processing requirements exceed consumers' abilities, making information a barrier despite its relevance (Bawden & Robinson, 2020; Matthes et al., 2020). Adding additional voluntary information on food labels can sometimes decrease consumer recall and comprehension, leading to cognitive overload and confusion (Bogliacino et al., 2023).

4.1. Policy implication

This result provides evidence which supports the inclusion of simultaneous labelling as a policy mechanism to promote healthy and environmentally sustainable food choices, thus acting on the demand side of the food system. Various policy initiatives and actions address this need. For example, the UK government's Food Data Transparency Partnership (FDTP) aiming to use better data to improve food system sustainability and health, could propose a standardized simultaneous labelling scheme that presents both health and environmental scores to guide future food labelling regulations (DEFRA, 2024). While there appears to be some differentiation between responses towards simultaneous labelling according to food categories, it may be impractical to design different approaches at a food category level rather than a food system level, as this would reduce consumer's ability to compare between products within different categories. Priming strategies may be particularly effective in influencing healthy and environmentally sustainable food choices in retail and food delivery contexts, as opposed to restaurant context. Policymakers should collaborate with stakeholders, such as consumers, retailers, and food delivery platforms, to co-develop priming strategies and determine how such information is presented.

The results suggest that there is an asymmetry in consumer response to the fiscal measures applied, such that taxes exert a negative effect on some consumer choices, while subsidies do not positively impact on these. This aligns with existing evidence suggesting that taxes, such as those on sugar-sweetened beverages, will reduce their consumption (Tiboldo et al., 2024; Wang et al., 2025). Taxing unhealthy (e.g., high-energy dense) products has been more successful in reducing calorie consumption than subsidizing healthy products (Cheikh Ismail et al., 2025). Therefore, implementing taxes on foods may be a policy priority. The revenue raised from taxes might be used to develop interventions to reduce the negative impacts of foods and subsidise farmers who produce healthy and sustainable food products, thereby creating a virtuous circle. From a UK policy perspective, this suggests that existing policies such as the Soft Drinks Industry Levy, which applies to the production and importation of soft drinks containing added sugar, are effective in promoting healthier food choices (Briggs et al., 2013; HM Revenue & Customs, 2016). In light of this, taxing foods based on both H-score and E-score may be an effective way to simultaneously promote healthy and environmentally sustainable diets among UK consumers.

5. Conclusion

Transforming food consumption patterns is fundamental for establishing food systems that are resilient to climate change and support long-term healthy food systems. One potential intervention to guide consumers towards healthier and more environmentally sustainable dietary choices is the implementation of simultaneous labelling that integrates both health and environmental scores. Our research demonstrated a significant effect of simultaneous labelling, suggesting its potential as a promising intervention. The results indicated that the cognitive mechanism of this interaction effect differs by food category, as evidenced by the varying importance of the environmental score. In contrast, the health score consistently played a primary role in driving food choice across all conditions. Furthermore, the effectiveness of informational priming was found to be highly dependent on the purchasing contexts. Finally, our analysis of fiscal interventions revealed a significant asymmetry, with taxes proving to be a more effective tool for discouraging unhealthy and less environmentally friendly food choices than the subsidies.

This study has several limitations that need consideration for future research. First, to avoid potential multicollinearity regarding the simultaneous label and tax/subsidy attribute, we made an alternative's label and its tax/subsidy unrelated which might not perfectly reflect the real world. For instance, a product with good environment and health scores might still be subject to taxation, creating a dynamic that might not be fully captured in this analysis. Future research could involve nesting attributes to improve the design (Lancsar & Louviere, 2008), for example, to integrate label and tax/subsidy into a single attribute or create a tiered system where these attributes are consistently linked across multiple levels. Second, we showed pictures of two selected meals but did not provide detailed ingredient information in order to minimise cognitive overload and reduce the risk of unintended confounding inferences. Future research should therefore explore how information messages can strike an appropriate balance between informational completeness and cognitive load. Such messages could be co-developed with consumers using participatory approaches, such as stakeholder workshops, to enhance both clarity and practical relevance. Furthermore, the experimental design was conducted online. To enhance the validity of the findings, a Living Lab approach, which investigates respondents' preferences towards simultaneous labelling in real-world restaurant and canteen settings in UK and Europe, is currently underway as part of this project to address this limitation. Within these real-world environments, the research design will further differentiate between, for example, out-of-home sectors. Third, further analyses can be conducted using the data collected in the current study. For example, the interaction between fiscal measures and labelling could be explicitly examined in future research. In addition, the extent to which background variables, such as socio-demographic characteristics, explain variation in attribute importance within WTP can be investigated to help better account for heterogeneity in attribute preferences underlying participants' purchase decisions. This will be considered in a future analysis of the data set.

CRediT authorship contribution statement

Rao Fu: Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Shan Jin:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **Francisco Areal:** Writing – review & editing, Writing – original draft, Supervision, Investigation, Formal analysis, Conceptualization. **Paul Brereton:** Writing – review & editing. **Jayne V. Woodside:** Writing – review & editing. **Jelena Vljajic:** Writing – review & editing. **Beatrice Smyth:** Writing – review & editing. **Anne P. Nugent:** Writing – review & editing. **David Livingstone:** Writing – review & editing. **George Hutchinson:** Writing – review & editing. **Eva-Leanne Thomas:** Writing –

review & editing. **Leona Lindberg:** Writing – review & editing. **Lynn J. Frewer:** Writing – review & editing, Supervision, Resources, Project administration, Funding acquisition, Conceptualization.

Ethical statement

This study involving human participants was reviewed and approved by the University Ethics Committee at Newcastle University (Ref: 49492/2023).

All participants provided informed consent to participate in this study. They were informed about the study's purpose, procedures, potential benefits, data management, and their right to withdraw at any time without penalty. Consent was obtained electronically before participation in the online discrete choice experiment.

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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.foodqual.2026.105932>.

Data availability

Data will be made available on request.

References

- Agyemang, P., Kwofie, E. M., Baum, J. I., & Wang, D. (2024). The design and development of a dashboard for improving sustainable food choices. *Science of the Total Environment*, 930, Article 172726. <https://doi.org/10.1016/j.scitotenv.2024.172726>
- Aidoo, R., Abe-Inge, V., Kwofie, E. M., Baum, J. I., & Kubow, S. (2023). Sustainable healthy diet modeling for a plant-based dietary transitioning in the United States. *npj Science of Food*, 7(1), 61. <https://doi.org/10.1038/s41538-023-00239-6>
- van den Akker, K., Barteleit, D., Brouwer, L., Luijckers, S., Nap, T., & Havermans, R. (2022). The impact of the nutri-score on food choice: A choice experiment in a dutch supermarket. *Appetite*, 168, Article 105664. <https://doi.org/10.1016/j.appet.2021.105664>
- de Alcantara, M., Martins, I. B. A., Ares, G., & Deliza, R. (2025). Relative effect of warning labels on food choice: Case study with four product categories after the implementation of the brazilian regulation. *Food Quality and Preference*, 124, Article 105359. <https://doi.org/10.1016/j.foodqual.2024.105359>
- Alsubhi, M., Blake, M., Nguyen, T., Majmudar, I., Moodie, M., & Ananthapavan, J. (2023). Consumer willingness to pay for healthier food products: A systematic review. *Obesity Reviews*, 24(1), Article e13525. <https://doi.org/10.1111/obr.13525>
- An, R. (2013). Effectiveness of subsidies in promoting healthy food purchases and consumption: A review of field experiments. *Public Health Nutrition*, 16(7), 1215–1228. <https://doi.org/10.1017/S1368980012004715>
- Andreyeva, T., Marple, K., Moore, T. E., & Powell, L. M. (2022). Evaluation of economic and health outcomes associated with food taxes and subsidies: A systematic review and meta-analysis. *JAMA Network Open*, 5(6), Article e2214371. <https://doi.org/10.1001/jamanetworkopen.2022.14371>
- Apaolaza, V., Hartmann, P., Echebarria, C., & Barrutia, J. M. (2017). Organic label's halo effect on sensory and hedonic experience of wine: A pilot study. *Journal of Sensory Studies*, 32(1), Article e12243. <https://doi.org/10.1111/joss.12243>
- Applegate, E., Carins, J., Vincze, L., Stainer, M., & Irwin, C. (2025). The impact of front-of-package design features on consumers' attention and selection likelihood of protein bars: An eye-tracking study. *Food Quality and Preference*, 126, Article 105427. <https://doi.org/10.1016/j.foodqual.2025.105427>
- Arbiol, J., Yabe, M., Nomura, H., Borja, M., Gloriani, N., & Yoshida, S. (2015). Using discrete choice modeling to evaluate the preferences and willingness to pay for leptospirosis vaccine. *Human Vaccines & Immunotherapeutics*, 11(4), 1046–1056. <https://doi.org/10.1080/21645515.2015.1010901>
- Babakhani, N., Andy, L., & Dolnicar, S. (2020). Carbon labels on restaurant menus: Do people pay attention to them? *Journal of Sustainable Tourism*, 28(1), 51–68. <https://doi.org/10.1080/09669582.2019.1670187>
- Bandura, A. (1990). Selective activation and disengagement of moral control. *Journal of Social Issues*, 46(1), 27–46. <https://doi.org/10.1111/j.1540-4560.1990.tb00270.x>
- Barbera, S., Hammond, P. J., & Seidl, C. (1998). *Handbook of utility theory*. Kluwer Academic Publishers.
- Bawden, D., & Robinson, L. (2020). *Information overload: An introduction*. Oxford University Press. <https://doi.org/10.1093/acrefore/9780190228637.013.1360>
- Bazzani, C., Scarpa, R., Begalli, D., & Capitello, R. (2025). Reporting nutritional information on wine packaging: Does it affect consumers choices? Evidence from a choice experiment in Italy. *Food Policy*, 131, Article 102800. <https://doi.org/10.1016/j.foodpol.2025.102800>
- Ben-Akiva, M. E., & Lerman, S. R. (1985). *Discrete choice analysis: Theory and application to travel demand*. 9. MIT press.
- Besson, T., Lalot, F., Bochar, N., Flaudias, V., & Zerhouni, O. (2019). The calories underestimation of "organic" food: Exploring the impact of implicit evaluations. *Appetite*, 137, 134–144. <https://doi.org/10.1016/j.appet.2019.02.019>
- Biermann, G., & Rau, H. (2020). The meaning of meat: (un)sustainable eating practices at home and out of home. *Appetite*, 153, Article 104730. <https://doi.org/10.1016/j.appet.2020.104730>
- Biswas, D., Jalali, H., Ansariipoor, A. H., & De Giovanni, P. (2023). Traceability vs. sustainability in supply chains: The implications of blockchain. *European Journal of Operational Research*, 305(1), 128–147. <https://doi.org/10.1016/j.ejor.2022.05.034>
- den Boer, A. C. L., Kok, K. P. W., Gill, M., Breda, J., Cahill, J., Callenius, C., ... Broerse, J. E. W. (2021). Research and innovation as a catalyst for food system transformation. *Trends in Food Science & Technology*, 107, 150–156. <https://doi.org/10.1016/j.tifs.2020.09.021>
- Bogliacino, F., Charris, R., Codagnone, C., Folkvord, F., Gaskell, G., Gómez, C., Liva, G., & Montealegre, F. (2023). Less is more: Information overload in the labelling of fish and aquaculture products. *Food Policy*, 116, Article 102435. <https://doi.org/10.1016/j.foodpol.2023.102435>
- Börger, T. (2016). Are fast responses more random? Testing the effect of response time on scale in an online choice experiment. *Environmental and Resource Economics*, 65(2), 389–413. <https://doi.org/10.1007/s10640-015-9905-1>
- Bou Fakhreddine, L., Sánchez, M., & García Martínez, M. (2025). From risk perception to informed choices: How consumers use food labels in health-related contexts. *Journal of Risk Research*, 28(7), 681–704. <https://doi.org/10.1080/13669877.2025.2553076>
- Braga, J. N., Ferreira, M. B., & Sherman, S. J. (2015). The effects of construal level on heuristic reasoning: The case of representativeness and availability. *Decision*, 2(3), 216–227. <https://doi.org/10.1037/dec0000021>
- Briggs, A. D. M., Mytton, O. T., Kehlbacher, A., Tiffin, R., Rayner, M., & Scarborough, P. (2013). Overall and income specific effect on prevalence of overweight and obesity of 20% sugar sweetened drink tax in UK: Econometric and comparative risk assessment modelling study. *BMJ : British Medical Journal*, 347, f6189. doi:<https://doi.org/10.1136/bmj.f6189>
- Büttner, V., Gassler, B., & Teuber, R. (2024). Does the eco-score lead to a halo effect? Influence of a sustainability label on product perceptions and purchase intention. *Food Quality and Preference*, 121, Article 105246. <https://doi.org/10.1016/j.foodqual.2024.105246>
- Chaudhary, V., Sharma, D., Nagpal, A., & Kalro, A. D. (2024). The role of health-related claims and situational skepticism on consumers' food choices. *European Journal of Marketing*, 58(6), 1600–1629. <https://doi.org/10.1108/EJM-08-2022-0621>
- Cheikh Ismail, I., Osaili, T. M., Obaid, R. S., Hashim, M., Ahmed, M., Al-Fayadh, F., ... Al Dhaheri, A. S. (2025). Food choice motivations and perceptions of healthy eating: A cross-sectional study among consumers in the UAE. *BMC Public Health*, 25(1), 442. <https://doi.org/10.1186/s12889-024-20836-8>
- Chen, M., Chen, Y., Qi, R., Hsiao, J. H., Lam, W. W. T., & Liao, Q. (2024). Testing the effects of health-benefit, environmental-benefit and co-benefit priming for promoting sustainable food choice and their psychological mechanisms: A randomized controlled trial combined with eye tracking. *Journal of Environmental Psychology*, 100, Article 102485. <https://doi.org/10.1016/j.jenvp.2024.102485>
- Collins, O., Higgins, K., Karbo, R. T., Clark, B., Sari, N. H., Raley, M., ... Frewer, L. J. (2025). Consumer attitudes to combined sustainability and nutrition labelling of foods: An exploratory study. *International Journal of Consumer Studies*, 49(6), Article e70139. <https://doi.org/10.1111/ijcs.70139>
- Comini, L. d. O., Lopes, S. O., Rocha, D. M. U. P., Silva, M. M. d. C., & Hermsdorff, H. H. M. (2025). The effects of subsidies for healthy foods on food purchasing behaviors, consumption patterns, and obesity/overweight: A systematic review. *Nutrition Reviews*, 83(7), e1722–e1739. <https://doi.org/10.1093/nutrit/nuae153>
- Cook, R. D., & Nachtreim, C. J. (1980). A comparison of algorithms for constructing exact D-optimal designs. *Technometrics*, 22(3), 315–324. <https://doi.org/10.1080/00401706.1980.10486162>
- Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, 2(3), 198–209. <https://doi.org/10.1038/s43016-021-00225-9>
- Cummings, R. G., & Taylor, L. O. (1999). Unbiased value estimates for environmental goods: A cheap talk design for the contingent valuation method. *American Economic Review*, 89(3), 649–665. <https://doi.org/10.1257/aer.89.3.649>
- De Bauw, M., De La Revilla, L. S., Poppe, V., Matthys, C., & Vrancken, L. (2022). Digital nudges to stimulate healthy and pro-environmental food choices in e-groceries. *Appetite*, 172, Article 105971. <https://doi.org/10.1016/j.appet.2022.105971>
- De Bauw, M., Matthys, C., Poppe, V., Franssens, S., & Vrancken, L. (2021). A combined Nutri-score and 'eco-score' approach for more nutritious and more environmentally friendly food choices? Evidence from a consumer experiment in Belgium. *Food*

- Quality and Preference*, 93, Article 104276. <https://doi.org/10.1016/j.foodqual.2021.104276>
- DEFRA. (2024). Food Data Transparency Partnership. <https://www.gov.uk/government/groups/food-data-transparency-partnership#terms-of-reference>.
- Degeratu, A. M., Rangaswamy, A., & Wu, J. (2000). Consumer choice behavior in online and traditional supermarkets: The effects of brand name, price, and other search attributes. *International Journal of Research in Marketing*, 17(1), 55–78. [https://doi.org/10.1016/S0167-8116\(00\)00005-7](https://doi.org/10.1016/S0167-8116(00)00005-7)
- Department for Environment Food & Rural Affairs, D. (2022). Government food strategy (F. & R. A. Department for Environment, Ed.). <https://www.gov.uk/government/publications/government-food-strategy/government-food-strategy#foreword>.
- Dieteren, C. M., Bonfrer, I., Brouwer, W. B. F., & van Exel, J. (2023). Public preferences for policies promoting a healthy diet: A discrete choice experiment. *The European Journal of Health Economics*, 24(9), 1429–1440. <https://doi.org/10.1007/s10198-022-01554-7>
- Ditlevsen, K., Denver, S., Christensen, T., & Lassen, J. (2020). A taste for locally produced food - values, opinions and sociodemographic differences among 'organic' and 'conventional' consumers. *Appetite*, 147, Article 104544. <https://doi.org/10.1016/j.appet.2019.104544>
- Dowd, S. M., & Artisticco, D. (2016). Type and strength of self-construal interact with the influence of anchoring heuristics in appraisals of self-efficacy. *Learning and Individual Differences*, 49, 400–405. <https://doi.org/10.1016/j.lindif.2016.05.018>
- Dubois, P., Albuquerque, P., Allais, O., Bonnet, C., Bertail, P., Combris, P., Lahlou, S., Rigal, N., Ruffieux, B., & Chandon, P. (2021). Effects of front-of-pack labels on the nutritional quality of supermarket food purchases: Evidence from a large-scale randomized controlled trial. *Journal of the Academy of Marketing Science*, 49(1), 119–138. <https://doi.org/10.1007/s11747-020-00723-5>
- European Union. (2020). Farm to fork strategy: For a fair, healthy and environmentally friendly food system. (e. Union, ed.). <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0381>.
- Ewing, G., & Sarigöllü, E. (2000). Assessing consumer preferences for clean-fuel vehicles: A discrete choice experiment. *Journal of Public Policy & Marketing*, 19(1), 106–118. <https://doi.org/10.1509/jppm.19.1.106.16946>
- Fanzo, J., Haddad, L., Schneider, K. R., Béné, C., Covic, N. M., Guarin, A., ... Rosero Moncayo, J. (2021). Viewpoint: Rigorous monitoring is necessary to guide food system transformation in the countdown to the 2030 global goals. *Food Policy*, 104, Article 102163. <https://doi.org/10.1016/j.foodpol.2021.102163>
- FAO, & WHO. (2019). *Sustainable healthy diets. Guiding principles*. <https://doi.org/10.4060/CA6640EN>
- Fearne, A., Borzino, N., De La Iglesia, B., Moffatt, P., & Robbins, M. (2022). Using supermarket loyalty card data to measure the differential impact of the UK soft drink sugar tax on buyer behaviour. *Journal of Agricultural Economics*, 73(2), 321–337. <https://doi.org/10.1111/1477-9552.12462>
- Fedorov, V. V. (2013). *Theory of optimal experiments*. Elsevier.
- Ferrari, L., Cavaliere, A., De Marchi, E., & Banterle, A. (2019). Can nudging improve the environmental impact of food supply chain? A systematic review. *Trends in Food Science & Technology*, 91, 184–192. <https://doi.org/10.1016/j.tifs.2019.07.004>
- Fretes, G., Wilson, N. L. W., Corvalan, C., Economos, C. D., & Cash, S. B. (2025). Front-of-pack labels and young consumers: An experimental investigation of nutrition and sustainability claims in Chile. *Food Quality and Preference*, 127, Article 105432. <https://doi.org/10.1016/j.foodqual.2025.105432>
- García-Torres, S., Albareda, L., Rey-García, M., & Seuring, S. (2019). Traceability for sustainability – Literature review and conceptual framework. *Supply Chain Management: An International Journal*, 24(1), 85–106. <https://doi.org/10.1108/SCM-04-2018-0152>
- Gaupp, F., Ruggeri Laderchi, C., Lotze-Campen, H., DeClerck, F., Bodirsky, B. L., Lowder, S., ... Fan, S. (2021). Food system development pathways for healthy, nature-positive and inclusive food systems. *Nature Food*, 2(12), 928–934. <https://doi.org/10.1038/s43016-021-00421-7>
- Ge, L., Guan, X., Tang, L., Zhu, Q., Zhong, Y., & Lan, M. (2025). The effectiveness of digital nudging in improving dietary quality: A systematic review of randomized controlled trials. *BMC Public Health*, 25(1), 2804. <https://doi.org/10.1186/s12889-025-24069-1>
- Gibson, M., Mason-D'Croz, D., Norberg, A., Conti, C., Boa Alvarado, M., & Herrero, M. (2025). Degrowth as a plausible pathway for food systems transformation. *Nature Food*, 6(1), 19–24. <https://doi.org/10.1038/s43016-024-01108-5>
- Glenk, K., Meyerhoff, J., Akaichi, F., & Martin-Ortega, J. (2019). Revisiting cost vector effects in discrete choice experiments. *Resource and Energy Economics*, 57, 135–155. <https://doi.org/10.1016/j.reseneeco.2019.05.001>
- Greene, D., Nguyen, M., & Dolnicar, S. (2024). How do you choose your meal when you dine out? A mixed methods study in consumer food-choice strategies in the restaurant context. *Appetite*, 203, Article 107683. <https://doi.org/10.1016/j.appet.2024.107683>
- Grigoriadis, V., Livingstone, D., Thomas, E.-L., Brereton, P., Woodside, J., Nugent, A., Smyth, B., Hutchinson, G., Vljajic, J., Areal Borrego, F., Collins, O., Sari, N., Fu, R., & Frewer, L. (2025). Developing the Sus-health index: A combined measure for describing environmental impact and nutritive value of foods and meals. *Philosophical Transactions of the Royal Society, B: Biological Sciences*, 380(1935), Article 20240160. <https://doi.org/10.1098/rstb.2024.0160>
- Gutiérrez, M.-J., Inguanzo, B., & Orbe, S. (2025). Reducing the environmental impact of food consumption through fiscal policies: The case of Spain. *Ecological Economics*, 233, Article 108596. <https://doi.org/10.1016/j.ecolecon.2025.108596>
- Hafner, E., Hristov, H., Grunert, K. G., & Pravst, I. (2026). From perception to preference: Insights on front-of-package nutrition labelling effectiveness from a choice experiment under time-pressure. *Food Quality and Preference*, 136, Article 105765. <https://doi.org/10.1016/j.foodqual.2025.105765>
- Heeremans, E., Geuens, M., & Vermeir, I. (2025). Healthy labels, healthy portions? The impact of favorable nutri-scores on consumers portion size selection and food intake. *Food Quality and Preference*, 128, Article 105485. <https://doi.org/10.1016/j.foodqual.2025.105485>
- Hess, S., & Palma, D. (2025). Frequently asked questions for apollo. <https://www.apollochoicemodelling.com/faq.html>.
- HM Revenue & Customs. (2016, December 5). (*Soft Drinks Industry Levy*).
- Hughes, J. P., Weick, M., & Vasiljevic, M. (2024). Can environmental traffic light warning labels reduce meat meal selection? A randomised experimental study with UK meat consumers. *Appetite*, 200, Article 107500. <https://doi.org/10.1016/j.appet.2024.107500>
- Hughner, R. S., McDonagh, P., Prothero, A., Shultz, C. J., II, & Stanton, J. (2007). Who are organic food consumers? A compilation and review of why people purchase organic food. *Journal of Consumer Behaviour*, 6(2–3), 94–110. <https://doi.org/10.1002/cb.210>
- Jürkenbeck, K., Sanchez-Siles, L., & Siegrist, M. (2024). Nutri-score and eco-score: Consumers' trade-offs when facing two sustainability labels. *Food Quality and Preference*, 118, Article 105200. <https://doi.org/10.1016/j.foodqual.2024.105200>
- Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.
- Kilders, V., Caputo, V., & Lusk, J. L. (2023). Consumer preferences for food away from home: Dine in versus delivery. *American Journal of Agricultural Economics*, 106(2), 496–525. <https://doi.org/10.1111/ajae.12428>
- Kilders, V., Tan, Y., Nayga, R. M., & Yang, W. (2025). Motivation and intended use transparency: Shaping consumer responses to a red meat tax through information disclosure. *European Review of Agricultural Economics*, Article jbafo36. <https://doi.org/10.1093/erae/jbafo36>
- Klotz, M., Krpan, D., Lohmann, P. M., Galizzi, M. M., & Reisch, L. A. (2025). Stop, think, buy: An online randomised controlled experiment comparing the effects of traffic light nutritional labelling and price promotion on steering consumer food choice. *Appetite*, 211, Article 108005. <https://doi.org/10.1016/j.appet.2025.108005>
- Kuhfeld, J. W. (2001). Multinomial logit, discrete choice modeling. An introduction to designing choice experiments, and collecting, processing and analyzing choice data with SAS. SAS institute TS-643.
- Laguna-Camacho, A., & Booth, D. A. (2015). Meals described as healthy or unhealthy match public health education in England. *Appetite*, 87, 283–287. <https://doi.org/10.1016/j.appet.2015.01.007>
- Lancsar, E., & Louviere, J. (2008). Conducting discrete choice experiments to inform healthcare decision making. *Pharmacoeconomics*, 26(8), 661–677. <https://doi.org/10.2165/00019053-200826080-00004>
- Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods: Analysis and applications*. Cambridge university press.
- Lusk, J. L., & Schroeder, T. C. (2004). Are choice experiments incentive compatible? A test with quality differentiated beef steaks. *American Journal of Agricultural Economics*, 86(2), 467–482. <https://doi.org/10.1111/j.0092-5853.2004.00592.x>
- Lusk, J. L., & Schroeter, C. (2012). WHEN DO FAT TAXES INCREASE CONSUMER WELFARE? *Health Economics*, 21(11), 1367–1374. <https://doi.org/10.1002/hec.1789>
- Malone, T., & Lusk, J. L. (2018). A simple diagnostic measure of inattention bias in discrete choice models. *European Review of Agricultural Economics*, 45(3), 455–462. <https://doi.org/10.1093/erae/jby005>
- Markovina, J., Stewart-Knox, B. J., Rankin, A., Gibney, M., de Almeida, M. D. V., Fischer, A., ... Frewer, L. J. (2015). Food4Me study: Validity and reliability of food choice questionnaire in 9 European countries. *Food Quality and Preference*, 45, 26–32. <https://doi.org/10.1016/j.foodqual.2015.05.002>
- Matthes, J., Karsay, K., Schmuck, D., & Stevic, A. (2020). "Too much to handle": Impact of mobile social networking sites on information overload, depressive symptoms, and well-being. *Computers in Human Behavior*, 105, Article 106217. <https://doi.org/10.1016/j.chb.2019.106217>
- Maubach, N., Hoek, J., & Mather, D. (2014). Interpretive front-of-pack nutrition labels. Comparing competing recommendations. *Appetite*, 82, 67–77. <https://doi.org/10.1016/j.appet.2014.07.006>
- McFadden, D. (1972). Conditional logit analysis of qualitative choice behavior.
- Mehrabi, S., Perez-Mesa, J. C., & Giagnocavo, C. (2022). The role of consumer-citizens and connectedness to nature in the sustainable transition to agroecological food systems: The mediation of innovative business models and a multi-level perspective. *Agriculture*, 12(2). <https://doi.org/10.3390/agriculture12020203>
- Mertens, E., Kuijsten, A., van Zanten, H. H. E., Kaptijn, G., Dořková, M., Mistura, L., D'Addezo, L., Turrini, A., Dubuisson, C., Havard, S., Trolle, E., Geleijnse, J. M., & Veer, P. van 't. (2019). Dietary choices and environmental impact in four European countries. *Journal of Cleaner Production*, 237, 117827. doi:<https://doi.org/10.1016/j.jclepro.2019.117827>
- Morren, M., Mol, J. M., Blasch, J. E., & Malek, Ž. (2021). Changing diets - testing the impact of knowledge and information nudges on sustainable dietary choices. *Journal of Environmental Psychology*, 75, Article 101610. <https://doi.org/10.1016/j.jenvp.2021.101610>
- Office for National Statistics. (2023). 2021 census. <https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/age-groups/latest/#dat-sources>.
- Ornelas Herrera, S. I., Baba, Y., Kallas, Z., Meers, E., Michels, E., Hajdu, Z., & Spinagel, A. M. (2025). The role of environmental attitudes and consumption patterns in consumers preferences for sustainable food from circular farming system: A six EU case studies. *Agricultural and Food Economics*, 13(1), Article 7. <https://doi.org/10.1186/s40100-025-00350-0>
- Osawe, O. W., Grilli, G., & Curtis, J. (2023). Examining food preferences in the face of environmental pressures. *Journal of Agriculture and Food Research*, 11, Article 100476. <https://doi.org/10.1016/j.jafr.2022.100476>

- Osman, M., Schwartz, P., & Wodak, S. (2021). Sustainable consumption: What works best, carbon taxes, subsidies and/or nudges? *Basic and Applied Social Psychology*, 43(3), 169–194. <https://doi.org/10.1080/01973533.2021.1889553>
- Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, 360(6392), 987–992. <https://doi.org/10.1126/science.aag0216>
- Ren, Y., Liu, Q., Wu, G., & Loy, J.-P. (2025). Consumer preferences for sugar-sweetened beverages: Evidence from online surveys and laboratory eye-tracking choice experiments. *Food Policy*, 130, Article 102791. <https://doi.org/10.1016/j.foodpol.2024.102791>
- Revelt, D., & Train, K. (1998). Mixed logit with repeated choices: Households choices of appliance efficiency level. *The Review of Economics and Statistics*, 80(4), 647–657. <https://doi.org/10.1162/003465398557735>
- Rockström, J., Edenhofer, O., Gaertner, J., & DeClerck, F. (2020). Planet-proofing the global food system. *Nature Food*, 1(1), 3–5. <https://doi.org/10.1038/s43016-019-0010-4>
- Sacks, G., Kwon, J., & Backholer, K. (2021). Do taxes on unhealthy foods and beverages influence food purchases? *Current Nutrition Reports*, 10(3), 179–187. <https://doi.org/10.1007/s13668-021-00358-0>
- Sanjari, S. S., Jahn, S., & Boztug, Y. (2017). Dual-process theory and consumer response to front-of-package nutrition label formats. *Nutrition Reviews*, 75(11), 871–882. <https://doi.org/10.1093/nutrit/nux043>
- Scarpa, R., Thiene, M., & Train, K. (2008). Utility in willingness to pay space: A tool to address confounding random scale effects in destination choice to the alps. *American Journal of Agricultural Economics*, 90(4), 994–1010. <https://doi.org/10.1111/j.1467-8276.2008.01155.x>
- Schebesta, H., & Candel, J. J. L. (2020). Game-changing potential of the EUs farm to fork strategy. *Nature Food*, 1(10), 586–588. <https://doi.org/10.1038/s43016-020-00166-9>
- Schmidt, J. C., Fox, S., Hughes, A., Betts, A., Flowers, J., Newton, J., & Clark, S. (2020). The Burden of Disease in England compared with 22 peer countries. A report for NHS England. https://assets.publishing.service.gov.uk/media/5e1735f2ed915d3b0b00c7cc/GBD_NHS_England_report.pdf
- Siegerink, V. E., Delnoij, J., & Alpariz, F. (2024). Public preferences for meat tax attributes in the Netherlands: A discrete choice experiment. *Food Policy*, 128, Article 102675. <https://doi.org/10.1016/j.foodpol.2024.102675>
- Statista Research Department. (). Veganism and vegetarianism in the United Kingdom - statistics & facts. <https://www.statista.com/topics/7297/veganism-in-the-united-kingdom/#editorsPicks>. Statista.
- Stewart-Knox, B. J., Póinhos, R., Fischer, A. R. H., Rankin, A., Bunting, B. P., Oliveira, B. M. P. M., & Frewer, L. J. (2025). Association between nutrition self-efficacy, health locus of control and food choice motives in consumers in nine European countries. *Journal of Health Psychology*, 30(3), 543–558. <https://doi.org/10.1177/13591053241249863>
- The Climate Change Committee. (2025). The seventh carbon budget advice for the UK government. <https://www.theccc.org.uk/publication/the-seventh-carbon-budget/#the-seventh-carbon-budget>.
- Tiboldo, G., Castellari, E., & Moro, D. (2024). The distributional implications of health taxes: A case study on the Italian sugar tax. *Food Policy*, 126, Article 102671. <https://doi.org/10.1016/j.foodpol.2024.102671>
- Train, K. (2016). Mixed logit with a flexible mixing distribution. *Journal of Choice Modelling*, 19, 40–53. <https://doi.org/10.1016/j.jocm.2016.07.004>
- Train, K., & Weeks, M. (2005). Discrete choice models in preference space and willingness-to-pay space. In R. Scarpa, & A. Alberini (Eds.), *Applications of simulation methods in environmental and resource economics* (pp. 1–16). Springer Netherlands. https://doi.org/10.1007/1-4020-3684-1_1
- Train, K. E. (2009). *Discrete choice methods with simulation*. Cambridge university press.
- Vetschera, R., Weitzl, W., & Wolfsteiner, E. (2014). Implausible alternatives in eliciting multi-attribute value functions. *European Journal of Operational Research*, 234(1), 221–230. <https://doi.org/10.1016/j.ejor.2013.09.016>
- Vittersø, G., & Tangeland, T. (2015). The role of consumers in transitions towards sustainable food consumption. The case of organic food in Norway. *Journal of Cleaner Production*, 92, 91–99. <https://doi.org/10.1016/j.jclepro.2014.12.055>
- Wang, J., Wei, Y., Galizzi, M. M., Kwan, H. S., Zee, B. C. Y., Fung, H., ... Chong, K. C. (2025). Perceptions, willingness-to-pay, and associated socio-demographics of sugar-sweetened beverage taxation in an affluent Asian setting. *Appetite*, 214, Article 108195. <https://doi.org/10.1016/j.appet.2025.108195>
- Wilson, A. L., Buckley, E., Buckley, J. D., & Bogomolova, S. (2016). Nudging healthier food and beverage choices through salience and priming. Evidence from a systematic review. *Food Quality and Preference*, 51, 47–64. <https://doi.org/10.1016/j.foodqual.2016.02.009>
- Yamim, A. P., & Werle, C. O. C. (2025). Nutri-score label influence on food purchase intention depends on consumers' expectations of healthiness. *Appetite*, 207, Article 107870. <https://doi.org/10.1016/j.appet.2025.107870>
- Yue, M., Jin, S., Tindale, S., Vicario-Modroño, V., Sánchez-Zamora, P., Gallardo-Cobos, R., ... Frewer, L. J. (2024). Segmenting consumers of meat and dairy products from five European countries: Implications for promoting sustainable food choices. *Sustainable Production and Consumption*, 47, 47–58. <https://doi.org/10.1016/j.spc.2024.03.034>
- Zhang, C., & Conrad, F. (2014). Speeding in web surveys: The tendency to answer very fast and its association with straightlining. *Survey Research Methods*, 8(2), 127–135. <https://doi.org/10.18148/srm/2014.v8i2.5453>
- Ziauddeen, N., Page, P., Penney, T. L., Nicholson, S., Kirk, S. F. L., & Almiron-Roig, E. (2018). Eating at food outlets and leisure places and “on the go” is associated with less-healthy food choices than eating at home and in school in children: Cross-sectional data from the UK national diet and nutrition survey rolling program (2008–2014). *The American Journal of Clinical Nutrition*, 107(6), 992–1003. <https://doi.org/10.1093/ajcn/nqy057>