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Do front-of-pack ‘green labels’ increase sustainable food choice and willingness-to-pay in U.K. consumers?

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ABSTRACT

Aim: In a series of pre-registered online studies, we aimed to elucidate the magnitude of the effect of general sustainability labels on U.K. consumers' food choices.
Methods: Four labels were displayed: *‘Sustainably sourced’*, *‘Locally sourced’*, *‘Environmentally friendly’*, and *‘Low greenhouse gas emissions’*. To ensure reliable results, contingency valuation elicitation was used alongside a novel analytical approach to provide a triangulation of evidence: Multilevel-modelling compared each label vs. no-label; Poisson-modelling compared label vs. label. Socioeconomic status, environmental awareness, health motivations, and nationalism/patriotism were included in our predictive models.
Results: Exp.1 Multilevel-modelling ($N = 140$) showed labelled products were chosen 344% more than non-labelled and consumers were willing-to-pay ~£0.11 more, although no difference between label types was found. Poisson-modelling ($N = 735$) showed consumers chose *Sustainably sourced* and *Locally sourced* labels ~20% more often but were willing-to-pay ~£0.03 more only for *Locally sourced* products. Exp.2 was a direct replication. Multilevel-modelling ($N = 149$) showed virtually identical results (labels chosen 344% more, willingness-to-pay ~£0.10 more), as did Poisson-modelling ($N = 931$) with *Sustainably sourced* and *Locally sourced* chosen ~20% more and willingness-to-pay ~£0.04 more for *Locally sourced* products. Environmental concern (specifically the ‘propensity to act’) was the only consistent predictor of preference for labelled vs. non-labelled products.
Conclusions: Findings suggest front-of-pack ‘green labels’ may yield substantive increases in consumer choice alongside relatively modest increases in willingness-to-pay for environmentally-sustainable foods. Specifically, references to ‘sustainable’ or ‘local’ sourcing may have the largest impact.

1. Introduction

Food is an important consumer impact area in sustainability efforts, alongside housing and energy-consuming products (Tukker et al., 2010a; Evans et al., 2017). There is growing concern regarding the negative consequences of the food system on both human and planetary health (Bhunnoo and Poppy, 2020; Croft et al., 2018). The role of consumer decisions in sustainability issues is well established (Hertwich, 2008; Jackson, 2008; Tukker et al., 2010b; Dermody et al., 2015), but most research to date has focussed on production systems and more is needed at the consumer level (O'Rourke and Ringer, 2016; Brach et al., 2018; Lazzarini et al., 2018). Consumer-led, bottom-up demand is critical in generating impetus for sustainable change in food production systems, with front-of-pack labelling a potentially cost-effective way of influencing consumer behaviour.

1.1. Food labelling and sustainability

Consumer concern around the food system has increased, reflected in consumer demand for attributes suiting their social and ethical

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priorities, as well as growing pro-environment consumerism (Barber et al., 2009; Sepúlveda et al., 2016; Dermody et al., 2018a). The sustainable qualities of food are credence attributes – widely-valued characteristics – which are not observable prior to purchasing or experienced post-purchase, and thus are difficult to signal (Van Loo et al., 2014; Yang and Renwick, 2019). However, labelling enables communication of intangible attributes directly to the consumer (Dermody et al., 2018b).

Research exploring the impact of sustainability labelling on food choice is abundant, as indicated by recent reviews and meta-analyses (Röös and Tjärnemo, 2011; Tobi et al., 2019; Tully and Winer, 2014). A plethora of methods and analyses are found throughout this literature: discrete choice experiments and conjoint analyses (Bronnmann and Asche, 2017; Lombardi et al., 2017; Loureiro and Umberger, 2007; Michaud et al., 2013; Onozaka and McFadden, 2011), contingent valuation vs. inferred valuation (Drichoutis et al., 2016; Mostafa, 2016; Salladarré et al., 2016), fractional factorial designs (Feucht and Zander, 2018), product differentiation modelling (Brécard, 2014), structural equation modelling (Peschel et al., 2016), and hedonic analyses (Bissinger, 2019). This analytical variation is embedded within additional macro variation in study locale (online vs. in-store), product selection (single product vs. multiple), label type (real labels already in-use vs. novel labels), and others. The current study seeks to implement novel methodological and analytical approaches to the investigation of sustainability labelling and thus provide a triangulation of evidence that, alongside standard approaches, allows for greater confidence in the direction and estimates of effects.

1.2. Environmentally-focused sustainability labels

Myriad labels and schemes exist (Brach et al., 2018; World Cancer Research Fund International, 2019), and debates surrounding them are currently at the forefront of U.K. policy debates and strategy (Dimbleby, 2021; Winchester, 2021). However, evidence-to-date suggests that although consumer awareness of sustainability has increased, the impact of the labels – although positive – is small while consumer understanding is poor (Garnett et al., 2015a; Koenig-Lewis et al., 2014). Further, sustainability information needs to be absorbed quickly as consumers often make relatively quick decisions at the point of purchase (Milosavljevic et al., 2011), with many perceiving high levels of time pressure (Herrington and Capella, 1995; Silayoi and Speece, 2004). This suggests clear, simple labels may provide the best method to inform and guide consumer decisions.

Sustainability includes several dimensions categorised into social, ethical, economic, and environmental factors (Hanss and Böhm, 2012). 'Organic' remains the biggest sub-market in sustainable food (Janβen and Langen, 2017), with a wealth of existing research on organic and 'Fair Trade' labelling (Janssen and Hamm, 2014; Schleenbecker and Hamm, 2013; Thogersen et al., 2015). Environmental sustainability specifically comprises factors such as local food production, sustainable farming, low carbon footprints and food miles, anti-deforestation, and others (Lazzarini et al., 2018), and a recent systematic review found environmental attributes were most preferred by consumers, with social attributes close behind (Tobi et al., 2019). However, messages with an environmental focus are difficult to tease apart from social and ethical attributes; for example, French consumers who typically buy local food were not driven by environmental motives like reducing carbon via less distance travelled, but rather due to a lack of trust in the food supply chain and to support their local economy (Sirieix and GillesSchaer, 2008). There is comparatively little research on how novel, more general environmental messages can influence consumers (Lazzarini et al., 2018).

There is evidence that general sustainability messages have benefits relating to (although perhaps not driven by) consumer perceptions of environmental sustainability. One review found that 'local food' was believed to be tastier and of higher quality and, unlike 'organic food', was not perceived as expensive (Feldmann and Hamm, 2015). Other studies report consumers' greater willingness-to-pay (WTP) a premium for locally-grown foods than for organic (Costanigro et al., 2011a; James et al., 2009a). The latter finding is important when trying to overcome premiums associated with sustainable foods, particularly in less affluent groups who identify cost as a barrier to sustainable choices (McGale et al., in Prep), or food producers unwilling to adopt sustainable practices for fear of reduced profits (Dessart et al., 2019). The evidence reviewed so far suggests that messages must be concise, easily absorbable, and showcase the environmental and social attributes of sustainability if they are to appeal to as many consumers as possible. Thus, this study examines a range of such messages.

1.3. Individual differences

When creating novel advice or messaging at the population level, identifying drivers of individual variability is vital (Vecchio et al., 2016). Various demographic factors modulate responses to sustainability messaging, namely age, sex, and socioeconomic status (Grunert et al., 2018; Carpio and Isengildina-massa, 2009). Notably, consumer perceptions of how important a product is to them, relative to their needs, interests, and values ('consumer involvement') can influence how product information is sought during decision-making and purchasing (Zaichkowsky, 2009; Verbeke and Vackier, 2004a; Behe et al., 2013). Individuals who are more 'involved' will actively seek and apply the information prior to purchasing (Verbeke and Vackier, 2004b). For example, those willing to pay a premium for sustainable products were more 'pro-environment' and showed greater environmental awareness (Carley and Yahng, 2018a; Magnier and Schoormans, 2015), although evidence is mixed (Yadav and Pathak, 2016). Due to mixed results, and that most of these studies focussed solely on 'organic' products (Asif et al., 2018; Hughner et al., 2007; Hsu and Chen, 2014; Lee and Yun, 2015), the present study explored whether environmental concern predicts choice and WTP for foods showing general sustainability messages. Additionally, support for local goods could be driven by distrust of the supply chain, support for the local economy, or to bolster national identity (Caldwell, 2003). We therefore measure whether consumers' strength of national identity or patriotism influences message preference. Finally, given overlap in perceptions of sustainability (e.g., local) with health (Mirosa and Lawson, 2012), we measure consumers' health motivations in food choice.

1.4. Aims and hypotheses

Here we employ contingent valuation elicitation using a hypothetical online shopping experience containing a variety of food 'groups' (meat, fish, dairy, vegetables, and fruit), multiple foodstuffs within each group (e.g., beef, chicken, etc. for meat), and multiple products within each foodstuff (e.g., two beef products, two chicken, etc.). Participants make dichotomous choices between matched product pairs, before indicating their WTP for each product, with each one containing one of four novel sustainability labels (plus no-label control products). Crucially, our design uses both Poisson modelling (between-subjects design) and multilevel modelling (within-subjects design), which to our knowledge is a novel mixed-analysis approach in this field. This, in addition to the use of multiple products, novel labels, and large sample sizes provides a unique contribution to the literature.

Across two pilots and two well-powered, pre-registered (https://osf.io/ub5hr), online surveys of U.K. consumers, we assess the influence of four novel, concise, front-of-pack sustainability labels on food choice and WTP. This is done by comparing labelled products to matched no-label controls (*Multilevel Model design*) and labelled products to other labelled products (*Poisson design*). We hypothesise that choice selection and WTP will be greater for labelled vs. non-labelled products, with no rank order predictions for label type. Further, higher environmental concern will predict greater choice and WTP for labelled products, and age for non-labelled.

2. General methods

Two online studies were conducted using Qualtrics (Provo, UT, 2020), who recruited from their market panels. Inclusion criteria were being a U.K. consumer and a 'meat eater' (i.e., *not* a pollotarian, pescatarian, vegetarian, vegan, etc.), due to the inclusion of meat products. See Appendices section *A.2.1* for further details. These studies followed two pilot studies (see Fig. 1), which used similar procedures and similar sustainability messaging. The key differences were i) message wording, and ii) label design. Pilot labels possessed visual imagery and design features relating to the message, whereas the two main studies employed plain labels to solely isolate the effects of the message. Pilot findings are briefly outlined in section *3.1.* (further details in *A.3.1.*). All studies received ethical approval from the University of Liverpool Research Ethics Committee.

2.1. Procedure

Participants were randomly allocated to one of two survey designs (*Poisson* or *Multilevel Modelling*) based on sample size quotas (see section *3.2.* onward). Both surveys followed the same five-step procedure: i) Information/Consent, ii) Demographics (age, sex, SES), iii) Forced Choice Procedure (FCP) and WTP, iv) Self-report questionnaires (environmental concern, health motivations of food choice, nationalism/patriotism), and v) Debrief. Two attention checks were included in each survey (e.g., "Please select *'Hello'*"). See Fig. 1 for a graphical outline of all the experiments contained in this paper.

2.1.1. Stimuli

Labels: Four sustainability messages displayed on plain labels in white writing against a blue background (Fig. 2). Blue was chosen as the predominant colour for three reasons: i) to match current U.K. nutritional labels, ii) avoid associations with "good/bad" or "go/stop", such as red, amber, and green (traffic light labelling), and iii) avoid colour

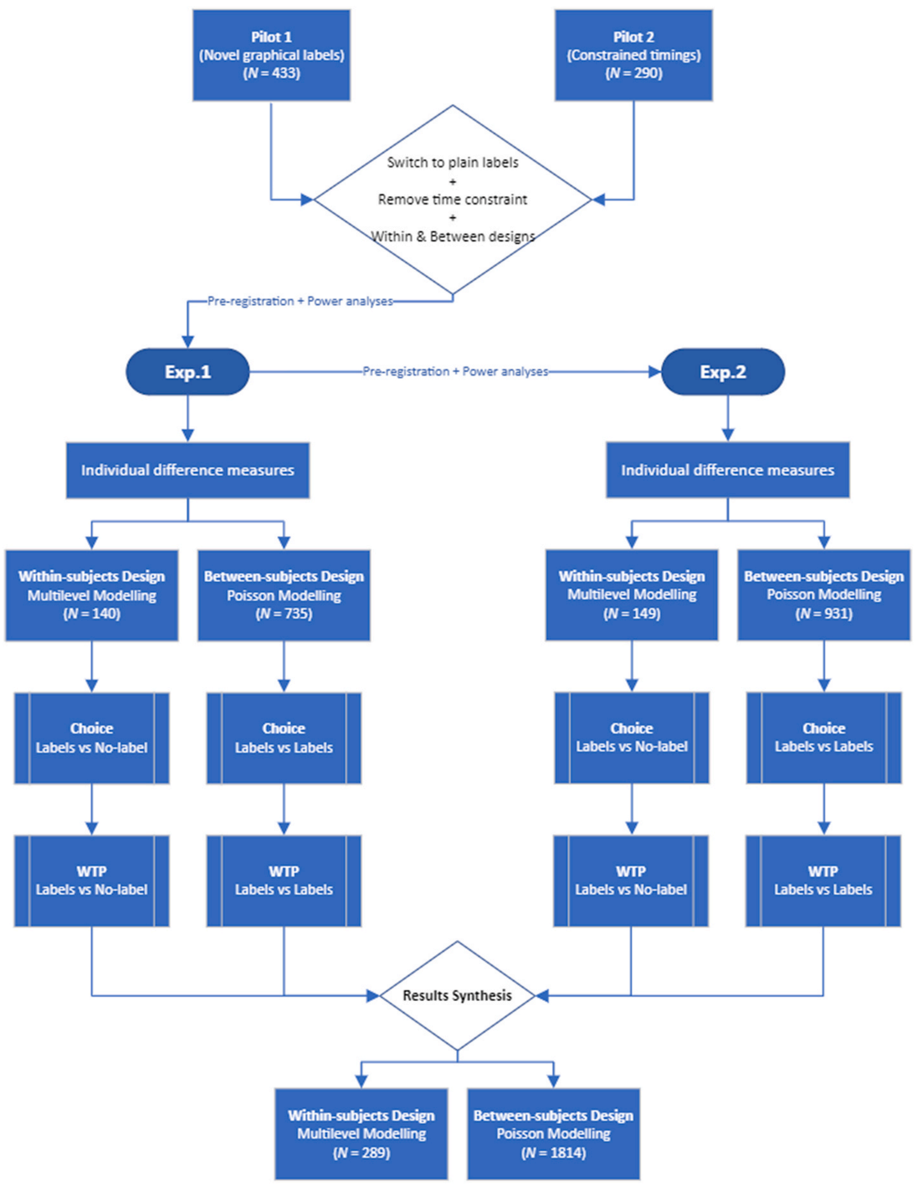

Fig. 1. Graphical overview of the experiments contained within this paper. WTP = Willingness-to-pay. *Note.* 'Individual difference measures' are actually collected both before (demographics) and after (environmental concern, health motivations of food choice, nationalism/patriotism) the 'Choice' and 'WTP' sections, but are shown only at the beginning here for simplicity.

Fig. 2. *Top row:* Sustainability labels; *Middle row:* Forced-Choice Procedure (FCP), a snapshot of the EF vs. SS condition (salmon items) in the Poisson design; *Bottom row:* Willingness-to-pay (WTP) visual analogue scale, with £4.00 reflecting typical salmon retail price at U.K. supermarkets. This mid-point retail price was specific to each foodstuff. The VAS pointer (circle) starts at '50'. *Note.* The specific product (item image) each label appeared on was counterbalanced across participants.

schemes virtually never used in front-of-pack labelling (e.g., black and white). The messages were: *Sustainably sourced* (SS), *Locally sourced* (LS), *Environmentally friendly* (EF), and *Low greenhouse gas emissions* (GhG). All labels focussed primarily on *environmental* sustainability, although LS also taps into social and economic attributes. Labels were 3.7 cm^2, font Calibri, 14–18, bold (font size differed due to text length).

Food: Twenty individual food images were used (i.e., specific products, each with its own packaging), with two images per foodstuff (i.e., two salmon items, two chicken, etc.), across five food 'groups' (meat, fish, dairy, vegetables, and fruit). Foodstuffs were as follows: beef, salmon, cheese, tomatoes, strawberries, chicken, haddock, ice cream, mushrooms, and raspberries. Individual food images were obtained from the websites of popular U.K. supermarkets and adapted for use in this study, with any potentially influential packaging or branding information removed or concealed to the best of our ability. Specifically, food weight, nutritional information, country of origin, and branding was either standardised or concealed. Stimuli found at https://osf.io/ub5hr.

2.1.2. Forced-choice procedure and willingness-to-pay

The FCP was employed in both Multilevel Modelling (MLM) and Poisson designs. Participants saw a series of food items, in each trial choosing one of two options to buy, *"if each option were identical in price"*. After choosing, participants indicated how much they would be willing-to-pay (WTP) for each item on a visual analogue scale (VAS). The VAS operated on a 0–100 scale; *monetary* scale-point values differed across products, with scale-point 50 presenting recommended retail price in popular U.K. supermarkets (pointer starting position also at '50'). Each 10-point decrease/increase presented progressive 10% monetary decreases/increases (Fig. 2).

MLM: A within-subjects design compared labels to no-label controls. Participants viewed 40 trials of *label vs. no-label* products, with each of the four messages shown across 10 different trials (and 10 different products). Thus, participants viewed *all* the following: *SS vs. control* (× 10), *LS vs. control* (× 10), *EF vs. control* (× 10), and *GhG vs. control* (× 10). Trials were randomised.

Data processing: Hierarchical datasets were structured so that trials were nested within participants, resulting in a two-level structure. Between-person variation was treated as a random effect via inclusion of the random intercept for the 'participant' variable to provide better estimates of within-person variance (Enders and Tofighi, 2007). Between-person variables were grand-mean centred to better estimate within-person variance (Kreft et al., 1995). To ensure appropriate inclusion of 'participant' as a random effect, a two-level null model (no predictors) was compared to a single-level model using a χ^2 likelihood-ratio test. The test also assessed model fit by comparing conditional models to their null hierarchical counterparts. Analyses were run in RStudio v.March 1, 1073 (RStudio Team, 2020) using R package 'lme4' (Bates et al., 2015).

Poisson: A between-subjects design compared labels to each other directly. Participants viewed 10 trials of *label vs. label*, except for a control group (*Control vs. Control*). Thus, participants viewed *one* of the following: *SS vs. LS*, *SS vs. EF*, *SS vs. GhG*, *LS vs. EF*, *LS vs. GhG*, *EF vs. GhG*, or *Control vs. Control*. Participants were randomly allocated to conditions; trials and product/message location (left/right) were randomised.

Data processing: Optimal models were chosen via evaluations of Goodness of Fit statistics, namely estimates of data dispersion (scale parameter method was chosen based on Deviance and Pearson χ^2 values), Akaike's Information Criterion (AIC), and Bayesian Information Criterion (BIC). Analyses performed in SPSS v.25.0 (IBM Corp., 2017) and JASP v.0.9.2.0 (JASP Team, 2020).

2.1.3. Demographics and questionnaires

Participants' age, sex, and a proxy of socioeconomic status were attained, with the latter measured using the five-class version of National Statistics Socioeconomic Classification (NS-SEC), a measure used by the U.K. government (Office for National Statistics. Standard Occupational Classification, 2010). After the FCP/WTP segment came self-report questionnaires. Questionnaire order was randomised. Internal reliabilities (Cronbach's alphas) are given in Appendices (Table A2); alphas range from .78 to .90. Table 1 shows only small differences in some health motive subscales between experimental samples; for even the largest effect size (0.28), 89% of the samples' responses overlap (Magnusson 2020).

Environmental concern (EC): Measured using the 'Environmental module' of the International social survey program (ISSP), which measures three subscales (*Propensity to Act*, *Environmental Risk Perception*, and *General Environmental Concern*; sum total values) via five-point Likert scales, using *'very unwilling-willing'*, *'not at all dangerous-extremely dangerous'*, and *'not at all concerned-very concerned'* (Lo, 2016).

Health motivations (HM): Measured using the Health and Taste Attitude Scale – Revised (HTAS-R), a seven-point Likert scale (*'strongly disagree-strongly agree'*) measuring food choice motives (mean values): *health*, *taste*, *price*, *mood*, and *weight control* (Naughton et al., 2015).

Nationalism/Constructive patriotism (N/CP): Measured using the 'Nationalism and Constructive Patriotism' module of the ISSP (Davidov, 2011), a five-point Likert scale (*'strongly disagree-strongly agree'*) for N, and a four-point Likert scale (*'not proud at all-very proud'*) for CP (mean values for both).

3. Results

3.1. Pilots

Two pilot studies used similar methods and sustainability messages to our two main experiments. Results are presented briefly here. The messages were: i) 'Produced by sustainable farms', ii) 'Locally produced on U.K. farms', iii) 'Produced in the U.K.', and iv) 'Miles travelled' (Appendix *A.3.1.*).

Table 2
Random intercept binary logistic models examining Label Choice.

		B	SE	*p*	OR	95% CI
M1						
Likelihood Ratio χ^2	1.70			.19		
Choice constant. (SS vs. C)		**1.48**	**.18**	**< .001**	**4.39**	**3.11–6.22**
LS vs. C		.004	.10	.96	1.01	.83–1.21
EF vs. C		.07	.10	.46	1.07	.89–1.29
GhG vs. C		−.06	.10	.56	.94	.79–1.14
M2						
Likelihood Ratio χ^2	**50.05**			**< .001**		
Choice constant		**1.48**	**.15**	**<.001**	**4.39**	**3.26–5.97**
LS vs. C		.004	.10	.96	1.00	.83–1.21
EF vs. C		.07	.10	.46	1.07	.89–1.29
GhG vs. C		−.06	.10	.56	.94	.78–1.14
EC: GEC		.09	.20	.66	1.09	.74–1.62
EC: ERP		.05	.03	.12	1.05	.99–1.11
EC: PtA		**.10**	**.03**	**.001**	**1.11**	**1.04–1.18**
HM: WC		.21	.13	.11	1.23	.95–1.59
HM: Mood		**−.47**	**.16**	**.003**	**.63**	**.46–.85**
HM: Price		−.001	.15	.99	1.00	.74–1.62
HM: Taste		−.06	.15	.70	.94	.71–1.27
HM: Health		.33	.22	.12	1.39	.91–2.13
Nationalism		−.28	.18	.11	.76	.53–1.07
Constructive Patriotism		.39	.27	.15	1.48	.86–2.53
Age		−.001	.01	.85	1.00	.98–1.02
Sex (Male)		−.50	.30	.09	.60	.34–1.09
SES		.14	.11	.19	1.15	.93–1.44

B: Unstandardized beta/Log OR; SE: Standard error; OR: Odds Ratio; 95% CI: Wald confidence interval (OR); SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions; C: Control; EC: Environmental concern; HM: Health motivations; GEC: General environmental concern; ERP: Environmental risk perception; PtA: Propensity to act; WC: Weight control; Sex (female = reference); SES: Socioeconomic status; $p < .05$: **bold**.

3.1.1. Pilot 1

A Poisson regression ($N = 433$) adjusting for sex and age with label type as the predictor showed a statistically significant effect of label, χ^2 (Croft et al., 2018) = 24.73, $p < .001$. *Sustainable Farms* (32.6% more), *Miles travelled* (15.3% more), and *Locally produced* (11.2% more) were chosen more than no-label products (baseline comparator: *no-label vs. no-label*).

Table 1
Demographics and self-report questionnaire responses across datasets.

	Experiment 1		Experiment 2			
	MLM	*Poisson*	*MLM*	*Poisson*	MLM_{diff}	$Poisson_{diff}$
N	140	735	149	1079	–	–
% Female	51.4%	49.8%	50.3%	49.1%	.018	.007
Age	37.2 ± 15.6	41.3 ± 15.1	40.45 ± 13.5	40.2 ± 13.1	.182	.076
NS-SEC	1 (62.4%)	1 (52.9%)	1 (65%)	1 (51.5%)	.152	.029
EC: PtA	28.9 ± 5.5	27.9 ± 6.2	28.1 ± 6.2	27.9 ± 5.8	.141	.009
EC: ERP	26.7 ± 5.5	26.81 ± 4.9	26.3 ± 5.4	26.7 ± 5.1	.116	.029
EC: GEC	3.8 ± 0.9	3.7 ± 1.0	3.6 ± 1.1	3.6 ± 0.9	.182	.072
HM: Health	4.7 ± 0.9	4.8 ± 1.0	4.6 ± 0.9	4.7 ± 1.0	.146	.147**
HM: Taste	5.2 ± 1.3	5.4 ± 1.2	5.2 ± 1.2	5.2 ± 1.3	.086	.129**
HM: Price	4.7 ± 1.1	4.9 ± 1.2	4.9 ± 1.2	4.8 ± 1.2	.166	.048
HM: Mood	4.7 ± 1.2	4.9 ± 1.2	4.8 ± 1.2	4.7 ± 1.3	.099	.153***
HM: WC	4.8 ± 1.4	4.8 ± 1.6	4.4 ± 1.5	4.6 ± 1.6	.283*	.134**
Nationalism	3.0 ± 1.0	3.1 ± 0.9	3.2 ± 1.1	3.1 ± 0.9	.163	.038
CP	2.7 ± 0.7	2.8 ± 0.7	2.8 ± 0.7	2.7 ± 0.7	.213	.082

N = Sample size; NS-SEC = Mode (% cases); the rest are all M ± SD. EC: Environmental concern; PtA = Propensity to Act (score out of 45); ERP = Environmental Risk Perception (score/35); GEC = General Environmental Concern (score/5); HM = Health Motivation (WC = weight control) (all HM scores/7); Nationalism (score/5); CP = Constructive Patriotism (score/4); $MLM/Poisson_{diff}$ show Welch's *t*-test (Cohen's *d*) or χ^2 (Cramer's V; % Female) (*$p < .05$; **$p < .01$; ***$p < .001$).

3.1.2. Pilot 2

An identical study, except for an explicit 2-s time constraint on participants' choices ($N = 290$). An identical Poisson regression showed an effect of label type, χ^2 (Jackson, 2008) = 19.03, $p = .049$, with *Miles travelled* chosen 29.8% *less* than no-label. *Sustainable Farms* (15.3% less), *Locally produced* (17.4% less), and *U.K.* (1.4% less) were also chosen less than no-label, although $p_s > .15$.

3.2. Experiment 1

The MLM sample size ($N = 140$) was considerably larger than the minimum recommended ($N > 50$) for bias-free MLM (Maas and Hox, 2005). A pre-registered power analysis was conducted for the Poisson design using G*Power v.3.1.3 (Faul et al., 2009) (https://osf.io/ub5hr); however, due to increased funds becoming available prior to launch, an additional analysis was run to detect an 11% change (the smallest statistically significant effect in *Pilot 1*) with ~92% power ($N = 735$).

3.2.1. MLM (within-subjects) design

After exclusion of 28 participants (24 for missing data; four for failed attention checks; see *A.2.1*), final $N = 140$ (*Ntrials* = 5600). The MLM design uses a within-subjects design to compare *labels vs. no-labels*. Labels' relative performance against other labels was thus inferred indirectly, based on the magnitude of each label's effect on choice and WTP. Choice counts and WTP averages in Tables A3 and A.4.

3.2.1.1. MLM design: choice. For choice responses, random intercept binary logistic models were created using a generalized linear MLM approach with a maximum-likelihood estimation by Laplace approximation via a BOBYQA optimizer (max. iterations = 10,000). Dummy variables were created to compare label types (*Sustainably sourced*, *Locally sourced*, *Environmentally friendly*, and *Low greenhouse gas emissions*), with SS the reference category. Three models were built: M1) assessed main effects of label type, M2) explored if there existed predictors of choice of labelled vs. non-labelled products (regardless of type), and M3) included an interaction term between label type and any statistically significant predictors identified in M2. For brevity, Model 3 is presented in Table A7. Odds ratios (ORs) > 1 indicate higher selection of labelled products (Table 2).

A two-level null-model was a better fit to the data than a single-level model, χ^2 (Tukker et al., 2010a) = 1266.32, $p < .001$, with labelled products chosen 4.44 × more than no-label. In M1, the odds of SS products being chosen were 4.39× greater than no-label. Entering all predictors in M2 improved fit; examination of the intraclass coefficients (ICC) revealed 58.19% ($ICC^{Within} = 0.582$) of variance was within person and 41.81% ($ICC^{Between} = 0.418$) between person. *Environmental concern: Propensity to Act* predicted preference for labelled products and *Health motivations: Mood* for non-labelled products.

3.2.1.2. MLM design: WTP. A 2 × 4 (Label Presence × Label Type) Repeated-Measures ANOVA showed greater WTP for labelled ($M = 49.28 \pm 15.88$) vs. non-labelled ($M = 45.47 \pm 14.62$) products, $F(1, 139) = 36.05$, $p < .001$, $\eta_p^2 = 0.206$, VS-MPR = 1,290,000 ('diagnosticity' of a p-value showing its maximum likelihood under H_1 vs. H_0; here, p is over 1.2 million times more likely under H_1 (Sellke et al., 2001)). This translates to increased WTP of ~£0.11. There was no main effect of Label Type, $F(3, 417) = 1.129$, $p = .337$, $\eta_p^2 = 0.008$, VS-MPR = 1.004, nor any interaction, $F(3, 417) = 2.231$, $p = .084$, $\eta_p^2 = 0.016$, VS-MPR = 1.768 (Fig. 3).

Next, we explored whether individual differences predict WTP differences (score: *WTP for labelled product−WTP for non-labelled product*) across label types via multiple regression; positive coefficients indicate greater WTP for labelled products (Table 3). The two-level structure for WTP score was a better fit than the single-level model, χ^2 (Tukker et al., 2010a) = 599.16, $p < .001$. Models were created in an identical fashion to Choice models. M1 showed WTP score was 3.76 VAS points higher for SS vs. no-label products (the constant shows *SS vs. C* when all other predictors are held at zero; the same does not apply to the other categorical predictors). M2 further improved fit; comparison of the variance partition coefficients (VPCs) revealed the model predicted 22.82% of the variance in WTP at the participant level and 3.92% at the trial level. Every extra selection of a label (vs. non-label) product predicted a ~9-point (£0.27) increase in WTP for label (vs. non-label) products, and higher *Environmental concern: Propensity to Act* scores predicted greater WTP for labelled products.

Table 3
Random intercept linear models predicting WTP difference score.

		B	SE	95% CI	p
M1					
Likelihood Ratio χ^2	5.87				.12
WTP constant. (SS vs. C)		**3.76**	**.74**	**2.46–5.23**	**< .001**
LS vs. C		−.82	.64	−2.13-.46	.20
EF vs. C		.43	.64	−.83-1.66	.50
GhG vs. C		.57	.64	−.64-1.73	.37
M2					
Likelihood Ratio χ^2	**276.29**				**< .001**
WTP constant		**3.76**	**.66**	**2.45–5.18**	**< .001**
LS vs. C		−.83	.62	−2.17-.40	.18
EF vs. C		.34	.62	−.89-1.60	.59
GhG vs. C		.65	.62	−.56-1.89	.29
Choice (label)		**9.01**	**.55**	**7.89–10.14**	**<.001**
EC: GEC		−.79	.81	−2.52-.86	.33
EC: ERP		−.10	.12	−.35-.14	.40
EC: PtA		**.27**	**.13**	**.03–.51**	**.03**
HM: WC		.16	.51	−.78-1.08	.75
HM: Mood		.38	.61	−.71-1.61	.54
HM: Price		−.41	.59	−1.61-.74	.48
HM: Taste		−.26	.58	−1.34-.91	.65
HM: Health		.65	.83	−1.06–2.24	.44
Nationalism		−.24	.68	−1.60–1.06	.73
Constructive Patriotism		−.98	1.07	−3.42–1.16	.36
Age		−.04	.04	−.13-.04	.31
Sex (Male)		.31	1.18	−2.18–2.53	.79
SES		.03	.42	−.79-.92	.95

Difference score: *WTP left-sided label−WTP right-sided label.* Positive coefficients indicate increases in predictor → increase in WTP for labelled products. B: Unstandardized beta/Log OR; SE: Standard error; 95% CI: Bootstrapped (500 samples) confidence interval; SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions; C: Control; EC: Environmental concern; HM: Health motivations; GEC: General environmental concern; ERP: Environmental risk perception; PtA: Propensity to act; Sex (female = reference); SES: Socioeconomic status; $p < .05$: **bold**. *Note[1]*. Odds ratio not calculated as B value is not log odds. *Note[2]*. 'Choice (label)' not appropriate for inclusion in M3 due to its within-person, multilevel (trial-by-trial) nature.

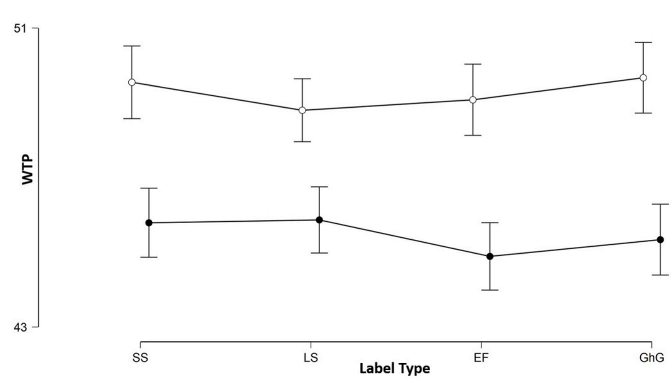

Fig. 3. R-M ANOVA assessing WTP (values are visual analogue scale points) for labelled (○) vs. non-labelled (●) products. One WTP VAS point ≈ £0.03. SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions. Error bars = 95% confidence intervals.

3.2.2. Poisson (between-subjects) design

The final $N = 735$ after one participant was excluded (all WTP responses = zero). The between-subjects design ($n \approx 104$ per condition) built upon MLM analyses to directly compare *label vs. label*. Choice counts and WTP averages in Tables A5 and A.6.

3.2.2.1. Poisson design: choice. Two models were built: M1 assessed main effects of label type while adjusting for demographic variables (sex, age, SES); M2 the effects of label type interacting with all predictor variables (see Table 1). ORs >1 indicate higher selection of the left-sided labelled product (Table 4). M1 showed SS and LS products were chosen 17–23% more than GhG products, with SS chosen ~14% more than LS. M2 shows various interactions (see Discussion).

3.2.2.2. Poisson design: WTP. WTP for different labels was assessed via a R-M ANOVA with label location (left-sided vs. right-sided product) as the R-M factor and condition as a between-subjects factor. WTP was higher for left-sided vs. right-sided labels (this reflects our organisation of data into left = most chosen, right = least chosen), $F(1, 728) = 4.152$, $p = .042$, $\eta_p^2 = 0.006$, VS-MPR = 2.765. There was little evidence of a main effect of condition, $F(6, 728) = 1.893$, $p = .080$, $\eta_p^2 = 0.015$, VS-MPR = 1.828. There was an interaction between location and condition, $F(6, 728) = 3.371$, $p = .003$, $\eta_p^2 = 0.027$, VS-MPR = 22.581, indicating WTP differences between specific label types within certain conditions. Bonferroni *post-hoc* comparisons showed WTP was higher (~£0.07) for *LS vs. GhG*, $p = .002$, $d_{RM} = 0.303$ (Fig. 4; Table A9).

Next, we explored whether individual differences predict WTP differences (score: *WTP for left-sided product−WTP for right-sided product*) across conditions via multiple regression. This analysis deviates slightly from pre-registration; see A.3.2.2.2. We use a data-driven approach to build a model by first running a multiple regression containing all predictors (Table A.10) and then refining by choosing only the best predictors; see A.3.2.2.2. Table 5 shows greater selection of SS (vs. GhG), LS (vs. GhG), and EF (vs. GhG) products predicted greater WTP for the same labels. Higher *Health motivations: Price* scores predicted higher WTP for EF (vs. GhG), while older age predicted lower WTP for LS (vs. GhG).

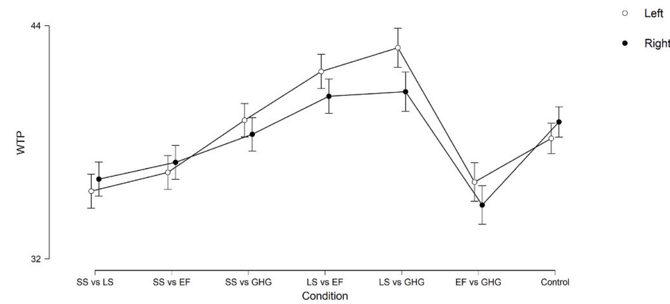

Fig. 4. *Post-hoc t*-tests assessing WTP (values are visual analogue scale points) across conditions and labels (○: left-sided, ●: right-sided). One WTP VAS point ≈ £0.03. SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions; Control: No-label. Error bars = 95% confidence intervals (*$p < .05$; **$p < .007$).

3.3. Experiment 2

Exp.2 is a direct replication of Exp.1. Sample size for the MLM design was identical to Exp.1 ($N = 150$). A power analysis determined sample size to detect a 9% change (the smallest main effect size of label type [*LS vs. EF*] affecting choice in Poisson M1, Exp.1, Table 4) with 90% power

Table 4
Poisson regressions examining Label Choice.

		B	SE	Wald χ^2	*p*	OR	95% CI
M1							
Likelihood Ratio χ^2	**18.70**				**.005**		
SS vs. LS		**.143**	**.063**	**5.163**	**.023**	**1.154**	**1.020–1.305**
SS vs. EF		.088	.064	1.905	.168	1.092	.964–1.238
SS vs. GhG		**.174**	**.063**	**7.632**	**.006**	**1.190**	**1.052–1.346**
LS vs. EF		.085	.064	1.761	.185	1.089	.960–1.234
LS vs. GhG		**.240**	**.062**	**15.131**	**< .001**	**1.271**	**1.126–1.434**
EF vs. GhG		.098	.064	2.329	.127	1.103	.973–1.250
M2							
Likelihood Ratio χ^2	**174.38**				**< .001**		
Age × SS vs. LS		**.009**	**.003**	**7.666**	**.006**	**1.009**	**1.003–1.016**
Age × SS vs. EF		.007	.004	3.747	.053	1.007	1.000–1.014
Age × SS vs. GhG		.002	.003	0.474	.491	1.002	.996–1.008
Age × LS vs. EF		**.011**	**.004**	**10.155**	**.001**	**1.011**	**1.004–1.018**
Age × LS vs. GhG		**.007**	**.003**	**6.974**	**.008**	**1.007**	**1.002–1.012**
Age × EF vs. GhG		.005	.003	3.232	.072	1.005	1.000–1.011
Age × C vs. C		.000	.004	0.011	.915	1.000	.993–1.008
PtA × SS vs. LS		.010	.010	1.151	.283	1.010	.992–1.029
PtA × SS vs. EF		−.010	.010	1.119	.290	.990	.972–1.009
PtA × SS vs. GhG		−.015	.010	2.301	.129	.985	.966–1.004
PtA × LS vs. EF		−.009	.010	1.137	.286	.991	.973–1.008
PtA × LS vs. GhG		**.026**	**.009**	**7.822**	**.005**	**1.026**	**1.008–1.045**
PtA × EF vs. GhG		**−.023**	**.010**	**5.145**	**.023**	**.977**	**.957–.997**
PtA × C vs. C		.008	.010	0.650	.420	1.008	.989–1.027
CP × SS vs. LS		**.189**	**.079**	**5.711**	**.017**	**1.209**	**1.035–1.412**
CP × SS vs. EF		−.057	.077	0.549	.459	.945	.813–1.098
CP × SS vs. GhG		**−.186**	**.086**	**4.725**	**.030**	**.830**	**.702–.982**
CP × LS vs. EF		−.164	.090	3.330	.068	.849	.711–1.012
CP × LS vs. GhG		−.098	.085	1.338	.247	.907	.768–1.070
CP × EF vs. GhG		.028	.086	0.102	.750	1.028	.868–1.218
CP × C vs. C		−.077	.098	0.627	.429	.926	.765–1.121

B: Unstandardized beta/Log OR; SE: Standard error; OR: Odds ratio; 95% CI: Confidence interval; $p < .05$: **bold.** In Model 1 (1 main effect) sex, age, and SES were entered as covariates; *no-label control vs. no-label control* is used as the reference category. SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions; C: Control; PtA: Environmental concern: Propensity to Act. In Model 2 (13 interaction effects), only effects which had a statistically significant ($p < .05$) impact on the model are reported. Due to slight overdispersion, scale parameter method = Pearson χ^2 in both models. Positive coefficients indicate greater choice for left-sided vs. the right-sided product.

Table 5
Multiple regression predicting WTP difference score.

	SS vs. LS		SS vs. EF		SS vs. GhG		LS vs. EF		LS vs. GhG		EF vs. GhG	
dsba	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Sex	.249	1.284	−.963	1.377	.670	1.204	−.427	1.349	−1.817	1.438	−1.249	1.377
Age	−.066	.050	−.012	.054	−.061	.041	−.018	.052	−.114**	.044	.039	.045
EC: GEC	−.494	.618	−.638	.699	.125	.614	.922	.703	.568	.843	.615	.701
HM: Health	−.192	.644	.225	.791	.638	.693	.468	.780	−.447	.834	−.001	.772
HM: Taste	.659	.615	.308	.661	−.136	.593	−.635	.655	.069	.755	−1.273	.725
HM: Price	.507	.588	.321	.590	−.428	.543	.898	.758	.143	.551	1.850**	.690
Nationalism	.597	.726	−.371	.801	−.127	.751	−.665	.793	−.152	.986	−.736	.929
CP	−1.059	1.108	−.502	1.134	1.260	1.185	−1.157	1.251	.074	1.394	−2.105	1.223
Choice (*left*)	−.470*	.235	.150	.281	.967***	.243	−.022	.240	1.147***	.240	.707**	.267
R^2 | *Adj.* R^2	.132 | .049		.031 | −.060		.179 | .100*		.074 | −.013		.209 | .136**		.204 | .128**	

Difference score: *WTP left-sided label−WTP right-sided label*. B: Unstandardized beta/Log OR; SE: Standard error. Positive coefficients indicate increases in predictor → increase in WTP for left-sided labels. *$p < .05$; **$p < .01$; ***$p < .001$. SS = Sustainably sourced; LS = Locally sourced; EF = Environmentally friendly; GhG = Low greenhouse gas emissions; Control (*no-label vs. no-label*) condition is omitted. Sex (female = reference category); EC = Environmental concern; HM = Health motivations; GEC = General environmental concern; CP = Constructive patriotism; Choice (*left*) = choice for the left-sided label (DV, Poisson model).

(N = 931) (https://osf.io/hwfjg). Model builds and analyses were identical to Exp.1.

3.3.1. MLM (within-subjects) design

Final $N = 149$ (*Ntrials* = 5960) after 16 participants were excluded (nine for missing data; seven for failed attention checks). Choice counts and WTP averages in Tables A3 and A.4.

3.3.1.1. MLM design: choice. A two-level null-model was a better fit than a single-level model, χ^2 (Tukker et al., 2010a) = 347.36, $p < .001$. Labelled products were chosen 4.44 × more than non-labelled (not shown in table). SS products were chosen 4.35 × more than no-label (M1). M2 improved fit; the ICC revealed 53.54% ($ICC^{Within} = 0.535$) of variance was within person while 46.46% ($ICC^{Between} = 0.465$) was between person. *Environmental concern: Propensity to Act* and *Health motivations: Health* scores predicted preference for labelled products. Conversely, higher *Health motivations: Taste* and *Nationalism* scores predicted *reduced* choice for labelled products. M3 show in Table A11.

3.3.1.2. MLM design: WTP. A 2 × 4 (Label Presence × Label Type) R-M ANOVA showed greater WTP for labelled ($M = 46.15 \pm 19.90$) vs. non-labelled ($M = 42.66 \pm 18.51$) products, $F(1, 148) = 28.84$, $p < .001$, $\eta_p^2 = 0.163$, VS-MPR = 81,978. This translates to an increased WTP of ~£0.10. There was no main effect of Label Type (Huynh-Feldt correction, $\varepsilon = 0.976$), $F(2.93, 433.32) = 1.30$, $p = .274$, $\eta_p^2 = 0.009$, VS-MPR = 1.038, nor an interaction (Huynh-Feldt correction, $\varepsilon = 0.695$), $F(2.08, 308.49) = 1.21$, $p = .299$, $\eta_p^2 = 0.008$, VS-MPR = 1.016 (Fig. 5).

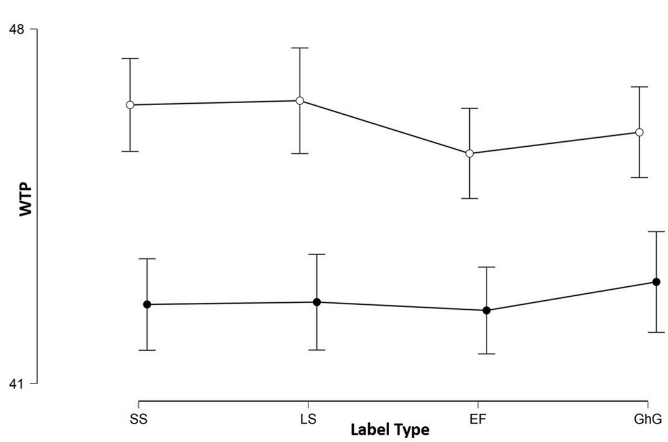

Fig. 5. R-M ANOVA assessing WTP (values are visual analogue scale points) for labelled (○) vs. non-labelled (●) products. One WTP VAS point ≈ £0.03. SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions. Error bars = 95% confidence intervals.

Next, we explored whether individual differences predict WTP differences (*WTP for labelled product−WTP for non-labelled product*). A two-level null-model was a better fit than a single-level model, χ^2 (Tukker et al., 2010a) = 763.04, $p < .001$. WTP was 3.94-points higher for SS vs. no-label products (M1). M2 further improved model fit; comparison of VPCs revealed the model predicted 28.94% of variance in scores at the participant level and 5.81% at the trial level. Every extra selection of label (vs. non-label) products predicted a ~7-point (£0.21) increase in WTP score for label (vs. non-label) products. Various individual differences predicted WTP differences (see Discussion).

3.3.2. Poisson (between-subjects) design

Final $N = 1079$ ($n \approx 155$ per condition) after ten participants were

Table 6
Random intercept binary logistic model examining Label Choice.

		B	SE	*p*	OR	95% CI
M1						
Likelihood Ratio χ^2	2.46			.12		
Choice constant. (SS vs. C)		**1.47**	**.18**	**< .001**	**4.35**	**3.07–6.19**
LS vs. C		.08	.10	.37	1.08	.91–1.31
EF vs. C		.05	.10	.57	1.05	.88–1.27
GhG vs. C		−.05	.09	.57	.95	.79–1.14
M2						
Likelihood Ratio χ^2	**40.60**			**< .001**		
Choice constant		**1.47**	**.16**	**<.001**	**4.35**	**3.18–5.96**
LS vs. C		.08	.09	.37	1.08	.91–1.31
EF vs. C		.05	.09	.57	1.05	.88–1.27
GhG vs. C		−.05	.09	.57	.95	.79–1.14
EC: GEC		−.29	.21	.15	.75	.50–1.12
EC: ERP		.04	.04	.32	1.04	.96–1.12
EC: PtA		**.07**	**.04**	**.05**	**1.07**	**1.00–1.14**
HM: WC		.04	.14	.79	1.04	.79–1.37
HM: Mood		.21	.18	.25	1.23	.87–1.75
HM: Price		.001	.18	.99	1.00	.70–1.42
HM: Taste		**−.47**	**.18**	**.009**	**.63**	**.44–.89**
HM: Health		**.75**	**.24**	**.001**	**2.12**	**1.33–3.35**
Nationalism		**−.33**	**.17**	**.05**	**.72**	**.52–.99**
Constructive Patriotism		−.21	.28	.45	.81	.47–1.40
Age		.02	.01	.12	1.02	.99–1.05
Sex (Male)		−.20	.32	.54	.82	.44–1.53
SES		.10	.10	.31	1.11	.91–1.36

B: Unstandardized beta/Log OR; SE: Standard error; OR: Odds Ratio; 95% CI: Wald confidence interval (OR); SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions; C: Control; EC: Environmental concern; HM: Health motivations; GEC: General environmental concern; ERP: Environmental risk perception; PtA: Propensity to act; WC: Weight control; Sex (female = reference); SES: Socioeconomic status; $p < .05$: **bold**.

excluded (eight for missing choice data; two for failed attention checks). Choice counts and WTP averages in Tables A5 and A.6.

3.3.2.1. Poisson design: choice. Analysis plan was identical to Exp.1. Results mostly replicated those of Exp.1 (Table 8).

3.3.2.2. Poisson design: willingness-to-pay. Analysis plan was identical to Exp.1. A R-M ANOVA showed no difference in WTP between left-sided and right-sided labels, $F(1, 1072) = 1.270$, $p = .260$, $\eta_p^2 = 0.001$, VS-MPR = 1.050. There was no main effect of condition, $F(6, 1072) = 0.610$, $p = .610$, $\eta_p^2 = 0.003$, VS-MPR = 1.000. There was an interaction between location and condition, $F(6, 1072) = 3.281$, $p = .003$, $\eta_p^2 = 0.018$, VS-MPR = 19.325, indicating WTP differences between specific label types within certain conditions. Bonferroni-corrected *post-hoc* tests showed WTP was higher (~£0.05) for *LS vs. EF*, $p = .001$, $d_{RM} = 0.264$ (Fig. 6; Table A.13).

Next, we explored whether individual differences predict WTP differences (*WTP for left-sided product−WTP for right-sided product*) across conditions via multiple regression. Analyses were identical to Exp.1 (Table A.14). The final model (Table 9) was identical to the one in Exp.1. The only consistent predictor of WTP for a label was frequency of choice of said label.

3.4. Results Synthesis

Given Exp.1 and 2 were identical, data were pooled. Findings are summarised (further details in *A.3.4*).

3.4.1. MLM (within-subjects) design

Total $N = 289$ ($Ntrials = 11{,}560$); choice counts and WTP averages in Tables A3 and A4. Labelled products were chosen 4.44 × more than non-labelled products, with SS chosen 4.39 × more than no-label (Table A.15). ICCs revealed 53.74% of variance was within person, 46.26% between person. Higher *Environmental concern: Propensity to Act* and *Health motivations: Health* scores predicted preference for labelled products. Conversely, *Nationalism* predicted *reduced* choice for labelled products. WTP was higher (~£0.11) for labelled vs. non-labelled products, with no differences between labels (Figure A.2). VPCs revealed 20.81% of variance in scores was explained at the participant level, 3.89% at the trial level. Every extra selection of label (vs. non-label) products predicted an ~8-point (£0.24) increase in WTP score for label (vs. non-label) products (Table A.16).

3.4.2. Poisson (between-subjects) design

Total $N = 1814$ ($n \approx 260$ per condition); choice counts and WTP averages in Tables A5 and A6. SS and LS products were chosen 17% and 25.8% more (respectively) than GhG products. Older consumers were more likely to choose SS, LS, and EF products 0.4–0.8% more often than GhG products (Table A.17). Consumers were WTP ~£0.03–0.06 more for LS products vs. EF and GhG (Table A.18; Figure A3). The only robust predictor of WTP was product choice; every extra selection of SS, LS, or EF (vs. GhG) predicted WTP increases (~£0.0015–0.03) for the same product (Table A.20).

Table 7
Random intercept linear models predicting WTP difference score.

		B	SE	95% CI	p
M1					
Likelihood Ratio χ^2	4.72				.19
WTP constant. (SS vs. C)		**3.94**	**.75**	**2.52–5.42**	**< .001**
LS vs. C		.04	.61	−1.15–1.34	.95
EF vs. C		−.84	.61	−2.07-.33	.17
GhG vs. C		−.98	.61	−2.26-.25	.11
M2					
Likelihood Ratio χ^2	**223.36**				**< .001**
WTP constant		**3.96**	**.65**	**2.79–5.42**	**< .001**
LS vs. C		−.06	.06	−1.22–1.15	.93
EF vs. C		−.90	.06	−2.01-.32	.13
GhG vs. C		−.93	.06	−2.08-.30	.12
Choice (label)		**7.29**	**.54**	**6.20–8.33**	**<.001**
EC: GEC		.25	.75	−1.39–1.88	.74
EC: ERP		**.35**	**.15**	**.09–.63**	**.02**
EC: PtA		**−.26**	**.12**	**−.48–−.01**	**.04**
HM: WC		.34	.51	−.59-1.37	.50
HM: Mood		.48	.64	−.79-1.64	.45
HM: Price		−.80	.64	−2.13-.50	.21
HM: Taste		−.43	.66	−1.64-.81	.52
HM: Health		1.53	.85	−.15-3.26	.07
Nationalism		**−1.34**	**.60**	**−2.49–−.09**	**.03**
Constructive Patriotism		.79	1.02	−1.13–2.86	.44
Age		−.07	.05	−.16-.03	.16
Sex (Male)		−1.85	1.17	−4.22-.38	.11
SES		−.66	.38	−1.48-.05	.08

Difference score: *WTP left-sided label−WTP right-sided label.* Positive coefficients indicate increases in predictor → increase in WTP for labelled products. B: Unstandardized beta/Log OR; SE: Standard error; 95% CI: Bootstrapped (500 samples) confidence interval; SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions; C: Control; EC: Environmental concern; HM: Health motivations; GEC: General environmental concern; ERP: Environmental risk perception; PtA: Propensity to act; Sex (female = reference); SES: Socioeconomic status; $p < .05$: **bold**. *Note[1]*. Odds ratio not calculated as B value is not log odds. *Note[2]*. 'Choice (label)' not appropriate for inclusion in M3 due to its within-person, multilevel (trial-by-trial) nature.

4. Discussion

We present data from over 2800 participants, amassed via hypothetical online shopping paradigms using contingent valuation elicitation alongside novel analyses. Across six samples we explored U.K. consumers' purchasing decisions towards foods displaying 'green messages'. The labels 'Sustainably sourced', 'Locally sourced', 'Environmentally friendly', and 'Low greenhouse gas emissions' were compared to no-label controls in the Multilevel Model (*MLM*) design, and to each other in the Poisson design. The primary outcomes were frequency with which each label was selected (*Choice*) and willingness-to-pay (*WTP*). Demography, health motivations, environmental concern, and nationalism/patriotism were also measured. Consumers were far more likely to choose and were willing-to-pay more for labelled products when directly compared with non-labelled products, with no substantial differences between label types. However, when directly compared to each other 'Sustainably sourced' and 'Locally sourced' were chosen most (especially compared to 'Low greenhouse gas emissions'), with WTP highest for 'Locally sourced' products. The most consistent and robust predictor of WTP was choice: increased selection of a label was associated with greater WTP for that label. Other individual differences either inconsistently predicted outcomes or lacked associations to purchasing behaviour altogether.

4.1. Label vs. no-label

Across MLM datasets, labelled products were chosen 4.44 × (344%) more often than no-label products, with no substantial differences between label types. WTP was ~3.8 VAS (visual analogue scale) points higher for labelled products, with no differences between label types. The statistical evidence for this effect was overwhelming and translates into consumers' willing to pay an ~£0.11 premium (one VAS point ≈ £0.03, averaged across food products) for identical products possessing a 'green message' (of any stripe). Importantly, however, WTP ranged from VAS-points ~41–50 (actual retail price: 50), perhaps suggesting consumers were *not* willing-to-pay more than current retail price for *any* products, which would translate to no real-world premiums. Alternatively, since consumers were not made aware of the recommended retail price (RRP) and it is unlikely they had explicit knowledge of the RRP of each product, consumers may have simply been conservative in their estimated WTP by selecting from only the bottom 50% of prices.

Regarding associations between individual differences and product

Table 8
Poisson regressions examining Label Choice.

		B	SE	Wald χ^2	p	OR	95% CI
M1							
Likelihood Ratio χ^2	**48.62**				**< .001**		
SS vs. LS		.020	.050	0.159	.690	1.020	.925–1.125
SS vs. EF		−.029	.050	0.325	.569	.972	.880–1.073
SS vs. GhG		**.145**	**.049**	**8.901**	**.003**	**1.156**	**1.051–1.272**
LS vs. EF		.056	.049	1.283	.257	1.057	.960–1.165
LS vs. GhG		**.222**	**.048**	**21.702**	**< .001**	**1.248**	**1.137–1.371**
EF vs. GhG		−.021	.050	0.184	.668	.979	.887–1.080
M2							
Likelihood Ratio χ^2	**234.32**				**< .001**		
Age × SS vs. LS		**.006**	**.003**	**5.229**	**.022**	**1.006**	**1.001–1.012**
Age × SS vs. EF		**.009**	**.003**	**9.198**	**.002**	**1.009**	**1.003–1.015**
Age × SS vs. GhG		**.009**	**.003**	**13.224**	**< .001**	**1.010**	**1.004–1.015**
Age × LS vs. EF		**.010**	**.003**	**12.455**	**< .001**	**1.010**	**1.004–1.016**
Age × LS vs. GhG		**.006**	**.003**	**5.242**	**.022**	**1.006**	**1.001–1.011**
Age × EF vs. GhG		.003	.003	1.455	.228	1.003	.997–1.009
Age × C vs. C		.003	.003	0.963	.326	1.003	.997–1.009

B: Unstandardized beta/Log OR; SE: Standard error; OR: Odds ratio; 95% CI: Confidence interval; $p < .05$: **bold.** In Model 1 (1 main effect) sex, age, and SES were entered as covariates; *no-label control vs. no-label control* is used as the reference category. SS = Sustainably sourced; LS = Locally sourced; EF = Environmentally friendly; GhG = Low greenhouse gas emissions; C = Control; In Model 2 (13 interaction effects), only effects which had a statistically significant ($p < .05$) impact on the model are reported. Due to slight overdispersion, scale parameter method = Pearson χ^2 in both models. Positive coefficients indicate greater selection of the left-sided vs. the right-sided product.

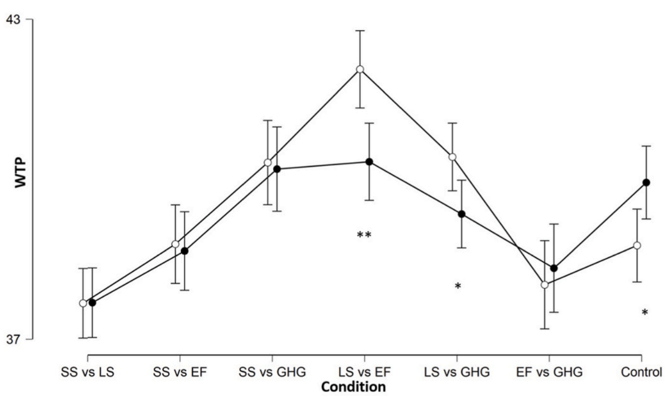

Fig. 6. *Post-hoc t*-tests assessing WTP (values are visual analogue scale points) across conditions and labels (○: left-sided, ●: right-sided). One WTP VAS point ≈ £0.03. SS: Sustainably sourced; LS: Locally sourced; EF: Environmentally friendly; GhG: Low greenhouse gas emissions; Control: No-label. Error bars = 95% confidence intervals (*$p < .05$; **$p < .007$).

choice, higher 'propensity to act' (*Environmental concern*) scores consistently predicted higher selection of labelled products. This supports previous work showing more 'involved' or 'pro-environment' consumers actively seek out 'green information' and are even willing to pay more (Verbeke and Vackier, 2004b; Magnier and Schoormans, 2015; Carley and Yahng, 2018b). However, in both Exp.2 and the Results Synthesis, increases in PtA served to *reduce* the likelihood of selecting 'Locally sourced' products. This result is without precedent in the literature but given its substantial effect in Exp.2 it should be incorporated in future studies to assess its interaction with 'local' messaging. Further, *Health motivations* predicted increased choice for labelled products and this supports previous findings that health and sustainability are often viewed as overlapping concepts (Mirosa and Lawson, 2012; Scheelbeek et al., 2020). However, the health motivations 'Mood' and 'Taste' predicted *reduced* selection of labelled products, suggesting that consumers who grant priority to foods' taste, look, and ability to make them feel better believe that *non*-sustainable foods are superior. Finally, *Nationalism* reduced choice for labelled products and we found no evidence that it predicted support for local foods (Caldwell, 2003).

Regarding individual differences and WTP, only one variable showed consistent effects: every extra selection of a labelled (vs. no-label) product predicted a ~7-9-point increase on the WTP VAS, amounting to increases of £0.21–0.27 for labelled products. This suggests

Table 9
Multiple regression predicting WTP difference score.

	SS vs. LS		SS vs. EF		SS vs. GhG		LS vs. EF		LS vs. GhG		EF vs. GhG	
	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Sex	−1.73	.94	−.30	1.11	.14	1.14	.53	1.08	.37	.94	−1.53	1.19
Age	.02	.04	−.01	.04	.04	.05	−.02	.04	.04	.04	.05	.05
EC: GEC	.23	.47	.23	.56	−.37	.62	−.67	.57	.10	.50	−.15	.65
HM: Health	.95	.52	−.91	.64	.38	.62	.35	.66	.06	.49	1.22	.82
HM: Taste	−.31	.48	−.35	.49	−.43	.56	.93	.54	−.21	.42	−.69	.58
HM: Price	.59	.46	.30	.51	.42	.50	−.89	.52	−.33	.40	.29	.57
Nationalism	−.50	.57	.91	.63	.22	.66	.18	.66	−.25	.52	−1.41*	.66
CP	−.07	.81	.71	.90	.76	.98	.48	.90	.74	.76	2.06*	1.01
Choice (*left*)	−.47**	.18	.49*	.23	.73***	.22	.02	.22	.48**	.17	.20	.30
R^2 | *Adj.* R^2	.127 | .072*		.078 | .020		.106 | .051		.051 | −.007		.086 | .029		.075 | .019	

Difference score: *WTP left-sided label−WTP right-sided label*. B: Unstandardized beta/Log OR; SE: Standard error. Positive coefficients indicate increases in predictor → increase in WTP for left-sided labels. *$p < .05$; **$p < .01$; ***$p < .001$. SS = Sustainably sourced; LS = Locally sourced; EF = Environmentally friendly; GhG = Low greenhouse gas emissions; Control (*no-label vs. no-label*) condition is omitted. Sex (female = reference category); EC = Environmental concern; HM = Health motivations; GEC = General environmental concern; CP = Constructive patriotism; Choice (*left*) = choice for the left-sided label (DV, Poisson model).

consumers are willing to back-up their choices, paying more for products they choose. All other associations were inconsistent across studies. Our findings show less robust effects of 'environmentalism' on WTP than previous studies (Verbeke and Vackier, 2004b; Magnier and Schoormans, 2015; Carley and Yahng, 2018b), but are in-line with larger research reports showing that environmental factors are a low priority for consumers (Garnett et al., 2015b; Owen et al., 2007; Grunert et al., 2014). Finally, all WTP multilevel models explained ~5 × more variance at the participant level than at the trial level, suggesting variation in WTP was more a function of inter-person characteristics than labelling.

4.2. Label vs. label

The MLM design allowed consumers the freedom to select some labels but not others (or none); the Poisson design forced them to choose one label over another. Exp.1 showed consumers most frequently chose the 'Sustainably sourced' (vs. 'Locally sourced' and 'Low greenhouse gas emissions') and 'Locally sourced' products (vs. 'Low greenhouse gas emissions'). Effects were quite large, with ~15–27% increased selection of SS and LS products vs. others. Exp.2 showed ~15–25% increased selection of SS and LS vs. GhG. Results are robust across all Poisson designs (including Pilot 1, but excluding Pilot 2, likely due to its time-constraint feature) and support earlier work showing consumer preference for 'local' products (Feldmann and Hamm, 2015; Costanigro et al., 2011b; James et al., 2009b; Schjøll, 2016). Further, results are consistent with previous findings that, aside from factors like taste and cost, American students preferred 'sustainability' messages over other green messages, including 'local' (Silva et al., 2018). Our findings show larger effects than previous work (Owen et al., 2007; Grunert et al., 2014), possibly due to consumers' increasing concern around sustainability in recent years (Garnett et al., 2015b).

Regarding WTP, Exps.1 and 2 showed that consumers were willing to pay small premiums of ~£0.03–0.06 for LS products vs. others. Results were robust across samples and showed consumers' WTP more only for 'local' products, replicating past findings (Carpio and Isengildina-massa, 2009; Costanigro et al., 2011b). It should be noted that much previous work is limited in its use of labels, foods, use of categorical as opposed to continuous price ranges, sample size, and parameter estimation (e.g., Costanigro et al., found WTP ranges from ~$0.20–9.00 for apples). In contrast, our results demonstrate the premiums which consumers are willing to pay for locally sourced foods are vastly more modest, at least when compared to other green alternatives. Finally, as with MLM data, WTP ranges never exceeded VAS-point 50 (RRP).

Regarding associations between individual differences and choice, findings were mostly inconsistent. 'Age' was the most robust predictor: each one-year increase amplified selection of SS, LS, and EF products (vs. others) by 0.4–0.8% (i.e., when forced to choose, older consumers prefer any message other than 'Low greenhouse gas emissions', contrary to hypotheses). Findings were equally inconsistent for WTP. Product choice was the only semi-reliable predictor (excluding Exp.2): using Results Synthesis data, every extra selection of SS, LS, and EF (all vs. GhG) increased WTP by ~£0.0015–0.03. Similarly, excluding Exp.2, a one-point increase in 'Concern for price' (*Health motivations*) increased WTP for EF by £0.03–0.06. Other associations were inconsistent and difficult to tie to anything theoretically meaningful.

4.3. Limitations and future directions

The studies detailed here outline robust methodology and preliminary evidence for assessing the acceptance of green messaging in U.K. consumers. However, given that we were constrained to online 'shopping' and needed to manipulate product packaging (removing branding, etc.), ecological validity could be improved via alternative methodologies (e.g., does brand recognition interact with green messaging?). Future work should also investigate the time-constraint feature of Pilot 2 using improved methods, as well as comparing subgroups separated by diet (e.g., omnivores vs. vegans) due to the potential differences in relevant characteristics (e.g., environmental concern) – higher EC groups may show even larger effects. Relatedly, our study may possess selection bias due to data exclusion; however, see A.2.1. Additionally, we were only able to assess consumer acceptance as it is currently; it would be prudent to explore how altering awareness of sustainability issues via experimental manipulation might improve acceptance. Moreover, given all WTP ranges were below RRP, future studies should directly examine consumers' willingness-to-pay above retail price (e.g., by making consumers aware of current RRP). Finally, real-life (laboratory) auction paradigms where participants bid on labelled vs. non-labelled products may be a helpful way to uncover revealed preferences.

4.4. Conclusions

Using a novel analytical approach, five of six datasets of over 2800 U.K. consumers showed several consistent findings regarding preferences for 'green labels': i) Multilevel modelling revealed overwhelming preference for label vs. no-label products in both choice and willingness-to-pay (~£0.11 premium), with no specific label performing best, ii) Poisson modelling revealed that, when forced to choose between labels, consumers preferred 'Sustainably sourced' and 'Locally sourced' messages, and were willing-to-pay a ~£0.05 premium for the latter, and finally iii) Environmental concern (specifically 'propensity to act') was the only consistent predictor of choosing label vs. no-label products, suggesting that increasing this attribute in consumers might also increase sustainable consumerism. Finally, given the U.K. government's current debates and its '25-year Environment Plan' committed to reducing the U.K.'s environmental footprint by enhancing and supporting more sustainable supply chains (Dimbleby, 2021; Winchester, 2021; HM Government, 2018), and given the food system is responsible for ~26% of anthropogenic greenhouse gas emissions (Poore and Nemecek, 2018), the use of 'green labelling' may be a straightforward, cost-effective strategy for governments, NGOs, policy makers, and the private sector to induce consumer-driven, sustainable change.

Ethical statement

All studies received ethical approval from the University of Liverpool Research Ethics Committee (U.K.).

CRediT authorship contribution statement

Jay J. Duckworth: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Mark Randle:** Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – review & editing. **Lauren S. McGale:** Writing – original draft, Writing – review & editing. **Andrew Jones:** Formal analysis, Writing – review & editing. **Bob Doherty:** Conceptualisation, Writing – review & editing, Funding acquisition. **Jason C.G. Halford:** Conceptualization, Writing – review & editing, Funding acquisition. **Paul Christiansen:** Conceptualization, Methodology, Software, Validation, Formal analysis, Writing – review & editing, Funding acquisition.

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.

Data availability

Data are available on the Open Science Framework (OSF)

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Appendix A. Supplementary data

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