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## **STUDY PROTOCOL**

**Study title:** Effectiveness of information-based versus structural interventions on food choices by socioeconomic position: a randomized controlled trial in an experimental online supermarket

**Short title:** ED and SEP Online Supermarket Study

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## 1. BACKGROUND AND RATIONALE

People of lower socioeconomic position (SEP) are more likely to have obesity than people of higher SEP and SEP inequities in obesity in Europe are widening [1]. Lower socioeconomic position (SEP) is associated with a more energy dense diet [2], [3]. Consumption of more energy dense foods has been consistently linked to higher energy intake in experimental studies [4] and results from prospective cohort studies have shown a positive association between energy density (ED) of the total diet and BMI [4]. Thus, the association between SEP and obesity may be mediated, in part, by the consumption of a more energy-dense diet [5]. Interventions that reduce dietary energy density would benefit public health, particularly among people of lower SEP.

In the UK, 26% of the adults eat meals out one or more times per week and 20% eat takeaway meals at home one or more times per week, suggesting that the major part of the meals consists in food prepared at home [6]. People from lower SEP tend to spend a greater proportion of their average food expenditure on prepared-at-home produce (such as products purchased in supermarkets) as opposed to catering services than people of higher SEP (lowest equivalised disposable income decile group: 74% vs. highest: 60%) [7]. Thus, nutrition interventions targeting supermarket purchases provide an opportunity to benefit the diet of all of the population and people of lower SEP in particular.

Information-based nutrition interventions are one of the most common approaches to improving diet [8], [9]. An example of an information-based intervention is menu energy labelling in restaurants [10]. This type of interventions has been suggested to be less effective among people of lower compared to higher SEP [11], [12]. However, systematic reviews of the impact of menu energy labelling has highlighted the limited quality of evidence supporting this hypothesis [11], [13]. It has been suggested that structural interventions that target core features of the food environment (i.e., reducing portion sizes, increasing the availability of healthier food options) and require individuals to use a low level of agency may be most effective and most equitable [8], [14], [15]. However, there is a lack of empirical evidence to support this hypothesis.

Information-based interventions typically rely on people being motivated by health in their food choices [16]. Yet, health may be a less influential motive for food choice among people of lower SEP [17]. Thus, SEP based differences in food choice motives, and notably health motivation, may explain why information-based interventions could be less effective among people of lower vs. higher SEP.

The aim of this study is to examine how an information-based intervention (labelling of lower ED food products) and a structural intervention (greater proportion of lower ED options in food product ranges) affect the ED of food purchases within a virtual online supermarket [18] in participants of lower vs. higher SEP. The primary hypothesis is that labelling will reduce the ED of virtual online supermarket food purchases to a greater extent in participants of higher SEP vs. lower SEP. Conversely, we hypothesise that a greater proportion of lower ED options will decrease the ED of food purchases equally among participants of lower and higher SEP. The secondary hypothesis is that differences in health-based food choice motives in participants of lower vs. higher SEP will mediate the differential effect that ED labelling has on ED of food purchases among participants of lower vs. higher SEP.

## 2. OBJECTIVES, OUTCOMES MEASURES AND HYPOTHESES

OBJECTIVES	OUTCOME MEASURES	HYPOTHESES
Primary objective		

To examine the effectiveness of an information-based intervention (ED labelling) and a structural nutrition intervention (greater proportion of lower ED options) on the ED of virtual online supermarket food purchases; and if this effect is different between participants of lower and higher SEP.	Mean ED (kcal/100g) of foods purchased	SEP will influence the effect of the interventions. In particular, ED labelling will reduce ED of foods purchased to a greater extent in participants of higher vs. lower SEP. Conversely, a greater proportion of lower ED options will decrease ED of food purchases equally among participants of lower and higher SEP.
<b>Secondary objectives</b>  To investigate the psychological processes that explain why an information-based intervention (ED labelling) and a structural nutrition intervention (greater proportion of lower ED options) may have differential effects on ED of food purchases among participants of lower vs. higher SEP.	Health and weight control food choices motives (questionnaire score)	The participants of higher SEP will be more motivated by health and weight control in their food choices than participants of lower SEP, which will moderate the relationship between SEP and the effect of ED labelling on ED of foods purchased.

### 3. EXPERIMENTAL DESIGN

This study will be a 2x2 randomised controlled trial with information-based intervention (no labelling / labelling) and structural intervention (default proportion / increased proportion of lower ED food items) as between-subject factors and ED (kcal/g) of food purchases during an online supermarket-shopping task as dependent variable.

### 4. PARTICIPANTS AND RECRUITMENT

#### 4.1. Recruitment

Participants will be recruited through an online recruitment panel (Prolific) in which participants are compensated proportionate to the time it takes to complete the online study ( $\approx$  £5/hour reward participants).

Participants' recruitment will be stratified by gender (50% male, 50% female), student status (3.5% yes and 96.5% no) [19] and qualification levels; the proportion of low (below level 4) versus high (level 4 or above) qualification levels will be based on current population statistics from the Labour Force Survey (LFS) 2013 for adults aged 19-64 in England [20]:

- **60% lower qualification levels**
  - No formal qualifications
  - 1–3 GCSEs or equivalent

*(Level 1: first certificate; GCSE - grades 3, 2, 1 or grades D, E, F, G; level 1 award; level 1 certificate; level 1 diploma; level 1 ESOL; level 1 essential skills; level 1 functional skills; level 1 national vocational qualification (NVQ); music grades 1, 2 and 3)*

- 4+ GCSEs or equivalent

*(Level 2: CSE - grade 1; GCSE - grades 9, 8, 7, 6, 5, 4 or grades A\*, A, B, C; intermediate apprenticeship; level 2 award; level 2 certificate; level 2 diploma; level 2 ESOL; level 2 essential skills; level 2 functional skills; level 2 national certificate; level 2 national diploma, level 2 NVQ; music grades 4 and 5; O level - grade A, B or C)*

- A level or equivalent

*(Level 3: A level; access to higher education diploma; advanced apprenticeship; applied general; AS level; international Baccalaureate diploma; level 3 award; level 3 certificate; level 3 diploma; level 3 ESOL; level 3 national certificate; level 3 national diploma; level 3 NVQ; music grades 6, 7 and 8; tech level)*

- **40% higher qualification levels**

- Certificate of higher education (CertHE) or equivalent

*(Level 4: certificate of higher education (CertHE); higher apprenticeship; higher national certificate (HNC); level 4 award; level 4 certificate; level 4 diploma; level 4 NVQ);*

- Diploma of higher education (DipHE) or equivalent

*(Level 5: diploma of higher education (DipHE); foundation degree; higher national diploma (HND); level 5 award; level 5 certificate; level 5 diploma; level 5 NVQ)*

- Bachelor or equivalent

*(Level 6: degree apprenticeship; degree with honours - for example bachelor of the arts (BA) honours, bachelor of science (BSc) honours; graduate certificate; graduate diploma; level 6 award; level 6 certificate; level 6 diploma; level 6 NVQ; ordinary degree without honours)*

- Master's degree or equivalent

*(Level 7: integrated master's degree, for example master of engineering (MEng); level 7 award; level 7 certificate; level 7 diploma; level 7 NVQ; master's degree, for example master of arts (MA), master of science (MSc); postgraduate certificate; postgraduate certificate in education (PGCE); postgraduate diploma)*

- Doctorate or equivalent

*(Level 8: doctorate, for example doctor of philosophy (PhD or DPhil); level 8 award; level 8 certificate; level 8 diploma)*

**4.2. Inclusion criteria**

- UK residents, aged  $\geq 18$  years
- Fluent in English
- Have access to a computer and Internet
- Responsible for a substantial proportion of household grocery shopping

**4.3. Exclusion criteria**

- Unable to provide informed consent and to comply with the study requirements
- Any of the following dietary restrictions:
  - Vegetarian
  - Vegan
  - Gluten-free
  - Sugar-free
  - Dairy/lactose-free

- Food allergy (e.g. milk, eggs, nut, wheat, fish, etc.)

## 5. METHODS

### 5.1. Online shopping task

#### Experimental online supermarket

This study will use an online supermarket platform ([www.woodssupermarket.co.uk](http://www.woodssupermarket.co.uk)) developed to mimic an online supermarket website [18]. As prior work has suggested it is inappropriate to combine food and drinks when calculating ED [21], all the drinks will be removed from the online supermarket.

#### Shopping task

Participants will be asked to complete a shopping task using a pre-determined shopping list of 10 items (**Table 1**).

**Table 1.** Description of the food shopping list.

Food items	Department	Aisle	Shelf	Number of products	Mean ED (min-max)
A packet of biscuits	Food Cupboard	Biscuits & crackers	<b>Biscuits</b>	247	478 (341-574)
A standard sized loaf of bread	Bakery	<b>Bread</b>		142	251 (186-345)
A chilled pizza	Dairy, eggs & chilled	Pizza, pasta & garlic bread	<b>Pizza</b>	24	269 (221-319)
An ice cream tub	Frozen	Ice cream & ice	<b>Ice cream tubs</b>	142	225 (76-341)
A chilled ready meal for one	Dairy, eggs & chilled	Ready meals	<b>Meals for one</b>	185	145 (71-316)
A pack of sausages	Meat & fish	Bacon & sausages	<b>Sausages</b>	53	263 (145-473)
A sharing bag of crisps or savoury snacks	Food Cupboard	Crisps, nuts & snacking fruit	<b>Sharing crisps</b>	144	490 (397-580)
A pre-packed piece of cheese	Dairy, eggs & chilled	Dairy & eggs	<b>Cheese</b>	334	321 (59-527)
A pack of yogurts	Dairy, eggs & chilled	Dairy & eggs	<b>Yogurts</b>	251	87 (39-193)
A jar of jam or sweet spread	Food Cupboard	<b>Jams, honey &amp; spreads</b>	<i>Excluding 'Savoury pastes' and 'Marmite &amp; yeast extracts</i>	156	392 (139-650)

These categories were chosen as representing major contributors to UK diet [22] and because in each category there are products with a range of EDs.

## Interventions

Participants will be randomly allocated to one of the following groups:

- default proportion & no labelling (D);
- default proportion & labelling (DL);
- increased proportion of lower ED food items & no labelling (I);
- increased proportion of lower-ED food items & labelling (IL).

The interventions will only be applied in the aisles and shelves of the online supermarket that include food items from the shopping list. Lower ED products will be defined in relation to a threshold for each aisle or shelf:  $\text{lower ED} \leq \text{median of ED distribution within a food category}$ .

In the *labelling* conditions (DL and IL) “healthier choice” badges will be added to the food item pictures when the above criterion is met. For *labelling* conditions only, instructions when logging-into the platform will introduce the badges to the participants: “In the online supermarket, the green tick allows you to see which products (e.g. muesli) in each product category (e.g. cereals) are healthier choices with fewer calories per gram than most other products in the same category.” The design of the badge is based on previous research investigating the effect of front-of-package nutrition labelling on food choices [23] (**Figure 1**).



**Figure 1.** Healthier choice badge display in the labelling conditions when  $\text{lower ED} \leq \text{median of ED distribution within a food category}$ .

In the *increased proportion* of lower ED food items conditions (I and IL) the proportion of lower ED vs. higher ED options will be reversed (67% lower ED – 33% higher ED) relative to the *default proportion* conditions (D and DL) (33% lower ED – 67% higher ED) (**Table 2**).

**Table 2.** Food items proportion and “healthy” labelling within a specific food category

	d1	d2	d3	d4	d5	d6	d7	d8	d9	d10
Default proportion No labelling	present	absent	absent	absent	present	absent	present	present	present	present
Default proportion Labelling	present healthy	absent	absent	absent	present healthy	absent	present	present	present	present
Increased proportion No labelling	present	present	present	present	absent	present	absent	absent	absent	present
Increased proportion Labelling	present healthy	present healthy	present healthy	present healthy	absent	present	absent	absent	absent	present

*di: food items in a given food category with ED ≤ i<sup>th</sup> decile of ED distribution within this food category*

Comments on Table 1:

- *d5 or d6* is absent to create a gap between lower and higher ED options that makes “healthier choice” badges credible;
- *d1 (min) and d10 (max)* remain in all conditions.

### 5.2. Measures of socioeconomic position

Four measures of socioeconomic position will be included. Participants will be asked to report:

- their highest educational qualification;
- their number of years in higher education;
- their after tax household income and their household composition in order to calculate their equivalised disposable income [24];
- their household postcode, which will be linked to the English Index of Multiple Deprivation (IMD) [25] for the purpose of other research;
- a subjective measure of their socioeconomic position using the MacArthur Scale of Subjective Social Status (SSS) [26].

### 5.3. Measure of health and weight control food choice motives

We will use the ‘Health’ and ‘Weight control’ subscales from the Food Choice Questionnaire developed Steptoe et al. 1995 [27].

## 6. STUDY FLOW

<b>RECRUITMENT</b> <i>(Prolific)</i>	<ul style="list-style-type: none"> <li>▪ Predefined screening questions of Prolific website will be used to target the sample <b>(Appendix A)</b></li> <li>▪ Participants who will meet the inclusion/exclusion criteria will be e-mailed by Prolific and/or will be offered to complete our study on their Prolific account <b>(Appendix B)</b></li> <li>▪ Eligible participants who want to take part on the study will click on the start button and be redirected to our study website</li> </ul>			
<b>INFORMED CONSENT</b> <i>(Qualtrics)</i>	<ul style="list-style-type: none"> <li>▪ Participants will read the information sheet <b>(Appendix C)</b></li> <li>▪ Participants who want to proceed will tick a consent box <b>(Appendix D)</b></li> <li>▪ Participants will be allowed to contact the investigator via the “Contact researcher” button on Prolific webpage</li> </ul>			
<b>BASELINE ASSESSMENTS</b> <i>(Qualtrics)</i>	<ul style="list-style-type: none"> <li>▪ Participants will complete a baseline questionnaire on demographic, grocery shopping and health data <b>(Appendix E)</b></li> </ul>			
<b>RANDOMISATION</b> <i>(Qualtrics)</i>	<ul style="list-style-type: none"> <li>▪ Participants will be randomly allocated to one of the four experimental conditions; same number of participants in each of the four groups.</li> </ul>			
	Default proportion & no labelling (D)	Default proportion & labelling (DL)	Increased proportion & no labelling (I)	Increased proportion & labelling (IL)
<b>ONLINE SHOPPING TASK</b> <i>(Woods)</i>	<ul style="list-style-type: none"> <li>▪ Instructions will be displayed <b>(Appendix F)</b></li> <li>▪ The shopping list will be displayed and participants will do the shopping task.</li> </ul>			
<b>HEALTH AND WEIGHT CONTROL MOTIVES</b> <i>(Qualtrics)</i>	<ul style="list-style-type: none"> <li>▪ Health and weight control food choice motives will be assessed – questions will be randomised <b>(Appendix G)</b></li> </ul>			



<b>DEBRIEFING</b> <i>(Qualtrics)</i>	<ul style="list-style-type: none"> <li>▪ Aim guessing in an open-ended response format</li> <li>▪ Insight on the participants' perception of the online shopping task (<b>Appendix H</b>)</li> <li>▪ Text to tell the participants what the study was about (<b>Appendix I</b>)</li> </ul>
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## 7. STATISTICAL ANALYSIS

All statistical analyses will be performed using SAS version 9.3 (SAS Institute, Inc., 2012 SAS® 9.3. Cary, NC). The level of significance will be set at  $p < 0.05$  for primary and sensitivity analyses and at  $p < 0.01$  for secondary analyses.

### 7.1. Definition of population for analysis

Only participants who have completed the entire study (i.e., baseline assessments + online shopping task + questionnaires) will be included in the analysis. Participants who will have failed at least one attention check or have not complied with the shopping task will be excluded.

Two attention checks will be included:

- In the baseline questionnaire, item 9: This is an attention check. How many times have you visited the planet Mars? Several times / Just once / Never. Correct answer: Never
- In the food choice questionnaire, item 7: This is an attention check. Please choose the answer 2 'Not important'. Correct answer: 2 'Not important'.

We will analyse data from participants who bought at least 5 items out of 10 categories of the shopping list and, if participants buy more than the 10 items requested, as in previous research we will include all items bought [28], [29]. Outcome measures will be based on all the foods in the shopping baskets.

### 7.2. Participant's characteristics

A table will present the baseline characteristics by condition group and overall. The table will include gender, age, ethnic group, proportion of students, highest educational qualification, years in higher education, equivalised household income, subjective socioeconomic position, BMI, dieting status, grocery shopping in supermarkets frequency, grocery shopping online frequency. Continuous variables will be summarised using means and standard deviations. Categorical variables will be summarised using counts and percentages.

### 7.3. Description of variables

#### Primary outcome

The main outcome variable is the **mean ED of the food items purchased** (kcal/100g) calculated as:

$$\text{Mean ED} = \frac{\sum_{i=1}^{10} \text{energy}_i}{\sum_{i=1}^{10} \text{weight}_i} \times 100$$

with *energy* in kcal, *weight* in g and *i* representing each food in the shopping list.

#### Secondary outcomes

#### **From the shopping task:**

- **Total energy** (kcal) of the foods purchased
- **Energy from total sugar** (% of total energy)
- **Energy from saturated fatty acids (SFA)** (% of total energy)
- **Salt content** (g/100g)
- **Proportion of lower ED foods** (as defined paragraph 5.1.) in the basket of foods purchased
- **Cost** (£, £/100g and £/100kcal) of the foods purchased

#### From the debriefing questionnaire:

- **Validity:** mean of item “*I would normally buy [the 10 items on the shopping list]*” for all the food items coded as: 1 = Never; 2 = Very rarely; 3 = Rarely; 4 = Occasionally; 5 = Frequently; 6 = Very frequently.
- **Kcal influence:** answer to the item “*The choices I made during online shopping were influenced by how many calories I thought were in the options available.*” coded as: 1 = Strongly disagree; 2 = Disagree; 3 = Slightly disagree; 4 = Neutral; 5 = Slightly agree; 6 = Agree; 7 = Strongly agree

#### Independent variables

##### **SEP**

#### **Level of education**

- **Highest educational qualification** will be coded from 1 to 9: 1 = No formal qualifications; 2 = 1–3 GCSEs; 3 = 4+ GCSEs; 4 = A level; 5 = Certificate of higher education (CertHE); 6 = Diploma of higher education (DipHE); 7 = Bachelor; 8 = Master’s degree; 9 = Doctorate, and as a binary variable as *lower* (values: 1, 2, 3, 4) or *higher* (values: 5, 6, 7, 8, 9).
- **Years in higher education**, as a continuous variable
- **Level of education (composite score):** In order to account for years in higher education and highest education qualification when characterising each participants’ education level, we will z-score the two variables and create an average of the two to form a composite score called ‘*level of education*’.

**Equivalent household disposable income:** The OECD-modified equivalence scale will be used to adjust household income, taking into account household size and composition [24]. Equivalent income will be calculated by dividing the after tax household income by the sum of the equivalence value of all the household members: first adult = 1, additional adult or child aged 14 and over = 0.5, child aged 0-13 = 0.3.

**Subjective SEP:** The measure of the Subjective Social Status using the MacArthur Scale will be coded from 1 to 10.

#### **Health and weight control food choice motives**

Both health and weight control scores will be computed by averaging ratings for individual items of each dimension (health motivation: 6 items; weight control motivation: 4 items). Response options range from 1 to 4: 1 = Not at all important; 2 = A little important; 3 = Moderately important; 4 = Very important. Cronbach’s alpha will be calculated as an indicator of internal consistency in order to compare our data with the original study that developed this measure [27].

#### Other variables

**BMI:** Self-reported height will be recalculated into height in metres (1 ft = 0.3048 m, 1 in = 0.0254 m). Self-reported weight will be recalculated into weight in kilograms. (1 stone = 6.35029 kg, 1 lb = 0.453592 kg). BMI will be calculated as weight (kg) / height (m<sup>2</sup>). BMI data will be trimmed for implausible values excluding weight for less than 30 kg and more than 250 kg, height for less than 145 cm and more than 3m, BMI < 14 or BMI > 48 [30], [31].

**Aim guessing:** Participants who identify the aim of the study as being to examine the influence of labelling or increased proportion of lower ED/healthier food items on food purchases will be coded as being aware of the study aims. Responses will be independently coded by two researchers, with discrepancies in coding decisions resolved by a third researcher.

#### 7.4. Missing data

We do not anticipate missing data for analysis of the primary outcome for the population because ED is calculated based on the food database embedded in the online supermarket platform. We do not anticipate missing data either for the dependant variables because the questionnaires will not allow missing answers. Data from participants who start but not finish the study will not be included. Any *a posteriori* withdrawal will be reported and reasons for withdrawal will be documented (e.g., incorrect answers, technical problems).

#### 7.5. Primary analyses

The measure of SEP used in our primary analysis will be the *level of education* because previous research showed that people of higher education were more likely to use nutrition labels [32], [33].

**ANCOVA** will be used to test the effect of *labelling* (categorical variable: yes or no), *proportion* (categorical variable: default or increased), *level of education* (continuous variable) and *labelling\*level of education* and *proportion\*level of education* interactions on the *mean ED of foods purchased*. If this analysis reveals the predicted significant interaction between *labelling* or *proportion* condition and the continuous measure of *level of education* on *mean ED*, we will further examine the nature of the interactions by conducting floodlight analysis [34]. We will calculate the Johnson–Neyman point defined as the value of *educational level* for which the effect of *labelling* (or *proportion*) reaches statistical significance [35]. Values of *level of education* above this point will correspond to significant differences between the *labelling* and *no labelling* conditions (resp. the *default* and increased *proportion* conditions) whereas values below the point will not. The floodlight analysis will be run using the SAS macro developed by Hayes & Matthes, 2009 [36].

#### 7.6. Sensitivity analyses

Sensitivity analyses will be conducted to examine whether the pattern of results from the primary analyses differ after excluding participants guessing the aims of the study.

We will repeat our main analyses with a more stringent criteria for having completed the shopping task as intended (excluding any participants who did not select 10 items in total and 1 item from each category on the shopping list).

We will also repeat the main analysis substituting the composite variable *level of education* by *years in higher education* as a continuous covariate (ANCOVA) and by *highest educational qualification* split into lower vs. higher qualification levels as a binary covariate (2x2x2 ANOVA).

We will report whether sensitivity analyses result in deviations from the pattern of significance to the main analyses (i.e., any significant differences between conditions becoming not significant, and vice versa).

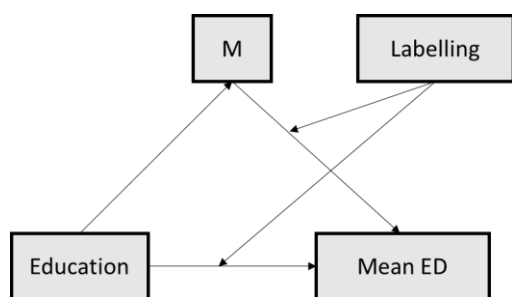
## 7.7. Secondary analyses

### Moderated mediation analysis

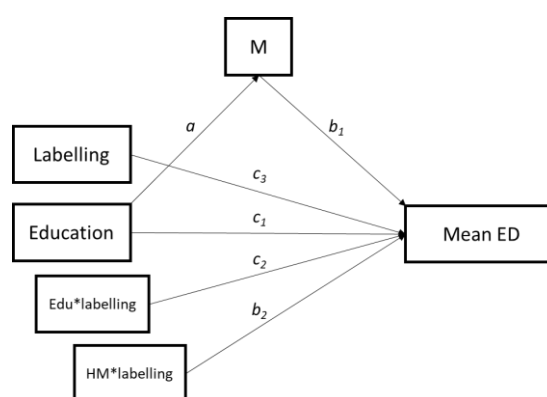
We will describe health and weight control motivation in the overall sample using mean and standard deviation and report the correlation (Pearson's) between the health and weight control motivation scores and level of education.

If the primary analyses suggest that *level of education* moderates the effect of *labelling* or *proportion* on the *mean ED of foods purchased* (i.e., the *labelling\*level of education* or *proportion\*level of education* interaction is significant), mediation analyses will be performed in order to examine the extent to which 1/ health food choice motive, 2/ weight control food choice motive mediates the effect of *level of education* on the *mean ED*.

Conceptual diagram example (labelling):



Statistical diagram example (labelling):



Conditional indirect effect of *level of education* on the *mean ED* through a mediator (M) =  $a(b_1 + b_2 \text{labelling})$ .

The moderated mediation will be tested by estimating the conditional indirect effect of *level of education* on the *mean ED* through M for *labelling* and *no labelling* conditions (resp. the *default* and *increased proportion* conditions) and testing the conditional indirect effect for those conditions using bias-corrected bootstrap. We will use the PROCESS macro (Model 15) on SAS software that provides asymmetric bias-corrected bootstrap confidence intervals for inference about the conditional indirect effects using 5,000 bootstrap samples [37]. Moderated mediation will be tested by determining whether or not the confidence interval for the difference between conditional indirect effects for *labelling* vs. *no labelling* conditions (resp. the *increased* and *baseline availability* conditions) contains zero.

### Analyses of secondary outcomes

For descriptive purposes we will code each participant product selection based on the food categories outlined in the shopping list and repeat the primary analysis strategy on each of the 10 food categories individually.

To further investigate the effect of the interventions and level of education, we will repeat the primary analysis strategy with the following dependent variables:

- on total energy of the foods purchased;
- on energy from total sugar;
- on energy from SFA;
- on salt content;

- on proportion of lower ED foods in the basket of foods purchased;
- on cost of the foods purchased.

We will also repeat the primary analysis including the interaction between labelling and proportion in the model.

#### Debriefing questionnaire

We will explore whether the shopping list was valid and the extent to which participants reported being influenced by calorie content when making food choices. Responses to the debriefing questionnaire will be analysed.

- We will report the distribution of responses for *validity* and *kcal influence* (mean, SD, median, quartiles Q1 and Q3) in the overall sample.
- Two ANCOVAs will be run (as in primary analysis) to test the effect of *labelling*, *proportion* and *level of education* on (a) *validity* and (b) *kcal influence* to investigate whether the responses differ across conditions and SEP.

For the labelling conditions only, we will report the percentage of participants who know what the “healthier choice” badge means, i.e., who tick the answer “Fewer calories per gram option”.

#### **7.8. Sample size**

##### To observe differences between the intervention groups and interaction with SEP

In a previous study (n=1,088) using the online supermarket platform, two types of nutritional interventions targeting a reduction of saturated fat (SFA) were compared: 1/ altering the default order of products in ascending order of SFA content 2/ offering explicit swaps with lower SFA [28]. This study showed a large main effect (f=0.42) of altering the default order: -4.78% (95%IC: -5.43 to -4.12) of energy from SFA; and a small-to-medium main effect (f=0.12) of offering swaps: -1.48% (95%IC: -2.19 to -0.76) of energy from SFA. Regarding ED reduction, this study showed a small-to-medium main effect (f=0.14) of altering the default order: -5.16 (95%IC: -7.3 to -3.02); and no significant main effect (f=0.04) of offering swaps -1.5 (95% IC: -3.65 to 0.67).

Based on these previous results, we will power our analyses to detect small main effects (f=0.1) of the *labelling* and *increased proportion* interventions. In an ANCOVA including four groups (*control*, *labelling*, *increased proportion*, *increased proportion & labelling*) and one covariate (*level of education*), to detect a main effect of *labelling* or *increased proportion* we will require a sample size of 788 participants (197 per group) for 80% power at  $\alpha = 0.05$  (GPower 3.1).

A sample size of 788 participants will allow to detect small interaction effects (f=0.1) of *labelling* or *increased proportion* with *level of education* in an ANCOVA including four groups (*control*, *labelling*, *increased proportion*, *increased proportion & labelling*) and one covariate (*level of education*) for 80% power at  $\alpha = 0.05$  (GPower 3.1).

##### To observe a mediated effect of SEP through health and weight control motives

Based on existing literature we hypothesise that the relationship between SEP and food choice motives will be small-to-medium in size [38]. Moreover, in a previous trial we ran using a virtual fast food restaurant ([osf.io/ajcr6](https://osf.io/ajcr6)), we found a small-to-medium correlation between level of education and healthiness motivation ( $r=0.17$ ) as well as small-to-medium correlation between healthiness motivation and kcal ordered ( $r=-0.25$ ). Empirical estimates of sample sizes needed for 0.8 power in mediation analyses indicate that samples of  $\approx 380$  are sufficient to detect mediation through pathways that are small and small-to-moderate in statistical size using bias-corrected bootstrap tests

[39]. Thus, a sample of 788 participants (i.e., 394 per *labelling* or *proportion* condition) allow for adequate power in our planned moderated mediation analysis.

We will recruit a sample of 1,000 participants (= participants who completed the entire study) to account for potential data loss due to incorrect answers, technical problems, failed attention checks, no compliance with the shopping task (up to ~20%) resulting in a minimum sample of 788 participants for our primary analyses.

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## APPENDIX A: AUDIENCE (PROLIFIC WEBSITE)

### 1. Age

- 18 years old or over

### 2. Current country of residence

- UK

### 3. Fluent language

- English

### 4. Diet restriction

- None

### 5. Gender

**50% of participants**

- Male

**50% of participants**

- Female

### 6. Students

**96.5% of participants**

- No

**3.5% of participants**

- Yes

### 7. Highest education level

**60% of participants**

- No formal qualifications
- Secondary education (e.g. GED/GCSE)
- High school diploma/A-levels

**40% of participants**

- Technical/community college
- Undergraduate degree (BA, BS, other)
- Graduate degree (MA, MSc, MPhil, other)
- Doctoral degree (PhD, MD, other)

### 8. Are you the main (or shared) grocery shopper for the food that your household eats?

- Yes

**APPENDIX B: RECRUITMENT TEXT**

*“This is a study examining food purchases when shopping online. You will do some online grocery shopping on an experimental supermarket website and fill some questionnaires in about yourself. Please read the instructions carefully and answer the questions as accurately as possible. Failure to comply with the instructions may result in your submission being rejected. Please click on the start button to proceed. Overall the study will take no more than 25 minutes.”*

## APPENDIX C: INFORMATION PAGE



### Online Supermarket Study

You are being invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and feel free to ask us if you would like more information or if there is anything that you do not understand. We would like to stress that you should only agree to take part if you want to.

#### **What is the purpose of the study?**

The purpose of the study is to understand how different people make food purchases when shopping online.

#### **Why have I been chosen to take part?**

We are recruiting volunteers who fulfil the following criteria:

1. Aged 18 years
2. Fluent English speaker
3. Reside in the UK
4. Do not have any dietary restriction
5. Are the main (or shared) grocery shopper for their household

#### **Do I have to take part?**

No. Participation in this research is completely voluntary. You are free to withdraw at any time without explanation and without incurring a disadvantage.

#### **What will happen if I take part?**

You will provide some information about yourself (e.g., age, gender), before then completing an online grocery shopping task. You will also fill some questionnaires in about yourself. So that your awareness of the study hypotheses does not affect your behaviour in the study we provide more detailed information about the study aims at the end of the study. If you feel uncomfortable about this then you are free not to participate in this study. Overall the study will take no more than 25 minutes.

#### **How will my data be used?**

The University processes personal data as part of its research and teaching activities in accordance with the lawful basis of 'public task', and in accordance with the University's purpose of advancing education, learning and research for the public benefit. University of Liverpool employee Victoria Heath ([V.Heath@liverpool.ac.uk](mailto:V.Heath@liverpool.ac.uk)) acts as the Data Protection Officer for this study and any queries relating to the handling of your personal data can be sent to her or the

principal investigator (see contact details below). Further information on how your data will be used can be found in the table below.

How will my data be collected?	Through an online questionnaire.
How will my data be stored?	On a password protected computer server.
How long will my data be stored for?	Your personal data will be stored for up to 28 days and then deleted. All other information will be stored indefinitely.
What measures are in place to protect the security and confidentiality of my data?	We will store all data on password protected computer servers and we never share any of your personal data outside of the research team for this project.
Will my data be anonymised?	After the study your personal information will be stored separately from your other questionnaire responses to create an anonymised data set. After 28 days all personal information will be deleted, but up to this point you can contact us and ask to see your information or have it deleted.
How will my data be used?	Your anonymised data will be combined with other participants' data in order to be analysed.
Who will have access to my data?	The research team for this project will have access to your data.
Will my data be archived for use in other research projects in the future?	After the research team have anonymised your data and completed this research project, they will place the anonymised data sets on an archive (e.g. Open Science Framework) in case any other researchers want to use it for future research purposes.
How will my data be destroyed?	Your personal data will be destroyed electronically (deleting the files and removing them from the computer server).

**Are there any risks in taking part?**

There are no anticipated risks to you if you take part in the study.

**Are there any benefits in taking part?**

There are no direct benefits, other than the small monetary payment.

**What will happen to the results of the study?**

We intend to publish the results from this study in a scientific journal. However, as explained above any personal information you provide is deleted before this and you would therefore not be identifiable in report. If you are interested in the results of the study, please let us know and we will share the results of the study with you when we publish it.

**What will happen if I want to stop taking part?**

You are under no obligation to take part in this study; it is completely your choice. If you do decide to take part, you are free to withdraw at any time and

without giving any reason or explanation. Data collected up until the period you withdraw may be used, but only if you are happy for this to be done. Otherwise you may request that your data be destroyed and no further use is made of them.

**What if I am unhappy or if there is a problem?**

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Dr Lucile Marty (contact details below) and we will try to help. If you remain unhappy or have a complaint which you feel you cannot come to us with then you should contact the Research Governance Officer on 0151 794 8290 (ethics@liv.ac.uk). Please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

**Who can I contact if I have further questions?**

Please contact the principle investigator:

Dr Lucile Marty  
2.41b, Eleanor Rathbone Building  
Bedford Street South  
University of Liverpool,  
Liverpool,  
L69 7ZA,  
UK  
email: [lucile.marty@liverpool.ac.uk](mailto:lucile.marty@liverpool.ac.uk)

or the data protection officer:

Victoria Heath  
The Foundation Building,  
765 Brownlow Hill,  
University of Liverpool,  
Liverpool,  
L69 7ZX,  
UK,  
email: [V.Heath@liverpool.ac.uk](mailto:V.Heath@liverpool.ac.uk)

**I confirm I have read the information sheet**

- Yes

**APPENDIX D: CONSENT PAGE**



**Online Supermarket Study**

I confirm that I have read and have understood the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

I understand that taking part in the study involves completing online tasks and questionnaires.

I understand that my participation is voluntary and that I am free to stop taking part and can withdraw from the study at any time without giving any reason and without my rights being affected. I also understand that I have the right to lodge a complaint.

I understand that the information I provide is for research purposes and it will be held securely in line with data protection requirements at the University of Liverpool. In addition, I understand that personal information collected about me that can identify me (e.g. postcode) will never be shared beyond the study team.

I understand that shortly after completing the study, researchers will keep my personal data (e.g. postcode) and store it separately from my other questionnaire responses for up to 28 days on a computer, so that my anonymised questionnaire responses can later be deposited in an online data archive for sharing and used by other authorised researchers to support other research in the future.

I understand that I can ask for access to any of the information I provide and I can request the destruction or alteration of that information if I wish for up to 28 days after participating in the study. I understand that following this I will no longer be able to request access to or withdrawal of the information I provide because this information will have been deleted.

I provide my consent as a legal basis for the processing of my data as detailed previously, including the purposes of data processing, recipients of data and the right to withdraw my data.

07/04/2020, pre-registered

**I agree and consent to take part in the above study**

- Yes



## APPENDIX E: BASELINE QUESTIONNAIRE

### Eligibility screening:

- **Are you a fluent English speaker?**
  - Yes
  - No → screened out
  
- **Do you currently reside in the UK?**
  - Yes
  - No → screened out
  
- **Do you have any dietary restrictions?**
  - Vegetarian → screened out
  - Vegan → screened out
  - Gluten-free → screened out
  - Sugar-free → screened out
  - Dairy/lactose-free → screened out
  - Food allergy (e.g. milk, eggs, nut, wheat, fish, etc.) → screened out
  - None
  - Other → screened out
  
- **Are you the main (or shared) grocery shopper for the food that your household eats?**
  - Yes
  - No → screened out

### Questionnaire:

#### 1. Gender

- Male
- Female
- Other

#### 2. Age

- \_\_ (free text; range of 18-99)

#### 3. Ethnicity

- White
- Black
- Asian
- Mixed
- Other

#### 4. What is your current employment status?

- Full or part-time
- Student
- Retired
- Temporary or permanently sick or disabled
- Looking after home/family
- Other unemployed

**5. What is your highest educational qualification? If you are a student please select the diploma being studied for.**

- No formal qualifications
- 1–3 GCSEs or equivalent
- 4+ GCSEs or equivalent
- A level or equivalent
- Certificate of higher education (CertHE) or equivalent
- Diploma of higher education (DipHE) or equivalent
- Bachelor or equivalent
- Master’s degree or equivalent
- Doctorate or equivalent

**6. After leaving school (i.e. at 16 years old), how many further years of higher education (i.e. a formal course) did you study for?**

*Examples:*

*If you left school and did not go on to study further in higher education, your answer would be 0.*

*If you left school and then studied for two years for A levels, your answer would be 2.*

*If you completed A levels over two years and then also studied for a three year undergraduate degree, your answer would be 5.*

\_\_ (free text)

**7. What is your annual after tax household income, including all earners in your household, in GBP (to the nearest £1000)?**

£\_\_\_\_ (free text; range 0-999,999)

**8. How many people live at your house, including you?**

\_\_ adult(s) or child(ren) aged 14 and over (free text; range of 1-20)

\_\_ child(ren) aged under 14 (free text; range of 1-20)

**9. What is the postcode of your current home address?**

\_\_\_\_ (free text)

**10. This is an attention check. How many times have you visited the planet Mars?**

- Several times
- Just once
- Never

**11. Think of a ladder (see image) as representing where people stand in society. At the top of the ladder are the people who are best off—those who have the most money, most education and the best jobs. At the bottom are the people who are worst off—who have the least money, least education and the worst jobs or no job. The higher up you are on this ladder, the closer you are to people at the very top and the lower you are, the closer you are to the bottom. Where would you place yourself on the ladder?**



**Choose the number whose position best represents where you would be on this ladder:**

\_\_ (free text: range 1-10)

**12. On average, how much do you spend on supermarket shopping per week?**

£\_\_ \_\_

**13. How often, on average over the past year, have you shopped in a supermarket for food or groceries?**

- Less than once a month
- 1-3 times per month
- 1-2 times per week
- 3-4 times per week
- 5 times per week or more often

**14. How often, on average over the past year, have you shopped online for food or groceries?**

- Never or not in the last year
- 1-3 times in the last year
- 4-11 times in the last year
- 1-3 times per month
- once per week or more often

**15. Are you currently dieting?**

- Yes
- No

**16. Weight**

\_\_ . \_\_ kg

\_\_ st and \_\_ lb

**17. Height**

\_\_\_ cm

\_ ft and \_\_ in

## **APPENDIX F: ONLINE SHOPPING TASK INSTRUCTION**

*“We would like you to do online grocery shopping on a supermarket website. This is not a real commercial site, and you will not be asked to spend your own money.*

*You are given a shopping list and we ask you to buy all the items on the list. You can cross out the items on the list once you have added them to your trolley. You do not need to buy additional items. To search for the items from the shopping list, you can either go through the website categories or use the searching bar by copy-pasting the name of the shopping list item.*

*When doing the shopping task, please select foods you and your household would be likely to choose.”*

**APPENDIX G: HEALTH AND WEIGHT CONTROL MOTIVES**

**Instruction:** “Several different factors influence our choice of food. Read each item carefully and decide how important the item is to you. There are no right or wrong answers – we are interested in what is important to you”

**It is important to me that the food I eat on a typical day...**

		<i>Not at all important 1</i>	<i>A little important 2</i>	<i>Moderately important 3</i>	<i>Very important 4</i>
<b>Health</b>					
<b>1.</b>	<i>contains a lot of vitamins and minerals</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>2.</b>	<i>keeps me healthy</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>3.</b>	<i>is nutritious</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>4.</b>	<i>is high in protein</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>5.</b>	<i>is good for my skin/teeth/hair/nails etc.</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>6.</b>	<i>is high in fibre and roughage</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Weight control</b>					
<b>7.</b>	<i>is low in calories</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>8.</b>	<i>helps me control my weight</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>9.</b>	<i>is low in fat</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**APPENDIX H: DEBRIEFING QUESTIONNAIRE**

**Aim guessing:**

***What do you think we were expecting to find in this study?***

[Free text]

**Questionnaire:**

- ***What do you think this logo means?***  
*Select which of the following apply to the logo.*



- Lower in price option
- Fewer calories per gram option
- Lower in salt per gram option
- Lower in sugar per gram option
- Lower in saturated fat per gram option

- ***The choices I made during online shopping were influenced by how many calories I thought were in the options available.***

○	○	○	○	○	○	○
1	2	3	4	5	6	7
Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree

- ***I would normally buy [the 10 items on the shopping list]:***

	Never 1	Very Rarely 2	Rarely 3	Occasionally 4	Frequently 5	Very Frequently 6
Item 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Item 10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

- ***What is your highest educational qualification? If you are a student please select the diploma being studied for. \*Consistency check\****

- No formal qualifications

07/04/2020, pre-registered

- 1–3 GCSEs or equivalent
- 4+ GCSEs or equivalent
- A level or equivalent
- Certificate of higher education (CertHE) or equivalent
- Diploma of higher education (DipHE) or equivalent
- Bachelor or equivalent
- Master's degree or equivalent
- Doctorate or equivalent



## **APPENDIX I: DEBRIEFING TEXT**

*“In this study we were interested in the effect of nutrition interventions on online grocery shopping. You have seen one version of the online supermarket but other participants have seen different ones. The difference between the four versions of the online supermarket is the food items they offer. In the first version, the food offer reflects what you can find in an online supermarket in the UK; in the second one low-energy badges are added to indicate the options with fewer calories per gram within a food category.; in the third one the proportion of lower-energy food items is increased; in the fourth one low-energy badges are added and the proportion of lower-energy food items is increased. We will compare the energy per 100g of the foods purchased by the participants from the four versions of the online supermarket. The results will help to identify the most promising intervention to reduce the overall energy of our diets.”*

*“Thank you very much for your participation in our study!”*