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Stop, think, buy: An online randomised controlled experiment comparing the effects of traffic light nutritional labelling and price promotion on steering consumer food choice[☆]

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ABSTRACT

Diet-related diseases are a global health concern, prompting governments to implement population-wide dietary improvements. In the UK, the traffic light system (TLS) of nutritional labelling aims to guide healthier food choices. However, concerns have arisen about whether retailer price promotions may counteract positive effects of the TLS on diet. To address these concerns, in the present research we investigated the effects of the TLS and price promotions on the healthiness of food choice, both individually and in combination. A pre-registered online randomised controlled trial (RCT) was conducted using a 2x3 factorial between-subjects design with TLS (control vs. TLS) and price promotion (no promotion vs. healthiest product promotion vs. unhealthiest product promotion) as interventions. A total of 1582 UK participants were randomised across the experimental conditions and asked to make a hypothetical purchase choice amongst four unbranded snack bars of varying healthiness. Price promotions were found to effectively increase the likelihood of choosing a promoted product, whether healthy or unhealthy. Price promotions on the unhealthiest food item were found to decrease the likelihood of the healthiest product being chosen. TLS labelling did not significantly impact food choice relative to the control. However, there was a tendency for the labelling to amplify the effect of price promotions on healthy products and dampen the effect on unhealthy products. Overall, our research offers new insights into how different forces may interact when multiple policy interventions are implemented in the retail environment and highlights the need to examine them in combination.

1. Introduction

Diet-related disease is a pressing global health issue. As the production of processed foods, rapid urbanisation and sedentary lifestyles have increased, dietary habits have shifted; with people consuming fewer fruits, vegetables, and fibrous grains, and instead replacing them with high-calorie, high-sugar, high-fat and high-salt foods (World Health Organization, 2020). These dietary changes are associated with a heightened risk of health issues such as overweight and obesity, type 2 diabetes, stroke, respiratory issues and thirteen types of cancer (Afshin et al., 2019; Centers for Disease Control and Prevention, 2022), which pose serious challenges to individuals and create a significant burden on society and the economy (Lobstein et al., 2023). In the UK, obesity's annual cost *alone* is estimated at £58 billion (Frontier Economics, 2022).

Critically, this burden is avoidable through population-wide preventative health interventions and demand-side policies promoting healthy eating (Ofei, 2005), such as informational campaigns, financial incentives, and changes to the choice architecture in retail food environments (Galizzi, 2014; Reisch, 2021). Evaluating the effectiveness of these policies is challenging, as they often operate simultaneously in real-world settings, potentially influencing each other's impact. While existing research compares interventions across multiple studies or experimental conditions (Capacci et al., 2012; Roberto & Gorski, 2015), relatively few studies assess the effects of multiple interventions applied

☆ The study was explained to participants in the online questionnaire. They were informed that they would participate in the survey via Prolific, and that their participation will be anonymous. All participants acknowledged an informed consent statement in order to participate in the study. They were financially compensated for their participation in the amount of £7.42/hour.

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simultaneously (Gupta et al., 2024; Mah et al., 2019; Wolgast et al., 2022). This gap is particularly critical in retail settings such as grocery stores, as although a promising avenue to support healthier food choices (Bauer et al., 2022a), they are rife with competing influences which may undermine intervention success (Bauer et al., 2022b; Castro et al., 2018; Department of Health and Social Care, 2023; Smithson et al., 2015).

In the UK, one of the existing policies to aid dietary health currently implemented in retail environments is traffic light system (TLS) nutritional labelling, which intends to encourage healthier food choices by helping consumers better understand the health contents of the food they purchase (Cadario and Chandon, 2019; Department of Health and Social Care, 2016). However, there is growing concern about the increasing prevalence of retail price promotions on unhealthy foods and their potential to counteract the benefits of the TLS (Department of Health and Social Care, 2023; Public Health England & Kantar Worldpanel UK, 2020). Influential theoretical and empirical models of consumer behaviour and decision-making highlight the key role of prices and price promotions on consumer choices (Farley & Ring, 1974; Lancaster, 1966; Ratchford, 1982), whilst research on food decision-making specifically identifies pricing and promotions as significant drivers of food choice (Gittelsohn et al., 2017; Martin et al., 2017; Watt et al., 2020) that may potentially interact with nutritional labelling and other healthy eating policies (Balcombe et al., 2010; Watt et al., 2023). Despite these findings, there is a notable lack of studies that directly compare the effects of price- and labelling-based interventions within the same trial (see: Waterlander et al., 2013), a surprising gap given the fundamental importance of understanding their interaction in shaping effective dietary policy interventions in complex real-world settings (Bauer et al., 2022c; Reisch, 2021).

Therefore, in the present research we examine the effects of TLS nutritional labelling alongside price promotions. In the next section, we provide an overview of previous literature regarding these two influences on food purchasing behaviour, examine how they may interact, and propose relevant hypotheses.

1.1. Traffic light system (TLS) nutritional labelling

The TLS is a nutritional labelling system used in the UK, appearing on the front of pre-packaged food products sold in retail outlets. It simplifies nutritional information by displaying key nutrients (energy, fat, saturated fat, sugars, and salt) coloured in either red, amber, or green (like a traffic light) to reflect whether the product contains 'High', 'Medium' or 'Low' amounts of each nutrient per serving, based on government guideline levels. The TLS was designed this way to encourage healthier choices between similar products (Scarborough et al., 2015), and as an improvement on existing back-of-pack labelling (Reference Intakes - RI) (Department of Health and Social Care, 2016).

Studies consistently show that the TLS is one of the easiest to understand nutritional labelling systems (Campos et al., 2011; Hawley et al., 2013; Ni Mhurchu et al., 2017; Roberto et al., 2012; Scarborough et al., 2015). Systematic reviews and meta-analyses find that TLS has a significant influence on decision-making, successfully encouraging healthier food choice across hundreds of studies (Bauer & Reisch, 2019; Cecchini & Warin, 2016; Feteira-Santos et al., 2020; Shangguan et al., 2019; Song et al., 2021). However, a major limitation of the literature is a lack of ecological validity. Most studies are based in labs or online, assess only discrete choices, and fail to account for other variables that may influence food choice, resulting in a poor representation of real-world shopping scenarios and limiting generalisability of results (Roberto et al., 2012; Song et al., 2021). Another limitation is the inconsistency in research design and outcome evaluation across studies (Feteira-Santos et al., 2020), resulting in vastly heterogenous effect sizes for TLS ranging from 1.9 % (Shangguan et al., 2019) to 29.36 % (Cecchini & Warin, 2016). Additionally, a minority of studies find non-significant results (Ni Mhurchu et al., 2017; Sacks et al., 2009). Overall, considering this body of research, the following hypothesis can be inferred.

H1. The presence of traffic light nutritional labelling (TLS) will increase the likelihood of a healthier food product being chosen, relative to when TLS is not present.

Many studies find that the effectiveness of the TLS is influenced by several factors, including gender (Balcombe et al., 2010; Cowburn & Stockley, 2005), people's interest in health and nutrition (Drichoutis et al., 2006), and how much attention they pay to the label (Bialkova et al., 2014; Krajbich, 2019; Rramani et al., 2020; Waterlander et al., 2012, 2013), with women, those with higher interest in health and nutrition, and those who pay more attention to the label more likely to respond. Interestingly, factors such as body mass index and hunger were found to have no effect (Vasiljevic et al., 2015). Overall, given that these factors may determine TLS effectiveness, we use them as control variables in our analysis.

1.2. Price promotions

Standard models of consumer behaviour and decision-making emphasise the key role of prices on consumer choices (Farley & Ring, 1974; Lancaster, 1966; Ratchford, 1982). Sales promotions are a key marketing strategy whereby businesses use a temporary campaign or offer to increase interest and demand for their products (Kelwig, 2022). Implemented across retail outlets, they involve either volume promotions (e.g. multi-buy offers such as buy-one-get-one-free), or price promotions (i.e. price discounts), often indicated by large and brightly coloured stickers to draw customers' attention toward the offers (Watt et al., 2023).

Promotions play a crucial role in shaping food purchases in the UK, where over a third of food and beverages are bought on promotion, and consumer spending on them is the highest in Europe (Smithson et al., 2015). However, these sales promotions are more often applied to unhealthy foods, undermining the effectiveness of healthy diets policies (Smithson et al., 2015). Recognizing this impact, the UK government has implemented policies to restrict volume price promotions to promote healthier food choices (Department of Health and Social Care, 2023).

Price promotions are effective at influencing people's buying behaviour, with the body of evidence strongly suggesting that advertised price reductions shift purchases towards the promoted product (Ailawadi et al., 2007; Blattberg & Neslin, 1990; Castro et al., 2018; Martínez-Ruiz et al., 2006; Watt et al., 2023). In the context of diet and health a systematic review of 42 publications found that price promotions on healthy foods have mainly positive results on food choices and in encouraging healthy diets (Adam & Jensen, 2016). This informs the second hypothesis tested in this research.

H2. The presence of a price promotion on a food product within a choice set will increase the likelihood that the promoted product is chosen over other products, relative to when there is no promotion.

However, research indicates that individual differences influence the relationship between price promotions and people's food purchases. These include decision-making style (Gaston-Breton & Duque, 2015; Nowlis & Simonson, 2000), price consciousness, that is, the degree to which a consumer focuses exclusively on paying low prices (Lichtenstein et al., 1993; Tellis & Gaeth, 1990; van der Molen et al., 2021), and sale proneness, that is, the "increased propensity to respond to a purchase offer because the sale form in which the price is presented positively affects purchase evaluations" (Lichtenstein et al., 1990, p. 235). Therefore, we use these measures as control variables in our analysis.

1.3. Comparing and combining TLS with price promotions

Although various studies have been conducted on testing the impact of TLS and price promotions on healthy food choices, the two factors have only been evaluated in isolation, with no assessment of their compared or combined effect. However, real-world retail settings, such as supermarkets and grocery stores, are typically complex environments laden with many stimuli and concurrent, and possibly competing, strategies and interests (Castro et al., 2018).

In principle, price promotions can interact with non-price features of food products such as TLS. On the one hand, it is possible to imagine reinforcing or amplifying effects of price promotions: when the healthy nutritional message conveyed by the TLS is accompanied by a sale or price promotion on the healthy food products, consumer's attention is attracted by a double set of reinforcing stimuli both pointing positively to a given food item (Lowe et al., 2010; Waterlander et al., 2010). On the other hand, price promotions can also have potentially an opposing role: think of all instances where sales or price promotions are on food products with less healthy nutritional scores according to the TLS. In these cases, consumers receive conflicting and mixed messages about the attractiveness of a given food item, leading to more complex and nuanced choices which can require trade-offs between competing preferences, goals, and motivations. The underlying processes and mechanisms behind these more complex decision-making trade-offs can be very rich and diverse. Originally high prices, for example, can signal to consumers high quality of food items, which, in turn, can be associated to higher expectations of better taste and flavour. Lowered prices, on the other hand, are inherently attractive to budget-constrained consumers and can induce them to forego health considerations and to sacrifice nutritionally healthy items in favour of a 'good deal'.

There is also increasing evidence about 'moral licensing' effects in consumer choices, where different sequences of decisions over time can make more (or less) likely to choose and purchase healthy food items (Bhargave et al., 2015; Biswas et al., 2025; Donkers et al., 2020; Khan & Dhar, 2006; Marcum et al., 2018; Stillman & Woolley, 2023; Trudel-Guy et al., 2019; van Ittersum et al., 2024). In our case, the positive feeling of 'winning a good deal' and being 'financially savvy' may license consumers to abandon being health conscious (in this or future decisions). Since both behaviours require self-restraint against immediate desires, therefore fulfilling one (saving money) might create a sense of justification to forgo the other (choosing a healthier option). Rigorously identifying these combined effects of TLS and price promotions is critical to helping policymakers make informed decisions for real-world retail settings and enhance the battle against diet-related disease.

Studies comparing "TLS-like" health interventions (including non-price interventions, such as choice architecture manipulations, nutrition education, and labelling) with "price-promotion-like" interventions (price reductions, discounts, and price promotions) find that, when applied separately to one another, price-related interventions have a larger influence on food choice relative to non-price interventions, especially those more similar to the TLS (Horgen & Brownell, 2002; Lowe et al., 2010; Ni Mhurchu et al., 2010; Waterlander et al., 2013). One study showed neither intervention having effects alone, but when combined congruently, they increased the proportion of healthy purchases (Hoenink et al., 2020). Thus, we introduce two new hypotheses.

H3. When TLS is present, a price promotion on a product with the 'healthiest' TLS will increase the likelihood that, on average, a healthier food product is chosen, relative to when the price promotion is not present.

H4. When TLS is present, a price promotion on a product with the 'unhealthiest' TLS will increase the likelihood that, on average, an unhealthier food product is chosen, relative to when the price promotion is not present.

2. Method

2.1. Sample

The study was conducted amongst a sample of $N = 1582$ respondents (53.7 % Female, 45.0 % Male), who were based in the UK (proxy for being familiar with TLS labelling) and over 18 (proxy for having independently purchased food for personal consumption). Participants were recruited via the online panel provider Prolific and paid £0.60 to take part in a 5-min survey. Sample size calculations were based on a 0.05 significance level, 80 % statistical power, and a conservative effect size of $d = 0.3$, leading to a minimum sample size of $N = 176$ participants in each of the six experimental conditions.

2.2. Experimental design

To study the influence of both TLS labelling and price promotions on people's food choice, a six-arm online randomised controlled trial (RCT) with a 3x2 factorial between-subjects design was used (Fig. 1). Price promotion was manipulated at three levels: no promotion, promotion on the healthiest product (healthy promotion), or promotion on the unhealthiest product (unhealthy promotion). Nutritional labelling was assessed on two levels: no TLS or TLS. Study design and hypotheses were pre-registered on AsPredicted.org (#136670).

The experiment was conducted as an online hypothetical choice scenario, as this methodology has been shown to reduce social desirability bias whilst accurately measuring decision making (Auger & Devinney, 2007; Norwood & Lusk, 2011). To increase the ecological validity of findings, the choice scenario was designed to emulate what consumers would face when using real online grocery shopping websites. This was achieved through webpage formatting and displaying a selection of differentiated products within a single product category, accompanied by listed prices (Fig. 2). Additionally, an adjusted cheap talk script (from van Loo et al., 2014), was displayed ahead of the choice scenario to provide context, reduce noise, minimise hypothetical bias and improve external validity (Huls et al., 2023; Penn & Hu, 2019) (**Supplementary Materials B**).

2.3. Materials and manipulations

Across all experiment conditions, participants were exposed to a set of four food products of varying healthiness: (i) the unhealthiest, (ii) unhealthier than average, (iii) healthier than average and (iv) the healthiest. We generated nutritional values for each item based on nutritional guidelines for energy, fat, saturates, sugars, and salt, as defined by UK government recommendations (Department of Health and Social Care, 2016). Food items with higher levels of these nutrients are considered "unhealthier" and those with lower levels are considered "healthier".

The product chosen was a snack bar (i.e. cereal/granola/protein bar), as they are a popular product (Global Snack Bars Market, 2023) with varied nutritional composition across brands and flavours, ensuring that the generated differences in nutritional value would be familiar and realistic (Vasiljevic et al., 2015) (see Supplementary Materials Table A1 for comparison of generated values to actual snack bars retailed in the UK). They are also a non-essential purchase item (falling outside of staple grocery purchases) with close substitutes, meaning consumers are more likely to be responsive to changes in decision-making factors (Thow et al., 2014).

For each snack bar, a product image, Reference Intake (RI) table, and price (in GBP, per unit and 100g) were displayed (see Fig. 2). To control for the effects of packaging on product perception and choice (Creusen & Schoormans, 2005; Schulte-Holierhoek et al., 2017; Togawa et al., 2019), particularly when food brands are unrecognised (Deliza & MacFie, 2001), the pairing of product images and nutritional information was randomised equally across all conditions. This ensured that each combination of snack bar packaging and its associated nutritional label was presented without a fixed pattern, meaning that any potential bias arising from the packaging would be evenly spread across all conditions.

For conditions where a price promotion was present (3, 4, 5 and 6; Fig. 1), the promoted product's price was highlighted in red text, with an 'original' price crossed out next to it, and a yellow box appearing above

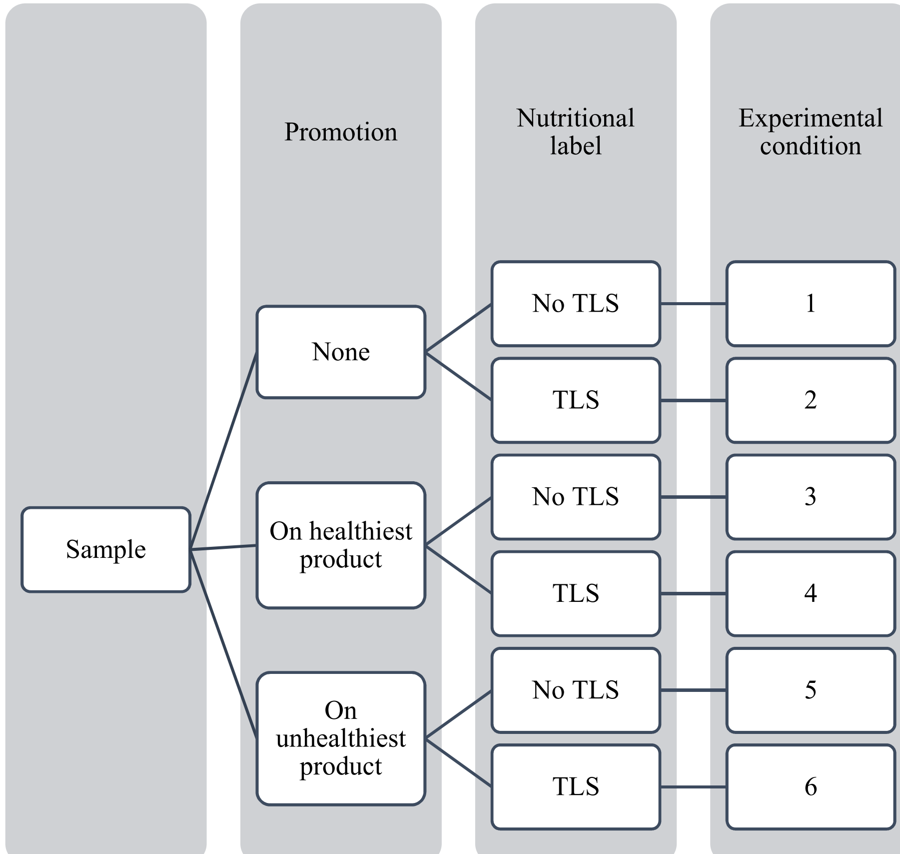


Fig. 1. Experimental design and conditions.

them with the text “Special Offer!”. Crucially, to isolate the price promotion’s effect on food choice and eliminate potentially confounding effects of relatively lower prices, the promoted products had the same price as all the other products (i.e., £1.10; Fig. 2). This price was chosen to reflect the mid-range average retail price of a cereal bar sold individually, determined by taking an average of multiple cereal bar prices across different top UK grocery retailers at the time of data collection. The “original price” of the discounted product was then set at 20 % higher (£1.38), as this is a common percentage discount top UK retailers use on lower priced items. This approach was used to enhance ecological validity by ensuring that the prices reflected real-world purchasing conditions.

To isolate the effects of the TLS on food choice (over the presence of nutritional information), the RI table was displayed across all conditions (e.g., Fig. 2), acting as a control for “no TLS” conditions, ensuring participants had equal information across all conditions. For “TLS” conditions (2, 4 and 6; Fig. 1), a TLS diagram reflecting the values of the RI table was presented above it (e.g., Fig. 2).

2.4. Outcome variables

Product choice was the primary outcome measure (Hieke & Wilczynski, 2012; Vasiljevic et al., 2015). Variables identified in the literature to influence the primary outcome measure were also assessed as additional measures of interest (Table 1). Questions and scales were taken or adapted from validated measures wherever possible to maximise the construct and criterion validity of the survey.

2.5. Procedure

The experiment was delivered as an online survey through the survey platform Qualtrics. Data were collected over the course of 2 days (26–June 27, 2023). The survey consisted of 14 questions and took an average of 4 min 51 s to complete. Participants were first briefed, and electronic informed consent was obtained in accordance with the research ethics policy of the London School of Economics and Political Science (Grove, 2022). Although participants were made aware of the outcome variable of interest (product choice), they were not made aware of the manipulated variables to reduce experimental demand effects. Next, an introductory text including an adjusted cheap talk script from van Loo and colleagues (2014), was displayed. Then participants were exposed to one of the six choice scenarios (Fig. 2) and asked which product they would buy. Questions related to secondary measures were then asked. Amongst these, the attention check question “People are very busy these days and some do not properly read survey questions. To show that you’ve read this much, answer both “Extremely interested” and “Very interested".” was randomly placed (Oppenheimer et al., 2009). See **Supplementary Materials B** for the full survey.

2.6. Analysis

Responses that were incomplete, failed the attention check ($n = 76$) or taken on the non-final survey version ($n = 154$) were excluded. $N = 1352$ completed responses were analysed. Additional measures consisting of multi-item scales (Price consciousness & Sale proneness and Eating self-control) were operationalised in accordance with prior studies, whereby scores for these measures were determined for each respondent by taking the mean score of their answers. The impact of each intervention on the likelihood of product choice being healthier was investigated using ordered logistic regressions. Base model estimates included the predictor variable (intervention) on the dependent variable (choice). All variables were tested for significant differences across conditions via a randomisation balance check (see Supplementary Materials Table A2). Those that significantly varied across conditions

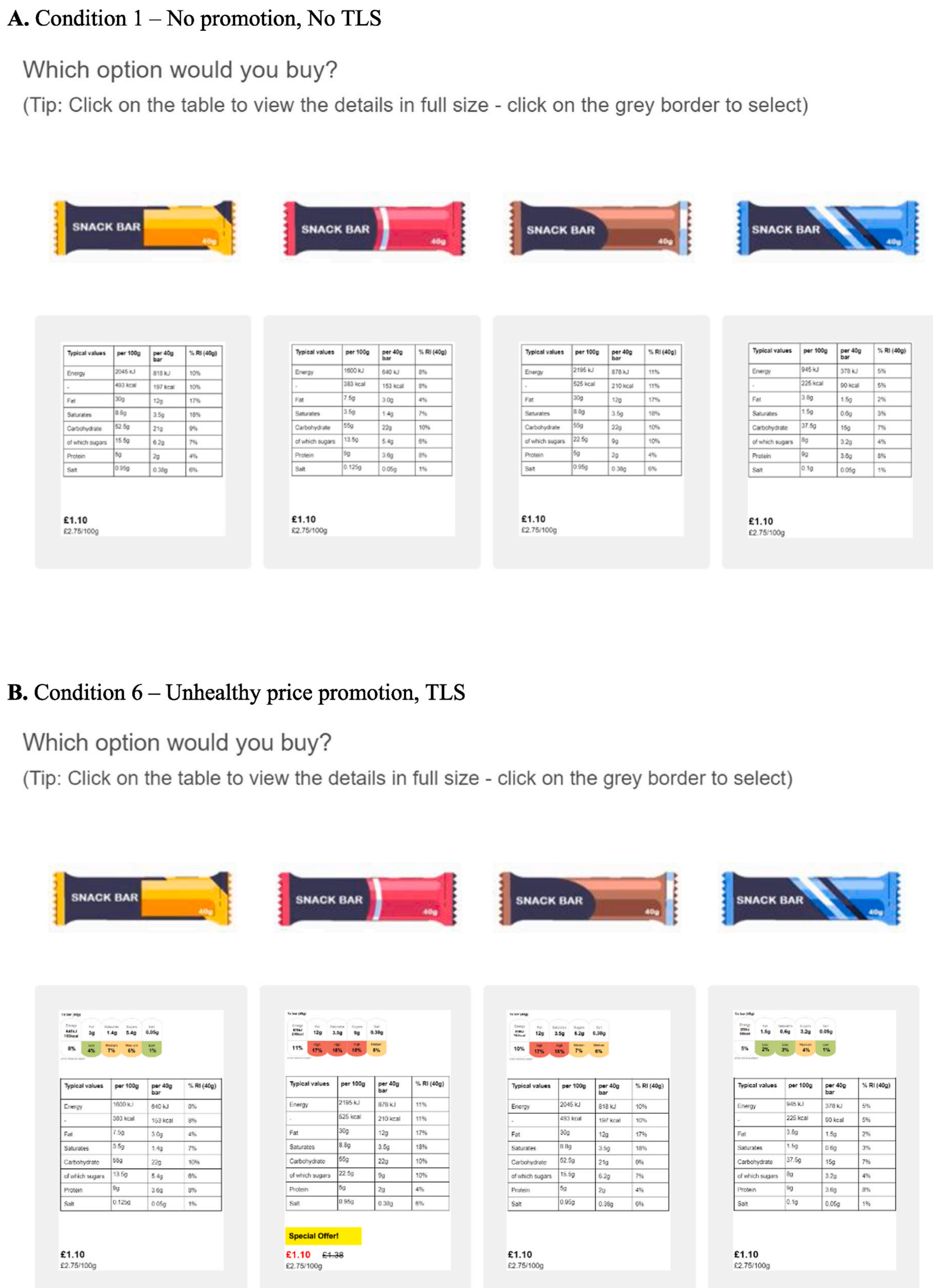


Fig. 2. Examples of experimental choice scenarios (Conditions 1 and 6). **A.** Condition 1 – No promotion, No TLS. **B.** Condition 6 – Unhealthy price promotion, TLS. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 1
Secondary measures assessed in survey.

Measure	Significance Demonstrated In	Collection Method	Validated Measure
Demographics			
Gender	Balcombe et al., 2010; Cowburn & Stockley, 2005	1 multiple choice question	N/A
Personal income	Chen & Antonelli, 2020; Nakamura et al., 2015	1 multiple choice question	N/A
Individual Differences			
Product category familiarity	Vyth et al. (2010)	1 multiple-choice question	Hoek et al. (2017)
Caring about diet	Cowburn & Stockley, 2005; Drichoutis et al., 2006; Grunert & Wills, 2007	1 multiple-choice question	Not used
Dietary needs	Cowburn & Stockley, 2005; Grunert & Wills, 2007	1 multiple-choice question	Hoek et al. (2017)
Health consciousness	Cowburn & Stockley, 2005; Drichoutis et al., 2006; Grunert & Wills, 2007	1 multiple-choice question	Dutta, 2007; Dutta-Bergman, 2004; Laffan et al., 2021
Price consciousness & Sale proneness	Waterlander et al., 2012, 2013	11 statements on a 7-point Likert scale	*Price Perception Construct* (Lichtenstein et al., 1993)
Eating self-control	Bauer, van der Laan, et al., 2022; Giesen et al., 2012; Haws et al., 2016; Thunström, 2019	10 statements on a 7-point Likert scale (Strongly disagree – Strongly agree)	*Eating Self-Control Items* (Haws et al., 2016; Thunström, 2019)
Wellbeing Measures			
Satisfaction with choice	Laffan et al. (2021)	1 multiple-choice question	Not used
Emotional response to choice	Laffan et al., 2021; Thunström, 2019	7-point pain scale as implied by smiley faces	*Feelings Scale* (Thunström, 2019)

Note. Attentional focus (Bialkova et al., 2014; Krajbich, 2019; Rramani et al., 2020; Waterlander et al., 2012, 2013) was also collected for exploratory purposes but was not included in the final analysis. Price consciousness & Sale proneness and Eating self-control scores for each respondent were determined by taking the mean score of their answers, in accordance with the methodology of the studies cited in column Validated Measure.

were included in full model estimates as control variables. These control variables were gender, health consciousness, caring about diet and eating self-control. Analyses were conducted using Stata (version 17.0, StataCorp LLC). See **Supplementary Materials C** for analysis code.

2.6.1. Estimation

In our analysis we utilise an ordered logit model due to the ordinal nature of the outcome variable, which reflects ranked categories of healthiness in snack bar choices. This model is appropriate for handling ordered outcomes where the exact spacing between categories is not assumed to be equal. It allows us to estimate the effect of the interventions on the probability of selecting a healthier or less healthy option and allows us to control for additional factors influencing snack bar choices. The outcome variable (choice) can take any of the following values:

1 = *Most unhealthy choice*

2 = *Semi − unhealthy choice*

3 = *Semi − healthy choice*

4 = *Most healthy choice*

Following our pre-registration, we estimate the log odds separately for each intervention: traffic light system (TLS), merit price promotion, and demerit price promotion, allowing us to evaluate their distinct effects on the healthiness of snack bar choices:

$$\log\left(\frac{P(Y_i \le j)}{P(Y_i > j)}\right) = \beta_{j0} + \beta_1 \text{ intervention}_i + X_i$$

where $j = 1, 2, 3$ represent the thresholds between the 4 ordered levels of the outcome variable (i.e. the choice of snack bar as detailed above), and β_{j0} are the threshold-specific intercepts. The coefficient $\beta 1$ represents the effect of the intervention, which can be TLS (traffic light system), merit price promotion, or demerit price promotion. X is a vector of control variables (gender, health consciousness, caring about own diet and eating self-control). We interpret the coefficients as odds ratios and compute marginal effects to explore substitution patterns between categories.

3. Results

3.1. Descriptive statistics

Summary statistics for key participant characteristics are presented in Supplementary Materials Table A3. Participants were more often women (53 %), with an average income of £20,001 to £30,000, and ate cereal bars once a month (29 %). Furthermore, they cared a moderate amount about their diet (41 %), were very health conscious, moderately sensitive to prices and sales, and had a medium level of eating self-control. 55 % indicated they didn't have any dietary needs, with the remaining 45 % indicating that they did.

3.2. Main effects

Table 2 displays the ordered logistic regression estimates for the effect of each intervention combination on product choice as odds ratios.

Table 2
Ordered logistic regression odds ratio estimates for the effect of interventions (TLS and price promotions) on product choice.

	Base model	Full model
Panel A. Separate Effects		
TLS [a]	1.146 (0.226)	1.134 (0.229)
Healthy price promotion [b]	1.643** (0.344)	1.502* (0.324)
Unhealthy price promotion [b]	0.627** (0.120)	0.556*** (0.110)
Controls	No	Yes
Panel B. Combined Effects		
Healthy price promotion + TLS [c]	1.635** (0.347)	1.547** (0.340)
Controls	No	Yes
Unhealthy price promotion + TLS [c]	0.744 (0.145)	0.662** (0.134)
Controls	No	Yes

Note. This table contains ordered logistic regression estimates of the effect of TLS nutritional labelling and price promotions on likelihood of choosing a product that was one category healthier (higher category = higher healthiness). Controls in the Full model include gender, health consciousness, caring about diet and eating self-control. Standard errors are in parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.
[a] Simple ologit regression, using TLS as the explanatory variable. Compares condition "no promotion, TLS" to the reference group of "no promotion, no TLS". No TLS = RI table only (n = 447).
[b] Simple ologit regression, using (un)healthy promotion as the explanatory variable. Compares condition "(un)healthy promotion, no TLS" to reference group of "no promotion, **no TLS**"(n = 673).
[c] Simple ologit regression, using (un)healthy promotion as the explanatory variable. Compares condition "(un)healthy promotion, TLS" to reference group of "no promotion, **TLS**" (n = 452).

These describe the relative odds of a participant picking a product that was one category healthier, given exposure to the intervention. In **Panel A**, separate effects on product choice are presented: for each of the 3 interventions, a separate simple ordered logistical regression is used; where the only explanatory variable is one of the interventions, i.e. either TLS, or healthy price promotion, or unhealthy price promotion. In **Panel B**, combined effects are presented: for each of the 2 types of price promotion, a simple ordered logistic regression where the explanatory variable is either healthy price promotion or unhealthy price promotion is used, however only the conditions in which TLS is present (i.e. comparing no promotion + TLS against healthy price promotion + TLS) are compared. These form the base model. For the full model, controls (gender, measures of health consciousness, level of caring about diet, and eating self-control) are added as additional variables.

To provide insight into how the interventions affected choice at each level of healthiness, we also generated marginal estimates for the full regression model in Table 3. The regressions are the same as in Table 2 (see paragraph above) and displayed in a different order, with **Panel A** displaying the effect of TLS on product choice and **Panel B** displaying the effects of each type of price promotion and then combined interventions, for easier comparison.

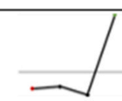
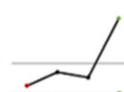
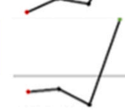
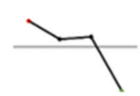
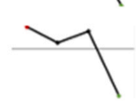
3.2.1. *TLS on food choice*

In **Panel A** of Table 2, for both base and full estimates, the variable TLS was found not to significantly predict the dependent variable: no significant differences were detected in the likelihood of a participant choosing a healthier item when they were exposed to the TLS (without a promotion) versus when they were not. Thus, hypothesis H_1; *The presence of TLS will increase the likelihood of a healthier food product being chosen, relative to when TLS is not present*, cannot be supported by the findings of this experiment.

3.2.2. *Healthy price promotions on food choice*

A price promotion on the healthiest product, was found to have a significant and positive relationship of 1.5-fold on the healthiness of product choice (Panel A Table 2): on average, the odds of choosing a healthier product were approximately 1.5 times higher (SE = 0.324) in the group with a healthy price promotion when compared to the group

Table 3
Marginal estimates for the effect of interventions (TLS and price promotion) on product choice (full model)

	Unhealthiest 1	Unhealthier 2	Healthier 3	Healthiest 4	Visualisation
Panel A. TLS					
TLS [a]	-0.008	-0.007	-0.011	0.027	
	(0.013)	(0.011)	(0.019)	(0.043)	
Frequency [b]	32	33	82	300	
Panel B. Price Promotions					
	Price promotion on healthiest product				
Healthy price promotion [c]	-0.038*	-0.015*	-0.024*	0.076*	
	(0.020)	(0.008)	(0.013)	(0.040)	
Frequency	41	26	58	325	
Healthy price promotion + TLS [d]	-0.022*	-0.018*	-0.040*	0.079**	
	(0.011)	(0.009)	(0.20)	(0.040)	
Frequency	25	24	73	331	
	Price promotion on unhealthiest product				
Unhealthy price promotion [c]	0.077***	0.023***	0.030***	-0.131***	
	(0.027)	(0.009)	(0.010)	(0.043)	
Frequency	72	34	59	279	
Unhealthy price promotion + TLS [d]	0.041**	0.012*	0.033**	-0.086**	
	(0.020)	(0.007)	(0.016)	(0.042)	
Frequency	52	20	82	298	

[a] Simple ologit regression, using TLS as the explanatory variable. Compares condition "no promotion, TLS" to the reference group of "no promotion, no TLS". No TLS = RI table only.

[b] Refers to the frequency of choice made across compared experimental conditions.

[c] Simple ologit regression, using (un)healthy promotion as the explanatory variable. Compares condition "(un)healthy promotion, no TLS" to reference group of "no promotion, **no TLS**".

[d] Simple ologit regression, using (un)healthy promotion as the explanatory variable. Compares condition "(un)healthy promotion, no TLS" to reference group of "no promotion, **TLS**".

Note. This table contains the conditional marginal effects of the ordered logistic regression estimates of the effect of TLS nutritional labelling and price promotions on the healthiness of product choice (with a higher category representing higher healthiness). Coloured cells highlight the promoted product. Visualisation maps the conditional marginal effects of the explanatory variable on the likelihood of choosing each healthiness category of product (x-axis), with a reference line at zero indicating no change in probability. Controls include gender, health consciousness, caring about diet and eating self-control. Standard errors are in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

with no promotion. **Panel B** in Table 3 shows that this was mainly driven by a shift towards the promoted ("healthiest") item, with the chances of it being chosen having increased by 7.6 percentage points relative to when there was no promotion. The price promotion also decreased the chances of the non-promoted items being chosen, with the "unhealthiest" having the largest decrease at −3.8 percentage points relative to no promotion. This finding supports H_2: *The presence of a price promotion on a food product within a choice set will increase the likelihood that the promoted product is chosen over other products, relative to when there is no promotion.*

3.2.3. Unhealthy price promotions on food choice

Similarly, an unhealthy price promotion was effective at shifting consumer choice. The estimated odds ratio indicates a significant negative relationship of 0.556-fold (SE = 0.110) compared to no promotion (Panel A Table 2): on average, the odds of choosing a healthier product were approximately 44.4 % lower in the group with an unhealthy price promotion than no promotion. **Panel B** in Table 3 shows that an unhealthy price promotion increased the chances of the promoted ("unhealthiest") item being chosen by 7.7 percentage points, once again supporting H_2: *The presence of a price promotion on a food product within a choice set will increase the likelihood that the promoted product is chosen over other products, relative to when there is no promotion.* However, the biggest shift in consumer choice was *away* from the "healthiest" product, with a significant and sizable decrease in the chances of it being chosen of 13.1 percentage points (Panel B Table 3), relative to when there was no promotion.

3.3. Combined effects

Panel B of Table 2 shows the effects of combining TLS and price promotion interventions, where we found similar effects to standalone price promotions. When the healthy price promotion was combined with the TLS, the estimated odds ratio revealed a significant positive relationship of 1.55-fold (SE = 0.340) compared to when there was no promotion: on average, when the TLS was present, the odds of choosing a healthier product were approximately 1.55 times higher in the group with a healthy price promotion when compared to the group with no promotion, thus supporting H_3*: When TLS is present, a price promotion on a product with the 'healthiest' TLS will increase the likelihood that, on average, a healthier food product is chosen, relative to when the price promotion is not present.* The increase was mainly driven by the increase in the probability of the promoted ("healthiest") option being chosen (7.9 percentage points), relative to when no promotion was present, with the probability of the "unhealthiest" item being chosen reduced by 2.2 percentage points, "unhealthier" by 1.8 percentage points, and "healthier" by 4 percentage points.

On the other hand, when the unhealthy price promotion was combined with the TLS, the estimated odds ratio indicates a significant negative relationship of 0.662-fold (SE = 0.134) compared to no promotion (Panel B Table 2): on average, when the TLS was present, the odds of choosing a healthier product were approximately 33.8 % lower in the group with an unhealthy price promotion than no promotion. The probability of the promoted ("unhealthiest") option being chosen increased by 4.1 percentage points relative to when there was no promotion (Panel B Table 3), providing support to H_4: *When TLS is present, a price promotion on a product with the 'unhealthiest' TLS will increase the likelihood that, on average, an unhealthier food product is chosen, relative to when the price promotion is not present.* The probability of both middle options being chosen also increased, with the "unhealthier" option being 1.2 percentage points more likely to be chosen, and the "healthier" option being 3.3 percentage points more likely (Panel B Table 3). The probability of the "healthiest" item being chosen, however, decreased by 8.6 percentage points (Panel B Table 3).

3.4. Exploratory analyses and secondary outcomes

3.4.1. Influence of eating self-control

When participants were split by eating self-control (above median score = high self-control, below the median score = low self-control, median score of 3.6), we found differing effects for each of the interventions (Supplementary Materials Table A4). Those with low self-control were more influenced by the TLS, having a significantly higher likelihood of choosing a healthier item than those with high self-control. This reflects previous findings such as in Bauer and colleagues (2022b), whereby those with low self-control are more affected by micro-environmental changes. However, we also found that there was no significant difference between the groups when exposed to a healthy price promotion, and when exposed to an unhealthy price promotion, those with high self-control had a significant decrease in the likelihood to choose a healthier product relative to those with low self-control. This may indicate that people with lower eating self-control are more influenced by nutrition-related, rather than price-related interventions, and thus may benefit to a greater degree from interventions that are perceived to be more directly connected to dietary health such as the TLS.

3.4.2. Intervention effects on wellbeing measures (satisfaction and feelings)

Additional analyses revealed that although participants' satisfaction with their choice of product was not significantly impacted by the presence of the interventions, how they felt about the nutritional value and health impact of their choice was affected (Supplementary Materials Table A5). The results suggested that, on average, the odds of a participant being one unit happier about the nutritional value and health impact of their choice were approximately 1.48 times higher in the condition where participants were exposed to the TLS when compared to the group without the TLS, and that this was driven by a 1.55 times higher chance of being one unit happier when the healthiest option was chosen (Supplementary Materials Table A6). This could suggest that although the TLS does not directly affect people's food choices, its presence may have an added value of providing a positive experience for those that make healthy choices.

4. Discussion

4.1. Effects of TLS labelling and price promotions on food choice

This study investigated the effects of TLS labelling and price promotions on the healthiness of hypothetical food choice. We found that price promotions were effective at increasing the likelihood that a promoted product was chosen over others (relative to when the promotion was absent), and this could be used to encourage both healthy and unhealthy food choices. Accordingly, study hypotheses H_2, H_3 and H_4 were supported. However, we did not find evidence for TLS labelling having a significant impact on the healthiness of food choice relative to an RI table. Therefore, study hypothesis H_1 was not supported, which echoes some previous findings that demonstrated directional but statistically non-significant effects (Ni Mhurchu et al., 2017; Sacks et al., 2009), but differs from some other studies that did find an effect (e.g. Balcombe et al., 2010; Ducrot et al., 2016). This mixed evidence is likely due to differences in setting, i.e. virtual supermarket simulations instead of a webpage, and measurement, i.e. considering overall health of a basket of goods rather than a single item: a common issue in this research area, as food choice studies span many different disciplines (Bauer & Reisch, 2019).

Nonetheless, the presence of TLS may have a promising role in encouraging healthy food choice when used in combination with price promotions. We observed a difference in the magnitude of both price promotions' effect sizes when they were used in combination with the TLS than when used alone. For healthy price promotions, although small, there was a slight increase in magnitude between when the healthy price promotion was combined with the TLS relative to when the price promotion was used alone (Table 2). This change in effect size magnitude was much larger for unhealthy price promotions, with the TLS dampening the detrimental effect of the price promotion (Table 2) and increasing the probability of the "unhealthiest" option being chosen by less (Table 3). This finding is relevant to policy, as it could suggest that despite a lack of an isolated effect on food choice, TLS labelling still complements other health policies, such as those restricting the high rate of price promotions on unhealthy foods (Department of Health and Social Care, 2023).

Furthermore, exploratory analyses suggested that the presence of TLS may have favourable spillover effects without directly changing behaviour, such as a positive effect on wellbeing. We observed that the TLS may have increased how positively people feel about the nutritional value and health impact of their choice, especially those who made the healthiest choice. This could potentially reinforce the healthy choice behaviour and thus encourage people to make it again in the future, indirectly supporting its aim as a health policy.

Another noteworthy result was that unhealthy price promotion *decreased* the chances of the "healthiest" product being chosen relative to when there was no promotion (Table 3). This is particularly interesting as the decrease caused by the unhealthy price promotion is much larger than the added value of the healthy price promotion (Tables 2 and 3). Since the "healthiest" option was by far the most chosen item by participants across all conditions (Table 3, Frequency), one interpretation of this finding is that the oversized effect of the unhealthy price promotion may have occurred via participants potentially defaulting to the healthiest choice, and only switching when there was a compelling reason to do so, i.e. when another product was on promotion. Studies find that price reductions can act as a guilt-mitigating mechanism (Chen et al., 2022; Mishra & Mishra, 2011) and reduce the importance people place on health goals (Haws & Winterich, 2013) in food purchasing decisions. This also follows evidence on 'moral licensing' effects in consumer choice (Bhargave et al., 2015; Biswas et al., 2025; Donkers et al., 2020; Khan & Dhar, 2006; Marcum et al., 2018; Stillman et al., 2023; Trudel-Guy et al., 2019; van Ittersum et al., 2024), with the potential of 'getting a good deal' licensing unhealthy dietary choices. However, this displacement in evaluative weighting may be particularly amplified in our study, as there are limited factors with which to assess the products (price, nutritional information, and packaging). Therefore, this effect should be further explored in future research, using additional qualitative measures to explore self-reported reasons for choice.

4.2. Limitations of the study

The main limitation of this study was the stylised environment of the choice setting, which could limit the generalisation of findings to real-world choices. Firstly, to isolate the effect of promotion itself on food choice from the effect of reduced pricing, the promoted product was priced identically to the non-promoted products. This is not how price promotions appear in real shopping scenarios, where often the price promotion makes a product cheaper than alternatives. Although this approach was taken to prevent confounding the effects of promotion and price, it creates an unavoidable trade-off with the ecological validity of the choice scenario. Additionally, snack bar packaging stimuli were not as differentiated as they would be in real life, lacking branding, flavour, and size differences, each of which would have large impacts on decision making. This provided limited information or points of difference for participants to draw from, which may have led to overestimated effects. Finally, since the experiment only involved hypothetical choices, and participants did not actually have to pay for or consume the food product, decisions were inconsequential. This is of particular importance as promotional effects may be more influential when choices are incentive-compatible or when participant's own money is used (Rosenboim & Shavit, 2012; Thaler & Johnson, 1990).

To further strengthen the study and overcome its main limitations, future research should replicate this study with design changes, such as other settings, to enhance the generalisability and external validity of the findings. For example, the research may use images of recognisable branded snack bars and consider the influence of consumer's pre-existing preference. Other settings could include using online grocery website simulations, can give participants a budget to spend, and could assess multiple purchases over one grocery trip. In the ideal case, randomised controlled field experiments should be used in naturally occurring settings (Bleich et al., 2017). This would also provide more relevant measures of well-being to be measured across all intervention conditions. It would also be interesting to explore whether the effects found for snack bars also occur for different food products (e.g. yoghurts, biscuits, crisps) and compare the effect sizes across different food products. Researchers could also compare across functionally different food products, such as comparing snack foods against ready meals, or comparing across the types of promotions, i.e. comparing price "discounts" against multi-buy offers (such as in Mishra & Mishra, 2011).

4.3. Conclusions and implications

This study explored the effects of nutritional labelling and price promotions on hypothetical food choice, and whether they can be used to encourage healthier diets. We contribute to the literature by assessing the combined influence of the TLS and price promotions on food choices, and by examining the potentially different role of price promotions on healthy and unhealthy food items.

Our findings suggest that TLS does not have an impact on consumer's pre-packaged food choices, but price promotions on both healthy and unhealthy products do, increasing the likelihood that a promoted product is chosen over others. Price promotions on unhealthy products were found to decrease the likelihood that the healthiest product is chosen, a finding that supports policy-level restrictions on sales promotions of unhealthy foods. However, when examining the combined effect of TLS and price promotions, our findings suggest that the TLS may amplify the effect of price promotions on healthy products and dampen the effect of those on unhealthy products.

Recommendations for policy include: (i) considering the use of price promotions on healthy substitute food products to encourage purchase of healthier foods and; (ii) restricting promotions on unhealthy foods as much as possible, as they are likely to not only increase unhealthy food purchases, but also reduce healthy food purchases. Related literature argues that a combination of these two recommendations may be the optimal strategy to encourage healthy food consumption (Glanz et al., 2012; Watt et al., 2023). Despite TLS not having a significant effect alone, we do not recommend the system should be discontinued, since an additive value was observed when the system was used in combination with the price promotions. Thus, we recommend that future public health policies should investigate interventions jointly with contextual behavioural influences, as this provides a more accurate portrayal of their impact. This study proffers a framework for such research and advocates better policy design, using behavioural science to tackle the population health crises of unhealthy diets and related diseases (Bauer et al., 2022b, 2022c; Reisch, 2021).

CRediT authorship contribution statement

Michelle Klotz: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Dario Krpan:** Writing – review & editing, Validation, Supervision, Data curation. **Paul M. Lohmann:** Writing – review & editing, Validation, Supervision, Data curation. **Matteo M. Galizzi:** Writing – review & editing. **Lucia A. Reisch:** Writing – review & editing, Resources, Funding acquisition.

Ethical statement

Ethical approval for the involvement of human subjects in this study was granted by The London School of Economics and Political Science University Research Ethics Committee Research Ethics Committee, Reference number 230228, dated 06/14/2023.

Participants gave informed consent via the statement "I confirm that I have read the information above and agree to take part in this study." where an affirmative reply was required to enter the survey. They were able to withdraw from the survey at any time without the need for explanation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2025.108005.

Data availability

The data and code needed to replicate the analysis are available on the OSF repository at https://osf.io/f5ym8/

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