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EMERGING RESEARCH

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# Encouraging healthier grocery purchases online: A randomised controlled trial and lessons learned

**Amanda Bunten**[1,2] | **Becky Shute**[3] | **Sarah E. Golding**[1,4] | **Caroline Charlton**[1] | **Lucy Porter**[1] | **Zachary Willis**[3] | **Natalie Gold**[1,5,6] | **Ayoub Saei**[1] | **Bethan Tempest**[3] | **Nilani Sritharan**[3] | **Rohan Arambepola**[1,7] | **Amy Yau**[1,8] | **Tim Chadborn**[1]

[1]Public Health England Behavioural Insights, Public Health England, London, UK

[2]GSK, London, UK

[3]Sainsbury's, London, UK

[4]School of Hospitality & Tourism Management, University of Surrey, Guildford, UK

[5]Behavioural Practice, Kantar Public, London, UK

[6]Centre for Philosophy of Natural and Social Science, London School of Economics, London, UK

[7]Big Data Institute, Li Ka Shing Centre for Health Information and Discovery, University of Oxford, Oxford, UK

[8]Department of Public Health, Environments & Society, London School of Hygiene & Tropical Medicine, London, UK

**Correspondence**
Lucy Porter, Public Health England Behavioural Insights, Public Health England, Wellington House, 133-155 Waterloo Road, London SE1 8UG, UK.
Email: L.Porter@exeter.ac.uk

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## Abstract

Online supermarket platforms present an opportunity for encouraging healthier consumer purchases. A parallel, double-blind randomised controlled trial tested whether promoting healthier products (e.g. lower fat and lower calorie) on the Sainsbury's online supermarket platform would increase purchases of those products. Participants were Nectar loyalty membership scheme cardholders who shopped online with Sainsbury's between 20th September and 10th October 2017. Intervention arm customers saw advertisement banners and recipe ingredient lists containing healthier versions of the products presented in control arm banners and ingredient lists. The primary outcome measure was purchases of healthier products. Additional outcome measures were banner clicks, purchases of standard products, overall purchases and energy (kcal) purchased. Sample sizes were small due to customers navigating the website differently than expected. The intervention encouraged purchases of some promoted healthier products (spaghetti [$B = 2.10$, $p < 0.001$], spaghetti sauce [$B = 2.06$, $p < 0.001$], spaghetti cheese [$B = 2.45$, $p = 0.001$], sour cream [$B = 2.52$, $p < 0.001$], fajita wraps [$B = 2.10$, $p < 0.001$], fajita cheese [$B = 1.19$, $p < 0.001$], bakery aisle products ($B = 3.05$, $p = 0.003$) and cola aisle products [$B = 0.97$, $p < 0.002$]) but not others (spaghetti mince, or products in the yogurt and ice cream aisles). There was little evidence of effects on banner clicks and energy purchased. Small sample sizes may affect the robustness of these findings. We discuss the benefits of collaborating to share expertise and implement a trial in a live commercial environment, alongside key learnings for future collaborative research in similar contexts.

**KEYWORDS**
behaviour change, consumer purchasing behaviour, diet, health improvement, online grocery shopping

## BACKGROUND

Consuming excess calories can lead to weight gain and poor health (Lim et al., 2012; PHE, 2018; Scarborough et al., 2011). Adults in England consume an average of 195 excess calories per day, with the figure rising to 320 excess calories per day among people with overweight and obesity (PHE, 2018). Reducing energy intake by as little as 30–100 calories a day could have a considerable effect on population obesity levels (Hall et al., 2011; Rodearmel et al., 2007).

Our environments strongly influence the type and amount of food we buy and eat (PHE, 2015; Swinburn et al., 2011). The visibility and accessibility of energy-dense foods in everyday food environments is an important driver of high-calorie food choice (PHE, 2015; Swinburn et al., 2011). Exposure to food cues (such as food pictures, adverts and promotions) can trigger cravings, influence eating behaviour and ultimately lead to weight gain (Boswell & Kober, 2016). This can be seen in the success of food promotions in Britain, where approximately 40% of money spent on food goes towards promoted foods (PHE, 2015). The majority of promotions and adverts are currently for energy-dense foods (Coates et al., 2019).

Retail environments such as supermarkets could be adapted to support consumers to make healthier choices. Public Health England's (PHE) calorie reduction programme aims to partner with supermarkets (among other food businesses) to reduce the calories purchased and consumed by the public (PHE, 2018). Online supermarket platforms in particular allow rapid adaptation of webpages and iterative testing of interventions in live retail environments, and have the potential for wide population reach; in 2019, 30% of British adults purchased food and drink from online grocery websites (Statista, 2021b) and online food shopping increased by 76% in the UK from 2019 to 2020 due to the COVID-19 pandemic (Kantar, 2020). A 2021 survey of consumers showed that over 40% of the sample intended to continue purchasing groceries from online supermarkets as restrictions eased (Statista, 2021a).

A recent study in a virtual online supermarket found that placing products lower in saturated fat at the top of product pages was an effective strategy for reducing the saturated fat purchased by participants (Koutoukidis et al., 2019), consistent with evidence that people often select the default choices presented to them (Choi et al., 2004; Loeb et al., 2017; Peters et al., 2016; Shepherd et al., 2014). Suggesting low salt/saturated fat product alternatives reduced the salt purchased by participants in another virtual online supermarket (Payne Riches et al., 2019) and the saturated fat purchased in a real online supermarket (Huang et al., 2006). This suggests that promoting healthier items in online supermarket environments can influence consumer purchases.

### The current study

This collaborative project between PHE Behavioural Insights and Sainsbury's aimed to test whether promoting healthier versions of popular products (see Methods for the definition of 'healthier products' used in this trial) via select website banners and recipe ingredient lists could encourage online supermarket consumers to purchase these healthier items in place of standard versions of these products. Banners are a form of visual advertisement placed on webpages (see figures in Methods for examples from this trial) and in this case, either promoted ingredients for a recipe ('recipe bundle' banners, which clicked through to recipe ingredient lists) or products from the same 'aisle' on the website (e.g. bakery, yogurt and cola – 'in-aisle' banners, which clicked through to the relevant product aisle lists). Banners presented either healthier (intervention arm) or standard products (control arm). We expected healthier intervention banners to lead to healthier purchases by priming, which refers to the ability of subtle cues in the environment to influence behaviour and choices (Wilson et al., 2016). Research from in-person supermarkets has shown that prompts/cues for products (e.g. through labels and posters) can encourage purchases of those products (Golding et al., 2021).

We also expected the pre-set recipe ingredient lists (promoted via the recipe bundle banners) to increase purchases of healthier products in the intervention arm due to the tendency to stick with the status quo and retain pre-selected choices (Choi et al., 2004; Loeb et al., 2017; Peters et al., 2016; Shepherd et al., 2014). Clicking on two of the in-aisle banners (yogurt and ice cream) also took intervention arm participants to a product list (for yogurt or ice cream, respectively) that had been reordered to present healthier options first (clicking on the remaining in-aisle banners – bakery, food cupboard and cola – took participants to the same product list, regardless of trial arm, as it was not possible to implement product list reordering for all in-aisle banners in time for the intervention launch). Previous research has shown that reordering products in online supermarket settings can encourage healthier purchasing behaviours (Koutoukidis et al., 2019).

Overall, we hypothesised that participants in the intervention arm (who saw healthier banners, healthier recipe ingredient lists and reordered product lists for ice cream and yogurt) would be more likely to purchase healthier products and less likely to purchase standard products. We also hypothesised that participants in the intervention arm would purchase less energy (in kcal, both total energy and energy per 100 g) from these products.

# METHODS

## Study design

A double-blind, parallel randomised controlled trial (RCT) with two arms (intervention vs. control) was conducted.

### Participants and randomisation

Customers who were cardholders of the Nectar loyalty membership scheme were eligible for inclusion in this trial to allow consistent trial arm allocation throughout the trial period even when customers accessed the website on different devices. The great majority of website users are Nectar cardholders, as reported by the Sainsbury's team. Power calculations using approximate sample sizes based on past page view data were conducted to estimate the minimum detectable effect size (exact data cannot be shared due to it being of a commercially sensitive nature) at 80% power. For recipe bundle banners, a minimum difference of 6%–9% would be needed to be able to detect differences in product purchases between trial arms based on expected sample sizes. For in-aisle banners, the minimum difference sat between 12% and 30% (with some variation for specific product aisles).

All Nectar cardholders who logged in to the Sainsbury's website during the trial period were randomly allocated on a 1:1 basis to the intervention or control arm. Customers were blind to their allocation, as were statisticians at the time of data analysis (data were labelled as belonging to group A or group B).

### Ethical considerations

Consent for trial participation was not sought from customers directly, as bringing attention to the trial may have impacted the validity of the results. However, all Nectar loyalty membership scheme cardholders have agreed to terms and conditions that state that Nectar cardholders' data would be used for research purposes in order to understand shopping behaviour. No data were shared outside of Sainsbury's in accordance with these terms and conditions, with all analyses completed on-site at Sainsbury's offices. Ethical approval was granted by the PHE Research Ethics and Governance Group (reference R&D 215).

## Intervention

The intervention was developed collaboratively between Sainsbury's and PHE Behavioural Insights (see Appendix S1 for information on this process), and centred around presenting images of healthier products in selected webpage banner advertisements (customers in the control arm saw the same banners but with standard products shown in images).

## Selecting standard and healthier products to feature in banners

In consideration of normal business activity, the teams created intervention and control banners for products that were already scheduled to be featured in banners and recipe ingredient lists. Some scheduled banners (i.e. those containing non-Sainsbury's branded products) could not be modified to differ between intervention arms for contractual reasons, and so some banners were instead created using only Sainsbury's own brand products to allow modification between trial arms.

The Sainsbury's healthier product list was consulted to identify the healthier products to show in intervention banners compared to the standard products shown in control banners. A set of criteria were established for matching healthier and standard products based on evidence that food choices can be influenced by brand preferences (Fernqvist & Ekelund, 2014), price differences (Hartmann-Boyce et al., 2018; Nakamura et al., 2015) and pack size (which consumers may use to judge price value; Ordabayeva & Chandon, 2016; Vermeer et al., 2010). Healthier products promoted in the intervention arm were therefore required to:

- be a 'like-for-like' swap from the same sub-category as the standard product (e.g. for standard beef mince, 5% fat beef mince would be a suitable healthier alternative, but 2% fat turkey mince would not)
- be produced by the same brand (such as Sainsbury's, however, not all featured products were Sainsbury's own brand)
- have a pack size or volume that fell within ±10% of the standard product's pack size/volume
- have a price that fell within ±10% of the standard product's price
- meet at least one of the following criteria: (i) 30% fewer calories, (ii) 30% less fat, (iii) 30% less saturated fat, (iv) 30% less sugar and (v) 25% less salt than the standard product.

Products identified as candidate healthier alternatives were cross-checked by nutritionists at PHE.

## Banners

Two types of banner were developed (recipe bundles and in-aisle). Recipe bundle banners were shown on the homepage and displayed images of the (healthier or standard) products needed for a recipe (fajitas or spaghetti bolognese; see Figure 1).

Clicking recipe bundle banners took customers to a product list of the recipe ingredients. These also differed by trial arm (standard products in the control arm and healthier products in the intervention arm). Customers could add all ingredients to their baskets with a single click, or they could select items individually (see Figure 2).

In-aisle banners showed a selection of (healthier in intervention and standard in control) products and were shown in the relevant aisle as follows: (i) bakery products (wrap, garlic bread and naan) banners in the bakery aisle, (ii) food cupboard products (baked beans, tomato ketchup and jam) banners in the food cupboard aisle, (iii) cola banners in the drinks aisle, (iv) Greek and natural yogurt banners in the dairy aisle and (v) ice cream banners in the frozen aisle (Figure 3).

Clicking in-aisle banners took customers to the relevant product list (e.g. clicking on the bakery banner took customers to the bakery product list page). These product lists did not differ between trial arms for the bakery, food cupboard and cola product lists, however, they did differ for the ice cream and yogurt banners, with healthier items displayed higher in the list (it was not feasible to implement this intervention across multiple product categories in time for the trial). Unlike recipe bundle banners, customers could navigate to these product list pages without clicking on the banners (i.e. by taking different routes through the website; Figure 4).

## Procedure

The Sainsbury's team advised on seasonality effects on shopping behaviour (e.g. around school holidays and in the lead-up to Christmas), which may impact the efficacy of interventions and the generalisability of results. To avoid this, and to fit with usual business activities, a 3-week intervention period was set beginning 20th September 2017. The running periods for each banner are listed in Table 1. During this time, customers who were logged into their Nectar loyalty membership scheme accounts when landing on the Sainsbury's online shopping home page were randomised to the intervention or control arm. Customers browsed the website and completed their shopping as usual. Customers consistently saw the intervention or control version of the website throughout the trial period.

## Outcomes

The primary outcome was purchases of promoted healthier products. Secondary outcome measures were purchases of promoted standard products (to check whether increases in healthier purchases were matched by a decrease in standard purchases), overall purchases (to check for any potential unintended impacts on sales), banner clicks (to check for any potential unintended impacts on banner engagement) and energy (kcal) purchases from promoted products.

## Analyses

### Banner clicks

Banner clicks were analysed first to check whether the numbers of customers engaging with the banners


**FIGURE 1** Screenshots of control and intervention promotions for the recipe bundles

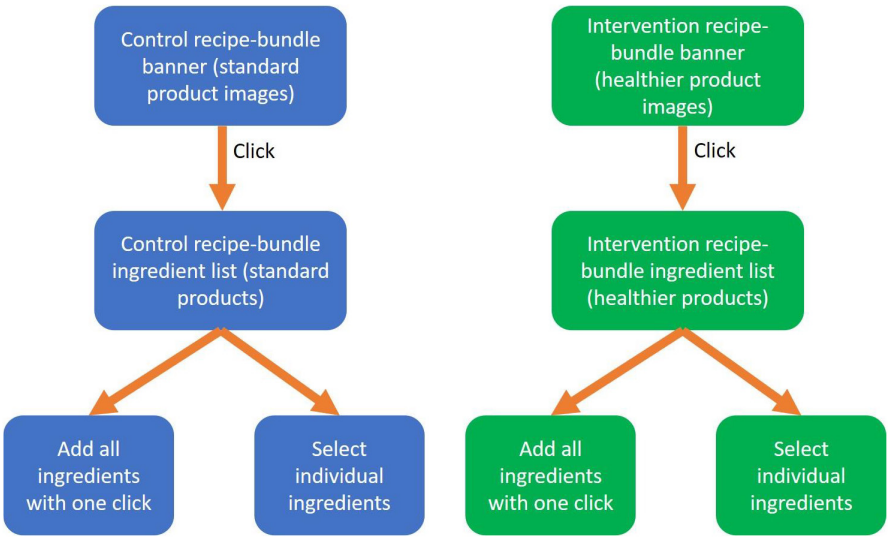


**FIGURE 2** Customer journeys in the control and intervention arms

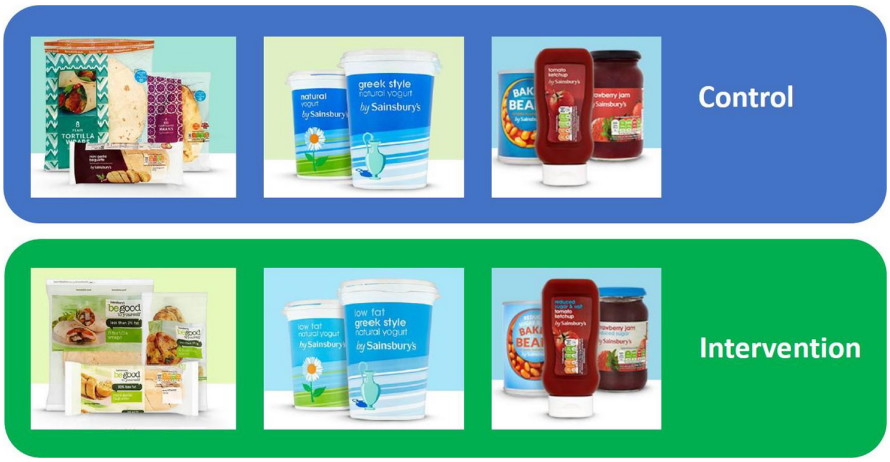


**FIGURE 3** Screenshots for control and intervention in-aisle banners

differed between trial arms, as this would affect the primary outcome of healthy purchases. The observed number of customers clicking intervention or control banners was compared against the estimated number of webpage visits for the page hosting that banner. Estimated webpage visits were used as it was not possible to obtain exact webpage visit data. Trial arms were compared using chi-square analyses.

## Purchases of promoted products (healthier, standard and overall)

The impact on purchases of promoted products was assessed using slightly different methods for the recipe bundle banners versus in-aisle banners. Given that the recipe bundle ingredient lists could only be accessed by clicking on the recipe bundle banners, we compared trial arms on the number of customers purchasing products *out of those who clicked on the banner*. For in-aisle banners, given that the product lists could be accessed by alternative routes through the website (i.e. without clicking the banner at all), we compared trial arms on the number of customers purchasing products *out of the total estimated webpage visits* (as including only those who clicked on the banner would underestimate the number of customers able to access these product lists).

For each in-aisle banner, the impact on healthier purchases, standard purchases and overall purchases was analysed once at the aisle level (i.e. one analysis for the cola banner, one for the bakery banner, etc.). For recipe bundles, the impact was analysed for all products combined but also for each ingredient separately (e.g. spaghetti, mince and cheese). This was to assess the impact on purchases as a whole, as well as impacts on specific ingredients (e.g. perhaps customers would be more willing to buy low-fat cheese but not whole wheat spaghetti).

Unadjusted logistic regression models were used to compare trial arms on healthier purchases, standard purchases and overall (healthier and standard combined) purchases separately. The critical significance level was adjusted for multiple outcomes using Bonferroni corrections. This was done separately for each banner as follows. For the spaghetti bolognese recipe bundle banner, the critical $p$ value was adjusted for 15 outcomes (five ingredient categories – mince,

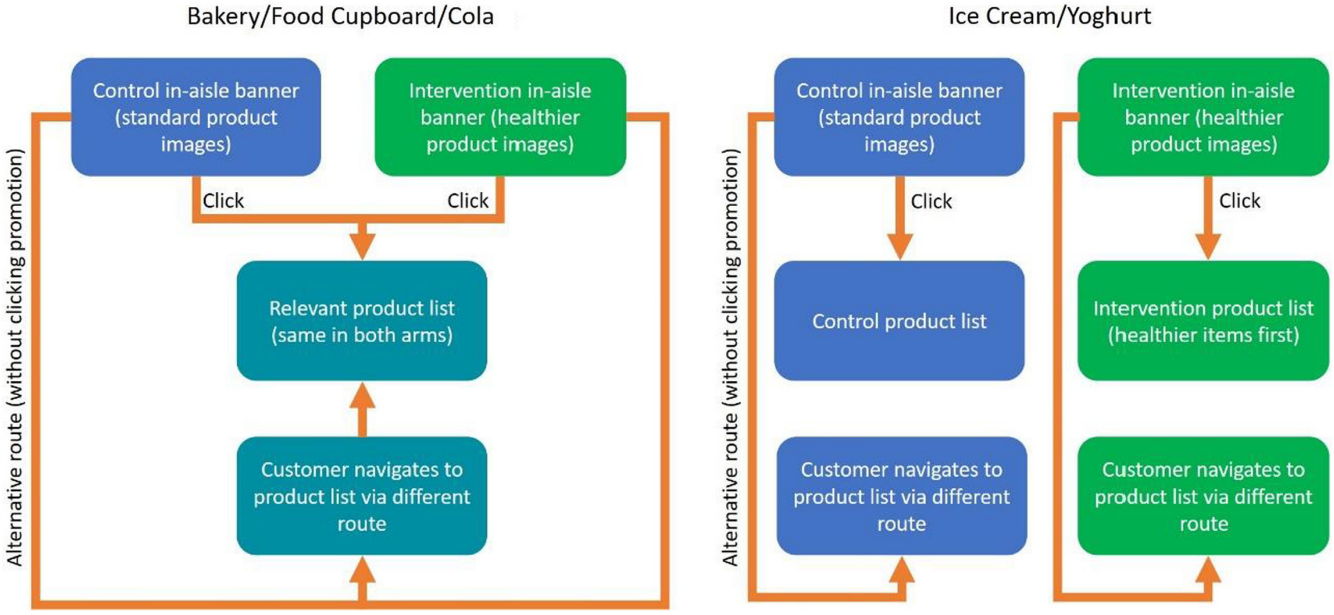


**FIGURE 4** Customer journeys in the control and intervention arm for in-aisle promotions

**TABLE 1** Location, content and duration of the trial promotions

| Banner location | Banner type | Duration |
|---|---|---|
| Homepage | Recipe bundle – Spaghetti bolognese | 1 week (27th Sept–3rd Oct) |
| Homepage | Recipe bundle – Fajitas | 1 week (4th–10th Oct) |
| Bakery aisle top-of-page banner (beacon) | In-Aisle – Tortillas, mini naans, mini garlic baguette and garlic baguette | 3 weeks (20th Sept–10th Oct) |
| Food cupboard middle-of-page banner (springboard) | In-Aisle – Baked beans 4 pack, baked beans tin, tomato ketchup, strawberry jam, apricot jam, raspberry jam, blackcurrant jam, cream of tomato soup and granola | 3 weeks (20th Sept–10th Oct) |
| Drinks zone top-of-page banner (beacon) | In-Aisle – Cola | 1 week (4th–10th Oct) |
| Dairy zone top-of-page banner (beacon) | In-Aisle – Greek style yogurt & natural yogurt | 1 week (27th Sept–3rd Oct) |
| Frozen zone top-of-page banner (beacon) | In-Aisle – soft scoop ice cream | 2 weeks (20th Sept–3rd Oct) |

*Note:* Springboard refers to pages at a higher level than an aisle (e.g. a home page, or a page bringing together products from different aisles, such as a 'food cupboard' page) and beacon refers to a positioning at the top of an aisle page.

spaghetti, cheese, sauce and all ingredients combined – which were each assessed separately for healthier versions, standard versions and both combined), and was set at $p = 0.003$. For the fajita recipe bundle banner, the critical $p$ value was adjusted for 12 outcomes (four ingredient categories – sour cream, wraps, cheese and all ingredients combined – which were each assessed separately for healthier versions, standard versions and both combined), this was set at $p = 0.004$. Three analyses were conducted for each in-aisle promotion (healthier products, standard products and both combined) and so the Bonferroni-adjusted $p$ value was 0.017.

### Calories purchased from trial products

Calories purchased from trial products were assessed using linear regression to compare trial arms on the outcomes of total calories purchased, and calories per 100 g. As two analyses were conducted on related outcomes (calories per 100 g and total calories), the critical $p$ value was adjusted using a Bonferroni correction to $p = 0.025$, except for the fajita recipe bundle and the bakery in-aisle banners for which only total calories were analysed due to some data for calories per 100 g not being available at the time of analysis.

## RESULTS

### Sample characteristics

Due to the commercially sensitive nature of the data, it is not possible to share exact sample sizes (webpage visit estimates, click rates, etc.). Instead, we converted the expected ranges of click rates used in our power

calculations into a scale from 0 (lower bound of the expected range) to 100 (upper bound), and converted the observed number of clicks across both intervention arms into a value along that scale, to create an indicator of how our observed sample size compared to expectations (values below 0 indicate clicks lower than expected). For the following intervention types, the indicator value was as follows: fajita bundle (16.65), spaghetti (–42.58), bakery (16.44), yogurt (9.77) and ice cream (–22.22), suggesting that all sample sizes were lower than expected or towards the lower end of the expected range. As estimates were not provided for either cola or food cupboard interventions, an indicator could not be calculated. The commercially sensitive nature of the data also extends to the demographic information about the participant sample.

## Banner click rates

Click rates did not differ between trial arms for the majority of banners (see Table 2), however, the likelihood of clicking was significantly lower in the intervention arm for the fajita recipe bundle ($\chi^2 = 11.87$, $p < 0.001$), and was significantly higher in the intervention arm for the bakery in-aisle banner ($\chi^2 = 13.52$, $p < 0.001$).

## Purchases of healthier products

There was a significant increase in purchases of promoted healthier products for the spaghetti bolognese recipe bundle banner ($B = 0.89$, SE = 0.22, 95% CI [0.45, 1.33], $p < 0.001$), the fajita recipe bundle banner ($B = 1.72$, SE = 0.17, $p < 0.001$, 95% CI [1.28, 2.05]), the bakery in-aisle banner ($B = 3.05$, SE = 0.102, $p = 0.003$, 95% CI [1.04, 5.05]) and the cola in-aisle banner ($B = 0.97$, SE = 0.31, $p = 0.002$, 95% CI [0.36, 1.59]). The food cupboard, yogurt and ice cream in-aisle banners did not appear to significantly impact overall purchases of the promoted healthier products (see Table 3).

As planned, purchases for the recipe bundle banners were analysed separately for each ingredient contained in the recipe lists. For the spaghetti bolognese recipe bundle, customers in the intervention arm were more likely to buy healthier versions of spaghetti ($B = 2.10$, SE = 0.54, 95% CI [1.04, 3.16], $p < 0.001$), sauce ($B = 2.06$, SE = 0.54, 95% CI [0.99, 3.13], $p < 0.001$) and cheese ($B = 2.45$, SE = 0.75, 95% CI [0.99, 3.91], $p = 0.001$). With an adjusted significance threshold, there were no statistically significant differences between trial arms in purchases of healthier mince ($B = 0.56$, SE = 0.23, 95% CI [0.10, 1.02], $p = 0.16$). For the fajita recipe bundle, customers in the intervention arm were more likely to buy healthier versions of all individual ingredients – sour cream ($B = 2.52$, SE = 0.30, 95% CI [1.75, 3.11], $p < 0.001$), wraps ($B = 2.10$, SE = 0.25, 95% CI [1.45, 2.60], $p < 0.001$) and cheese ($B = 1.19$, SE = 0.26, 95% CI [0.53, 1.70], $p = 0.16$).

**TABLE 2** Chi-square analyses comparing likelihood of clicking on banners between trial arms

| Advert | $\chi^2$ | *p* |
|---|---|---|
| Spaghetti bolognese bundle | 0.31 | 0.576 |
| Fajita bundle | 11.87 | <0.001 |
| Food cupboard | 2.85 | 0.092 |
| Bakery | 13.52 | <0.001 |
| Yogurt | 0.18 | 0.668 |
| Cola | 0.17 | 0.680 |
| Ice cream | 0.08 | 0.777 |

## Purchases of standard products

These analyses were conducted to understand whether any increases in purchases of healthier products were accompanied by decreases in purchases of standard products (to help understand if customers appeared to be swapping standard for healthier products, or simply adding healthier products on top of their usual purchases).

The significant increase in purchases of healthier spaghetti bolognese ingredients (reported above) was accompanied by a significant decrease in purchases of standard products in the intervention arm ($B = –0.82$, SE = 0.23, 95% CI [–1.26, –0.38], $p < 0.001$). However, at the individual product level, the only significant decrease was seen in purchases of standard sauce ($B = –1.60$, SE = 0.47, 95% CI [–2.51, –0.68], $p < 0.001$), meaning that significant increases in healthier spaghetti and cheese purchases were not matched by significant decreases in standard spaghetti and cheese purchases (see Table 4). As with healthier mince, purchases of standard mince were not affected by the intervention.

The significant increase in overall purchasing of healthier fajita bundle ingredients (reported above) was matched by a decrease in purchasing of standard ingredients ($B = –1.00$, SE = 0.11, $p < 0.001$, 95% CI [–1.30, –0.78]). Mirroring the increases in healthier purchases, significant decreases in purchasing were seen for standard sour cream ($B = –1.87$, SE = 0.21, $p < 0.001$, 95% CI [–2.41, –1.46]), wraps ($B = –1.24$, SE = 0.13, $p < 0.001$, 95% CI [–0.67, –0.16]) and cheese ($B = –0.59$, SE = 0.16, $p < 0.001$, 95% CI [–1.01, –0.27]).

There was no evidence of a significant decrease in standard product purchases for any in-aisle banners (meaning that the increases in healthier purchases of bakery and cola products reported above were not matched by a similar decrease in standard products from these categories).

**TABLE 3** Results of logistic regression analyses comparing the likelihood of purchasing healthier products between the intervention and control arms for each banner

| Banner | *B* | SE | *p* | 95% CI (lower) | 95% CI (upper) |
|---|---|---|---|---|---|
| Spaghetti bolognese bundle (all combined) | 0.89 | 0.22 | **<0.001** | 0.45 | 1.33 |
| Spaghetti | 2.10 | 0.54 | **<0.001** | 1.04 | 3.16 |
| Sauce | 2.06 | 0.54 | **<0.001** | 0.99 | 3.13 |
| Mince | 0.56 | 0.23 | 0.016 | 0.10 | 1.02 |
| Cheese | 2.45 | 0.74 | **0.001** | 0.99 | 3.91 |
| Fajita bundle (all combined) | 1.72 | 0.17 | **<0.001** | 1.28 | 2.05 |
| Wraps | 2.10 | 0.25 | **<0.001** | 1.45 | 2.60 |
| Sour cream | 2.52 | 0.30 | **<0.001** | 1.75 | 3.11 |
| Cheese | 1.19 | 0.26 | **<0.001** | 0.53 | 1.70 |
| Food cupboard | 0.06 | 0.34 | 0.866 | −0.61 | 0.72 |
| Bakery | 3.05 | 1.02 | **0.003** | 1.04 | 5.05 |
| Yogurt | 1.61 | 1.10 | 0.142 | −0.54 | 3.76 |
| Cola | 0.97 | 0.31 | **0.002** | 0.36 | 1.59 |
| Ice cream | −0.59 | 0.56 | 0.292 | −1.68 | 0.51 |

*Note:* Reference group = control. Bold = significant after Bonferroni corrections.
Abbreviation: SE, standard error.

**TABLE 4** Results of logistic regression analyses comparing the likelihood of purchasing standard products between the intervention and control arms for each banner

| Banner | *B* | SE | *p* | 95% CI (lower) | 95% CI (upper) |
|---|---|---|---|---|---|
| Spaghetti bolognese bundle (all combined) | −0.82 | 0.23 | **<0.001** | −1.26 | −0.38 |
| Spaghetti | −0.88 | 0.35 | 0.014 | −1.57 | −0.18 |
| Sauce | −1.60 | 0.47 | **<0.001** | −2.51 | −0.68 |
| Mince | −0.96 | 0.34 | 0.005 | −1.63 | −0.29 |
| Cheese | −0.90 | 0.32 | 0.005 | −1.51 | −0.28 |
| Fajita bundle (all combined) | −1.00 | 0.11 | **<0.001** | −1.30 | −0.78 |
| Wraps | −1.24 | 0.13 | **<0.001** | −1.59 | −0.98 |
| Sour cream | −1.87 | 0.21 | **<0.001** | −2.41 | −1.46 |
| Cheese | −0.59 | 0.16 | **<0.001** | −1.01 | −0.27 |
| Food cupboard | −0.55 | 0.27 | 0.041 | −1.07 | −0.02 |
| Bakery | −0.10 | 0.44 | 0.827 | −0.95 | 0.76 |
| Yogurt | −0.10 | 0.44 | 0.827 | −0.95 | 0.76 |
| Cola | 0.41 | 0.32 | 0.209 | −0.23 | 1.04 |
| Ice cream | −0.41 | 0.91 | 0.657 | −2.19 | 1.38 |

*Note:* Reference group = control. Bold = significant after Bonferroni corrections.
Abbreviation: SE, standard error.

## Energy purchased

Energy (in kcal) purchased was lower in the intervention arm than the control arm for the fajita recipe bundle (total kcal: $B = -792.30$, SE = 208.00, $p < 0.001$), the cola in-aisle banner (total kcal: $B = -1090.20$, SE = 401.00, $p = 0.013$; kcal per 100 g: $B = -19.76$, SE = 6.11, $p = 0.004$) and the bakery in-aisle banner (total kcal: $B = -1753.20$, SE = 724.10, $p = 0.023$). As expected, based on the product purchase results, no significant differences in energy purchased were observed for the food cupboard, yogurt or ice cream in-aisle banners. Despite significant increases in healthier purchases and significant decreases in standard purchases within the spaghetti bolognese recipe bundle, no significant differences in energy purchased were observed between trial arms (see Table 5).

## Overall purchases

These analyses were conducted to understand whether the intervention affected overall likelihood of purchasing, helping to understand the commercial viability of such banners.

For the spaghetti recipe bundle banner, there was no evidence of a statistically significant intervention effect on overall likelihood of purchasing ($p$ = 0.420), which was also the case when analysing overall purchases of each ingredient separately (spaghetti, sauce, cheese and mince). For the fajita recipe bundle, there was no evidence of a statistically significant effect on overall likelihood of purchasing ($p$ = 0.061), which was also the case for cheese and sour cream, however, customers in the intervention arm were significantly less likely to purchase wraps (regardless of whether they were healthier or standard; $B$ = −0.38, SE = 0.11, $p$ < 0.001, 95% CI [−0.67, −0.16]), indicating a potential negative impact of the intervention on overall sales of this product. For the in-aisle banners, the overall likelihood of customers making a purchase was only impacted for the bakery banner, where customers in the intervention arm were more likely to make a purchase than those in the control arm ($B$ = 0.97, SE = 0.35, $p$ = 0.006, 95% CI [0.28, 1.66]), indicating that this banner may have had a positive effect on overall sales (see Table 6).

# DISCUSSION

We aimed to test whether promoting healthier products via webpage banners on a live, commercial online supermarket shopping platform would encourage healthier purchases and reduce overall energy (in kcal) purchased. In most cases, there was no evidence that showing healthier products in promotional banners significantly affected click rates or overall likelihood of making a purchase, suggesting that the intervention did not impact customer engagement or overall sales (although it should of course be noted that without equivalence testing or Bayesian analysis, this absence of evidence does not equate to evidence of absence of an effect). Regarding effects on product purchases, we observed an intervention effect on some product types but not others. Specifically, we observed significantly higher purchases (vs. control) for healthier versions of spaghetti, sauce and cheese within the spaghetti bolognese recipe bundle, for all ingredients within the fajitas recipe bundle and for products under the bakery and cola in-aisle banners. We also observed significantly lower purchases (vs. control) for standard versions of sauce within the spaghetti bolognese recipe bundle and all ingredients in the fajita recipe bundle. However, we did not observe any significant differences between trial arms for purchases of healthier mince within the spaghetti bolognese recipe bundle or for healthier products under the food cupboard, yogurt and ice cream in-aisle banners. We also did not observe any significant differences between trial arms for purchases of standard spaghetti, cheese and mince within the spaghetti bolognese recipe bundle, or for standard products under any of the in-aisle banners.

The changes in product purchases that we did observe did not always translate into reductions in calories purchased; the only significant reductions in calories purchased occurred for the bakery and cola in-aisle banners. This may be because the criteria for a healthier alternative did not specify that products should be lower in energy, necessarily (they could have been lower in fat or sugar instead). It is also interesting to note that no effects were observed for the ice cream

**TABLE 5** Results of linear regression analyses comparing energy in kcal purchased between the intervention and control arms for each banner

| | *B* | SE | *p* |
|---|---|---|---|
| Calories purchased per 100 g | | | |
| Spaghetti bolognese bundle | −26.69 | 12.94 | 0.040 |
| Food cupboard | −60.65 | 31.33 | 0.062 |
| Yogurt | 2.75 | 13.57 | 0.843 |
| Cola | −19.76 | 6.11 | **0.004** |
| Ice cream | −4.00 | 5.08 | 0.446 |
| Total calories purchased | | | |
| Spaghetti bolognese bundle | 6.07 | 433.88 | 0.989 |
| Fajitas bundle | −792.30 | 208.00 | **<0.001** |
| Food cupboard | −905.80 | 666.40 | 0.184 |
| Bakery | −1753.20 | 724.10 | **0.023** |
| Yogurt | −175.00 | 551.10 | 0.757 |
| Cola | −1090.20 | 401.00 | **0.013** |
| Ice cream | −478.80 | 307.30 | 0.143 |

*Note:* Reference group = control. Bold = significant after Bonferroni corrections.
Abbreviation: SE, standard error.

**TABLE 6** Results of logistic regression analyses comparing the likelihood of overall purchasing between the intervention and control arms for each banner

| Banner | *B* | SE | *p* | 95% CI (lower) | 95% CI (upper) |
|---|---|---|---|---|---|
| Spaghetti bolognese bundle (all combined) | −0.16 | 0.20 | 0.420 | −0.56 | 0.24 |
| Spaghetti | 0.34 | 0.26 | 0.195 | −0.18 | 0.86 |
| Sauce | 0.12 | 0.28 | 0.659 | −0.42 | 0.66 |
| Mince | 0.09 | 0.21 | 0.676 | −0.33 | 0.50 |
| Cheese | −0.07 | 0.26 | 0.786 | −0.57 | 0.44 |
| Fajita bundle (all combined) | −0.20 | 0.10 | 0.061 | −0.47 | 0.01 |
| Wraps | −0.38 | 0.11 | **<0.001** | −0.67 | −0.16 |
| Sour cream | −0.17 | 0.13 | 0.191 | −0.49 | 0.08 |
| Cheese | −0.07 | 0.14 | 0.632 | −0.42 | 0.20 |
| Food cupboard | −0.31 | 0.24 | 0.093 | −0.78 | 0.16 |
| Bakery | 0.97 | 0.35 | **0.006** | 0.28 | 1.66 |
| Yogurt | −0.09 | 0.42 | 0.835 | −0.91 | 0.73 |
| Cola | 0.57 | 0.27 | 0.038 | 0.03 | 1.10 |
| Ice cream | −0.54 | 0.48 | 0.777 | −1.47 | 0.39 |

*Note:* Reference group = control. Bold = significant after Bonferroni corrections.
Abbreviations: SE, standard error.

or yogurt banners, which used a combination of presenting healthier products in banners, and re-ordering product lists to display healthier products at the top of lists.

Recipe bundle banners, which also provided pre-set ingredient lists for customers to add to their baskets with one click, appeared particularly successful at encouraging purchases of healthier products over standard products, supporting the notion that people tend not to exchange the default options (i.e. ingredients in the lists) presented to them (although it should be noted that for the spaghetti bolognese recipe bundle, while there was a trend for increased purchasing of healthier mince and decreased purchasing of standard mince in the intervention arm, these differences were not significantly different after Bonferroni adjustments for multiple comparisons, suggesting that the effectiveness of this intervention may vary depending on the specific ingredient or product in question).

Evidence reviews have previously suggested that promoting healthier foods in in-store supermarkets (e.g. through prompts/cues such as adverts and labels, or through suggesting product swaps) could be effective strategies to influence consumer purchasing behaviour and improve public health (Golding et al., 2021; Hartmann-Boyce et al., 2018). Promoting healthier foods in simulated online supermarkets (e.g. through suggesting swaps or revising the order of product lists) has also been shown to impact consumer purchases (e.g. Forwood et al., 2015; Koutoukidis et al., 2019; although see also Bunten et al., 2021). Our findings add to this literature by showing that promoting healthier products through website banners in a live, commercial online supermarket can sometimes increase purchases of those products, however, the pattern of findings in this trial suggest that the effects of these interventions may vary across product types. Interestingly, Koutoukidis et al. (2019) found that product list re-ordering had a greater effect on consumer purchasing than suggesting swaps alone, which contrasts with our finding that product list re-ordering in addition to promotional banners did not have a statistically significant effect on purchases. However, the study by Koutoukidis et al. (2019) occurred in a simulated online experiment, and it may be that for real-world purchasing decisions, other strategies need to be used in combination to enhance intervention effects, such as price discounts and vouchers (Golding et al., 2021; Hartmann-Boyce et al., 2018).

Alternatively, it could be that small sample sizes contributed to this null effect by reducing statistical power – yogurt banner click rates were towards the lower end of the expected range, while ice cream banner click rates were lower than expected. Sample sizes for the trial as a whole were towards the lower end (or below) of the expected range, and discussions with the Sainsbury's web team revealed that this may have been because customers often did not land on the homepage after logging into their Nectar loyalty membership scheme accounts (which was necessary for randomisation and inclusion in the trial). Therefore, part of our eligible sample was not included in this study, constituting a limitation of the current study.

Another limitation is that customer purchases were primarily assessed via the binary outcome of whether a customer bought anything from a particular category or not, which may have reduced sensitivity to detect

changes in total quantities of items purchased. This could explain why some intervention banners increased healthier product purchases and decreased standard product purchases, but did not significantly affect total calories purchased – it is possible that customers were purchasing more items instead.

A third limitation is that likelihood of purchasing recipe bundle ingredients was calculated from observed banner clicks (rather than estimated page views) as customers could only access recipe bundle product lists by clicking on the banners. However, this means that these analyses do not account for differences between trial arms in terms of banner clicks. These results should therefore only be interpreted in light of the analyses assessing likelihood of clicking. For example, as customers in the intervention arm were statistically significantly less likely to click on the fajitas recipe bundle banner than control customers, the results reported for this banner may overestimate the intervention's effects on purchases. Finally, while the Sainsbury's team confirmed that Nectar cardholders as a whole are representative of the UK population, we were not able to access detailed demographic information about the sample of participants in this study, and therefore cannot comment decisively about the generalisability of these findings.

A key strength of this research is the setting for this study. As the intervention was delivered live on the website of one of the UK's largest supermarket retailers, we were able to test the effect of these intervention strategies on consumers' actual shopping behaviour. In addition, a number of lessons were learned during the process, some of which were identified only at the end (see Lessons learned for future research) and some of which were identified and acted upon from the outset due to collaborative work between the teams at PHE and Sainsbury's. For example, the Sainsbury's team helped to identify seasonal time periods (e.g. school holidays and lead-up to Christmas) which may have impacted shopping behaviour. Avoiding these period helped to avoid implementing the trial at a time when the results may have been impacted by seasonality effects. Insights from Sainsbury's regarding how advertising space is booked by different brands also helped both organisations to collaborate and develop intervention materials that could feasibly be implemented without breaching the conditions of existing advertising contracts. The teams also worked closely together to identify a number of evidence-based intervention options that were also commercially acceptable to the retailer. Future research should build off these learnings, both those accounted for in the design of this trial and those uncovered at a later stage (detailed below in Lessons learned for future research). This will aid in the development of strong collaborations between organisations, and the design and implementation of robust evaluations of interventions.

## Lessons learned for future research

This trial was an ambitious project and provided an opportunity for the teams at PHE and Sainsbury's to collaborate and learn about each other's methods and ways of working. As a result of this project, a number of learnings for future trials of this kind have been identified that can help support future collaborations among retailers, academics and other stakeholders.

### Lesson 1: Account for the customer journey

Learnings about the customer journey through the Sainsbury's website were gained, which could be used to inform the design of future trials. As noted above, observed click rates were consistently towards the lower end of (or lower than) the projected ranges estimated during power calculations. This is because it was observed only at the end of the trial period that customers were often logging into their Nectar loyalty membership scheme accounts after visiting the homepage and then not returning to that page (where they would have been included and randomised). From this, we therefore recommend that future research teams examine customer journeys through these websites before implementation, in order to ensure that intervention and methodological design accommodate customer usage patterns.

### Lesson 2: Specify data availability

Another key learning was that it was not possible to obtain exact data regarding the number of trial participants who had visited the webpages for each banner (estimated webpage visits were used instead) and to match this with their purchase data, as originally planned. This would have helped in terms of better understanding customers' purchasing behaviour after exposure to the banners. Instead, likelihood of purchasing was calculated either from banner click rates (recipe bundles) or estimated page views (in-aisle banners), neither of which allow us to conclusively assess the impact of having viewed the intervention banners.

Both of these issues were only identified after the trial had ended. Due to the data protection arrangements in place at Sainsbury's, statisticians from PHE were only able to access data on-site, meaning that data could not be continually monitored for such issues. For future trials operating under similar requirements, we recommend (i) that mock-up versions of the available data are provided to statisticians and research teams in advance (in order to ensure that the type of data available will meet the needs of the analysis plan) and (ii) arranging interim visits to check

the data (including sample sizes) in order to identify any issues regarding participant recruitment throughout the trial.

## CONCLUSIONS

The findings of this trial suggest that promoting healthier products in online supermarkets can sometimes lead to healthier purchases by consumers, however, due to the limitations discussed above (particularly regarding small sample sizes and the use of estimated, rather than observed, page view data) further research is needed to confirm the effectiveness of this type of intervention. Nevertheless, the study provides a number of useful learnings for future research regarding establishing collaborations across sectors, including key learnings on feasibility, which could be of benefit to research teams working in partnership across retail, academic and public sector organisations.

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### CONFLICT OF INTEREST

Becky Shute, Zachary Willis, Bethan Tempest and Nilani Sritharan were all employees of J Sainsbury plc while this trial was underway. This research did not receive any additional funding and was conducted as part of business-as-usual activities for Sainsbury's and Public Health England.

### DATA AVAILABILITY STATEMENT

Data is not available due to it being of a commercially sensitive nature.

### ORCID

*Lucy Porter* https://orcid.org/0000-0001-8277-4138

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## SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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