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Food in the news: effects of exposure to information about ultra-processed vs. high in nutrients of concern foods on consumer perceptions and intake

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ABSTRACT

Media reporting of the associations between intake of ultra-processed foods (UPFs) and negative health outcomes has become common. The objective was to examine the impact of exposure to public facing information about UPFs on consumers in a laboratory experiment. In a mixed-design, we used a methodology that resulted in participants (N = 96: mean age = 46.28, 49 % female) being exposed to one of three mock news articles detailing: (1) the negative health outcomes associated with UPF consumption and its unnatural manufacturing process (UPF article); (2) the negative health outcomes associated with consumption of foods high in fat, salt or sugar (HFSS article); or (3) online food shopping trends (control article). Immediately after exposure to the news article, participants were given *ad-libitum* access to UPFs (which were also HFSS) and non-UPFs (which were also not HFSS). Intake of UPFs and non-UPFs, and ratings of disgust, naturalness, and pleasantness of UPFs and non-UPFs were measured after exposure to articles. Results showed that perception ratings and intake of UPFs and non-UPFs did not reliably differ between conditions. However, participants in the UPF and HFSS conditions reported that the article they were exposed to increased concerns of consuming both UPFs and HFSS foods (relative to the control) and there was some evidence that rated pleasantness of consumed UPF/HFSS foods was reduced. In conclusion, public facing information about UPFs (or HFSS foods) likely affects consumer perceptions and avoidance of UPFs/HFSS foods, but may not impact on immediate food intake.

1. Introduction

Ultra-processed food (UPF) is a term first introduced in 2009 as part of the NOVA classification system for food processing (Monteiro, 2009). NOVA characterises food items according to their level of industrial processing and UPFs are categorised as having the highest level of processing, being defined as food products which ‘are formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes’ (Monteiro et al., 2019). Monteiro and colleagues (2019) have proposed that a practical way to determine whether a food is a UPF, is by identifying whether the ingredients of a food contain substances or formulations that are not used in home cooking, such as artificial sweeteners or stabilisers.

UPFs have, for some time, made a relatively large contribution to many national diets, with the proportion of daily energy intake estimated to range from 15 % to 58 %, with the UK being at the higher end of this range at 56.8 % (Martini et al., 2021). A number of recent studies have linked consumption of UPFs with increased risk of a range of negative health outcomes, including obesity, heart disease, diabetes, cancer and early death (Lane et al., 2021, 2024; Pagliai et al., 2021), however the extent to which these associations reveal causality is debated (e.g., (Robinson & Jones, 2024)). Nevertheless, these findings have led to widespread news coverage, and public interest, of the potential risks associated with consuming UPFs (e.g. The Guardian (2024)). Although intake (or restriction) of UPFs is not included in national dietary guidance in the UK, in a recent nationally representative study, the majority of UK adults reported being aware of UPFs and reported considering whether a food is UPF when deciding whether to consume it (Robinson et al., 2024). However, no research we are aware of has examined the effect that exposure to public facing information about UPFs may have on dietary choice and intake.

One reason why UPFs may attract a significant public interest is because this way of classifying foods differs to traditional ‘nutrient-based’ models of food classification (Dicken et al., 2024). Much national dietary guidance and nutrition policy focuses on reducing consumption

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Abbreviations

BMI	(Body Mass Index)
UPF	(Ultra-processed food)
HFSS	(High in fat, salt or sugar)
FFQ	(food frequency questionnaire)
DEBQ	(Dutch Eating Behaviour Questionnaire)
PANAS	(Positive and negative affect schedule)
PME	(Perceived message effectiveness)

of foods high in nutrients of concern, such as fat, salt and/or sugar (HFSS) and has done so for some time (Department of Health and Social Care, 2023; NHS, 2022). Although many UPFs are relatively high in fat, salt and/or sugar (Kesaite et al., 2024), UPF status is not determined by a food's nutritional composition but instead primarily focuses on level of processing. What is less clear is whether public facing information about food processing has a different psychological impact on consumers than traditional public health messaging focusing on foods' nutritional profiles. Given growing use of the term UPF in mainstream media (Russell et al., 2024), understanding potential impacts on the public is now of importance.

Public facing information about UPFs may decrease desire to consume foods classed as UPFs for multiple reasons. Firstly, as consumption of UPFs is associated with negative health outcomes, public awareness of the links between UPF consumption and negative health outcomes may decrease consumption of UPFs. This reasoning is consistent with the Health Belief Model which suggests that perceptions of risk determine likelihood of engaging in behaviour (Green et al., 2020). Yet, this potential mechanism would not be specific to food processing, as consumption of foods high in nutrients of concern (e.g., HFSS foods) is also associated with a range of negative health outcomes (Barrett et al., 2024).

Public facing information which includes the description of the industrial processing involved in the production of UPFs may also affect consumer behaviour. The key distinction between processing vs. nutrient approaches to food classification is that UPFs are characterised by being highly industrially processed, and so by their very nature are artificial and 'unnatural'. Humans show a preference towards 'naturalness' (Rozin et al., 2004) and a food's degree of 'naturalness' can be markedly reduced when a food is perceived to be contaminated via chemical or physical transformations, such as processing (Rozin, 2005). Furthermore, consumers are thought to associate unnatural contaminations with feelings of disgust (Egolf et al., 2019) and disgust tends to have a strong negative impact on food evaluations (Egolf et al., 2018). For example, cultured foods (foods created using cell and tissue culture) are perceived by some as being unnatural and disgusting (Herziger, 2024; Siegrist & Hartmann, 2020), which can in turn reduce their acceptance to consumers (Herziger, 2024). This line of reasoning suggests that public facing information about UPFs could have a marked effect on consumer perceptions and cause avoidance of foods, which traditional public health messaging about the nutritional composition of foods would be hypothesised not to have.

Although there are growing calls for public health nutrition policy to address food processing, there is a lack of evidence on the impact that public facing information about UPFs vs. more traditional messaging based on nutrients (such as HFSS), have on consumer behaviour. In the present study, we examined the impact that public facing information about UPFs (vs. HFSS foods and vs. a control condition) has on food intake and sensory perceptions of food. In a baseline session, measurements of food intake and sensory ratings of snack foods (consisting of both UPF/HFSS and non-UPF/HFSS foods) were taken after exposure to a non-food related news article. In a second session, the same participants were randomised to one of three experimental conditions. In one condition, participants read a news article outlining the definition of UPFs, information about food processing, examples of UPFs, their less healthy macronutrient profile and associated health risks (UPF article). In another condition, participants read a matched article, which instead focused on HFSS foods, listing examples of these foods, and describing their macronutrient profile and associated health risks (but not their levels of processing) (HFSS article). In a third condition, participants read a neutral article unrelated to food processing, nutrition or health (control article). After exposure to news articles, participant food intake and ratings of the sensory characteristics of snack foods were again measured.

We hypothesised that, relative to the control condition, both UPF and HFSS-based public facing information would decrease consumption of foods classed as UPF/HFSS. We also hypothesised that due to humans' apparent tendency to avoid, and be disgusted by, artificially transformed 'unnatural' substances, UPF information would affect acceptability of UPFs (i.e., reduced pleasantness and naturalness, increased disgust) and further decrease their consumption (relative to HFSS information).

2. Method

2.1. Participants

Participants were recruited through online advertisements (i.e., social media) and word-of-mouth between June 2024 and September 2024. We powered the study to detect a small-moderate within (session: baseline vs. experimental) * between (condition: UPF, HFSS, control) subject's interaction effect of $f = 0.175$ (indicative of a small-to-moderate effect), using an alpha level of $p < .05$ and 80 % power, resulting in a required $N = 57$. Due to uncertainty over a likely effect size, we increased our planned sample size up to $N = 100$. The sample was stratified by gender (50:50), and student status (capped at 10 %) to reflect UK demographics. To take part, participants had to be a UK resident, able to attend laboratory visits on campus in Liverpool, be aged 18 or above, have a BMI between 18.5 and 32.5, be proficient in English, and declare willingness to eat each test food. Individuals could not participate if they were using medication which affects appetite, were pregnant, had a current or previously diagnosed eating disorder, were currently on a diet, had any food allergies or intolerances, or had any other restrictions relating to the test foods (e.g., were on a vegan diet). The study was approved by the University of Liverpool Institute of Psychology, Health and Society Research Ethics Committee (ethics reference number: 6154). The study methodology and analysis plan were pre-registered on the Open Science Framework https://osf.io/dv5jw/

2.2. Design

The study used a mixed design with a within-subjects independent variable of session (baseline, experimental) and a between-subjects independent variable of condition (control, HFSS, UPF). There was a washout period of at least one week between sessions. Participants were randomly allocated to their condition via Qualtrics and researchers were blinded to condition allocation.

2.3. Measures and materials

News articles: Participants were given 3 minutes to read the news article, and were then given an additional 3 minutes to answer questions directly related to the news article (the article was not present during this time). In the baseline session, participants were exposed to a news article on the topic of working from home. In the experimental session, participants were randomly allocated to be shown one of three news articles. The UPF news article was based on UK news coverage and popular media relating to UPFs and research linking UPFs to health outcomes. Specifically, it outlined what UPFs are (with a focus on industrial processing), the negative health effects associated with consumption of UPFs, and examples of UPFs. The HFSS article was matched to be the same length and use similar language; it outlined what HFSS foods are, the negative health effects associated with consumption of HFSS foods, and examples of HFSS foods. The example foods (and images) listed in the UPF and HFSS articles were identical, as we selected foods that were classed as both UPF and HFSS. The control condition news article was matched for length to the other articles and outlined online grocery shopping trends, and examples of foods ordered online, but did not detail these foods in relation to processing, nutrition or health. See supplementary materials for all articles in full.

Participants were asked to name the example foods listed in their article. We used this question as an explicit attention check – if participants were unable to name a food listed in their article, they were excluded from all analyses on the basis of not having followed study instructions.

Ad-libitum taste test: We used a validated snack food intake measurement (Robinson et al., 2017). Participants were given 10 min to rate four test foods (carrot batons and grapes [non-HFSS/UPF], tortilla chips and chocolate chip cookies [HFSS/UPF]) on sweetness, saltiness, pleasantness, disgust, crunchiness, and naturalness, on a 100-point visual analogue scale with anchors '0 - Not at all' and '100 – Extremely'. Participants were instructed to consume as much of the foods as desired and to help themselves to the test foods once they had completed ratings.

Demographic measures: Participants reported their age, gender, ethnicity, and highest educational qualification. See supplementary materials for frequency counts of ethnicity and highest educational qualification.

Positive and Negative Affect Schedule (PANAS; (Watson et al., 1988)*) and hunger ratings*: The PANAS consists of two 10-item subscale measuring positive and negative affect on a 5-point scale from 1 ('Not At All') to 5 ('Very Much'). Hunger was also rated using the same response format.

Body Mass Index (BMI): This was calculated from measured weight (kg)/height (m)^2.

End-of-study-questionnaires: At the end of the experimental session, participants completed the following measures:

Aim guessing: Participants were asked what they believe the study aims were (free-text).

Food frequency questionnaire (FFQ): Participants were asked to report how frequently they consumed each of the taste test foods using a validated food frequency questionnaire (Riboli et al., 2002). Response options were: 1 = Never, 2 = Less than once per month, 3 = 1–3 times per month, 4 = Once a week, 5 = 2–4 days per week, 6 = Once a day or more.

*Prior experience of UPFs and HFSS foods – taken from (*Robinson et al., 2024*):* Participants were asked whether they had heard of ultra-processed food and whether they had heard of foods high in fat, salt and/or sugar. Response options were: Unsure; No; Yes. Participants were also asked whether they consider whether a food is ultra-processed and whether a food is high in fat, salt, and/or sugar when deciding whether to eat it (Response options: Unsure; No; Yes – I try to avoid eating ultra-processed foods/foods that are high in fat, salt and/or sugar; Yes – I never eat any ultra-processed foods/foods that are high in fat, salt and/or sugar; Yes – I try to eat ultra-processed foods/foods that are high in fat, salt and/or sugar; Yes – I only ever eat ultra-processed foods/foods that are high in fat, salt and/or sugar).

*Perceived message effectiveness (PME) – adapted from (*Baig et al., 2019*) :* Participants were asked to what extent the article they were shown, made them feel discouraged from wanting to consume UPFs/HFSS foods, concerned about the health effects of UPFs/HFSS foods, and that consuming UPFs/HFSS foods seems unpleasant. Questions were asked separately for UPFs and HFSS foods. Response options were: Very slightly or not at all, A little, Moderately, Quite a bit, Extremely. The mean score across the items was used for the outcome. Internal reliability of PME was good for both the UPF items ($\omega_t = 0.90$) and for the HFSS items ($\omega_t = 0.90$).

*Dutch Eating Behaviour Questionnaire – restraint subscale (DEBQ; (*Van Strien et al., 1986*)):* Participants completed the restraint subscale of the DEBQ, consisting of ten items. Response options were: Never, Seldom, Sometimes, Often, Very Often. The scale showed good internal reliability ($\omega_t = 0.93$).

2.4. Procedure

Sessions were completed in a laboratory setting at the University of Liverpool. Sessions started between 10:45 and 16:30 and the two sessions were at least one week apart from each other and were held at the same time of day. A cover story was used to blind participants to the true aims of the study – participants were told that the study was investigating the effect of fasting on mood and taste perception. Participants were told that for the first session, they were required to abstain from eating for at least 2 h, as is considered best practice in laboratory eating behaviour research (Robinson et al., 2018). Participants were also told that in the second session, they would be asked to either consume a meal immediately before the session, or to abstain from eating for at least 2 h prior to the session. In actuality, there was no manipulation, and all participants were asked to abstain from eating for at least 2 h in the second session. For the first (baseline) session, participants gave informed consent and completed inclusion criteria checks along with demographic measures, and PANAS and hunger ratings. Next, participants were informed that there would be a short delay, due to the researcher needing to prepare the test food, and asked whether they could complete a news literacy task unrelated to the current study (all participants agreed to this in both sessions). At this point, participants were presented with the news article task. Upon completion of this task, the researcher returned with the test foods and the participant completed the taste test. Participants then completed a new set of PANAS and hunger ratings, and were informed that, prior to the second session, they should abstain from eating for at least 2 h. For the second (experimental) session, compliance with study instructions (i.e., abstaining from eating) was checked and participants completed the first PANAS and hunger ratings. As in the first session, participants were then asked to complete the news literacy task again and were randomized to one of the three conditions (UPF, HFSS, control). Participants next completed the taste test, a PANAS and hunger ratings, and the end-of-study questionnaires. Participants were then debriefed and compensated for their time.

2.5. Data analysis

2.5.1. Primary analyses

Food intake: Mixed 2 x (session: baseline, experimental) x 3 (condition: UPF, HFSS, Control) ANOVAs were conducted on food intake (in grams) for UPF/HFSS foods and non-UPF/non-HFSS foods.

Ratings of UPF/HFSS foods: Mixed 2 x (session: baseline, experimental) x 3 (condition: UPF, HFSS, control) ANOVAs were conducted on pleasantness ratings, naturalness ratings, and disgust ratings of the UPF/HFSS foods and the non-UPF/non-HFSS foods.

Mood and hunger ratings: Conducted only for ratings obtained in the experimental session, mixed 2 x (time: pre-taste test, post-taste test) x 3 (condition: control, HFSS, UPF) ANOVAs were conducted on PANAS ratings (separately for positive affect and negative affect), hunger ratings, and disgusting ratings (single item taken from the PANAS).

Perceived message effectiveness: One-way ANOVAs were conducted to test whether mean scores of perceived message effectiveness for UPF foods and HFSS foods separately, differed based on the article condition.

2.5.2. Sensitivity analyses

We examined if results remained the same when participants who correctly guessed the aims of the study were removed from all analyses.

3. Results

In total, 104 participants completed both sessions. Eight participants failed the attention check, resulting in a final analytic sample size of 96. See Table 1 for participant characteristics.

3.1. Food intake

UPF/HFSS: Two 2 (session: baseline, experimental) x 3 (condition: control, HFSS, UPF) ANOVAs were conducted on the number of grams consumed for the two food types. For UPF/HFSS intake, there was a significant main effect of session $F(1,93) = 19.60$, $p < .001$, $\eta p^2 = 0.174$, whereby intake was greater in the experimental session (mean = 43.63g, SD = 28.80) compared with the baseline session (mean = 33.31g, SD = 18.28, d = 0.46). There was a non-significant session × condition interaction $F(2,93) = 0.18$, $p = .832$, $\eta p^2 = 0.004$, and a non-significant main effect of condition $F(2,93) = 0.67$, $p = .516$, $\eta p^2 = 0.014$.

Non-UPF/HFSS: There were non-significant main effects of session $F(1,93) = 1.02$, $p = .316$, $\eta p^2 = 0.011$ and condition $F(2,93) = 1.86$, $p = .161$, $\eta p^2 = 0.039$, and a non-significant session × condition interaction effect $F(2,93) = 0.94$, $p = .396$, $\eta p^2 = 0.020$.

See Table 2 and Fig. 1 for food intake data by condition.

Due to the non-normal distribution of food intake, the analyses were conducted again after transforming the food intake values, using log10 transformation. The statistical significance of findings remained unchanged (see supplementary materials for results).

Table 1

Participant characteristics and hunger ratings, split by condition – mean ± standard deviation or frequency count is reported unless otherwise stated. For FFQ outcomes, the mode is reported in addition to the mean and standard deviation.

	UPF (n = 30)	HFSS (n = 32)	Control (n = 34)	Total Sample (n = 96)
Age (years)	47.77 ± 18.91	47.13 ± 17.70	44.18 ± 17.03	46.28 ± 17.74
Gender (Male:Female: Non-binary)	15:15:0	16:15:1	17:17:0	48:47:1
BMI (kg/m^2)	25.28 ± 4.41	26.49 ± 4.47	25.96 ± 4.25	25.92 ± 4.36
Ethnicity (white:not white)	28:2	27:5	25:9	80:16
Education level (degree: no degree)	19:11	19:13	21:13	59:37
Dietary restraint (out of 5)	2.56 ± 0.78	2.99 ± 0.73	2.56 ± 0.83	2.70 ± 0.80
FFQ – Cookies (mode)	2.80 ± 1.13 (3)	2.88 ± 1.36 (2)	3.18 ± 1.57 (3,4)	2.80 ± 1.13 (2)
FFQ - Crisps and Tortilla Chips (mode)	3.67 ± 1.12 (5)	3.53 ± 1.32 (4)	3.41 ± 1.37 (2,5)	3.67 ± 1.12 (4,5)
FFQ - Carrot Sticks (mode)	2.67 ± 1.24 (2)	2.75 ± 1.37 (3)	3.38 ± 1.33 (4)	2.67 ± 1.24 (2)
FFQ – Grapes (mode)	3.50 ± 1.23 (1,2)	4.00 ± 1.24 (5)	3.79 ± 1.37 (5)	3.50 ± 1.23 (5)
Hunger ratings (baseline session – pre-taste test)	2.77 ± 1.07	2.66 ± 0.97	2.68 ± 1.27	2.70 ± 1.11
Hunger ratings (baseline session – post-taste test)	1.70 ± 1.06	1.44 ± 0.62	1.44 ± 0.82	1.52 ± 0.85
Hunger ratings (experimental session – pre-taste test)	2.93 ± 1.08	3.00 ± 1.22	3.38 ± 0.99	3.11 ± 1.10
Hunger ratings (experimental session – post-taste test)	1.80 ± 0.81	1.50 ± 0.72	1.59 ± 0.89	1.63 ± 0.81

BMI = body mass index, FFQ = food frequency questionnaire, scored from 1 to 6: 1 = Never, 2 = Less than once per month, 3 = 1–3 times per month, 4 = Once a week, 5 = 2–4 days per week, 6 = Once a day or more. Hunger ratings were scored on a 1–5 scale.

3.2. Pleasantness ratings

UPF/HFSS: There was a non-significant main effect of session $F(1,93) = 2.27$, $p = .135$, $\eta p^2 = 0.024$, non-significant session × condition interaction $F(2,93) = 2.94$, $p = .058$, $\eta p^2 = 0.059$, and a non-significant main effect of condition $F(2,93) = 1.29$, $p = .279$, $\eta p^2 = 0.027$. The statistical significance of the interaction differed when participants who failed an attention check were excluded (see unplanned analysis section below).

Non-UPF/HFSS: There was a non-significant main effect of session $F(1,93) = 0.77$, $p = .383$, $\eta p^2 = 0.008$, a non-significant session × condition interaction $F(2,93) = 1.64$, $p = .200$, $\eta p^2 = 0.034$ and a non-significant main effect of condition $F(2,93) = 1.66$, $p = .196$, $\eta p^2 = 0.034$.

3.3. Naturalness ratings

UPF/HFSS: There was a non-significant main effect of session $F(1,93) = 3.10$, $p = .082$, $\eta p^2 = 0.032$, a non-significant session × condition interaction $F(2,93) = 0.347$, $p = .708$, $\eta p^2 = 0.007$ and a non-significant main effect of condition $F(2,93) = 0.07$, $p = .935$, $\eta p^2 = 0.001$.

Non-UPF/HFSS: There was a non-significant main effect of session $F(1,93) = 0.13$, $p = .717$, $\eta p^2 = 0.001$, session × condition interaction $F(2,93) = 0.63$, $p = .535$, $\eta p^2 = 0.013$, and a non-significant main effect of condition $F(2,93) = 1.74$, $p = .181$, $\eta p^2 = 0.036$.

3.4. Disgusting ratings

UPF/HFSS: There was a significant main effect of session $F(1,93) = 5.46$, $p = .022$, $\eta p^2 = 0.055$, whereby disgust ratings were greater in the second session (mean = 23.21, SD = 37.99) compared with the baseline session (mean = 15.78, SD = 26.48, d = 0.24). However, there was no significant session × condition interaction $F(2,93) = 1.13$, $p = .328$, $\eta p^2 = 0.024$, or main effect of condition $F(2,93) = 0.13$, $p = .876$, $\eta p^2 = 0.003$.

Non-UPF/HFSS: There was also a significant main effect of session $F(1,93) = 4.54$, $p = .036$, $\eta p^2 = 0.047$, where ratings were greater in the experimental session (mean = 16.23, SD = 26.69) compared with the baseline condition (mean = 11.21, SD = 21.71, d = −0.21). However, there was no significant session × condition interaction $F(2,93) = 1.38$, $p = .257$, $\eta p^2 = 0.029$, or main effect of condition $F(2,93) = 1.01$, $p = .368$, $\eta p^2 = 0.021$.

See Table 2 for pleasantness, naturalness and disgust ratings.

3.5. Perceived message effectiveness (PME)

In analyses examining the effect of article condition on perceived message effectiveness scores relating to UPFs, there was a significant effect $F(2,93) = 15.35$, $p < .001$, $\eta p^2 = 0.248$. Scores were significantly greater in the UPF condition (mean = 3.63, SD = 0.85) compared with the control condition (mean = 2.15, SD = 1.43, $p < .001$) but did not significantly differ with those in the HFSS condition (mean = 3.43, SD = 1.14, $p = .492$). Scores in the HFSS condition were also significantly greater than scores in the control condition ($p < .001$).

Similarly, in analyses examining the effect of article condition on perceived message effectiveness scores relating to HFSS foods, there was a main effect of condition $F(2,93) = 13.95$, $p < .001$, $\eta p^2 = 0.231$. Scores in the HFSS condition were significantly greater (mean = 3.34, SD = 1.14, $p < .001$) than scores in the control condition (mean = 2.03, SD = 1.30). Scores were also significantly greater in the UPF condition (mean = 3.32, SD = 0.99) compared with the control condition ($p < .001$). The HFSS and UPF conditions did not significantly differ ($p = .942$). See

Table 2
Means and standard deviations of food intake (grams) and sensory ratings of food (scored out of 200), split by condition, food type (UPF/non-UPF), and session. Naturalness, Pleasantness and Disgust ratings were scored out of a total of 200 (due to two foods being rated).

	UPF (n = 30)	HFSS (n = 32)	Control (n = 34)	p-value of condition × session interaction effects
UPF food consumed – baseline session (grams)	32.19 ± 17.61	35.87 ± 21.47	31.89 ± 15.69	p = .832
UPF food consumed – experimental session (grams)	41.79 ± 23.88	48.17 ± 37.90	40.98 ± 22.52	
Non-UPF food consumed – baseline session (grams)	84.28 ± 37.38	104.50 ± 49.59	95.06 ± 52.66	p = .396
Non-UPF food consumed – experimental session (grams)	91.93 ± 35.82	113.13 ± 53.66	91.35 ± 57.17	
UPF Pleasantness ratings – baseline session	138.27 ± 41.50	148.41 ± 36.27	145.65 ± 35.77	p = .058
UPF Pleasantness ratings – experimental session	129.50 ± 41.84	138.50 ± 42.76	151.09 ± 36.37	
UPF Naturalness ratings – baseline session	37.40 ± 37.64	42.56 ± 46.48	35.65 ± 46.31	p = .708
UPF Naturalness ratings – experimental session	32.23 ± 38.93	30.94 ± 34.39	31.44 ± 38.47	
UPF Disgust ratings – baseline session	18.87 ± 28.65	13.81 ± 27.27	14.91 ± 24.20	p = .328
UPF Disgust ratings – experimental session	21.93 ± 32.29	27.84 ± 48.41	19.97 ± 31.69	
Non-UPF Pleasantness ratings – baseline session	146.53 ± 29.07	146.78 ± 35.90	157.26 ± 30.43	p = .200
Non-UPF Pleasantness ratings – experimental session	137.50 ± 33.77	151.47 ± 34.70	153.50 ± 33.26	
Non-UPF Naturalness ratings – baseline session	169.80 ± 54.21	161.84 ± 48.77	185.85 ± 35.20	p = .535
Non-UPF Naturalness ratings – experimental session	175.73 ± 43.18	171.97 ± 53.01	177.59 ± 49.96	
Non-UPF Disgust ratings – baseline session	12.70 ± 24.84	11.22 ± 21.91	9.88 ± 18.96	p = .257
Non-UPF Disgust ratings – experimental session	20.80 ± 32.25	19.16 ± 30.16	9.44 ± 14.40	

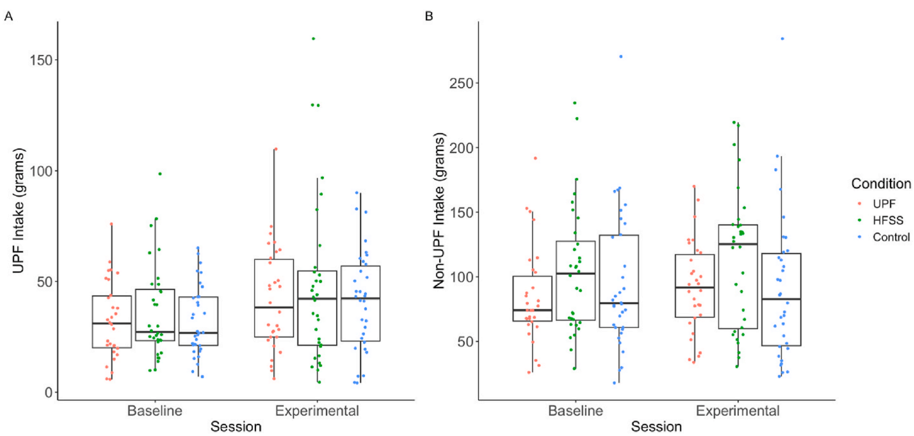

Fig. 1. Panel A) UPF intake by condition. Panel B) Non-UPF intake by condition.

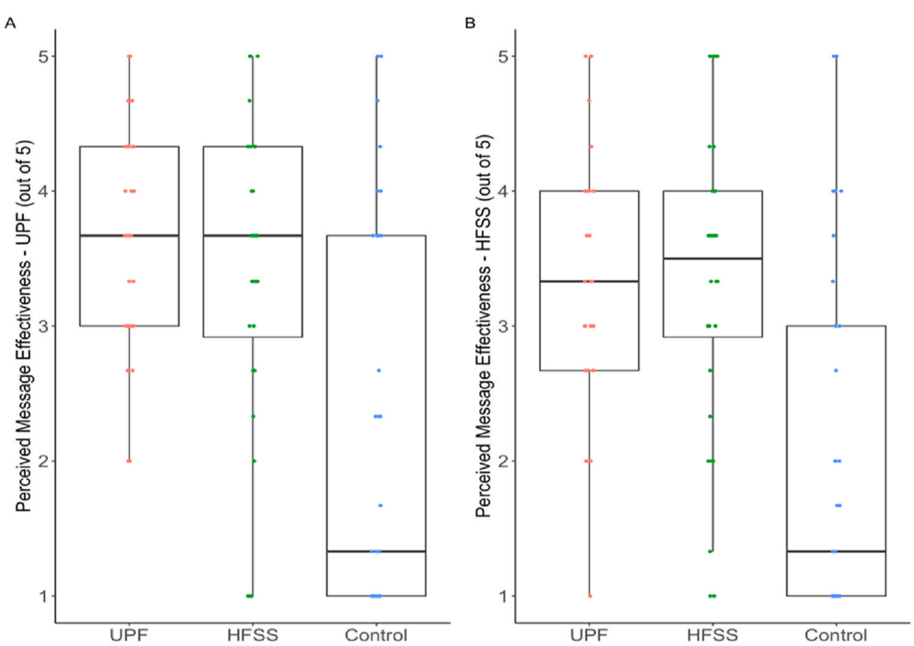

Fig. 2. Panel A) Average scores on perceived message effectiveness measure for UPFs, split by condition. Panel B) Average scores on perceived message effectiveness measure for HFSS foods, split by condition.

Fig. 2 for graphical representation of data.

Due to the non-normal distribution of perceived message effectiveness scores, these analyses were conducted again after transforming the PME average scores, using log10 transformation. The statistical significance of these findings remained unchanged (see supplementary materials for results).

3.6. End of study questionnaire

The majority of participants reported having heard of the terms UPF (88 %) and HFSS (89 %). It was also common for participants to report that when making food choices, they think about whether a food is UPF (72 %) or HFSS (82 %). See supplementary materials for data in full.

3.7. Sensitivity analyses

Excluding participants who guessed the aims ($N = 6$) or whose BMI was outside of the range defined in the eligibility criteria ($N = 6$), did not affect the statistical significance of analyses directly related to the study objectives. See supplementary materials for full details.

3.8. Unplanned analyses

We also ran all analyses with the inclusion of the eight participants who failed the attention check. The statistical significance changed for the following analyses: For pleasantness ratings of UPF foods, the session × condition interaction effect became significant: $F(2,101) = 4.98$, $p = .009$, $\eta p^2 = 0.90$. Breaking this interaction down with paired samples t-tests, pleasantness ratings of UPF foods were significantly lower in the experimental session than in the baseline session for participants in the UPF condition $t(35) = 2.48$, $p = .018$, $d = 0.41$ and the HFSS condition $t(33) = 2.53$, $p = .016$, $d = 0.43$, but not in the control condition $t(33) = -1.53$, $p = .136$, $d = -0.26$. For disgusting ratings of non-UPF foods, the main effect of session became non-significant $F(1,101) = 2.08$, $p = .152$, $\eta p^2 = 0.20$.

Outliers on food intake were examined through inspection of boxplots. This identified three outliers for the UPF food intake analysis, and four outliers for the non-UPF food intake analysis. Removal of these outliers did not affect the statistical significance of the primary analyses.

3.9. Bayesian analyses

Due to lack of statistically significant effects in support of hypotheses (e.g., food intake), we performed Bayesian analyses to determine the level of evidence for the alternative and null hypotheses, for all analyses. None of the non-significant findings presented moderate or strong support for the alternative hypothesis, as Bayes factors ranged from $BF_{10} = 1.83$ (negligible-to-weak evidence for the alternative hypothesis) to $BF_{10} = 0.01$ (moderate evidence in favour of the null hypothesis). See supplementary materials for further details.

4. Discussion

The present laboratory study investigated whether public facing information about UPFs affects perceptions and intake of food. We found no evidence that exposure to this specific type of information relating to food processing affected food ratings (pleasantness, disgust, naturalness) or intake for test foods that were both UPF and HFSS or foods that were neither UPF nor HFSS. In a condition in which participants were exposed to matched public facing information about food and health which focused on food nutrients rather than processing (HFSS foods), we also found no evidence that exposure affected food intake.

Exposure to public facing information about UPFs resulted in participants reporting lower desires to consume, and greater concerns and avoidance of, UPFs and HFSS foods. Similarly, exposure to public facing information about HFSS also produced a similar pattern of results for both UPFs and HFSS foods. We also found some evidence that rated pleasantness of consumed UPF/HFSS foods was reduced after exposure to public facing information about UPF and HFSS foods, but statistical significance depended on exclusion of participants who failed an attention check. Consistent with the Health Belief Model (Green et al., 2020), these findings suggest that exposure to public facing information about the health risks of foods, based on their level of processing or their nutrient profile, affected perceptions of foods to a similar degree. Instead, information about food-related health risks, whether processing or nutrient focused, appears to have acted as a perceived non-specific deterrent to consuming foods associated with health risks (e.g., both UPF and HFSS).

The lack of differential effects of exposure to public facing information about UPF vs HFSS foods may now warrant further investigation. There is an ongoing debate as to whether the concept of UPF should be incorporated into dietary guidelines or whether existing dietary policy which relies on a nutrient-based approach to identifying 'unhealthy' foods should be retained (Gibney et al., 2017; Messina et al., 2022). Therefore, further research understanding whether public health messaging based on food processing, produces similar or different effects on consumers to existing nutrition public health messaging should be investigated in the future.

We predicted that exposure to information about UPFs would result in lower food intake, reduced naturalness, and greater levels of disgust towards UPFs, as previous research has demonstrated that perceiving a food as being unnatural is associated with disgust towards that food (Herziger, 2024; Siegrist & Hartmann, 2020), which in turn can affect consumption behaviour (Herziger, 2024). One explanation for these hypotheses not being confirmed, may relate to participants' existing attitudes towards UPFs. Firstly, 88 % of participants reported being aware of UPFs and 70 % reported already avoiding consuming UPFs. These findings are consistent with recent research which found a high level of awareness and avoidance of UPFs by UK consumers (Robinson et al., 2024). We therefore assume that in the present study, most participants had existing knowledge about UPFs and, possibly, the negative effects associated with them. As acceptance towards a food is associated with its level of familiarity (Onwezen et al., 2021), many participants who were familiar with the test foods may had possessed a high level of acceptance for the test foods, meaning that the articles had a minimal impact on perceptions of these foods, as well as food intake. Future research may benefit from investigating whether previous experience and knowledge of UPFs moderate the influence of public facing UPF information on eating behaviour.

The observed lack of impact that both HFSS and UPF information had on food intake may also be due to methodological factors. Participants were exposed to a single news article outlining definitions, associated health effects and example food products (which included foods used in the taste test), whereas more prolonged exposure may have a larger effect on consumer behaviour. This is a limitation of the present research because media exposure in real life may occur repeatedly over time. Future studies examining the impact of prolonged exposure to messaging are therefore warranted and may produce different results. We also examined food intake during a single eating occasion and due to the taste test procedure, participants were required to consume at least a small amount of UPF/HFSS and non-UPF/non-HFSS test foods. If participants had the choice to abstain from eating foods, it is plausible that there may have been stronger effects of the HFSS and/or UPF news articles on intake behaviour, as feelings of disgust towards a food is negatively associated with willingness to try that food (Herziger, 2024). Immediate measurement of outcomes and a lack of further follow-up is a limitation of the present study. Future research would therefore benefit from examining the impacts of repeated media exposure and using repeated outcomes assessments over time. Given the present study was laboratory based, future research may also benefit from examining the impact on consumer behaviour in naturalistic settings.

Whilst we based the UPF news article on existing public facing information, we did not formally test believability of the news articles in the study. It is possible that some participants did not believe the content of the news article, as mistrust of news is increasing globally (Park et al., 2020). We did, however, find that participants reported that the news article made them want to avoid consuming UPF/HFSS foods (through the measure of perceived message effectiveness), which suggests that the news articles were taken seriously, and were effective as an experimental manipulation. We did not formally record whether participants considered the taste test foods used, to be UPF or HFSS and this would be preferable in future research.

Although our sample was balanced for gender and diverse in age, it was predominantly white and included more people with higher education qualifications (see Table 1). It will therefore be important for future research to use larger and more diverse samples, examine whether findings generalise to other participant groups and cultural contexts. Strengths of the study include the use of a detailed cover story, resulting in very few participants being aware of the study aims, reducing the likelihood that results are affected by demand characteristics (Kersbergen et al., 2019). Additionally, we included attention checks to ensure that only participants who could recall UPF/HFSS foods discussed in news articles (i.e., those used in the taste test), were included in analyses.

The present study may have real-world implications. Findings highlight the likelihood that exposure to news and media about UPF are likely to increase concerns over consuming UPFs. However, questions remain over the usefulness of advising the general public to limit its consumption of UPFs (Robinson & Johnstone, 2024), in part due to the mechanistic uncertainty regarding the link between UPFs and negative health outcomes (Robinson & Jones, 2024). Further research understanding how consumers respond to information about UPFs may now be valuable.

5. Conclusions

The present study suggests that public facing information about UPFs (or HFSS foods) likely affects consumer perceptions and avoidance of UPFs/HFSS foods, but may not impact on immediate food intake.

CRediT authorship contribution statement

Thomas Gough: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jenna R. Cummings:** Writing – review & editing, Writing – original draft, Conceptualization. **Rebecca Evans:** Writing – review & editing, Writing – original draft, Validation, Conceptualization. **Scott Hill:** Writing – review & editing, Project administration, Methodology. **Andrew Jones:** Writing – review & editing, Supervision, Conceptualization. **Eric Robinson:** Writing – review & editing, Validation, Formal analysis, Conceptualization.

Ethics

The study was approved by the University of Liverpool Institute of Psychology, Health and Society Research Ethics Committee (ethics reference number: 6154).

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Declaration of competing interest

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

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2025.108217.

Data availability

Data are available on the OSF: https://osf.io/dv5jw/

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