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Nudging towards sustainable dining: Exploring menu nudges to promote vegetarian meal choices in restaurants

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A B S T R A C T

Food choice behavior plays a large role in achieving sustainability goals. Meat in particular has a negative environmental impact as compared with plant-based food – and is more frequently chosen in restaurant contexts. To increase plant-based meal choices in restaurants, we tested three nudges for menus that are likely to be implemented by restaurant owners: a hedonic label (e.g., *artisanal* vegetable burger), a chef's recommendation (specifying the vegetarian option as the chef's favorite), and a salience nudge (a box around the vegetarian option). In an online experiment, we showed participants ($n = 513$) in four conditions (no nudge, hedonic label, chef's recommendation, and salience nudge) five menus with four meal options each, one of which was vegetarian. We asked participants to choose a meal and subsequently to rate these meals on how tasty and indulgent they were (taste and indulgence attributions). We then revealed which nudge was used to the participants and asked how participants received it. Results show that the hedonic label and chef's recommendation nudge (but not the salience nudge) both increase vegetarian meal choices. The hedonic label increased participants' attributions of indulgence of the meal, but not of tastiness. This finding fits with restaurants' gastronomic, pleasure-seeking context and shapes future directions of labeling interventions, namely that indulgence attributions can be increased in vegetarian foods. Furthermore, the nudges were generally well accepted and participants' intention to return to the (virtual) restaurant was high. Finally, customers expected the hedonic label nudge to be more effective in promoting vegetarian food choices than the other two nudges, partially corresponding with our findings of actual effectiveness.

1. Introduction

1.1. Sustainable food choice

Food choice behavior is crucial for achieving sustainability goals in relation to climate change mitigation (Intergovernmental Panel on Climate Change [IPCC], 2023). Food-related greenhouse gas emissions add up to 26% of total greenhouse gas emissions (Poore & Nemecek, 2018) and about 44% of this number are directly associated with consumer choices (IPCC, 2023). While a complete global shift to vegetarianism is unlikely in the short term, because eating meat is strongly ingrained culturally (Biermann & Rau, 2020; Leroy & Praet, 2015), moving towards sustainable food choices is imperative to combat climate change. Next to being an important source of greenhouse gas emissions, meat production requires a higher amount of fresh water (Mekonnen & Hoekstra, 2012) and significantly contributes to deforestation (Godfray et al., 2018). Plant-based foods have much less consequences for the environment: moving from a meat-based diet to plant-based diet would reduce greenhouse gas emissions significantly. An estimation by Tilman and Clark (2014) reports a possible halving of food production related greenhouse gas emissions when vegetarianism would be adopted globally, indicating the potential impact of promoting vegetarian food choices.

Measures to influence consumer food choice, such as mandatory vegetarian days in cafeterias or meat taxes, may involve binding sustainable choices. However, these types of measures risk reactance and backlash, decreasing the support for sustainable food choice (Lombardini & Lankoski, 2013), even when people are motivated to change their diet. A more promising approach lies in nudging (Thaler & Sunstein, 2008), because many decisions made about food intake are automatic (Wansink & Sobal, 2007). Making use of automatic processes, priming (Wilson et al., 2016), defaults (Bergeron et al., 2019; Campbell-Arvai et al., 2014) and social norms (Mollen et al., 2013) are therefore considered to be potentially effective ways of directing consumer choice towards more sustainable food choice. While sustainable food choice has multiple dimensions, in this study we focus on vegetarian food choice, as moving towards a plant-based diet is a large part of the food choice transition necessary to mitigate climate change (IPCC, 2023).

1.2. Nudging in the restaurant context

A particularly promising area to implement nudges is the restaurant

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context. This is because of two reasons. First, meat intake is relatively high in restaurants, and flexitarians more often eat meat in this context than in the home context (Biermann & Rau, 2020). This may be because taste and social function of meat consumption is valued more in restaurants than in a home context (Claessens et al., 2023). Research has demonstrated that the taste of meat is the most prominent reason for meat consumption (Bos & Keuchenius, 2021; Mullee et al., 2017). Second, and more importantly, a recent meta-analysis (Cadario & Chandon, 2019) revealed that nudging interventions focused on food choice in a restaurant context are generally more effective than those focusing on food choice in the home context (i.e., nudges that are in supermarkets). This is because food choices in a restaurant context are typically more individual choices than in a supermarket context, as they are more spontaneous and not influenced by considerations about family meals (Cadario & Chandon, 2019). Another reason for nudges being more effective in restaurants lies in the more limited number of food options in this context as compared with a supermarket setting where people shop for home meals. This makes it easier to implement a nudge, which is also reflected in the number of studies in the meta-analysis by Cadario & Chandon done in supermarkets (38) versus that in restaurants and cafeterias (261). Because in a restaurant food choice is determined by the available menu, interventions can focus specifically on the menu as a unique and powerful tool to steer behavior towards more sustainable food choices (Filimonau & Krivcova, 2017; Wansink & Love, 2014). Different aspects of the menu can be altered; the menu item descriptions (e.g., Turnwald et al., 2019), the inclusion of additional information (e.g., Visschers & Siegrist, 2015), visual design (e.g., Feldman et al., 2011), or the location of the items on the menu (e.g., Dayan & Bar-Hillel, 2011; Langen et al., 2022). In view of these promising features, our research will examine effects of nudging sustainable choices in a restaurant setting by altering the presentations of food options in the menu.

We focus on three specific menu nudges: a hedonic label nudge, a chef's recommendation nudge, and a salience nudge. Our choice for these nudges is driven by considerations of impact and feasibility to implement. Specifically, acceptability of nudging interventions by restaurant owners and customers was a primary concern when choosing these three specific types of nudges. Results from co-creation sessions with restaurant owners revealed that these three nudges were considered to be the most suitable by restaurant owners (Regio Foodvalley, 2023). Below, we elaborate in detail on these three types of nudges.

1.2.1. Hedonic label nudge

The first nudge is the hedonic label nudge, which consists of a description emphasizing the taste features of a dish on the menu (e.g., *fresh seasonal* risotto primavera; Bacon & Krpan, 2018). Previous research attests of the effects of hedonic labels. Hedonic labels have proven effective in increasing sustainable food choices in a cafeteria setting (Ohlhausen & Langen, 2020) and university cafeterias (Turnwald et al., 2019). Hedonic labels (e.g., *sizzlin'* green beans) increased vegetable selection by 14% compared to basic labels, and even 29% when compared to health-focused labels (e.g., *nutritious* green beans) (Turnwald et al., 2019). In another series of studies, Turnwald and Crum (2019; cf. Turnwald et al., 2017) demonstrated a similar increase in vegetarian choices when comparing labels emphasizing tastiness to labels emphasizing the healthy features of food. For an overview of literature on the effectiveness of (hedonic) wording on food choice and taste attributions, see also Piqueras-Fiszman and Spence (2015). Based on a meta-analysis by Cadario and Chandon (2019), we expect the hedonic label menu, as a hedonic enhancement nudge, to have an effect size d of 0.32.

The effect of these hedonic labels may be explained by an increase of expectations that meals will taste fine. For example, it has been shown that food described with hedonic labels generated more positive comments and was rated as more appealing, tasty, and caloric compared to the same food that was unlabeled (Wansink et al., 2005). Similarly, in a study by Boles et al. (2022) a fruit-and-vegetable smoothie labeled as pleasurable (versus healthy) heightened both attributions of taste and the actual taste experience. The mediating mechanism of taste attributions was supported in a study by Turnwald et al. (2019), demonstrating that positive taste attributions fully mediate the relationship between the hedonic label and vegetable intake. These previous studies show the promise of hedonic labeling – especially over health-focused labeling in promoting sustainable food choices. However, to date, effects of hedonic labels on *vegetarian* food choices have not been tested.

Additionally, the exact nature of the positive attributions caused by the hedonic label is unclear. In previous studies, the effect of hedonic labeling nudges on two different attributions has been treated as highly similar: tastiness attributions were examined in studies by Turnwald et al. (2017, 2019), while Turnwald and Crum (2019) and Boles et al. (2022) focused on indulgence attributions of similar hedonic labels. While the concepts of tastiness and indulgence are related, they are not the same (see e.g., Boles et al., 2022, for a label that is indulgent but not tasty: "Crave - pleasure, indulgence, freedom"). We therefore suggest to distinguish between tastiness and indulgence by addressing both features. We argue that indulgence attribution may be a better explaining variable than taste attribution for the effect of hedonic labeling on food choice. Previous research by Claessens et al. (2023) and Biermann and Rau (2020) shows that hedonic motives like treating oneself are more important to people eating in a restaurant than at home, hinting that the underlying motive is not taste per se but rather indulging oneself.

1.2.2. Chef's recommendation nudge

The second nudge is a chef's recommendation on the menu, presenting the desired option as the chef's favorite. Several studies support the notion that a chef's recommendation may direct sustainable choices in a restaurant setting. For example, Bacon and Krpan (2018) found that a "chef's recommendation" was successful in increasing vegetarian menu choices, but only in participants with relatively high meat intake. However, it should be noted that in their study, the chef's recommendation was combined with making the recommendation more salient by bracketing. Another study found that customers chose a specific soup dish in a canteen labeled as the "suggestion of the chef' 1.7 times more often than when it was presented with the regular name (Broers et al., 2019). In other studies, promoting one dish as "Dish of the Day" lead to a large increase in the choice for that option (Perez-Cueto, 2021; Saulais et al., 2019). Importantly, our research suggests that restaurant owners were enthusiastic about this nudge because they deemed it authentic and implementable (Regio Foodvalley, 2023).

Literature is unclear about what type of nudge the chef's recommendation is. It has been suggested that it may either relate to a default effect (Broers et al., 2019), a salience effect (Bacon & Krpan, 2018), a social norm (Wansink & Love, 2014), or an authoritarian heuristic (Cialdini, 2003). Because of this, we took the most conservative approach for classifying the chef's recommendation in Cadario & Chandon's to obtain the expected effect size. Other plausible fits for the chef's recommendation nudge are the categories "healthy eating calls" ($d = 0.24$), and "hedonic enhancements" ($d = 0.32$). We argue that the chef's recommendation as we use it is not conceptually similar to the "visual enhancement" nudges as presented by Cadario and Chandon (2019) (e.g., food at eye-level, transparent containers, placed first on menus, or placed near the cash register), and therefore take the estimated effect size for an evaluative labeling nudge: $d = 0.17$.

1.2.3. Salience nudge

The third nudge is the salience nudge. Salience nudges consist of drawing attention to the relevant cue in order to achieve behavioural change, often used in restaurants by placing a box around certain food options on the menu. For example, placing boxes around healthy items in a menu affected food choice independently from a simple textual recommendation (Feldman et al., 2014). Effects of making food options more salient have been shown to be independent of taste preferences (Dai et al., 2020), Similarly, Bacon and Krpan's (2018) used a combined

nudge consisting of both a description ("chef's favorite") and graphical menu design in the form of a box that serves as an eye catcher (salience nudge) in their setup, which was successful in increasing vegetable food choice. Lastly, increasing the salience of a healthy buffet by using footprint stickers on the floor had a small positive effect on healthy food choices in a study by Bauer et al. (2021), but only for infrequent guests of the cafeteria, not regulars. Based on the meta-analysis of Cadario and Chandon (2019), we expect that the salience nudge, as a visual enhancement nudge, to have an effect size of $d = 0.13$ in the context of food choice. In summary, the salience is a versatile and often used tool, but has not been (uniquely) tested in the context of food choice on a menu.

1.3. This research

In sum, we will investigate the effect of three types of menu nudges on vegetarian food choice, and investigate how attributions of taste and indulgence contribute to this. We will do so by employing them in an online menu setting similar to Bacon and Krpan (2018), looking at the effect of these nudges on desired food choice and meal attributions. We will also address customers' acceptance of the menu interventions after being subjected to them, because customers' nudge appreciation is an important factor for a nudge's long-term success (Chowdhury, 2021). Research suggests that nudges focused on the nudgee's health are generally well-accepted (Reisch et al., 2017; Reisch & Sunstein, 2016), especially with those reporting dissatisfaction with their own attempts at reducing meat intake (Kukowski et al., 2023). Even for willing restaurant owners (as per Regio Foodvalley, 2023), it is important to understand how their customers perceive the nudges and the restaurant employing them. To this end, we measure three items: customers' nudge acceptance, their intention to return to the restaurant, and customers' perceived nudge effectiveness.

Whereas all three nudges have been shown to be effective in influencing food choice, they have not been directly compared to each other. Based on the meta-analysis by Cadario and Chandon (2019), we expect the hedonic label menu, as a hedonic enhancement nudge, to be the most effective, with an expected effect size d of 0.32, then the chef's recommendation, as an evaluative labeling nudge ($d = 0.17$) and then the salience nudge ($d = 0.13$).

We will test the following hypotheses.

H1. participants in the nudge conditions choose more vegetarian options than those in the control condition. This effect is largest for the hedonic label condition, followed by the chef's recommendation menu and the salience menu.

H2. participants in the hedonic label condition attribute both more a) tastiness and b) indulgence to the vegetarian options than those in the salience menu, chef's recommendation menu, or control conditions.

H3. participants in the hedonic label condition have higher a) acceptance of the nudge, b) intention to return to the restaurant, and c) perceived effectiveness of the nudge, than those in the other two nudge conditions,

2. Method

2.1. Design

To investigate the impact of the menu nudges on vegetarian meal choice, an experimental between-subjects design with four conditions was used: hedonic label, chef's recommendation, salience, and control. Participants were randomly assigned to one of these conditions. Each experimental condition entailed five consecutive hypothetical menu choices, followed by questions about meal attributions, nudge evaluation, average meat consumption, and demographics.

2.2. Procedure

Participants were recruited in March and April 2023 using social media and the university's participant recruitment system. The data was collected using the online platform Qualtrics. After providing informed consent, participants were asked to indicate whether they adhered to a vegetarian, vegan or pescatarian diet. If this was the case, they were directed to the end of the questionnaire. Remaining participants provided demographic information and were randomly assigned to one of four experimental conditions in which they were presented with the corresponding hypothetical menu task. After completing this task, participants answered questions about their attributions and the menu. Lastly, participants were asked to indicate how many days they eat meat in an average week. After completing the study, participants were thanked for their participation and were debriefed about the purpose of the study. To reduce the possible impact of bots on the data, participants were recruited using the university's participant recruitment system and personal recruitment; no monetary reward was offered which would also disincentivize bot response. Additionally, time spent filling out the survey was checked. No anomalies were found.

2.3. Participants

A priori power analysis using G*Power 3.1 (Faul et al., 2009) revealed that to find an effect with a power of 0.90 and $\alpha = 0.05$ for the salience nudge menu nudge, which has the smallest expected effect size ($d = 0.13$; Cadario & Chandon, 2019), 460 participants would be required. In total, 633 participants were recruited. Participants had to be at least 18 years old, fluent in Dutch and not vegetarian, vegan, or pescatarian. Of the 633 participants, 34 were excluded because they indicated not to eat meat and 86 did not complete the task, resulting in a final sample of 513 participants, of whom 129 in the control condition, 127 in the hedonic label condition, 124 in the chef's recommendation condition, and 133 in the salience condition. Participants were randomly distributed over conditions by Qualtrics, aiming at equal distributions between groups. See Fig. 1 for the flowchart of participation.

2.4. Measures and materials

2.4.1. Demographics

Participants were asked about their gender, age, highest level of education and BMI. BMI was included because of its association with meat intake (Bacon & Krpan, 2018; Key et al., 2006).

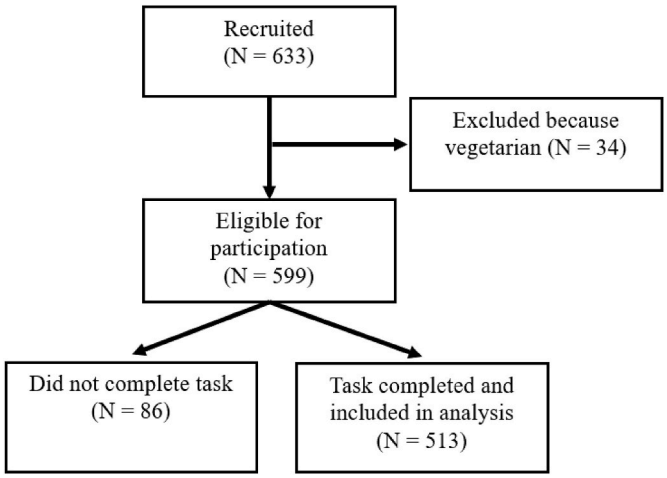

Fig. 1. Participant flowchart.

2.4.2. Menu task

To measure nudge effectiveness, a menu hypothetical choice task was used. Participants were instructed to imagine they were eating out at their favorite restaurant and to choose the meals they would like to eat. They were presented with five consecutive menu choices, each menu consisting of four meals that were presented in line with their assigned condition, with one option being vegetarian (i.e., the desired choice) (see Fig. 2). The menus for the conditions differed in the framing or design of the vegetarian meal (Fig. 2). In the control condition, a standard menu was presented; in the hedonic label condition, the vegetarian option was enhanced using an appealing, taste, description; in the chef's recommendation menu condition, the desired option was labeled as "chef's favorite"; in the salience nudge menu condition, a stand-out box was placed around the desired meal. For each menu, the meal options were equivalent (e.g., four different burgers, one of which was vegetarian), and had the same price to avoid price being a deciding factor. The meals were presented in the same order (i.e., the vegetarian option was always in the same position) for each condition, as previous research found that changing the order of the menu (e.g., Dayan & Bar-Hillel, 2011; Kurz, 2018; Langen et al., 2022) can steer menu choices.

2.4.3. Meal attributions, meat consumption, and tastiness beliefs

After completing the menu task, participants were shown three out of five vegetarian meals that had been presented to them during the task. All participants rated the same three meals. For each meal, participants were asked to what extent they thought the meal would be tasty and indulgent, ranging from "1 = not at all" to "5 = very", based on Turnwald and Crum (2019).

Participants were asked about their average weekly meat consumption, as prior research found a difference in menu nudge effectiveness based on previous meat intake. To measure average meat consumption,

Fig. 2. Example of menus for different conditions (translated to English, original in Dutch).

one item (Bacon & Krpan, 2018) was used: How many days do you eat meat during lunch and/or dinner in a regular week?" with answers ranging from "0 = no days" to "7 = every day". We also asked participants about their beliefs that vegetarian food is untasty, as taste beliefs have been shown to be an especially important consideration in the restaurant context (Claessens et al., 2023; Kunz et al., 2023). We used two statements about vegetarian meals being untasty, and asked people to rate their agreement (ranging from "1 = completely disagree" to "5 – completely agree").

2.4.4. Acceptance, perceived effectiveness, & intention to return

After the menu task, participants were shown the menu with the nudge they were subjected to, compared side-by-side with the same menu as it was presented to the control condition. It was explained to participants how the nudge was designed to increase the choice for the vegetarian options. Participants then rated the nudge they had been exposed to. Participants in the control condition did not receive these questions. On 1–5 scales (completely disagree – completely agree), participants rated their acceptance of the nudge ("I approve of this strategy", based on Evers et al., 2018), perceived effectiveness of the nudge ("This strategy is effective and will therefore ensure that more people will opt for the vegetarian dish", based on van Gestel et al., 2021), and their intention to return to the restaurant ("I would return to this restaurant now that I know it uses this strategy", based on Weiss et al., 2005).

2.5. Analytic strategy

First, randomization checks were done on possible covariates (age, gender, education, BMI, meat consumption, and vegetarian = untasty belief). Variables that differed between groups were included as covariates in the subsequent analyses. To test Hypothesis 1, we used a poisson regression with condition as independent variable and number of vegetarian choices as dependent variable. To test Hypotheses 2 and 3, one-way ANOVAs are performed for each DV separately, with condition as independent variable and the respective variable as dependent variable. Where necessary due to the violation of test assumptions, non-parametric equivalents were used for hypothesis testing. In case of significant differences between groups, estimated marginal means were used as a post hoc test to determine group differences. The Tukey method was used to control for multiple testing. Data and scripts can be found on the Open Science Framework: https://osf.io/pmz63/?view_only=f9fa20a9e88f4b3bbf3490718aea474d.

2.6. Pilot

To ensure the hedonic labels fit the foods presented in the menu and test the effectiveness of the setup, the hedonic label nudge was piloted on a smaller scale. In a virtual restaurant setting, participants chose from five menus with four options (2 vegetarian with hedonic label, 2 meat options) – otherwise, the setup and analysis was the same as the one used in the main study. Demographics and meat-eating frequency were also assessed. Data was collected from 116 participants; 19 participants were excluded for not completing the experimental task, 10 for not eating meat, and 2 for correctly guessing the study's purpose, leaving 85 participants for our analysis. Of these 85 participants, 43 were female and 42 were male. The average age was 36.94 ($SD = 17.75$). The average participant ate meat 4.50 times per week ($SD = 1.62$). There was a significant difference between groups based on their average meat consumption per week ($F(1, 83) = 4.67$, $p = .03$), with participants in the control condition consuming more meat on average ($M = 4.88$, $SD = 1.45$) than those in the experimental condition ($M = 4.14$, $SD = 1.70$). This variable was taken as a covariate in later analyses. No difference between groups was found for gender ($\chi^2(1) = 0$, $p = 1$) or age (Kruskal Wallis $\chi^2(1) = 0.66$, $p = .42$). A mixed ANOVA was used to determine whether conditions differed in food selection, which was the case: the total number of vegetarian choices in the hedonic label condition ($M = 2.90$, $SD = 1.21$) was higher ($F(1, 82) = 8.01$, $p < .01$) than that in the control condition ($M = 2.21$, $SD = 1.26$), indicating that the hedonic labels were suitable for the main experiment.

3. Results

3.1. Randomization checks

Four participants were removed as univariate outliers in BMI before conducting the analyses, as they were more than three interquartile lengths away from the interquartile range. There was no difference between groups based on gender ($\chi^2(3) = 3.97$, $p = 0.27$), age (Kruskal Wallis $\chi^2(3) = 3.59$, $p = 0.31$) or education level ($\chi^2(9) = 3.06$, $p = 0.962$). Participants also did not differ significantly between condition based on their BMI ($F(3, 471) = 1.10$, $p = 0.62$), or their weekly meat intake ($F(3, 505) = 0.77$, $p = 0.51$). A regular ANOVA initially showed a significant difference between groups for their vegetarian = untasty beliefs ($F(3, 505) = 2.65$, $p = 0.048$) but no significant differences between groups were found when conducting a posthoc analysis based on estimated marginal means. None of the variables were therefore included as co-variates in the main analyses.

3.2. Descriptives

Of the 513 participants, 148 were male (28.8%), 363 were female (70.8%) and 2 indicated to be neither (0.4%). The average participant was 34.42 years old (SD = 15.36, median = 26, range 18–81), indicating a relatively young sample. Most participants (380, 74%) had received higher education, 89 participants (17.3%) had received at least vocational education, and only 44 (8.6%) had received high school or less as their highest level of education. Participants (N = 479) provided information on their BMI; the average BMI was 23.95 (SD = 3.71, median = 23.38, range 17.18–40.09). The average participant made relatively few vegetarian choices ($M = 0.99$, $SD = 1.15$, range 0–5). The participants ate meat on average on 4.50 days of the week ($SD = 1.75$, median = 5, range 1–7). Participants did not consider vegetarian meals to be untasty ($\alpha = 0.75$, $M = 2.05$, $SD = 0.89$, range 1–5).

See Table 2 for a complete report of correlations. The dependent variable Vegetarian choices significantly negatively correlated with days of meat intake ($r = -0.45$, $p < 0.001$), vegetarian = untasty beliefs ($r = -0.33$, $p < 0.001$), and significantly positively with intention to return ($r = 0.20$, $p < 0.01$) and nudge acceptance ($r = 0.21$, $p < 0.01$).

3.3. Main analyses

On average, participants made 0.99 ($SD = 1.15$) vegetarian choices (out of five). First, we analyzed whether some vegetarian dishes were more popular than others, using a mixed model approach with choice, meal option, and condition as fixed effects, and participant ID as random slope. We found that the percentage of people choosing the vegetarian meal greatly differed between meals $F(4, 2020) = 18.51$, $p < 0.001$. A Bonferroni-corrected post-hoc analysis based on estimated marginal meals revealed that the first two food options were significantly less often chosen than food option 3, 4 and 5. The frequency with which the different meals were chosen can be found in Table 1.

Table 1
Percentage vegetarian dish chosen per dish.

Order number	Food option	Percentage chosen
1	Vegetable burger	13.4%
2	Leek mash	13.9%
3	Vegetable casserole	30.3%
4	Vegetable stew	21.2%
5	Pasta with tomato sauce	20.0%

Table 2
Correlation table (corrected for multiple comparisons).

	Gender	Age	Education	Intention to return	Nudge acceptance	Meat intake per week	Vegetarian choices	BMI	Vegetarian = untasty	Meal tasty	Meal indulgence
Gender											
Age	−0.06										
Education	0	−0.4***									
Intention to return	0.10	−0.26***	0.3***								
Nudge acceptance	0.08	−0.05	0.1	0.28***							
Meat intake per week	−0.17**	0.08	−0.22***	−0.29***	−0.26***						
Vegetarian choices	0.02	0.02	0.11	0.2**	0.21**	−0.45***					
BMI	−0.18**	0.14*	−0.04	−0.07	−0.05	0.06	−0.01				
Vegetarian = untasty	−0.2***	0.08	−0.21***	−0.33***	−0.23***	0.44***	−0.33***	−0.01			
Meal tasty	0.18**	−0.07	0.06	0.25***	0.2**	−0.26***	0.36***	0.02	−0.38***		
Meal indulgence	0.18**	−0.05	0.03	0.26***	0.22**	−0.24***	0.34***	0.02	−0.31***	0.71***	

Note: *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

To test Hypothesis 1, we ran a Poisson regression with number of vegetarian choices as outcome variable and condition as predictor. An effect of condition was found on the number of vegetarian choices participants made: χ^2 (3, 505) = 15.13, p = 0.001, R^2 = 0.021). A Bonferroni-corrected post hoc based on estimated marginal means then revealed that participants in the hedonic label condition (M = 1.21, SD = 1.29) chose vegetarian options 1.60 times more often ($p < 0.001$) than those in the control condition (M = 0.76, SD = 1.03), and 1.33 times more often (p = 0.02) than those in the salience nudge condition (M = 0.92, SD = 0.97). Additionally, participants who received the chef's recommendation nudge (M = 1.07, SD = 1.26) chose vegetarian options 1.42 times more often ($p < 0.01$) than those in the control condition. These findings are illustrated in Figs. 3 and 4. To check whether nudge effectiveness differed between the meals, we used a mixed model approach with choice, meal option, and condition as fixed effects, and participant ID as random slope. We found no interaction between food choice per meal and condition F (12, 2020) = 0.70, p = .75, indicating

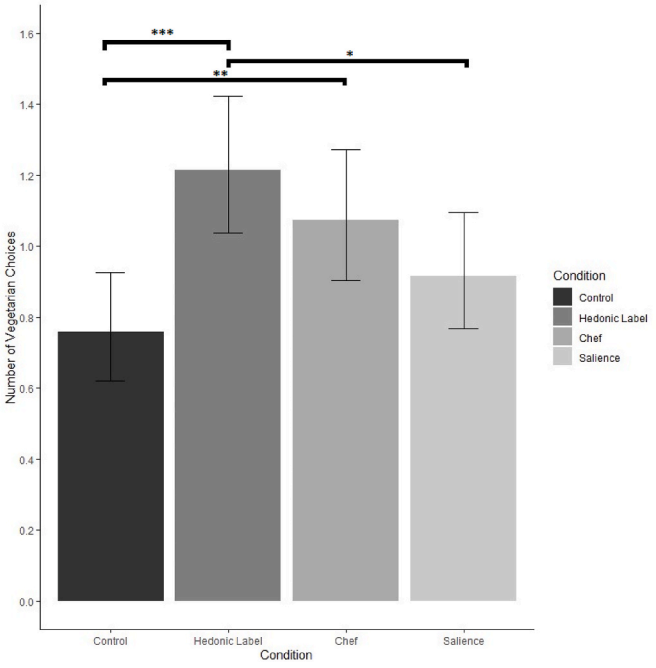

Fig. 3. Average number of Vegetarian Choices per Condition.
Note: *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

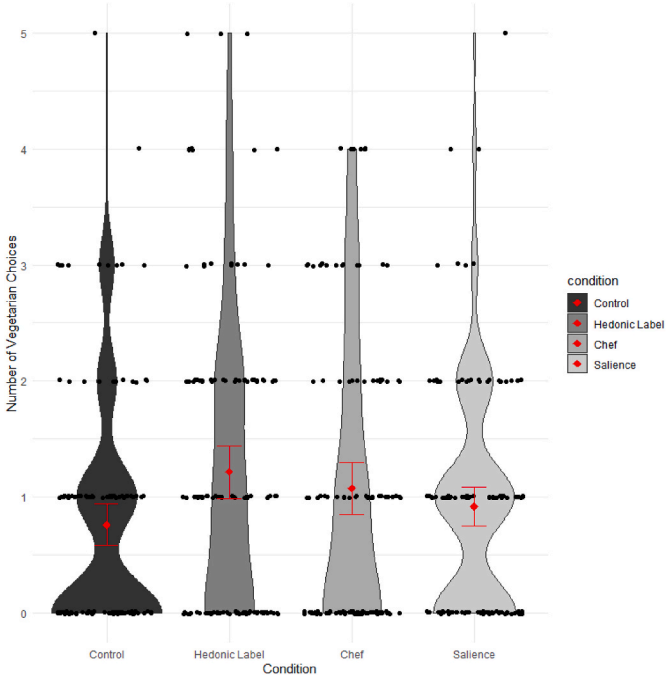

Fig. 4. Violin plots and individual datapoints of vegetarian food choice per condition.

the nudges were equally effective for each of the five presented menus.

Participants rated the vegetarian meals as tasty (M = 3.53, SD = 0.73, range 1–5) but not that indulgent (M = 2.83, SD = 0.74, range 1–5). For Hypothesis 2, we tested the different attributions with separate ANOVAs. No effect of condition was found for taste attribution F (3, 505) = 2.041, p = 0.11 rejecting Hypothesis 2a. An effect of condition was found for indulgence attribution F (3, 505) = 6.93, $p < 0.001$, eta squared = 0.04, confirming Hypothesis 2b. Post hoc analysis based on estimated marginal means revealed that participants who received the hedonic labeling condition (M = 3.08 SD = 0.73) rated the vegetarian meal options as more indulgent than those in the control condition (M = 2.70 SD = 0.68, p < 0.001, d = 0.559), those in the salience condition (M = 2.75, SD = 0.73, p = 0.002, d = 0.45) and those in the chef's recommendation condition (M = 2.80, SD = 0.78, p = 0.014, d = 0.38).

For Hypothesis 3, we tested whether the nudge conditions differed in participants' nudge acceptance, perceived effectiveness, or intention to

return to the restaurant. The participants who evaluated the menus (i.e., participants not in the control condition, $n = 384$) indicated they were somewhat positive about their intention to return ($M = 3.39$, SD = 0.91, range 1–5), indicated to generally approve of the nudge ($M = 3.71$, SD = 0.97, range = 1–5) and perceived the nudge they were subjected to, to be effective in stimulating sustainable choices ($M = 3.25$, $SD = 0.96$, range 1–5).

Descriptives can be found in Table 3.

For Hypothesis 3a, we found no difference between the conditions in acceptance of the nudge, $F(2, 378) = 1.90$, $p = 0.15$. For Hypothesis 3b, no differences between conditions in participants' intention to return ($F(2, 378) = 1.00$, $p = 0.37$) were found. Finally, for Hypothesis 3c, a significant difference was found between conditions based on the perceived effectiveness of their nudge ($F(2, 378) = 4.49$, $p = 0.01$, eta squared = 0.02). Posthoc analysis based on estimated marginal means revealed that the hedonic label nudge ($M = 3.43$, $SD = 0.87$) had higher perceived effectiveness (Estimate = 0.35, $SE = 0.12$, $t(378) = 2.30$, $p < 0.01$, $d = 0.38$) than the salience nudge ($M = 3.09$, $SD = 0.98$).

4. Discussion

4.1. Main findings

In this study, we investigated three promising menu nudges (hedonic label, chef's recommendation, salience) and their effectiveness in increasing vegetarian food choice in a restaurant context. Additionally, we distinguished between two elements of hedonic labeling that might drive its effect: attributions of taste and attributions of indulgence. Furthermore, to practically inform restaurant owners about how customers react to the nudges, we measured customers' nudge acceptance, perceived nudge effectiveness, and their intention to return to the restaurant.

First, we found that the hedonic label condition and the chef's recommendation nudges were statistically equally effective in increasing vegetarian food choice in our menu task – and were effective across different vegetarian meals. This is consistent with previous findings in the literature (Bacon & Krpan, 2018; Boles et al., 2022; Turnwald et al., 2017; Turnwald et al., 2019; Turnwald & Crum; 2019). The salience nudge had no effect on food choice. These findings suggest that the hedonic label and the chef's recommendation nudge are better suited than a salience nudge to encourage vegetarian choice in the restaurant context. As such, our study is the first to examine the effectiveness of a 'clean' chef's recommendation nudge, as it is commonly used in restaurants. Previous research (Bacon & Krpan, 2018) had only tested the chef's recommendation combined with a salience nudge in the form of a box. In view of our findings, these effects can be attributed to the chef's recommendation element rather than the salient box.

Second, we found that the hedonic label nudge – but not the chef's recommendation or salience nudges - increased attributions of indulgence whereas perceptions of tastiness were unaffected by this nudge. Previous studies on the effects of taste attributions (Turnwald & Crum, 2019; Turnwald et al., 2019) should be reconsidered in view of these novel findings. Although attributions of taste and indulgence are associated, our study suggests that indulgence is the driving factor of choice. This finding aligns with the successes of the hedonic label in earlier studies as well as the hedonic contexts that restaurants present (Biermann & Rau, 2020; Claessens et al., 2023). Whereas attributions of indulgence apparently are important for understanding the effect of the hedonic label nudge, the effect of the chef's recommendation nudge may lie in a different mechanism, in particular as an authority cue (Cialdini, 2003). Previous research on health messages shows that these were more readily accepted by the public when they came from an expert source (Young Lee & Sundar, 2013; Hu & Sundar, 2013). In a similar vein, the chef can be seen as an expert on food and their recommendation can therefore be taken seriously. Alternatively, given that the restaurant is a context of hedonism (Biermann & Rau, 2020; Claessens et al., 2023), the chef's recommendation could be viewed as a permission for a treat. That this treat supposedly does not have to contain meat is a promising perspective for future interventions targeting food intake, and is in contrast with the idea that meat is more enjoyable than plant-based food.

Third, we found that all nudges were deemed acceptable by the customers, and we found no difference in customers' intention to return to restaurants using the nudges. That it is perceived as more effective than the other nudges by the customers, is not reflected in lower approval (as expected by Cadario & Chandon; 2019, who find a negative relation between perceived nudge effectiveness and nudge approval). This indicates that in practice, all three nudges can be used by restaurants without customers reacting negatively to the nudges' usage.

Altogether, attempts to change food choice in a restaurant are a high-impact approach to reduce meat intake, which is a large driver of climate change. The restaurant setting lends itself well to interventions to promote sustainability, as the menu allows for a very controlled food choice environment. The success of the hedonic label and the chef's recommendation nudge in our study lends itself to easily implementable methods to increase sustainable meal intake in the high-impact context of the restaurant. It should be noted, however, that the home context constitutes a larger part of people's food intake, which limits the total impact of restaurant interventions on sustainability goals.

4.2. Limitations

This study is subject to several limitations. First, the study was not carried out in a real restaurant but entailed hypothetical meal choices. For choices that are strongly associated with habits – like choosing between healthy and unhealthy meals (Herziger & Hoelzl, 2017) – a hypothetical scenario might not always lead to the same choices as a real-world scenario. To counteract this, we took several measures to ensure ecological validity. First, we included a proxy of real-world vegetarian food choice in our study – self-reported average meat intake. In doing so, we introduced real-world decision making in this hypothetical scenario. Additionally, our findings are congruent with earlier studies in real-world settings (Broers et al., 2019; Turnwald et al., 2019) in which respectively the chef's recommendation and hedonic label nudge were tested. Finally, earlier online menu task studies reported findings similar to experiments in more naturalistic locations (Bacon & Krpan, 2018; Liu et al., 2012), leading us to conclude that the online and hypothetical nature of our study is not a serious detriment for extrapolating towards a real-world setting. Nevertheless, it should be considered that important contextual factors for food choice like time of day, hunger, being able to perceive the food, and the (often) social setting of the restaurant were not addressed in this study.

Second, acceptance, perceived effectiveness, and intention to return were only tested for the nudge conditions because the questions were formulated explicitly about the nudge. This means the general acceptance of a nudge (versus not nudging at all) was not tested. Future research could focus on the overall experience, especially for intention to return. However, we have not much reason to believe that the nudges' transparency leads to lower evaluations. Earlier research demonstrated that a nudge's transparency or lack thereof does not change food choice or the opinion about food choices (Kroese et al., 2016), reducing the

Table 3
Average score per nudge condition for acceptance, intention to return, and perceived effectiveness.

	Acceptance	Intention to return	Perceived effectiveness
Overall	3.71 (0.97)	3.39 (0.91)	3.25 (0.95)
Hedonic label	3.84 (0.83)	3.44 (0.74)	3.43 (0.87)
Chef's recommendation	3.68 (1.05)	3.42 (1.00)	3.25 (0.99)
Salience nudge	3.62 (1.00)	3.30 (0.96)	3.09 (0.98)

impact of this limitation. Furthermore, most people welcome such assistance in food choice (Kroese et al., 2016), especially when one's perceived efficacy in choosing healthy options is low (Kukowski et al., 2023).

Lastly, it should be noted that our sample is predominantly highly educated and relatively young compared to the general population. Additionally, given that the questionnaire was in Dutch, little cultural diversity is to be expected and our results will be hard to generalize across cultures. Future research could aim to including various cultures and backgrounds, to test the effectiveness of nudging on food choice across a more diverse sample.

4.3. Conclusion

To increase choices for plant-based meals in the restaurant context, we tested three different menu nudges in direct comparison. The hedonic label nudge and the chef's recommendation nudge is more effective compared to the salience nudge in increasing vegetarian choices. Furthermore, all tested nudges were deemed acceptable by the customer and did not affect intention to return to the restaurant. Our findings on meal attributions also suggest that this effect is more driven by attributions of indulgence rather than taste, at least in the restaurant context where hedonistic motives are more important. This means that and increase in indulgence attribution can be achieved in vegetarian, healthy foods, paving the way for other interventions nudging customers towards desirable food choices.

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Ethical statement

The study was approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences of Utrecht University on January 12, 2023. The approval is based on the documents send by the researchers as requested in the form of the Ethics committee and filed under number 23–0044.

CRediT authorship contribution statement

Robert J. Weijers: Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Formal analysis. **Iris W.H. Claessens:** Methodology, Conceptualization. **Marleen Gillebaart:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Denise T.D. de Ridder:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors have no competing interest to declare.

Data availability

The manuscript contains a link to the Open Science Framework, where the data can be found: https://osf.io/pmz63/?view_only=f9fa20a9e88f4b3bbf3490718aea474d

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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.2024.107376.

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