

M. SMITS (0244708) – NUDGING TOWARDS VEGETARIAN MEAL CHOICE,  
EFFECTIVENESS OF MENU NUDGES AND ROLE OF MEAL EXPECTATIONS

Master thesis

**Nudging towards vegetarian meal choice in restaurants: An examination of the  
effectiveness of menu nudges and the role of meal expectations**

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**Abstract**

People are increasingly eating out in restaurants, where they prefer to eat meat, which negatively impacts environment and health. Despite people intending to reduce their meat intake, their behaviour fails to change. One way to change behaviour is by nudging. In this online experimental study, 509 Dutch participants were randomly assigned over four conditions (i.e., control, appealing description, recommendation, visibility enhancement) to compare three menu nudges in their effectiveness in increasing vegetarian meal choice. Two out of three menu nudges, which restaurant owners consider acceptable, positively impacted vegetarian meal choice in an online restaurant setting. As expected, framing a meal in an appealing, taste-focused, way (i.e., appealing description) and stating a meal as chef's favourite (i.e., recommendation) resulted in more vegetarian meal choices than increasing the salience of a meal (i.e., visibility enhancement). It was argued that these two nudges, which both provide decision information, would be more effective because they change people's expectations about vegetarian meals (i.e., tastiness, indulgence, popularity, safe choice in taste). However, the effectiveness of the nudges could not fully be explained by changing meal expectations; only tastiness mediated the relationship between the appealing description and vegetarian meal choice. Future research is necessary to explain what factors contribute to the effectiveness of nudges. Finally, it is recommended for restaurants owners and policy makers to use either the appealing description or recommendation nudge to promote healthy and sustainable eating.

*Keywords:* vegetarian meal choice, menu nudges, meal expectations, healthy eating, sustainable eating

## **Introduction**

Human behaviour is the main driver of climate change, resulting in an increasing growth of greenhouse gasses (GHG) till this day (United Nations, n.d.). Climate change is caused by several human behaviours, but one that has been gaining attention over the years is meat consumption (e.g., Clark et al., 2020; Godfray et al., 2018). Meat production is an important source of GHG emissions, requires a high amount of fresh water and contributes to the cutting down of forests (Godfray et al., 2018; Mekonnen & Hoekstra, 2012). To achieve the Dutch Climate Agreement of a 49% CO<sub>2</sub> reduction by 2030, actions must be taken to shift towards more plant-based protein intake (Rijksoverheid, 2019). A reduction in meat intake could reduce GHG emissions by approximately 3 to 30% (Yip et al., 2013). Moreover, red and processed meat has negative consequences for human health, such as increased risks for colorectal cancer, cardiovascular diseases and diabetes (Sinha et al., 2009; Wolk, 2017). To meet the guidelines of the Health Council of the Netherlands (2015), we should limit our animal-based food consumption, while eating more plant-based foods. Transitioning from high to low meat diets may reduce mortality rates by 6 to 10% (Springmann et al., 2016). Thus, emphasising the need to reduce our meat consumption for both environment and health.

Currently, 4% of the Dutch population follows a vegetarian diet, while 27% follows a flexitarian diet, in which respectively meat intake is completely disregarded and reduced (Bos & Keuchius, 2021). Motivators for such diets are related to health, environment, animal welfare and the sustainability perspective; the need for a continued quality of life combined with a responsibility for current and future generations (Leitzmann, 2014). A substantial amount of meat eaters realises the importance of reducing their meat intake; 43% has the intention to consume less meat (Bos & Keuchenius, 2021). However, especially the taste and habit of eating meat makes it hard for them to limit their intake (Bos & Keuchenius, 2021). Consequently, an intention-behaviour gap is observed; people do not follow up on their intentions in their behaviour (Bos & Keuchenius, 2021; De Bakker & Dagevos, 2012; Laffan et al., 2023).

This is particularly relevant for out-of-home eating, since people favour meat consumption in restaurants compared to at home. Interestingly, this effect is bigger for flexitarians (Biermann & Rau, 2020). Moreover, in restaurants, the importance of taste compared to health increases; treating oneself gains attention (Biermann & Rau, 2020). Consequently, people consume less sustainable and healthy meals in restaurants (Biermann & Rau, 2020), implying that the environmental and health impact of out-of-home eating is relatively high. This is especially concerning in the light of the rising trend of out-of-home eating. For instance, in 2016 a growth of 4.5% was visible, with especially people aged 18 to

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36 eating in restaurants regularly (FoodService Instituut, 2017). In total, about 5% of the Dutch food consumption takes place in restaurants (RIVM, 2018). Therefore, the focus of this study is on restaurants, specifically, the influence of menu nudges on vegetarian meal choice.

### **Nudging**

One promising way to help people change their behaviour is nudging. A nudge can be defined as “any aspect of the choice architecture that alters people’s behaviour in a predictable manner, without forbidding options or significantly changing their economic incentives” (Thaler & Sunstein, 2021, p. 8). The goal is to help people make better decisions in their own interest, increasing their wellbeing, as judged by themselves. In other words, the choice they would have made under full attention, with complete information, unlimited cognitive ability and complete self-control (Thaler & Sunstein, 2021, p. 7). Therefore, nudges steer people towards choices they would prefer to make themselves in ideal circumstances.

Using nudges to change eating behaviour is not new; a big variety of nudges have been tested before, including nudging in restaurants to influence meal choice (Cadario & Chandon, 2020). In their meta-analysis, which compared the influence of different healthy eating nudges, Cadario & Chandon (2020) found positive effects of different sort of restaurant nudges. Especially behavioural-oriented nudges, including size and convenience enhancement (e.g., serving smaller portions), were effective. In this study, the focus is on menu nudges, since they are considered acceptable by restaurant owners (Regio Foodvalley, 2022) and are also effective in increasing the amount of healthy and vegetarian food choices made in restaurants (Bacon & Krpan, 2018; Cadario & Chandon, 2020; Campbell-Arvai et al., 2014; Langen et al., 2022).

There are three menu nudges that restaurant owners are especially willing to implement: an appealing description by taste-focused framing, a recommendation by stating it as “chef’s favourite” and visibility enhancement by using a stand-out box (Regio Foodvalley, 2022). The effect sizes of these nudges range from low to medium, with the biggest effect for an appealing description ( $d = .32$ ), followed by a recommendation ( $d = .24$ ) and visibility enhancement ( $d = .13$ ; Cadario & Chandon, 2020). The possibility for a large-scale implementation, which is achievable based on the acceptance of restaurant owners, makes it likely to significantly contribute to a lower meat intake. Therefore, this study compares these nudges in terms of effectiveness in increasing vegetarian meal choice. More research is necessary because little previous research has focused on the implementation of these nudges in menus, especially, there is a lack of studies focused on vegetarian choices (Bacon & Krpan, 2018). Additionally, more research is needed on factors explaining the effects of nudges (Münscher et al., 2016).

### **Behavioural barriers and meal expectations**

Nudges are assumed to influence vegetarian meal choice by overcoming underlying behavioural barriers for reducing meat consumption (Thaler & Sunstein, 2021). It is expected that behavioural barriers can be overcome by changing people's expectations about vegetarian meals. The focus is on two barriers, most relevant for this study, which facilitate the intention-behaviour gap in the failure to reduce meat consumption (Laffan et al., 2023). A first barrier is self-control problems, which arise when choices and their consequences are separated in time (i.e., delayed gratification; Thaler & Sunstein, 2021, p. 95; Wyss et al., 2022). A primarily plant-based diet is beneficial in the long run, but there is a lack of benefits now. As a result, meat eaters are likely to choose meals with meat since they consider this more tasteful (Bos & Keucheniuss, 2021). However, by changing people's expectations about a vegetarian meal's tastiness and indulgence, consuming the meal can also be considered beneficial now (Turnwald & Crum, 2019). Thus, people do not need to exert self-control to refrain from choosing a meal with meat (Metcalf & Mischel, 1999). The appealing description nudge can effectively target these meal expectations by providing decision information (i.e., changing the way information is presented) in the form of reframing vegetarian meals in an appealing way (Münscher et al., 2016). When the framing is focused on taste, people expect the meals to be more tasteful and indulgent, which influences their food choice (Turnwald & Crum, 2019).

A second barrier is perceived social norms towards meat. Social norms can be defined as perceived behaviour of others in the reference group, as well as beliefs about what others regard as appropriate (Bicchieri, 2005). Social norms are automatically acted on without deliberately reflecting on the choices (Bicchieri, 2005). Meat eaters are likely to stick to meals with meat because their perceived norm is that little people in their social environment eat vegetarian meals (Bos & Keucheniuss, 2021). Consequently, when norms imply that people are eating less meat, individuals are more likely to choose vegetarian meals (Harguess et al., 2020). By changing people's expectations about the meal being popular and a safe choice in taste, perceived norms change (Higgs, 2015). The recommendation nudge can effectively target these expectations by providing decision information in the form of a social reference point, which is a respected messenger who influences opinions and behaviours (Münscher et al., 2016). The mechanism behind this is peripheral processing, which relies on cues as heuristics and credibility to associate positivity with a message (Kitchen et al., 2014; Liu et al., 2022). Since a chef is considered a credible source, stating a vegetarian meal as "chef's favourite" results in more positive expectations about a meal being popular and a safe choice, which influences food choice (Higgs, 2015; Münscher et al., 2016).

In summary, the appealing description and recommendation nudge, which provide decision information, can help overcome behavioural barriers for reducing meat consumption by changing meal expectations. Since the nudges use different techniques to provide decision information (i.e., reframing information, providing a social reference point), which target different streams of judgement and decision making, different meal expectations are affected (Münscher et al., 2016). In contrast, the visibility enhancement nudge does not provide decision information; it provides decision assistance by providing reminders of the vegetarian meal through increasing salience (Münscher et al., 2016). Information that is salient and easily accessible has a higher chance to guide behaviour (Münscher et al., 2016). However, since this nudge does not change the presented information, it is unlikely to change people's expectations regarding vegetarian meals. Therefore, the visibility enhancement nudge is likely less effective.

### **Relevance and hypotheses**

Since little previous research has compared these menu nudges against each other in their effectiveness in increasing vegetarian meal choices, this study is theoretically relevant. Additionally, meal expectations have not yet been examined in relation to menu nudges. This includes the assumption that nudges that provide decision information target meal expectations, while nudges that provide decision assistance do not. Therefore, this research contributes to the choice architecture literature. Information regarding this could help to better understand how nudges affect behaviour and could be used to optimise the working of nudges.

These theoretical insights can be practically relevant since it can help with choosing appropriate nudges that can be implemented in real restaurants in the Netherlands and possibly abroad. Moreover, knowledge regarding meal expectations can help with shaping the nudges in a suitable way. Therefore, this study answered the following research question: “*What is the impact of menu nudges on the selection of vegetarian meals in restaurants, in relation to meal expectations, among the Dutch adult population?*” To answer this question, two hypotheses were formulated (figure 1). The first hypothesis was based on the meta-analysis of Cadario & Chandon (2020), which revealed that the effect sizes of the nudges differ in increasing healthy meal choices, with appealing description being most effective, followed by recommendation and visibility enhancement. The second hypothesis was based on the argumentation that decision information nudges change people's expectations about vegetarian meals and therefore influence vegetarian meal choice (Harguess et al., 2015; Münscher et al., 2016; Turnwald & Crum, 2019).

H<sub>1</sub>: The use of menu nudges (i.e., appealing description, recommendation, visibility enhancement) leads to the selection of more vegetarian meals, yet the menu nudges differ in their effectiveness of doing so with the appealing description nudge being most effective, followed by respectively the recommendation and visibility enhancement nudge.

H<sub>2</sub>: For the menu nudges that provide decision information (i.e., appealing description, recommendation), more positive expectations about vegetarian meals mediates the relationship between the nudge and the selection of vegetarian meals.

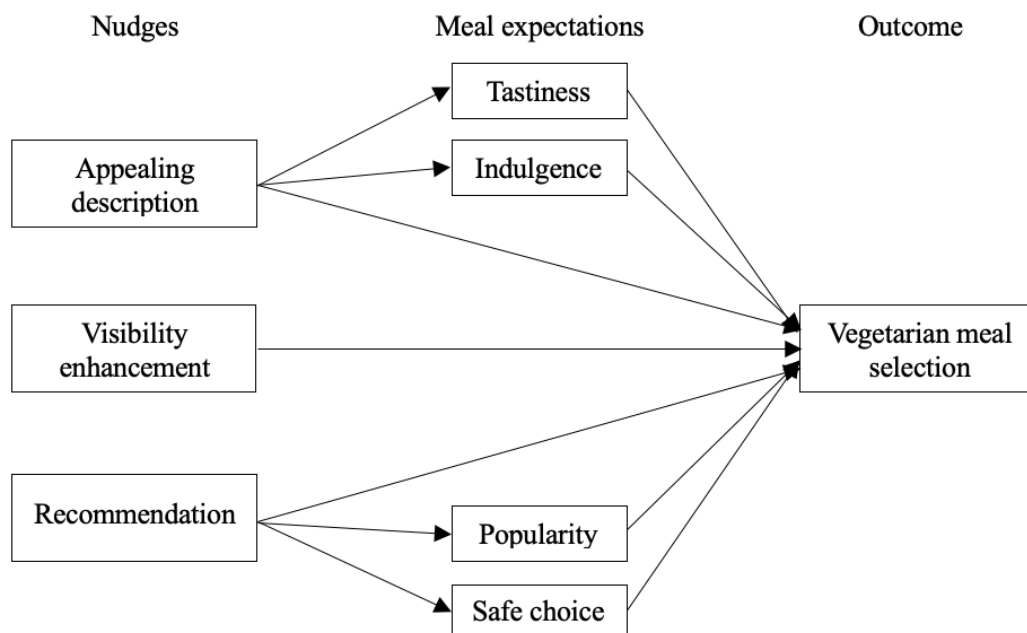
H<sub>2a</sub>: The appealing description nudge leads to more positive expectations about the tastiness of the meal, which in turn leads to selecting the vegetarian meal more often.

H<sub>2b</sub>: The appealing description nudge leads to more positive expectations about the indulgence of the meal, which in turn leads to selecting the vegetarian meal more often.

H<sub>2c</sub>: The recommendation nudge leads to more positive expectations about the popularity of the meal, which in turn leads to selecting the vegetarian meal more often.

H<sub>2d</sub>: The recommendation nudge leads to more positive expectations about the safe choice of the meal, which in turn leads to selecting the vegetarian meal more often.

H<sub>2e</sub>: The visibility enhancement nudge does lead to selecting the vegetarian meal more often, but this relation is not mediated by changing expectations of the meal.



**Figure 1**

*Visualisation of the proposed hypotheses.*

*Note:* As indicated in H<sub>1</sub>, the effect of appealing description on vegetarian meal selection is expectedly the biggest, followed by respectively recommendation and visibility enhancement.

## Methods

### Design

To investigate the impact of the menu nudges on vegetarian meal choice, an experimental between-subjects design with four conditions was used, which were: appealing description menu, recommendation menu, visibility enhancement menu and control menu. Each experimental condition received a hypothetical menu task and questions about meal expectations, average meat consumption and demographics. This study has been approved by the Ethical Review Board of the Faculty of Social and Behavioural Sciences of Utrecht University under number 23-0044.

### Participants

Power analyses were carried out before the data collection to determine the number of participants needed based on different effect sizes of the nudges. 420 participants were needed to find an effect for the nudge with the highest effect size ( $d = .32$ ; Cadario & Chandon, 2020). People could only participate if they met the inclusion criteria of being at least 18 years old and a Dutch inhabitant. Additionally, participants were excluded in case they indicated being a vegetarian, vegan or pescatarian or in case they indicated to not eat meat with their meals in an average week. In total, 633 participants started the questionnaire, but 37 participants were excluded since they did not eat meat. Additionally, all unfinished questionnaires ( $N = 86$ ) were excluded, leaving 510 participants. However, one outlier was removed based on very unusual demographics (e.g., BMI) and scores. Therefore, the number of participants used for the data analysis was 509. Thus, the estimated power for the appealing description nudge was reached, but not for the recommendation and visibility enhancement.

Considering the different experimental conditions, the control condition had 127 participants, the appealing description condition 125, the recommendation condition 124 and the visibility enhancement condition 133. Additionally, the sample consisted of 70.7% ( $N = 360$ ) women, 29.1% ( $N = 148$ ) men and one participant indicated to be “other”. The age of participants ranged between 18 and 81, with a mean age of 34.35 ( $SD = 15.25$ ). Additionally, the educational level was relatively high, with respectively 45.0% and 29.5% of participants indicating to either having completed or currently following education at a university or university of applied science. On average, the BMI of the sample was 23.94 ( $SD = 3.68$ ), which is considered healthy. Lastly, on average, participants indicated that they eat meat on 4.5 days a week ( $SD = 1.72$ ). This is lower than the average meat consumption, which is six days for Dutch adults (RIVM, 2020).



### **Measures and materials**

The data was collected with the use of an online questionnaire. The questionnaire contained measures for sociodemographic characteristics, the menu task, meal expectations and average meat consumption. The original English items were translated to Dutch by the researchers.

***Sociodemographic characteristics.*** To get some insight into the sample characteristics, participants were asked about their gender (i.e., male, female, other), age, highest/current level of education (i.e., primary school, secondary school, vocational education, university of applied science, university) and BMI (i.e., height, weight).

***Menu task.*** To measure vegetarian food choice, a hypothetical menu task was used in which participants were randomly assigned to one of four conditions (i.e., control, appealing description, recommendation, visibility enhancement). Each participant was presented with five different menus corresponding to their assigned condition. The menus consisted of four meals, including one vegetarian, which could be considered similar (e.g., four burgers) and had the same price. Participants were given the instruction to imagine they were eating out at their favourite restaurants and to choose the meals they would like to eat. The menus for the conditions differed in the framing or design of the vegetarian meal (figure 2). The control condition was a standard menu. The appealing description menu framed the vegetarian meal in an appealing, taste-focused, way. The recommendation menu stated the vegetarian meal as “chef’s favourite”. Lastly, in the visibility enhancement menu a stand-out box was placed around the vegetarian meal. Similar tasks conducted by Bacon & Krpan (2018) and Claessens et al. (2023) were used as inspiration.

***Meal expectations.*** After completing the menu task, participants were shown three of the vegetarian meals that were presented to them during the task. For each meal, participants were asked to what extent they thought the meal would be tasty, indulgent, popular and a safe choice in taste, ranging from “1 = not at all” to “5 = very”. This was based on a scale of Turnwald & Crum (2019).

***Average meat consumption.*** Participants were asked about their average meat consumption in a week to exclude participants based on their lack of meat consumption and to control for this variable in analyses. To measure average meat consumption, a similar (one item) scale as that of Bacon & Krpan (2018) was used ranging from “0 = no days” to “7 = every day” by using the question: “How many days do you eat meat during lunch and/or dinner in a regular week?”.



**Figure 2**

*Example of menus for different conditions.*

*Note: The menus have been translated from Dutch to English.*

### **Procedure**

Participants were recruited between March 23<sup>rd</sup> and April 21<sup>st</sup> in 2023, with the use of social media (i.e., Facebook, LinkedIn, Instagram, WhatsApp) and Sona (i.e., a platform for bachelor Psychology students to earn subject credits). Furthermore, participants were asked to share the questionnaire with others. Therefore, a broader range of participants could be reached. The data collection was done by a team of three researchers with the use of Qualtrics. Before the experiment, some study information was provided and participants were explicitly asked to give their informed consent (Appendix A). After giving informed consent, participants were asked to indicate whether they follow a vegetarian, vegan or pescatarian diet. Participants who answered this question with “yes” were immediately sent to the end of the questionnaire and were thanked for their willingness to participate. The remaining participants were asked about their demographics. Next, participants were randomly assigned to one of four experimental conditions (i.e., appealing description, recommendation, visibility enhancement, control) and were presented with the corresponding hypothetical menu task. After completing the task, participants rated their expectations of tastiness, indulgence, popularity and safe choice of three vegetarian meals that were shown to them, regardless of their choices and assigned condition. Lastly, participants were asked to indicate how many days they eat meat in an average week. After completing the questionnaire, participants were thanked for their willingness to participate and were debriefed about the purpose of the study (Appendix B).

### **Statistical analyses**

The statistical analyses were conducted with the use of IBM SPSS Statistics v28. After the exclusion of participants, the descriptive data of the variables and correlations between the variables were retrieved. After this, a randomisation check was performed, to check whether the demographic variables were evenly distributed over the experimental conditions. Additionally, the data was checked on assumptions relevant for the tests used for the hypothesis testing. In case assumptions were violated, the decision for the statistical tests would be reconsidered. Moreover, outliers were removed in case scores were more than 1.5 times the interquartile range (IQR) lower or higher than the lower or upper limit, since they violate test assumptions and were therefore expected to influence outcomes.

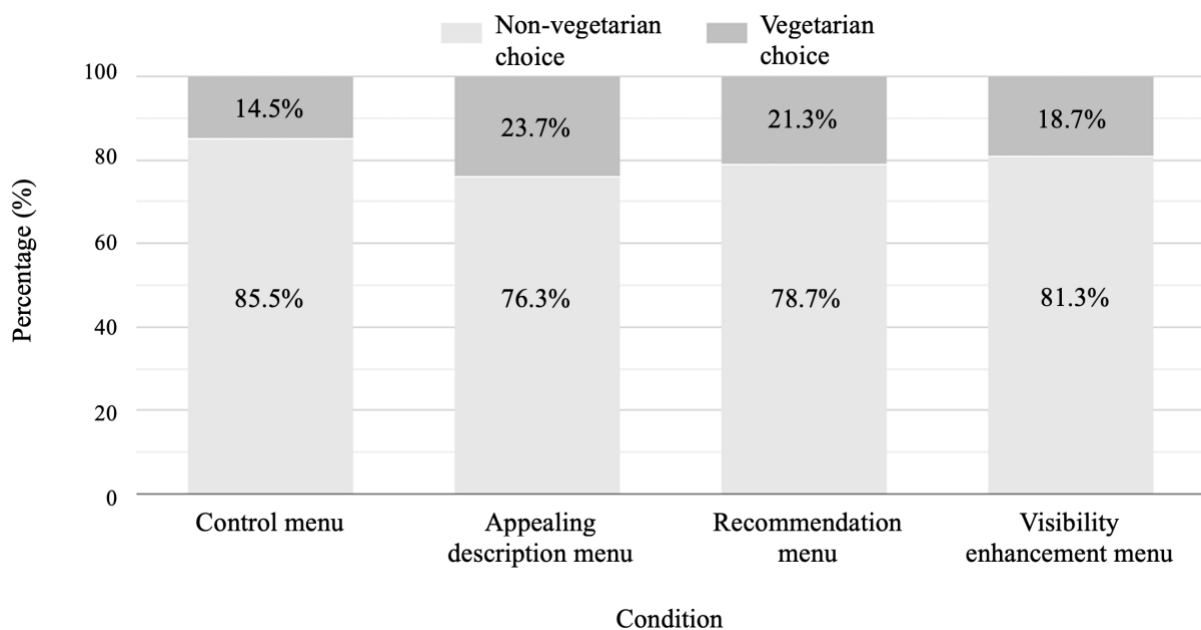
For hypothesis 1, a one-way ANCOVA with four groups (i.e., control, appealing description, recommendation, visibility enhancement) was carried out to compare the vegetarian meal choices between the conditions. With the use of pairwise comparison, the differences in the effectiveness of the nudges became visible. For hypothesis 2, a parallel

mediation analysis was carried out. The regression model consisted of the independent variable X (i.e., nudging conditions), four mediators which were the meal expectations ( $M_1$  = tastiness,  $M_2$  = indulgence,  $M_3$  = popularity,  $M_4$  = safe choice) and the dependent variable Y (i.e., vegetarian meal choice). The X variable was a categorical variable with four levels, whereas the mediators and Y variable were continuous. To carry out this analysis, model 4 of the PROCESS macro for SPSS was used (Hayes, 2013).

## Results

### Descriptive analysis and correlations

In total, 19.5% ( $SD = 22.67$ ) of the chosen meals during the menu task were vegetarian. In the control condition, 14.5% ( $SD = 19.14$ ) of the chosen meals were vegetarian, in the appealing description condition 23.7% ( $SD = 25.32$ ), in the recommendation condition 21.3% ( $SD = 25.21$ ) and in the visibility enhancement condition 18.7% ( $SD = 19.73$ ). Figure 2 shows an overview of the choices made. Concerning the meal expectations, on average participants rated the expectations for the vegetarian meals quite neutral to positive, with a mean of 3.52 for tastiness ( $SD = .73$ ), 2.83 for indulgence ( $SD = .74$ ), 3.01 for popularity ( $SD = .72$ ) and 3.38 for safe choice ( $SD = .77$ ). Table 1 shows the means and standard deviations of the different conditions. Additional descriptive statistics and correlations of study variables, independent of the conditions, are visible in table 2.



**Figure 2**

*Overview of vegetarian and non-vegetarian meal choices in the conditions.*

**Table 1**

*Means and standard deviations of the meal expectations for the conditions.*

Condition	Meal expectations							
	Tastiness		Indulgence		Popularity		Safe choice	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	3.47	.72	2.69	.67	2.93	.69	3.34	.77
Appealing description	3.66	.65	3.09	.73	3.09	.73	3.34	.62
Recommendation	3.46	.87	2.81	.77	3.12	.82	3.41	.87
Visibility enhancement	3.59	.69	2.76	.74	2.92	.65	3.44	.79

### Randomisation check

To check whether demographic characteristics were evenly distributed over the four conditions, one-way ANOVAs were used. No significant differences were found for gender ( $F(3, 505) = 1.38, p = .248$ ), age ( $F(3, 505) = 1.59, p = .191$ ), BMI ( $F(3, 471) = 1.33, p = .264$ ), education ( $F(3, 505) = .14, p = .936$ ) and average reported meat consumption ( $F(3,505) = .48, p = .697$ ). Therefore, the randomisation was successful.

### Hypotheses testing

#### *Effectiveness of menu nudges*

Before testing whether vegetarian meal choice differed significantly over the conditions, the data was checked on assumptions. The assumption of homogeneity was violated, but since sample sizes of the conditions were approximately equal this could be disregarded. Therefore, the one-way ANCOVA analysis was carried out, controlling for gender and average meat consumption. 11 outliers were removed because their scores were more than 1.5 times the IQR lower or higher than the lower or upper limit, resulting in a total sample of  $N = 498$ .

The results of the ANCOVA suggested that at least two experimental conditions were significantly different from each other ( $F(3, 492) = 9.23, p < .001$ ). A pairwise comparison revealed that, compared to the control condition, the appealing description ( $M = 10.98, 95\% CI [6.20, 15.76], SD = 2.43, p < .001$ ) and recommendation ( $M = 10.18, 95\% CI [5.38, 14.98], SD = 2.44, p < .001$ ) resulted in a higher percentage of vegetarian meal choices, but not visibility enhancement ( $M = 3.94, 95\% CI [-.82, .8.70], SD = 2.42, p = .105$ ). Therefore, two out of three nudges resulted in more vegetarian meal choices.

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**Table 2**

*Descriptive statistics and Spearman correlations of study variables.*

	N	M	SD	1	2	3	4	5	6	7	8	9	10
1. Gender <sup>a</sup>	509	1.71	.46	-									
2. Age	509	34.35	15.25	-.07	-								
3. BMI	475	23.94	3.68	-.17**	.35**	-							
4. Education <sup>b</sup>	509	4.11	.97	-.00	-.40**	-.29**	-						
5. Vegetarian meal choice <sup>c</sup>	509	19.49	22.67	.20**	-.00	-.13**	.12**	-					
6. Tastiness	509	3.52	.73	.18**	-.08	-.04	.05	.35**	-				
7. Indulgence	509	2.83	.74	.19**	-.05	-.04	.03	.34**	.71**	-			
8. Popularity	509	3.01	.72	.16**	-.06	.06	.00	.16**	.42**	.44**	-		
9. Safe choice	509	3.38	.77	.13**	-.21**	.04	.06	.28**	.55**	.48**	.50**	-	
10. Meat consumption	509	4.52	1.72	-.16**	.10*	.17**	-.23**	-.43**	-.25**	-.24**	-.09	-.24**	-

*Note:* A strong correlation between tastiness and indulgence is observed. There is a covariance of .32 between the variables.

\*Correlation is significant at the .05 level (2-tailed)

\*\*Correlation is significant at the .01 level (2-tailed)

<sup>a</sup> 1 = male, 2 = female, 3 = other

<sup>b</sup> 1 = primary school, 2 = secondary school, 3 = vocational education, 4 = university of applied sciences, 5 = university

<sup>c</sup> In percentages (%)

Additionally, the appealing description resulted in a higher percentage of vegetarian meal choices compared to the visibility enhancement ( $M = 7.04$ , 95% CI [2.31, 11.78],  $SD = 2.41$ ,  $p = .004$ ), but not compared to the recommendation ( $M = .80$ , 95% CI [-3.97, 5.57],  $SD = 2.43$ ,  $p = .742$ ). Lastly, the recommendation resulted in more vegetarian meal choices compared to the visibility enhancement ( $M = 6.24$ , 95% CI [1.49, 10.99],  $SD = 2.42$ ,  $p = .010$ ). Therefore, the results revealed that the appealing description and recommendation are more effective than the visibility enhancement, but not that the appealing description is more effective than the recommendation. Thus,  $H_1$  is not fully supported.

### ***Indirect effect of meal expectations***

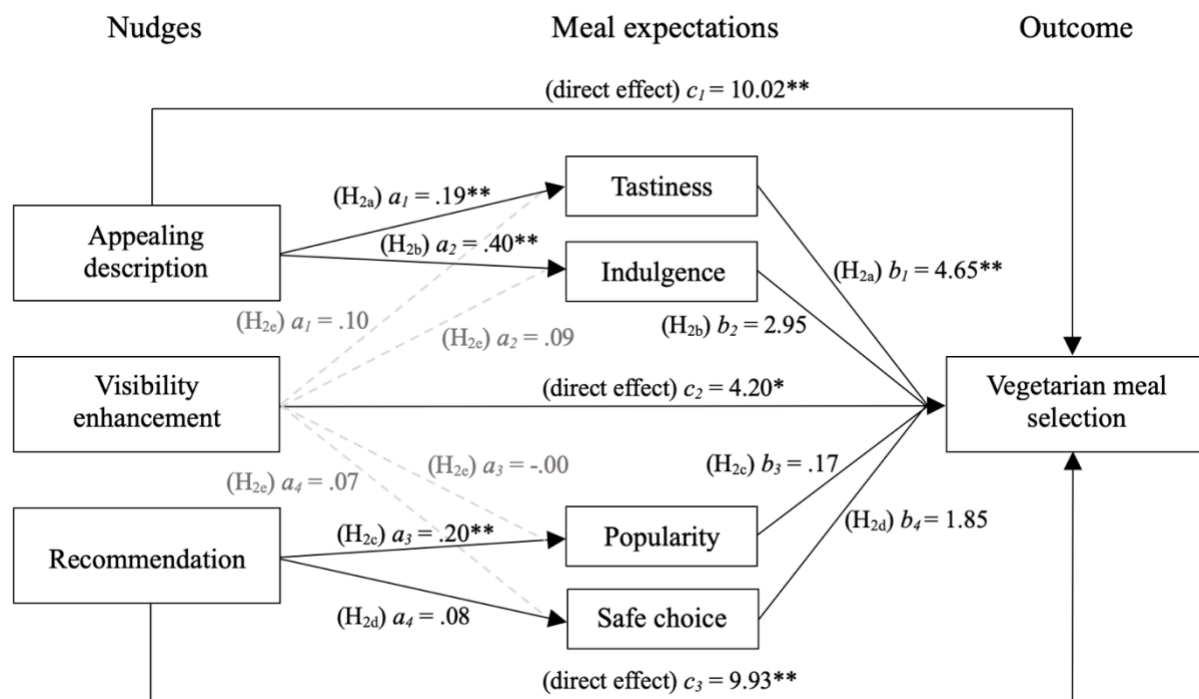
Since the results suggested that two nudges were more effective than the control condition, indirect effects of mediators were tested for as well. Since no assumptions were violated, the parallel mediation analysis was carried out, controlling for gender, age and average meat consumption. Outliers were removed for tastiness ( $N = 11$ ), indulgence ( $N = 2$ ), popularity ( $N = 23$ ) and safe choice ( $N = 14$ ) because they were more than 1.5 times the IQR lower or higher than the lower or upper limit, resulting in a total sample of  $N = 454$ .

The effects of the parallel mediation analysis are presented in figure 4. The appealing description resulted in higher expectations of tastiness ( $a_1 = .19$ ,  $SE = .09$ ,  $t = 2.21$ ,  $p = .027$ ) and indulgence ( $a_2 = .40$ ,  $SE = .09$ ,  $t = 4.54$ ,  $p < .001$ ) of vegetarian meals. Additionally, a higher score on tastiness resulted in more vegetarian meal choices ( $b_1 = 4.65$ ,  $SE = 1.92$ ,  $t = 2.42$ ,  $p = .016$ ), but this was not found for indulgence ( $b_2 = 2.95$ ,  $SE = 1.82$ ,  $t = 1.63$ ,  $p = .104$ ). A 95% bias-corrected confidence interval based on 10.000 bootstraps samples indicated that the indirect effect through tastiness ( $a_1b_1 = .90$ ) was entirely above zero, 95% CI [.06, 2.17], but not for indulgence ( $a_2b_2 = 1.20$ ), 95% CI [-.20, 2.81]. Moreover, more vegetarian meals were selected ( $c_1 = 10.02$ ,  $SE = 2.64$ ,  $t = 3.80$ ,  $p < .001$ ) even when considering the indirect effect of the mediators. Thus, the relationship between the appealing description and vegetarian meal choice is mediated through tastiness, but not through indulgence. Therefore,  $H_{2a}$  has been supported, whereas  $H_{2b}$  has been rejected.

Additionally, the recommendation resulted in higher expectations of popularity of vegetarian meals ( $a_3 = .20$ ,  $SE = .08$ ,  $t = 2.43$ ,  $p = .016$ ), but not of safe choice ( $a_4 = .08$ ,  $SE = .09$ ,  $t = .87$ ,  $p = .383$ ). However, neither a higher score of popularity ( $b_3 = .17$ ,  $SE = 1.66$ ,  $t = .11$ ,  $p = .916$ ) nor safe choice ( $b_4 = 1.85$ ,  $SE = 2.00$ ,  $t = 1.12$ ,  $p = .265$ ) resulted in more vegetarian meal choices. In line with this, the 95% bias-corrected confidence interval based on

10.000 bootstrap samples indicated that the indirect effects through popularity ( $a_3b_3 = .04$ ) and safe choice ( $a_4b_4 = .14$ ) were not entirely above zero, with 95% CI [-.81, .92] for popularity and 95% CI [-.25, .77] for safe choice. It was found that the recommendation resulted in more vegetarian meal choices directly ( $c_3 = 9.93$ ,  $SE = 2.51$ ,  $t = 3.96$ ,  $p < .001$ ). Yet, it cannot be said that the relationship between the recommendation and vegetarian meal choice is mediated through popularity and safe choice. Thus,  $H_{2c}$  and  $H_{2d}$  have been rejected.

Lastly, as expected, the visibility enhancement did not result in higher expectations of tastiness ( $a_1 = .10$ ,  $SE = .08$ ,  $t = 1.23$ ,  $p = .230$ ), indulgence ( $a_2 = .09$ ,  $SE = .07$ ,  $t = 1.07$ ,  $p = .288$ ), popularity ( $a_3 = -.00$ ,  $SE = .08$ ,  $t = -.02$ ,  $p = .981$ ) and safe choice ( $a_4 = .07$ ,  $SE = .09$ ,  $t = .88$ ,  $p = .420$ ) of vegetarian meals. Therefore,  $H_{2e}$  has been supported. The menu did not have a direct effect on vegetarian meal choice ( $c_2 = 4.20$ ,  $SE = 1.92$ ,  $t = 1.63$ ,  $p = .093$ ) either.



**Figure 4**

*Effects ( $\beta$ ) of parallel mediation analysis.*

\*Tends towards a significant effect ( $\alpha = .1$ ).

\*\*Indicates a significant effect ( $\alpha = .05$ ).

## Exploratory analyses

### *Effect sizes of menu nudges*

The decision was made to determine the effect sizes (i.e., Cohen's d) of the menu nudges to get more insight into their effectiveness and to compare them to previous research.



Independent-samples t-test were used to compare the means of the appealing description and recommendation to the control menu. The effects of covariates could not be controlled for in this analysis. Compared to the control, the effect size of the recommendation ( $t(244) = 3.25, p < .001$ ) was  $d = .41$  with 95% CI [.16, .67] and the effect size of the appealing description ( $t(245) = 4.13, p < .001$ ) was  $d = .52$  with 95% CI [.27, .77]. This indicates effects that tend towards medium (Cohen, 1992).

***Moderation of average meat consumption***

Finally, it was tested whether the relationship between the menu nudges and vegetarian meal choice was moderated by average meat consumption, since the Pearson’s correlation suggested a moderate correlation. Contradictory to the finding of Bacon & Krpan (2018), that nudges can backfire on people that eat little meat, the correlation pointed towards the opposite direction. The moderation analysis, controlling for gender, was performed using PROCESS model 1. Results revealed that the interaction between the appealing description and average meat consumption ( $\beta = -3.46, SE = 1.46, t = -2.37, p = .006$ ) was statistically significant, as well as for the recommendation ( $\beta = -3.60, SE = 1.41, t = -2.56, p = .011$ ). No significant effect was found for the interaction with visibility enhancement ( $\beta = -.34, SE = 1.47, t = -.23, p = .820$ ). Table 3 shows the statistics of different moderation values for the appealing description and recommendation. The analysis revealed that average meat consumption positively moderates the relationship between the menu nudges and vegetarian meal choice, but only for people who eat a little or average amount of meat. Thus, the menu nudges were more effective for people who eat less meat in general.

**Table 3**

*Moderation of average meat consumption.*

	Moderation value	Estimate ( $\beta$ )	SE	95% CI		t	p
				lower	upper		
Appealing description	2.86	16.60	3.38	9.95	23.25	4.91	<.001
	4.56	10.73	2.42	5.98	15.47	4.44	<.001
	6.26	4.85	3.54	-2.10	11.80	1.37	.180
Recommendation	2.86	16.41	3.45	9.64	23.19	4.76	<.001
	4.56	10.29	2.42	5.52	15.05	4.24	<.001
	6.26	4.16	3.46	-2.45	10.77	1.24	.223

## Discussion

### Effectiveness of menu nudges

The first aim of this study was to gain more insight into the effectiveness of three menu nudges (i.e., appealing description, recommendation, visibility enhancement) in increasing vegetarian meal choice in restaurants. It was hypothesised that all three nudges would increase vegetarian meal choice and that the appealing description would be most effective followed by the recommendation and visibility enhancement. In this study, it was found that the appealing description and recommendation were effective in increasing vegetarian meal choice. Both nudges were more effective in doing so than the visibility enhancement, for which no effect was found. Thus, the nudges that provide decision information were more effective than the nudge that provides decision assistance, implying that changing the way information is presented is more effective than providing reminders (Münscher et al., 2016). This finding is in line with the meta-analysis of Cadario & Chandon (2020), who found higher effect sizes for the appealing description and recommendation. Remarkably, the effect sizes in this study were even higher. However, the lack of an effect of the visibility enhancement nudge in this study was not expected based on Cadario & Chandon's (2020) study. This could be explained by the small effect of this nudge (Cadario & Chandon, 2020), which only becomes visible with larger study samples. The sample size of this study, which was not big enough to determine the effect size ( $d = .13$ ) of this nudge, could be considered a limitation.

Additionally, based on the study of Cadario & Chandon (2020) it was expected that the appealing description would be more effective in increasing vegetarian meal choice than the recommendation. In this study, no difference was found in their effectiveness. A difference between the studies that could explain this finding is that this study focused on vegetarian meals, whereas Cadario & Chandon (2020) focused on healthy meals. Rosenfield and Tomiyama (2020) offer an explanation related to this; concerns about the tastiness of vegetarian meals is the most important factor that prevents people from eating vegetarian. Meals with meat are perceived as more tasteful and less boring. Since the goal of the appealing description is to increase people's perception of tastiness, this might, relative to the recommendation, have been less effective for vegetarian meals compared to healthy meals which do include meat. Another reason could be the small difference in effectiveness between the nudges (Cadario & Chandon, 2020), which can only be detected with a larger study sample.

Furthermore, it should be considered that the results from this study were more positive than those of Bacon & Krpan (2018), who used somewhat comparable menus. A reason for the higher effectiveness of the nudges in this study could be due to differences in the design of the

menus. One difference is that Bacon & Krpan (2018) used a “v” symbol to indicate vegetarian meals, which can result in resistance. Emphasising that a meal does not contain meat results in more taste concerns (Rosenfield & Tomiyama, 2020). Therefore, people might be less likely to choose the vegetarian meal. Additionally, participants in this study had characteristics that are correlated with a willingness to eat less meat. Females (47%) compared to males (37%) are more likely intending to eat less meat, as well as younger and higher educated people (54-56%) compared to the average population (42%; Bos & Keuchorius, 2021). Possibly, they are more influenced by the nudges because they perceive less barriers to vegetarianism. However, these sample characteristics lead to a limited generalisability to the general population, which can be considered a limitation of this study.

Lastly, the role of average meat consumption differed from results of Bacon & Krpan (2018). In this study, people who eat less meat in general were more effected by the menu nudges; they chose the vegetarian meals more often. This could be explained by personal preferences that tend more towards vegetarianism or the perception of social norms that favour vegetarianism (Bos & Keuchorius, 2021; Harguess et al., 2020). However, Bacon & Krpan (2018) reported that people who eat little meat were negatively impacted by the nudges. One reason for this could again be the use of a “v” symbol, which can result in resistance due to taste concerns (Rosenfield & Tomiyama, 2020). Also, they included more options on their menus which contained meat. Since, especially, flexitarians favour meat in restaurants compared to at home (Biermann & Rau, 2020), the big variety of choices might have enhanced this. Overall, due to the inconsistencies, this finding should be interpreted carefully.

### **Indirect effect of meal expectations**

The second aim of the study was to gain insight into the role of meal expectations. It was hypothesised that meal expectations would mediate the relationship between the nudges that provide decision information (i.e., appealing description, recommendation) and vegetarian meal choice. First, it was expected that tastiness and indulgence would mediate the relationship for the appealing description. This study found that the appealing description resulted in higher expectations of tastiness and indulgence. However, only higher expectations of tastiness resulted in more vegetarian meal choices. The finding that indulgence did not mediate the relationship was not expected based on research of Turnwald and Crum (2019). In their study, meals were described in a way that emphasised taste and indulgence strongly (e.g., by using terms as “indulgent” and “mouthwatering”). In this study meals were described by terms targeting taste indirectly (e.g., by using terms as “artisanal” and “Burgundian”) and focusing

less on indulgence. Since the meal descriptions did not target indulgence directly, it might have been less effective in changing actual choice. It could be argued that self-control problems were not targeted effectively enough (Thaler & Sunstein, 2021, p. 95); people did not perceive the vegetarian meal as indulgent enough to consider its consumption beneficial now.

Additionally, it was expected that the recommendation would target expectations regarding popularity and safe choice. To start, the recommendation did result in higher expectations of popularity. Yet, this expectation failed to result in more vegetarian meal choices. This was not expected based on research of Higgs (2015). An explanation is that higher expectations about popularity alone are not enough to change behaviour. Even though norms regarding other's choices contribute to meal choice, personal preference plays an important role as well (Bos & Keuchenius, 2021); people who have negative beliefs towards vegetarian meals will not change their behaviour solely based on norms. Furthermore, the menu did not result in higher expectations of safe choice in taste. Apparently, a recommendation of a chef is not a reason to perceive a meal as a safe choice. Higgs (2015) mentioned that eating norms affect behaviour because they reveal safe choices. However, it is possible that norms of opinion leaders (i.e., a chef) do not give people clear information regarding this, since a chef is not perceived as someone in their reference group (Bicchieri, 2005). Thus, the nudge might not target this expectation because safe choices are only influenced by the reference group.

Finally, the relationship between visibility enhancement and vegetarian meal choice was not mediated by meal expectations. This was expected since this nudge does not provide decision information (Münscher et al., 2016). Yet, based on the findings of this study, it cannot be said that nudges that provide decision information are more effective than the nudge that provides decision assistance because of mediation through meal expectations. Future research on the lack of this effect is necessary. For instance, it could be hypothesised that personal preferences or pre-existing norms moderate the relationship between meal expectations and vegetarian meal choice (Bos & Keuchenius, 2021; Harguess et al., 2020). For now, since only tastiness mediated the relationship, no clear conclusions can be drawn about the reason behind the higher effectiveness of these nudges.

## **Implications**

To our knowledge, this is one of the first studies that has compared these nudges against each other in terms of being effective in increasing vegetarian meal choice. Based on the findings, it can be said that at least two nudges, appealing description and recommendation, are effective in increasing vegetarian meal choices, in addition to healthy food choices in general (Cadario

& Chandon, 2020). It extends the toolbox of effective menu nudges to implement for promoting vegetarian meal choices, which till now included mainly defaults and menu positioning (Campbell-Arvai et al., 2014; Langen et al., 2022). In line with this, a practical implication for restaurant owners and policy makers is to consider using either the appealing description or recommendation to reach the goal of more vegetarian choices. Especially, since these nudges are considered acceptable by restaurant owners (Regio Foodvalley, 2022). In contrast, they should consider that the visibility enhancement nudge is not as effective in increasing vegetarian meal choice and thus should give preference to other nudges.

Additionally, it is important to consider that for the appealing description, more positive expectations about the vegetarian meal's tastiness contribute to more vegetarian choices. This was also suggested by Turnwald and Crum (2019). Therefore, a practical implication for restaurant owners and policy makers is to focus the framing of the vegetarian meal on tastiness, since this is the ingredient that partially explains the effect. However, they should consider that it was not confirmed that positive expectations about a meal's indulgence, popularity and safe choice in taste influence vegetarian meal choice (Higgs, 2015; Turnwald & Crum, 2019). Therefore, potential menu nudges do not have to focus on this.

### **Limitations and future research**

Several limitations of this study must be discussed. First, the experiment was conducted online instead of in real restaurants. A realistic menu design and scenario were used to minimize the disadvantages of the design. Yet, various stimuli that are present in a restaurant setting could not be included. Previous studies that have been conducted online have reported similar results to experiments conducted in realistic settings (Liu, 2012), which might be the case for these nudges as well. Additionally, a limitation is the generalisability of the findings. In this study, menus with four meals, which could be considered similar, were used. Moreover, meal prices were all set the same. However, real restaurants usually offer a wide variety of meals with different prices. Therefore, it has yet to be understood if these nudges can be successfully implemented and are effective in actual restaurants. A recommendation is to study the effectiveness of the menu nudges in a realistic setting, to better understand if the effects are similar as in online settings with simple designs.

Another limitation is the practical implementation of the appealing description nudge. In this study, the vegetarian meal was the only meal that was described in a tasteful way, but in real restaurant often all meals are described in an appealing way. Therefore, it could be harder to differentiate vegetarian meals from other meals based on the description. A

recommendation is to study whether an appealing (taste-focused) description of a vegetarian meal is more effective in steering meal choice compared to appealing descriptions of meals with meat, to better understand the effectiveness of this nudge in a realistic context.

A final limitation is the limited previous literature available to underpin factors that explain the effectiveness of nudges. In this study, it was researched whether meal expectations could explain the effect. Yet, most meal expectations failed to show an effect on vegetarian meal choice. Future research should therefore focus on what explains this lack of an effect and on other factors that could be responsible for the effectiveness of nudges. In line with this, more research is needed on the role of average meat consumption, to better interpretate the effect of this variable in relation to menu nudges and vegetarian meal choice.

### **Conclusion**

In conclusion, the appealing description and recommendation nudge were effective in increasing vegetarian meal choices in an online restaurant setting, but no effect of the visibility enhancement nudge was detected. Nudges that provide decision information were therefore found to be more effective than nudges that provide decision assistance. Additionally, tastiness was found to mediate the relationship between the appealing description and vegetarian meal choice, but no mediating effect of the other meal expectations was found. Thus, it cannot be said that changing meal expectations fully explain the higher effectiveness of nudges that provide decision information. More research is needed to explain what factors are responsible for this and to better understand the effects of these nudges in a realistic setting. Overall, it is recommended for restaurants owners and policy makers to use either the appealing description nudge, with a focus on tastiness, or the recommendation nudge to promote healthy and sustainable food choices.

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**Appendix A**  
**Informed consent**

Hello,

For our Master Thesis that we are currently working on for our Master in “Social, Health and Organisational Psychology” at Utrecht University, we are conducting research on the topic of eating in a restaurant setting. The focus of the research is on meal choices, meal expectations and the acceptance of behavioural influence. We will measure this with the use of an online experiment and some survey questions. You will be asked to choose a meal from a menu a few times. Afterwards, there will be some closed questions regarding this. Participating in this study takes about 5 to 10 minutes. To participate in this study, you are required to be at least 18 years old and live in the Netherlands. You are not able to participate in this study in case you follow a vegetarian (no meat and fish), vegan (no animal products at all) or pescatarian (no meat) diet. In that case, you can close this study now.

This study has been approved by the Ethics Review Board of the Faculty Social & Behavioural Sciences at Utrecht University (number 23-0044). Before choosing to participate in this study, we would like to inform you that participating is completely voluntarily. At each point in time during the study, you are free to end your participation for whatever reason. In addition, the study is completely anonymous. The data provided by you cannot be traced back to you in any way. The retrieved data will be saved for 10 years in an anonymised format which is only accessible to the researchers.

In case you have any questions, remarks or complaints, you can contact (one of) the researchers below.

Researchers and contact information:

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Thank you in advance!

By clicking on the box “I give consent”, you indicate that you have read the information above and give consent for participation in this study and the use of your data. Again, we want to emphasise that at every point of time during this experiment, you can change your mind and end your participation.\*

*\*This text has been translated from Dutch to English.*

## **Appendix B**

### **Debriefing**

The questionnaire is finished. Thank you for participating in this study.

In case you have any questions, remarks or complaints, you can contact (one of) the researchers below.

Researchers and contact information:

Michelle Smits (m.smits1@students.uu.nl)

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### **Debriefing**

The purpose of this study is to research the effect of nudges on meal choices that people make in a restaurant setting. In this case, the nudges are simply said changes in the menu design that can promote certain choices. During the experiment, you were assigned to one of four experimental conditions, if you indicated to not follow a vegetarian, vegan or pescatarian diet. One of the four condition did not include a nudge. In this case, you were presented with a standard menu design. The other three conditions all had a nudge included in the menu design. These nudges were an appealing description of one of the meals, the denoting of one meal as “chef’s favourite” or a stand-out box around one of the meals. The purpose of this was to make people choose the vegetarian meal more often, since these meals are more sustainable than meals with meat. In addition, consuming vegetarian meals can have benefits for your health.

Beforehand, we could not inform you about the purpose of this study because this could have influenced the choices you would have made during the experiment.\*

*\*This text has been translated from Dutch to English.*