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(Not) Eating for The Environment:

The Impact of Restaurant Menu Design on Vegetarian Food Choice

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Abstract

Previous research has shown that restaurant menu design can influence food choices. However, it remains unknown whether such contextual effects on food selection are dependent on people's past behavior. In the present study, we focused on vegetarian food choices, given their important implications for the environment, and investigated whether the influence of different restaurant menus on the likelihood of selecting a vegetarian dish is moderated by the number of days on which people reported eating only vegetarian food during the previous week. In an online scenario, participants were randomly assigned to four different restaurant menu conditions—control (all dishes presented in the same manner), recommendation (vegetarian dish presented as chef's recommendation), descriptive (more appealing description of vegetarian dish), and vegetarian (vegetarian dishes placed in a separate section)—and ordered a dish for dinner. The results showed that the recommendation and descriptive menus increased the likelihood of vegetarian dish choices for infrequent eaters of vegetarian foods, whereas these effects tended to reverse for those who ate vegetarian meals more often. The vegetarian menu had no impact on the infrequent vegetarian eaters' choice but backfired for the frequent vegetarian eaters and made them less likely to order a vegetarian dish. These findings indicate that people's past behavior is an important determinant of the impact of nudging on food choices, and that achieving sustainable eating may require more personalized interventions.

Keywords: choice architecture, nudging, environment, eating, menu, vegetarian

Introduction

Agriculture has an important impact on environmental resources. Growing food currently generates nearly 25% of global green-house gas (GHG) emissions, occupies roughly half of all vegetated land, and accounts for 70% of fresh water use (Searchinger et al., 2013). However, different types of food have different effects. The production of plant-based foods generally has much smaller consequences for the environment than the production of meat and farmed fish, and the highest impact comes from producing meat from ruminant animals including beef and lamb (Clark & Tilman, 2017; Naylor et al., 2005; Ranganathan et al., 2016). For example, livestock production itself accounts for nearly 80% of agricultural GHG emissions, thus having an undesirable effect on climate change (McMichael, Powles, Butler, & Uauy, 2007). Livestock production also negatively influences biodiversity because it requires a substantially larger land area compared to the production of vegetarian foods (Naylor et al., 2005).

The adverse impact of agriculture on the environment has been steadily increasing and this trend is expected to continue partly as a result of population growth but also because rising affluence leads to higher calorie consumption per person and proportionally higher consumption of animal products (Tilman & Clark, 2014). Between 1961 and 2009 global availability of animal-based protein grew by 59% compared to a 14% growth in plant-based protein and the demand for meat and dairy could rise by 80% between 2006 and 2050 (Ranganathan et al., 2016). Many scientists therefore propose that, to achieve sustainable food production in the future, it is important to limit the proportion of animal products in people's diets (McMichael et al., 2007; Springmann, Godfray, Rayner, & Scarborough, 2016; Wirsenius, Azar, & Berndes, 2010).

One may think that solving the environmental perils associated with the consumption of meat and farmed fish would require persuading a large proportion of the population to become vegetarian. However, meat and fish are important sources of nutrition, variety, and pleasure in people's diets and it is not necessary to completely stop eating them to yield considerable environmental benefits. For example, Tilman and Clark (2014) estimated annual per capita GHG emissions from food production for the global-average income-dependent diet projected for 2050. This diet refers to the foods that people are expected to consume globally in 2050 if per capita GDP grows as predicted. According to Tilman and Clark's (2014) estimates, a global adoption of a Mediterranean diet, which involves moderate amounts of meat and seafood, instead of the income-dependent diet, which is heavily based on meat, would reduce annual per capita GHG emissions from food production by 30%. This considerable difference is primarily accounted for by a smaller proportion of ruminant meats, poultry, pork, and seafood in the Mediterranean (vs. income-dependent) diet, and a larger proportion of fruits and vegetables. Influencing people to decrease their consumption of meat and fish and eat more fruit and vegetables can therefore make an important contribution to the sustainability of food production (Ranganathan et al., 2016).

Barriers to Eating for the Environment

There are a number of barriers that make it difficult for policymakers to influence consumers to adopt environmentally friendly diets. On the one hand, many people do not make a strong connection between the environment and food, and even when they do, they are more likely to be concerned about packaging and transport than the effect of eating different types of

food (Macdiarmid, Douglas, & Campbell, 2016). On the other hand, given its important role in intra-community relationships and contribution to social bonding, eating meat is deeply ingrained in various cultures (Leroy & Praet, 2015). Meat is culturally accepted not only because it is important for social relationships, but also because it is universally regarded as a symbol of affluence and success (Smil, 2002). Indeed, the amount of meat consumed has been shown to rise with per capita income and has increased globally with GDP over the last 50 years (Tilman & Clark, 2014). Growth in meat consumption has been particularly rapid in some Northeast and Southeast Asian countries (e.g. China, Japan, Vietnam, and Thailand) as a result of economic development and globalization of the food industry (Nam, Jo, & Lee, 2010). In addition to cultural factors, lack of competence can also be an important barrier to reducing the intake of meat and eating more fruits and vegetables. People feel competent in preparing meat dishes and serving them to others (Lea, Crawford, & Worsley, 2006), whereas they may lack knowledge and skills necessary to prepare vegetarian meals (Lea et al., 2006; Lea & Worsley, 2001; Pohjolainen, Vinnari, & Jokinen, 2015).

Overall, most people indicate that their choices regarding what to eat are shaped by many factors with different degrees of importance, including taste, health, cost, mood, culture, competence, and so on, whereas the environment is infrequently evoked as a consideration (Connors, Bisogni, Sobal, & Devine, 2001; Macdiarmid et al., 2016; Pollard, Kirk, & Cade, 2002; Steptoe, Pollard, & Wardle, 1995).

Contextual Influences on Food Consumption

However, recent developments in the field of behavioral science indicate that it is not necessary to change people's conscious preferences and considerations to influence what they eat (Dolan & Galizzi, 2015; Dolan et al., 2012; Marteau, Hollands, & Fletcher, 2012). Indeed, much of our decision making about food is automatic (Wansink & Sobal, 2007) and is influenced by factors including salience (e.g. Wansink, 2016), priming (e.g. North, Hargreaves, & McKendrick, 1999), defaults (e.g. Wansink, 2015), and social norms (Cruwys, Bevelander & Hermans, 2015). In other words, to impact people's behavior, it should be sufficient to change the context in which they act.

One of the simplest ways to influence food consumption based on the principles of behavioral science is by changing the design of restaurant menus (Wansink & Love, 2014). The main design features that have been investigated are: the location of items on the menu (Dayan & Bar-Hillel, 2011; Wansink, 2015), how individual items are described (Wansink, Painter, & Van Ittersum, 2001), the inclusion of additional information (Visschers & Siegrist, 2015), and the visual design of the menu (Feldman, Mahadevan, Su, Brusca, & Ruzsilla, 2011). For example, people are more likely to select items from the top or bottom of a single list of foods or beverages (Dayan & Bar-Hillel, 2011), and location has been shown to affect choice from a bi-fold menu (Feldman et al., 2011). The impact of location on food choices occurs because of the primacy and recency effects (people are most likely to remember the last and first things they see) that are created by people's natural gaze motion (where the reader first looks and how their gaze moves around a printed page) when looking at a menu (Bowen & Morris, 1995).

The way that food is described has also been shown to have an impact on both the choices that people make and their perceptions of the food after consumption (Wansink et al., 2001; Wansink, Van Ittersum, & Painter, 2005). Wansink and Love (2014) recommend four types of

words which can influence consumer choice in restaurants: words with sensory appeal, words that trigger happy memories, geographic or location names with positive associations, and the names of well-liked brands. Besides manipulating food descriptions, attracting attention to menu items by adding boxes around them can increase the sales of these items (Feldman et al., 2011; Feldman, Su, Mahadevan, Brusca & Hartwell, 2014). Also, associating foods with certain symbols or colors can make people more likely to select these foods relative to simply providing information about the foods (Wagner, Howland, & Mann, 2015). Moreover, priming with images (e.g. the sea) related to particular food types (e.g. fish) can increase the consumption of these foods (Guéguen, Jacob, & Ardiccioni, 2012).

Although there is less research on the influence of menu design on the choice of vegetarian food, evidence suggests that this contextual feature can also be effective in this regard. For example, the use of a separate default menu containing only vegetarian items was found to significantly increase the proportion of people selecting a vegetarian dish (Campbell-Arvai, Arvai, & Kalof, 2014), and the use of a colorful 'climate-friendly choice' logo combined with information posters increased the proportion of people who selected climate friendly meals in a cafeteria (Visschers & Siegrist, 2015).

The Best Predictor of Future Actions Is Past Behavior

Behavioral scientists have demonstrated that changing the context in which people act (e.g. by manipulating restaurant menu designs) shapes food choices. However, less is known about whether and to what extent the effectiveness of these behavioral interventions is moderated by factors beyond the immediate context in which the choice is made. For example, an established

finding from psychological literature is that past behavior is one of the factors that most convincingly predicts future behavior (Aarts, Verplanken, & Knippenberg, 1998; Gardner, 2015; Ouellette & Wood, 1998). In the domain of food consumption, the extent to which a person drank alcohol, consumed meat, or ate breakfast in the past is likely to predict these behaviors in the future (Conner, Norman, & Bell, 2002; Conner, Warren, Close, & Sparks, 1999; Saba & Di Natale, 1998; Wong & Mullan, 2009).

Past behavior is one of the strongest predictors of future eating because it determines both automatic and deliberate decision-making processes that jointly shape people's actions (Ajzen, 2002). On the one hand, frequent repetitions of certain behaviors in the past lead to the formation of a habit—an automatic tendency to undertake these behaviors that does not require much thinking (Gardner, 2015; Lally & Gardner, 2013; Verplanken & Orbell, 2003; Wood & Rünger, 2016). For example, frequently consuming candies in the past predicted stronger habit strength concerning this eating behavior (Verplanken & Orbell, 2003). On the other hand, frequent repetitions of a behavior in the past also strengthen people's deliberate intentions to perform this behavior (Conner et al., 1999; Wong & Mullan; 2009). For example, frequently drinking in the past made people more likely to intend to undertake this action in the future (Conner et al., 1999). Importantly, habits and intentions do not operate in isolation—instead, they jointly shape people's actions (Webb & Sheeran, 2006; Wood & Rünger 2016). Therefore, because past behavior determines both habits and intentions, it predicts future behavior over and above either of these two processes (Ajzen, 2002). For example, Wong and Mullan (2009) found that past eating behavior was a stronger predictor of breakfast consumption than intentions.

Considering that past behavior determines both automatic and deliberate processes and generally predicts behaviors such as eating more effectively than these processes individually

(Ajzen, 2002; Ouellette & Wood, 1998; Wong & Mullan, 2009), in the present article we use past behavior as a measure of a person's overall propensity to make specific food choices. We find it more convenient to measure this propensity by asking people to report their past eating behavior than by asking them to report intentions and habits involved in eating, considering that people do not always have good insight into their mental states (Nisbett & Wilson, 1977).

Given the importance of past actions in the context of food choice, understanding the potential of behavioral science interventions to influence eating for the environment requires understanding whether and to what extent the impact of the interventions depends on past eating choices. Indeed, resolving this conundrum can clarify whether these interventions work for different individuals regardless of their usual eating choices, or whether they can influence pro-environmental eating only for a subgroup of individuals who eat vegetarian meals more or less regularly.

Study Overview

The present study aims to examine whether the effectiveness of different restaurant menus in nudging pro-environmental food choice depends on the frequency at which people ate vegetarian dishes in the past. We decided to focus on food choice in restaurants because this is a simpler environment in which to change behavior than at home, and the barriers associated with the social norms of the household and with lack of knowledge and skill in sourcing ingredients or preparing food can therefore be avoided. Furthermore, our focus is on people who are neither vegetarian nor vegan, given that vegetarians and vegans have already made the decision not to eat meat and fish.

To accomplish the research objective, we employed three different restaurant menu designs as treatments and one control design. The 'recommendation' treatment involved highlighting one of the vegetarian dishes on the menu with a box and the words "Chef's Recommendation". This treatment was selected because previous research suggests that attracting attention to menu items can increase the likelihood of their choice (e.g. Feldman et al., 2011, 2014). The 'descriptive' treatment involved changing the description of the dish to increase sensory appeal. This treatment was selected because words that convey sensory appeal are known to enhance food choice (Wansink & Love, 2014), and also because in practice restaurateurs might find it a more acceptable intervention concerning vegetarian dishes than the one used for the recommendation menu. The 'vegetarian' menu involved placing the vegetarian dishes in a separate section of the menu. The treatment was selected because restaurants often use this design, and yet it is unknown whether presenting vegetarian meals in a separate section increases the likelihood of choice or actually decreases it by signaling that this section is not for the non-vegetarians. In the 'control' menu, all dishes were presented in the same manner.

Given that investigating how the effectiveness of nudging may depend on past behavior has been neglected in previous research, it is difficult to predict how exactly the treatments should influence vegetarian food choices for people who ate vegetarian dishes frequently or infrequently in the past. One possibility is that infrequent vegetarian eaters will not be susceptible to the effects of restaurant menu design because they are strongly prone to avoiding vegetarian foods, and that only frequent vegetarian eaters will be impacted. This prediction is in line with previous research which indicates that influencing people to adopt behaviors they do not frequently pursue is challenging, even if they consciously intend to change their actions (Duhigg, 2012; Graça, Oliveira, & Calheiros, 2015; Latvala et al., 2012; Norman, Conner, &

Bell, 2000). However, it is also possible that nudging pro-environmental food choice may backfire for the frequent vegetarian eaters and thus encourage them to order meat or fish instead. This prediction is in line with previous research on moral licensing, according to which undertaking a behavior that is considered healthy or morally desirable can lead one to subsequently make a less healthy or morally desirable choice (Blanken, van de Ven, & Zeelenberg, 2015; Chiou, Yang, & Wan, 2011; Fishbach & Dhar, 2005; Messner & Brügger, 2015). In the context of food consumption, eating vegetarian meals is usually perceived as morally superior and healthier compared to eating non-vegetarian foods (Fox & Ward, 2008; Ruby & Heine, 2011). Therefore, any restaurant menu interventions that emphasize vegetarian meals may signal to frequent vegetarian eaters that they have already engaged in the morally superior food choice on numerous occasions, thus prompting them to select meat or fish instead. Given the competing theoretical accounts that allow for different hypotheses, we refrained from predicting the exact direction of influence the treatment menus will exert on vegetarian food choices depending on how frequently people ate vegetarian dishes in the past. Instead, we simply predicted that the past behavior may change this influence and thus serve as a moderator.

Method

Participants and Design

Eight hundred fifty-three participants (453 female) were recruited using Prolific Academic—a crowdsourcing platform tailored for research—and paid a fixed sum of £0.75 for taking part. All participants were U.K. resident adults whose first language is English. The

median age was 34 years, which is younger than the median age of 47 years for the UK adult population (Office for National Statistics, 2016). However, data suggest that younger adults are more likely to eat in restaurants than older people (Prior, Phillips, & O'Driscoll, 2014). All participants gave their consent before completing the study, which was conducted in accordance with the research ethics policy of the London School of Economics and Political Science. Those who could not choose freely from the items on the menu due to restricted diets, including those who described themselves as vegetarian or vegan, were identified with a question at the end of the study so they could be excluded from the analysis. The experimental design involved *restaurant menu design* (recommendation vs. descriptive vs. vegetarian vs. control) as a between-subjects factor.

Materials and Measures

Restaurant Menus

The menus used (Figure 1) were based on the main course section from an actual restaurant menu which was simplified to remove the dish of the day and the various options offered on some items (e.g. different sauces offered with the steak) so that participants could make a single choice without further information. The descriptions of the dishes were edited to make them consistent across all items by removing words which were not necessary to identify the food. For example, on the original menu one of the dishes was named after the restaurant and this name was removed. The resulting control menu included three meat dishes (Chicken Cacciatora, Steak Frites, and Hamburger), three fish dishes (Lobster & Crab Roll; Sautéed King Prawns, and Deep Fried Haddock) and two vegetarian dishes (Risotto Primavera and Ricotta & Spinach

Ravioli), with the vegetarian dishes appearing in first and last place on the list. The prices on the original menu varied with the two cheapest items being Hamburger and Ricotta & Spinach Ravioli. The original prices were included in all of the menus.

Three treatment menus were created by adding different interventions to the control menu. For the recommendation menu, the vegetarian dish at the top of the menu was highlighted with a box and captioned "Chef's Recommendation". On the descriptive menu, the name of the vegetarian dish at the top of the menu was changed from "Risotto primavera" to "Fresh seasonal risotto primavera". This description was selected as the most preferred from four draft descriptions, two for each of the two vegetarian dishes, which were evaluated using paired preference tests with 100 participants drawn from the same pool as that used for this study. For the vegetarian menu, the two vegetarian options were placed together at the bottom of the menu under a line and the heading "Vegetarian Dishes". On all menus except the vegetarian menu the vegetarian dishes were indicated with the symbol '*(v)*' after the name of the dish along with the footnote '*v-suitable for vegetarians*' (Figure 1).

Figure 1. Restaurant menus used in the present research. Menu names are for identification only and were not shown to participants.

Main Measures

To assess whether the frequency at which people ate vegetarian dishes in the past moderates the influence of restaurant menu design on vegetarian food choice we measured the frequency of eating vegetarian during the previous seven days on a scale from "1 = everyday" to "8 = no days" using the following question: "During the previous seven days, on how many days did you eat neither meat nor fish?" For the sake of simplicity, we refer to this moderator variable as *past behavior* when describing the statistical analyses in the results section. Moreover, to make the results more intuitive, we recoded the variable in such a way that eating vegetarian on zero days during the previous seven days corresponded to 0, eating vegetarian on only one day corresponded to 1, eating vegetarian on 2 days corresponded to 2, eating vegetarian on 3 days corresponded to 3, and so on.

Furthermore, *vegetarian food choice* was measured by recording the dish that each participant selected from the restaurant menu to which s/he was allocated and then coding the vegetarian food choices as 1 and all other choices as 0.

Control Measures

To ensure that the results of statistical analyses probing the hypothesis are not confounded by additional variables that may play a role in food consumption, we asked participants to report their *gender* because we expected this variable may be an important determinant of vegetarian food choice. While adult men and women eat similar amounts of fruit and vegetables and fish per day, men consume 46% more meat and 54% more red meat than women (Bates et al., 2014). Moreover, Ruby (2012) established that women are generally more likely to be vegetarian

relative to men. Meat is considered to be metaphorically masculine (Rozin, Hormes, Faith, & Wansink, 2012) and vegetarian men are perceived to be less masculine than men who eat meat (Ruby & Heine, 2011). Men are less likely than women to choose a vegetarian dish from a menu (Campbell-Arvai et al., 2014) and women are more likely to express a preference for white meat over red meat and for plant versus animal protein (De Boer & Aiking, 2011). Given these differences, it was important to assess gender as a control variable.

Moreover, we asked participants to report their weight and height to enable calculation of *Body Mass Index* (BMI). We found it important to assess this variable given its associations with vegetarian diet (Key, Appleby, & Rosell, 2006). We also asked participants to report their *age* because this variable is known to play a role in food choices (Drewnowski & Shultz, 2001), and we measured their *hunger* on a scale from "1 = not hungry at all" to "4 = very hungry" using the following question: "How hungry are you feeling now?" (i.e. at the time of the experiment).

Exploratory Measures

To gain additional insights into the impact of the restaurant menus on food choices, we measured several exploratory variables. Participants' *future intentions regarding vegetarian food consumption* were measured by asking them to indicate, on a scale from "0 = no intention" to "10 = very strong intention", how strongly they intended to eat more fruit and vegetables over the next three months. Moreover, we measured their *future intentions regarding eating a healthier diet*, using the same scale, by asking them how strongly they intended to eat a healthier diet over the next three months. Finally, we assessed participants' *health-related beliefs regarding eating vegetables, meat, or fish* on a scale from "1 = Strongly disagree" to "7 =

Strongly agree" using the following items: a) I think that eating vegetables is healthy; b) I think that eating meat is healthy; and c) I think that eating fish is healthy.

Procedure

Participants completed the study on-line using any laptop or desktop computer but not a mobile device. After giving their consent, they were asked to imagine a scenario in which they were catching up with a friend for dinner in a nice restaurant one evening during the week. To make it easier for them to imagine the scenario, they were also presented with an image of a cozy table in a restaurant. They then saw one of the four randomly assigned menus and were asked to select a main course they would have for dinner. Subsequently, participants were presented with the items described under the main, control, and exploratory measures in the materials section. Finally, they were asked whether their diet was omnivore, pescetarian, vegetarian, vegan, or restricted in some other way. We used this question to identify individuals who could not choose freely from the items on the menu due to restricted diets and whose data thus had to be excluded from statistical analyses.

Results

Data Preparation and Preliminary Analyses

Excluded Cases

Out of 853 people who completed the study, 76 (8.9%) described their diet as vegetarian or vegan comprising 10.8% of the women and 6.8% of the men. A further 22 respondents (2.6% of the total) reported some other dietary restriction. Of the remaining 755 participants five did not select any items from the menu and were also excluded. The remaining responses from 750 participants, 365 (48.7%) men and 385 women, were included in the main statistical analysis: 194 of these participants were in the control menu condition, 185 in the recommendation menu condition, 185 in the descriptive menu condition, and 186 in the vegetarian menu condition (Table 1).

Table 1

Number of Participants in the Four Restaurant Menu Conditions per Each Level of Past Behavior (0-7 Days)

	Past Behavior*								
	0 days	1 day	2 days	3 days	4 days	5 days	6 days	7 days	
Menu	*Number of Participants*								*Total*
Control	70	44	39	20	5	11	2	3	194
Recommendation	71	48	28	22	8	5	3	0	185
Descriptive	73	43	34	14	10	4	5	2	185
Vegetarian	88	27	32	14	11	7	4	3	186
Total	302	162	133	70	34	27	14	8	750

* Past Behavior is the number of days in the past week on which a participant reported consuming only vegetarian foods.

Past Behavior

Table 1 shows the distribution of participants across the four restaurant menu conditions depending on the frequency of past behavior—on how many days (out of the previous seven days) they consumed only vegetarian foods. As can be seen from the table, most of the

participants consumed only vegetarian meals on relatively few days, whereas few participants consumed such meals on all of the previous seven days.[1]

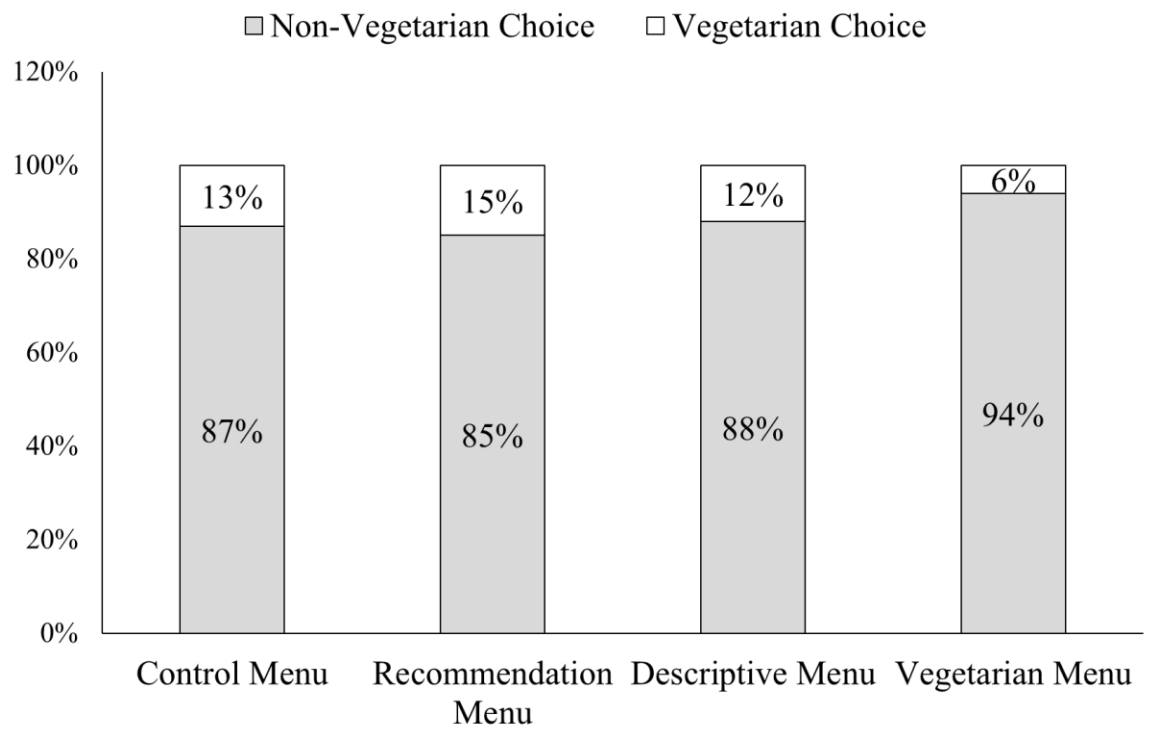

Figure 2. Descriptive summary of the proportion of participants who selected a vegetarian versus non-vegetarian dish in each of the four restaurant menu conditions.

Vegetarian Food Choice

Figure 2 provides a descriptive summary of the proportion of individuals who selected a vegetarian versus non-vegetarian dish in each of the four menu conditions. On average, more

[1] In this regard, it is important to clarify why individuals who reported eating vegetarian on all previous seven days were not excluded from analyses, unlike those who self-identified as vegetarians. The difference is that the latter individuals by default indicated that they eat neither meat nor fish, whereas the former individuals indicated that their diet is not restricted only to vegetarian meals and they do eat meat and/or fish, even if during the previous seven days they ate only vegetarian dishes. Therefore, although the former participants are classified as frequent vegetarian eaters, their eating choice is not restricted only to vegetarian foods, whereas vegetarians have already committed themselves to excluding meat and fish from their diets and therefore do not belong to the segment of the population at which our interventions are aimed.

participants preferred a non-vegetarian dish over a vegetarian one. To probe whether *vegetarian food* choice significantly differed in the recommendation, descriptive, or vegetarian menus relative to the control menu, we performed a logistic regression analysis. *Restaurant menu design*, represented by three dummy variables—one for the recommendation menu, one for the descriptive menu, and one for the vegetarian menu (the control menu therefore served as baseline)—was used as the independent variable. Nagelkerke's pseudo R^2 for the logistic regression model was 0.024, with the likelihood ratio χ^2 (3) = 9.219, and p = .027, thus indicating that the model with all the predictors included had a better fit compared to the model with only the constant included.[2] The recommendation menu, Odds Ratio = 1.104, 95% CI [0.618, 1.973], p = .738, and the descriptive menu, Odds Ratio = 0.917, 95% CI [0.503, 1.673], p = .779, did not influence vegetarian food choice relative to the control menu, whereas the vegetarian menu decreased the odds of selecting a vegetarian dish, Odds Ratio = 0.406, 95% CI [0.195, 0.848], p = .016.

Main Analysis: Past Behavior Moderates the Influence of Menu Design on Vegetarian Food Choices

To probe our hypothesis that past behavior should moderate the influence of restaurant menu design on vegetarian food choices, we computed an interaction with *restaurant menu design* (comprising three dummy variables—recommendation menu, descriptive menu, and vegetarian menu—with the control menu serving as baseline) as an independent variable, and

[2] In addition to the logistic regression analysis, we performed Pearson's chi-squared test associated with Figure 2. Similar to the logistic regression model, this test was statistically significant, Pearson χ^2 (3) = 8.222, p = .042, thus indicating that the extent to which participants selected vegetarian versus non-vegetarian dishes differed across the restaurant menu conditions.

past behavior as a continuous moderator that was centered prior to analyses (Hayes, 2013). Logistic regression was used given that *vegetarian food choice* was a dichotomous dependent variable.

Nagelkerke's pseudo R^2 for the logistic regression model was 0.148, with χ^2 (7) = 58.976, p < .001, thus indicating that the model with all the predictors included had a better fit compared to the model with only the constant included. As can be seen from Table 2, both the recommendation and descriptive menus interacted with past behavior, whereas the interaction term with the vegetarian menu was not significant. To compute the overall significance of the three interaction terms, we implemented a Wald test that yielded a significant finding, χ^2 (3) = 11.9, p = .008, thus showing that the effect of restaurant menu design on vegetarian food choices depended on participants' past behavior. Importantly, considering that the moderator was centered prior to computing the interaction terms (Hayes, 2013), Table 2 also indicates that none of the effects of menus on vegetarian choice reached conventional significance levels when the value of past behavior was average (1.399). Whereas the recommendation and descriptive menus slightly increased the odds of choosing a vegetarian dish (by roughly 88% and 50% respectively), and the vegetarian menu decreased the odds (by roughly 52%), none of these odds were beyond chance levels.

Table 2

The Interaction Between Restaurant Menu Design and Past Behavior in Influencing Vegetarian Food Choice

Predictor	Wald	Odds Ratio (Vegetarian vs. Other)	95% CI for Odds Ratio	p-value
Constant	67.138	0.090	[0.051, 0.161]	< .001

Recommendation Menu (RM)	3.079	1.883	[0.929, 3.817]	.079
Descriptive Menu (DM)	1.189	1.502	[0.723, 3.123]	.276
Vegetarian Menu (VM)	2.164	0.483	[0.183, 1.274]	.141
Past Behavior	27.904	2.049	[1.570, 2.673]	< .001
RM x Past Behavior	9.290	0.560	[0.385, 0.813]	.002
DM x Past Behavior	7.725	0.604	[0.423, 0.862]	.005
VM x Past Behavior	1.391	0.790	[0.534, 1.169]	.238
Overall Interaction Significance		χ^2 (3) = 11.9, p = .008		

Note: Model R^2 = 0.148 (Nagelkerke), Model χ^2 (7) = 58.976, p < .001
Control Menu is the reference category.
Past Behavior (M = 1.399, SD = 1.623) was centered prior to analysis.

To further clarify the interaction terms, we used the Process package developed by Hayes (2013) to compute the Johnson-Neyman regions of significance (Johnson & Neyman, 1936). This technique identifies the values on the continuum of past behavior at which point the effect of a restaurant menu on vegetarian choice transitions between statistically significant and nonsignificant. As can be seen from Table 3, for the recommendation menu, the first cut-off point is 1.226, and the odds ratio 2.080. These values indicate that, for infrequent vegetarian eaters (those who ate only vegetarian on 1.226 or fewer days out of the past seven days), the recommendation menu increased the odds of selecting a vegetarian dish by roughly 108% (odds ratio = 2.080), with the odds increasing below the cut-off point of 1.226 days. Between the cut-off points of 1.226 and 4.314 the recommendation menu did not significantly impact vegetarian food choice, and after the latter cut-off value the impact was negative. In other words, for more frequent vegetarian eaters (those who avoided meat and fish on 4.314 or more days), this menu decreased the odds of selecting a vegetarian dish by roughly 65.3% (odds ratio = 0.347) or more. The results for the descriptive menu can be interpreted in a similar manner. When it comes to the vegetarian menu, the findings are slightly different. They indicate that, for infrequent vegetarian eaters (those who ate neither meat nor fish on 0-1.969 days), this menu had no impact

on vegetarian choices. However, for more frequent vegetarian eaters (those who ate vegetarian on 1.969 days or more), the vegetarian menu decreased the odds of selecting a vegetarian dish by 57.8% or more. As a general rule, the odds ratios computed at lower levels of past behavior may be considered as more robust than those computed at higher levels, given that the number of infrequent vegetarian eaters was larger than the number of frequent vegetarian eaters (see Table 1).

Table 3

Moderator Values Defining Johnson-Neyman Significance Regions

	Significance Region			
Menu	**First Cut-off Point** (moderator value below which a menu significantly impacts vegetarian choice)		**Second Cut-off Point** (moderator value above which a menu significantly impacts vegetarian choice)	
	Moderator Value	Odds Ratio	Moderator Value	Odds Ratio
Recommendation Menu	1.226	2.080	4.314	0.347
Descriptive Menu	0.284	2.638	3.985	0.407
Vegetarian Menu	n/a	n/a	1.969	0.422

Note: Cut-off points are based on *p*-values of .05

To ascertain that the findings were not confounded by other factors that may have played a role in participants' food choices, we computed the same interaction analyses as discussed above while including the control variables (gender, BMI, age, and hunger) as covariates. The results did not significantly change. Both the interaction between the recommendation menu and past behavior ($p = .001$), and between the descriptive menu and past behavior ($p = .001$), remained statistically significant, whereas the interaction between the vegetarian menu and past behavior was again not significant ($p = .137$). The Johnson-Neyman significance regions were also relatively similar to the ones obtained without the control variables: for the recommendation

menu, the first and the second cut-off values were 1.269 and 3.925 respectively; for the descriptive menu, they were 0.737 and 3.509 respectively, and for the vegetarian menu, the second cut-off value was 1.886, whereas the first cut-off value was absent. Therefore, no confounding influences were identified. Out of the four control variables used in the confound testing, only gender strongly predicted vegetarian food choice ($p < .001$, odds ratio = 1.138), whereas BMI, age, and hunger were not significant as predictors (all $ps > .285$).

Exploratory Analyses

In addition to the main analysis that probed our hypothesis, we performed several analyses concerning the exploratory variables—*future intentions regarding vegetarian food consumption*, *future intentions regarding eating a healthier diet*, and *health-related beliefs regarding eating vegetables, meat, or fish*.

First, by employing multiple linear regression, we found that past behavior interacted with the descriptive menu in influencing future intentions regarding vegetarian food consumption, $b = -0.410$, 95% CI [−0.723, −0.098], $p = .010$. As indicated by the Johnson-Neyman significance region (Second cut-off point: Moderator Value = 2.762, $b = -0.655$), for infrequent vegetarian eaters (those who ate neither meat nor fish on 0-2.762 days), this menu had no impact on future intentions. However, for more frequent vegetarian eaters, (those who ate vegetarian on 2.762 days or more), it decreased the strength of their intention to eat vegetarian in the future by 0.655 points of the scale or more.

Second, we found that past behavior interacted with the descriptive menu in influencing future intentions regarding healthier diet, $b = -0.484$, 95% CI [−0.800, −0.168], $p = .003$. As

indicated by the Johnson-Neyman significance region (Second cut-off point: Moderator Value = 2.417, $b = -0.600$), for infrequent vegetarian eaters (those who ate neither meat nor fish on 0-2.417 days), this menu had no impact on intended healthy eating. However, for more frequent vegetarian eaters, (those who ate vegetarian on 2.417 days or more), it decreased the strength of their intention to eat healthier in the future by 0.600 points of the scale or more.

Finally, by employing a repeated measures ANOVA (corrected using Greenhouse-Geisser estimates of sphericity), we found that people's beliefs regarding how healthy it is to eat vegetables differed from their beliefs regarding how healthy it is to eat meat or fish, F (1.533, 1148.417) = 756.032, $p < .001$, $\eta_p^2 = .502$. More precisely, simple contrasts showed that eating vegetables ($M = 6.629$, $SD = 0.570$) was perceived as healthier compared to eating meat ($M = 5.089$, $SD = 1.219$), F (1, 749) = 995.477, $p < .001$, $\eta_p^2 = .571$, and compared to eating fish, ($M = 6.065$, $SD = 0.802$), F (1, 749) = 375.063, $p < .001$, $\eta_p^2 = .334$. This finding is in line with previous research showing that people tend to perceive vegetarian diets as healthier than diets that involve meat and/or fish (e.g. Fox & Ward, 2008; Key et al., 2006).

Overall, none of the reported exploratory analyses significantly changed after the control variables were used as covariates.

Discussion

The environmental sustainability of food production can be improved by people shifting their diets to increase the proportion of plant based food and reduce the proportion of animal products (Clark & Tillman, 2017; Ranganathan et al., 2016; Tilman & Clark, 2014). Behavioral scientists have suggested that a large proportion of human behavior is shaped by unconscious

forces, and people's food consumption can therefore be changed by manipulating the context in which they act (Dolan et al., 2012; Marteau, et al., 2012). For example, in one of the key findings from behavioral science literature on food choice, items were found to be up to twice as popular when they were placed at the beginning or the end of the list of their category options than when they were placed in the middle of the list (Dayan & Bar-Hillel, 2011). However, the extent to which the effectiveness of such nudging interventions is confined by factors beyond the context itself remains relatively unknown, especially in the domain of pro-environmental food choice where few studies have been conducted so far (e.g. Campbell-Arvai et al., 2014). Given that past behavior is one of the most important non-contextual predictors of human actions (e.g. Ouellette & Wood, 1998), in the present paper we focused on this variable as a potential boundary condition for the influence of context on vegetarian food choice. More precisely, we investigated whether previous frequency of eating vegetarian dishes determines the influence of three different restaurant menu designs—recommendation, descriptive, and vegetarian (vs. control)—on vegetarian food choice.

The findings revealed that people who ate vegetarian foods with different degrees of frequency in the previous seven days responded differently to the menu designs. The recommendation menu increased the likelihood of selecting a vegetarian dish for infrequent vegetarian eaters, but reduced it for more frequent vegetarian eaters. A similar pattern of findings was obtained for the descriptive menu. Moreover, exploratory analyses showed that this menu weakened the frequent vegetarian eaters' intentions to eat either vegetarian or healthy diets in the future. Finally, the vegetarian menu did not have an effect on the extent to which the infrequent vegetarian eaters selected a vegetarian dish, but it had a negative impact on frequent vegetarian eaters and made them less likely to choose vegetarian. All the results remained highly

robust after testing for potential confounding influences of gender, age, BMI, and hunger. Overall, the findings showed that, whereas certain menus can have a positive impact on pro-environmental food choice, they can also backfire and decrease the likelihood of this choice, depending on how frequently people ate vegetarian meals in the past.

Considering that our findings indicate that certain behavioural interventions that were previously shown to increase the likelihood of food choice, including attracting attention to menu items (Feldman et al., 2011, 2014), or using the words that convey sensory appeal when describing the dishes (Wansink & Love, 2014), can backfire under specific circumstances, it is important to discuss potential mechanisms behind such effects. Indeed, what may have been the mechanism behind the present finding that the interventions we created decreased vegetarian food choice for frequent vegetarian eaters? One possible explanation concerns the phenomenon known as moral licensing, according to which undertaking an action that is perceived as healthy or morally desirable can influence a person to subsequently make a less healthy or morally desirable choice (Chiou et al., 2011; Fishbach & Dhar, 2005; Messner & Brügger, 2015). When it comes to eating, vegetarian foods are usually perceived as morally superior or healthier relative to other foods (Radnitz, Beezhold, & DiMatteo, 2015; Ruby & Heine, 2011), and our exploratory analyses suggest that this was also the case in the present experiment, given that participants perceived vegetables as healthier than meat or fish. Therefore, the menu interventions may have made the concept of vegetarian eating more salient, thus signalling to frequent vegetarian eaters that they have already engaged in the morally superior food choice on numerous occasions and prompting them to select meat or fish instead. Although this mechanism offers a plausible explanation for the present effects, it will need to be more stringently tested in future research that goes beyond self-reported measures employed in the

present experiment, considering that moral licensing frequently occurs outside of people's awareness (Blanken et al., 2015).

Contributions of the Present Research

In order to understand the main contributions of the present research, it is necessary to examine its practical and theoretical implications. From a practical perspective, it indicates that policy makers who intend to use contextual interventions to produce desirable effects on people's food consumption or choices need to carefully consider whether these interventions can have negative consequences for certain individuals. As a tool of policy making, contextual interventions have been subjected to different criticisms on ethical grounds (e.g. Grüne-Yanoff, 2012; Ménard, 2010; Thaler & Sunstein, 2003), and the present research indicates that implementing specific contextual interventions may not be fully ethical if it has not been established that they do not disadvantage certain individuals, such as the ones who formed specific behavioral patterns in the past. As our findings indicate, frequent vegetarian eaters were discouraged from selecting a vegetarian dish by all the three menus, which indicates that, outside of their awareness, they were influenced to behave less environmentally friendly than they usually do, which may not be in line with their underlying beliefs and preferences. Moreover, our findings also suggest that certain menus may actually influence people to form future eating intentions that are less healthy, which may have different implications for their health and wellbeing. For all these reasons, policy makers need to establish that a contextual intervention they are planning to implement does not have negative consequences for certain groups of individuals, even if it produces a positive behavioral change for many others.

From a theoretical point of view, the present findings open new insights into person-specific boundaries of contextual effects on behavior. Previous research mostly focused on how different menu designs or food labels impact choices (e.g. Campbell-Arvai et al., 2014; Dayan & Bar-Hillel, 2011; Wansink et al., 2001) but failed to establish whether and how specific personal characteristics or behavioral patterns determine the effectiveness of these interventions. Our research showed that past behavior is not only one of the most important predictors of future action (Ouellette & Wood, 1998) but also constrains the effectiveness of different menu designs in prompting pro-environmental food choice. Considering our findings, we posit that the next step in researching the impact of nudging on food choice should involve determining whether there are other person-specific variables that constrain the effectiveness of interventions. Moreover, researchers will need to identify whether some contextual interventions are particularly strong and cannot be undermined even by various person-specific factors to determine key features that characterize such robust interventions.

Limitations of the Present Research

Finally, it is necessary to understand the limitations of our research. One of the limitations is that the experiment was conducted online rather than in a real restaurant. We implemented a "restaurant scenario" task in the experimental procedure to minimize the disadvantages of conducting our research online and to make the food choice more convincing. More precisely, we asked participants to imagine a scenario that was supposed to influence them to adopt a mental state like the one they would experience in a real restaurant. The scenario involved catching up with a friend for dinner in a nice restaurant one evening during the week (for a

similar approach, see Brunstrom & Shakeshaft, 2009; Haws & Liu, 2016). To make this scenario easier to imagine, we also presented participants with an image of a cozy table in a restaurant. Given that some other impactful menu studies (e.g. Liu, Roberto, Liu, & Brownell, 2012) were also conducted online and reported to obtain similar results to experiments conducted in naturalistic locations, previous research indicates that the online mode of administration should not be considered a serious disadvantage.

Another limitation concerns the generalizability of our findings. Whereas we explored how different menu designs with specific food options influence vegetarian choices, restaurant menus usually vary to a great degree and consist of different food options, varying price ranges, and different visual characteristics. Therefore, to establish that our findings apply across a wide range of contexts, future research will need to tackle whether the interventions we proposed can be successfully adapted to many different restaurant menus and produce similar findings. Different cultures will also need to be considered, given that pro-environmental food habits tend to be culture-specific (e.g. Ruby, Heine, Kamble, Cheng, & Waddar, 2013; Tiu Wright, Nancarrow, & Kwok, 2001).

The final limitation of the present research concerns our failure to consider the role of values in food choices, given that research has demonstrated that values are an important determinant of how frequently people eat meat or fruits and vegetables (De Boer, Hoogland, & Boersema, 2007; Graham & Abrahamse, 2017). For example, Dietz et al. (1995) have shown that individuals holding traditional values are less likely to be vegetarians. Moreover, Graham & Abrahamse (2017) have shown that meat consumption is positively related to self-enhancement values and negatively related to self-transcendence values. Also, they have demonstrated that these values determine the effectiveness of different framing messages in decreasing people's

intentions to eat meat. Therefore, by failing to include the values linked to vegetarian food consumption as control variables in our research, we failed to establish that these values did not confound some of our effects. However, the possibility of such a confounding influence remains very low, given that we used randomization to assign participants to the restaurant menu conditions (Field, 2013).

Conclusion

Overall, the findings from this research suggest that, even if certain restaurant menus can encourage pro-environmental food choice for infrequent vegetarian eaters, they can also backfire for frequent vegetarian eaters and have an undesirable impact on food selection. Our experiment therefore points out that any contextual interventions aimed at nudging pro-environmental behavior need to be carefully examined in relation to people's past eating choices to avoid undesirable behavioral effects, and suggests that achieving sustainable eating may require more personalized interventions.

Author contributions

Linda Bacon originated the study idea and design, acquired the data, performed initial data analyses, and led the writing. Dario Krpan assisted with study design and data analysis and jointly worked with the first author in writing the manuscript. The work conducted by Linda Bacon was undertaken for her dissertation as part of the LSE Executive Masters in Behavioural Science.

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