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(Not) Eating for The Environment:  
The Impact of Restaurant Menu Design on Vegetarian Food Choice

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24 Abstract

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

42

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

44

45

46

## 47 **Introduction**

48

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

60 The adverse impact of agriculture on the environment has been steadily increasing and this  
61 trend is expected to continue partly as a result of population growth but also because rising  
62 affluence leads to higher calorie consumption per person and proportionally higher consumption  
63 of animal products (Tilman & Clark, 2014). Between 1961 and 2009 global availability of  
64 animal-based protein grew by 59% compared to a 14% growth in plant-based protein and the  
65 demand for meat and dairy could rise by 80% between 2006 and 2050 (Ranganathan et al.,  
66 2016). Many scientists therefore propose that, to achieve sustainable food production in the  
67 future, it is important to limit the proportion of animal products in people's diets (McMichael et  
68 al., 2007; Springmann, Godfray, Rayner, & Scarborough, 2016; Wirsenius, Azar, & Berndes,  
69 2010).

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

86

### 87 *Barriers to Eating for the Environment*

88

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

93 food (Macdiarmid, Douglas, & Campbell, 2016). On the other hand, given its important role in  
94 intra-community relationships and contribution to social bonding, eating meat is deeply  
95 ingrained in various cultures (Leroy & Praet, 2015). Meat is culturally accepted not only  
96 because it is important for social relationships, but also because it is universally regarded as a  
97 symbol of affluence and success (Smil, 2002). Indeed, the amount of meat consumed has been  
98 shown to rise with per capita income and has increased globally with GDP over the last 50 years  
99 (Tilman & Clark, 2014). Growth in meat consumption has been particularly rapid in some  
100 Northeast and Southeast Asian countries (e.g. China, Japan, Vietnam, and Thailand) as a result  
101 of economic development and globalization of the food industry (Nam, Jo, & Lee, 2010). In  
102 addition to cultural factors, lack of competence can also be an important barrier to reducing the  
103 intake of meat and eating more fruits and vegetables. People feel competent in preparing meat  
104 dishes and serving them to others (Lea, Crawford, & Worsley, 2006), whereas they may lack  
105 knowledge and skills necessary to prepare vegetarian meals (Lea et al., 2006; Lea & Worsley,  
106 2001; Pohjolainen, Vinnari, & Jokinen, 2015).

107 Overall, most people indicate that their choices regarding what to eat are shaped by many  
108 factors with different degrees of importance, including taste, health, cost, mood, culture,  
109 competence, and so on, whereas the environment is infrequently evoked as a consideration  
110 (Connors, Bisogni, Sobal, & Devine, 2001; Macdiarmid et al., 2016; Pollard, Kirk, & Cade,  
111 2002; Steptoe, Pollard, & Wardle, 1995).

112

113 *Contextual Influences on Food Consumption*

114

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

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

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

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

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

154

155 *The Best Predictor of Future Actions Is Past Behavior*

156

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



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

167 Past behavior is one of the strongest predictors of future eating because it determines both  
168 automatic and deliberate decision-making processes that jointly shape people's actions (Ajzen,  
169 2002). On the one hand, frequent repetitions of certain behaviors in the past lead to the  
170 formation of a habit—an automatic tendency to undertake these behaviors that does not require  
171 much thinking (Gardner, 2015; Lally & Gardner, 2013; Verplanken & Orbell, 2003; Wood &  
172 Runger, 2016). For example, frequently consuming candies in the past predicted stronger habit  
173 strength concerning this eating behavior (Verplanken & Orbell, 2003). On the other hand,  
174 frequent repetitions of a behavior in the past also strengthen people's deliberate intentions to  
175 perform this behavior (Conner et al., 1999; Wong & Mullan, 2009). For example, frequently  
176 drinking in the past made people more likely to intend to undertake this action in the future  
177 (Conner et al., 1999). Importantly, habits and intentions do not operate in isolation—instead,  
178 they jointly shape people's actions (Webb & Sheeran, 2006; Wood & Runger 2016). Therefore,  
179 because past behavior determines both habits and intentions, it predicts future behavior over and  
180 above either of these two processes (Ajzen, 2002). For example, Wong and Mullan (2009) found  
181 that past eating behavior was a stronger predictor of breakfast consumption than intentions.

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

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

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

196

### 197 *Study Overview*

198

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

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

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

230 Bell, 2000). However, it is also possible that nudging pro-environmental food choice may  
231 backfire for the frequent vegetarian eaters and thus encourage them to order meat or fish instead.  
232 This prediction is in line with previous research on moral licensing, according to which  
233 undertaking a behavior that is considered healthy or morally desirable can lead one to  
234 subsequently make a less healthy or morally desirable choice (Blanken, van de Ven, &  
235 Zeelenberg, 2015; Chiou, Yang, & Wan, 2011; Fishbach & Dhar, 2005; Messner & Brügger,  
236 2015). In the context of food consumption, eating vegetarian meals is usually perceived as  
237 morally superior and healthier compared to eating non-vegetarian foods (Fox & Ward, 2008;  
238 Ruby & Heine, 2011). Therefore, any restaurant menu interventions that emphasize vegetarian  
239 meals may signal to frequent vegetarian eaters that they have already engaged in the morally  
240 superior food choice on numerous occasions, thus prompting them to select meat or fish instead.  
241 Given the competing theoretical accounts that allow for different hypotheses, we refrained from  
242 predicting the exact direction of influence the treatment menus will exert on vegetarian food  
243 choices depending on how frequently people ate vegetarian dishes in the past. Instead, we  
244 simply predicted that the past behavior may change this influence and thus serve as a moderator.

245

## 246 **Method**

247

### 248 *Participants and Design*

249

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

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

263

#### 264 *Materials and Measures*

265

##### 266 *Restaurant Menus*

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

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

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

Control Menu

**Risotto primavera (v)**  
Peas, mushrooms, lemon 14.00

**Lobster & crab roll**  
Avocado, lettuce, lemon mayonnaise 17.00

**Sautéed king prawns**  
Chili, garlic & parsley, basmati rice 22.50

**Deep fried haddock**  
Minted peas, hand cut chips, sauce tartar 15.50

**Chicken cacciatore**  
Roasted chicken breast, mushrooms, tomato, olives 14.50

**Steak frites**  
Rump pavé, hand cut chips, béarnaise sauce 19.50

**Hamburger**  
Relish, hand cut chips 13.50

**Ricotta & spinach ravioli (v)**  
Asparagus, butter & sage sauce 13.50

v – suitable for vegetarians

Descriptive Menu

**Fresh seasonal risotto primavera (v)**  
Peas, mushrooms, lemon 14.00

**Lobster & crab roll**  
Avocado, lettuce, lemon mayonnaise 17.00

**Sautéed king prawns**  
Chili, garlic & parsley, basmati rice 22.50

**Deep fried haddock**  
Minted peas, hand cut chips, sauce tartar 15.50

**Chicken cacciatore**  
Roasted chicken breast, mushrooms, tomato, olives 14.50

**Steak frites**  
Rump pavé, hand cut chips, béarnaise sauce 19.50

**Hamburger**  
Relish, hand cut chips 13.50

**Ricotta & spinach ravioli (v)**  
Asparagus, butter & sage sauce 13.50

v – suitable for vegetarians

Recommendation Menu

**Chef's Recommendation**

**Risotto primavera (v)**  
Peas, mushrooms, lemon 14.00

**Lobster & crab roll**  
Avocado, lettuce, lemon mayonnaise 17.00

**Sautéed king prawns**  
Chili, garlic & parsley, basmati rice 22.50

**Deep fried haddock**  
Minted peas, hand cut chips, sauce tartar 15.50

**Chicken cacciatore**  
Roasted chicken breast, mushrooms, tomato, olives 14.50

**Steak frites**  
Rump pavé, hand cut chips, béarnaise sauce 19.50

**Hamburger**  
Relish, hand cut chips 13.50

**Ricotta & spinach ravioli (v)**  
Asparagus, butter & sage sauce 13.50

v – suitable for vegetarians

Vegetarian Menu

**Lobster & crab roll**  
Avocado, lettuce, lemon mayonnaise 17.00

**Sautéed king prawns**  
Chili, garlic & parsley, basmati rice 22.50

**Deep fried haddock**  
Minted peas, hand cut chips, sauce tartar 15.50

**Chicken cacciatore**  
Roasted chicken breast, mushrooms, tomato, olives 14.50

**Steak frites**  
Rump pavé, hand cut chips, béarnaise sauce 19.50

**Hamburger**  
Relish, hand cut chips 13.50

---

Vegetarian Dishes

**Risotto primavera (v)**  
Peas, mushrooms, lemon 14.00

**Ricotta & spinach ravioli (v)**  
Asparagus, butter & sage sauce 13.50

290

291 *Figure 1.* Restaurant menus used in the present research. Menu names are for identification only

292 and were not shown to participants.

293

294 *Main Measures*

295 To assess whether the frequency at which people ate vegetarian dishes in the past  
296 moderates the influence of restaurant menu design on vegetarian food choice we measured the  
297 frequency of eating vegetarian during the previous seven days on a scale from “1 = everyday” to  
298 “8 = no days” using the following question: “During the previous seven days, on how many days  
299 did you eat neither meat nor fish?” For the sake of simplicity, we refer to this moderator variable  
300 as *past behavior* when describing the statistical analyses in the results section. Moreover, to  
301 make the results more intuitive, we recoded the variable in such a way that eating vegetarian on  
302 zero days during the previous seven days corresponded to 0, eating vegetarian on only one day  
303 corresponded to 1, eating vegetarian on 2 days corresponded to 2, eating vegetarian on 3 days  
304 corresponded to 3, and so on.

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

308

309 *Control Measures*

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



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

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

328

### 329 *Exploratory Measures*

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

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

340

341 *Procedure*

342

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

354

355 **Results**

356

357 *Data Preparation and Preliminary Analyses*

358

359 *Excluded Cases*

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

368

369 Table 1

370 *Number of Participants in the Four Restaurant Menu Conditions per Each Level of Past*371 *Behavior (0-7 Days)*

<i>Menu</i>	<b>Past Behavior*</b>								<i>Total</i>
	0 days	1 day	2 days	3 days	4 days	5 days	6 days	7 days	
	<i>Number of Participants</i>								
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
<b>Total</b>	<b>302</b>	<b>162</b>	<b>133</b>	<b>70</b>	<b>34</b>	<b>27</b>	<b>14</b>	<b>8</b>	<b>750</b>

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

374

375 *Past Behavior*

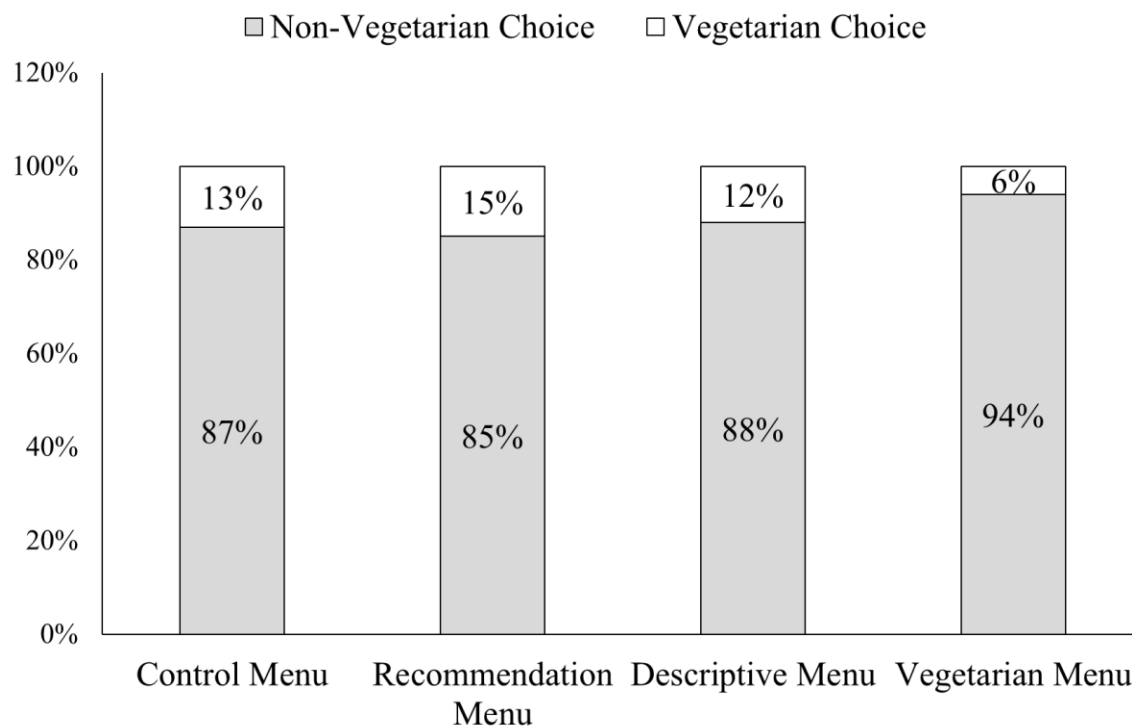
376 Table 1 shows the distribution of participants across the four restaurant menu conditions

377 depending on the frequency of past behavior—on how many days (out of the previous seven

378 days) they consumed only vegetarian foods. As can be seen from the table, most of the

379 participants consumed only vegetarian meals on relatively few days, whereas few participants  
380 consumed such meals on all of the previous seven days.<sup>1</sup>

381



382

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

385

386 *Vegetarian Food Choice*

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

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<sup>1</sup> 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.

389 participants preferred a non-vegetarian dish over a vegetarian one. To probe whether *vegetarian*  
390 *food* choice significantly differed in the recommendation, descriptive, or vegetarian menus  
391 relative to the control menu, we performed a logistic regression analysis. *Restaurant menu*  
392 *design*, represented by three dummy variables—one for the recommendation menu, one for the  
393 descriptive menu, and one for the vegetarian menu (the control menu therefore served as  
394 baseline)—was used as the independent variable. Nagelkerke's pseudo  $R^2$  for the logistic  
395 regression model was 0.024, with the likelihood ratio  $\chi^2(3) = 9.219$ , and  $p = .027$ , thus indicating  
396 that the model with all the predictors included had a better fit compared to the model with only  
397 the constant included.<sup>2</sup> The recommendation menu, Odds Ratio = 1.104, 95% CI [0.618, 1.973],  
398  $p = .738$ , and the descriptive menu, Odds Ratio = 0.917, 95% CI [0.503, 1.673],  $p = .779$ , did not  
399 influence vegetarian food choice relative to the control menu, whereas the vegetarian menu  
400 decreased the odds of selecting a vegetarian dish, Odds Ratio = 0.406, 95% CI [0.195, 0.848],  $p$   
401 = .016.

402

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

405

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

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<sup>2</sup> 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  $\chi^2(3) = 8.222$ ,  $p = .042$ , thus indicating that the extent to which participants selected vegetarian versus non-vegetarian dishes differed across the restaurant menu conditions.

410 *past behavior* as a continuous moderator that was centered prior to analyses (Hayes, 2013).

411 Logistic regression was used given that *vegetarian food choice* was a dichotomous dependent  
412 variable.

413 Nagelkerke's pseudo  $R^2$  for the logistic regression model was 0.148, with  $\chi^2(7) = 58.976$ ,  $p$   
414  $< .001$ , thus indicating that the model with all the predictors included had a better fit compared to  
415 the model with only the constant included. As can be seen from Table 2, both the  
416 recommendation and descriptive menus interacted with past behavior, whereas the interaction  
417 term with the vegetarian menu was not significant. To compute the overall significance of the  
418 three interaction terms, we implemented a Wald test that yielded a significant finding,  $\chi^2(3) =$   
419  $11.9$ ,  $p = .008$ , thus showing that the effect of restaurant menu design on vegetarian food choices  
420 depended on participants' past behavior. Importantly, considering that the moderator was  
421 centered prior to computing the interaction terms (Hayes, 2013), Table 2 also indicates that none  
422 of the effects of menus on vegetarian choice reached conventional significance levels when the  
423 value of past behavior was average (1.399). Whereas the recommendation and descriptive  
424 menus slightly increased the odds of choosing a vegetarian dish (by roughly 88% and 50%  
425 respectively), and the vegetarian menu decreased the odds (by roughly 52%), none of these odds  
426 were beyond chance levels.

427

428 Table 2

429 *The Interaction Between Restaurant Menu Design and Past Behavior in Influencing Vegetarian*

430 *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	$\chi^2 (3) = 11.9, p = .008$			

Note: Model  $R^2 = 0.148$  (Nagelkerke), Model  $\chi^2 (7) = 58.976, p < .001$

Control Menu is the reference category.

Past Behavior ( $M = 1.399, SD = 1.623$ ) was centered prior to analysis.

431

432 To further clarify the interaction terms, we used the Process package developed by Hayes  
433 (2013) to compute the Johnson-Neyman regions of significance (Johnson & Neyman, 1936).

434 This technique identifies the values on the continuum of past behavior at which point the effect  
435 of a restaurant menu on vegetarian choice transitions between statistically significant and

436 nonsignificant. As can be seen from Table 3, for the recommendation menu, the first cut-off  
437 point is 1.226, and the odds ratio 2.080. These values indicate that, for infrequent vegetarian

438 eaters (those who ate only vegetarian on 1.226 or fewer days out of the past seven days), the

439 recommendation menu increased the odds of selecting a vegetarian dish by roughly 108% (odds  
440 ratio = 2.080), with the odds increasing below the cut-off point of 1.226 days. Between the cut-

441 off points of 1.226 and 4.314 the recommendation menu did not significantly impact vegetarian

442 food choice, and after the latter cut-off value the impact was negative. In other words, for more

443 frequent vegetarian eaters (those who avoided meat and fish on 4.314 or more days), this menu

444 decreased the odds of selecting a vegetarian dish by roughly 65.3% (odds ratio = 0.347) or more.

445 The results for the descriptive menu can be interpreted in a similar manner. When it comes to

446 the vegetarian menu, the findings are slightly different. They indicate that, for infrequent

447 vegetarian eaters (those who ate neither meat nor fish on 0-1.969 days), this menu had no impact

448 on vegetarian choices. However, for more frequent vegetarian eaters (those who ate vegetarian  
 449 on 1.969 days or more), the vegetarian menu decreased the odds of selecting a vegetarian dish by  
 450 57.8% or more. As a general rule, the odds ratios computed at lower levels of past behavior may  
 451 be considered as more robust than those computed at higher levels, given that the number of  
 452 infrequent vegetarian eaters was larger than the number of frequent vegetarian eaters (see Table  
 453 1).

454

455 Table 3

456 *Moderator Values Defining Johnson-Neyman Significance Regions*

Menu	Significance Region			
	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

457

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



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

472

### 473 *Exploratory Analyses*

474

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

479 First, by employing multiple linear regression, we found that past behavior interacted with  
480 the descriptive menu in influencing future intentions regarding vegetarian food consumption,  $b =$   
481  $-0.410$ , 95% CI  $[-0.723, -0.098]$ ,  $p = .010$ . As indicated by the Johnson-Neyman significance  
482 region (Second cut-off point: Moderator Value = 2.762,  $b = -0.655$ ), for infrequent vegetarian  
483 eaters (those who ate neither meat nor fish on 0-2.762 days), this menu had no impact on future  
484 intentions. However, for more frequent vegetarian eaters, (those who ate vegetarian on 2.762  
485 days or more), it decreased the strength of their intention to eat vegetarian in the future by 0.655  
486 points of the scale or more.

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

489 indicated by the Johnson-Neyman significance region (Second cut-off point: Moderator Value =  
490 2.417,  $b = -0.600$ ), for infrequent vegetarian eaters (those who ate neither meat nor fish on 0-  
491 2.417 days), this menu had no impact on intended healthy eating. However, for more frequent  
492 vegetarian eaters, (those who ate vegetarian on 2.417 days or more), it decreased the strength of  
493 their intention to eat healthier in the future by 0.600 points of the scale or more.

494 Finally, by employing a repeated measures ANOVA (corrected using Greenhouse-Geisser  
495 estimates of sphericity), we found that people's beliefs regarding how healthy it is to eat  
496 vegetables differed from their beliefs regarding how healthy it is to eat meat or fish,  $F(1.533,$   
497  $1148.417) = 756.032, p < .001, \eta_p^2 = .502$ . More precisely, simple contrasts showed that eating  
498 vegetables ( $M = 6.629, SD = 0.570$ ) was perceived as healthier compared to eating meat ( $M =$   
499  $5.089, SD = 1.219$ ),  $F(1, 749) = 995.477, p < .001, \eta_p^2 = .571$ , and compared to eating fish, ( $M =$   
500  $6.065, SD = 0.802$ ),  $F(1, 749) = 375.063, p < .001, \eta_p^2 = .334$ . This finding is in line with  
501 previous research showing that people tend to perceive vegetarian diets as healthier than diets  
502 that involve meat and/or fish (e.g. Fox & Ward, 2008; Key et al., 2006).

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

505

## 506 **Discussion**

507

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

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

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

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

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

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

560

561 *Contributions of the Present Research*

562

563 In order to understand the main contributions of the present research, it is necessary to  
564 examine its practical and theoretical implications. From a practical perspective, it indicates that  
565 policy makers who intend to use contextual interventions to produce desirable effects on  
566 people's food consumption or choices need to carefully consider whether these interventions can  
567 have negative consequences for certain individuals. As a tool of policy making, contextual  
568 interventions have been subjected to different criticisms on ethical grounds (e.g. Grüne-Yanoff,  
569 2012; Ménard, 2010; Thaler & Sunstein, 2003), and the present research indicates that  
570 implementing specific contextual interventions may not be fully ethical if it has not been  
571 established that they do not disadvantage certain individuals, such as the ones who formed  
572 specific behavioral patterns in the past. As our findings indicate, frequent vegetarian eaters were  
573 discouraged from selecting a vegetarian dish by all the three menus, which indicates that, outside  
574 of their awareness, they were influenced to behave less environmentally friendly than they  
575 usually do, which may not be in line with their underlying beliefs and preferences. Moreover,  
576 our findings also suggest that certain menus may actually influence people to form future eating  
577 intentions that are less healthy, which may have different implications for their health and  
578 wellbeing. For all these reasons, policy makers need to establish that a contextual intervention  
579 they are planning to implement does not have negative consequences for certain groups of  
580 individuals, even if it produces a positive behavioral change for many others.

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

594

#### 595 *Limitations of the Present Research*

596

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

604 similar approach, see Brunstrom & Shakeshaft, 2009; Haws & Liu, 2016). To make this  
605 scenario easier to imagine, we also presented participants with an image of a cozy table in a  
606 restaurant. Given that some other impactful menu studies (e.g. Liu, Roberto, Liu, & Brownell,  
607 2012) were also conducted online and reported to obtain similar results to experiments conducted  
608 in naturalistic locations, previous research indicates that the online mode of administration  
609 should not be considered a serious disadvantage.

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

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

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

632

633 *Conclusion*

634

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



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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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