Routledge
Taylor & Francis Group

Journal of Sustainable Tourism

ISSN: 0966-9582 (Print) 1747-7646 (Online) Journal homepage: www.tandfonline.com/journals/rsus20

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To cite this article: Sofie Voss, Helena Andre, Florian Kock, Marion Karl & Alexander Josiassen (23 Dec 2024): Guiding pro-environmental behaviour: examining the impact of cognitive and behavioural interventions on sustainable food choices in hospitality, Journal of Sustainable Tourism, DOI: 10.1080/09669582.2024.2439983

To link to this article: https://doi.org/10.1080/09669582.2024.2439983

Published online: 23 Dec 2024.

JOURNAL OF SUSTAINABLE TOURISM
https://doi.org/10.1080/09669582.2024.2439983

Guiding pro-environmental behaviour: examining the impact of cognitive and behavioural interventions on sustainable food choices in hospitality

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ABSTRACT

Food consumption represents a substantial share of tourism's global CO_2 emissions. Yet, experimental research on reducing high-emission food choices among tourists is scarce. This study explores how cognitive and behavioural interventions affect the likelihood of choosing vegetarian dishes in hotel restaurants. The authors conducted covert field experiments using theory-informed menu designs to encourage vegetarian food choices. In two hotels, 647 participants received one of four menu conditions: the hotel's default menu or one of three intervention menus. The intervention menus were designed to test cognitive (using the bandwagon effect) or behavioural interventions (using framing and anchoring biases). The results show that the behavioural interventions outperformed the cognitive intervention in increasing vegetarian orders. When presented with the behavioural intervention, participants had up to 654% (95% CI [2.21, 49.80]) higher odds of choosing vegetarian dishes than the cognitive intervention group. The odds increased to 950% (95% CI [1.26, 27.35]) when the participants were presented with a framing and anchoring-based behavioural intervention. The results indicate that behavioural interventions are more effective in encouraging pro-environmental food choices in hotel settings than cognitive interventions. This study contributes to the literature on pro-environmental behaviour change, presenting suggestions for further studies and practical, theoretical, and managerial implications.

ARTICLE HISTORY
Received 22 May 2024
Accepted 26 November 2024

KEYWORDS
Pro-environmental behaviour; nudging; field experiments; cognitive biases; menu design; food choice

ASSOCIATE EDITOR
Anna S. Mattila

Introduction

Food is a primary contributor to the tourism sector's global greenhouse gas emissions (Lenzen et al., 2018). Food systems contribute a third to global anthropogenic greenhouse gas emissions (Crippa et al., 2021), with the livestock industry alone accounting for up to 14.5% of global greenhouse gas emissions (Rojas-Downing et al., 2017). While such food provision leaves a substantial environmental footprint, plant-based diets tend to have a much lower carbon footprint than meat-based ones (Ritchie, 2020). This significant burden on the climate and environment highlights the need for sustainable food choices.

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Although lowering the consumption of high-emission foods has not been at the top of the tourism research agenda (Demeter et al., 2023), efforts devoted to investigating environmentally sustainable tourism are increasing. However, most pro-environmental behaviour studies in tourism and hospitality focus on problem descriptions rather than providing empirical testing (Dolnicar, 2020). Juvan and Dolnicar (2016) suggest that investigations on pro-environmental behaviour should be guided by observing actual tourist behaviour, such as through field studies. Nonetheless, a recent review by Demeter et al. (2023) showcases that, to date, only 21 actual behaviours have been examined in 146 interventions. Only 16 interventions have been aimed at lowering high-emission or increasing low-emission food consumption (Demeter et al., 2023). Based on insights from theory-based interventions tested in experimental and quasi-experimental field research, Dolnicar (2020) highlights nudging and alterations in the choice architecture as the highest-impact interventions to date. Nudging refers to subtle interventions that steer people towards a particular behaviour without restricting their choices or significantly altering their economic incentives (Thaler & Sunstein, 2008). Still, despite the promising results of nudging interventions, only 13 out of the 146 interventions included Demeter et al.'s (2023) study applied nudging, showcasing the limited use of nudges in the literature on pro-environmental behaviour change in the hospitality sector.

Given the higher footprint of meat-based food consumption, researchers (Bacon & Krpan, 2018; Garnett et al., 2019; Kurz, 2018) have sought to use nudging interventions to encourage consumers to choose vegetarian food options. Three nudging approaches can be identified in the literature (Cadario & Chandon, 2020): cognitive, affective and behavioural. Cognitive and affective approaches focus on altering how people think and respectively feel about specific dishes on a menu, while behavioural approaches aim at influencing participants' dining-related choice behaviour by altering the choice architecture (Cadario & Chandon, 2020). Behavioural approaches include interventions such as expanding the selection of vegetarian alternatives or making vegetarian menu items the default choice (Garnett et al., 2019; Gravert & Kurz, 2021). Among the three intervention foci, cognitive approaches have generally been less successful than behavioural approaches (Demeter et al., 2023). Despite the growing body of research, the literature currently underrepresents studies that focus on applying a behavioural nudging methodology to influence participants' choice architecture and behaviour towards more environmentally friendly menu items. Further, there is a lack of comparative studies that test cognitive and behavioural interventions in real-world hospitality settings.

Our research thus compares the effectiveness of cognitive and behavioural interventions to determine which strategy is more effective in encouraging participants to consume less high-emission food, i.e. meat-based dishes. We address the aforementioned gaps in tourism literature by empirically testing the effects of three theory-based interventions in two covert field experiments conducted at two hotels. These hotels exhibited contrasting characteristics: urban versus rural, leisure versus conference, family-oriented versus business-focused, and outsiders versus hotel guests. Thus, our study compares the effect of the two intervention strategies, cognitive and behavioural, in two vastly different hotel settings. These interventions are designed to be easily implemented in real settings without restricting options or vastly changing monetary incentives (Thaler & Sunstein, 2008).

Literature review

Guiding pro-environmental behaviour in the tourism and hospitality context

Leisure tourists often go on vacation to disconnect and relax without wanting to think about the environmental footprint of their behaviour (Dolnicar & Demeter, 2024). This inclination to

ignore one's environmental impact whilst on vacation has been an ongoing challenge for tourism and hospitality academics and practitioners working to change people's pro-environmental behaviour. Even environmentally conscious people exhibit a lower level of pro-environmental behaviour while on holiday than at home (Dolnicar & Grün, 2009). One of the main challenges in research on sustainable hospitality is the infamous attitude-behaviour gap and the social desirability bias. Survey-based experiments, as opposed to field experiments, tend to be more affected by the attitude-behaviour gap, as they rely on stated behavioural intention rather than actual behaviour (Juvan & Dolnicar, 2016).

Considering the long history of research on this topic, the interventions tested in field experiments are surprisingly limited. In a review of field experiments within sustainable tourism, Demeter et al. (2023) demonstrate that the majority of interventions focus on the reuse of towels (51 interventions), followed by food waste reduction (25 interventions). Other clusters include eating low-emission foods and reducing water consumption while encouraging consumption of less high-emission food, which only accounts for two interventions (Demeter et al., 2023). The two studies encourage less high-emission food consumption either by limiting the visibility of high-emission foods (Gravert & Kurz, 2021) or by increasing the portion of low-emission buffet options. Demeter et al. (2023) further found that most experiments to date rely either on beliefs or a combination of social norms and beliefs (116 out of 146 interventions). Yet, the success rate of these experiments is the lowest (47%–58%) compared to studies relying on other approaches, such as behaviour-based interventions with changes in the choice architecture (success rate of 82%). These findings indicate a clear need for a paradigm shift towards more behaviourally anchored interventions that promise higher nudge efficacy. In addition, further evidence is needed on their performance relative to cognitive belief-based approaches in order to encourage such behaviour-based nudging approaches. However, researchers find a lack of comparative studies of different types of interventions in field experiments (Demeter et al., 2023). A comparative study would serve as a crucial tool to compare the effectiveness of the different types of interventions in the same environment. Hence, the present research attempts to contribute to this comparative study.

Pro-environmental food choice

Food production accounts for over 20% of global greenhouse gas emissions (Hertwich & Peters, 2009) and 38% of the use of all habitable land, posing a significant burden on the climate and environment. This issue is often addressed through reducing food waste. However, the environmental impact of our diet is mainly influenced by the type of food consumed rather than the quantity produced (Poore & Nemecek, 2018). For example, producing 100 g of protein from beef results in 50 kg of CO_2eq emissions and 164 m^2 of land use per year, whereas the same amount of protein from peas results in only 0.4 kg of CO_2eq emissions and 3.4 m^2 of land use per year (Poore & Nemecek, 2018). Dietary changes, especially shifting to a plant-based diet, offer a promising way to reduce the environmental impact of food. This change can reduce land use by 76%, greenhouse gas emissions by 49%, and freshwater use by 50% (Poore & Nemecek, 2018). Seeing that most people tend to eat meat, particularly while eating out, because meat is considered a treat and even a signifier of hospitality (Biermann & Rau, 2020), it is challenging to change behaviour in this context. Tourism and hospitality academics could play an essential role in discovering how to change people's behaviour and delivering easy-to-implement interventions for the industry to increase pro-environmental behaviour in this particular context. Nevertheless, when looking at the available literature in hospitality, we see little focus on over-meat consumption (i.e. high-emission foods) (Demeter et al., 2023), except for a few recent studies (Fechner et al., 2023; Zinn et al., 2023).

Similar to pro-environmental behaviour interventions in general, studies on plant-based or vegetarian food choices in restaurants have tried three approaches to change behaviour: cognitive—providing or enhancing information; affective—using hedonic cues; behavioural—change in the choice architecture. The cognition-focused set of studies aims to inform restaurant guests of the negative consequences of their food choices, for instance, by providing carbon footprint information (Babakhani et al., 2020) or by educating guests about the benefits of their food choices for local organic production (other) or for their health (self) (Cozzio et al., 2022). Yet overall, cognitive approaches seem to have the weakest impact on food choices, according to a review of field experiments on healthy eating (Cadario & Chandon, 2020). Studies focusing on dietary change towards plant-based dishes in restaurants that apply this approach have shown a significant uptake in pro-environmental food choice (Fechner et al., 2023; Turnwald et al., 2019; Turnwald & Crum, 2019). Still, the approach with the highest success rate for healthy food choice (Cadario & Chandon, 2020), changing the choice architecture, also seems to be the most promising for pro-environmental food choice. For instance, increasing the number of vegetarian dishes on a menu (Garnett et al., 2019), placing these dishes in a more prominent position (Kurz, 2018), or not separating them from meat dishes as often the case in restaurant menus (Bacon & Krpan, 2018) have all been successful interventions. The cognitive approach, although the technique with the lowest success rate, represents the most utilised mechanism for behaviour change in studies on pro-environmental food choices (Demeter et al., 2023). Most studies focus on the power of social influence, which affects our beliefs or social norms and is rooted in a cognitive approach. Despite the promising results of both cognitive and behavioural approaches, there is a need for comparative studies to determine which method is more effective in promoting pro-environmental food choices.

Cognitive approach: the bandwagon effect

The bandwagon effect highlights the impact of social dynamics on the individual's decision-making process (Leibenstein, 1950). Because of the desire for harmony or conformity within a group of people, individual choices are significantly influenced by the observed choices of others (Leibenstein, 1950). This effect causes people to act impulsively in response to the influence of peers or similar masses (Thaler & Sunstein, 2008). When most group members exhibit a particular attitude or behaviour, it becomes increasingly difficult for an individual group member to do the contrary. Although research on the bandwagon effect in the hospitality and tourism field is limited, some studies have employed this effect to influence travel decisions and the choice of restaurants (Boto-García & Baños-Pino, 2022; Ha et al., 2016). In their studies, Boto-García & Baños-Pino (2022) showed that consumer demand for eco-friendly hotels increased when many others chose them, while Ha et al. (2016) found that customers' intention to dine at a restaurant was significantly impacted by the restaurant's crowdedness. These findings suggest that leveraging social norms through the bandwagon effect can influence pro-environmental choices in hospitality settings.

Behavioural approach: framing and anchoring biases

Behavioural-based interventions are usually based on a change in choice architecture. Nudge theory identifies choice architecture as a key way to influence the behaviour and decision-making of consumers (Thaler & Sunstein, 2008). This strategy has drawn the attention of public policymakers over the recent decade, as it is particularly successful in

changing behaviours without affecting people's perceptions, attitudes or experiences (Mertens et al., 2022). Nudges are used to change how people behave based on an alteration of the presentation of the options available (i.e., the choice architecture). This means people are not restricted in their choices per se and are free to behave however they like (Van Roekel et al., 2023). Yet, the choice architecture of the options presented encourages them to exhibit a desired behaviour (Thaler & Sunstein, 2008).

In contrast to approaches relying on people's conscious thinking to change their behaviour, nudging relies on automatic and subconscious cognitive processes of decision-making (Thaler & Sunstein, 2008). Nudges that create successful behaviour change draw on various behavioural economics theories explaining human behaviour. Often, these theories refer to heuristics, which can illustrate the bias behind decision-making. In the context of pro-environmental behaviour in the hospitality sector, two seminal theories related to human biases are particularly promising for the development of nudges aimed at changing food choices: the framing bias (Tversky & Kahneman, 1981) and the anchoring bias (Sherif et al., 1958; Tversky & Kahneman, 1974).

Framing is a key component of a nudge (Thaler & Sunstein, 2008). The framing bias will cause a decision-maker to respond differently to alternative framings of objectively equivalent problem descriptions (Tversky & Kahneman, 1981). The framing approach highlights that not only the communicated information matters but also *how* the information is presented to the person being confronted with the nudge (Lehner et al., 2015). For example, Gravert and Kurz (2021) presented the participants with one of two interventions. The first intervention offered a meat dish, noting that a vegetarian option could be requested. The second intervention offered a vegetarian dish, noting that a meat dish was available at request. Their experiment achieved a 25% decrease in meat dishes ordered at a restaurant merely by presenting the menu framed in favour of vegetarian food (Gravert & Kurz, 2021).

The anchoring bias, on the other hand, makes people subconsciously rely on the first piece of information they receive about a given topic to make predictions or estimates (Tversky & Kahneman, 1974). All information presented after that will automatically be evaluated against the first information, acting as an anchor. Therefore, the anchoring bias skews people's perception of reality, subjectivising their judgement because all information provided after the anchor is filtered through the initial framework. The anchoring bias is closely related to the framed default option, as when considering the pros and cons of a decision, consumers tend to treat the default option as the reference point and consequently choose this option (Samuelson & Zeckhauser, 1988). The anchoring bias has been tested in terms of how effectively it can be used in environmental nudging (Mirsch et al., 2017). For instance, a study nudging participants towards pro-environmental behaviours by presenting them with an anchor in the form of carbon offset payments resulted in a substantial increase in payments on an online flight-booking platform (Székely et al., 2016). Another study used the anchoring bias by presenting vegetarian options in a university restaurant, leading to a 6% increase in vegetarian orders (Kurz, 2018).

Hypotheses development

Our study compares the results from two interventions based on a cognitive approach (bandwagon effect) and a behavioural approach (framing and anchoring bias). Grounded in evidence from both types of interventions (cognitive and behavioural), we expect both approaches to affect the number of vegetarian dishes ordered. However, prior research suggests that behavioural

interventions relying on changes in choice architecture are generally more effective than cognitive interventions when promoting pro-environmental behaviour (Cadario & Chandon, 2020; Demeter et al., 2023). Therefore, our first hypothesis aims to compare the overall effectiveness of behavioural versus cognitive interventions:

H1: The Behavioural Intervention is more effective than the Cognitive Intervention in increasing vegetarian orders in a hotel restaurant setting.

In our study, we implement two types of Behavioural Interventions: one that presents vegetarian options first (the Vegetarian Behavioural Intervention) and one that presents non-vegetarian options first (the Non-Vegetarian Behavioural Intervention). Given the anchoring and framing effects, we expect that presenting vegetarian options first will lead to a higher increase in vegetarian orders compared to presenting non-vegetarian options first (Tversky & Kahneman, 1974, 1981). We expect the Non-Vegetarian Behavioural Intervention to have a lower effect than the Cognitive Intervention, as we are purposely anchoring the participants to the non-vegetarian options on the menu, presented first. Thus, our second hypotheses compare the effectiveness of these two types of behavioural interventions:

H2a: The Vegetarian Intervention is more effective than the Cognitive Intervention in increasing vegetarian orders in a hotel restaurant setting.

H2b: The Non-Vegetarian Intervention is less effective than the Cognitive Intervention in increasing vegetarian orders in a hotel restaurant setting.

The structure of our hypotheses first establishes the expected superiority of behavioural interventions over cognitive ones (H1) and then examines the relative effectiveness of different types of behavioural interventions (H2a and H2b). This approach allows us to explore not only whether behavioural nudges are more effective but also how the design of these nudges influences their impact on pro-environmental food choices.

Materials and methods

We conducted a series of covert field experiments in two hotel restaurants. In each experiment, we carried out four interventions based on cognitive and behavioural approaches to compare their efficiency. We developed the interventions based on theory, mindful of their being as inexpensive and easily implementable as possible.

Hotel 1, located in central Copenhagen, Denmark, is a family-owned chain of upscale boutique hotels that considers sustainability the fundamental element of its operation. Their restaurant serves the menu à la carte, mainly catering to leisure guests. Their waiters collect the consumers' orders through the restaurant's ordering software. We conducted the field experiments in four weeks, spanning March and April 2022. We collected data from food orders for the default group from March 8 to March 12, 2022. The Cognitive Intervention took place from March 22 to March 26, 2022. The Vegetarian Behavioural Intervention ran on March 16, March 18, March 29, March 31, and April 2. The Non-Vegetarian Behavioural Intervention ran on March 17, March 19, March 30, and April 1. We conducted the data collection for these intervention groups in an alternate manner to have equally many weekdays and weekend days for intervention to ensure a higher degree of randomisation.

Hotel 2, located in the nature of Copenhagen's rural area, mainly caters to business and conference participants. The restaurant operates with a monthly menu distributed to the company organisers before the conference. Although it is the first B Corp Certified hotel chain in Nordic countries, its menu surprisingly includes meat. A vegetarian menu was available upon

Table 1. Overview of the experimental conditions at each hotel.

Type	Default group	Cognitive intervention	Vegetarian behavioural intervention	Non-vegetarian behavioural intervention
Menu Conditions at Hotel 1	The menu included all the dishes together. Vegetarian options were indicated in a less visible font and colour under the non-vegetarian options.	The default group condition menu was given, with the cognitive sentence added in the upper right corner.	The double-sided menu (although without a label) divided all dishes into vegetarian and non-vegetarian sections. The vegetarian side was presented first.	All dishes were divided into vegetarian and non-vegetarian sections on two sides of the double-sided menu (although without a label). The non-vegetarian side was presented first.
Menu Conditions at Hotel 2	Before their visit, a non-vegetarian menu was sent to the visiting company, asking if any participants had a special diet (e.g. vegetarian). If not stated otherwise, the participants were served the hotel's default non-vegetarian menu (excluding red meat). This procedure was carried out under all the experimental conditions.	The participants were presented with a flyer, including a cognitive sentence inquiring about which menu they wanted for dinner (vegetarian, vegan, or meat), without the menus being shown.	A vegetarian and a non-vegetarian menu was created. Each menu was depicted on one side of the flyer, with the vegetarian side presented first. The participants also had to fill in their personal information on this site.	A vegetarian and a non-vegetarian menu was created. Each menu was depicted on one side of the flyer. The non-vegetarian side was presented first. The participants also had to fill in their personal information on this side of the flyer.

request, improvised by the kitchen team based on the seasonal availability of plant-based ingredients at their disposal on a particular evening. The experiments were conducted for six weeks, from the end of March to the start of May 2022. We collected the data for the default group from March 28 to April 2, 2022. The Cognitive Intervention took place from April 4 to April 9, 2022. The Vegetarian Behavioural Intervention ran from April 18 to April 23, 2022. The Non-Vegetarian Behavioural Intervention ran from April 27 to May 3, 2022. Appendix A illustrates a detailed comparison between the two hotels' characteristics and the data collection process.

Experimental design

To ensure that we could measure the impact of the chosen theories in isolation, we designed two interventions: Cognitive Intervention and Behavioural Intervention. The interventions aimed to reduce participants' meat consumption (i.e. high-emission foods) at the hotels. Table 1 details the experimental conditions for each hotel.

The Cognitive Intervention draws upon the bandwagon effect, which states that people follow what their peers do (Leibenstein, 1950). To test Hypothesis 1 (i.e. a behavioural intervention is more effective than a cognitive intervention in increasing vegetarian orders in a hotel restaurant setting), we added the sentences below to the menus of the two hotels. The wording of the initial sentence and the presentation of the menus differed slightly for each hotel (see Figure 1), as they were based on the hotel's default menu.

- Hotel 1: "At [Hotel 1], over half of our menu is vegetarian. 85% of our participants choose to eat vegetarian dishes while staying here. Are you eating vegetarian today?"
- Hotel 2: "At [Hotel 2] our traditional menu does not include red meat. 85% of our participants choose to eat vegetarian dishes while staying here. Are you eating vegetarian today?"

Figure 1. From left to right: the altered menus for the Cognitive Intervention for Hotel 1 and Hotel 2.

The two variations of the Behavioural Intervention are based on a behavioural approach, and they were constructed to test how anchoring and framing biases influence consumer choices. In this experimental design, we designed a two-sided menu which featured vegetarian-only dishes on page one (i.e. framing effect) and non-vegetarian dishes on Page 2. We instructed the waiters to execute one of two interventions: in the Vegetarian Behavioural Intervention (i.e. anchoring effect), participants received the menu side with the vegetarian-only dishes first and in the Non-Vegetarian Behavioural Intervention (i.e. anchoring effect), participants received the menu side with the non-vegetarian dishes first (Figure 2).

The interventions at the hotels were carried out according to each hotel's specific needs. As in most covert field experiments, explicit participant consent was not gathered from hotel participants, as the aim was to observe actual unbiased consumer behaviour in a hotel setting. At Hotel 1, we were in direct contact with the waiter team, visiting the hotel daily to ensure that the physical menus were in place and that the waiter team was briefed on how to record the experiment results. The participants' orders were automatically added to the restaurant's ordering software, from which we extracted the results at the end of the experimental period. At Hotel 2, most participants had already ordered the menus before their stay, so we had to introduce a method for making them reevaluate their choices. We placed the experimental flyers in front of each participant's chair before the conference started in the morning (please see Hotel 2's flyers in Figures 1 and 2). The flyers were passed on to the conference coordinator, who input the results in a Google Sheets file provided by the researchers.

Figure 2. Top row: the altered menus for the Vegetarian Behavioural Intervention for Hotel 1, left side presented first. Bottom row: the altered menus for the Vegetarian Behavioural Intervention for Hotel 2, left side presented first.

Statistical analysis

The combined valid sample of this study included 647 participants. At Hotel 1, we recorded the choices of 419 participants and 228 at Hotel 2. The sample consisted primarily of Danish participants. Due to the nature of our covert field experiments, we were unable to gather further reliable demographical information from the participants, as this would have made them aware of the experiment.

We report the absolute and relative frequencies of ordering vegetarian dishes in each intervention group and hotel, along with 95% confidence intervals for the proportions. Additionally, to inferentially answer the hypotheses, we estimated two logistic regression models, focusing on the main response variable "non-vegetarian or vegetarian dish chosen" on the level of the individual participant. Both models estimate the differences between the odds of a person ordering a vegetarian dish in the intervention groups: Model A (answering Hypothesis 1) estimates the overall difference between the Cognitive Intervention and the two Behavioural Interventions by utilising a binary variable "Cognitive or Behavioural Intervention" as the main independent variable. Model B (answering Hypotheses 2a and 2b) estimates the detailed differences between the three intervention groups by utilising a categorical variable with three respective categories as the main independent variable. To account for potentially differing effect structures in the two hotels, the effect of the intervention was estimated in an interaction with the hotel indication in both models. The overall hotel effect was tested based on a likelihood ratio test (Fahrmeir et al., 2013), comparing the more detailed model B to an identical model which excluded the hotel effect. The effect structures in the two hotels were significantly different ($p = 0.0377$).

Overdispersion was not present in both models, with dispersion parameters being 1.07 for both models A and B. Model estimation was performed with function 'glm' in the open-source software R (R Core Team, 2023). In the spirit of open research, the code and data are publicly available in an open-source GitHub repository (https://github.com/bauer-alex/guidingFoodChoice-PEB_supp.git).

Results

Figure 3 visualises the observed relative frequencies of ordered vegetarian dishes. We recorded a substantial decrease in non-vegetarian orders. We recorded an increase in vegetarian orders in all experimental conditions when compared to the pre-experimental condition (the default

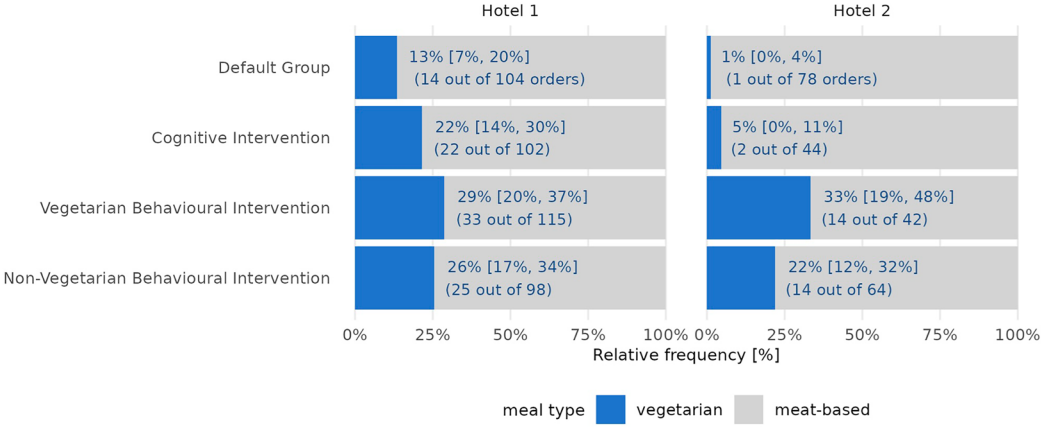

Figure 3. The observed distribution of ordered vegetarian dishes per intervention and hotel. In each intervention group, labels state the relative frequencies of vegetarian orders with 95% confidence intervals and the absolute frequencies of vegetarian orders among the total orders.

Table 2. Regression-based results for the three main hypotheses, reported separately for the two hotels.

	Hotel 1			Hotel 2		
	Odds Ratio	95% CI	*p*-value	Odds Ratio	95% CI	*p*-value
H1: Behavioural intervention vs. cognitive intervention	1.36	[0.78, 2.38]	0.2811	7.54	[1.71, 33.20]	0.0076*
H2a: Vegetarian behavioural intervention vs. cognitive intervention	1.46	[0.79, 2.72]	0.2296	10.50	[2.21, 49.80]	0.0031*
H2b: non-vegetarian behavioural intervention vs. cognitive intervention	1.25	[0.65, 2.40]	0.5114	5.88	[1.26, 27.35]	0.0239*

Note: Number of participants = 465, representing the full dataset excluding the default group. CI = confidence interval.
*$p < 0.05$.

group), with the Behavioural Intervention substantially outperforming the Cognitive Intervention. The following section will discuss the results according to the intervention at play (Cognitive or Behavioural Intervention). After that, we will discuss the results by comparing the effects within each hotel.

The results of the logistic regression model, estimating the effect of the Cognitive and Behavioural Interventions, can be found in Table 2 and Figure 4.

Results of the individual interventions

Our Hypothesis 1 stated that a behavioural intervention would be more effective than a cognitive intervention in increasing vegetarian orders. We found evidence in favour of Hypothesis 1 in both Hotel 1 (Odds Ratio = 1.36, 95% Confidence Interval (CI) [0.78, 2.38] and Hotel 2 (Odds Ratio = 7.54, 95% CI [1.71, 33.20]. Although not statistically significant, in Hotel 1, the participants in the Behavioural Intervention had 36% higher odds of ordering a vegetarian dish than those in the Cognitive Intervention. In Hotel 2, the Vegetarian Behavioural Intervention led to a statistically significant increase in vegetarian orders, as participants had 654% higher odds of ordering a vegetarian dish than those in the Cognitive Intervention. Thus, Hypothesis 1 is supported.

Our Hypothesis 2a stated that the Vegetarian Behavioural Intervention would be more effective than the Cognitive Intervention in increasing vegetarian orders in a hotel restaurant setting. Although not statistically significant, we found evidence in favour of Hypothesis 2a in both Hotel 1 (Odds Ratio = 1.46, 95% CI [0.79, 2.72] and Hotel 2 (Odds Ratio = 10.50, 95% CI [2.21, 49.80]. Hence, in Hotel 1, the participants in the Vegetarian Behavioural Intervention had 46% higher odds of ordering a vegetarian dish than those in the Cognitive Intervention. In Hotel 2, the Vegetarian Behavioural Intervention led to a statistically significant increase in vegetarian orders, as participants had 950% higher odds of ordering a vegetarian dish than those in the Cognitive Intervention. Thus, Hypothesis 2a is supported.

Our Hypothesis 2b stated that the Non-Vegetarian Behavioural Intervention would be less effective than the Cognitive Intervention in increasing vegetarian orders in a hotel restaurant setting. We found evidence against Hypothesis 2b in both Hotel 1 (Odds Ratio = 1.25, 95% CI [0.65, 2.40] and Hotel 2 (Odds Ratio = 5.88, 95% CI [1.26, 27.35]. Although not statistically significant, in Hotel 1, the participants in the Non-Vegetarian Behavioural Intervention had 25% higher odds of ordering a vegetarian dish than those in the Cognitive Intervention. In Hotel 2, the Non-Vegetarian Behavioural Intervention led to a statistically significant increase in vegetarian orders, as participants had 488% higher odds of ordering a vegetarian dish than those in the Cognitive Intervention. Thus, Hypothesis 2b is rejected.

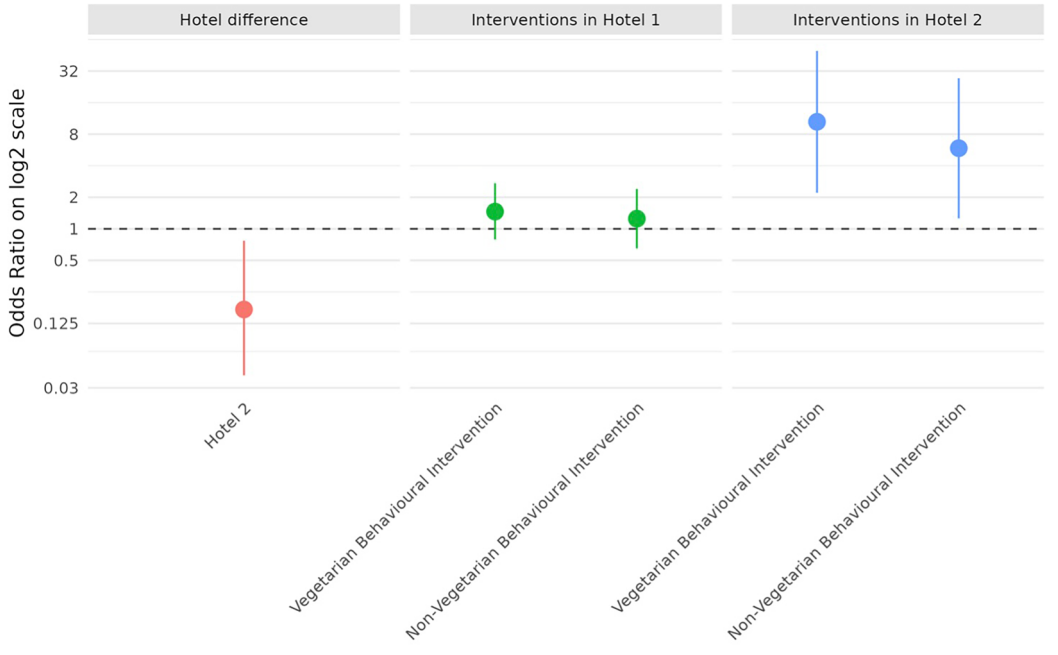

Figure 4. Estimated odds ratios with 95% confidence intervals visualising the effect estimates from the detailed regression model (model B) which separately includes all three intervention groups. The hotel effect compares Hotel 2 with Hotel 1. The intervention effects compare the two variations of the Behavioural Intervention with the Cognitive Intervention.

Apart from evaluating the effect size of the Behavioural Interventions compared to the Cognitive Intervention, we compared the hotels against one another. As we can see in Figure 4, the mere fact of staying in Hotel 2 influenced the participants towards the non-vegetarian options. On average (given similar conditions, without being intervention specific), the odds of a participant in Hotel 2 ordering a vegetarian dish, compared to a participant in Hotel 1, are multiplicatively lower by the factor of 0.17. This translates into the odds for the participant in Hotel 2 of ordering a vegetarian dish being, on average, 83% lower than in Hotel 1. However, we accounted for Hotel 2's predisposition towards non-vegetarian dishes in the analysis. Given the similar results in both hotels regarding the effect size of the different interventions (the Cognitive Intervention having the least effect and the Vegetarian Behavioural Intervention having the strongest effect), we attribute the reflected changes to the nudging interventions rather than the pre-existing participant preferences. Figure 4 shows that the results in Hotel 1 and Hotel 2 have a similar trend, highlighting the Vegetarian Behavioural Intervention as the strongest to encourage the participants to eat vegetarian.

Discussion

Our study addresses the gap in comparative studies examining the effectiveness of cognitive and behavioural interventions in reducing restaurants' CO_2 emissions. Specifically, we conducted two covert field experiments in two hotels, implementing cognitive and behavioural interventions to increase the ordering of vegetarian dishes. By conducting the experiments in two independent locations (their specific characteristics are detailed in Appendix A), we increased the generalisability and robustness of the results. This approach helped minimise the impact of potential location-specific bias or confounding variables that might affect one location. The results demonstrate that behavioural interventions based on alterations

in the menu's choice architecture are most effective in influencing food choices in both locations. In particular, behavioural interventions where the desired dish is presented first (Vegetarian Behavioural Intervention) demonstrated the strongest effect. Conversely, cognitive approaches aimed at presenting information about food choices (e.g. in our study, we informed participants about what other people tend to do; Leibenstein, 1950) yielded a weaker effect. Our findings provide clear evidence of the superiority of behavioural interventions over cognitive approaches in encouraging pro-environmental food choices. These two approaches have so far only been tested in separate individual studies, neglecting the need for a direct comparison of both types of interventions, cognitive and behavioural, within one field experiment (Demeter et al., 2023).

In both hotels, the Cognitive Intervention, rooted in the bandwagon effect (Leibenstein, 1950), demonstrated a noticeable increase in vegetarian orders (see Figure 3). By adding a sentence to the menus stating that eating vegetarian at the restaurant was the most common option, our experiment showcases the bandwagon as effective at influencing food choices. The literature shows that consumers tend to be unwilling to cognitively process pro-environmental behaviour messaging in hedonic settings (Dolnicar & Demeter, 2024; Dolnicar & Grün, 2009). Pro-environmental messaging tends to attract little attention on restaurant menus (Babakhani et al., 2020) and often fails to substantially increase pro-environmental behaviour in hedonic settings (Dolnicar et al., 2017). However, consumers still tend to be affected by the behaviours of others (Boto-García & Baños-Pino; Ha et al., 2016). So, despite advancing the limited bandwagon research within the tourism industry, our results align with Demeter et al.'s (2023) observations that cognitive strategies tend to have a lower success rate, highlighting the need for a different and more efficient approach.

The impact of the Behavioural Intervention was substantially higher than that of the Cognitive Intervention, emphasising the importance of altering the choice architecture for pro-environmental consumption (Cadario & Chandon, 2020). Designed to tap into anchoring and framing biases, the Behavioural Intervention emerged as a powerful tool for influencing meal choices. Building on the framing bias (Tversky & Kahneman, 1981), our study strategically positioned vegetarian-only dishes on the menu's first page, creating an anchoring effect (Tversky & Kahneman, 1974). This intervention substantially increased the likelihood of participants opting for vegetarian dishes in both hotels by nudging them towards vegetarian dishes, aligning with the success observed in previous studies (Gravert & Kurz, 2021). This underscores the potential of leveraging behavioural biases in choice architecture to drive pro-environmental choices (Thaler & Sunstein, 2008). The stronger effect of the Behavioural Intervention in both Hotel 1 and Hotel 2 resonates with findings from Cadario and Chandon (2020), emphasising the effectiveness of behavioural interventions in shaping consumer choices.

While our study found that behavioral interventions were more effective than cognitive interventions in both Hotel 1 and Hotel 2, it is essential to consider how the differing participant profiles might have influenced the effectiveness of the interventions, that is, primarily leisure guests in Hotel 1 and business travellers in Hotel 2. Business guests may have limited time and prefer quicker decision-making processes, making them more responsive to behavioural interventions that simplify choices without requiring extensive cognitive processing. On the other hand, leisure guests may have more time to consider their options and might be more open to cognitive interventions that provide information or appeal to social norms. Nonetheless, Warde and Martens (2000) highlight that even in business settings, food serves not only a utilitarian function but also provides pleasure and an opportunity for social interaction, blending practicality with hedonic enjoyment. Consequently, participants at both hotels, whether for business or leisure, can be viewed as engaging in hedonic consumption. Nonetheless, looking at the societal level, eating non-vegetarian is still viewed as the societal norm, the status quo (Poore & Nemecek, 2018). When considering this, we could assume that an individual's desire to conform with what the majority of society does, namely adhering to the engrained

non-vegetarian diet, might have a stronger effect on the bandwagon effect than the sentence we framed. Our study thus demonstrates that the effect is true when conducting comparative experiments in different locations.

Interestingly, as seen in Figure 3, even if participants were presented with the non-vegetarian options first (Non-Vegetarian Behavioural Intervention), the percentage of participants that ordered the vegetarian dishes was still higher than that in the Cognitive Intervention. When the customers were presented with the Vegetarian Behavioural Intervention, we expected them to pick a dish on the vegetarian side of the menu, following the anchoring theory (Tversky & Kahneman, 1974). Conversely, when presented with the Non-Vegetarian Behavioural Intervention, we anticipated they would choose a non-vegetarian dish. We observed that the food choice was influenced by which side of the menu was introduced first. However, participants in the Non-Vegetarian Behavioural Intervention still ordered more vegetarian dishes than the default group. We see this as a result of both hotels' Cognitive Intervention menus unintentionally nudging participants towards the non-vegetarian options by anchoring (Tversky & Kahneman, 1974) the participants to non-vegetarian dishes. Thus, when we split the menu into vegetarian and non-vegetarian sides in the Behavioural Intervention, we removed the anchor towards non-vegetarian options at both hotels. For instance, the Cognitive Intervention menu in Hotel 1 stated 'House Burger', and underneath, in a less visible colour, 'Vegan option available'. When we split it into two sides, the non-vegetarian side still stated 'House Burger', but the vegetarian side stated 'Vegan House Burger'. As the theory of framing predicts (Tversky & Kahneman, 1981), we can see that establishing a new default ultimately changes people's behaviour, emphasising the importance of choosing the default with care. We have seen that the framing of choices holds the most significant impact on the participants' decision-making. Research by Parkin and Attwood (2022) suggests that avoiding labelling and presenting vegetarian dishes as an alternative to meat options can encourage vegetarian food consumption. This is clearly corroborated in our study, as our findings indicate that merely presenting the vegetarian options separately from the non-vegetarian options, without explicitly stating which are vegetarian and non-vegetarian, can increase the overall vegetarian dishes consumed by removing any inherent anchors (Tversky & Kahneman, 1974).

Conclusion

This research examines whether using a cognitive (based on the bandwagon effect) or a behavioural approach (based on the framing and anchoring biases) to design interventions will foster pro-environmental behaviour. Despite the widely acknowledged challenge of altering individuals' food choices, our study revealed that behavioural interventions employing framing and anchoring can effectively influence hotel guests' choices without relying on monetary incentives or excluding specific (i.e. meat-based) options.

In conclusion, our study emphasises the practical effectiveness of behavioural interventions, specifically using behavioural interventions to promote pro-environmental food choices in hotels. The Behavioural Intervention is a cost-effective and easily implementable strategy for hotels aiming to reduce the environmental impact of participants' food choices, comply with new regulations, and gain a competitive advantage. By strategically framing menu options, hotels can not only cater to consumer preferences but also steer them towards more sustainable and environmentally friendly choices in line with the broader goals of the industry.

Theoretical implications

Our research contributes to the broader literature on pro-environmental behaviour in tourism and hospitality by providing concrete evidence that behaviourally-informed interventions can

surpass cognitive ones in effectiveness. Through two covert field experiments, our research demonstrates that behavioural interventions, particularly those leveraging framing and anchoring biases, are more effective than cognitive approaches based on theories, such as the bandwagon effect, in promoting actual vegetarian food choices. We chose these specific interventions due to their previously demonstrated efficiency, ease of use, particularly for managers, and the novelty of applying them in the tourism industry. This finding underscores the efficacy of subtle changes in choice architecture to influence consumer behaviour, thereby contributing to the limited research in tourism and hospitality. By empirically validating these interventions in two independent real-world settings, our study expands the literature on cognitive biases, emphasising their practical utility in driving significant behavioural shifts. We suggest a paradigm shift towards executing more field experiments grounded in seminal behavioural economics to examine pro-environmental behaviour nudges further.

Managerial implications & impact statement

The results provide valuable insights for hotel managers and policymakers seeking pro-environmental solutions in the hospitality sector. As the industry continues to grapple with environmental challenges, incorporating such interventions can foster more responsible consumer behaviour and reduce the ecological footprint of dining experiences. The study interventions are versatile, and the results suggest that they could be applied to other hospitality subsectors: food and beverage, travel and tourism, events and recreation, and potentially in different industries. Therefore, any food-offering venue (e.g. takeaway establishments) providing its clients with a menu in any format (digital, flyer, paper or displayed at the location) could implement our interventions.

A key takeaway for hospitality practitioners is the importance of menu design in reducing a venue's footprint. Appendix B calculates the yearly CO_2 savings for Hotel 2 if they implemented the Vegetarian Behavioural Intervention. By estimating the emissions of each menu (the vegetarian vs the non-vegetarian menus at Hotel 2), we found that the vegetarian menu (1.7 kg of CO_2) accounted for nearly half of the CO_2 emissions of the non-vegetarian menu (2.9 kg of CO_2). Thus, by implementing our Vegetarian Behavioural Intervention over a year, Hotel 2 could reduce its carbon footprint by 1.9 tons (see Appendix B) and save up to 13% of its yearly dinner CO_2 emissions. This shows us that, even in pro-environmentally focused hotels, small and subtle changes in a hotel's environment can still impact the participants' unsustainable behaviours and, thus, the hotels' emissions. We suggest that hotel restaurant managers update their menus to include the Vegetarian Behavioural Intervention to encourage vegetarian food consumption and lower their impact on the environment. The Behavioural Intervention, using framing and anchoring, suggests that portraying vegetarian choices prominently in the menu influences participant choices positively towards vegetarian options.

Although we chose to focus on vegetarian options to reduce the restaurants' CO_2 emissions, hotels and restaurants may find other benefits in promoting vegetarian dishes. From a cost perspective, vegetarian meals often rely on plant-based ingredients, which tend to be cheaper than meat-based products. This cost differential can lead to higher profit margins for the venue. Furthermore, vegetarian dishes typically require less preparation time. This could translate into faster service, improving customer satisfaction and table turnover rates, thereby enhancing operational efficiency. Moreover, by catering to the growing number of customers who seek healthier and more sustainable food options, hotels and restaurants can tap into a broadening market segment, potentially attracting a more diverse clientele. These financial and operational incentives provide additional reasons for promoting vegetarian dishes beyond environmental concerns, aligning profit and sustainability goals.

Additionally, it is crucial to frame non-vegetarian and vegetarian dishes similarly to avoid the meat option becoming the norm whereby a vegetarian option is considered "special". These interventions are easily implementable and do not incur extra costs for the establishment (apart from printing and redesigning the menu). For policymakers, the menu design findings could be implemented in public institutions (such as schools, hospitals, and government cafeterias) to lower CO_2 emissions. It would also be environmentally prudent if the present findings about menu design were reflected in hospitality education.

Limitations & further research

A key area for future research is to address the potential novelty effects of the menus. Any returning participants might have chosen a vegetarian option simply because the menus were new and different. While the study demonstrates significant immediate impacts of behavioural interventions on food choices, it does not examine whether these changes in behaviour are sustained over time. A mixed-methods longitudinal study design could be particularly useful here. For instance, quantitative data could be collected through repeated surveys over a longer period to track participants' menu choices across multiple visits. Meanwhile, qualitative insights could be gathered through interviews or focus groups with the participants, helping to understand their changing perceptions and motivations behind food choices over time. This approach would provide a deeper understanding of the persistence of nudging effects and whether habituation diminishes their influence. Additionally, it could explore how participants' environmental attitudes evolve and how these attitudes correlate with sustained behavioural change. We encourage future studies to incorporate longitudinal mixed-method approaches, to combine quantitative and qualitative insights to understand nudging effects on menu choice behaviour better. Future research could examine the unintended consequences of extensively promoting vegetarian options, such as potential revenue reduction, or build on Júnior et al. (2023) by using storytelling to enhance loyalty and long-term customer relationships.

Moreover, while our study employed a one-way design with four treatment groups, future research could explore a more complex factorial design (e.g. 2 [Default/Cognitive] × 3 [Default/Vegetarian Behaviour/Non-Vegetarian Behaviour]). Such a design was not feasible within the scope of this study due to practical constraints, but it could provide more nuanced insights into the interaction between different types of interventions in a real-world setting. Future studies would benefit from the opportunity to test these interactions, offering a more detailed understanding of how behavioural and cognitive nudges jointly affect decision-making.

Another limitation of this study is its context-specific nature. Considering that we conducted the experiments in two already environmentally conscious hotels, which could be considered market leaders. This hotel niche could have affected the bandwagon effect, as we could assume that most of the participants eating at the hotels were environmentally conscious customers. It would be interesting for future research to adjust the percentage shown on the menus (i.e. '85% of our participants choose to eat vegetarian dishes while staying here'), to see the change in effect of the intervention. This scope may affect the generalisability of the findings to other settings, such as different types of hotels, cultural contexts, or broader geographic locations.

Lastly, Hotel 1's Cognitive Intervention menu was built on the hotel's original, pre-experimental default menu), depicting the vegetarian dishes in lighter and smaller font sizes. Thus, the Cognitive Intervention menu could have anchored and biased the participants to believe that the non-vegetarian dishes were more important, as they were essentially highlighted on the menu. By splitting the menu into vegetarian and non-vegetarian, we created an anchor depending on which side was shown first. However, we also removed the anchor from the Cognitive Intervention group that highlighted the non-vegetarian dishes. As the menu used in the Cognitive

Intervention Group was not explicitly designed for the experiment, it reflects the standard offerings of the hotels jointly with the cognitive sentence of '85% of our participants choose to eat vegetarian dishes while staying here'. Given the inherent anchoring bias towards non-vegetarian dishes in Hotel 1's Cognitive Intervention menus, we urge future studies to include an unbiased control group to provide a baseline. Moreover, we recommend future studies to include a menu specifically designed for the control group—one that is neutral and free from bias, thereby serving as a proper control condition.

Disclosure statement

No potential conflict of interest was reported by the authors.

Data deposition & availability statement

The data that support the findings of this study are openly available in the open-source GitHub repository: https://github.com/bauer-alex/guidingFoodChoicePEB_supp.git

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Appendices

Appendix A. Table comparison of Hotel 1 and Hotel 2

Experiment Sections	Hotel 1	Hotel 2
Data collected	Price per item Total price Quantity Date Day of the week Table number Food ordered Name of the reservation (if any) Beverages ordered Nationality Kitchen comments People per table	Name Surname Nationality Menu ordered Company name Date Staying at the hotel or not Gender Allergies
Data collection location	On-site	Online
Data collection method	Researchers personally retrieved the data from the Trivec system at the end of the experimental period.	Results received the data daily, updated by the staff.
Data collection tool	On their specific system; Trivec	On an online Google Sheets document
Data treatment	Extensive cleaning process	Data directly in a usable format
Design of the pre-experimental menu	Each dish highlighted, followed by a brief description of the dish (in some cases).	Each main ingredient highlighted, followed by a brief description of the dish.
Experiment period	March–April (First location)	April–May (Second location)
Experiment rollout	1. Default Group 2. Vegetarian and Non-Vegetarian Behavioural Intervention 3. Cognitive Intervention 4. Vegetarian and Non-Vegetarian Behavioural Intervention	1. Default Group 2. Cognitive Intervention 3. Vegetarian Behavioural Intervention 4. Non-Vegetarian Behavioural Intervention
First point of contact	Hotel Chain Owner	Hotel Chain CEO
Participants' knowledge of the experiment	Not informed	Informed on the first page of the flyer
Participant segment	Guests and walk-ins going to the hotel restaurant for leisure.	Guests staying at the hotel, business guests following a conference.
Level of expertise in sustainability	High	High (Danish market leader)
Location	In the city (Copenhagen)	In a rural suburb of the city (Copenhagen)
Menu design	The menu layout was designed in cooperation with their marketing department.	The researchers designed the menu layout (flyers).
Menu language	English	Danish
Method of obtaining results	Staff filing the information	Questionnaire to participants
Nationalities	Mainly Danish	Mainly Danish
Pre-experimental Menu	Constituted of more vegetarian than non-vegetarian dishes.	Fixed menu, meat-based, with the possibility of changing it to vegetarian.
Pre-experimental moment of dish decision	A few minutes after getting the menu	1.5 wk prior to the hotel visit

Appendix B. Detail of the calculations of the CO_2 emissions at Hotel 2

Table B1. Overview of Hotel 2's Vegetarian menu's CO_2, counted per menu.

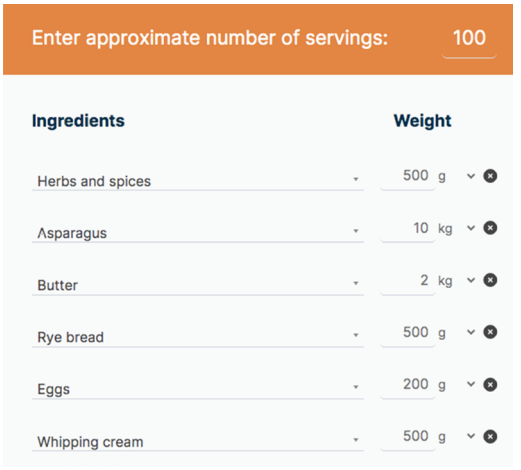
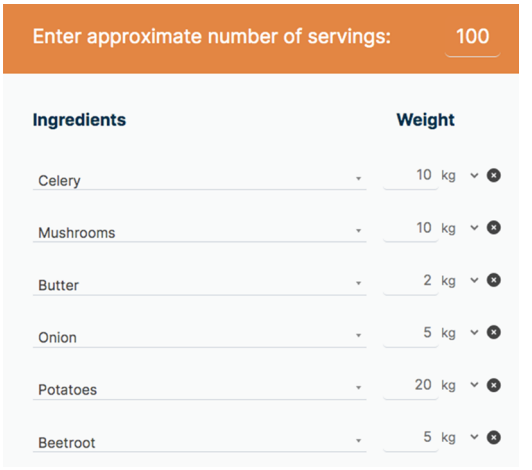
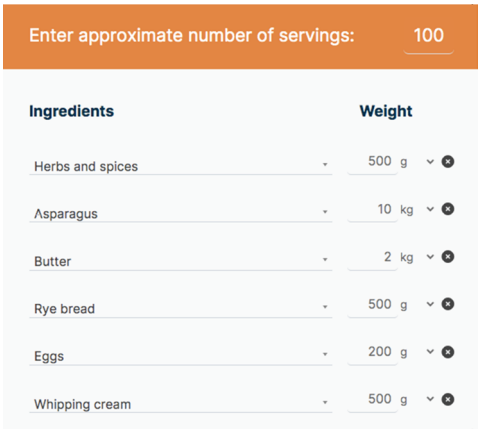
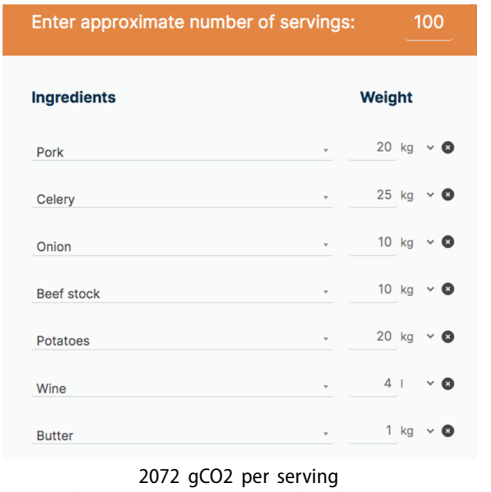
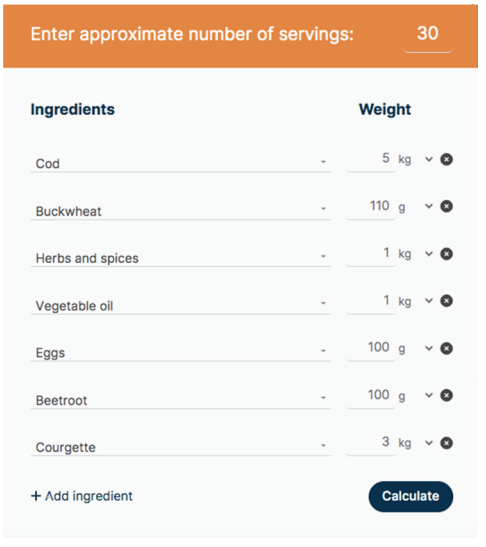
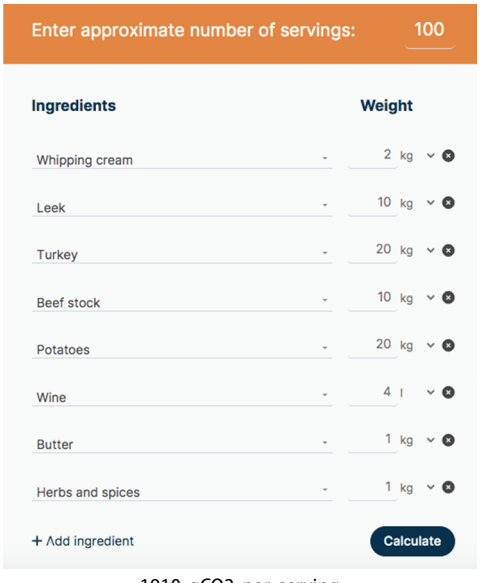
Vegetarian menu	
Starter	Main Course
	
937 gCO2 per serving (according to My Emissions Food Carbon Footprint Calculator)	784 gCO2 per serving (according to My Emissions Food Carbon Footprint Calculator)

Table B2. Overview of Hotel 2's non-vegetarian menu's CO_2, counted per menu.

	Non-vegetarian menu	
	Starter	Main course
Menu 1 (served half of the week)		
	937 gCO2 per serving (according to My Emissions Food Carbon Footprint Calculator)	2072 gCO2 per serving (according to My Emissions Food Carbon Footprint Calculator)

(*Continued*)

Table B2. (Continued)

	Non-vegetarian menu	
Menu 2 (served half of the week)		
	788 gCO2 per serving (according to My Emissions Food Carbon Footprint Calculator)	1910 gCO2 per serving (according to My Emissions Food Carbon Footprint Calculator)

To better illustrate the reduction in greenhouse gas (GHG) emissions driven by our interventions, we express results in kilograms (Kg) of CO_2. Jointly with Head Chef at Hotel 2, we calculated the CO_2 saved at their hotel during the experimental period. Thanks to Hotel 2's fixed menus (i.e., all participants who choose the vegetarian option receive the same dishes, and so will all participants who choose the non-vegetarian menu), we were able to conduct a straightforward analysis of the effect of the menu choice on the restaurant's CO_2 emissions. We used the "My Emissions Food Carbon Footprint Calculator" to estimate CO_2 for non-vegetarian and vegetarian menu options. This calculator requires inputs for each ingredient and its quantity but assumes UK-based origins without specifying exact countries (My Emissions, 2022). While useful, this limitation prevents us from fully representing Hotel 2's commitment to sourcing ingredients locally. Additionally, the calculator does not factor in emissions from the cooking process, which is often an important component of dish-related emissions (Berners-Lee, 2020). Although the menu in Hotel 2 had three courses (starter, main and dessert), we excluded the desserts from the calculation, as these were the same for each menu, regardless of whether the participant had chosen vegetarian or non-vegetarian.

Our calculations showed that emissions averaged 2.9 kg CO_2 per meal for the non-vegetarian menu, while the vegetarian menu averaged 1.7 kg CO_2. This yields a difference of approximately 1.2 kg CO_2 per meal saved when a participant opts for the vegetarian over the non-vegetarian menu. Using Berners-Lee's (2020) proposed annual CO_2 "allowance" of 5 tonnes per person, we derived a daily limit of 13.7 kg CO_2. A non-vegetarian meal at 2.9 kg CO_2 represents roughly 21% of this daily allowance, whereas a vegetarian meal at 1.7 kg CO_2 represents 12%.

Vegetarian menu (grams of CO_2) (see Table A1**):**

$$\text{Starter} + \text{Main Course} = 937 + 784 = 1{,}721 \approx \mathbf{1.7\,kg\ CO_2}$$

Non-vegetarian menu (grams of CO_2) (see Table A2**):**

$$(\text{Starter 1} + \text{Main Course 1}) + (\text{Starter 2} + \text{Main Course 2})/2 \text{ (as each menu is served half of the week)}$$
$$= (937 + 2{,}072) + (788 + 1{,}910)/2 = 2{,}853 \approx \mathbf{2.9\,kg\ CO_2}$$

Based on our sample, we estimated the yearly CO_2 emissions for dinners at Hotel 2. We will compare the application of no intervention (i.e. based on the default group) to the application of the Vegetarian Behavioural Intervention (i.e. the intervention that showed the strongest effect). To do so, we assume that the restaurant is open all year (i.e. 52 week) and only serves dinner five days per week (Monday to Friday).

Based on days of observation in Hotel 2 without any interventions in place, we assume that 98.7% of the dinner meals per year are non-vegetarian and 1.3% are vegetarian, resulting in a carbon footprint of 14.2 tons of CO_2. Based on our days of observation with the Vegetarian Behavioural Intervention in place, we assume that 66.7% of dinner meals per year are non-vegetarian and 33.3% are vegetarian, resulting in a carbon footprint of 12.3 tons of CO_2. Accordingly, the Vegetarian Behavioural Intervention could save up to 13% of the yearly dinner CO_2 emissions. These results underscore the environmental benefits of our approach, showing tangible impacts in reducing hotel-related emissions through strategic menu adjustments.