When are "Dish of the Day" nudges most effective to increase vegetable selection?

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1 Introduction

Almost 1.8 million deaths were estimated to be specifically attributable to insufficient vegetable consumption worldwide in 2010 (Lim et al., 2012). In more than half of all European countries, including France, the intake of fruits and vegetables is well under the WHO-issued recommendation of 400 g of fruits and vegetables per day (Dubuisson et al., 2010), prompting public health action to promote increased consumption. While this generally targets fruits and vegetables as a single food group, vegetables often account for fewer than 50% of intake within the category. Yet, vegetables present specific health benefits, distinct sensory properties and consumption characteristics, suggesting a need for more targeted actions (Appleton et al., 2016; Glasson, Chapman, & James, 2011). Over the years, out-of-home eating has gained a prominent role in Europe, accounting, for example, for 15 to 20% of meals in France (Orfanos et al., 2007).

Therefore, the foodservice sector has become a necessary player in this public health issue (Lachat, Roberfroid, Huybregts, Van Camp, & Kolsteren, 2008) and is increasingly considered as such in the public policy debate surrounding healthy eating environments. In Europe, public intervention in this domain has focused primarily on the food offer itself, in particular in institutional foodservice, with, for instance, the introduction of mandatory standards for offer in school canteens in several countries (Saulais, 2015). Another approach, in commercial foodservice especially, is to target consumers behaviours at the point of decision (the restaurant), and design interventions that promote both the selection and increased consumption of healthier dishes, and particularly of vegetables. The majority of these point-of-choice interventions in foodservice have focused on providing nutritional information to consumers through product labelling (calorie labelling, traffic light labelling, or healthy food labels). Notably, in the United States, restaurant chains have, since 2018, been required to provide calorie information on menus by the Patient Protection and Affordable Care Act (ACA). However, such strategies seem to have unclear, and sometimes even adverse outcomes on consumers' behaviours (Bleich et al., 2017; Cohen & Babey, 2012).

In parallel, there is increasing evidence that food choices rely on minimized cognitive efforts (Adamowicz & Swait, 2013) achieved through the use of simple heuristics (Scheibehenne, Miesler, & Todd, 2007). Heuristics are "rules of thumb" which reduce the cognitive effort necessary to make a decision by relying on cues from the choice environment. According to this framework, the choice architecture, that is to say the way choice tasks are framed in the environment, can have an impact on the outcome decisions (Kahneman, 2003; Tversky & Kahneman, 1981). In the case of food choices,

factors such as the order and presentation of menu items (Dayan & Bar-Hillel, 2011), the variety of food categories to choose from (Bucher, Siegrist, & van der Horst, 2013; Bucher, van der Horst, & Siegrist, 2011), and the convenience of access to the food items at a buffet (Rozin et al., 2011) have all been found to affect consumers' decisions at the point of choice. A behavioural change approach, referred to as "nudging" (Thaler & Sunstein, 2008), is derived from this view. Contrary to information-based interventions, nudges target the way choices are framed, with the purpose of guiding decision-makers in a specific direction, while leaving the possibility of easily opting out if desired. This framework has recently gained considerable interest for the promotion of healthier or more sustainable food choices (Loewenstein, Asch, Friedman, Melichar, & Volpp, 2012), inspiring a large number of field studies over the past few years. In foodservice environments specifically, there is some evidence that healthier food choices can be achieved through salience (increasing attention to the option, for instance through descriptive or personally-relevant information) and priming (providing subconscious cues, for instance by changing visibility of healthy options or by altering the position of healthier items through changing order or distance to the consumer) (Bucher et al., 2016; Ozturk, McInnes, Blake, Frongillo, & Jones, 2016; Wilson, Buckley, Buckley, & Bogomolova, 2016).

'Nudging' restaurant customers at the point of choice therefore appears as an operationally viable avenue for foodservice stakeholders. Changes in menu design have been considered especially relevant. In 2010, the EU-funded HECTOR project conducted a SWOT analysis of the foodservice sector, which resulted in the identification of five strategies to foster healthier behaviours. One of these strategies was "to better market healthy options in and out of the catering environment, i.e. use the 'Chef's Recommendation' to promote healthier choices" ((Lachat et al., 2010), p.198). Although not explicitly named a nudge by the authors, this strategy corresponds to a choice architecture intervention, in the sense that it is based on the way the options are presented to consumers. Indeed, identifying a dish as "Dish of the day" (DoD) alters the framing of the dish options within the choice environment, which in turn impacts on the search process.

Scientific evidence regarding point-of-choice nudge interventions in foodservice contexts remains limited in geographical scope and in precision, especially in commercial foodservice (Filimonau, Lemmer, Marshall, & Bejjani, 2017). Several authors have called for more research grounded in decision-making theory to identify the conditions of successful deployment of a 'nudging' strategy (Kirman, 2016; Szaszi, Palinkas, Palfi, Szollosi, & Aczel, 2018). Several steps are needed to achieve such a goal. One is the replication of choice architecture interventions in other settings to strengthen existing evidence. Another crucial question is how the type and the number of alternatives in a nudged choice set may impact the way the nudge impacts consumers' decisions (Marchiori, Adriaanse, & De Ridder, 2017). Lastly, a more practical challenge is the assessment of the consequences of choice architecture actions on consumer behaviour (Marchiori et al., 2017): if changes in the choice

architecture nudge consumers in a direction that they later regret, this might compromise the persistence of the effect in the longer term, and impact the motivation of foodservice professionals to implement such actions if they have adverse effects on consumer satisfaction – a concern that the foodservice sector itself expressed regarding the implementation of DoD interventions (Lachat et al., 2010).

This article presents the results of an experiment designed to study the effect of a DoD nudge aiming to increase the probability that a consumer chooses a vegetable-based dish in a self-service restaurant setting. More precisely, the primary objective is to replicate the DoD effect in this particular setting, and to investigate how two key characteristics of the choice set, (i) the type and popularity of dishes offered and (ii) the number of alternatives to choose from, impact the effectiveness of this nudge. A secondary objective is to consider the consequences of nudging consumers towards healthier dishes in terms of food intake, food waste, and overall satisfaction.

2 "Dish of the day" and decision-making for food away-from-home

2.1 What is a "Dish of the day" intervention?

In a survey conducted in 2016 on a sample of 461 French employees eating their lunch in restaurants on workdays, 38.2% of respondents stated that "Dish of the day" or "Specialty of the house" was one of the criteria that could affect their decision-making on what to choose[1]. Foodservice operators have themselves highlighted that they can promote healthier choices through their on-going practice of "chef's recommendation" or "Dish of the day" (Lachat et al, 2010). Promoting healthier options as DoD therefore appears to have potential as an effective and feasible strategy to increase selection of such options. Setting a dish as DoD in a restaurant affects the choice architecture by changing the way the options are described, as well as the way the task (here, the task of selecting a dish among various options) is structured (Johnson et al., 2012): when a dish is featured as DoD, the task becomes a sequence that can be described as: (1) Choosing whether or not to accept the DoD option and (2) If not accepted, then choose between the remaining alternatives.

Although there have been several attempts to classify choice architecture strategies in the past years (eg. (Hollands et al., 2013)), including nudges for food choices (Broers, Van den Broucke, Taverne, & Luminet, 2019), none, to our knowledge, has specifically included DoD interventions within such typologies. Taking into consideration several of these typologies, Wilson et al. 2016, based on Blumenthal-Barby & Burroughts (2012), propose that nudges for healthy food choices can be classified in six categories: 'Priming', 'salience', 'default', 'incentives', 'commitment and ego', and 'norm and messengers' (Blumenthal-Barby & Burroughs, 2012; Wilson et al., 2016). Advertising a dish as DoD in a restaurant may alter the task of choosing a dish in ways that could fall into several of these categories.

First, featuring a dish by labelling it "Dish of the day" may make the featured option more salient than the alternatives. In their systematic review on nudging for healthy food choices, Wilson et al. (2016) identify several studies investigating salience as a nudging strategy to encourage healthier food choice, using a variety of nudging techniques: calorie content labels, traffic light labels, descriptive labels, descriptive labels coupled with taste-testing, and verbal invitations to describe portions. While nutrition and health labelling tend to make one aspect of the dish more salient, featuring a dish as DoD could make this option more salient by changing the description of the dish itself. The way a dish is described has been hypothesized to have an impact on food perception and acceptance (Hartwell & Edwards, 2009), attitudes (Lu & Chi, 2018), and purchase intentions (Fakih, Assaker, Assaf, & Hallak,

[1] Source: FOOD – Fighting Obesity Through Offer and Demand. 2016 Barometer. French sample. http://www.food-programme.eu/en/barometers/france/

2016), however the effects on food selection are less clear (Wilson et al., 2016). In a school cafeteria setting, Morizet et al. (2012) compared choices of familiar vs unfamiliar vegetable dishes in the absence or presence of a descriptive label (basic description or a description referring to a model character). They found that labelling may have a positive impact on children's selection of unfamiliar vegetables, but this result was only observed for one of the two types of vegetables tested (Morizet, Depezay, Combris, Picard, & Giboreau, 2012). Another study conducted among recreational sports participants investigated salience as a potential nudge strategy, and found no effect of changing the descriptive labelling of healthy food items on the selection of these items (Olstad, Goonewardene, McCargar, & Raine, 2014).

In a real restaurant, a DoD may also act as a 'priming' intervention as it alters the visibility and accessibility of the options. A DoD is typically visible in more forms and places than a regular dish: it may for instance appear on menu displays and boards, leaflets within the menu, and sometimes as an oral description by the waiter. Such a display increases exposure to the DoD option and may therefore provide subconscious cues to the decision-maker regarding this option. Although DoD as priming interventions have not, to our knowledge, been specifically investigated in previous studies, Wilson et al. (2016) found evidence of a consistent positive influence of nudges combining salience and priming on healthier food choices in foodservice settings.

Some authors also suggest that introducing featured dish options such as DoD may also, in specific contexts, be perceived by some consumers as a recommendation and act as an implicit default choice or a social norm (Wisdom, Downs, & Loewenstein, 2010). Depending on the choice procedure in the restaurant, an option featured as DoD may indeed signal the option as a pre-set choice, easier to select than alternatives.

The common feature of all these DoD interventions is that they aim to affect choice without making the consumer reflect on the content of the option itself (in the case of food choice, the healthiness of the dish relative to alternative options) (Hansen & Jespersen, 2013). Beyond that, the type of nudging technique (salience, priming, default) that DoD interventions correspond to can be debated, mostly because the methods by which such interventions are conducted in the field can vary greatly, and thus impact the mechanism behind the DoD effect and its size. In the rest of this article, we focus more closely on two possible factors of variation:

- Dish type: the dish featured as DoD, which can be appealing (that is to say, an option that is popular and has a large market share) or unappealing (this is generally the case of dishes that are rich in vegetables).

- Menu size: the number of options to choose from, and therefore the number of alternative options to the DoD.

This study considers these two factors in the context of a DoD nudge aimed to increase selection of a vegetable-enriched dish in a restaurant setting. The purpose of the study was to test three hypotheses, drawn from previous choice architecture evidence, relating to the possible impact of DoD in the field:

2.2 Hypotheses

2.2.1 The "Dish of the Day" effect: increase in relative choice

The first aim of a DoD intervention is to increase the choice of the nudged option relative to the other alternatives.

To our knowledge, only two published point-of-choice studies have used strategies featuring a target (i.e. healthier or more sustainable) dish option as the primary choice, both with promising results. The first study examined sandwich choices in a fast-food restaurant using a menu card with "featured dishes" (sandwiches) that made the choice of healthier sandwich options slightly more convenient to choose than less healthy options (Wisdom et al., 2010). The second study recorded the hypothetical meal choices of student participants when presented either with default menus with meat-free meal options (with the possibility of opting for meat-based options presented as a side menu) or conventional menus with both meat-free and meat-based options (Campbell-Arvai, Arvai, & Kalof, 2012). In both cases, recommending a healthy dish option had a positive impact on the selection of that dish. Following these two studies, DoD could contribute to increased choice of the featured option. The experiment presented in this article aimed to replicate this 'DoD effect' in a self-service restaurant setting, using DoD to feature a target option. Hence our first hypothesis:

H1: The relative choice for a given alternative will increase when the alternative is recommended as DoD, compared to the control condition without DoD recommendation

2.2.2 The moderating role of dish popularity

The type of options and number of alternatives are characteristics of the choice set that have been previously identified as key elements of the choice task design (Marchiori et al., 2017) that are needed in order to infer principles of choice architecture that could then be used by foodservice professionals in their restaurants. Indeed, little is known of the conditions under which an intervention gains or loses in effectiveness.

Regarding the type of dishes, the size of the effect of a nudge appears to be linked with the initial selection share of the option, that is to say, its popularity. In the hypothetical dish choice study by Campbell-Arvai et al. (2012), the introduction of default menus had a differential impact depending on whether the target dish options were perceived as appealing or as unappealing: the increase in choice probability was highest for unappealing options set as defaults (compared with a neutral situation), although appealing options remained more frequently chosen than less appealing ones (Campbell-Arvai et al., 2012). In a recently published study, Boers et al. (2019) looked at the effects of different nudge approaches on increasing the selection of vegetables in a university buffet restaurant. The results suggest that the effectiveness of nudging depends on the specificity and/or the familiarity of the nudged products, which could also be related to dish popularity. Outside the food domain, this effect has also been observed for other types of economic choices using pre-set choice or default options (Roca, Hogarth, & Maule, 2006; Samuelson & Zeckhauser, 1988). The second hypothesis of this study therefore concerns the popularity of the dish as a condition for DoD nudge effectiveness:

H2: The DoD effect will be stronger for an unappealing dish compared to an appealing dish

2.2.3 The moderating role of menu size

A second element to consider when investigating the choice task is whether the menu size – that is to say, the number of options to choose from, impacts the effectiveness of the nudge. This is a key operational question, as the number of options proposed in foodservice settings varies significantly depending on the size of the restaurant, number of consumers, and the type of operator. Foodservice companies may see a higher number of options as a benefit to consumers, since it provides them a higher probability of optimizing their choices. Differentiation is thus a strategy commonly used in supermarkets to create added value (Oppewal & Koelemeijer, 2005). Conversely, an extensive literature review on choice avoidance (Iyengar & Lepper, 2000; Scheibehenne, Greifeneder, & Todd, 2010) suggests that the larger the number of options, the more decision-makers try to avoid making active choices, as search costs increase. It can be hypothesized that, in the presence of a larger number of dish options, consumers may be inclined to rely more on a decisional help such as a featured dish, to minimize the cognitive effort of searching options at the point of decision. Hence our third hypothesis:

H3: The DoD effect will increase with the number of options to choose from

To our knowledge, no study has specifically investigated this question for vegetable choices in foodservice settings or has looked at how the number of options may moderate the effect of featuring a dish as DoD.

Figure 1 summarizes the three hypotheses and main variables tested in this study. An experiment was conducted in a self-service experimental restaurant to study the impact of introducing a DoD option in the main dish selection task. The type of the nudged dish and the menu size (number of alternatives) varied across experimental conditions in order to compare the resulting probability of selecting the vegetable-enriched dish. The resulting intake, food waste, and consumer satisfaction, were also measured in each condition and compared in order to look at the potential consequences of variations in terms of consumer satisfaction and consumption behaviour.

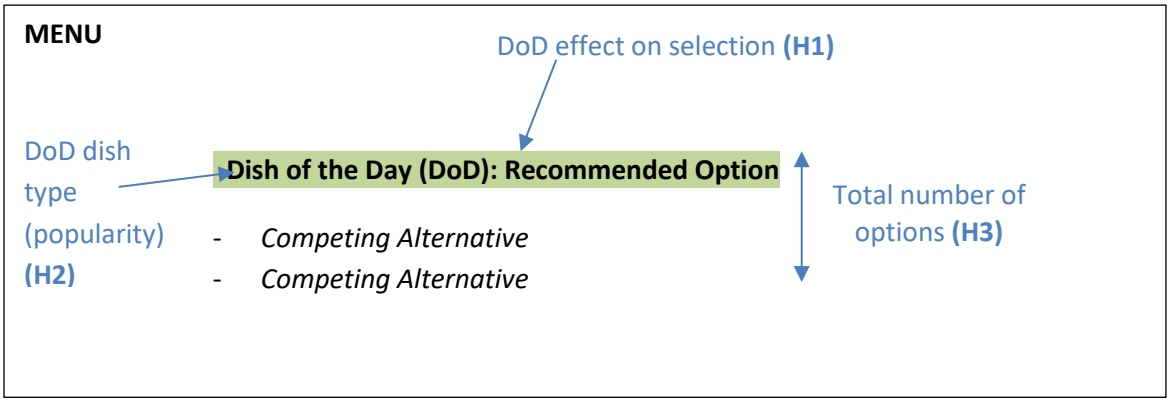

Figure 1: Summary of hypotheses

3 Material and methods

3.1 Experimental approach

In order to test these hypotheses, a living lab experiment was set up. Living laboratories, or living labs, are platforms of research and innovation where users are studied in their natural environment (Niitamo, Kulkki, Eriksson, & Hribernik, 2006). In the present case, the living lab is an experimental restaurant, and users are food consumers. This restaurant is composed of a kitchen and a restaurant that are both equipped to be entirely flexible and allow reproduction of any type of ecological catering environment (Dougkas, Saulais, & Giboreau, 2019). In such an experimental setting, contrary to that of a classical laboratory, participants come with the primary goal of having a meal experience, and not of completing a survey, even if they are aware that experimental studies may take place during their meal. The living lab is located within a place identified locally as a restaurant, instead of a university campus. Participants are not paid to participate, but they pay for their own meal, like in any restaurant. They are not recruited for the experiment, but rather make a booking for a table. As standard procedure, all customers sign a consent form at arrival even if they are not part of any study. Foodservice professionals operate the restaurant (food preparation and service) even when no experiments are conducted. However, like in a traditional laboratory, the platform allows researchers to strictly control procedures as well as context, including the food offer (portions, number of options, quality, prices), several physical ambiance variables (temperature, lighting), information provision, and service procedures (Dougkas et al., 2019), and to record and manage social interactions, making it possible to systematically investigate parameters of interest within a realistic environment. Although the food offer and operational procedures are strictly controlled, this control is not made apparent to consumers, and in terms of subject experience, living laboratory experiments are similar to *natural field experiments* "*where the environment is one where the subjects naturally undertake these tasks and where the subjects do not know that they are in an experiment*"(Carpenter et al., 2005, p.7), with the difference that, for ethical reasons, participants are informed of the nature of the platform (but usually not the nature of the study), as they have to sign a consent form to provide authorization for their data to be recorded even when no tests are being conducted[2].

For this study, the restaurant was set up as a self-service restaurant. The experimental task studied was the choice of food for a meal, a natural task which required neither supplementary

[2] An analogy could be made, to some extent, with medical research conducted in university hospitals, where patients may be asked to sign a consent form for their individual data to be used for research, although they primarily may have come with the objective of being examined or treated.

cognitive effort nor awareness of the experiment from participants. A questionnaire allowed the recording of complementary variables, but it was filled out at the end of the meal rather than before.

3.2 Participants

In total, two-hundred and ninety-four (294) restaurant customers participated in the study [98 men and 196 women; mean age: 51,6 years, s.d. 17,1]. They booked a table at the restaurant following advertisements that were sent via two primary means: (i) an email was sent to a database of consumers who had volunteered to be updated on events at the experimental restaurant, including tests and openings and (ii) advertisements (flyers and posters) were distributed in the local area, in public places as well as local companies. The flyer advertised for the opportunity to try out an ephemeral cafeteria concept at the living lab. To mirror the typical clientele of commercial cafeterias, no specific exclusion criteria were defined for recruitment. However, for this article, only the adult (over 18) sample was retained.

Participants booked a table on-line for one of the ten possible days of test, and were contacted again by phone or email for confirmation. As standard procedure, the day prior to their reserved time, participants were contacted again by phone to remind them of their registration for the following day. Consumers on the waiting list were called in the event of another consumer's cancellation.

3.3 Experimental setting

The restaurant was arranged to reconstruct a self-service restaurant. It included two areas: a choice area (where participants chose from the food presented in a buffet) and a dining area where participants could eat their meal once chosen (Figure 2). The choice area was designed to mirror a typical French cafeteria, where starters and desserts are chosen first, and the main (hot) dish is chosen at the end of the line. Participants paid 10 euros for a full meal composed of a starter, a main dish, and a dessert. Hot and cold beverages could be purchased in addition.

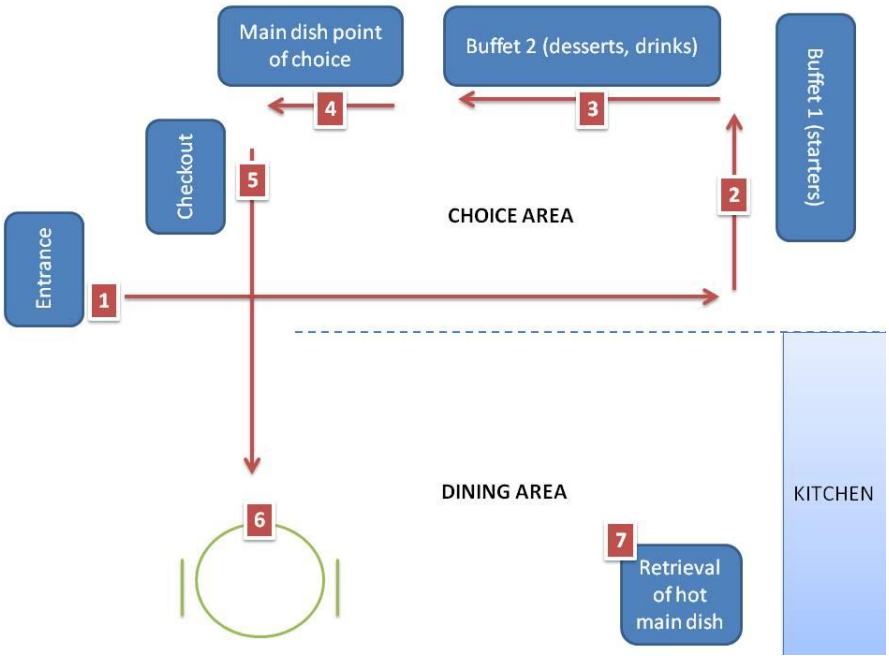

Figure 2: Configuration of the self-service restaurant setting

The numbers indicate the sequence of the customer's experience.

3.4 Food offer

The food options available at the buffet are described in the table below (Table 1). Portions were fixed and controlled for all foods. As the experiment focused on the choice of main course, there were no variations in the way the other courses were presented during the experimental campaign. For starter and dessert, some limited choice (described in the table below) was introduced to mirror real life cafeteria conditions. The buffet items in each section except the main dish (toppings, desserts, drinks) were displayed in a randomized order so as not to affect the choices of participants.

To ensure constant dish quality, all dishes (with the exception of desserts which were bought ready-made) were prepared and frozen on site in a single batch for the whole experimental campaign prior to the first session. The required number of portions was then re-heated for each lunch session.

The main course recipes were all hot dishes created by culinary arts professionals prior to the test. The Veggie Burger [vg1] and the Pea Pie [vg2] are vegetable-enriched dishes that were developed in the context of the European project VeggiEAT, following a specific recipe development process that included consumer feedback and acceptability evaluation. The recipe for the third dish, meatballs (nvg), was created specifically for this experiment as a meat-based alternative to the vegetable-enriched dishes. While the recipe using turkey and quinoa was innovative, meatballs are a typical and popular dish in French self-service restaurants.

Table 1: Description of food offer

Course	Dish	Portion size in g (Mean ± sd)	Choice
Starter	Corn soup contained in a casserole with cover	130g ± 0.92	One topping to choose among 3: Paprika (3.5g) / Chopped Chorizo (20g) / Chopped chervil (1.5g)
Main course	Vegetable Burger [vg1] (vegetable steaks made of red kidney beans, corn, chickpea, egg and flour), with burger bread, served with a seasoned salad as a side dish	268.7g ± 75.46	Type of dish (see experimental design)
	Peas Pie [vg2] (pie crust, filled with baked center made from baked peas, pea purée, eggs and cream) served with a seasoned salad as a side dish	262.08g ± 77.8	
	Meat Balls [nvg] (turkey meat balls with quinoa and tomato sauce) served with a seasoned salad as a side dish	267,85g ± 74.4	
Dessert	Fruits	1 pear or 1 apple or 2 clementines	Type of dessert
	Yogurt	100g	
	Millefeuille Pastry	140 g	Flavour of millefeuille (vanilla, chocolate, or caramel)
Drinks	tea, coffee, red wine, white wine, fruit juice, sparkling water		Type of drink

3.5 Experimental design

The experiment was designed to study the impact of a DoD nudge on the frequency of selecting the target dish, which was the vegetable burger (vg1). The experimental conditions tested two types of variations of the DoD setting: (1) Type of dish nudged as DoD option: either vg1 as the DoD, or nvg

as the DoD; and (2) Number of options: either 1 or 2 alternative choices to vg1. Two neutral conditions, where no dish was in the DoD position, were also studied as references to allow the measuring of effect sizes: T1-0 (two options, none is DoD) and T2-0 (three options, none is DoD). Five treatments were thus defined (Table 2). As the focus of the experiment was on vg1, we did not test DoD for vg2 in the three options version, and only considered the impact of increasing the number of alternative options when vg1 was DoD compared to a neutral setting where no dish was DoD.

Table 2: Experimental Treatments

Treatment	Dish of the day (DoD) option	Number of options	Number of sessions
T1-0 – Neutral (2 options)	None	2 (Veggie Burger + Meatballs)	2
T1a –vg1 as DoD, 1 alternative to DoD	Veggie Burger (vg1)	2 (Veggie Burger + Meatballs)	2
T1b – vg1 as alternative to DoD, 1 alternative to DoD	Meatballs (nvg)	2 (Veggie Burger + Meatballs)	2
T2-0 –Neutral (3 options)	None	3 (Veggie Burger + Pea Pie + meatballs)	2
T2a – vg1 as DoD, 2 alternatives to DoD (3 options)	Veggie Burger (vg1)	3 (Veggie Burger + Pea Pie + meatballs)	2

T1a and T1b allow measurement of the size of the DoD effect through the assessment of the proportion of participants who chose the DoD in these conditions in comparison with the neutral condition T1-0 (Hypothesis 1). Direct comparison of T1a and T1b allow assessment of the impacts of dish popularity (Hypothesis 2). T2-0 measures how choices are distributed when one extra dish option is proposed as a neutral choice, in comparison with T1-0. In T2a, vg1 is the DoD, and the choice of vg1 can be compared to T2-0 to evaluate the relative effect. Differences in choice between T2a and T2-0 versus T1a and T1-0 allow assessment of the impact of the number of options (Hypothesis 3).

3.6 Experimental procedure

The experimental campaign was conducted over 10 sessions in November 2015, which all took place at lunch time, from Monday to Friday, over the course of two weeks (2 non-consecutive sessions per treatment). Upon arrival, participants first signed a consent form (Figure 2, zone 1), to agree to the use of their data for research, although there was no information on the specific goals of the study. Participants were then given instructions to choose their food, which consisted of information such as

where to take a tray, the number of items that could be chosen, and where to pay. They were also given a short questionnaire with instructions to complete one part during and one part after their lunch, as well as a tray that was labelled with a unique identifier code to allow the recording of individual choices. They then headed to the choice area, where they first took their starter (zone 2), then one dessert (zone 3), and an optional drink. Finally, they headed to the zone of main course choice (zone 4), before paying at the checkout (zone 5). They then headed to the dining area (zone 6) where they consumed their meal and filled out the questionnaire.

The choice of main course went as follows. At the end of the self-service line (zone 4), an experimenter (dressed like the restaurant operators) presented the consumers with the choice of main hot dishes, always using the same pre-written discourse. The choice was based only on the description of the dishes, as consumers could not see dishes at this stage (they were prepared in a separate kitchen). This organization allowed for greater fluidity in customer flow, while also mirroring the organization of most French self-service restaurants where the main dish is ordered at the same time as the other dishes, but is served once the starter is consumed.

Depending on whether the treatment included a DoD option or not, the ordering procedure was different. On days that included no DoD, the choices were presented orally to consumers by the experimenter, who said “Today as a main dish, you have a choice between the options shown on the menu board”. The dish options were shown on a clearly visible menu board, posted at the point of choice. In conditions with a DoD, the experimenter (impersonating a waitress/waiter) said “today our Dish of the day is [DoD]. Other alternatives are available on the menu board” and showed the menu board, which featured the DoD and the other alternatives. To minimize the possibility that indicating the terms “Dish of the day” provided extra information that could be considered by consumers for their choice (for instance, DoD inducing a belief on the freshness of the dishes), it was specified from the beginning of the test that all dishes were made by the Culinary Masters students on site, in order to minimize beliefs on differentiated levels of freshness. Figure 3 shows the menu board presentation for T1-0 and T1a. For treatments T1-0, T2-0 and T2a, where more than one dish was presented as a non-DoD option, a randomization of order was conducted in each session. While randomization order was balanced in sessions T1-0 and T2a, only two out of six combinations appeared for T2-0 (as only 2 sessions were conducted per treatment): vg1- vg2-nvg and vg2-nvg-vg1[3].

[3] This incomplete randomization plan for T2a sessions may lead to an overestimation of the effect when comparing T2-0 and T2a. Although the data does not allow us to exclude the existence of this potential bias, the absence of a fixed session effect in the two-option treatments suggests that its extent may be limited.

Consumers then indicated their choice to the operator at the checkout counter (which was located next to the point of dish choice, as seen in figure 2), and received a token for the dish that they had chosen. The consumers could see the menu board at this stage as well. Then they paid for their meal, ate their starter, and once finished, went to retrieve their hot dish (zone 7).

Figure 3: Examples of menu cards posted for dish choice in the 2-options treatments: *Left: Neutral choice configuration in T1-0, Right: configuration in T1a, with vg1 as DoD***.**

3.7 Data collection and analysis

For each participant, three types of variables were collected during the experiment: **choices**, **self-reported evaluations**, and **quantities consumed**. Each participant was identified by a unique code, which allowed the connection of all types of data to the same individual. The method of collection of each type of data is presented in Table 3.

Table 3 : Variables collected and method of measurement

Type of data	Method	Variables	Unit / scale
Choices	Photograph of tray at counter	Choice of topping Choice of main dish Choice of dessert Choice of drinks	Category of dish chosen as observed through video observation
Quantities	Weighing of plate before and after the meal	Percentage plate waste of starter, main dish, dessert	Percentage (%) = (B-A)/B With A and B = respectively, weight in grams of plates and containers after (A) and before (B) the meal.
Self-reported evaluations	Questionnaire filled out	Year of birth Gender	Number Male or Female

throughout the meal	Occupation	Farmer / Employee, / Worker, / Unemployed, / Retired / Student, Executive/Self employed
	Liking of starter, main dish, dessert	9-point scale ranging from “I dislike it very much” to “I like it very much”
	Hunger before and after meal	9 point scale from “I am not hungry at all” to “I am very hungry”
	Emotional state before and after meal	9-point scale from “I feel very unwell” to “I feel very well”
	Score of vegetable liking (/90)	Cumulated liking scores for 10 common vegetables (green beans, peas, corn, carrots, salad, tomatoes, zucchini, broccoli, cauliflower, spinach) rated each on a 9-pt scale (“How much do you generally like this vegetable”)
	Frequency of vegetable consumption	4-point frequency scale 1 : less than once a week) 2 : several times a week 3 : Once a day 4 : More than once a day

All data were analysed using the R statistical environment (R core team, 2015). We conducted an analysis of DoD effects at the aggregated group level, then at the individual level.

Main course choices were first examined across treatments, in order to assess the impact of the DoD treatments on the probability of choosing vg1 versus nvg or vg2 at the group level. We examined the differences in choice rates and calculated what we labelled (following the standards in the behavioural economics literature) as a *bias*: that is to say, the difference between the selection of the dish when placed in nudged versus in neutral (non-nudged) conditions.

For dish i, the absolute bias (additional choices made towards a dish when it is DoD), b^i and the relative bias, r^i were calculated as :

$$\mathbf{b^i = DOD^i - NEUT^i} \text{ and } \mathbf{r^i = (DOD^i - NEUT^i)/NEUT^i}$$

where DOD^i and $NEUT^i$ are the proportions of participants who chose i, respectively, when it was the DoD dish, and when it was in the neutral condition. Pearson's Chi-squared tests were used to compare the proportions of vg1 versus other options across all treatments, across the two-options treatments (T1-0 vs T1a vs. T1b), and across the three-options treatments (T2-0 vs. T2a).

Secondly, we analysed individual-level data to estimate the determinants of the probability of choosing the target dish vg1. We looked at two sets of factors potentially affecting this probability:

- Choice set factors: type of dish (whether vg1 was the DoD, the alternative to DoD, or in a neutral position), and number of alternatives (either two or three options in the choice set);
- Individual factors : age, occupation, gender, hunger, emotional state, liking of vegetables

To account for possible session-related effects, the probability of selecting vg1 was estimated through a linear mixed model with a binomial distribution, using the Laplace approximation for random factor 'Session'. The estimation used function glmer from R package lme4 (Bates, Mächler, Bolker, & Walker, 2015).

For both the two- and three-option treatments, a fully specified model was estimated, as well as a model selected using AIC calculations. The selection step was conducted to keep the most relevant variables in the final model. Interactions between the experimental factors and individual characteristics were also included in the model selection process. As the relative probability depends, mechanically, on the number of alternatives, two databases were analysed separately, using, respectively, the data from the treatments with two options (T1-0, T1a and T1b) and the data from those with three options (T2-0 and T2a). Choices between two and three options on an individual level were not estimated, since the two-and three-option treatments were intended as separate experimental branches, with different factors of variation (type vs number of options), objectives and hypotheses.

Finally, in order to assess the consequences of the treatments on consumers' intake and satisfaction, the resulting quantities consumed and liking of the vegetable burger were compared across conditions, using parametric tests (Student two-sample tests).

4 Results

4.1 Participants' characteristics

The characteristics of participants are presented in **Table 4**. The samples were balanced across treatments in terms of gender distribution. However, the participants in the T1a treatment group were

on average slightly younger than those in the other groups. In terms of preferences for vegetables, the cumulated scores (as defined in **Table 4**) are not statistically different across groups. Self-reported initial and final hunger scores, as well as initial and final wellbeing scores, were not different between groups.

Table 4: Participants' characteristics across treatments

Treatment						**F Value, Pr(>F)**	**Fisher's exact test**
	T1-0	**T1a**	**T1b**	**T2-0**	**T2a**		
N	61	57	56	60	60		
Mean Age (sd)	54,1 (17, 6)	46,2 (17,1)	48,6 (18,9)	55,5 (16,5)	52,9 (13,9)	F=3.1 ; p=0.01	
Gender (%F)	68,9%	73,7%	69,6%	61,7%	60,0%		*P=0,50*
Initial Hunger (9-pt scale) (sd)	7,3 (1,5)	7,3 (1,5)	7,1 (1, 6)	7,4 (1,2)	7,2 (1,1)	F=0.4 p=0.82	
Final Hunger (9-pt scale) (sd)	1,6 (1,5)	1,4 (1,1)	1,6 (1,4)	2,2 (2,1)	1,7 (1,4)	F=2.2; p=0.07	
Initial wellbeing (9-pt scale) (sd)	8,0 (1,3)	8,1 (1,1)	8,1 (1,2)	8,1 (1,1)	8,2 (0,9)	F=0.2; p=0.95	
Final wellbeing (9-pt scale) (sd)	7,9 (1,3)	7,7 (1,4)	7,7 (1,7)	7,8 (1,3)	7,8 (1,1)	F=0.4; p=0.81	
Liking of vegetables (/90) (sd)	72,4 (9, 9)	75,3 (9,6)	74,0(10, 4)	75,7 (8, 8)	76,8(10, 4)	F=1.7 p=0.15	

4.2 Main course choices

Table 5 summarizes main course choices in function of the experimental condition, as well as absolute and relative bias for the DOD with reference, respectively, to the T1-0 treatment (in the case of T1a and T1b) and to the T2-0 treatment (for T2a).

Table 5: Proportions of main course dish choices across experimental condition

T1-0 (No DoD; 2 options)	**T1a**	**T1b** (nvg is DoD, 2 options)	**T2-0** (No DoD, 3 options)	**T2a** (vg1 is DoD, 3 options)

		(vg1 is DoD, 2 options)			
Nb participants	61	57	55	60	60
% vg1	34,4%	**59,6**%	27,3%	23,3%	**53,3%**
% nvg	**65,6%**	40,4%	**72,7%**	**51,7%**	35,0%
% vg2	x	x	x	25,0%	11,7%
Bias		25,2%	7.1%		30%
Relative bias		73%	11%		129%
Chi-squared tests	T1-0 vs. T1a vs. T1b : X-squared = 13.60, p-value = 0.001			T2-0 vs. T2a : X-squared = 11.42, p-value< 0.001	
	All treatments: X-squared = 25.13, p-value< 0.001				
	Relative bias: T1a vs. T1b vs. T2a : p-value< 0.001				

In the neutral treatment T1-0, 34,4% of participants chose vg1 over nvg. In both the two- and the three -option conditions, the treatments had an impact on the distribution of choices among the options ($p<0.001$ in both cases), suggesting an effect of DoD on choice.

Differences in the size of this effect were observed depending of the type of the dish placed as DoD. When vg1 was placed as DoD (T1a), 25,2% more participants chose vg1, for a total of 59.6%. When nvg was the DoD, the bias in favour of this dish was smaller, and only amounted to 7.1%. Likewise, the relative bias in favour of the DoD diminishes significantly when the initial share of the dish (evaluated in neutral condition) increases: it is the highest in T2a (73%) and the smallest in T1b (11%), suggesting that the least popular items benefit the most from the DoD intervention.

Increasing the number of alternatives affected the choice of vg1 and nvg in the neutral situation: in T2-0, adding an option reduces selection of both vg1 (by 11.1%) and nvg (13.9%) in comparison with T1-0. Presenting vg1 as the DoD in the 3-option situation (T2a), increased selection rate by 30% for this dish, compared to the neutral, 3-option condition T2-0. The relative bias for vg1 increased significantly between the 2 and 3-option treatments, going from 73% in T1a to 129% in T2a.

4.3 Determinants of choice of Dish of the Day

Based on the selection model step, the determinants of Pr ($VG1^i$=1), the probability of an individual i choosing the target dish vg1 in each database, were estimated using mixed-effects binomial regression models specified as follows:

For the two-option treatments: **$Pr(VG1^i) \sim VG1STATUS^i + Age^i$**

For the three-option treatments: **$Pr(VG1^i) \sim VG1STATUS^i + Age^i$**

Where

- **VG1STATUS**^{i} is a categorical variable whose value is 'NEUTRAL' if i was assigned to a treatment where there was no DoD (reference value in the model), 'DOD' if vg1 was the DoD in the treatment, and 'NDOD' if nvg was the DoD.
- **Age** is the age of the participant, in years

All other potential explanatory variables were excluded from the selected model as their addition increased AIC scores. The results of the model's estimation for both variety situations (one or two alternatives to vg1) are presented in Table 6, as well as the fully specified model (with all variables) for reference.

	2-options models (T1-0, T1a, T1b)							
	Taking into account sessions as random effects							
	Selected model				*Fully specified model*			
	Estim.	*Std. Err.*	*z value*	*Pr(>|z|)*	*Estim.*	*Std. Err.*	*z value*	*Pr(>|z|)*
(Intercept)	1.06	0.60	1.76	0.08	1,88	1,32	1,43	0,15
VG1STATUS =NDOD (Reference = NEUTRAL)	-0.55	0.49	-1.29	0.26	-0,57	0,43	-1,31	0,19
VG1STATUS = DOD (Reference = NEUTRAL)	**0.91**	**0.46**	**1.97**	**0.05**	**0,92**	**0,41**	**2,26**	**0,02**
Age	**-0.03**	**0.01**	**-3.30**	**<0.001**	**-0,03**	**0,01**	**-3,18**	**0,00**
GENDER (1=male)					-0,62	0,39	-1,60	0,11
HungerBefore (scale of 1-9)					-0,06	0,12	-0,53	0,60

Frequency of vegetable consumption (scale of 1 to 4)					-0,08	0,22	-0,39	0,70

Table 6: Logit Model Coefficients Estimates for Probability of Choosing vg1 in the two-options model

	3-options models (T2-0, T2a)							
	Selected model				*Full model*			
	Estimate	Std, Error	z value	Pr(>|z|)	Estimate	Std, Error	z value	Pr(>|z|)
(Intercept)	1,69	0,90	1,87	0,06	0,03	1,66	0,02	0,99
VG1STATUS = DOD (Reference = NEUTRAL)	**1,50**	**0,61**	**2.44**	**0.01**	**1,48**	**0,44**	**3,35**	**<0.01**
Age	**-0,06**	**0,02**	**3,40**	**<0,01**	**-0,06**	**0,02**	**3,50**	**<0,01**
GENDER (1=male)					0,01	0,45	0,02	0,98
HungerBefore (scale of 1-9)					0,00	0,19	0,00	1,00
Frequency of vegetable consumption (scale of 1 to 4)					0,53	0,28	1,92	0,06

Table 7: Logit Model Coefficients Estimates for Probability of Choosing vg1 in the three-options model

Two factors are significantly related to the probability of choosing vg1. The first factor is experimental: when vg1 is the DoD, then the probability of choosing vg1 increases. This is true in both models, although this effect appears to be weakly significant in the two-option model (p=0,05). The second factor is individual: younger participants had a higher probability of choosing vg1, independently of the experimental treatment.

Conversely, gender, initial state of hunger, and habitual preferences for vegetables, were not robust predictors of the probability of choosing vg1. Likewise, no interaction effect between the individual characteristics and the DoD conditions were found in the model selection process. Although

session effects were accounted for as random effects in the model estimation, other clustering variables that have not been tested may have also affected the independence of individual data, such as the number of participants in a session or the group sizes (at each table).

4.4 Impact of nudging on liking, meal choice and quantity consumed

Table 8 reports the percentage plate waste and liking of the dishes across treatments. Two two-factor ANOVAs were conducted at the group level to test whether (i) the amount of plate waste, and (ii) the liking score, are associated with the treatment and with the type of dish. Regarding (i) plate waste, the results do not suggest a statistically significant link between the amount of food wasted and the experimental condition (F= 1.33; p=0,25), between the plate waste and the type of dish (F=2.29; p=0.10), and between treatment x type of dish (F=0.34; p=0.89). Likewise, regarding (ii) liking, no difference in liking score could be identified between treatments (F=1.83; p=0.12), between dishes (F=0.93; p=0,40), nor between dish x treatment (F= 2.16; p=0.06).

Table 8 : Mean plate waste and liking score of all dishes across treatments

	T1-0		**T1a**		**T1b**		**T2-0**		**T2a**	
Mean (sd)	**Liking**									
	N	Liking score	*N*	Liking score	*N*	Liking score	*N*	Liking score	*N*	Liking score
vg1	*21*	5,81 (2,25)	*34*	6,21 (1,77)	*15*	6,13 (2,13)	*14*	6,57 (1,09)	*32*	6,31 (1,69)
nvg	*40*	6,88 (1,74)	*23*	6,35 (1,43)	*40*	5,55 (2,16)	*31*	5,97 (2,01)	*21*	6,19 (1,6)
vg2							*15*	4,93 (1,39)	*7*	6,86 (1,86)
Mean % (sd)	**Waste**									
	N	% waste	*N*	% waste	*N*	% waste	*N*	% waste	*N*	% waste
vg1	*21*	9% (10%)	*34*	9% (13%)	*15*	13% (15%)	*14*	10% (12%)	*32*	6% (8%)
nvg	*40*	9% (12%)	*23*	6% (12%)	*40*	9% (11%)	*31*	6% (8%)	*21*	6% (11%)
vg2							*15*	3% (7%)	*7*	2% (2%)

5 Discussion

A living lab experiment was conducted in a real self-service environment in order to examine the effects of setting a dish as DoD on consumers' dish choices. The primary purpose of this research was to replicate the DoD effect in this setting and to investigate under which conditions such a strategy could effectively affect choice. Two factors that are crucial in the set-up of food choice in a cafeteria environment were specifically investigated: the type of dishes available, and the number of alternatives.

5.1 H1: replication of the "Dish of the Day" effect

Although featuring healthier dishes as DoD has been described as a simple, straightforward and inexpensive way to encourage consumption of vegetables (Lachat et al., 2010), the 'DoD effect' has only been investigated in a limited number of foodservice settings. The first hypothesis (H1) was therefore that the DoD effect would replicate in this particular setting – in other words, that setting an option as DoD would have a significant effect on dish selection. This hypothesis is verified in the experiment: in all conditions, featuring a dish in the DoD position significantly increased the frequency of its selection in comparison with the neutral position.

5.2 H2: effect of the popularity of the nudged dish

Beyond this replication, the experiment was designed to test two hypotheses regarding the conditions of effectiveness of the DoD effect. Hypothesis H2 was that the size of the DoD effect would be different depending on the initial popularity of the option set up as DoD, and larger for initially less popular options. This hypothesis is overall verified: when comparing T1a and T1b, the size of the DoD effect was the largest for T1a, in which the DoD was vg1, the least selected dish in neutral conditions. In other words, the relative bias of selection was highest for the dish that had the lowest choice rate in the neutral position: when vg1 was DoD (T1a), choices of nvg decreased by 26% (compared with T1-0), whereas when nvg was DoD (T1b), choices of vg1 decreased only by 7%. This difference in absolute effect size may be due to the fact that the initial proportion of nvg choice (revealed in T1-0) was higher; leaving a lower number of people left to be "nudged". However, the difference in relative effect also suggests differences in the way the nudge acted in T1a (where the nudge was targeting those who would have chosen vg1 in T1-0) and in T1b (where the nudge targeted those who would have chosen nvg in T1-0). A possible explanation for this asymmetry of effects could be an asymmetry of attention: outside the food domain, Geng (2016) found that deviations (from what would be the predicted choice

544 in a neoclassical approach) are of greater magnitude when an option set as the default is an initially
545 less favoured option than when it is a most favoured, or dominant one (Geng, 2016).

546 **5.3 H3: effect of the number of alternatives**

547

548 The third hypothesis (H3) was that increasing the number of alternatives would reinforce the
549 impact of DoD. We observe this effect especially in terms of relative bias for the DoD. In absolute
550 terms, vg1 as the DoD option was chosen slightly more frequently in the situation with three
551 alternatives than with two alternatives, although this was not statistically significant. The relative bias,
552 on the other hand, was significantly stronger in the three-option task (129% versus 73% for the two-
553 option task). While a large body of literature has investigated the relations between variety and choice,
554 to our knowledge the link between number of alternatives and the effects of nudges for food have not
555 been investigated experimentally. Research on choice overload suggest that, although people are
556 more satisfied with variety, an excessive number of food choice options can be demotivating and can
557 lead to confusion (Iyengar & Lepper, 2000; Johnson et al., 2012). This phenomenon, sometimes
558 labelled the "Tyranny of Choice", could explain why preference for the "path of least resistance" (as
559 coined by Samuelson and Zeckhauser (1988)) and, therefore, the influence of the DoD nudge, both
560 seem to increase with the number of alternatives in the choice set.

561 **5.4 Consequences of the nudge on subsequent behaviour and satisfaction**

562

563 A secondary objective of the study was to assess the consequences of the nudge on consumers'
564 satisfaction and consumption behaviour, and more generally the relevance and legitimacy of
565 interventions such as the one described in this paper to address behavioural changes in the long term
566 (Loewenstein et al., 2012; Lusk, 2014). If participants find themselves nudged to select a dish, but are
567 disappointed by it, then the intervention has a negative outcome for them, and there is a risk that they
568 may adapt their behaviour so as not to be affected by the nudge a second time. In the case of this
569 experiment, some evidence of the potential impact of the nudge for individuals was provided by
570 measures of the differences in plate waste and liking of the selected dish across treatments. We found
571 no significant difference in consumer satisfaction with the dish (which seems to indicate that those
572 who were "nudged" towards vg1 did not like or dislike it significantly more, and likewise for nvg) or in
573 plate waste across treatments and dishes. Using these particular measures of satisfaction, there was
574 therefore no evidence that consumers perceived the choice of the option labelled as DoD as a loss.
575 However, in some other nudge experiments, evidence suggests that consumer intake may be affected
576 by nudging. Just and Price (2013) for instance found that adding a piece of fruit by default to students'

trays (with the possibility of giving it back) increased selection but also induced more waste (Just & Price, 2013). The difference could come from the palatability of the dish towards which the nudge was operated, and the perceived substitutability of options. Raw fruits may not be strongly palatable overall, while, in our experiment, the "target" product, vg1, was specifically designed and developed to be acceptable in a self-service context, through prior product development steps in the project. This increased attractiveness could have prevented a loss of satisfaction induced by nudging. Furthermore, some of the measures in our experiment were obtained on small subgroups (for instance, only seven participants evaluated vg2 in T2a), therefore, the test of the impact effects may be underpowered. Further research should be dedicated to exploring this specific aspect of nudging interventions. Additionally, participants in our study had also paid for their dish (as opposed to receiving a free dish), thus they had already made a commitment to the dish or had invested interest in consuming and liking it. However, an answer to this question would require further exploration of participants' beliefs and perceptions towards the different dishes.

5.5 Policy implications

The foodservice sector, and especially the commercial restaurant sector, has only recently come under the attention of policy makers to address the challenge of fostering healthier eating behaviours, and regulations have primarily focused on the provision of information, with mixed results regarding actual food choice behaviours. Policy interventions targeting the market environment have been identified as a potentially effective approach when it comes to fostering healthier behaviours (Brambila-Macias et al., 2011). In particular, nudging interventions have shown some promising empirical results (Bergeron, Doyon, Saulais, & Labrecque, 2019; Friis et al., 2017). However, several recently published meta-analyses have concluded that the quality of evidence on nudging is still insufficient to properly support implementation on a large scale (Bucher et al., 2016; Szaszi et al., 2018).

The research presented in this article focuses on one type of intervention, DoD, which has been recommended as a potential strategy to encourage healthier food choices. This research aimed to contribute to this need for more data on nudges by, first, replicating the DoD effect in a specific foodservice setting, and, second, by investing the conditions of the effects of this nudge, using a standardized and controlled approach.

In this living lab setting, the DoD effect was replicated and led to an increase in relative choice of the nudged dishes. In terms of effectiveness, we show, firstly, that this DoD effect is greater for dishes that are initially (in neutral conditions) less popular. Such strategies could then be beneficial in terms

of vegetable consumption, considering that taste, attractiveness and familiarity are amongst the main barriers to vegetable consumption (Appleton et al., 2016). Secondly, we find that the menu size has an impact on the DoD effect: the larger the number of options, the bigger the DoD effect size. DoD strategies could therefore be most impacting in environments such as commercial cafeterias or chain restaurants, where multiple options are available.

Another key point in the policy debate surrounding the use of nudges to encourage healthier eating is the public acceptance of such measures to promote healthy eating, especially in comparison to other possible policy instruments (Hagmann, Siegrist, & Hartmann, 2018), and their legitimacy to promote what is identified by choice architects as a "more desirable" behaviour. By assessing the effect of the nudge on consumer satisfaction and food intake, this research contributes to this debate by measuring the consequences of the use of nudges to encourage vegetable consumption.

5.6 Limitations

This study is a pilot experiment that aimed to provide some insights for choice architecture in foodservice settings, specifically on the question of how some conditions of implementation may impact the effect of a DoD nudge intervention. Living lab experiments are becoming increasingly used in the process of designing public health interventions in order to identify optimal conditions for implementation of an intervention on a larger scale. However, this methodology does not guarantee the generalizability of results to other settings (Sunstein, 2017). Although the living lab allows for controlled, systematic experiments in realistic conditions and aims to increase the transferability of results, the scope of our results remains limited by the specificity of the context. In particular, one of the main limitations of this study is that it only considers variations within one version of a DoD nudge intervention. As noted previously, "DoD interventions" can refer to different nudging techniques, and other versions of this nudge can be found in the field, with variations regarding the media that is being used to signal the DoD (it can be written on a board, displayed on a screen, announced by the waiter at a table-service restaurant, in different fonts or colors…), the way the description is worded ("Dish of the day", "Chef's recommendation", "Featured dish", etc.), or whether the ordering procedure is differentiated for the featured dish and its alternative (is it easier to order the DoD?). This study tried to minimize these variations in order to isolate the specific effects of the popularity of the dish and the number of alternatives, but we cannot rule out the possibility that the aforementioned variations could induce different decision-making mechanisms and lead to different effects. In particular, the food ordering procedure used in this experiment, with the presence of an experimenter orally presenting the choice, could have had an impact on decisions, and could potentially have strengthened the effect of the nudge or induced demand effects for the DoD. Similarly, varying the dishes themselves – in

terms of familiarity, palatability and nutrition density- could have led to different effect sizes. Replications of the experiment in other settings are therefore necessary to get a more robust view of the effects studied.

Likewise, although the size of the effects measured in this study is consistent with previous studies on featured dishes (eg. Wisdom et al. 2010), it is likely to be less important in other non-controlled, real life environments where other drivers of consumers' choices could intervene. In particular, the social cost of "refusing" the DoD to the experimenter may have been underestimated, and could have contributed to the extent of the observed effect, while opting out in the field may be perceived as easier. Furthermore, the design used in this study only allowed a partial exploration of the possible individual differences in sensitivity to the nudge. Yet, individual traits and preferences may moderate the effect of the intervention because of differences in prior preferences (Sunstein, 2017). In this study, the population in T1-0 was older than in T1a, therefore the extent of the DoD effect in T1a could be overestimated. Beyond socio-demographic characteristics, initial hunger and preferences for food, a more thorough investigation of the role that variables such as stress, attention, and time pressure play on individual sensitivity to the nudge would allow a better prediction of the possible factors of success and failure in real-world conditions. This needs to be addressed to prevent possible negative side-effects from nudges if some individuals are likely to be disproportionately affected by a nudge (Hansen, Skov, & Skov, 2016).

In practical terms, some issues require further investigation for the design of acceptable and optimal nudges for healthy eating in foodservice. In particular, this experiment looks at "one-shot" nudging, and does not assess the impact of using this nudge over a long period of time. In practical terms, it is important to ensure the persistence of the nudge effect, so that the nudge does not negatively affect consumers' satisfaction. If consumers' satisfaction decreases due to nudging, foodservice professionals may be discouraged to implement such measures in their restaurants to prevent negative impacts on sales in the long term. Long-term studies should be encouraged to investigate this question.

6 Conclusion

Although exploratory, this work aims to inform the debate on nudges in at least two ways. On the one hand, it presents an experimental investigation of the conditions of the effectiveness of a nudge. This topic has been identified as a key area for further research in recently published meta-analyses (Szaszi et al., 2018); particularly the links between the choice set characteristics and the effect of nudges (Marchiori et al., 2017). Although our paper also describes a context-specific study, it attempts to contribute to this reflection by using a controlled experimental approach in a realistic setting to test hypotheses grounded in decision-making principles within and outside the food domain. It also examines the consequences of the intervention on consumer satisfaction and consumption behaviour in a real eating situation.

The results bring some elements of reflection to choice architects regarding the practical implementation of nudge interventions to promote a healthier diet in the French population. To date, the majority of nudge research has been conducted in the USA (Filimonau et al., 2017; Szaszi et al., 2018). However, the strong social and cultural dimensions of food choice call for more country-specific perspectives on the effects of nudge interventions targeting healthy eating. Furthermore, there is some evidence that consumers' attitudes to nudge interventions may vary across populations (Reisch, Sunstein, & Gwozdz, 2017), which may lead to different reactions to such actions if they are made transparent to consumers.

The results suggest that there is potential for the foodservice sector to help address the challenge of increasing vegetable consumption using simple instruments. In particular, it appears that choice architects in the food domain should consider the size of choice sets, as well as consumers' preferences and the sensory characteristics of dish options, as crucial parameters in the design of adequate choice tasks.

Nudges could constitute a valuable complementary approach to current economic models of food decisions outside the home. Better knowledge of the characteristics of decisional processes for food, and the role they play both in the short term (on decisions at the point of choice) and long term (through the instalment of food habits) may provide useful clues to decrypt the mechanisms of food decisions and increase the effectiveness of behavioural change programs. A combination of choice architecture actions with other types of actions, such as culinary development interventions, allowing for the development of healthy, but well-appreciated alternative recipes, is a potentially interesting avenue.

7 References

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