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Nutritional labeling modifies meal composition strategies in a computer-based food selection task

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A R T I C L E I N F O

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A B S T R A C T

Nutritional information via simplified labelling on products' front of pack has become common in retail stores and is now concerning nowcollective catering. While numerous studies have investigated the effects of such information policies on consumers' decisions in shops, few studies have focused on choices made in collective catering. In such settings, consumers must compose a meal by combining dishes to be eaten during the same occasion. Each choice is then dependent of the selection of other foods, yielding a different decision problem as in a store where items are selected independently of one another. The aim of this study was to understand whether a nutritional labelling, (Nutri-Score®), modified the choices of consumers and more precisely modified the meal composition strategies - the associations between dishes made by consumers. A computerized menu composition task was designed, 371 participants were randomly redirected either to an interface displaying the Nutri-Score® of dishes, or to an interface showing the dishes without Nutri-Score®. Bayesian logistic regressions were used to explore dependency relationships between foods in presence or absence of Nutri-Score®. When considering dishes individually, no significant effects of the Nutri-Score® were observed, but significant effects of the Nutri-Score® on composition strategies could be observed. Two types of strategies seemed to emerge: homogeneous behaviors, where selected dishes had similar scores and, compensatory behaviors where selected dishes had contrasted scores. In conclusion, the effect of a nutritional labelling can have complex consequences on food decisions that extend beyond the selection of food items taken individually.

1. Introduction

Front-Of-Pack nutritional labelling of food products is now commonly used to guide consumers towards healthier food purchases (Ducrot et al., 2016). Among the most implemented nutritional labeling of this type, the Nutri-Score® labelling system is based on a 5 colors and 5 letters pictograms that aims to provide consumers with an accessible assessment of the nutritional quality of food items (Julia & Hercberg, 2017). This nutritional labelling system is increasingly present on manufactured food products and widely visible in retail stores in several countries. The Nutri-Score® system was initially developed in France and has recently been adopted, among others, by Belgium, Spain, Germany and Netherlands (Julia, 2020). The effect of such information on consumer choices is a complex issue that is yet to be determined and which is the subject of numerous academic works (Dubois et al., 2021). Irrespective of its actual effectiveness, the Nutri-Score® emerges to be a nutritional label that is being massively implemented in the retail sector. Since it is relatively simple to implement, potentially effective and relatively unexpensive for public authorities, several countries are even considering extending its display to other parts of the food system. In France for instance, the use of the Nutri-Score® labelling system in out-of-home catering and more precisely in collective catering is being seriously envisaged (HCSP, 2018; Ministère des solidarités et de la santé, 2019). The importance of this type of nutrition policy, if it is to be effective, is undoubtedly very high, since out-of-home catering and especially company restaurants and educational establishments' canteens, often accounts for a significant proportion of the meals consumed daily by the population (Saulais, 2015). For instance, in 2018, nearly 14% of the main meals eaten by the French population was eaten away from home and away from home catering is the habitual place of lunch

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during the week for 41.8% of the French population (ANSES, 2021).

While many studies have investigated the effects of nutritional labelling on in-store purchases (Packer et al., 2021), few have focused on the influence of such information systems on food choices in collective catering (Cerezo-Prieto & Frutos-Esteban, 2021; Christoph et al., 2016; Crosetto et al., 2016; Fernandes et al., 2015; Gomez & Le Minous, 2012; Hoefkens et al., 2011, p. 2, 2012; Kolodinsky et al., 2008; Merdji et al., 2019, p. 20; Seward et al., 2018; Werle & Pruski Yamim, 2019). Indeed, the rare studies carried out on the effects of information on choice behavior in collective catering have so far rather focused on measuring the effects of diverse labelling systems related to the environmental quality of food products (Merdji et al., 2019) or related to the origin of the ingredients or dishes (Fernandes et al., 2015). These studies showed that information given to the consumer has surprising effects that are often difficult to anticipate. One explanation for this is that the composition of a whole meal is a task that can involve complex trade-off mechanisms that result in making this composition quite distinct from the simple action of independently purchasing one several food products in a supermarket.

Indeed, in settings such as collective catering, the consumer's decision-making rules can be quite different from one in a supermarket. In collective catering, the consumer must compose a whole meal that will be consumed at a same eating occasion and that can include an association of starters, main courses, dairy products, desserts… In this case, new composition "rules" are considered in the decision-making process, they are related to often implicit associations or exclusions relationships between the chosen foods (e.g.: cheese comes with bread, only one dessert is generally selected, a fat and sweet food can be picked only if a food of better nutritional quality is also present to this meal etc.). This situation can be seen as a complex decision-making problem in which the decision maker selects items that establish intricate interrelationships.

There are therefore two issues that need to be addressed when looking at the effect of a nutritional labelling on consumption choices in out-of-home catering. Firstly, it is important to understand the composition rules that are applied by consumers when composing such meals. Secondly the way in which nutritional labelling modulates these complex and often nonconscious strategies in the making of a meal needs to be devised. The aim of this study ran in a simulation of a university canteen was to understand, on the one hand, the food choices strategies of college students in university collective catering, and on the other hand, whether and how the Nutri-Score® labelling system could influence this food selection process.

2. Methods and measures

2.1. Participants

Before the start of the data collection, the protocol received Ethics approval by the "C*omité d'Éthique de la Recherche*" of the University Paris-Saclay (CER-Paris-Saclay-2020–024/MS1). An invitation to participate in an online experiment consisting in a menu composition task was sent via a public mailing list ran by the French National Centre for Scientific Research (Information Relay in Cognitive Sciences, Paris, France, https://www.risc.cnrs.fr). The inclusion criteria for the participants of the study were to be students with age above 18 and registered in a higher education establishment in France. Upon completion of the experience, participants could participate in a draw to win 30 €.

2.2. Online experiment

An online experiment was developed using the PC IBEX platform (Zehr & Schwarz, 2018). It comprised two short questionnaires and a menu composition task (Fig.1). Before starting the experiment, the participants were informed about the study's management policy of personal data and were invited to give their consent to participate in the study. Participants were redirected to the experiment's page only if they gave their consent for participation to the study.

2.3. Measured parameters

The experiment started with the collection of personal information via a questionnaire: gender, age, height and weight and whether participants benefited from a scholarship. Then, the menu composition task consisted of visual interface displaying the menus proposed in a university restaurant in which participants were invited to compose the meal they would like to eat as if they were at the university canteen. The menus proposed for the experiment were real menus that had already been proposed by a local university canteen in the weeks preceding the experiment. For each menu, the participants composed their meal by

THURSDAY

Nutri-Score	Points	Starters	Nutri-Score	Points	Main courses	Nutri-Score	Points	Dairy products	Nutri-Score	Points	Fruits et desserts
A	1 point	Betterave et pomme	A	3 points	Filet de merlu blanc	D	1 point	Saint Nectaire	A	1 point	Compote pomme abricots
A	1 point	Tomate	C	0 point	*Sauce bonne femme*	D	1 point	Carré de l'est	A	1 point	Pomme gala
A	1 point	Sardines à l'huile	B	3 points	Chausson bolognaise	A	1 point	Yaourt nature	A	1 point	Banane
C	2 points	Galantine de dinde	C	3 points	Quiche lorraine	B	1 point	Petit suisse aux fruits	B	1 point	Cocktail de fruits
A	1 point	Salade de riz	A	3 points	*^ Lasagne aux légumes grillés	B	1 point	Yaourt aux fruits mixés	D	1 point	Mousse noix de coco
A	1 point	Champignon à la coriandre	A	4 points	*Bagnat burger				E	2 points	Brownie maison
			A	0 point	*Epis de maïs grillé*						
			A	0 point	*Pois cassé*						
B	0 point	Pain									

* = *vegetarian meal*
^ = *no side dishes can be chosen with this meal*

Fig. 1. Example of a menu presented in the online experiment with the display of Nutri-Score. The original version is in French; the titles and legends have been translated to English; the food items are still in French. This figure represents the fourth menu presented in the experiment. Participants randomly completed menus presented that way with the Nutri-Score® displayed and others completed an experiment where the Nutri-Score® label was not displayed. The "points" before each food items represent the cost of each item. In fact, a complete meal at the Crous university canteen costs 3.30 euros and consists of a total of 6 points.

selecting items and quantities among starters, main courses, dairy products and desserts. In the same way as in real conditions, points were associated with each dish to suggest the maximum number of items to be selected, the total number of points having to be below or equal to 6 (in real conditions, each point beyond the authorized number is charged). Five menus were successively proposed to the participants. Each participant was randomly seeing menus with or without the Nutri-Score® label for the entire duration of the task.

2.4. Questionnaire

Following the task composition, the participant was invited to fill in information via a second questionnaire related to the following points: (i) the habitual frequency of visits of university restaurant; (ii) hunger and satiety at the time of passing the experiment; (iii) the general importance granted to nutritional quality and environmental issues in selecting food products, (iv) the subjective perception of the nutritional quality of the meal composed in the preceding task.

2.5. Data collection and storage

The data collection lasted over one month and took place between June 15th and July 17th, 2020. After being anonymized, data collected during the experiment were downloaded from the server, stored locally for analysis. This data is in open access on https://osf.io/u2ky4/.

2.6. Data analysis

Statistical analysis was conducted using R version 3.6.3 with RStudio version 1.4.1106. Data was analyzed using Bayesian logistic regressions to provide estimates of the probabilities of selecting each considered dish in relation with the display of the Nutri-Score® on the participant's interface and the other dishes already selected in the menu (interactions and moderation effects between these latter explanatory variables were investigated in a second step).

Bayesian logistic regression was chosen considering the sparsity of our observation matrix, since some considered events being relatively rare (e.g. selecting one specific dessert). Bayesian logistic regression, allows to avoid separation issues, which is a common problem in such cases, even when the sample size is large (Gelman et al., 2008). Preliminary tests (not shown) confirmed that Bayesian logistic regression yielded similar results to those obtained by binary logistic regressions (explaining the probability of the choices of the foods considered) for the dishes whose choices were more frequent, allowing us to use Bayesian logistic regression for a more in-depth analysis.

Firstly, the items in the menu were grouped by their category (starter, main course, dairy products, dessert and bread) and their Nutri-Score® (A, B, C, D or E). Secondly, a model food category and different Nutri-Score® was designed as follow:

$$p\left(dish_{ij}\right) \sim labelling \times \left(age + gender + scholarship + BMI + frequency + hunger + nutritionconcerns + environmentalconcerns + \sum_{cat,cat \neq i}\left(\sum_{ns} is.dish_{cat,ns}\right)\right)$$

where $p(dish_{i,j})$ is the estimated probability of selecting the dish belonging to the food category i and assigned with the Nutri-Score®j. Labelling being a binary explanatory variable indicating if the Nutri-Score® labelling is displayed to the participant; *age, gender, scholarship, BMI, frequency, hunger, nutrition concerns, environmental concerns* refer to information collected via the questionnaires preceding or following the menu composition task; $is.dish_{cat.ns}$ is a variable encoding if the dish belonging to the category *cat* and of Nutri-Score® *ns* was also selected in the menu. Detailed analysis methods and R scripts are openly accessible and available on the osf.io repository of this project (https://osf.io/u2ky4/).

3. Results

3.1. Sample description

The sample collected consisted of 371 participants, resulting in 1855 observed meals. Table 1.

3.2. Descriptive analysis

Fig. 2 presents the number of selected dishes chosen according to the category (starters, main courses, dairy products, desserts) and Nutri-

Table 1
Presents the characteristics of the recruited sample.

Display of NS label	**Total** N = 371		Yes 186				No 185			
Gender	Women	Men	Women		Men		Women		Men	
	284	87	142		44		142		43	
	77%	23%	76%		24%		77%		23%	
Age (average)	22.9 (SD = 3.26)		22.7		23.5		23.1		22.4	
BMI (kg/m^2; average)	22.02 (SD = 3.3)		21.8		23.7		21.5		22.9	
Scholarship	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	102	269	41	101	9	35	38	104	14	29
	27%	73%	29%	71%	20%	80%	27%	73%	33%	67%

Study's online experiment sample description.

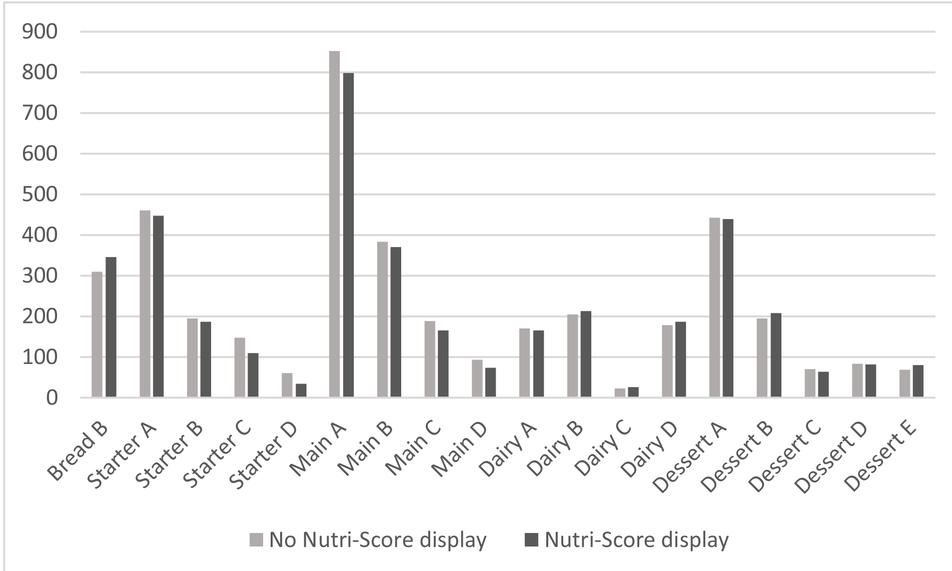

Fig. 2. Number of items chosen according to category and Nutri-Scores with and without display of Nutri-Score® labeling.

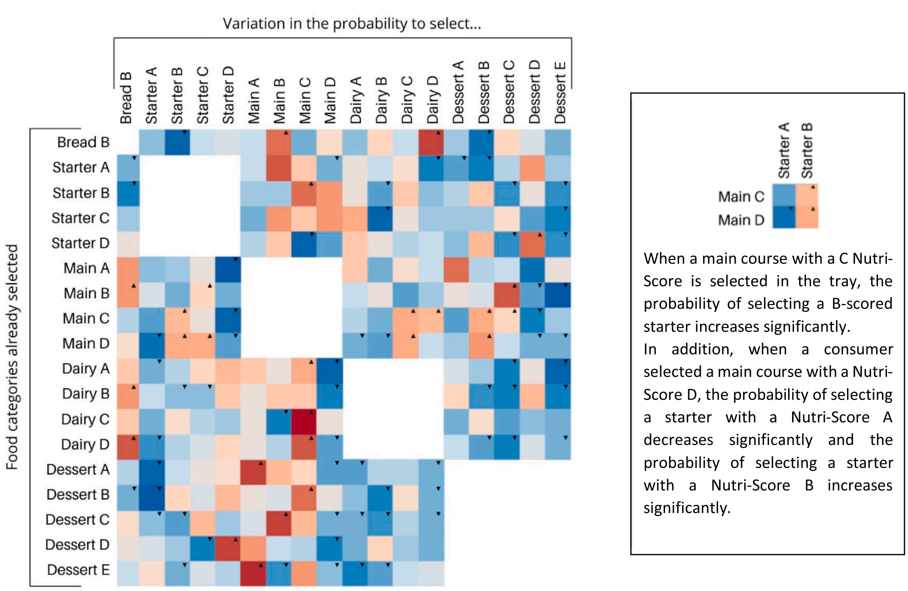

Fig. 3. Heatmap showing the meal choices strategies. The x-axis represents the food categories already selected and that represent the condition in the equation. The y-axis represents the variation in the estimated probability to select each food category according to the food categories already selected. The colors go from blue when there is an inverse correlation to red when the correlation is positive. The darker the color, the higher the correlation or inverse correlation. The square at the right is an example of the reading method of the heatmap. The letters next to the food categories indicate the Nutri-Score® of the food category in question.

Score® of the items. Statistical analysis did not reveal a significant overall effect of the Nutri-Score® on the choices of any of the considered dishes.

3.3. Meal composition strategies

Fig. 3 presents the meal composition strategies (i.e., the dependence relationships between selected dishes). Many dependency relationships were revealed by the analysis of the menu selection data. The main effects being exclusion mechanisms between foods such as desserts and dairy products (the estimated probability of selecting a dairy product is low if the participant has selected a dessert and vice versa) or compensation strategies in which a dish with a low Nutri-Score® is often associated with items with a higher Nutri-Score®.

Effects of the Nutri-Score® on food composition strategies are presented in detail in Fig. 4. In this figure, we focus on the moderating effect of the Nutri-Score® label on the food choice strategies. These effects can be categorized in 2 main tendencies:

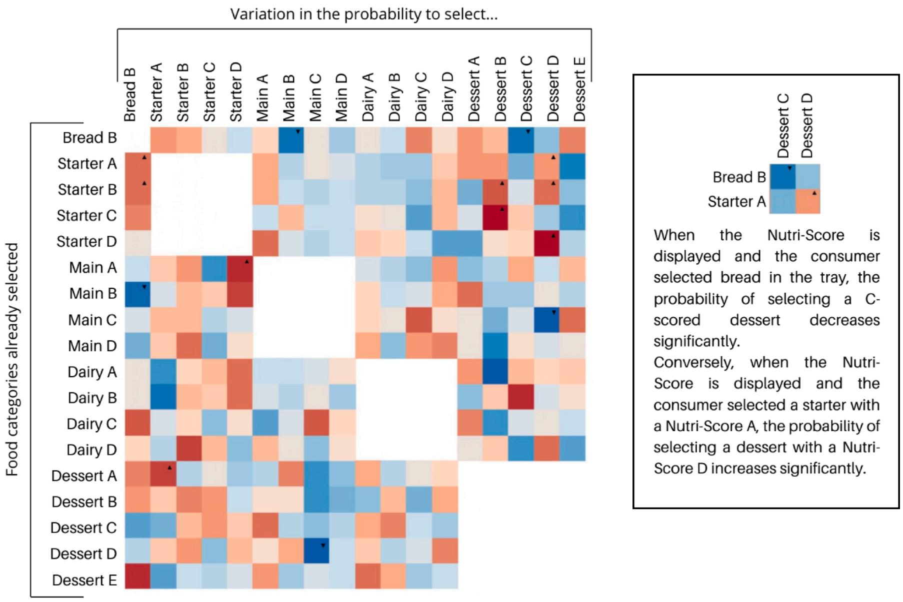

Fig. 4. Heatmap showing the meal choices strategies with the moderating effect of the Nutri-Score® display: The x-axis represents the food categories already selected and that represent the condition in the equation. The y-axis represents the variation in the estimated probability to select each food category according to the food categories already selected and specifically in under the effect of the Nutri-Score® display. The colors go from blue when there is an inverse correlation to red when the correlation is positive. The darker the color, the higher the correlation or inverse correlation. The square at the right is an example of the reading method of the heatmap. The letters next to the food categories indicate the Nutri-Score® of the food category in question.

(i) Induction of homogeneous behaviors where displaying the Nutri-Score® resulted in menus with a lower variability with respect to Nutri-Score® rankings between the starters and desserts. This induction applies to both ends of the Nutri-Score scale. These effects are illustrated by the following observations:

$$OR(starterA|dessertA) = 1.92$$

$$OR(dessertB|starterB) = 1.83$$

$$OR(dessertD|starterD) = 1.91$$

where $OR(starterA|dessertA)$ is the odds ratio describing the chances of choosing an A-scored starter given that an A-scored dessert had been selected when the Nutri-Score® was displayed compared to the chances of observing the same co-occurrence when the Nutri-Score® was not displayed. In the example presented here, the chances of observing "starter A when dessert A was selected" was 1.92 times greater when Nutri-Score® was displayed. Taken individually, these phenomena seem relatively infrequent, therefore for clarity purposes we decided to present odd ratios.

(ii) Induction of compensatory behaviors where displaying the Nutri-Score® resulted in trade-off behaviors where the participants selected items with divergent Nutri-Scores. These effects are illustrated by the following observations:

$$OR(starterD|mainA) = 1.99$$

$$OR(mainC|dessertD) = 0.16$$

$$OR(dessertB|starterC) = 3.00$$

$$OR(dessertD|starterA) = 1.44$$

$$OR(dessertD|starterB) = 3.34$$

$$OR(dessertD|mainC) = 0.32$$

In both figures Fig. 3 and Fig. 4, we observe unsymmetrical heatmaps because the conditional probabilities aren't inversible. For instance, the estimated probability of taking bread in the presence of the Nutri-Score® label increases significantly when the consumer already chose a starter with a score of A or B. Alternatively, there is no significant effect the other way around.

The appendix A shows the results of the food choice strategies of the Bayesian logistic regression operated on the whole model.

4. Discussion

Based on a computerized menu selection task, this study showed that,although the Nutri-Score® label had no significant effect on consumption choices on any of the presented dishes, an in-depth analysis of the evolution of the dependency relations between the selected dishes showed that the Nutri-Score® modifed meal composition strategies. This study suggests that understanding the effects of nutrition labelling on food decisions would benefit from considering the complex logic of food choices implemented by consumers.

Concerning the changes induced by the Nutri-Score, when considering the effect obtained without taking into account the specificities of the participants, the analysis indicated that there is no significant effect on food choices. This result is consistent with the contrasting effects of this type of labelling sometimes observed in numerous studies on nutrition labelling (in controlled or real consumption situations) (Crosetto et al., 2020; Dubois et al., 2021; Ducrot et al., 2016). Indeed, if studies on the effects of point-of-purchase nutritional labeling in university canteens have mainly observed a favorable effect of their presence on food choices (Cerezo-Prieto & Frutos-Esteban, 2021; Fernandes et al., 2015; Kolodinsky et al., 2008; Seward et al., 2018); other studies didn't succeed in showing a significant effect of nutritional labelling (Christoph et al., 2016; Hoefkens et al., 2011). Moreover, a study specifically targeting the Nutri-Score® in a university canteen setting found no significant effect of the implementation of this label on the short term (Werle & Pruski Yamim, 2019), this result is consistent with our findings.

The display of the Nutri-Score® in the choice interface significantly modified the probabilities of associations between food items. We were able to divide the strategies observed into two categories that were accentuated in the presence of the Nutri-Score® label: compensatory behaviors and homogeneous behaviors. Little has been said in the literature about food choices in the specific context of meal composition but trade-off effects in food decisions have already been observed. According to Merdji *et al.* food choices can be presented as series of trade-offs between determinants such as health, pleasure or sustainability (Merdji et al., 2019; Rozin et al., 1999). Our findings regarding the accentuation of homogeneous and compensatory behaviors when the Nutri-Score is displayed may originate from a modulation of trade-offs between dishes by stressing the importance of nutrition as a choice criterion.

This work was conducted on a study sample with marked specificities, making it difficult to generalize the observed results: students, predominantly women, frequenting university canteens in France. Focusing on this study sample is nevertheless relevant and informative in several respects. Firstly, students often have restrained budget dedicated to food purchases and low level of kitchen equipment, hence contrasting with other subgroups of the population. Students' behaviors however remain of particular interest since this subpopulation is often described for having an unbalanced diet (Levitsky et al., 2004) and this period in life is considered as a critical moment for adopting healthier eating behaviors. Secondly, the study sample was not evenly balanced and composed of 77% women and 23% men. However, observations from a total of 87 men were collected in this study probably ensuring reasonable statistical power. In addition, it is interesting to note that, together with our observations, recent works have reported that responses to nutritional labelling were rather similar across gender (Sarda et al., 2020). Moreover, as the French food model is known to be very structured with three meals scheduled at fixed times of the day (Rozin et al., 1999) observations made in a French context can't be easily generalized to other regions or countries. It is nevertheless interesting to note that even in a highly structured context we have been able to observe changes in response to nutrition labelling. This therefore suggests that similar changes are likely to occur in other regional contexts.

The socio-economic category of the participants would be an interesting explanatory factor to investiagte. In this work, although whether students benefited from a scholarship was recorded and used as a variable in the statistical models, this information alone wasn't sufficient to derive the socio-economic category of the participants since there are different types of scholarships (and some are not based on socio-economic criteria).

Lastly, a potential limitation to the generalizability of the results presented in this article is that this is an online study. The computer-based food choice experiment was conceived to be as close as possible from reality using menus chosen from a sample of real menus offered by a University Restaurant and opened only to students from French Universities. Nevertheless, it is legitimate to argue that such findings could not have been observed in a natural consumption situation. This question of the validity and generalizability of online studies in relation to reality has been much discussed in discrete choice experiments. The validity of such (hypothetical and online) discrete choice experiments method is well established and commonly used in economics and decision sciences (Richetin et al. (2022); (Brooks & Lusk, 2010; Louviere et al., 2000; Swait & Andrews, 2003). Studies comparing hypothetical and real choices (Carlsson & Martinsson (2001)) conclude with similarities in the results of their hypothetical and real choice experiments. Some authors have also pointed a higher risk of "desirability bias" in such online studies, since choices only marginally engage participants, they are more likely to respond in the way they imagine the experimenter expects them to respond (Costanigro et al., 2011). Here, since the labelling didn't impact the nutritional quality of the choices, this bias is certainly limited.

5. Conclusion

The novelty of this study relies in extending the observation of the effect of nutritional information beyond the selection of individual dishes, focusing rather on meal composition strategies. Nutri-Score® appeared not to have a significant effect on the each of the dishes considered individually but induced changes when considering the resulting composed meals. As this study consists of a computer-based experiment and not real-life observations, it will be necessary to make further observations in a real-life setting in a university canteen.

CRediT authorship contribution statement

Lynn Abou Jaoudé: Methodology, Investigation, Formal analysis, Writing – original draft, Visualization, Writing – review & editing. **Isabelle Denis:** Methodology, Validation, Writing – review & editing. **Sabrina Teyssier:** Methodology, Validation, Writing – review & editing. **Nathalie Beugnot:** Conceptualization, Funding acquisition, Writing – review & editing. **Olga Davidenko:** Methodology, Validation, Writing – review & editing. **Nicolas Darcel:** Supervision, Project administration, Funding acquisition, Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix a

Food choice strategies (bayesian logistic regression outputs)

	Bread B		Starter A		Starter B		Starter C		Starter D		Main A		Main B		Main C		Main D	
	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p
Bread B			1,45		1,89		1,03		0,77		1,09		0,55	*	1,14		0,71	
Starter A	1,78	*									1,43		0,82		1,08		1,46	
Starter B	3,52	*									2,10		1,43		0,60		0,69	
Starter C	2,11										1,27		1,01		0,78		0,55	
Starter D	1,16										2,89		0,78		5,14		11,80	
Main A	0,90		1,09		1,15		0,84		1,99	*								
Main B	0,43	*	0,87		1,49		0,80		3,07									
Main C	0,85		1,39		0,64		0,58		6,56									
Main D	0,46		2,99		0,65		0,29		29,48									
Dairy A	0,86		1,10		1,40		1,10		1,35		0,77		0,95		0,69		3,90	
Dairy B	0,65		0,83		1,87		1,98		1,19		0,98		0,76		0,82		2,85	
Dairy C	1,07		1,42		0,79		0,60		2,07		0,38		18,47		0,26		0,86	
Dairy D	0,53		1,53		1,75		1,23		0,53		1,06		1,24		0,39		2,08	
Dessert A	1,45		1,92	*	1,06		1,09		0,80		0,73		1,20		0,74		1,21	
Dessert B	2,37		2,65		1,34		1,76		0,52		1,07		1,17		0,34		0,64	
Dessert C	0,54		1,13		5,61		1,16		14,05		2,21		0,28		0,41		2,22	
Dessert D	0,86		1,36		2,69		1,31		0,78		0,80		1,79		0,16	*	20,99	
Dessert E	2,77		0,74		53,52		1,12		9,32		0,53		2,82		0,63		28,28	

	Dairy A		Dairy B		Dairy C		Dairy D		Dessert A		Dessert B		Dessert C		Dessert D		Dessert E	
	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p	OR	p
Bread B	1,09		0,82		1,82		0,69		1,25		1,56		0,45	*	0,73		1,89	
Starter A	1,03		1,03		0,90		1,68		1,60		1,94		0,98		1,44	*	0,87	
Starter B	1,09		1,71		0,48		2,24		1,00		1,83	**	3,97		3,34	*	43,45	
Starter C	0,87		2,23		0,32		1,74		1,21		3,00	*	1,29		1,43		0,99	
Starter D	1,03		1,36		2,02		0,53		0,83		0,81		20,59		1,91	*	16,54	
Main A	0,94		1,00		0,78		1,12		0,85		0,97		1,14		1,09		1,12	
Main B	0,99		0,78		4,86		1,32		1,12		0,77		0,27		1,55		2,44	
Main C	0,99		1,12		0,42		0,56		1,18		0,36		0,44		0,32	*	1,62	
Main D	2,79		1,79		0,31		1,38		1,27		0,23		0,94		22,72		21,20	
Dairy A									1,34		0,77		4,11		1,23		8,02	
Dairy B									0,79		2,41		6,64		0,66		3,44	
Dairy C									2,90		0,32		5,63		2,60		3,91	
Dairy D									1,09		1,82		1,89		1,55		1,37	
Dessert A	1,61		1,05		1,49		1,37											
Dessert B	1,06		2,97		0,44		2,31											
Dessert C	4,20		6,07		3,76		1,74											
Dessert D	2,25		0,75		2,98		3,04											
Dessert E	12,23		3,80		3,32		1,17											

References

ANSES. (2021). *Consommations alimentaires et apports nutritionnels dans la restauration hors foyer en France* (No. 2018-SA-0291; Rapport d'appui Scientifique et Technique). ANSES.

Brooks, K., & Lusk, J. L. (2010). Stated and Revealed Preferences for Organic and Cloned Milk: Combining Choice Experiment and Scanner Data. *American Journal of Agricultural Economics, 92*(4), 1229–1241.

Carlsson, F., & Martinsson, P. (2001). Do Hypothetical and Actual Marginal Willingness to Pay Differ in Choice Experiments?: Application to the Valuation of the Environment. *Journal of Environmental Economics and Management, 41*(2), 179–192. https://doi.org/10.1006/jeem.2000.1138

Cerezo-Prieto, M., & Frutos-Esteban, F. J. (2021). Towards healthy pathways: Effect of nutrition labels on eating behaviours in a university canteen. *Atención Primaria, 53* (5), Article 102022. https://doi.org/10.1016/j.aprim.2021.102022

Christoph, M. J., Ellison, B. D., & Meador, E. N. (2016). The Influence of Nutrition Label Placement on Awareness and Use among College Students in a Dining Hall Setting. *Journal of the Academy of Nutrition and Dietetics, 116*(9), 1395–1405. https://doi.org/10.1016/j.jand.2016.05.003

Costanigro, M., McFadden, D. T., Kroll, S., & Nurse, G. (2011). An in-store valuation of local and organic apples: The role of social desirability. *Agribusiness, 27*(4), 465–477. https://doi.org/10.1002/agr.20281

Crosetto, P., Lacroix, A., Muller, L., & Ruffieux, B. (2020). Nutritional and economic impact of five alternative front-of-pack nutritional labels: Experimental evidence. *European Review of Agricultural Economics, 47*(2), 785–818. https://doi.org/10.1093/erae/jbz037

Crosetto, P., Muller, L., & Ruffieux, B. (2016). Helping consumers with a front-of-pack label: Numbers or colors? *Journal of Economic Psychology, 55*, 30–50. https://doi.org/10.1016/j.joep.2016.03.006

Dubois, P., Albuquerque, P., Allais, O., Bonnet, C., Bertail, P., Combris, P., … Chandon, P. (2021). Effects of front-of-pack labels on the nutritional quality of supermarket food purchases: Evidence from a large-scale randomized controlled trial. *Journal of the Academy of Marketing Science, 49*(1), 119–138. https://doi.org/10.1007/s11747-020-00723-5

Ducrot, P., Julia, C., Méjean, C., Kesse-Guyot, E., Touvier, M., Fezeu, L. K., … Péneau, S. (2016). Impact of Different Front-of-Pack Nutrition Labels on Consumer Purchasing Intentions: A Randomized Controlled Trial. *American Journal of Preventive Medicine, 50*(5), 627–636. https://doi.org/10.1016/j.amepre.2015.10.020

Fernandes, A. C., de Oliveira, R. C., Rodrigues, V. M., Fiates, G. M. R., & da Costa Proença, R. P. (2015). Perceptions of university students regarding calories, food healthiness, and the importance of calorie information in menu labelling. *Appetite, 91*, 173–178. https://doi.org/10.1016/j.appet.2015.04.042

Gelman, A., Jakulin, A., Pittau, M. G., & Su, Y.-S. (2008). A weakly informative default prior distribution for logistic and other regression models. *The Annals of Applied Statistics, 2*(4), 1360–1383. https://doi.org/10.1214/08-AOAS191

Gomez, P., & Le Minous, A.-E. (2012). L'influence du format de l'étiquetage sur l'utilisation et la compréhension de l'information nutritionnelle: Résultats d'une expérimentation menée en restauration collective. *Revue d'Épidémiologie et de Santé Publique, 60*(1), 9–18. https://doi.org/10.1016/j.respe.2011.08.063

HCSP. (2018). *Avis relatif aux objectifs de santé publique quantifiés pour la politique nutritionnelle de santé publique (PNNS) 2018-2022* (p. 22) [Avis]. Haut Conseil de la Santé Publique.

Hoefkens, C., Lachat, C., Kolsteren, P., Van Camp, J., & Verbeke, W. (2011). Posting point-of-purchase nutrition information in university canteens does not influence meal choice and nutrient intake. *The American Journal of Clinical Nutrition, 94*(2), 562–570. https://doi.org/10.3945/ajcn.111.013417

Hoefkens, C., Pieniak, Z., Van Camp, J., & Verbeke, W. (2012). Explaining the effects of a point-of-purchase nutrition-information intervention in university canteens: A structural equation modelling analysis. *International Journal of Behavioral Nutrition and Physical Activity, 9*(1), 111. https://doi.org/10.1186/1479-5868-9-111

Julia, C. (2020). The Nutri-Score in France and beyond: Development, validation and transfer. *European Journal of Public Health, 30*(Supplement_5). https://doi.org/10.1093/eurpub/ckaa165.003

Julia, C., & Hercberg, S. (2017). Development of a new front-of-pack nutrition label in France: The five-colour Nutri-Score. *Public Health Panorama, 3*(4), 712–725.

Kolodinsky, J., Green, J., Michahelles, M., & Harvey-Berino, J. R. (2008). The Use of Nutritional Labels by College Students in a Food-Court Setting. *Journal of American College Health, 57*(3), 297–302. https://doi.org/10.3200/JACH.57.3.297-302

Levitsky, D. A., Halbmaier, C. A., & Mrdjenovic, G. (2004). The freshman weight gain: A model for the study of the epidemic of obesity. *International Journal of Obesity, 28* (11), 1435–1442. https://doi.org/10.1038/sj.ijo.0802776

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated Choice Methods: Analysis and Applications*. Cambridge University Press.

Merdji, M., Certenais, E., Mairesse, G., Kerhoas, N., Mourot, J., & Dourmad, J.-Y. (2019). Perception des messages associés à trois menus-tests servis en restauration collective: Santé, environnement et filière. *Cahiers de Nutrition et de Diététique, 54*(4), 230–239. https://doi.org/10.1016/j.cnd.2019.04.001

Ministère des solidarités et de la santé. (2019). *Programme National Nutrition Santé 2019-2023*. Ministère des solidarités et de la santé.

Packer, J., Russell, S. J., Ridout, D., Hope, S., Conolly, A., Jessop, C., … Croker, H. (2021). Assessing the Effectiveness of Front of Pack Labels: Findings from an Online Randomised-Controlled Experiment in a Representative British Sample. *Nutrients, 13* (3), 900. https://doi.org/10.3390/nu13030900

Richetin, J., Caputo, V., Demartini, E., Conner, M., & Perugini, M. (2022). Organic food labels bias food healthiness perceptions: Estimating healthiness equivalence using a

Discrete Choice Experiment. *Appetite, 172*, Article 105970. https://doi.org/10.1016/j.appet.2022.105970

Rozin, P., Fischler, C., Imada, S., Sarubin, A., & Wrzesniewski, A. (1999). Attitudes to food and the role of food in life in the U.S.A., Japan, Flemish Belgium and France: Possible implications for the diet-health debate. *Appetite, 33*(2), 163–180. https://doi.org/10.1006/appe.1999.0244

Sarda, B., Julia, C., Serry, A.-J., & Ducrot, P. (2020). Appropriation of the Front-of-Pack Nutrition Label Nutri-Score across the French Population: Evolution of Awareness, Support, and Purchasing Behaviors between 2018 and 2019. *Nutrients, 12*(9), 2887. https://doi.org/10.3390/nu12092887

Saulais, L. (2015). Foodservice, Health and Nutrition: Responsibility, strategies and perspectives. In P. Sloan & W. Legrand (Eds.), *The Routledge Handbook of Sustainable Food and Gastronomy* (pp. 253–266). 10.4324/9780203795699.

Seward, M. W., Block, J. P., & Chatterjee, A. (2018). Student experiences with traffic-light labels at college cafeterias: A mixed methods study: Student experiences with traffic-light labels. *Obesity Science & Practice, 4*(2), 159–177. https://doi.org/10.1002/osp4.159

Swait, J., & Andrews, R. L. (2003). Enriching Scanner Panel Models with Choice Experiments. *Marketing Science, 22*(4), 442–460. https://doi.org/10.1287/mksc.22.4.442.24910

Werle, C. O. C., & Pruski Yamim, A. (2019, May). *How continued exposition to a 5-color simplified FOP nutritional scheme influences purchases in a cafeteria: A field study*. Congrès International de l'Association Française de Marketing, Le Havre, France.

Zehr, J., & Schwarz, F. (2018). *PennController for Internet Based Experiments (IBEX)*. 10.17605/OSF.IO/MD832.