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Abstract

A widespread transition towards diets based on plant proteins as substitutes for animal proteins would contribute to food system sustainability. Such changes in consumer food choices can be fostered by public policy. We conducted an online experiment to test whether providing consumers with information regarding the negative consequences of meat consumption on the environment or health increases the substitution of animal-based proteins with plant-based proteins. The consumers had to make three meal selections, the first without exposure to information and the latter two after exposure to environmental or health information. One group of consumers served as the control and received no information. The results show that half of the consumers chose meals with animal proteins in all three cases. The information intervention had a limited impact on the average consumer. However, a latent class analysis shows that the information intervention impacted a sub-sample of the consumers. Information policy does not appear to be sufficient for altering consumer behaviour regarding the consumption of animal proteins.

Keywords: Experiment, information, food consumption, alternative proteins, environment, health.

JEL Classification: C93, D12, Q01.

L'apport d'informations augmente-t-il la substitution des protéines animales par des protéines végétales ? Une enquête expérimentale sur les choix des consommateurs

Résumé

Une transition généralisée vers des régimes alimentaires basés sur les protéines végétales comme substituts des protéines animales contribuerait à la durabilité du système alimentaire. De tels changements dans les choix alimentaires des consommateurs peuvent être encouragés par les politiques publiques. Nous avons mené une expérimentation en ligne pour tester si l'information des consommateurs sur les conséquences négatives de la consommation de viande sur l'environnement ou la santé augmente la substitution des protéines d'origine animale par des protéines d'origine végétale. Les consommateurs devaient faire trois choix de repas, le premier sans exposition à l'information et les deux derniers après exposition à l'information environnementale ou sanitaire. Un groupe de consommateurs a servi de témoin et n'a reçu aucune information. Les résultats montrent que la moitié des consommateurs ont choisi des repas à base de protéines animales dans les trois cas. L'apport d'information a eu un impact limité sur le consommateur moyen. Cependant, une analyse de classe latente montre que l'intervention informationnelle a eu un impact sur un sous-échantillon de consommateurs. La politique d'information n'apparaît pas suffisante pour modifier le comportement des consommateurs vis-à-vis de la consommation de protéines animales.

Mots-clés: Expérience, information, consommation alimentaire, protéines alternatives, environnement, santé

Classification JEL: C93, D12, Q01.

Does the provision of information increase the substitution of animal proteins with plant-based proteins? An experimental investigation into consumer choices

1. Introduction

During the past century, consumption of animal-based proteins in typical Western diets has increased dramatically in terms of both frequency and amount. Western diets are currently largely based on the consumption of meat, which contributes more than 15% of daily energy intake, 40% of daily protein intake and 20% of daily fat intake (Daniel *et al.*, 2011). Although this tendency has stabilized in France and the European Union since the beginning of the 2000s to approximately 85 kg of meat per capita per year (FranceAgriMer, 2015), meat consumption is still growing at the world level. According to the United Nations Food and Agriculture Organization (FAO), meat demand was 286 million tons in 2010 and should increase by approximately 200 million tons by 2050 (FAO, 2014). The increase in meat consumption, obviously associated with the extension of livestock production, imposes negative consequences on both the environment and public health (Hallström *et al.*, 2014; Tilman and Clark, 2014). For these reasons, a decrease in meat consumption is recommended, and particularly in high meat eating countries (Godfray *et al.*, 2018; Willett *et al.*, 2019). The current paper addresses whether an information policy may change consumers' behaviour regarding meat.

The effects of livestock production on the environment are currently well established (Poore and Nemecek, 2018). The contribution of livestock production to climate change and problems related to land use, biodiversity and water resources is clearly highlighted in the publication *Livestock's Long Shadow* by the FAO (Steinfeld *et al.*, 2006). Specifically, livestock is responsible for generating approximately 14.5% of total greenhouse gas emissions. In addition, Pimentel and Pimentel (2003) estimate that if the crops necessary for animal feed were consumed by humans, it would make available approximately 70% more calories than the amount currently available. Mekonnen and Hoekstra (2012) also show that 29% of the total water footprint of the world agricultural sector is related to the production of animal products. McMichael *et al.* (2007) state that assuming a 40% increase in the global population by 2050 and no advance in livestock-related greenhouse gas-reduction practices, global meat consumption needs to fall to an average of 33 kg per capita per year to stabilize emissions from this sector. Such a decrease would require a considerable reduction in meat consumption in industrialized countries and constrained growth in demand in developing countries (McMichael *et al.*, 2007; Hedenus *et al.*, 2014). Shifting diets towards reduced meat consumption has been identified as central to improving the sustainability of the food sector (Foley *et al.*, 2011; West *et al.*, 2014; Stoll-Kleemann and Schmidt, 2017). In the case of an extreme behavioural change, that is, the adoption of a vegetarian diet worldwide, emissions from food production would decline by 55%

per capita and the need for cropland by 600 million ha relative to the levels projected for 2050 based on current dietary patterns (Tilman and Clark, 2014).

The second major issue with meat over-consumption is related to public health. A substantial decrease in meat consumption in industrialized countries should benefit health, mainly by reducing the risk of obesity, cardiovascular diseases and stroke, type 2 diabetes and some cancers (Domingo and Nadal, 2017; Micha *et al.*, 2010; Vergnaud *et al.*, 2010; WHO, 2015). In 2015, the International Agency for Research on Cancer (IARC), an agency of the World Health Organization (WHO), summarized the results of an evaluation of the potential carcinogenicity of red and processed meat. Based on the accumulated scientific literature, the evaluation classified the consumption of red meat as "probably carcinogenic to humans" and processed meat as "carcinogenic to humans" (WHO, 2015; Bouvard *et al.*, 2015).[1] A meta-analysis indicates that excessive consumption of red meat, particularly processed meat, is associated with higher all-cause mortality (Larsson and Orsini, 2014). Reducing meat consumption in high meat eating countries thus aligns the objectives of improving the health of the population and enhancing environmental protection (Godfray *et al.*, 2018; Nelson *et al.*, 2016; Springmann *et al.*, 2016).

A decrease in meat consumption can occur when household diet and consumption habits are modified to feature more plant-based proteins (Bajzelj *et al.*, 2014; Tukker *et al.*, 2008). Indeed, plant-based proteins are a good substitute for animal-based proteins, allowing consumers to hold calorie and protein intake constant while limiting negative consequences on the environment and health (Aiking *et al.*, 2006). Although people have a growing interest in the health-related attributes of food and pay increasing attention to environmental issues, the majority of individuals are not aware of the negative consequences of livestock production and meat consumption on the environment and public health (Wellesley *et al.*, 2015). Only 28% of people agree that livestock production has significant impacts on the environment (de Boer *et al.*, 2013; Dibb and Fitzpatrick, 2014, 2015; Hartmann and Siegrist, 2017; Lea and Worsley, 2008; Tobler *et al.*, 2011). In addition, while 83% of respondents agree that human activity contributes to climate change, only 30% identified meat and livestock as a significant contributor (Dibb and Fitzpatrick, 2015). People are more aware of health concerns, but there is still strong heterogeneity among individuals, and some do not know that excessive meat consumption affects health in a negative way (Dibb and Fitzpatrick, 2014; Richardson *et al.*, 1993; Tobler *et al.*, 2011; Wezemael *et al.*, 2010).

Among possible regulatory actions (Bonnet *et al.*, 2020), information campaigns are suggested to be a good start to help change meat consumption behaviours (Apostolidis and McLeay, 2016;

[1] Based on epidemiologic data, a positive association between consumption of red meat and colorectal cancer has been shown with strong mechanic evidence. Pancreatic and prostate cancer is also associated with the consumption of red meat. The consumption of processed meat is classified as carcinogenic to humans on the basis of sufficient evidence for colorectal cancer. A positive association between the consumption of processed meat and stomach cancer has also been shown.

Spiller and Nitzko, 2015). The aim of this paper is thus to determine whether consumers shift their behaviour towards consumption of more plant-based proteins instead of animal-based proteins when they are informed about the environmental or health damage caused by meat consumption. We directly tested the impact of such an information policy on real consumers' choices by conducting a field choice experiment where a sample of consumers chose from three different processed products, each one with a meat version and a vegetarian version with very similar characteristics and protein levels. The consumers made their selections from among these six products and were instructed to take them home and eat them during the week. This task was repeated three times (once a week for three weeks). The consumers also completed questionnaires about their socio-demographics, eating habits and personality traits.

To evaluate the impact of information on consumers' willingness to substitute animal-based proteins with plant-based proteins, we organized three treatments that varied in terms of the information that participants received. The three treatments were randomly assigned and were as follows: a control treatment in which consumers received no information, a treatment in which consumers were informed about the negative consequences of meat consumption on the environment in terms of water use and a treatment in which consumers were informed about the negative consequences of meat consumption for health in terms of the possibility of developing a cardiovascular disease. The information was provided for the second and third food choices within the two treated groups. When making their second and third choices, participants could also consult the ratings and reviews left for each product.

The data show a strong consumer preference for animal-protein meals. Approximately 75% of the consumers chose a product with animal-based proteins as their first choice, and approximately half chose a product with animal-based proteins in all three stages of the experiment. Receipt of information about the environmental or health effects of meat consumption, either with or without additional information about others' opinions and comments, did not significantly impact average consumer preferences. Nevertheless, a latent class analysis shows that a sub-sample of the participants had lower preferences for animal-protein meals when they received the environmental or health information.

In the literature, several studies based on questionnaires have identified segments of consumers who are reluctant to reduce their consumption of meat substitutes. These studies indicate that a high consumption of meat, a low interest in meat substitutes, and a lack of willingness to adopt more plant-focused diets are still the dominant cultural pattern in most Western societies, even though some segments of consumers are more willing to change their dietary habits based on environmental or health motivations (de Boer *et al.*, 2007; Latvala *et al.*, 2012; Schösler *et al.*, 2012, 2015; de Boer *et al.*, 2013, 2014; Graça *et al.*, 2015). Other studies have measured consumers' preferences for diverse attributes of meat and meat substitutes and found that consumers are mainly affected by the type of meat, fat content, country of origin and price

(Apostolidis and McLeay, 2016). It has also been found that reading fictitious newspaper articles emphasizing the negative effects of meat consumption on animal welfare or health reduces consumers' intention to consume meat (Cordts *et al.*, 2014). Psychology and other motivations for intentions of meat reduction have also been investigated and such studies are continuing to expand (Kemper, 2020; Rosenfeld, 2018; Ruby, 2012).

Most of the studies then aim to analyse the impact of information on intentions to reduce meat consumption (see Harguess *et al.* (2020) for a systematic literature review of experimental studies on strategies for reducing meat consumption). Studies focusing on the impact of information on consumption itself (and not on intentions) are less widespread and often rely on self-reported consumption, e.g., Carfora *et al.* (2017, 2019). There is an obvious gap in the literature on the effect of public policy on reduction in real meat consumption (Taufik *et al.*, 2019). Our paper contributes to filling this gap. Closely related to our paper and in this streamline of research, some recent studies have analysed the impact of information about animal or plant-based proteins on consumers' real food choices. Austgulen *et al.* (2018) placed recipe booklets promoting vegetable dishes on stands in four large grocery stores in Oslo. The booklet focused on either the health benefits or the climate benefits of meals with plant-based proteins. The authors find that purchases of vegetables increased by approximately 10% per day over the level a year before, but they do not evaluate the effect on meat purchases. Direct substitutions between meals with animal-proteins and vegetarian proteins have been addressed only recently. Castellari *et al.* (2019) report the results of a laboratory experiment eliciting consumers' willingness to pay for beef burger meat and soy burger meat with and without information about the impact of beef and soy on health and the environment. They find only weak effects of the provision of information. In a choice experiment where participants selected among farm-raised beef and burger patties with plant-based proteins, Van Loo *et al.* (2020) also find minor effects of environmental information on willingness-to-pay for the products.

Our paper contributes to this literature, as it provides complementary tests evaluating the impact of information on real consumers' meat consumption behaviour. Our study has five main contributions to this literature. First, we study real choices and consumption of consumers between meals with animal-protein or vegetarian-protein instead of declared intentions. Second, we directly address the substitution between such meals instead of addressing only the increase of vegetable consumption or the decrease of meat consumption. Third, we compare the impact of two types of information, i.e. in terms of environment and health, on such substitutions. Fourth, consumers choose their products online and consume them at home that makes our study setting more natural and real, limiting some of the biases induced in lab experiments. Fifth, the methodology we use provides a highly controlled environment that makes our measure of the impact of information on meat consumption more accurate: we compare consumer behaviors when they receive the information to their initial choice without any information (whithin-control) and to other participants' choices who never receive any information throughout the experiment

(between-control). Our study thus provides new insights on the direct effect of environmental and health information on consumers' real consumption and substitution between plant-based proteins and animal proteins while limiting biases due to experimental evaluation.

The paper is organized as follows. The experimental design and procedures are detailed in section 2. Section 3 presents the results. Section 4 discusses the results and concludes.

2. Experimental design and procedures

The experiment was an online choice experiment in which participants made choices over a pre-defined set of ready-made food products on a dedicated website specifically developed for the study.[2] 309 consumers participated in our study. The participants were citizens of Dijon (a medium-sized city in eastern France) and were selected by an external recruitment company. The food product that was chosen by each participant was then ordered, and participants picked it up at the recruitment company's premises in the city centre of Dijon. They were instructed to consume it at home in the week following their order. To maximize the chances of participants eating the product within the allocated time, we asked them to take a picture of their meal on their plate and upload it to the website. We implemented real incentives to ensure that the participants truly received and consumed the product that they chose. Their choice thus revealed their own preferences and was not affected by hypothetical bias.[3]

2.1. Products

The pre-defined set of ready-made food products offered to the participants included six products existing on the market that constitute the main meal for lunch or dinner: three similar products, each with one version made of mainly animal-based proteins and one vegetarian alternative made of plant-based proteins. The products with and without animal-based proteins were chosen to have as similar a protein intake as possible to make choices comparable. The participants were informed of the weight of each product, which was the standard weight for a four-person main meal. They were also informed of the brands, ingredients, and nutritional facts of the products (all of them organic to guarantee minimum quality). The products are listed in table 1; the prices given here are indicative and were not given to the participants. A picture of the products, as they were offered to the participants on the website, is presented in Appendix A.

[2]The study design was submitted for approval to the Personal Protection Committee (registration number $2016 - A00353 - 48$), which noted that specific authorization was not required for this investigation. Then, the data were declared to the French Data Protection Authority (registration number: $\$oE19701952$).

[3]Studies show that consumers' intentions to make specific decisions are different from their real behaviour (Adamowicz and Swait, 2012; Webb and Sheeran, 2006).

Table 1: List of products

	With animal-based proteins	*Without animal-based proteins*
Couscous Proteins (Price)	Couscous with meat 11.1g/100g (€9.26)	Couscous with vegetables 7.15g/100g (€7.10)
Chili Proteins (Price)	Chili con carne with rice 7.45g/100g (€8.06)	Vegetarian chili with rice 6.65g/100g (€6.69)
Pasta Proteins (Price)	Pasta with bolognese sauce 7.75g/100g (€4.01)	Pasta with tomato basil sauce 7.75g/100g (€3.12)

2.2. Treatments

The experiment consisted of three treatments with a between-subjects design in the sense that a participant made decisions in only one treatment group. In the *control treatment* (CT), no information was provided, whereas in the *environment treatment* (ET) and the *health treatment* (HT), participants received information on the negative consequences of intake of animal-based proteins on the environment and health, respectively. Each treatment consisted of four stages with a one-week interval between them. Comparison across treatments and stages allows us to evaluate the impact of information on consumers' willingness to substitute animal-based proteins with plant-based proteins. Comparisons of the product choices across stages allow us to measure changes in each participant's choices over time and, together with comparisons of the product choices made in the environment or health treatment and the control treatment, identify whether the changes in choices were due to the information provided in the two information treatments.

Control treatment. In the control treatment, participants did not receive any external information about the consequences of animal-based protein intake. The four stages were as follows:

- Stage 1: During her first session on the website, each participant filled in questionnaires on her socio-demographic characteristics and food consumption habits and then chose and ordered a product among the six offered products.

- Stage 2: In her second session, each participant described the dish she chose in Stage 1, uploaded a picture of the meal on her plate, gave the product a rating (between 0 and 5) and wrote her review. Then, she chose and ordered another product from among the same six offered products.

- Stage 3: In her third session, each participant completed the same actions as in Stage 2 but for the product she chose at the end of that stage. Then, she was presented with the total number of participants (across all treatment groups) who wrote a review of the chosen product in Stage 1, the average of the star ratings for each product and an option to access the reviews. This additional information is aimed to provide social incentives

to affect choices of the participants.[4] This also makes the experiment more realistic as in real online food ordering, consumers can view the number of reviews and not the number of people who have bought the product. The participant then chose and ordered another product from among the same six offered products;

- Stage 4: In her fourth session, each participant described the dish she chose in Stage 3, uploaded a picture of the meal on her plate, gave the product a rating (between 0 and 5) and wrote her review. She then answered an end-of-experiment questionnaire on her personality traits.

Environment and health treatments. Unlike in the control treatment, in the environment and health treatments, an external intervention was set up after Stage 1: participants received additional information in Stage 2 and Stage 3 about the negative consequences of animal-based protein intake on the environment or health, respectively. Before choosing and ordering the product, participants could read a summary and illustrated card with the question tag "Did you know?" and the following explanation (see Appendix B for the text of cards):

- Information provided in the environment treatment: For 25% to 30% of proteins, the production of 1 kg, i.e. 2.2 lbs, of beef requires the consumption of 15000 l, i.e., 507210 US fl oz, of water, which is equivalent to 188 showers, whereas the production of 1 kg of pulses requires the consumption of only 4000 l, i.e., 135256 US fl oz of water, which is equivalent to 50 showers (Water Footprint Network).

- Information provided in the health treatment: Over-consumption of beef (consumption of more than 500 g, i.e., 1.1 lbs, per week) may lead to a decline in health and an increase in the risk of developing a cardiovascular disease. Consumption of 260 g, i.e., 0.57 lbs, of pulses is equivalent to consuming 210 g, i.e., 0.46 lbs, of beef and helps satisfy the recommendation to consume at least 58 g, i.e., 0.13 lb, of proteins per day (European Food Safety Authority).

Figure 1 summarizes the experimental design.

Together, the Control, Environment and Health treatments allow us to test the following two hypotheses:

Hypothesis 1: Environment and Heath information would make choices of vegetarian products more likely.

Hypothesis 2: Environment information would have a different impact than Heath information on products choices.

[4] In the context of food consumption, Friedrichsen and Engelmann (2018) and Teyssier *et al.* (2015) show that social incentives change the willingness-to-pay of individuals for fair-trade products.

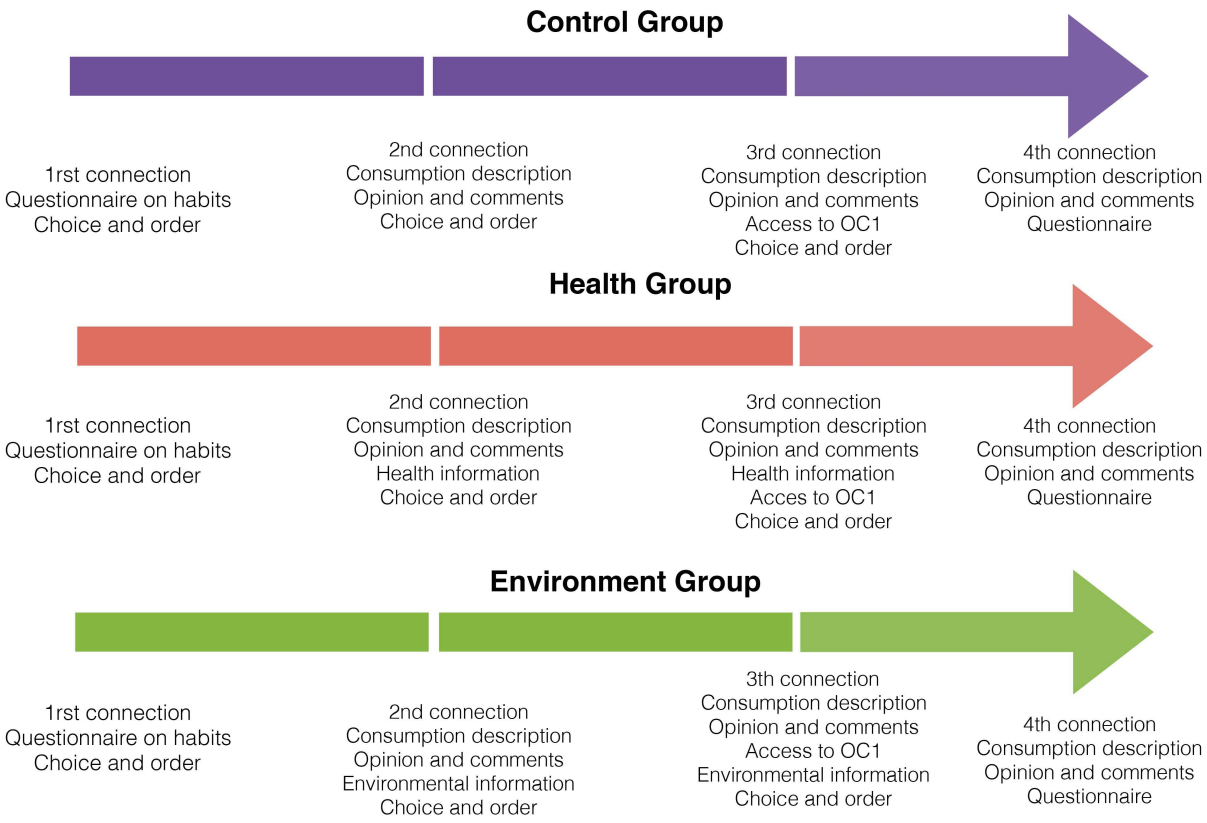


Figure 1: Stages in the control, environment and health treatments

2.3. Questionnaires

Participants had to answer questionnaires in both Stage 1 and Stage 4. The Stage 1 questionnaire asked about respondents' socio-demographic information (gender, age, number of children and number of adults in the family, education, net monthly family income) and food consumption habits (frequency of consumption of dairy products, vegetables, starches, fruits, red meat, white meat and fish as well as time spent cooking on weekdays and usual consumption of the offered products). We controlled for whether participants were frequent consumers of the products offered in the experiment: chili con carne, couscous and pasta bolognese. The Stage 4 questionnaire asked about personality traits (food neophobia and the Big-5 traits: openness, conscientiousness, extraversion, agreeableness and neuroticism). We constructed a food neophobia score as the mean of the response values between 1 and 5 (5-level Likert scale) for six of the Food Neophobia Scale items selected and translated into French following Ritchey *et al.* (2003). The Big-5 questions were developed based on the SOEP Scales Manual (Richter *et al.*, 2013) and consisted of 16 items. Each item was evaluated on a 7-point Likert scale.

2.4. Sample

Experiment participants were inhabitants of the city of Dijon (France) aged between 21 and 67 years old, with an average age of approximately 44. The conditions that they had to fulfil to

participate in the experiment were that they (i) agreed to take part in food purchases, (ii) had a computer or a smart phone (as the experiment was conducted online), (iii) agreed to log on to the dedicated website and order (for free) one product from a restricted set of six products once a week for three weeks, and (iv) agreed to consume the products that they ordered, take a picture of their plate when they consumed the product, and upload the picture to the website. A total of 309 consumers participated in the experiment: 102 in the control treatment group, 104 in the environment treatment group and 103 in the health treatment group.

The answers to the questionnaires for each treatment group are presented in Appendix C. Table C.1 presents participants' socio-demographic characteristics, table C.2 their eating habits, table C.3 their usual consumption of chili con carne, couscous and pasta bolognese and table C.4 their personality traits.

Half of the participants were women (157 women and 152 men). Their families were composed, on average, of 0.7 children and 1.9 adults. Forty-two percent held a diploma equivalent to the baccalaureate or below, 30% held a bachelor's degree and 28% held a master's degree or Ph.D. Net monthly family income was lower than €2300 for 38% of the participants, between €2300 and €3800 for 43% and higher than €3800 for 20%. Based on Wilcoxon rank-sum tests with significance at the 5% level, the socio-demographic characteristics of our sample of participants was balanced among the treatment groups.

We observe that 80% of participants reported consuming dairy products, vegetables and starches more than five times a week. Approximately 70% reported eating red meat, white meat or fish between one and four times a week. If we aggregate the data, we note that 28% of participants reported eating animal proteins between one and four times a week, 51% between five and seven times a week, and 20% more than seven times a week. According to Wilcoxon rank-sum tests, the answers were not significantly different among the treatment groups at the 5% level.

There was some heterogeneity in the distribution of food neophobia and the Big-5 personality traits among participants. However, we do not observe significant differences in the distribution of these traits among the treatment groups at the 5% level using Wilcoxon rank-sum tests, except for food neophobia between the control and environmental treatment groups ($z = 2.109$, $p = 0.035$).

The Cronbach alpha is greater than 0.5 for each of the five personality traits, which indicates acceptable internal consistency among each trait's inventory items. We obtain weaker internal consistency for conscientiousness and agreeableness, as in Bazzani *et al.* (2017); Ufer *et al.* (2019).[5]

[5]The Cronbach alpha is approximately 0.82 for openness, 0.52 for conscientiousness, 0.78 for extraversion, 0.52 for agreeableness and 0.70 for neuroticism.

3. Results

In this section, we first describe participants' choices in the different treatments and stages of the experiment and thus assess the impact of the provision of environmental and health information on food choices. Second, we study individual product choices depending on individual characteristics.

3.1. Descriptive statistics

We first describe consumers' product choices in each treatment and each stage of the experiment to give a general picture of the aggregated decisions. We present both the initial choices of participants, which correspond to the products that they chose on the website and took home from our distribution point, and the corrected choices, which are their product choices "corrected" for the sides that they reported consuming with the product. An initial choice of a vegetarian product that was consumed with animal proteins (meat, fish or charcuterie) is classified as a choice for the animal-protein version of the product. For the rest of the data analysis, we focus on the corrected choices, as they are more representative of the real consumption of animal proteins by the participants. We then present the dynamics of the individual choices over the three stages of the experiment.

Table 2 presents the frequency of food product choices, with the initial choices in columns 2, 4, 6 and the corrected choices in columns 3, 5, 7.

We observe that in Stage 1, i.e., before the information intervention, the shares of consumers who chose a meal without animal proteins are as follows: 29% in the control treatment, 26% in the environment treatment and 21% in the health treatment. When we correct for consumption of sides with meat, the shares of participants who did not consume animal proteins in Stage 1 become 21% in the control treatment, 18% in the environment treatment and 15% in the health treatment. The shares of both initial and corrected choices are not significantly different among the treatment groups in Stage 1 (Mann-Whitney rank-sum tests: $p > 0.1$). This suggests that the food choices were not different among the treatment groups when there was no intervention. We also note that the large majority of participants consumed animal proteins in the three treatments when there was no information intervention.

For Stage 2, the share of vegetarian initial choices (corrected choices) is approximately 29% (25%) for the control treatment, 28% (24%) for the environment treatment, and 27% (19%) for the health treatment. Despite the fact that consumers received some additional information in the environment and health treatments, the shares for these groups are not significantly different from the shares in the control treatment group (Mann-Whitney rank-sum tests: $p > 0.1$) or from the shares in Stage 1 of the same treatment (Mann-Whitney signed-rank tests: $p > 0.1$).

Table 2: Frequency of food choices by treatment and stage

Product	**Control tr.**		**Environment tr.**		**Health tr.**	
	initial	**corrected**	**initial**	**corrected**	**initial**	**corrected**
Stage 1						
Chili con carne	26.47	27.45	26.92	26.92	34.95	34.95
Couscous with meat	29.41	36.27	31.73	35.58	32.04	36.89
Pasta bolognese	14.71	15.69	15.38	19.23	11.65	13.59
Animal meal	**70.59**	**79.41**	**74.04**	**81.73**	**78.64**	**85.44**
Vegetarian chili	2.94	1.96	9.62	9.62	5.83	5.83
Couscous with vegetables	21.57	14.71	9.62	5.77	10.68	5.83
Tomato pasta	4.90	3.92	6.73	2.88	4.85	2.94
Vegetarian meal	**29.41**	**20.59**	**25.96**	**18.27**	**21.46**	**14.56**
Stage 2						
Chili con carne	31.37	31.37	26.92	26.92	23.30	24.27
Couscous with meat	14.71	17.65	24.04	25.00	23.30	27.18
Pasta bolognese	24.51	25.49	21.15	24.04	26.21	29.13
Animal meal	**70.59**	**74.51**	**72.12**	**75.96**	**72.82**	**80.58**
Vegetarian chili	3.92	3.92	8.65	8.65	4.85	3.88
Couscous with vegetables	13.73	10.78	11.54	10.58	12.62	8.74
Tomato pasta	11.76	10.78	7.69	4.81	9.71	6.80
Vegetarian meal	**29.41**	**25.49**	**27.88**	**24.04**	**27.18**	**19.42**
Stage 3						
Chili con carne	17.65	19.61	16.35	16.35	19.42	20.39
Couscous with meat	19.61	23.53	19.23	20.19	17.48	21.36
Pasta bolognese	24.51	30.39	26.92	27.88	30.10	33.98
Animal meal	**61.76**	**73.53**	**62.50**	**64.42**	**66.99**	**75.73**
Vegetarian chili	11.76	9.80	12.50	12.50	10.68	9.71
Couscous with vegetables	15.69	11.76	11.54	10.58	8.74	4.85
Tomato pasta	10.78	4.90	13.46	12.50	13.59	9.71
Vegetarian meal	**38.24**	**26.47**	**37.50**	**35.58**	**33.01**	**24.27**
N	102	102	104	104	103	103

For Stage 3, the share of vegetarian initial choices (corrected choices) is approximately 38% (26%) for the control treatment, 38% (36%) for the environment treatment, and 33% (24%) for the health treatment. We observe that the Stage 3 shares of vegetarian corrected choices are significantly higher for the environment treatment group than for the control treatment group (Mann-Whitney rank-sum tests: $p = 0.077$). We also observe that the shares of vegetarian choices in the environment and health treatment groups are higher for stage 3 than for stage 1 for the same treatment groups (Mann-Whitney signed-rank tests: in ET, $p = 0.052$ for initial choices and $p = 0.003$ for corrected choices; in HT, $p = 0.034$ for initial choices and $p = 0.059$ for corrected choices).

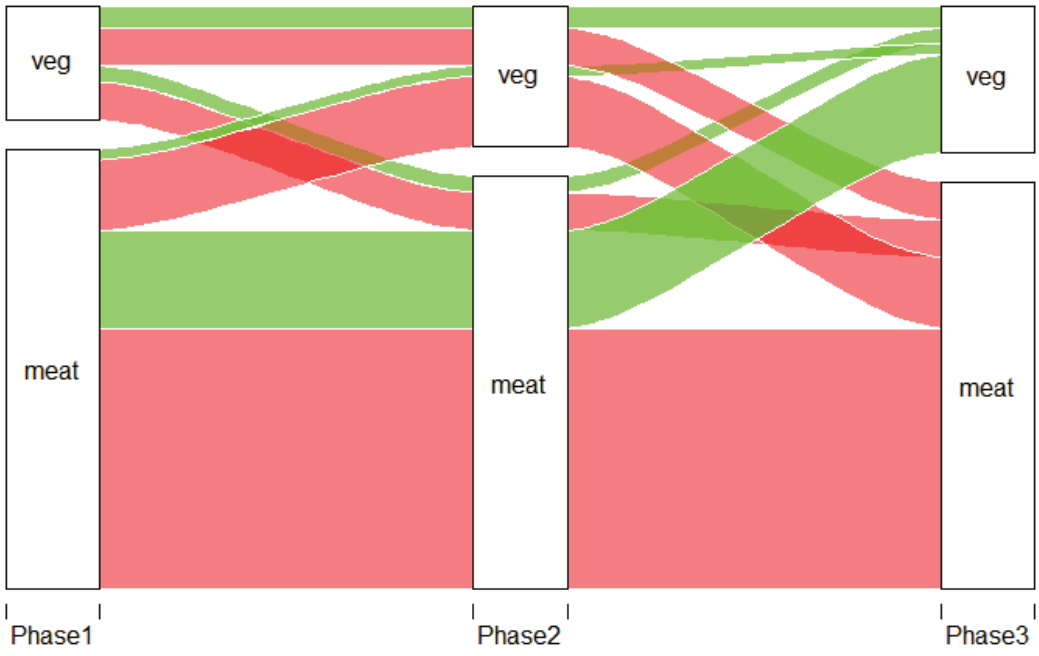
From the perspective of a descriptive analysis of the data, the study of the dynamics of individual food choices would give a more appropriate picture. Figures 2, 3 and 4 present the dynamics of the individual corrected choices in the control, environment and health treatment groups, respectively. These figures present at each stage of the experiment the share of participants who have chosen a meal with animal proteins ("meat") or a meal with vegetarian proteins ("veg") (the sum of the two equals 100%). The color red represents participants who have chosen a meal with animal proteins in Stage 3 while the color green represents participants who have chosen a meal with vegetarian proteins in Stage 3. The colors help to identify the trajectory of choices of the participants. These figures allow us to observe the changes in the types of meals chosen by participants over the different stages of the experiment.

The figures show that in the control treatment group, 47% of consumers consumed products with animal proteins in all three stages of the experiment, as did 45% in the environment treatment group and 54% in the health treatment group. Thus, a large proportion of the participants were not affected by the information intervention set up in the experiment. This leads to our first result:

Result 1: In the three treatment groups, an important share of consumers consumed animal proteins in each stage of the experiment: 47% in the control, 45% in the environment and 54% in the health treatment group.

At this stage of the data analysis, the results of our experiment already highlight that the information intervention on the negative environmental or health consequences of meat consumption did not dramatically modify consumption of animal proteins among participants. This result

Figure 2: Dynamics of vegetarian corrected choices in the control treatment group



suggests that the impact of provision of information on consumers' choices regarding plant-based proteins rather than animal proteins is limited and that consumers have strong habits regarding the consumption of animal proteins. This result is in line with the results of recent studies emphasizing that consumers are reluctant to modify their meat consumption behaviour, as in Lanz *et al.* (2018). This category of consumers may not be receptive to the information provided to them.

Figure 3: Dynamics of vegetarian corrected choices in environmental treatment group

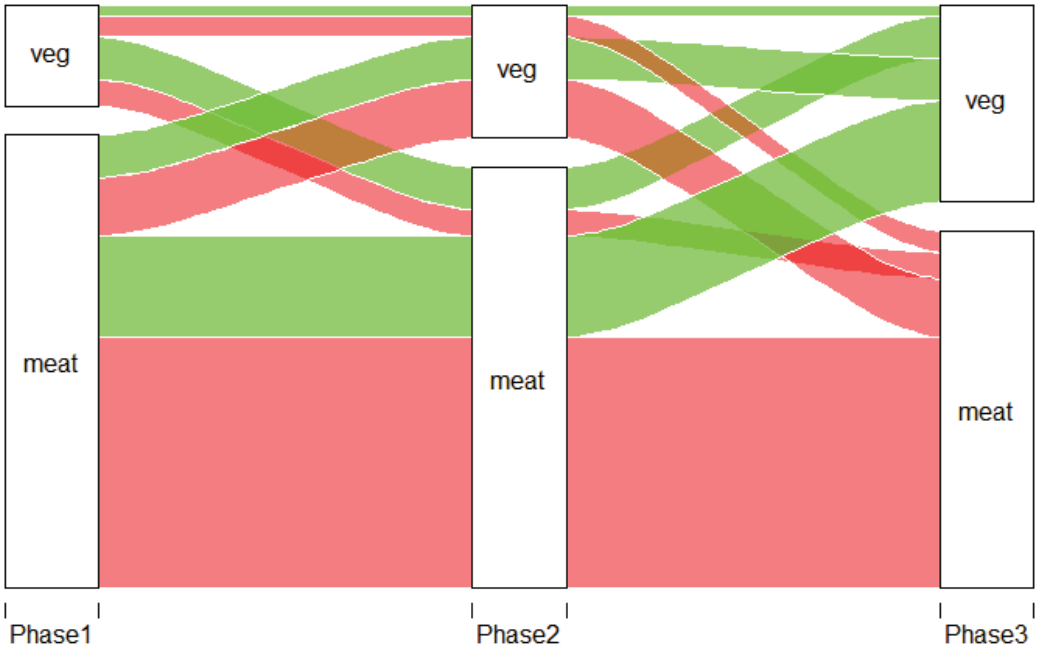
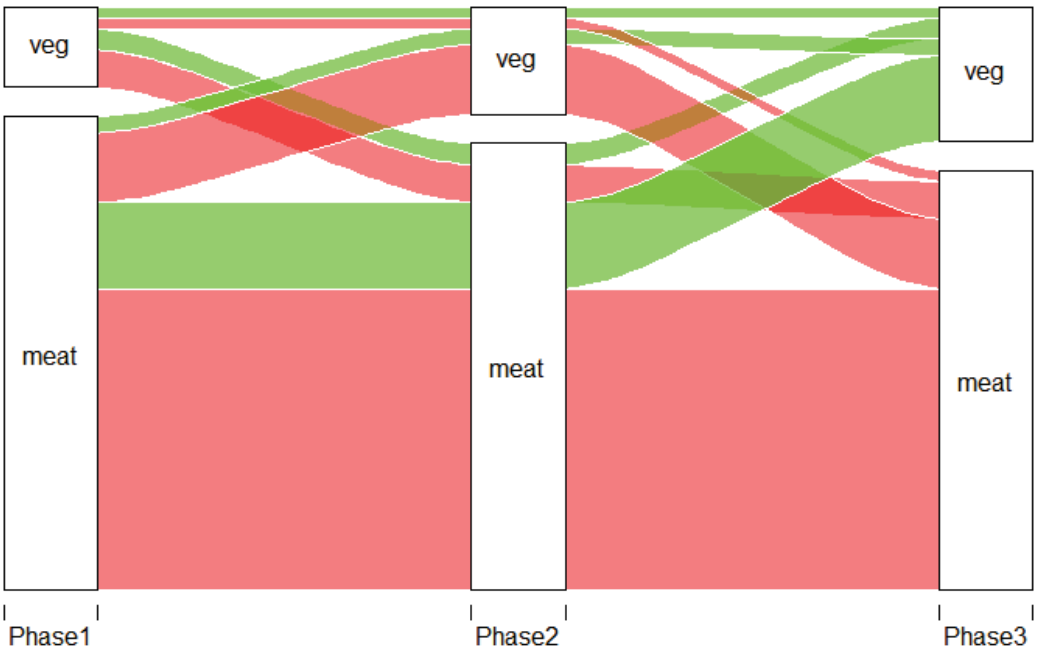


Figure 4: Dynamics of vegetarian corrected choices in health treatment group



In Stage 3, in addition to receiving environmental or health information, participants observed other consumers' average rating of the products chosen in Stage 1 and the number of reviews available for each product. Participants could also consult the reviews left by other participants. In total, 244 of the 309 participants left a review of the product chosen in Stage 1. The two main characteristics mentioned by participants were the taste and the quantity of the product: 126 reviews included a positive evaluation of the taste of the product, while 64 included a negative evaluation; 88 reviews described the quantity as insufficient, while 9 described it as reasonable. The environment was never mentioned, and only one review mentioned health. Nine reviews recognized the advantages of the organic attributes of the product. The content of the reviews appears to have had a limited impact on consumers' choices, as 243 participants (79%) never clicked on the button to read the reviews, while 29 participants clicked on one product review, and 37 clicked on more than one. Each product review was consulted between 17 and 27 times only.

The rating and number of reviews associated with each product were presented to all participants without a requirement to click on a button. Table 3 presents the average rating and the number of reviews for each product.

Table 3: Average rating and number of reviews for each product

Product	Average grade	Number of comments
Chili con carne with rice	4.088	69
Couscous with meat	4.135	80
Pasta with bolognese sauce	3.791	28
Vegetarian chili with rice	4.684	17
Couscous with vegetables	4.116	39
Pasta with tomato basil sauce	4.294	11

Note that the ratings attributed by consumers to the products that they chose in Stage 1 are quite high for all products. The lowest average rating was for the spaghetti bolognese (with an average rating of 3.791), and the highest was for the vegetarian chili (with an average rating of 4.684). As the average ratings are indicated with stars, distinctions among the products based on the actual product ratings are difficult to make. The number of comments is heterogeneous across the products and reflects participants' choices in Stage 1 of the experiment.[6]

[6]On average, over the three treatments, the percentage of participants who chose chili con carne with rice is 29%, couscous with meat 31%, pasta bolognese 14%, vegetarian chili with rice 6%, couscous with vegetables 14% and pasta with tomato basil sauce 6%, with corresponding percentages of reviews of 28%, 33%, 11%, 7%, 16% and 5%.

3.2. Econometric analysis of changes in product choices

We estimate a mixed logit regression to take into account the product type (couscous, chili or spaghetti) and the meat or exclusively plant based-protein content of the product. We estimate whether specific stages or treatments increase the number of choices for vegetarian meals. The mixed logit model is a discrete choice model that is consistent with Lancaster's theory of demand. Lancaster considers goods to be bundles of attributes with objective intensity levels and argues that the consumer derives utility from the amount of each attribute she consumes.

Each consumer i is faced with j alternatives in each of t choice situations. She chooses the alternative that maximizes her utility. The utility that consumer i obtains from choosing alternative j in choice situation t is $U_{ijt} = V_{ijt} + \epsilon_{ijt}$, where V_{ijt} is a function of observable attributes of the alternatives (depending on β_i, a vector of individual-specific coefficients, and x_{ijt}, a vector of observed attributes) and of the decision-maker, and ϵ_{ijt} is an unobserved random term. The random parameter logit model allows us to relax the assumption that the error terms are independently and identically distributed (IID) and then to take into account the heterogeneity of consumer preferences.

In the experiment, participants were asked to make three food product choices with six product alternatives for each choice. The main observable attributes of the alternatives are the product type (chili, couscous or pasta) and the vegetarian attribute (vegetarian proteins or animal proteins). The other dependent variables depend on the context of the task, i.e., the treatment (CT, ET, or HT) and the stage (Stage 1, 2 or 3). We thus define the utility function of the participants according to the product attributes and the context of the task:

$$\begin{aligned} U_{ijt} \;=\; & \beta_1\, couscous_{ijt} + \beta_2\, chili_{ijt} + \beta_{3i}\, vegetarian_{ijt} \\ & + \beta_4\,(vegetarian_{ij} \times stage2_t) + \beta_5\,(vegetarian_{ij} \times stage3_t) \\ & + \beta_6\,(vegetarian_{jt} \times environment_i) + \beta_7\,(vegetarian_{jt} \times health_i) \\ & + \beta_8\,(vegetarian_j \times environment_i \times stage2_t) \\ & + \beta_9\,(vegetarian_j \times environment_i \times stage3_t) \\ & + \beta_{10}\,(vegetarian_j \times health_i \times stage2_t) \\ & + \beta_{11}\,(vegetarian_j \times health_i \times stage3_t v) + \epsilon_{ijt} \end{aligned}$$

where $\beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}$ and β_{11} are the coefficients of the interaction terms for the vegetarian attribute, the treatment and the stage. The effect of the provision of environmental information is measured by β_8 and β_9 for Stage 2 and Stage 3, respectively, and the effect of the provision of health information is measured by β_{10} and β_{11}.

Table 4 presents the coefficients of the estimations. The random parameter logit is estimated using a maximum likelihood estimator with 500 Hamilton draws. Model (1) presents the coef-

ficients of the regression that we just described. Models (2) to (4) add some controls crossed with the vegetarian attribute: in model (2), we control for socio-demographic variables such as gender, age and income; in model (3), we control for eating habits in terms of the usual consumption of vegetables and animal proteins; in model (4), we control for psychological traits, namely, food neophobia and the Big-5 traits.

The coefficients obtained by the mixed logit regressions, with or without controls, emphasize

Table 4: Mixed logit estimations of corrected product choice by stage and treatment group

	Model (1)	Model (2)	Model (3)	Model (4)
Product characteristics				
Couscous	0.157* (0.080)	0.156* (0.080)	0.157* (0.080)	0.157* (0.080)
Chili	0.064 (0.082)	0.064 (0.082)	0.064 (0.082)	0.064 (0.082)
Vegetarian	-1.457*** (0.278)	-1.088** (0.471)	-1.405*** (0.355)	-1.154 (1.031)
Vegetarian crossed with stage and treatment group				
Stage 2	0.273 (0.352)	0.271 (0.352)	0.270 (0.350)	0.271 (0.351)
Stage 3	0.376 (0.350)	0.375 (0.351)	0.377 (0.349)	0.377 (0.350)
Environment	-0.168 (0.386)	-0.122 (0.386)	-0.141 (0.383)	-0.144 (0.386)
Health	-0.467 (0.404)	-0.436 (0.405)	-0.395 (0.402)	-0.424 (0.403)
Stage 2 × Environment	0.083 (0.502)	0.086 (0.502)	0.086 (0.501)	0.087 (0.502)
Stage 3 × Environment	0.590 (0.491)	0.590 (0.491)	0.586 (0.490)	0.593 (0.491)
Stage 2 × Health	0.106 (0.525)	0.106 (0.526)	0.109 (0.524)	0.103 (0.524)
Stage 3 × Health	0.323 (0.515)	0.324 (0.516)	0.323 (0.514)	0.319 (0.515)
Vegetarian crossed with socio-demographic variables				
Male		-0.044 (0.188)		
Age		0.0004 (0.008)		
Income in]1500-2300]		-0.512* (0.303)		
Income in]2300-3800]		-0.445* (0.259)		
Income higher than 3800		-0.486 (0.307)		
Vegetarian crossed with eating habits				
Vegetables 5 to 7 times per week			-0.164 (0.253)	
Vegetables more than 7 times per week			0.347 (0.256)	
Animal proteins 5 to 7 times per week			-0.062 (0.213)	
Animal proteins more than 7 times per week			-0.500* (0.284)	
Vegetarian crossed with personality traits				
Food neophobia				0.003 (0.148)
Openness				0.090 (0.097)
Conscientiousness				-0.009 (0.108)
Extraversion				-0.148* (0.087)
Agreeableness				0.091 (0.100)
Neuroticism				-0.102 (0.080)
SD: Vegetarian meal	0.766*** (0.184)	0.745*** (0.187)	0.688*** (0.192)	0.733*** (0.189)
AIC/BIC	3058.82 / 3138.31	3064.79 / 3177.39	3057.80 / 3163.78	3064.71 / 3183.94
Observations	5,562	5,562	5,562	5,562

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

that provision of information does not boost substitution of animal proteins with plant-based proteins. Supplying information on the negative environmental or health impact of meat consumption did not significantly change consumer preferences in either Stage 2 or Stage 3.[7] We summarize this finding in result 2:

Result 2: Provision of information about the negative consequences of meat consumption on the environment or health does not impact average consumer preferences for products with plant-based proteins.

This result suggests that information policy does not significantly impact eating habits in the short term. This result is in line with those of other studies on this topic. Specifically, regarding meat substitution, Castellari *et al.* (2019) show the limited impact of information on willingness to pay for beef. On average, participants in our experiment preferred to consume meals with animal proteins instead of exclusively plant-based proteins.

We also observe that participants appeared to derive higher utility from the couscous than from the pasta and chili. This is in line with the fact that couscous is known to be a favourite dish among the French population (TNS, 2011). We find that participants declaring an income between €1500 and €2300 or between €2300 and €3800 valued vegetarian meals less than those with lower incomes. Regarding eating habits, participants who reported consuming animal proteins more than 7 times per week valued products with plant-based proteins less. This suggests that consumers who have strong habits regarding meat consumption are not willing to change them. Food neophobia had no significant impact on product choice, and among the Big-5 personality traits, only extraversion had a significant impact, with participants with higher levels of extraversion valuing products with plant-based proteins less. The role of extraversion corroborates with Pfeiler and Egloff (2018a) that shows that people with higher extraversion self-report more consumption of meat. Model (3), which includes control for eating habits, has a slightly lower AIC (but higher BIC) than that of Model (1).[8]

In short, receiving information about the negative consequences of meat consumption on the environment or health had no effect on the average consumer. Consumers differ in their level of motivation to reduce meat consumption (Schösler *et al.*, 2014), and the consumers in our experiment may in turn have reacted differently to the environment or health information provided. We thus examine the role of information in product choices assuming heterogeneity in participants' preferences using a latent class approach with homogeneous consumers in each class.

[7] We also ran regressions including cross-interaction effects between products and information or the vegetarian attribute. The results are robust, and none of these interaction effects have a significant impact on preferences or deteriorate the Akaike (AIC) or Bayesian information criterion (BIC) indicators (results are available upon request).

[8] We also tested for an impact of the number of reviews in Stage 3 on the choice of product in Stage 3. Because of the endogeneity of the number of reviews as a product characteristic (the number depended on participants' choices in Stage 1), we conducted the analysis only on food product choices in Stage 3. We nevertheless find no significant effect of the number of reviews on participants' food choices in Stage 3.

The probability of observing consumer i's sequence of choices when she belongs to class c is a product of conditional logit formulas, $P_i(\beta_c) = \prod_{t=1}^{T} \prod_{j=1}^{J} \left[\frac{\exp(\beta_c x_{ijt})}{\sum_{j=1}^{J} \exp \beta_c x_{ijt}} \right]^{y_{ijt}}$, with β_c being the set of preference parameters in class c, x_{ijt} the vector of observed attributes and y_{ijt} a binary variable that equals 1 if consumer i chooses alternative j in choice situation t and 0 otherwise. The probability that consumer i belongs to class c depends on the individual characteristics of consumer i.

We base the number of classes on the AIC, BIC and corrected AIC (CAIC), which all indicate that the optimal number of classes is two. We use individual characteristics to define class membership. Gender, age and socio-economic status have been identified in the literature as key socio-demographic correlates of consumption of animal or plant-based proteins, along with motivational variables, such as familiarity with and repeated exposure to plant-based proteins, and personality traits (Graça *et al.*, 2019). We included the following classes in the model: male, age, income, frequency of animal protein consumption per week and, from the Big-5 questionnaire, conscientiousness, extraversion and neuroticism. The selection of these variables for class membership was guided by the possible identification of the model. We excluded some non-significant variables, such as frequency of vegetable consumption, neophobia and, from the Big-5 questionnaire, openness and agreeableness. We include only the middle category of frequency of animal-protein consumption per week (5 to 7 times per week); the reference class then includes consumers who reported consuming animal proteins less than 5 or more than 7 times per week because the AIC and BIC for this estimation are the lowest. We report the results of this estimation in Table 5.

The latent class analysis stratifies participants into two classes, each accounting for half. The separation of the consumers into two classes based on individual characteristics shows that the consumers in class 1 were impacted by the information that they received about the negative consequences of meat consumption on the environment or health in phase 3, whereas the consumers in class 2 were not affected by this information. We rename these classes "information-sensitive" and "information-independent" consumers, respectively. This result suggests that information campaigns have an impact but only on a portion of consumers. Result 3 summarizes this finding:

Result 3: Receipt of information about the negative consequences of meat consumption on the environment or health increases preferences for products with plant-based proteins among a sub-sample of consumers.

Participants' food product choices show that they were not all equally affected by the provision of information on the negative consequences of meat consumption on the environment or heath. We find that class membership is significantly driven by animal protein consumption habits and personality traits. Participants who reported consuming an average amount of animal proteins

Table 5: Latent class logit of corrected product choice by stage and treatment group

	Class 1 Information-sensitive	Class 2 Information-independent
Product characteristics		
Couscous	0.165 (0.116)	0.148 (0.123)
Chili	0.076 (0.116)	0.051 (0.124)
Vegetarian	-0.451 (0.340)	-22.724 (90.008)
Vegetarian crossed with stage and treatment group		
Stage 2	0.080 (0.405)	-20.248 (90.010)
Stage 3	-0.737 (0.519)	22.033 (90.008)
Environment	-0.687 (0.477)	20.847 (90.009)
Health	-1.421** (0.660)	21.140 (90.008)
Stage 2 × Environment	0.649 (0.615)	-20.797 (90.014)
Stage 3 × Environment	1.222* (0.711)	-20.665 (90.009)
Stage 2 × Health	-0.399 (0.880)	-19.423 (90.010)
Stage 3 × Health	1.543* (0.799)	-21.561 (90.009)
Model for classes		
Male	-3.142 (2.108)	
Age	0.076 (0.048)	
Income in]1500-2300]	-1.042 (1.406)	
Income in]2300-3800]	-0.844 (1.636)	
Income higher than 3800	2.122 (2.645)	
Animal proteins 5 to 7 times per week	-3.687* (2.165)	
Conscientiousness	1.994* (1.142)	
Extraversion	-1.625** (0.728)	
Neuroticism	-1.092** (0.527)	
Intercept	2.770 (3.982)	
Relative size	0.5	0.5
AIC/BIC	3066.40 / 3278.35	

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

per week were less likely to substitute animal proteins with plant-based proteins after receiving information than participants who reported consuming animal proteins less often or more often per week. Consumers with higher levels of conscientiousness or lower levels of extraversion or neuroticism were also more likely to be affected by the receipt of information. Conscientiousness has been found to be negatively related to meat consumption (Pfeiler and Egloff, 2018b) and our study complements this by adding that people with a high level of conscientiousness react more to the information suggesting a reduction of meat consumption. Gender is not significant but close to the 10% significance level ($p = 0.136$), which suggests that men were less likely to substitute animal proteins with plant-based proteins when they received the information. Consistent with the literature, the men in our sample seemed less open to following

plant-based diets. Age and income do not significantly impact class membership.

The finding of a positive impact of information on the choices of plant-based protein food products among only a portion of consumers is consistent with the review by Graça *et al.* (2019), who emphasize that consumers differ in their meat consumption and willingness to substitute animal proteins with plant-based proteins. They show that the majority of studies are consistent in the finding that females consume less meat than males and are more open to following plant-based diets. This is also the case for consumers of higher socio-economic status. Findings related to age are not consistent across studies, with some studies finding that younger consumers are more willing to follow plant-based diets, while in some other studies this is the case for older consumers. Graça *et al.* (2019) also focus on capability and opportunity variables, among them access to information, difficulty in cooking, or sensitivity to bitter taste (capability variables) and perceived norms or the importance of others in supporting the transition to a plant-based diet (opportunity variables). Consumers' motivation to reduce their animal protein consumption depends on many variables, such as beliefs or awareness of the consequences of following plant-based diets, taste experiences, perceived convenience, familiarity, meat attachment, etc. Consumption of plant-based proteins then clearly depends on consumers' individual characteristics, and our study additionally shows that the effectiveness of information interventions is also related to consumers' individual characteristics.

4. Discussion and conclusion

In this experiment, we investigated whether consumers substitute ready-made food products with animal proteins with ready-made food products with exclusively plant-based proteins when they receive information about the damage to the environment or health caused by meat consumption. We found that approximately half of the participants in our experiment always chose meals with animal-based proteins regardless of whether they were exposed to the information intervention. The information that the participants received did not significantly change their preferences on average. This result suggests that consumers have strong habits regarding meat consumption and are not easily convinced to modify their behaviour in the short term. This result reinforces the recent literature on the effect of information on meat consumption (Austgulen *et al.*, 2018; Castellari *et al.*, 2019). However, our results also show that when consumers were sorted according to their individual characteristics, a sub-sample responded to the information they received by increasing their preferences for plant-based protein products.

The lack of impact of information policy on the average consumer may come from the specificity of meat and its substitutes. Meat has a special characteristic. Indeed, meat has held a certain status in many societies for a long time (deFrance, 2009; Fiddes, 1991); in the 1970s, for example, it was seen by consumers as the food product with the highest value, with meals

structured around three components: meat or fish, a staple and vegetables (Douglas, 1972). Such preferences may be difficult to change, and meat is still currently one of the most popular food products in many countries (Verbeke *et al.*, 2010). In addition, meat is generally perceived to be healthy (Verbeke *et al.*, 2010). This belief is true if meat consumption is not too high, and therefore, consumers may not be aware of the negative effect of over-consumption of meat on health. In contrast, meat substitutes with plant-based proteins such as pulses are not spontaneously selected by consumers, perhaps due to a dislike of the taste, difficulty of preparation or perceptions of pulses as a food for vegetarians (Melendrez-Ruiz *et al.*, 2019). It is certainly more difficult to induce substitution of animal proteins with plant-based proteins among consumers who have strong habits regarding meat consumption than among consumers with more flexible consumption habits. It seems natural, then, to focus information interventions on younger people, such as children or teenagers (Wynes and Nicholas, 2017). We think that an important target for future research is the study of young people's reaction to information campaigns to shift food consumption behaviour towards more sustainable diets, including ones with less animal protein.

Other explanations may be related to consumers' psychology. According to cognitive dissonance theory (Festinger, 1957), it is possible that consumers with strong preferences for meals with animal-based proteins form self-serving beliefs that minimize the negative consequences of meat consumption on the environment or their health. In this case, the information intervention may not be strong enough to modify their beliefs and then their consumption decisions. The same argument is used by Hestermann *et al.* (2017) to explain the meat paradox, which describes how consumers form self-serving beliefs and ignore the consequences of meat consumption for animal welfare.

Our results suggest that providing information on the environmental or heath damages associated with the consumption of animal proteins is not sufficient to significantly alter meat consumption. In addition, we show that some consumers are sensitive to information and will substitute animal proteins with plant-based proteins. Therefore, provision of information is effective for part of the population. Our results provide the first insights into the role of individual characteristics and personality on the effectiveness of information campaigns related to meat consumption. Further research on the role of psychology and the social environment in meat consumption is needed to improve the general understanding of such food behaviour and to establish appropriate policy interventions.

Information campaigns can be coupled with other recommended policy interventions, such as consumer education, financial incentives or regulatory mechanisms. For instance, taxes on greenhouse gas emissions can affect meat consumption (Bonnet *et al.*, 2018; Briggs *et al.*, 2013; Edjabou and Smed, 2013) and may be less negatively perceived if they are accompanied by information campaigns. Some see change in norms as a key driver of global diet change

(Eker *et al.*, 2015; Higgs, 2015; Higgs and Ruddock, 2020; Nyborg *et al.*, 2016; Sparkman and Walton, 2017). Possible changes in norms could be helped along by information policy interventions (Dasgupta *et al.*, 2016), which may change preferences (Bowles, 1998). Information that presents the damages of meat consumption could also be complemented by some information presenting consumers with a transition framework and messages focused on good behaviours to adopt instead of the reasons why consumers should change their behaviour (de Boer and Aiking, 2019). Finally, public policy-makers must take into account the diversity of consumer characteristics and motivations and adapt the related policies accordingly.

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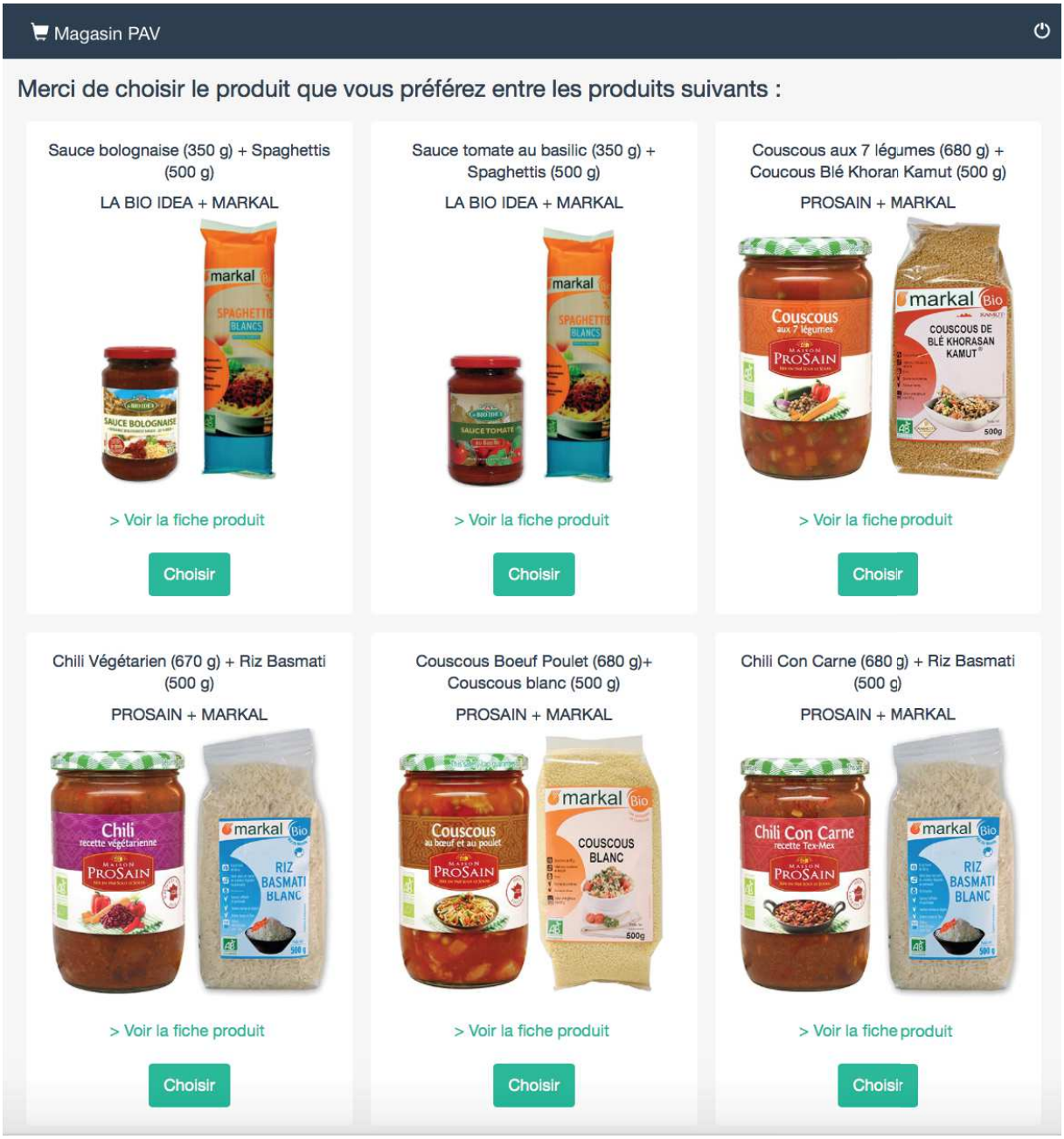
Appendix A Products in the experiment



Appendix B Cards presenting environment or health information to participants

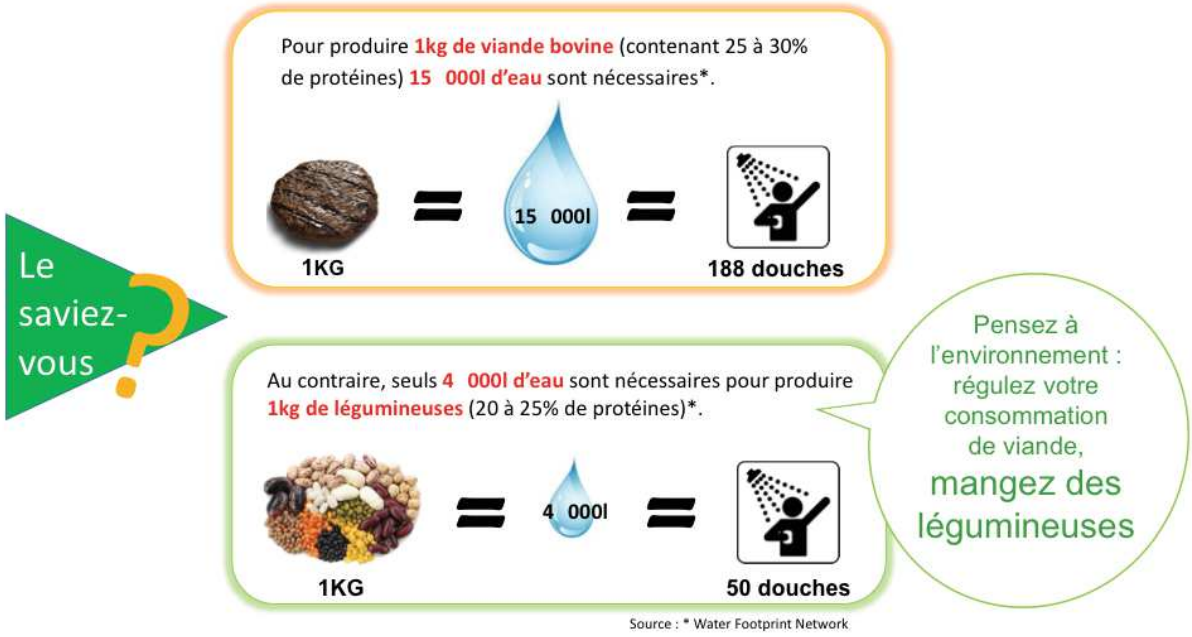


Figure B.1: Card in the environmental treatment

Figure B.2: Card in the health treatment

Appendix C Answers to questionnaires

Table C.1: Participants' socio-demographic characteristics

Variable	Total sample	CT	ET	HT
Male	49.19%	49.02%	48.08%	50.49%
Age[a] (21 to 67)	43.85 (12.11)	45.26 (12.23)	43.64 (12.11)	42.65 (11.95)
Number of children in family[a] (0 to 4)	0.74 (0.92)	0.59 (0.81)	0.84 (0.97)	0.79 (0.96)
Number of adults in family[a] (1 to 4)	1.87 (0.63)	1.82 (0.64)	1.81 (0.59)	1.97 (0.65)
Education				
Below baccalaureate	18.12%	14.71%	17.31%	22.33%
Baccalaureate	23.62%	29.41%	25.00%	16.50%
Bachelor's	30.10%	29.41%	28.85%	32.04%
Master's or Ph.D.	28.16%	26.47%	28.85%	29.13%
Family net monthly income (in euros)				
[0-1500]	17.48%	22.55%	14.42%	15.53%
]1500-2300]	20.06%	18.63%	25.96%	15.53%
]2300-3800]	42.72%	39.22%	37.50%	51.46%
]3800-]	19.74%	19.61%	22.12%	17.48%

Notes: [a] Averages are reported, with standard deviations in parentheses.

Table C.2: Participants' eating habits

Variable	Total sample	CT	ET	HT
Frequency of consumption (times per week):				
Diary products				
Less than 1	2.59%	0.98%	2.88%	3.88%
1 to 4	12.30%	12.75%	11.54%	12.62%
5 to 7	30.10%	35.29%	26.92%	28.16%
More than 7	55.02%	50.98%	58.65%	55.34%
Vegetables				
Less than 1	0.65%	0.98%	0.00%	0.97%
1 to 4	19.74%	14.71%	25.00%	19.42%
5 to 7	43.69%	42.16%	41.35%	47.57%
More than 7	35.92%	42.16%	33.65%	32.04%
Starches				
Less than 1	1.29%	1.96%	0.96%	0.97%
1 to 4	17.15%	18.63%	16.35%	16.50%
5 to 7	38.83%	37.25%	41.35%	37.86%
More than 7	42.72%	42.16%	41.35%	44.66%
Fruits				
Less than 1	6.47%	2.94%	5.77%	10.68%
1 to 4	26.21%	28.43%	26.92%	23.30%
5 to 7	32.04%	34.31%	30.77%	31.07%
More than 7	35.28%	34.31%	36.54%	34.95%
Red meat				
Less than 1	12.62%	13.73%	10.58%	13.59%
1 to 4	72.49%	73.53%	71.15%	72.82%
5 to 7	13.59%	10.78%	18.27%	11.65%
More than 7	1.29%	1.96%	0.00%	1.94%
White meat				
Less than 1	4.21%	4.90%	2.88%	4.85%
1 to 4	73.14%	74.51%	74.04%	70.87%
5 to 7	21.36%	17.65%	23.08%	23.30%
More than 7	1.29%	2.94%	0.00%	0.97%
Fish				
Less than 1	28.48%	25.49%	27.88%	32.04%
1 to 4	67.64%	68.63%	68.27%	66.02%
5 to 7	3.88%	5.88%	3.85%	1.94%
More than 7	0.00%	0.00%	0.00%	0.00%
Animal proteins[b]				
Less than 1	1.94%	0.98%	1.92%	2.91%
1 to 4	27.83%	21.57%	28.85%	33.01%
5 to 7	50.81%	61.76%	50.96%	39.81%
More than 7	19.82%	15.69%	18.27%	24.27%
Time spent on cooking				
Less than 15 minutes	27.18%	32.35%	24.04%	25.24%
15 to 30 minutes	49.19%	49.02%	54.81%	43.69%
More than 30 minutes	23.62%	18.63%	21.15%	31.07%

Notes: [b] Calculated based on answers to consumption frequency of red meat, white meat and fish.

Table C.3: Participants' usual consumption of offered food products

Variable	Total sample	CT	ET	HT
Consumption of chili con carne				
Never or very rarely	58.58%	57.84%	60.58%	57.28%
Sometimes	36.25%	37.25%	31.73%	39.81%
Often	5.18%	4.90%	7.69%	2.91%
Consumption of couscous				
Never or very rarely	36.25%	37.25%	37.50%	33.98%
Sometimes	52.43%	50.98%	55.77%	50.49%
Often	11.33%	11.76%	6.73%	15.53%
Consumption of pasta bolognese				
Never or very rarely	7.77%	11.76%	4.81%	6.80%
Sometimes	45.31%	49.02%	47.12%	39.81%
Often	46.93%	39.22%	48.08%	53.40%

Table C.4: Subjects' personality traits [a]

Variable[a]	Total sample	CT	ET	HT
Food neophobia	2.34 (0.70)	2.67 (0.74)	2.03 (0.63)	2.13 (0.73)
Openness	4.92 (1.14)	4.87 (1.21)	4.94 (1.19)	4.95 (1.00)
Conscientiousness	5.32 (0.93)	5.37 (0.97)	5.30 (0.95)	5.27 (0.86)
Extraversion	5.15 (1.22)	5.07 (1.19)	5.19 (1.29)	5.20 (1.20)
Agreeableness	4.88 (1.00)	4.97 (1.06)	4.82 (0.97)	4.86 (0.98)
Neuroticism	4.01 (1.26)	3.90 (1.19)	4.03 (1.33)	4.11 (1.27)

Notes: [a] Averages are reported, with standard deviations in parentheses.

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