A combined Nutri-Score and 'Eco-Score' approach for more nutritious and more environmentally friendly food choices? Evidence from a consumer experiment in Belgium.

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Abstract

The application of Nutri-Score on food products is ubiquitous throughout Europe and studies demonstrating its potential to stimulate healthier food choices are accumulating. At the same time, a strong need exists to evenly harmonize and activate the communication of environmental impacts on food products, in synergy with the Nutri-Score. This raises the question of whether the Nutri-Score could be expanded to an 'Eco-Score' that would similarly encourage environmentally friendly food choices. This paper reports a randomized control trial, in which a representative sample of 805 Belgian consumers was asked to hypothetically buy ingredients for a meal in a small-scale mock-up E-grocery environment. The experiment tested whether a combined Nutri-Score and Eco-Score affected the nutritional quality and environmental impact of consumers' food choices. This effect was compared to general and specific dietary recommendations on the one hand, and to detailed impact tables on the other hand. Since visual distraction often plays a role in informative persuasion, the treatments were evaluated subject to different levels of distraction caused by product images. The average nutritional quality index (NQI) and environmental impact index (EII) of the selected baskets were calculated to evaluate the effects of the manipulations. We find that a joint Nutri-Score and Eco-Score label improves the NQI but not the EII. The general- and specific recommendation as well as the detailed information also improved the NQI. However, the specific recommendation was the only treatment that also improved the EII. The improvements in NQI due to the scores could be explained by a reduced consumption of pork. The improvements in EII induced by the specific recommendation could mainly be explained by a reduction in beef consumption. Only very mild indications were found that product images interfered with the effect of the scores. This study provides some initial evidence and support for the use of dual Nutri-Score – Eco-Score label to induce transitions towards healthier and more sustainable diets. We also find that recommendations outside the classic Front-Of-Package label framework could be a promising way to realize such a transition. However, it remains to be tested whether similar effects occur in real E-groceries and on a longer time scale.

Key words: food choices; nutrition; sustainable eating; fop-labelling; consumer communication; food environment

1. Introduction

1.1. Background

Our European food system remains an important driver of climate change and environmental degradation. This is not only attributable to the agricultural sector, but the processing, packaging and retailing industries are also contributing to greenhouse gas emissions, water, air and soil pollution and biodiversity loss (Gerten et al. 2020; Poore and Nemecek 2018). Moreover, European consumers exhibit increasingly unhealthy dietary patterns, which is reflected in the rising prevalence of overweight and obesity as well as in the associated chronic diseases and health-care costs. In 2017, just under one million Europeans died of diseases related to unhealthy dietary patterns (European Commission 2020).

Although these health- and environmental challenges are often addressed separately, they are closely intertwined. In fact, diets including relatively more plant-based food, like fruits and vegetables, and less red and processed meat, are simultaneously related to lower environmental impacts and improved nutritional qualities (Biesbroek et al. 2014; Tilman and Clark 2014). Considering this rule of thumb in our diets would therefore result in both a healthier diet and a reduction in environmental burdens. This link between public health and environmental sustainability highlights the need for a comprehensive policy approach, to which the present study aims to contribute.

Processing and retailing companies can greatly affect food consumption habits (Donovan and Rossiter 1994; Sherman, Mathur, and Smith 1997). Whereas companies used to see sustainability as a cost, they increasingly embrace it as a business opportunity (Bonini and Görner 2011). By incorporating sustainability and presenting oneself accordingly towards stakeholders, customers and companies, a company can gain competitive advantage, attract more investors and increase its stock market value (Chang 2011). More money than ever is being invested in environmental sustainability, but there is still no agreement on a standardized way to objectively quantify and communicate environmental outcomes of activities, services and products. However, a standardized assessment and communication method could provide more certainties regarding returns on sustainability investments and hence incentivize more of these investments.

Next, consumers' awareness and interest in environmental sustainability has also grown drastically over the past decades and has resulted in a higher willingness-to-pay for more sustainable food products (Rousseau and Vranken 2013; Vanhonacker et al. 2013). Consumers' ability to reward sustainable production and to urge for a more environmentally responsible food supply could induce a demand-driven transition that would benefit both consumers' own health as those of their living environments (Grunert 2011). The introduction of hundreds of sustainability labels in the market has attempted to induce such a demand-driven transition. However, those labels do still not play a major role in food choices because they have to compete with food characteristics like price and taste (Grunert, Hieke, and Wills 2014b). Moreover, the diversity of existing labels is highly confusing and the use of misleading sustainability claims has led to mistrust amongst consumers (Castka and Corbett 2016; Chen and Chang 2013). As a result, about 50% of European consumers still have difficulties in identifying environmentally friendly products (European Commission 2019a). Hence, a transition in diets is being hampered by a lack of harmonized and reliable information.

In the pursuit of more uniformity in the calculation and communication of environmental impacts, the European Commission has been developing and testing the "Product/Organisation Environmental Footprint" (PEF/OEF) methodology (European Commission 2019b). The PEF methodology calculates the overall environmental footprint of products throughout their entire life cycles. Calculations are based on Life Cycle Assessments (LCA), in which 16 different environmental impact categories are considered. While a lot of progress has been made to assess environmental impacts in a uniform manner, debates are only starting to emerge on how these impacts should best be conveyed to stakeholders.

There are many parallels with the field of nutrition communication. The lack of uniformity and unambiguous communication has been a particular problem there as well. Only recently, things have changed more rapidly. Regulations on (misleading) health claims have become much more stringent and the debate on how nutritional contents should be communicated as front-of-package labels (FOP) has more or less been narrowed down to two major schools of thoughts: (1) those supporting Multiple Traffic Light labelling and (2) the supporters of the more recent Nutri-Score. (Chantal and Hercberg 2017). The Nutri-Score is winging its way around Europe as the standard communication vehicle of nutritional contents. It has proven to be a highly intuitive and attention-grabbing label that could encourage better food choices (Dubois et al. 2020; Egnell, Boutron, et al. 2019; Hagmann and Siegrist 2020; De Temmerman et al. 2021). On top of that, reformulations have already been observed within manufacturers' products since its launch (Vermote et al. 2020). It is therefore important to build on these insights when developing a uniform environmental score, in synergy with the Nutri-Score.

1.2. Consumer perspectives

Generally, dual-process theories postulate that consumer persuasion mainly operates through two routes: (1) an automatic, peripheral route and (2) a reflective, central route (Kahneman 2011; Petty and Cacioppo 1986). While peripheral and even entirely unconscious persuasion can induce behavioural changes, an informational approach remains essential for longer lasting and more predictable changes in dietary patterns (Lehner et al. 2016; Petty et al. 2009; Reisch et al. 2013). Since the health and environmental impacts of food products are not directly observable, displaying this information is essential to influence food choices. In the food environment, many factors may prevent information from being used in food choices (Grunert 2011). Consumers' motivation and ability to consider this information are major decisive factors for its use (Grunert, Hieke, and Wills 2014). When information is provided, a trade-off typically exists between accessibility and credibility. Simplified information is typically more accessible but oversimplified messages are prone to be ignored due to lack of trust (Nuttavuthisit and Thøgersen 2017; Tonkin et al. 2016). Similarly, more elaborate information can be perceived as more credible but too extensive information is prone to be ignored due to information overload. Therefore, this study evaluates the potential merits of easy-to-interpret and accessible labels (like the Nutri- and Eco-Score), to influence food choices and compares it to the potential of both more simplified and more elaborate information cues.

Nutri-Score's potential has been partially explained by its remarkable ability to attract attention (Dubois et al. 2020). Its highly recognisable and colourful design attempts to tap into the more accessible automatic route while its easily interpretable message content lowers the barrier for central processing. This outlines the hybrid nature of Nutri-Score. Therefore, we will test whether a dual scoring system with a Nutri-score and an Eco-score (with a design similar to the Nutri-Score), can simultaneously improve the environmental impact and nutritional quality of our food choices. Literature on the effect of dual labelling systems remains very scarce. One earlier study evaluated and supported the use of a dual traffic light system on meal choices in a canteen environment (Osman and Thornton 2019). However, the question of how a dual Nutri-Score - Eco-Score system would affect product choices in an E-grocery, remains unanswered.

While the scores themselves are relatively accessible, it can be argued that the consideration of both scores for all products still requires substantial cognitive effort. Nevertheless, recommendations on healthy and sustainable diets can be fairly easily reduced to the basic rule of thumb of *"relatively less (red) meat and more plant based"* (Poore and Nemecek 2018). This rule of thumb could therefore also be used as a hybrid information cue, as it can both attract attention and minimise the barrier to central processing. Therefore, this study investigates whether simple dietary recommendations, as an easy-to-implement alternative to the scores, can improve food choices from a nutritional and/or environmental point of view. The formulation of this recommendation is expected to matter. On the one hand, a general recommendation to eat less meat and more plant based is easily accessible but might be less activating. On the other hand, a specific recommendation with advised consumption quantities could be more activating due to its capacity to induce an anchoring heuristic. When people make estimations, they start from a reference point (the anchor) and make adjustments accordingly (Ariely et al. 2003; Tversky and Kahneman 1974). Displaying recommended consumption quantities (the reference point) in the food environment, is therefore expected to influence food choices. Hence, this study will assess the potential of specific and general dietary recommendations to steer food choices. To the best of our knowledge, it will be the first study to compare the effect of those information cues with the effect of a dual Nutri-Score – Eco-Score system.

While the dual Nutri- and Eco-Score is very accessible, the issue of mistrust could still arise or the scores could be perceived as too simplistic. This could be overcome by providing more detailed impact information on the calculations behind the scores. Tables with information on nutritional values of food products have long been available on food packages, known as Nutrition Facts Panels (NFP). Environmental impacts can be similarly tabulated into different impact categories, but this is still only applied for nutritional values. While NFP's are often not directly considered in food choices, their presence could encourage the use of the more interpretative scores (Block and Peracchio 2006; Ikonen et al. 2019). Therefore, this study also assesses the potential effect of such detailed impact tables containing nutritional and environmental information on food choices.

A factor that lowers consumers' ability to elaborate on information captured in labels is visual distraction (Petty et al. 1976; Van Trijp 2009). Visual distraction has recently been found to be a more important barrier to the consideration of labels than lack of motivation (Orquin et al. 2019). Distraction may cancel out many promising properties of food labels such as good perceptibility, evocation of positive attitudes, easy interpretability, or objective understanding. Due to the overabundance of stimuli, visual distraction plays a very prominent role in today's food environment (Spence et al. 2016). It is therefore relevant to assess whether visual distraction moderates the impact of the Nutri and Eco scores as well as the impact of the information cues on consumers' food choices.

With the accelerated growth in E-grocery, a vast share of consumers' food choices is changing scenery from physical to online. As consumers behave differently in both environments, the role of informational cues in food choices might differ as well. In an online shopping environment, sensory attributes (e.g. food appearance) play a less important role while the role of factual information (e.g. nutritional values) is more pronounced (Degeratu, Rangaswamy, and Wu 2000). This leads to less impulsive buying behaviour in online environments (Aragoncillo and Orús 2018). Therefore, more reflective processing is expected, resulting in more desirable effects of informational interventions. As such, it is appropriate to test and optimize the potential of information cues in an online shopping environment.

In this context, the present study aimed to evaluate the nutritional values and environmental impacts of food choices in response to (1) a dual Nutri-Score & Eco-Score labelling and to (2) specific recommendations, general recommendations and detailed information tables in (3) conditions with different levels of visual distraction. This was tested in a small mock-up E-grocery environment with 11 food products from diverse categories.

2. Materials and methods

2.1 Experimental design

A randomized control trial (RCT) was conducted in an E-grocery environment. Since the "Eco-Score" had not yet been established on the market, no real E-grocery environment could be used. Therefore, a mock-up E-grocery environment was created and embedded in a web-survey. The tool included only a limited range of 11[1] food products (Table 1). Before entering the tool, the following task was given: *"Imagine you are inviting five friends and you have decided to make a spaghetti bolognaise[2]. You are planning to buy the ingredients online. Without verifying the exact recipe, you are now going to buy the ingredients based on your gut feeling. Select the ingredients for 6 persons[3], (your 5 friends and you), as realistically as possible."* Respondents could then compose a shopping basket by clicking on products and specifying their desired quantities. For every product, respondents were free to select it or not. During the shopping task, they were allowed to adjust previously selected items and quantities. Once finished, they were shown an overview of their selections and the total price. Some final verifications and adjustments could be made before confirming the selected basket. With this final confirmation, the selection was recorded as data. It should be noted here that the task remained hypothetical and no real payment was required. The shopping task was preceded and followed by socio-demographic and dietary related questions. The complete experimental procedure is shown in Fig 1.

This study used a between-subjects approach to evaluate the effect of several treatments on consumers' food choices. Respondents were randomly allocated to one of 16 treatment groups (Table 2). During the task, respondents were exposed to a given treatment, embedded in the shopping environment. Apart from the treatments described further, all other things remained constant across experimental conditions, including prices and product orders. Therefore, although being very important aspects in consumption decisions, price and order effects could not explain any treatment effects.

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[1] For the selection of these products, 11 commonly used products to prepare spaghetti bolognaise were considered from four food categories (meat, vegetables, pasta and cheese). This selection had a wide variability in nutritional quality and environmental impact. In order to avoid biases due to e.g. brand loyalty, all references to existing brands were avoided.

[2] The choice for this meal is motivated by the fact that it is a well-known dish that most people can prepare without needing a recipe with the exact ingredients. Moreover, this dish can be made in many different ways, which still leaves room for personal preferences and switches between meat, vegetarian alternatives and vegetables without making the dish incomplete or odd.

[3] While households of 6 members are not the most common household composition, the goal was to activate rules-of-thumb that consumers apply in their decisions on quantities for one person as they would multiply this by six in this task.

Table 1: List of products included in the shopping experiment with corresponding scores, prices and purchasing units (P.U.)

Product	Nutri-Score	Eco-Score	Price	P.U.
Protein sources				
Minced beef	B	E	€7.75/kg	Kg
Minced chicken	B	C	€6.98/kg	Kg
Minced pork	D	C	€7.25/kg	Kg
Minced veggie	A	A	€7.14/kg	Kg
Vegetables				
Tomato	A	A	€1.45/kg	Piece
Onion	A	C	€0.99/kg	Piece
Carrot	A	A	€0.79/kg	Piece
Passata	A	A	€0.55/pc	Piece
Pasta	A	B	€0.34/pc	Piece
Pasta wholegrain	A	B	€0.79/pc	Piece
Grated cheese	D	D	€0.54/st	Piece

Figure 1: Experimental procedure

The RCT consisted of 16 experimental cells, determined by a full factorial design of two 2-level factors and one 4-level factor (2 x 2 x 4) (Table 2). These factors included (1) A combined Nutri-Score and an Eco-Score – (with vs without), (2) Additional information types – (a general recommendation, a specific recommendation, detailed information tables and control without additional info), (3) Visual distraction as caused by product images – (with vs without).

Combined Nutri-score and Eco-score. Two scores were displayed (vs. not) on each product tile: (1) the Nutri-Score, reflecting a product's nutritional quality and (2) an Eco-Score, reflecting a product's environmental impact. The factor had two levels: with and without product scores. The Nutri-Scores of the included products were calculated according to the standard methodology (Chantal and Hercberg 2017). The Eco-Scores were calculated according to the PEF methodology, based on 16 environmental impact categories (European Commission 2019b). Advised cut-off values for the categorization of PEF-scores as either A, B, C, D or E were not available, so the authors set those values while ensuring sufficient variability between product scores. All products with corresponding Nutri-Scores, Eco-Scores, prices and purchasing units are reported in Table 1. To respect the protective rights on Nutri-Score, we did not use the exact visual representation of Nutri-Score. An example of how the scores were applied is given in Fig A.1 in Appendix

A. Respondents in the condition with scores were briefly introduced to the meaning of Nutri-Score and Eco-Score before the task.

Additional information. There were three types of additional information and a control condition without additional information. In the *specific recommendation* condition, the following message was displayed below meat and vegetable products respectively: *"It is advised to not eat more than 100 g of meat per day. For red meat it is even advised to not eat more than 60g per day."* and *"It is advised to eat at least 400g of fruit and vegetables a day"*. These recommendations were based on the dietary guidelines of the World Health Organization (World Health Organization 2020). In the *general recommendation* condition, the following message was displayed on top of the shopping screen: *"Make plant-based food the main component of every meal and do a good deed for your health, for planet earth and for the environment"*. In the *detailed impact information* condition, a table with underlying impact categories of the single scores was displayed. When respondents hovered over a product with their mouse cursor, a pop-up screen showed these tables. The nutritional values included the levels of energy, sugar, saturated fatty acids, salts, fibre and protein per 100g of product. The environmental values were described in terms of CO_2 emission, water use and land use per 100g of product. Finally, a condition *without additional information* was included. An example of how these levels were applied is given in Fig A.1 and A.2 in Appendix A.

Distraction. The level of distraction during the shopping task was manipulated by displaying (vs. not) images of food products that strongly attract visual attention (Simmonds and Spence 2017; Spence et al. 2016). An example of this condition is given in Fig A.3 in Appendix A.

Table 2: Number of respondents per treatment group after data cleaning (n = 766). Respondents were randomly allocated to one of these 16 treatment groups.

	No scores		Scores	
	No image	Image	No image	Image
No additional information	49	50	46	48
General recommendation	49	49	51	46
Specific recommendation	47	48	48	46
Detailed impact information	48	48	46	47

The RCT was conducted in November 2018 in Flanders, the Northern, Dutch-speaking half of Belgium, among a representative sample of 805 household food decision makers. The experiment was conducted in Dutch. Respondents were recruited via e-mail by a subcontracted market research agency using quota per treatment on gender, age, and education level. People working in market research, marketing, advertising or in the food sector in general were considered as non-eligible to prevent demand effects. Potential respondents were not informed of the exact aim of the research to prevent any self-selection and/or forewarning bias. Eligible respondents were randomly allocated to one of the 16 treatment groups. Respondents received a financial reward after completion but were not asked to spend real money in the shopping task. The study was approved by the Social and Societal Ethics Committee of the university (SMEC) (reference code: G- 2018 11 1425). All participants gave informed consent and complete anonymity was guaranteed. After data cleaning, the final sample included 766 respondents, of which the socio-demographic characteristics are given in Table 3. The treatment groups did not differ in socio-demographic characteristics, as reported in Appendix B.

Table 3: Socio-demographic characteristics of sample. Means (standard deviations)- or frequencies (share) are given

	Participants (n=766)
Gender	
Male	405 (52.8%´)
Female	362 (47.20%)
Age	
18 – 34 years old	171 (22.29%)
35 – 54 years old	253 (32.99%)
> 54 years old	343 (44.72%)
Household size	
1	210 (27.38%)
2	313 (40.81%)
3	110 (14.34%)
4	94 (12.26%)
5	26 (3.39%)
6	9 (1.17%)
7	1 (0.13%)
> 7	4 (0.52)
Education (highest completed)	
None	9 (1.17%)
Primary school	21 (2.74%)
Secondary school	373 (48.63%)
Bachelor	217 (28.29%)
Master	119 (15.51%)
PhD	17 (2.22%)
Other	11 (1.43%)

2.2 Data

For each respondent, a nutritional quality index (NQI) of their basket of selections was calculated as the sum of the Nutri-Scores of the chosen products weighted by the corresponding amounts of product in kg, divided by the total consumption amount in kg (Eq 1). A lower NQI corresponds to better nutritional quality. The NQI can be negative and positive and is dimensionless. This sum was divided by total consumption because a certain consumption level of a product could mean a deficiency for one individual and an excess for another. Due to the lack of metabolic data to control for this variability, it was decided to consider only the relative composition of the basket.

$$Nutritional\ quality\ index\ = \frac{\sum Nutri\text{-}Score_i \times (kg\ of\ product\ selected)_i}{\sum (kg\ of\ product\ selected)_i} \qquad \text{(Equation 1)}$$

Similarly, the environmental impact index (EII) of respondents' baskets was calculated as the sum of all the PEF-based Eco-Scores of the chosen products, weighted with the corresponding amount of product in kg (Eq 2). The EII is strictly positive and dimensionless. A lower index corresponds to a lower environmental impact. In contrast to the NQI, the environmental impact associated with a food product does not depend on who is consuming it. Therefore, the weighted sum of scores was not divided by total consumption and an absolute measure was used. To validate the robustness of the NQI and EII, both indices were also calculated per amount of energy content (kJ) instead of per weight (kg) and this did not alter the results.

$$Environmental\ impact\ index = \sum Eco - Score_i \times (kg\ of\ product\ selected)_i \times 100 \quad \text{(Equation 2)}$$

Apart from the NQI and EII, several consumption quantities were considered. The total -, meat -, vegetable -, beef - , pork -, chicken- and vegetarian alternative- consumptions were reported. Separate vegetable consumptions were evaluated but not reported. Due to their overall good Nutri-Scores and Eco-Scores, changes within vegetables should not influence the NQI or EII. From the initial sample of 805 observations, 11 outliers in total consumption were dropped because they were three times the standard deviation away from the mean. Additionally, 28 observations with all four protein sources (beef, pork, chicken and vegetarian minced meat) being simultaneously selected, were dropped. To evaluate treatment effects, three-way ANOVA's were followed by planned contrasts between levels of the independent variables.

3. Results

On average, respondents selected 4.5 kg of food or 0.750 kg per person invited to the hypothetical dinner. Of this average, 1.13 kg were protein sources, 2.1 kg were vegetables, 1.1kg was pasta and 0.21 kg was grated cheese. This composition corresponded to an average NQI of -2.1 and an average EII of 0.023.

Table 4: Average basket characteristics and standard deviations. Quantities (kg) and NQI and EII

Measure	Mean (SD)
Total	4.5 (1.61)
Protein sources	**1.13(0.62)**
Beef	0.51 (0.62)
Pork	0.29 (0.52)
Chicken	0.23 (0.48)
Veggie	0.09 (0.32)
Vegetables	**2.10 (1.05)**
Onion	0.29 (0.21)
Tomato	0.69 (0.52)
Carrot	0.36 (0.31)
Passata	0.75 (0.61)
Grain products	**1.17 (0.53)**
Pasta	0.74 (0.63)
Pasta wholegrain	0.33 (0.51)
Grated cheese	**0.21 (0.62)**
Indices	
NQI	-2.12 (2.05)
EII	0.023 (0.019)

NQI. Figure 2 shows the means and standard deviations (between brackets) per experimental cell, for the NQI. A three-way ANOVA revealed a significant main effect of scores ($F(1, 751) = 3.92$, $p = 0.048$) and a significant main effect of type of information ($F(3, 751) = 3.35$, $p = 0.019$). All other effects did not reach significance (see Table C.1 in Appendix C for the full ANOVA table). Follow-up contrasts showed that the presence of the combined Nutri- and Eco-scores decreased the NQI of participants' selections, which means an improvement ($M_{\text{scores}} = -2.27$, $SD = 1.89$ vs. $M_{\text{no scores}} = -1.98$, $SD = 2.2$, $t(751) = -1.98$, $p = 0.048$). Compared to the control condition ($M_{\text{no additional info}} = -1.73$, $SD = 2.37$), all three types of information significantly lowered the NQI ($M_{\text{general recommendation}} = -2.18$, $SD = 1.9$, $t(751) = -2.12$, $p = 0.034$; $M_{\text{specific recommendation}} = -2.36$, $SD = 1.94$, $t(751) = -2.97$, $p = 0.003$; $M_{\text{detailed impact info}} = -2.23$, $SD = 1.93$, $t(751) = -2.37$, $p = 0.018$).

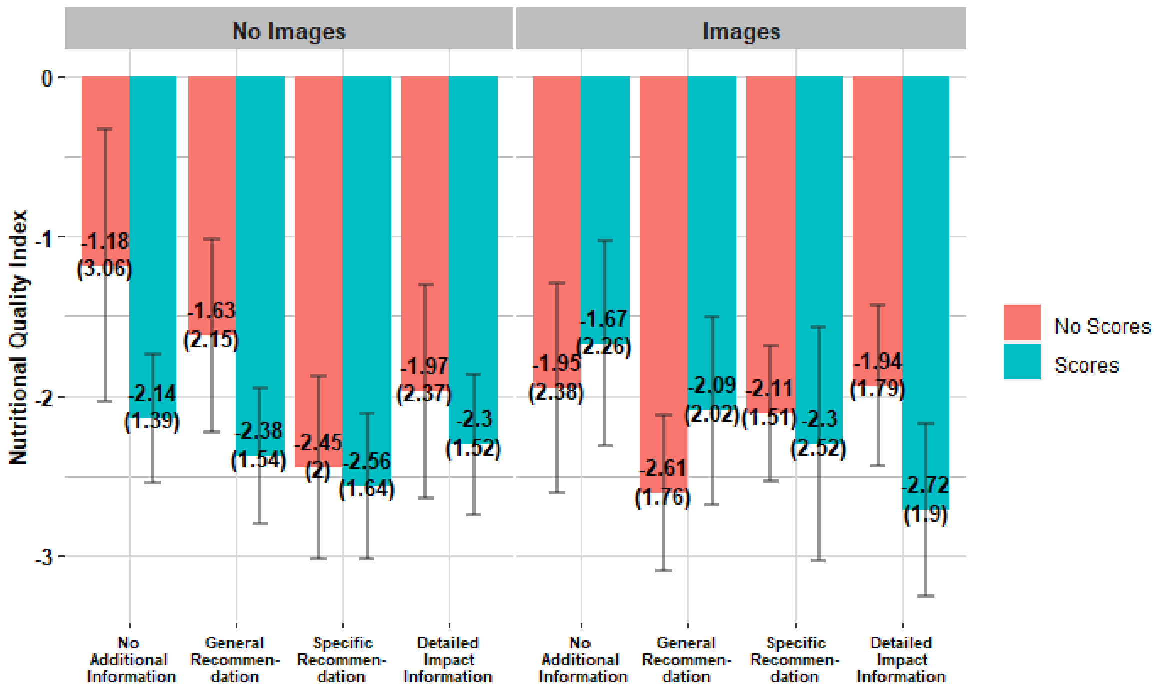

Figure 2: Mean NQI per experimental cell with standard deviations between brackets. Error bars show 95% confidence intervals.

EII. Figure 3 shows the means per experimental cell, for the EII. A three-way ANOVA revealed only a significant main effect of type of information ($F(3, 751) = 3.37$, $p = 0.018$). All other effects did not reach significance (see Table C.2 in Appendix C for the full ANOVA table). Follow-up contrasts showed that compared to the control condition ($M_{\text{control}} = 2.52$, $SD = 2.06$), the specific recommendation significantly decreased the EII ($M_{\text{specific recommendation}} = 1.99$, $SD = 1.75$, $t(751) = -2.69$, $p = 0.007$), but the general recommendation ($M_{\text{general recommendation}} = 2.21$, $SD = 1.77$, $t(751) = -1.57$, $p = 0.118$) and the detailed impact information did not ($M_{\text{detailed impact info}} = 2.5$, $SD = 2.09$, $t(751) = -0.04$, $p = 0.966$).

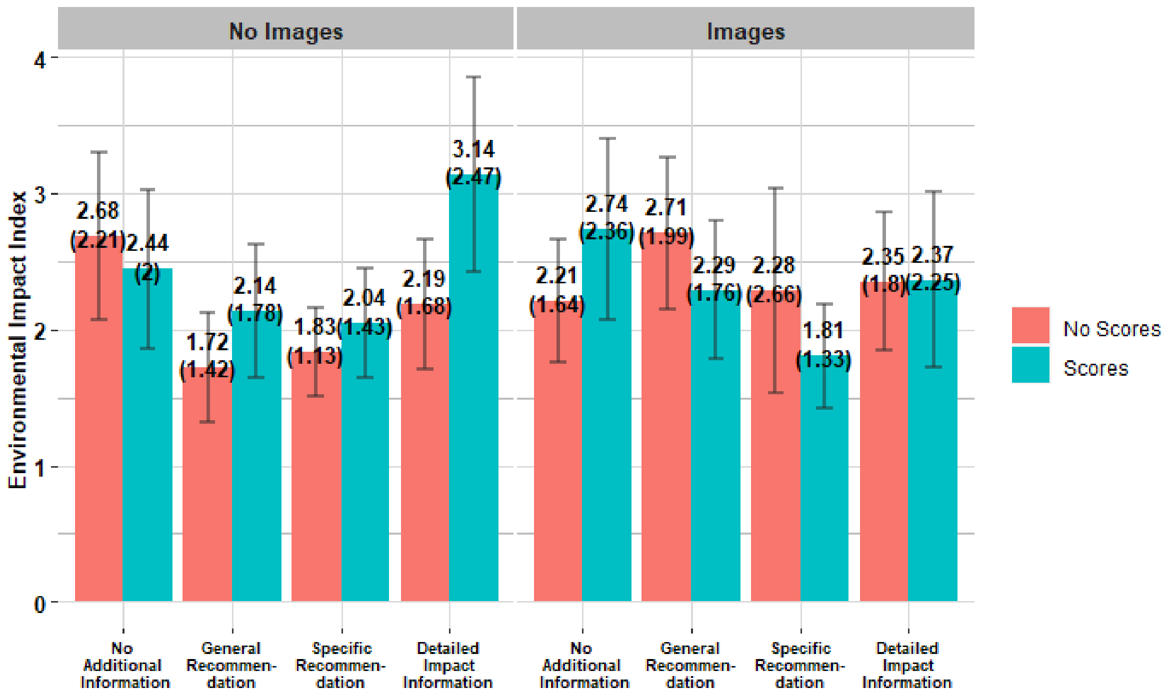

Figure 3: Mean EII per experimental cell with standard deviations between brackets. Error bars show 95% confidence intervals.

Total consumption. A three-way ANOVA revealed only a significant main effect of type of information ($F(3, 751) = 6$, $p < .001$). Follow-up contrasts showed that, compared to the control condition ($M_{\text{no additional information}} = 3.13$, $SD = 1.23$), the specific recommendation significantly decreased total consumption ($M_{\text{specific recommendation}} = 2.70$, $SD = 1.02$, $t(751) = -3.75$, $p < .001$), but the general recommendation ($M_{\text{general recommendation}} = 2.99$, $SD = 1.08$, $t(751) = -1.26$, $p = 0.208$) and the detailed impact info did not ($M_{\text{detailed impact info}} = 3.12$, $SD = 1.1858.41$, $t(751) = -0.14$, $p = 0.89$).

Meat and vegetables. Similarly, in terms of meat consumption, a three-way ANOVA revealed only a significant main effect of type of information ($F(3, 751) = 3.99$, $p = 0.008$). Follow-up contrasts showed that compared to the control condition ($M_{\text{no additional information}} = 0.91$, $SD = 0.60$), the specific recommendation significantly decreased consumption of meat ($M_{\text{specific recommendation}} = 0.72$, $SD = 0.49$, $t(751) = -3.39$, $p < .001$), but the general recommendation ($M_{\text{general recommendation}} = 0.84$, $SD = 0.51$, $t(751) = -1.2$, $p = 0.23$) and the detailed impact information did not ($M_{\text{detailed impact information}} = 0.84$, $SD = 0.54$, $t(751) = -1.25$, $p = 0.212$). In terms of vegetable consumption, a three-way ANOVA revealed no significant effects. These findings suggest that the decreased total consumption by the specific recommendation was the result of a reduction in meat consumption and not in vegetable consumption.

Beef. A three-way ANOVA revealed only a significant main effect of type of information ($F(3, 751) = 2.68$, $p = 0.046$). Follow-up contrasts showed that compared to the control condition ($M_{\text{no additional information}} = 0.48$, $SD = 0.57$), the specific recommendation significantly decreased beef consumption ($M_{\text{specific recommendation}} = 0.36$, $SD = 0.48$, $t(751) = -2.3$, $p = 0.022$), but the general recommendation ($M_{\text{general recommendation}} = 0.40$, $SD = 0.50$, $t(751) = -1.55$, $p = 0.121$) and the detailed impact information did not ($M_{\text{detailed impact info}} = 0.48$, $SD = 0.56$, $t(751) = 0.03$, $p = 0.979$). This reduction in beef consumption was the only observed effect that could explain the improvements in EII due to the specific recommendation.

Pork. A three-way ANOVA revealed only a significant main effect of scores ($F(1, 751) = 8.22$, $p = 0.004$). Follow-up contrasts showed that the presence of the combined Nutri- and Eco-scores decreased the amount of pork that participants chose (M_{scores} = 0.21, *SD* = 0.38 vs. $M_{\text{no scores}}$ = 0.30, *SD* = 0.49, $t(751) = -2.87$, p = 0.004). This reduction in pork consumption was the only observed effect that could explain the improvements in NQI due to the scores.

Chicken and vegetarian alternatives. Three-way ANOVA's revealed no significant effects on the amount of chicken and vegetarian alternatives consumed.

4. Discussion

In the pursuit of a more integrated nutritional and environmental food labelling system, this study aimed to evaluate the effects of a combined Nutri-Score and Eco-Score on food purchase intentions. The results demonstrate that jointly displaying Nutri-score and Eco-score in an E-grocery environment improved the nutritional quality index (NQI) of food choices, but not the environmental impact index (EII). This potential from a nutritional point of view is in line with the existing literature on Nutri-Score (Egnell, Talati, et al. 2019; Hagmann and Siegrist 2020; Vandevijvere et al. 2020). However, adding an Eco-Score did not equivalently lead to improvements from an environmental point of view. This could be an indication that the consideration of both scores was too burdensome and led to participants to only focus on the Nutri-Score. The fact that the improvement in NQI due to the scores could only be attributed to a reduction in pork consumption, which had a relatively poor Nutri-Score (D) but average Eco-Score (C), makes this a plausible explanation. Another explanation could be found in the visual arrangement of the scores. The Nutri-Score was visually arranged above the Eco-Score which makes a predominant reliance on Nutri-Score rather than Eco-Score far more likely. Therefore, further research is needed to determine what mainly drives the observed discrepancy in effects of NQI and EII.

All the information cues led to improvements in NQI's that were statistically indistinguishable from each other. Particularly for the detailed information tables, formatted in similar ways as nutrition facts panels (NFP), this is remarkable. Previous studies have found that NFP's are very often ignored by consumers during food decisions as they tend to search for more interpretative information (Block and Peracchio 2006). The online context and its associated more reflective consumer behaviour might possibly explain this discrepancy (Degeratu, Rangaswamy, and Wu 2000). The specific recommendation was the only intervention that led to improvements of both the NQI and the EII**.** Therefore, it could be considered the most effective intervention in this experiment. From a persuasive perspective, this could possibly be explained by the use of numeric values that induced an anchoring heuristic. From an environmental perspective, it could be argued that a reduced beef consumption, which was induced by the specific recommendation, is seen as the most effective dietary shift to reduce impact (Gerten et al. 2020; Poore and Nemecek 2018).

Images of food typically strongly attract visual attention (Spence et al. 2016). To account for this visual distraction, the display of product images was manipulated. The results provided no evidence that distraction hindered improvements by scores or additional information types at a statistical significance level of 0.05. When considering a milder significance level (0.1), it could be argued that with some particular additional information types, images did limit the effectiveness of the scores. However, given the relatively large sample size, we decided to adhere to adhere to $\alpha = 0.05$.

Policy implications

As part of their Green Deal, the European Commission (EC) set up the 'Farm-To-Fork strategy' to facilitate a sustainable transition of our complex food system. Central to this strategy lies the stimulation of more sustainable food -processing, -retail and – services and the facilitation of a shift towards healthy and sustainable diets. In this strategy, the EC committed to "*examine ways to harmonise voluntary green claims and to create a sustainable labelling framework that covers, in synergy with other relevant initiatives, the nutritional, climate, environmental and social aspects of food products.*" (European Commission 2020). This work delivers new insights in the potential of a combined Nutri-Score and Eco-Score. Since Nutri-Score is rapidly becoming the standard in Europe, one could advocate for the implementation of a resembling Eco-Score. The current excessive diversity of sustainability labels would thereby be addressed. Although no evidence was provided for its direct beneficial effects on food choices from an environmental point of view, it could be that with appropriate awareness-raising campaigns this could be achieved on the longer term. Additionally, having delivered some mild indications that the effectiveness of Nutri-Score would be affected by the product images, it is strongly recommended to consider this issue in regulations on packaging (labels) and product placements in (E-)groceries.

The improvements in nutritional quality as induced by the Nutri-Score could only be allocated to a reduction of products with poor scores. Therefore, it should be stressed that without those products having a score, no improvements would have been observed. This corroborates recent evidence highlighting the need to provide labels to all available products in order be effective (Hagmann and Siegrist 2020). This is still a highly debated issue. Therefore, this work could make a constructive contribution to policy makers in favour of a fully covered labelling system rather than a partial one.

Beyond that, the results of this experiment argue in favour of thinking also beyond the concept of a scoring system for all individual products. The experiment in this paper demonstrated how the provision of relatively simple recommendation on daily consumptions per product group could lead to even more desired dietary shifts. The recommendations tested in this study are only an illustration to demonstrate the potential. Future research could optimize the message content and visual design aspects.

Strengths and limitations

This study has bridged the gap between the growing body of literature on Nutri-Score and the scarce literature on dual labelling systems (Hagmann and Siegrist 2020; Julia and Hercberg 2017; Osman and Thornton 2019; Vandevijvere et al. 2020). Comparisons were made with interventions outside the classical FOP labelling framework. To the best of our knowledge, this is the first study, to provide empirical evidence on the effectiveness of the abovementioned interventions, subject to different levels of visual distraction. The application of an RCT provides a strong internal validity of the results, which supports the causality of the observed effects .

Despite these significant strengths, this study is not without limitations. The present study only captured instantaneous effects on food choices in a hypothetical E-grocery environment. The results would have been of greater value if tested in a longer term experiment in which real purchases were made. Although attempts were made to mimic a real life E-grocery environment and to present participants with a concrete shopping task, the results are still subject to hypothetical and desirability biases. The E-grocery tool included only 11 food products which is not realistic. This lowers the generalizability of these results. It is advisable to carry out similar experiments in more realistic environments to consolidate these results.

Further, Nutri-Score was already on the market during the data collection in 2018, while this is still not the case for Eco-Score. Familiarity with this score might have played a role, which we were unable to account for.

5. Conclusion

The use of a dual Nutri-Score and Eco-Scores system in an E-grocery environment could in the short term improve nutritional qualities of food choices while not reducing the environmental impacts associated with it. This improvement could only be allocated to a reduction of products with poor scores, highlighting the need to label the entire food range in order to be effective. By using more easy-to-implement interventions, such as a recommendation on daily consumptions per product group, shifts in food choices towards both improved nutritional qualities and reductions in environmental impacts could be induced. On top of that, the study found mild indications that the effectiveness of Nutri-Score is reduced by the nearby presence of food product images. Therefore, while it remains recommended to implement a dual Nutri-Score and Eco-Score system for the pursuit of more uniformity, further explorations a food environment that motivates and enables the transition towards more healthy and sustainable food choices is needed.

6. CRediT author statement

Michiel De Bauw: Conceptualization, Methodology, Software, Formal Analysis, Investigation, Writing – Original Draft, Visualization **Samuel Franssens:** Formal Analysis, writing, review & editing **Christophe Matthys:** Validation, Writing – review & editing, Funding acquisition **Veerle Poppe:** Validation, Supervision, Project administration, Funding acquisition **Liesbet Vranken:** Term; Conceptualization, Methodology, Validation, Data curation, Writing - review & editing, Supervision, Funding acquisition

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8. References

Aragoncillo, Laura, and Carlos Orús. 2018. "Impulse Buying Behaviour: An Online-Offline Comparative and the Impact of Social Media Comportamiento de Compra Impulsiva: Comparativa Online-Offline e Impacto de Las Redes Sociales." *Spanish Journal of Marketing-ESIC* 22(1): 2444–9709. http://creativecommons.org/licences/by/4.0/legalcodewww.emeraldinsight.com/2444-9709.htm.

Ariely, Dan, George Loewenstein, and Drazen Prelec. 2003. "'Coherent Arbitrariness': Stable Demand Curves without Stable Preferences." *Quarterly Journal of Economics* 118(1): 73–105.

Biesbroek, Sander et al. 2014. *Reducing Our Environmental Footprint and Improving Our Health: Greenhouse Gas Emission and Land Use of Usual Diet and Mortality in EPIC-NL: A Prospective Cohort Study*. http://www.ehjournal.net/content/13/1/27 (June 15, 2020).

Block, Lauren G., and Laura A. Peracchio. 2006. "The Calcium Quandary: How Consumers Use Nutrition Labels." *Journal of Public Policy and Marketing* 25(2): 189–96.

Bonini, Sheila, and Stephan Görner. 2011. "The Business of Sustainability." *https://www.mckinsey.com/business-functions/sustainability/our-insights/the-business-of-sustainability-mckinsey-global-survey-results*.

Castka, Pavel, and Charles J. Corbett. 2016. "Governance of Eco-Labels: Expert Opinion and Media Coverage." *Journal of Business Ethics* 135(2): 309–26.

Chang, Ching-Hsun. 2011. 104 Source: Journal of Business Ethics *The Influence of Corporate Environmental Ethics on Competitive Advantage: The Mediation Role of Green Innovation*. https://about.jstor.org/terms (September 18, 2020).

Chantal, Julia, and Serge Hercberg. 2017. "Development of a New Front-of-Pack Nutrition Label in France: The Five-Colour Nutri-Score." *Public health panorama* 03(04): 712–25.

Chen, Yu-Shan, and Ching-Hsun Chang. 2013. "Greenwash and Green Trust: The Mediation Effects of Green Consumer Confusion And." *Source: Journal of Business Ethics* 114(3): 489–500. https://www.jstor.org/stable/23433794?seq=1&cid=pdf-reference#references_tab_contents (April 25, 2019).

Degeratu, Alexandru M, Arvind Rangaswamy, and Jianan Wu. 2000. 17 Intern. J. of Research in Marketing *Consumer Choice Behavior in Online and Traditional Supermarkets: The Effects of Brand Name, Price, and Other Search Attributes*. www.elsevier.comrlocaterijresmar (February 8, 2021).

Donovan, Robert J, and John R Rossiter. 1994. "Store Atmosphere and Purchasing Behavior." *Journal of Retailing* 4359(November 1994).

Dubois, Pierre et al. 2020. "Effects of Front-of-Pack Labels on the Nutritional Quality of Supermarket Food Purchases: Evidence From a Large-Scale Randomized Controlled Trial." *SSRN Electronic Journal*.

Egnell, Manon, Zenobia Talati, et al. 2019. “Consumers’ Responses to Front-of-Pack Nutrition Labelling: Results from a Sample from the Netherlands.” *Nutrients*.

Egnell, Manon, Isabelle Boutron, et al. 2019. “Front-of-Pack Labeling and the Nutritional Quality of Students’ Food Purchases: A 3-Arm Randomized Controlled Trial.” *American Journal of Public Health*.

Erb, Karl Heinz et al. 2016. “Exploring the Biophysical Option Space for Feeding the World without Deforestation.” *Nature Communications* 7. www.nature.com/naturecommunications (April 25, 2019).

European Commission. 2019a. *Public Opinion in the European Union*.

———. 2019b. “The Development of the PEF and OEF Methods.” *https://ec.europa.eu/environment/eussd/smgp/dev_methods.htm*.

———. 2020. *COMMITTEE AND THE COMMITTEE OF THE REGIONS A Farm to Fork Strategy for a Fair, Healthy and Environmentally-Friendly Food System CONTENTS*. https://agridata.ec.europa.eu/Qlik_Downloads/Jobs-Growth-sources.htm (September 24, 2020).

Gerten, Dieter et al. 2020. “Feeding Ten Billion People Is Possible within Four Terrestrial Planetary Boundaries.” *Nature Sustainability*. https://doi.org/10.1038/s41893-019-0465-1 (January 21, 2020).

Grunert, Klaus G., Sophie Hieke, and Josephine Wills. 2014a. “Sustainability Labels on Food Products: Consumer Motivation, Understanding and Use.” *Food Policy* 44: 177–89. http://dx.doi.org/10.1016/j.foodpol.2013.12.001.

Grunert, Klaus G. 2011. “Sustainability in the Food Sector A Consumer Behaviour Perspective.” *International Journal on Food System Dynamics* 2(3): 207–18.

Grunert, Klaus G, Sophie Hieke, and Josephine Wills. 2014b. “Sustainability Labels on Food Products: Consumer Motivation, Understanding and Use.” http://dx.doi.org/10.1016/j.foodpol.2013.12.001 (February 26, 2019).

Hagmann, Désirée, and Michael Siegrist. 2020. “Nutri-Score, Multiple Traffic Light and Incomplete Nutrition Labelling on Food Packages: Effects on Consumers’ Accuracy in Identifying Healthier Snack Options.” *Food Quality and Preference* 83(December 2019): 103894. https://doi.org/10.1016/j.foodqual.2020.103894.

Ikonen, Iina, Francesca Sotgiu, Aylin Aydinli, and Peeter W J Verlegh. 2019. “Consumer Effects of Front-of-Package Nutrition Labeling: An Interdisciplinary Meta-Analysis.” *Journal of the Academy of Marketing Science*. https://doi.org/10.1007/s11747-019-00663-9.

Julia, Chantal, and Serge Hercberg. 2017. “Nutri-Score: Evidence of the Effective-Ness of the French Front-of-Pack Nutrition Label.” *Ernahrungs Umschau* 64(12): 181–87.

Kahneman, Daniel. 2011. “Thinking Fast, Thinking Slow.” *Interpretation, Tavistock, London*.

Lehner, Matthias, Oksana Mont, and Eva Heiskanen. 2016. “Nudging – A Promising Tool for Sustainable Consumption Behaviour?” *Journal of Cleaner Production* 134: 166–77.

http://dx.doi.org/10.1016/j.jclepro.2015.11.086.

Nuttavuthisit, Krittinee, and John Thøgersen. 2017. “The Importance of Consumer Trust for the Emergence of a Market for Green Products: The Case of Organic Food.” *Journal of Business Ethics* 140(2): 323–37.

Orquin, Jacob L. et al. 2019. “The Visual Ecology of Product Packaging and Its Effects on Consumer Attention.” *Journal of Business Research*. https://www.sciencedirect.com/science/article/pii/S0148296319300360#f0005 (January 28, 2020).

Osman, Magda, and Katie Thornton. 2019. “Traffic Light Labelling of Meals to Promote Sustainable Consumption and Healthy Eating.” *Appetite* 138: 60–71. https://www.sciencedirect.com/science/article/pii/S0195666318315289?dgcid=raven_sd_via_email (April 29, 2019).

Petrescu, Dacinia Crina, Iris Vermeir, and Ruxandra Malina Petrescu-Mag. 2020. “Consumer Understanding of Food Quality, Healthiness, and Environmental Impact: A Cross-National Perspective.” *International Journal of Environmental Research and Public Health* 17(1).

Petty, Richard E., & Barden, J., and S. C. Wheeler. 2009. “The Elaboration Likelihood Model of Persuasion: Developing Health Promotions for Sustained Behavioral Change.” In *Emerging Theories in Health Promotion Practice and Research*,.

Petty, Richard E., John T. Cacioppo, Richard E. Petty, and John T. Cacioppo. 1986. “The Elaboration Likelihood Model of Persuasion.” In *Communication and Persuasion*,.

Petty, Richard E., Gary L. Wells, and Timothy C. Brock. 1976. “Distraction Can Enhance or Reduce Yielding to Propaganda: Thought Disruption versus Effort Justification.” *Journal of Personality and Social Psychology*.

Poore, J, and T Nemecek. 2018. “Reducing Food’s Environmental Impacts through Producers and Consumers.” *Science* 360: 987–992. http://science.sciencemag.org/ (April 23, 2019).

Ramos, Saioa et al. 2020. “Food EnviroScore: New Methodology Based on Life Cycle Assessment to Easily Communicate Environmental Footprint of Food and Drink Products.” : 1–27.

Reisch, Lucia, Ulrike Eberle, and Sylvia Lorek. 2013. “Sustainable Food Consumption: An Overview of Contemporary Issues and Policies.” *Sustainability: Science, Practice, and Policy* 9(2): 7–25.

Rousseau, Sandra, and Liesbet Vranken. 2013. “Green Market Expansion by Reducing Information Asymmetries : Evidence for Labeled Organic Food Products.” *Food Policy* 40: 31–43. http://dx.doi.org/10.1016/j.foodpol.2013.01.006.

Sherman, Elaine, Anil Mathur, and Ruth Belk Smith. 1997. “Store Environment and Consumer Purchase Behavior : Mediating Role of Consumer Emotions.” *Psychology & Marketing* 14(July 1997): 361–78.

Simmonds, Gregory, and Charles Spence. 2017a. “Thinking inside the Box: How Seeing Products on, or through, the Packaging Influences Consumer Perceptions and Purchase

Behaviour.” *Food Quality and Preference* 62: 340–51. http://dx.doi.org/10.1016/j.foodqual.2016.11.010 (February 26, 2019).

———. 2017b. “Thinking inside the Box: How Seeing Products on, or through, the Packaging Influences Consumer Perceptions and Purchase Behaviour.” *Food Quality and Preference* 62: 340–51. http://dx.doi.org/10.1016/j.foodqual.2016.11.010.

Spence, Charles et al. 2016. “Eating with Our Eyes: From Visual Hunger to Digital Satiation.” *Brain and Cognition* 110: 53–63. http://dx.doi.org/10.1016/j.bandc.2015.08.006.

De Temmerman, Joyce, Eva Heeremans, Hendrik Slabbinck, and Iris Vermeir. 2021. “The Impact of the Nutri-Score Nutrition Label on Perceived Healthiness and Purchase Intentions.” *Appetite* 157(September 2020): 104995. https://doi.org/10.1016/j.appet.2020.104995.

Tilman, David, and Michael Clark. 2014. “Global Diets Link Environmental Sustainability and Human Health.” *Nature* 515(7528): 518–22. http://dx.doi.org/10.1038/nature13959.

Tonkin, Emma et al. 2016. “Consumer Trust in the Australian Food System - The Everyday Erosive Impact of Food Labelling.” *Appetite* 103: 118–27. http://dx.doi.org/10.1016/j.appet.2016.04.004.

Van Trijp, Hans C.M. 2009. “Consumer Understanding and Nutritional Communication: Key Issues in the Context of the New EU Legislation.” *European Journal of Nutrition* 48(SUPPL. 1): 41–48.

Tversky, Amos, and Daniel Kahneman. 1974. “Judgment under Uncertainty: Heuristics and Biases.” *Science* 185(4157): 1124 LP-1131. http://science.sciencemag.org/content/185/4157/1124.abstract.

Vandevijvere, Stefanie et al. 2020. “Consumers’ Food Choices, Understanding and Perceptions in Response to Different Front-of-Pack Nutrition Labelling Systems in Belgium: Results from an Online Experimental Study.” *Archives of Public Health* 78(1). https://doi.org/10.1186/s13690-020-00404-3 (May 11, 2020).

Vanhonacker, Filiep, Ellen J. Van Loo, Xavier Gellynck, and Wim Verbeke. 2013. “Flemish Consumer Attitudes towards More Sustainable Food Choices.” *Appetite* 62: 7–16. https://www.sciencedirect.com/science/article/pii/S0195666312004461 (February 17, 2020).

Vermote, Marie, Stephanie Bonnewyn, Christophe Matthys, and Stefanie Vandevijvere. 2020. “Nutritional Content, Labelling and Marketing of Breakfast Cereals on the Belgian Market and Their Reformulation in Anticipation of the Implementation of the Nutri-Score Front-of-Pack Labelling System.” *Nutrients* 12(4).

World Health Organization. 2020. “Healthy Diet.” *https://www.who.int/news-room/fact-sheets/detail/healthy-diet*. https://www.who.int/news-room/fact-sheets/detail/healthy-diet (June 15, 2020).

Appendix A

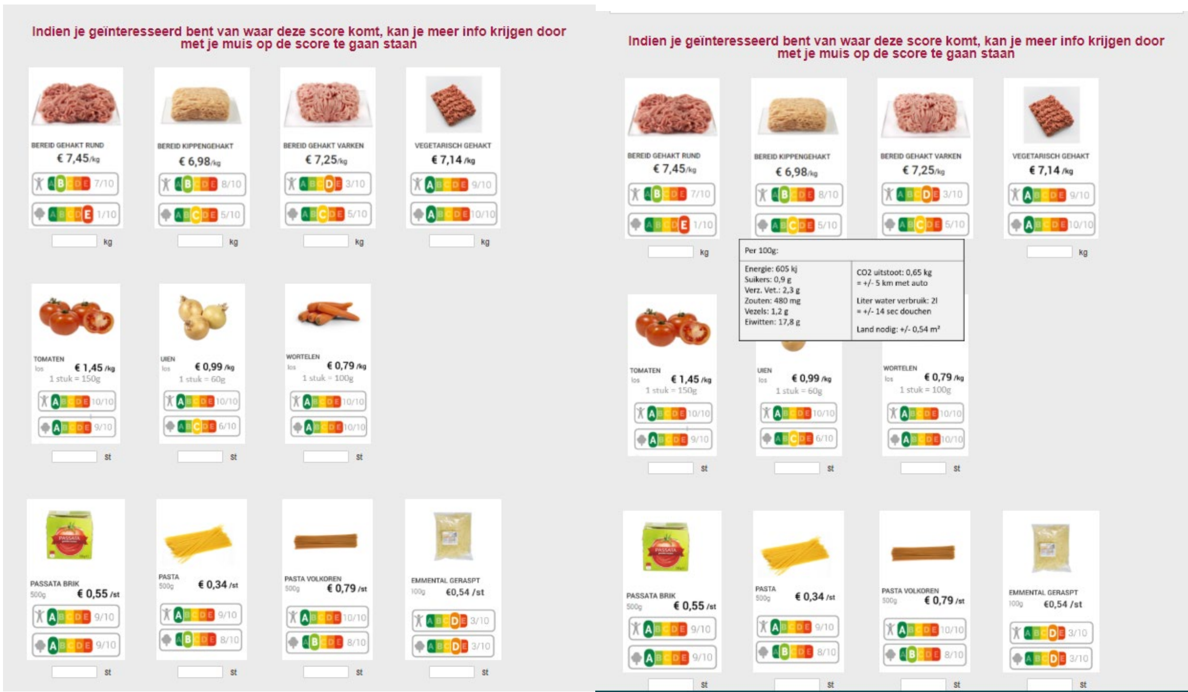

Fig A.1: Shopping screen with detailed impact information of products before (left) and after pop-up (right)

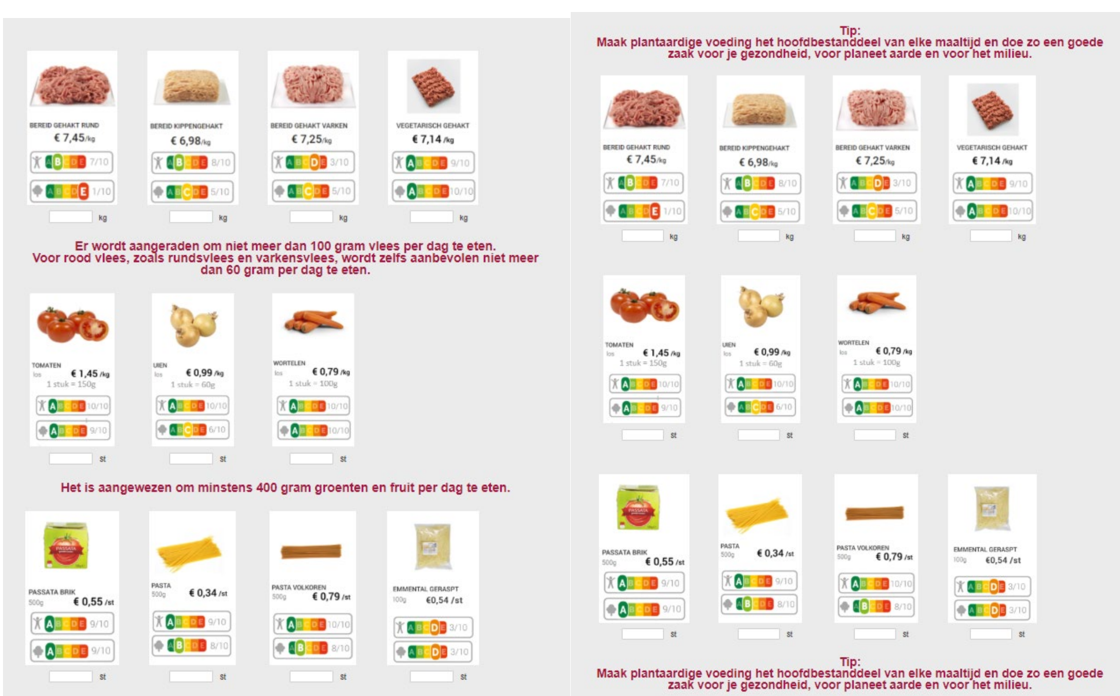

Fig A.2: Shopping screen with specific recommendation (left) and general recommendation (right)

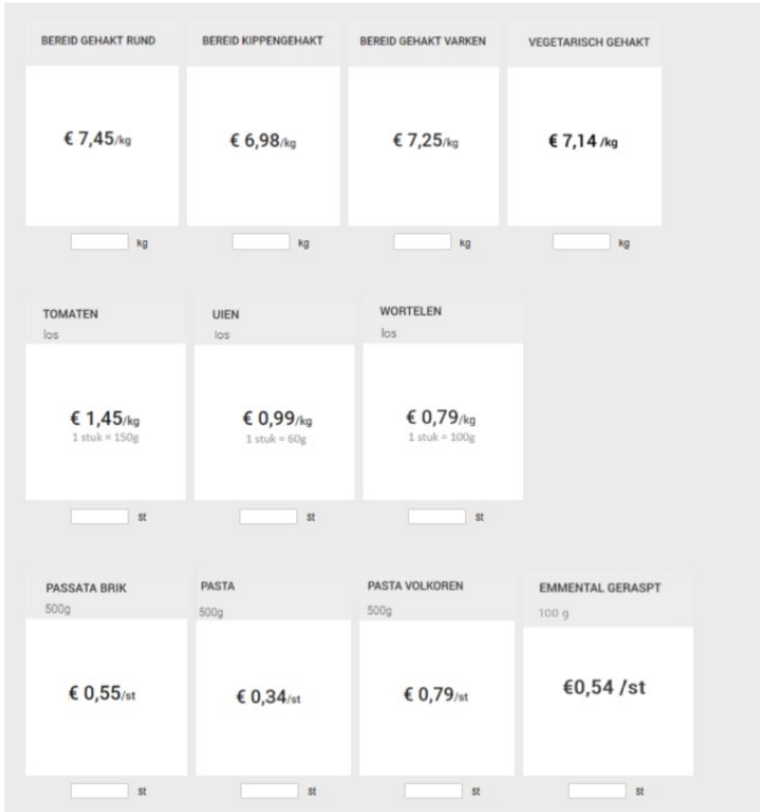

Fig A.3: Shopping screen without images

Appendix B

Tables below contain observed frequencies and Pearson standardized residual per treatment. The χ^2 statistics below the tables indicate that the socio-demographic characteristics are balanced over the different treatments.

Table B.1:Contingency table gender per treatment

Treatment Gender	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Male	26	22	25	26	26	25	25	26	23	28	28	24	24	23	26	28
	0.24	-0.47	0.14	0.13	0.13	-0.07	-0.17	-0.08	-0.26	0.42	0.21	-0.06	-0.27	-0.37	0.03	0.42
Female	21	24	21	22	22	23	24	24	23	21	23	22	24	24	23	21
	-0.25	0.49	-0.15	-0.14	-0.14	0.07	0.18	0.08	0.28	-0.44	-0.22	0.06	0.28	0.39	-0.03	-0.44

Pearson chi2(15) = 2.1954, Pr = 1.000

likelihood-ratio chi2(15) = 2.1973, Pr = 1.000

Table B.2: Contingency table age per treatment

Treatment Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
18 – 34	13	11	10	12	10	9	12	11	10	11	9	9	11	11	11	11
	0.78	0.23	-0.08	0.4	-0.21	-0.52	0.33	-0.04	-0.08	0.02	-0.7	-0.39	0.09	0.16	0.02	0.02
35 - 54	15	16	17	17	13	14	10	18	17	18	16	19	15	15	18	15
	-0.13	0.21	0.47	0.29	-0.71	-0.46	-1.53	0.37	0.47	0.46	-0.2	0.98	-0.21	-0.13	0.46	-0.29
> 54	19	19	19	19	25	25	27	21	19	20	26	18	22	21	20	23
	-0.44	-0.35	-0.35	-0.53	0.76	0.76	1.09	-0.29	-0.35	-0.41	0.67	-0.57	0.12	0	-0.41	0.23

Pearson chi2(30) = 11.7341 Pr = 0.999

likelihood-ratio chi2(30) = 11.9418 Pr = 0.999

Table B.3: Contingency table highest obtained education level per treatment

Treatment Education	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
No	1	0	0	1	1	0	2	0	0	2	0	0	0	0	1	1
	0.6	-0.74	-0.74	0.58	0.58	-0.75	1.88	-0.77	-0.74	1.88	-0.77	-0.74	-0.75	-0.74	0.56	0.56
Primary	1	1	2	0	1	0	2	1	1	1	2	1	4	2	1	1
	-0.25	-0.23	0.66	-1.15	-0.27	-1.15	0.57	-0.32	-0.23	-0.3	0.51	-0.23	2.34	0.63	-0.3	-0.3
Secondary	22	21	21	25	29	21	24	22	25	19	28	19	25	20	27	25
	-0.18	-0.29	-0.29	0.34	1.17	-0.49	0.04	-0.47	0.56	-0.99	0.64	-0.71	0.34	-0.6	0.65	0.24
Bachelor	15	11	14	13	7	12	15	20	11	14	10	19	13	15	13	15
	0.47	-0.56	0.27	-0.16	-1.79	-0.43	0.31	1.56	-0.56	0.04	-1.17	1.66	-0.16	0.47	-0.23	0.31
Master	7	10	6	9	8	10	4	5	5	13	9	5	6	9	6	7
	-0.11	1.07	-0.43	0.57	0.2	0.94	-1.31	-0.99	-0.8	1.96	0.39	-0.8	-0.53	0.63	-0.58	-0.22
PhD	0	1	2	0	2	3	1	1	4	0	0	1	0	1	1	0
	-1.02	-0.02	0.97	-1.03	0.91	1.88	-0.08	-0.1	2.95	-1.04	-1.06	-0.02	-1.03	-0.04	-0.08	-1.04

Pearson chi2(90) = 86.3615 Pr = 0.589

likelihood-ratio chi2(90) = 92.8715 Pr = 0.397

Table B.4: Contingency table household size per treatment

Treatment HH Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	14	10	14	12	16	17	11	10	11	12	13	15	13	13	14	15
	0.32	-0.73	0.4	-0.32	0.79	1.06	-0.66	-1	-0.45	-0.39	-0.26	0.68	-0.04	0.04	0.16	0.43
2	21	18	15	19	18	20	20	22	23	16	26	17	22	14	19	23
	0.42	-0.18	-0.87	-0.13	-0.36	0.09	0	0.35	0.98	-0.89	1.14	-0.41	0.55	-1.18	-0.22	0.67
3	6	5	9	5	7	5	11	7	6	10	4	8	4	10	6	7
	-0.29	-0.62	0.94	-0.72	0.04	-0.72	1.5	-0.06	-0.23	1.12	-1.23	0.55	-1.1	1.26	-0.39	-0.01
4	5	9	6	6	4	4	6	6	5	10	4	4	8	6	8	3
	-0.32	1.42	0.15	0.05	-0.78	-0.78	0	-0.05	-0.27	1.63	-0.9	-0.69	0.87	0.1	0.81	-1.23
5	0	4	0	5	1	1	1	4	1	1	1	1	1	3	1	1
	-1.26	1.96	-1.25	2.64	-0.49	-0.49	-0.51	1.77	-0.45	-0.51	-0.55	-0.45	-0.49	1.12	-0.51	-0.51
6	1	0	0	1	1	0	0	1	0	0	3	1	0	1	0	0
	0.6	-0.74	-0.74	0.58	0.58	-0.75	-0.76	0.54	-0.74	-0.76	3.1	0.63	-0.75	0.6	-0.76	-0.76
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.26	-0.25	-0.25	-0.26	-0.25	-0.25	-0.25	3.7	-0.25
More than 7	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0
	-0.5	-0.49	3.59	-0.5	1.5	1.5	-0.51	-0.51	-0.49	-0.51	-0.52	-0.49	-0.5	-0.5	-0.51	-0.51

Pearson chi2(105) = 105.6996 Pr = 0.462

likelihood-ratio chi2(105) = 88.2711 Pr = 0.880

Appendix C

Table C.1: Three-way ANOVA table with NQI as dependent variable

	SS	DF1	DF2	F	P
Intercept	3462	1	751	834	0.000
Score	16.3	1	751	3.92	0.048
Additional information	41.7	3	751	3.35	0.019
Images	1.85	1	751	0.44	0.505
Score x Additional info	5.73	3	751	0.46	0.710
Score x Image	11.8	1	751	2.84	0.092
Additional info x Image	11.1	3	751	0.88	0.447
Score x Additional info x Image	28.2	3	751	2.26	0.080
Residuals	3117	751	751		

Table C.2: Three-way ANOVA table with EII as dependent variable

	SS	DF1	DF2	F	P
Intercept	40.8	1	751	1113	0.000
Score	0.0286	1	751	0.780	0.378
Additional information	0.0371	3	751	3.37	0.018
Images	0.00952	1	751	0.260	0.611
Score x Additional info	0.101	3	751	0.914	0.434
Score x Image	0.0862	1	751	2.35	0.126
Additional info x Image	0.200	3	751	1.82	0.142
Score x Additional info x Image	0.232	3	751	2.11	0.097
Residuals	27.60	751	751		