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Analysis

Food labeling and eco-friendly consumption: Experimental evidence from a Belgian supermarket

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ABSTRACT

Using an incentive-compatible framed field experiment, we investigate whether consumers' food consumption is more eco-friendly when the information about a product's environmental impact is more easily accessible. Through an online survey, we identify a food label that is perceived to be the most easily accessible for assessing a product's eco-friendliness among six alternatives. These alternatives vary on multiple dimensions, including whether a standardized score of the overall environmental impact is added. This new food label is subsequently tested in an experimental food market embedded in a Belgian supermarket. We find that the presence of the new label that was preselected in the online survey leads to more eco-friendly food consumption relative to either the label currently used in the supermarket, or the label that contains the raw information of the environmental impact. In our experimental food market, the use of an easy-to-interpret but comprehensive environmental information label increases the overall eco-friendliness of our subjects' food consumption by about 5.3% relative to the default label used in current markets.

1. Introduction

Food consumption is one of the most important areas to improve environmental sustainability since it is responsible for one third of a household's total environmental impact (European Environmental Agency, 2005). Many consumers however give little thought to the links between their consumption and the environmental impact of food production (Grunert et al., 2014; de Boer et al., 2009). Behavioral change in food consumption can be powerful in reducing the use of natural resources (Gerbens-Leenes and Nonhebel, 2002). Though a number of studies indicate that most consumers claim to be willing to pay for environmentally superior food products, the share of eco-friendly produced food in total consumption has remained low (Rousseau and Vranken, 2013). This gap between consumers' attitude and their actual buying behavior has been referred to as the attitude/behavior gap (Vermeir and Verbeke, 2008). Our study examines to what extent a food label that is more effective in communicating environmental impacts can reduce this gap.

The attitude/behavior gap exists partly because the information provided in current food markets is uninformative of a product's environmental impact (Thibert and Badami, 2011; Tobler et al., 2011; Schumacher, 2010; Bleda and Valente, 2009). The existing labeling schemes typically emphasize only one single environmentally relevant factor, such as whether a product is organic, its carbon emissions or its place of origin (Grunert et al., 2014; Van Amstel et al., 2008). In addition, constant trade-offs underlie food purchases and product attributes such as brand image, use-by-date and nutrition information all compete with eco-labels in consumer behavior (Grunert et al., 2014). Lastly, greenwash news,[1] the multitude of eco-labels and the eco-labels' high degree of diversity make it difficult for consumers to use these labels as a reliable standard to differentiate between dirty and green products (Lozano et al., 2010; Schumacher, 2010; Van Amstel et al., 2008). As a result, even when consumers are motivated to and willing to consume more eco-friendly products, they have little access to a product's overall environmental impact and have to rely on heuristics or rule of thumbs for making their purchasing decisions, such as whether a product is organic or local (Scheibehenne et al., 2007). Relying on these heuristics,

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[1] The release of information to consumers about false environmental efforts alleged by firms (Lozano et al., 2010).

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however, does not always lead to optimal eco-friendly consumption as these signals are imperfect, and at times even misleading, for assessing the overall environmental impact (Tobert et al., 2011; Schumacher, 2010; Vermeir and Verbeke, 2008). Even worse, these heuristics gave rise to the common misperception that eco-friendly food is necessarily more costly (Bravo et al., 2013). We thus hypothesize that if it is true that the average consumer does have a preference for eco-friendliness and that the attitude/behavior gap is merely due to the poor accessibility of the relevant information, then the environmental impact of food consumption can be improved by designing more user-friendly food labels that effectively convey the overall eco-friendliness of a product.

Our paper focuses on three channels to make the information of environmental impact more accessible so that consumers can make ecologically responsible food choices. First, the food label must include more complete information to account for the interaction among the diverse environmental impacts (Thibert and Badami, 2011; Gerbens-Leenes et al., 2003). Recently, the introduction of a multi-criteria environmental information label based on the life-cycle approach[2] has been proposed as a possible solution to the questionable reliability of current labeling schemes (European Food SCP Round Table, 2012). To the best of our knowledge, there is no scientific evidence yet that directly supports the idea that the introduction of a multi-criteria labeling scheme will have a behavioral impact. Second, how environmental information is presented can matter (Van Amstel et al., 2008; Levy et al., 1996). We hypothesize that a standardized color scale is more accessible relative to raw information since it is difficult for non-experts to evaluate the impact of raw environmental information (Ölander and Thøgersen, 2014; Zander and Hamm, 2012). Last but not the least, a standardized score or grade of the overall environmental impact can be added to ease the cognitive load of consumers in processing the information so as to stimulate mainstream consumer demand for eco-friendly food, and indirectly urging producers to pursue eco-innovations (Triguero et al., 2013; Bleda and Valente, 2009; Teisl and Roe, 1998). This paper explores whether the introduction of a new label with more complete, standardized and easy-to-interpret environmental information leads to more eco-friendly food consumption.

Needless to say, our intuition of a new label's ability to convey information should be empirically tested before one makes any conclusive policy recommendation of introducing it in real food markets. There are very few studies that examine the demand for eco-labeled goods using actual purchase decisions of consumers (Brouhle and Khanna, 2012). So far, the plethora of studies examining consumers' attitudes towards and the willingness-to-pay for environmentally superior products rely only on stated preference methods and lab experiments (Bravo et al., 2013; Lusk et al., 2011; Birol and Koundouri, 2008; D'Souza et al., 2007). Stated preference studies are relatively easy to conduct, but they only measure attitudes, not behavior. When asked hypothetical questions that affect subjects' social image, consumers are more likely to overstate socially desirable attitudes (Cummings et al., 1995). Lab experiments, however, are prone to issues of external validity such as the fact that they are conducted in unfamiliar environments using non-representative samples, and are prone to experimental demand effects (Alfnes and Rickertsen, 2011; Levitt and List, 2007). In other words, the behavioral response to the new label in the lab by university students might differ from the behavioral response in a real supermarket by daily shoppers.

This paper makes several contributions. As far as we are concerned, our paper is the first to show the positive impact on incentivized food consumption of a more easy-to-interpret environmental information label based on the life-cycle approach using real shoppers. The second contribution of our paper is the design of an incentive-compatible experimental food market in a natural consumer environment to investigate the impact of the new label relative to the labels currently used in the supermarket. Very few studies have undertaken a (framed) field experiment to study the effect of environmental information on actual purchasing behavior (Brouhle and Khanna, 2012). Vanclay et al. (2011) found in a supermarket experiment that sales increased by 4% for products with a 'green light' carbon label. Matsdotter et al. (2014) use a randomized field experiment that suggests climate labeling increased demand for medium-fat, climate labeled milk by approximately 7%. These studies however used already existing labels or labels that only emphasized one single environmentally relevant factor. A framed field experiment combines the controllability of a lab with the heightened external validity of a field experiment (Harrison and List, 2004). By creating a natural food consumption environment with real supermarket food stands, we can better overcome the aforementioned problems associated with a lab setting that may induce artificial changes in behavior (Lusk et al., 2011; Benz and Meier, 2008). In addition, real products and actual cash are transacted, which makes the experimental market both non-hypothetical and incentive compatible, which increases the external validity of the observed behavior (Lusk and Shogren, 2007). Nevertheless, since our food market is still a controlled lab in an isolated corner of a supermarket, we are still able to investigate the causal effects of introducing a new label.

2. Methodology and Data Collection

In this paper, we use a two-step approach. As a first step, we conduct an online survey to elicit consumers' ratings of six alternative labels in terms of the accessibility of the environmental impact information. As a second step, we conduct a framed field experiment to investigate the impact of the preselected labels on actual food consumption. The between-subjects experimental design consists of three information treatments using three different food labels. In *Treatment Control*, we use the standard food label used by the supermarket to provide a baseline of the status quo food consumption in the current supermarket setting. In *Treatment Most*, we install the label that is perceived to be most effective in communicating the environmental impact of the food product. Last but not least, we also run *Treatment Least* with a label that is perceived to be least effective in communicating the environmental impact to control for the pure label effect, i.e. an effect that is irrespective of the informational content of the label (Hainmueller et al., forthcoming). As the provision of environmental information, regardless of how it is presented, may potentially prime subjects to be more eco-friendly in their purchase (Bougherara and Combris, 2009), this treatment also controls for the priming effect.

The rest of this section explains the design of the food labels, including the calculation of the overall standardized eco-friendliness score, and the selection of the food products to be purchased in the food market.

2.1. Creation of Environmental Impact Food Label

For the purpose of our study, all our food labels contain information of the overall environmental impact based on a review of the life-cycle analysis (LCA) literature.[3] We collect environmental impact data on global warming potential, primary energy use, water use, land use, pesticide use, acidification and eutrophication potential.[4] Using the LCA data,[5] we assess the environmental impact of the products

[2] Life-cycle analysis is a technique to assess environmental impacts and resources used throughout all stages of a product's life (Finnveden et al., 2009).

[3] Although stand-alone environmental indicators such as the carbon and water footprint are becoming increasingly popular, they do not provide an indication of the overall environmental impact since trade-offs between CO_2-emissions, water use and land use are common for agri-food products (Gerbens-Leenes et al., 2003).

[4] The LCA data were collected from the following papers: Blanke and Burdick, 2005; Williams et al., 2006; Blonk et al., 2008; Williams et al., 2008; Blonk et al., 2010; Bos and Dekker, in press; Mekonnen and Hoekstra, 2011. The included LCA studies have all been published in peer reviewed journals or in reports from universities or governments.

[5] A summary of the LCA data that we used for the nine food products can be found in Table A1 in the Appendix A.

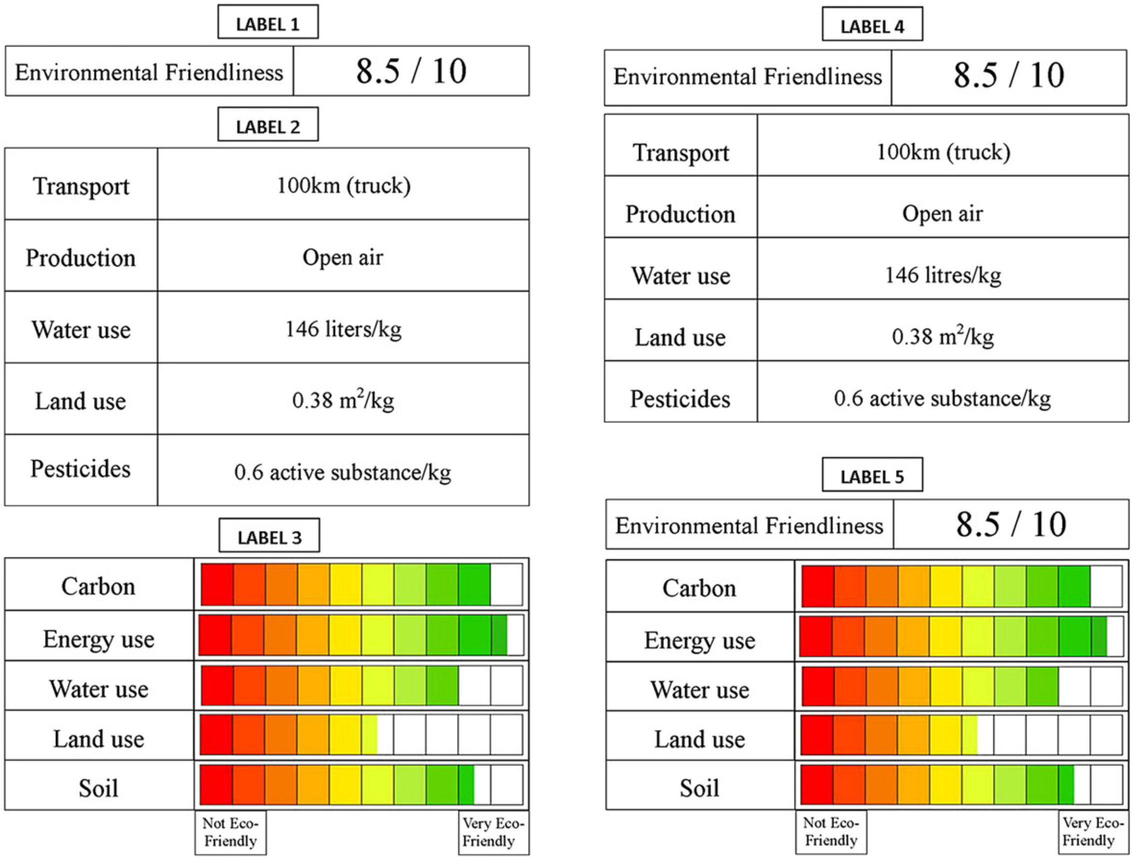

Fig. 1. Example of environmental information labels. Label 2 is the least effective environmental information label used in *Treatment Least*. Label 5 is the most effective used in *Treatment Most*. Label 6 consists of Label 1 + Label 2 + Label 3.

presented in the experimental food market and create six different environmental impact labels (see Fig. 1). The three core labels on the left column vary in the degree to which the LCA data are aggregated and translated into standardized scores, ranging from raw information at the attribute level, standardized color scale at the attribute level to standardized score at the product level. To allow for interaction effects of different labels, we also create labels that combine the core labels: Label 4 combines Labels 1 and 2; Label 5 combines Labels 1 and 3; Label 6 combines all three core labels.

The baseline information label, as shown under “Label 2” in Fig. 1, provides the raw information of the environmental impact on five raw categories: distance (km) and mode of transport, production (open air, greenhouse, intensive…), water use (litres per kg), land use (m^2/kg) and pesticides (active substance/kg). The raw information is presented in words and numbers without visualization. The second core label, as shown under “Label 3”, provides information under five environmental impact attributes: carbon emissions, energy use, water use, land use and soil.[6] However, the information is standardized and rated on a 10-point colored scale within each attribute with red indicating low eco-friendliness and green high eco-friendliness. The scale is partly inspired by the EU energy label (Directive 2010/30/EU). Unlike the 7 colored bars from the EU label, we use a 10-point scale. Above all, the label with the most aggregated information, as shown under “Label 1”, provides a standardized score at the product level so that shoppers can easily compare the overall environmental impact across products.

At present, there is no readily available methodology to relate and compare the LCA data of the different products or to calculate the overall environmental ‘score’ of a product (European Food SCP Round Table, 2012). Since the development of a harmonized methodology for the environmental assessment of food products is complex and outside the scope of this paper,[7] we construct the scale based on a weight set by Gloria et al. (2007) that was meant to assist environmentally preferable purchasing in the United States based on LCA results. The weight set is developed by a panel of 19 LCA experts, producers and users.[8] The panel weights 13 impact categories. We only use seven weights since they embody the major impact categories for agricultural food products. Accordingly we rescale the seven weights back to 100%, taking pesticides, acidification and eutrophication together. Carbon emissions take the largest weight (42.1%), followed by soil (24%), energy use (13.9%), water use (11.2%) and finally land use (8.8%) (see Table 1 for an overview of the calculated impact scores for each food product).

2.2. Selection of Labels to be Used for Different Information Treatments

Before testing the behavioral impact of a new label through a framed field experiment, we pre-test the six labels in terms of the accessibility of the environmental information through an online survey using a hypothetical choice experiment and a ranking elicitation. The online

6 We aggregate pesticide use, acidification and eutrophication into one impact term “soil” since acidification and eutrophication would probably not have a useful meaning to the average consumer.

7 The creation of a harmonized methodology is the main goal of the European Food SCP Round Table.

8 Note that the weighting of LCA is inevitably a value-based process that represents the scientific interpretation as well as ideological, political, and ethical principles. Although the weights are originally meant for the building and construction industry, panellists agreed to modify the goal of the weights to “environmentally preferable U.S. purchasing” (Gloria et al., 2007).

Table 1
The Food Products, Their Prices and Environmental Impact Scores.

Food products	Tomatoes			Apples			Proteins		
	BE conv.	BE org.	SP conv.	BE conv.	BE org.	NZ conv.	Steak	Chicken	Veggie burger
Impact categories[a]									
Carbon emissions	5.0	4.5	6.0	9.0	9.5	7.5	0.5	3.5	5.0
Energy use	5.0	4.5	8.0	9.5	9.5	9.0	4.0	6.0	7.0
Water use	9.5	9.5	9.0	8.0	8.0	7.0	1.5	3.5	5.0
Land use	9.5	9.5	7.5	5.5	5.0	6.5	0.5	2.0	3.0
Soil	8.5	9	7	8.5	9.5	7	2	3	4
Total EF score	6.5	6.5	7	8.5	9	7.5	1.5	3.5	5
Product price	€2.49/kg	€5.53/kg	€2.54/kg	€2.49/kg	€3.32/kg	€2.43/kg	€2.89 (ppu)	€2.71 (ppu)	€2.79 (ppu)

EF Score: eco-friendliness score; BE: Belgium, SP: Spain, NZ: New Zealand, Conv: conventional, Org: organic; PPU: price per unit.
[a] Environmental impact is standardized and rated on a 10-point scale.

survey was conducted in August 2012, and a total of 230 respondents completed the hypothetical choices and ranking exercise. Respondents had to indicate which apple they prefer between two apples in six hypothetical choices based on the information provided on the different labels. We asked participants to assume that price, origin, and other characteristics are the same for the two apples. After making their choices, respondents ranked the six labels from most clear to least clear. By introducing a hypothetical choice experiment to simulate food purchases before the ranking exercise, consumers are accustomed with the labels which ensure the validity of the ranking elicitation. This on-line survey allows us to select the least and most effective label – in their ability to communicate the environmental information – for the information treatments used in the experimental market.

2.3. Product Choice

For the product choice, we ensure that the main categories of daily food consumption are represented, namely fruit, vegetables and protein. Since the size/extent of food label impact can depend on other factors such as the price and product similarity (Vanclay et al., 2011; Brouhle and Khanna, 2012; McCluskey and Loureiro, 2003), having three distinct food categories in which the price premium and product similarity differ allows us to see if the food label impact is robust across different categories of food. Apples and tomatoes were chosen to represent fruit and vegetable categories since they are the most popular in Belgium with an average yearly consumption of 16.2 kg and 10 kg per inhabitant (VILT, 2011). For protein, we include two animal and one plant-based protein products: a beefsteak, a chicken breast and a veggie burger.[9] These products are chosen because they embody a direct trade-off linked to the environmental impact and to other attributes related to quality, safety and healthiness (Verbeke and Viaene, 1999).

Second, in order to further analyze whether an easy-to-interpret food label with a standardized score can overcome buying local or buying organic heuristics when these heuristics no longer lead to optimal eco-friendly food consumption, we include a local product (Belgian-Conventional tomato) that has a worse eco-friendly score than a foreign counterpart (Spanish-Conventional tomato). Likewise, we include an organic product (Belgian-Organic tomato) that has the same eco-friendly score as a non-organic product (Belgian-Conventional tomato). Nevertheless, within the apple categories, we include three variants in which the “going organic” and “going local” heuristics are in line with better eco-friendly consumption. The three variants in the order of most eco-friendly to least eco-friendly are organic-Belgian, conventional-Belgian and conventional-New Zealand.

[9] In Belgium, beef consumption decreased over the period 2004–2009 from 20 kg to 18 kg per person. Chicken meat consumption, however, increased by 25% to 20.45 kg (VILT, 2011). The market share for meat alternatives represents only 1% of the total protein market but shows a growing trend.

Overall, we make sure that the food products or variants within each category differ in the overall environmental impact score. The three categories also differ in substitutability due to different degrees of product similarity within each category. There is less product similarity in appearance for apples than for tomatoes as the two Belgian apples are of the Jonagold variety while the New Zealand one is of the Gala variety. Product similarity for the protein category is the smallest simply due to the distinct products offered.

The prices for these nine different products are kept exactly the same as those set by the supermarket to ensure that participants are faced with the same trade-off between price and other attributes in our experimental market as in their daily shopping context. The only treatment manipulation is the information provided about the products' environmental impact (see Table 1 for a summary of the products chosen, the eco-friendliness scores and prices).

2.4. Experimental Procedure and Design of Food Market

With the most and least effective environmental information labels selected through the on-line survey, we conducted the behavioral experiment in a local supermarket in January 2013. A pilot study was run 6 months earlier to fine-tune the details of the experiment. The target of 150 participants (50 per information treatment) was reached during the ninth day of the experiment. 150 participants were randomly allocated to the three information treatments in the food market. We implement the random assignment by switching the label after every subject while keeping all other conditions of the food market the same for the three groups. This also balances the time effect of certain hour of the day. The food market is set up in an isolated corner adjacent to the main entrance hall of a Belgian retail supermarket. To make the experimental market more natural and realistic, we use an open supermarket refrigerator for the protein products, and the typical supermarket stands for fruit and vegetables. We place fruit and vegetables loosely (in units) without the original packaging in straw baskets to refine the treatment effect. For the protein stand, products are kept in their original packaging for food security reasons. We also randomize the position of the food products to prevent a position effect and we ensure that participants are exposed to equal amounts of products so as to prevent a possible confounding effect of product popularity.

All customers are recruited in the main entrance hall of the supermarket with the exact same message: “Hello. We are from the KU Leuven and we are doing innovative research. We are interested in how we can better aid consumers in their shopping experience and how much information therefore needs to be present in the supermarket atmosphere. Therefore we ask whether you would like to participate in this research. In total it takes ten minutes and you will receive a 10 euro reward for your participation at the end of the study.” We only recruit people who enter the supermarket and have the intention to do grocery shopping.

Fig. 2. Diagram of the experimental procedure.

The experiment proceeds as follows (see Fig. 2): First, participants fill in a pre-experimental questionnaire that includes a short version of the Marlowe–Crowne Social Desirability Scale (Crowne and Marlowe, 1960) as well as a few questions on socio-demographics. We made sure that the questions selected do not trigger any priming effect on sustainability issues. After the participant finishes the questionnaire, the researcher explains the rules of the experimental food market before he shops in the experimental food market: (1) buy at least one product from each of the three stands[10] (2) use the 10 euro reward as credit (3) take home the products you choose, and (4) consider the trade-off between leaving the market with more products or with more cash. The researcher then leaves the food market and returns when the participant finishes shopping. There is only one participant shopping at a time. At last, the experimenter weighs the food chosen by the participant and calculates the remaining budget to be cashed out while the participant fills in a post-experimental questionnaire that elicits participants' food consumption habits, environmental knowledge and preferences for eco-friendly food products. Afterwards, the participant receives his purchases and the remaining budget in cash after handing in the post-experimental survey.

3. Results

This section covers the results of our analysis. As the first step, we elicit consumers' ratings of six alternative labels through an on-line survey to select the least and most effective label in terms of the accessibility of the environmental information. Next, we look at the average eco-friendliness of consumer baskets per treatment. Then we analyze the change in eco-friendliness in more detail through a market share and product choice analysis. We end with investigating the substitution between food groups.

3.1. Results of the On-line Choice Experiment and Contingent Ranking

To determine the least and most effective label in terms of the accessibility of the environmental information, we analyze the choices from both the choice experiment and the contingent ranking exercise (Table 2). Conditional logit estimations and the results of the contingent ranking indicate that respondents prefer the label that combines information on environmental impact at attribute level with the overall environmental score at product level the most (Label 5 in Fig. 1), and the label that only depicts raw information (Label 2 in Fig. 1) the least. Label 5 dominates the other labels since all the null-hypotheses of equal coefficients between this label and the others are significantly rejected at the 1% level using a Wald test (similar for Label 2). We thus select Label 2 as the least effective label to be used in *Treatment Least* and Label 5 as the most effective label in *Treatment Most* in the experimental market.

[10] To minimize the problem of missing data, we forced shoppers to choose at least one product, which might have led some in making a random choice. However, due to randomized assignments of participants to each treatment, the distortion is assumed to be balanced across treatments. Moreover, as shown by the data, only a small proportion of consumers go for the quasi-opt-out option and buy as minimal as possible. For apples, only 6 people bought less than 200 g (an average apple weighs 100–150 g) and for tomatoes 13 bought less than 200 g (an average tomato weighs 100 g).

3.2. Results of the Food Market Experiment

3.2.1. Descriptive Statistics

Table 3 presents the socio-demographics and food consumption habits of the 150 participants within each treatment. The supermarket where we run the experiment is located in a sub-urban area attracting people from different income class and geographical location. In our sample, 26% of participants are from the city, 41% from an urbanized municipality, 29% from a rural municipality and 4% from the countryside. Looking at the educational level of our sample however we note that a disproportionately high share of participants obtained a higher educational degree (80%) compared to the level of the total Belgian population older than 15 year (30%). Therefore we do not claim to have a perfect representation of the overall Belgian population. Nevertheless, although our sample is not 100% representative, our main objective was to select participants among the customers of a supermarket as subjects.

We test for differences in socio-demographics and food consumption habits between treatment groups to make sure that the samples are relatively balanced and there is no potential confound factor that drives the result other than the food label treatment effect. The treatment groups' socio-demographics, food consumption habits and health concerns do not differ between treatments at the statistical significant levels. We also test for differences in levels of happiness, trust, political preference and environmental knowledge and find no significant differences between treatment groups.

3.2.2. Eco-friendliness of Consumer Baskets per Treatment

We explore the information treatment effects on the average eco-friendliness per kilogram of products bought in the experimental market. We examine if the most efficient label (*Treatment Most*) stimulates consumers to buy a larger share of environmentally superior food products compared to the amount of eco-friendly products in consumers' food baskets participating in the *Treatment Control* and *Treatment Least*. The average eco-friendliness per kilogram for each individual consumer basket is calculated as the ratio of the environmental score of the product quantities in his/her basket to the total basket weight:

$$EF_{consumerbasket/kg} = \frac{1}{\sum_{i=1}^{9} weight_j} * \sum_{i=1}^{9} [Score_i * weight_i]$$

where *i* stands for the nine products in the food market, *score* for the environmental impact score at product level and *weight* for the amount of product (in kg) bought in the food market. Fig. 3 depicts the distribution of the consumer baskets' eco-friendliness of the three information treatments.[11] In the *Treatment Control* the distribution of consumers' eco-friendliness peaks at 6.62, while in *Treatment Most* it peaks at 7.38. The results of the non-parametric two-tailed Mann–Whitney–Wilcoxon tests show a significant difference between *Treatment Least* and *Treatment Most* ($z = -2.178$, $p = 0.0294$) and between *Treatment Control* and *Treatment Most* ($z = -2.764$ and $p = 0.0057$), but not between *Treatment Control* and *Treatment Least* ($z = -0.834$, $p = 0.4042$). Testing for differences between product categories over

[11] We employ Gaussian kernel functions with a bandwidth that minimizes the mean integrated squared error.

Table 2
Conditional Logit Model Estimates and Relative Ranking for the Least and Most Effective Environmental Information Cards.

Environmental information	Clogit (1)		Clogit (2)		Ranking
Raw info (Label 2)			−1.585***	(0.167)	6
Score at attribute level (Label 3)	0.584***	(0.116)	−0.387***	(0.115)	4
Overall score at product level (Label 1)	0.480***	(0.113)	−0.456***	(0.117)	2
Raw info + score at attribute level + overall score (Label 6)	0.427***	(0.117)	−0.539***	(0.135)	5
Raw info + score (Label 4)	0.482***	(0.105)	−0.480***	(0.123)	3
Score at attribute level + score (Label 5)	1.286***	(0.151)			1
Log likelihood	−1048.63		−1021.14		
Observations	3220		3220		

treatments, we see that the result is robust within all three categories when comparing *Treatment Control* and *Treatment Most* (Table 4). As a robustness check, we also run the same tests comparing the consumer baskets' eco-friendliness across treatments based on the calories of the product instead of the weight and the results are robust. Altogether, these results show that the preselected label with the most accessible environmental information increases the overall eco-friendliness of our subjects' food consumption by about 5.3%. This finding is in line with Vanclay et al. (2011) who found in a supermarket experiment that sales increased 4% for products with a ‘green light’ carbon label. Lastly, we ran two logistic regressions[12] to see whether the increase in average eco-friendliness in participants' consumption baskets is robust when two different sets of control variables are included. We include a set of socio-demographics and a set of food consumption habits as controls since previous research linked these factors to play a role in eco-friendly consumption (see e.g. Bravo et al., 2013 or D'Souza et al., 2007). Regression results indicate that the treatment differences are robust controlling for these variables.

3.2.3. Market Share Analysis and Product Choice per Information Treatment

We now analyze the market shares and the likelihood of choosing a specific type of product to understand in detail how the most accessible environmental information increases the overall eco-friendliness of our subjects' food consumption. Table 5 describes the market share of each product per information treatment. Compared to the *Treatment Control*, the market share of the most eco-friendly alternative in *Treatment Most* increases substantially in all of the three categories: the share of Spanish conventional tomatoes increases by 178%; the share of Belgian organic apples increases by 44% and the share of the veggie burger also increases by 129%. Moreover, the increased market shares of the most eco-friendly alternatives were in substitution of the least eco-friendly alternatives. In *Treatment Least*, although the share of the most environmental friendly alternative increases in both the fruit and the protein categories, it was in substitution of the second best alternative. The share of the least eco-friendly alternatives such as the New Zealand apple and the steak does not decrease. Moreover, the share of the Spanish conventional tomatoes decreases, substituted by the organic local variant.

We now present the results of the multinomial logistic regressions of the treatment effects on the likelihood of choosing a specific type of product within a food stand (product category). As shown in Table 6, consumers' consumptions shifted away from less eco-friendly alternatives in all categories in *Treatment Most*. The likelihood of consumers choosing the two less friendly alternatives is lower relative to the most eco-friendly alternative within each food category. The negative coefficients are statistically significant at least at the 10% level for all alternatives except for the Belgian conventional apple. One potential explanation is that the most eco-friendly apple is a relatively more expensive alternative. In *Treatment Least*, although consumers shifted their demand, the negative coefficients are not statistically significant except for chicken. Hence, we do not find any strong supporting evidence for the mere information effect.

3.2.4. Substitution Between Food Groups

Finally we examine whether the information treatments also induce substitution between food groups. In particular, we compare the proportion of fruit and vegetables, plant-based protein and animal protein across treatments. Table 7 shows that substitution between the three product categories occurs when the most accessible environmental information is present. The proportion of fruits and vegetables and plant-based proteins increases in *Treatment Most* compared to *Treatment Control* while the proportion of animal

Table 3
Participants' Socio-demographics and Consumption Habits Within Each Treatment.

Description	Treat control (%)	Treat least (%)	Treat most (%)	χ^2 test (p-value)
Gender				
Male	46%	46%	46%	Pr = 1.000
Female	54%	54%	54%	
Age				
≤25	8%	6%	10%	Pr = 0.58
26–54	76%	76%	68%	
≥55	16%	18%	22%	
Education				
University	40%	33%	56%	Pr = 0.385
Higher education	42%	47%	26%	
Secondary school	18%	20%	18%	
Income class				Pr = 0.297
Higher	38%	23%	48%	
Middle	56%	71%	44%	
Lower	4%	6%	6%	
Member of nature organization (yes)	26%	18%	26%	Pr = 0.551
Vegetarian (yes)	4%	6%	10%	Pr = 0.472
Fruits per day				Pr = 0.154
≤1	24%	40%	22%	
1–2	54%	38%	44%	
≥2	22%	22%	34%	
Meat frequency				Pr = 0.206
<Once a week	10%	6%	12%	
Once a week	10%	4%	4%	
2–4 times a week	40%	60%	32%	
5–6 times a week	24%	20%	32%	
Daily	16%	10%	20%	
Health concern				Pr = 0.711
Not much	22%	20%	20%	
Much	44%	50%	38%	
Very much	34%	30%	42%	

Note: we use the Pearson Chi-square test and consider a p-value of less than 0.1 to be significant.

[12] We run the logistic regressions with one dependent variable being *Treatment Most* versus *Treatment Control* and the other being *Treatment Most* versus *Treatment Least*. The independent variables are the average eco-friendliness per kilogram for each individual consumer basket and two different sets of control variables: socio-demographics (age, gender, income level, number of kids, education level, member of nature organization and area type) and food consumption habits (number of fruits eaten per day, meat and fish frequency per week and health concern).

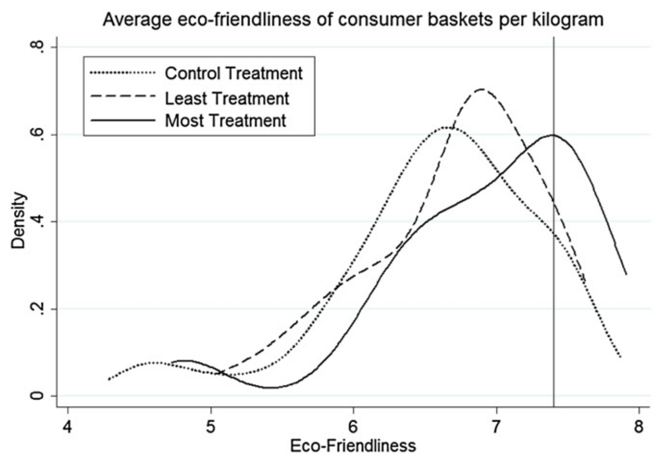

Fig. 3. Kernel density estimates of the eco-friendliness of consumer baskets per kilogram per information treatment.

Table 5
Food Products' Market Shares per Treatment.

Food products	EF score	Market shares per treatment			%Change most/control
		Control	Least	Most	
BE conv. tomato	6.5/10	50%	50%	34%	−35%
BE org. tomato	6.5/10	32%	38%	16%	−50%
SP conv. tomato	7/10	18%	12%	50%	178%
Pearson Chi-square = 22.07 Pr = 0.000					
BE conv. apple	8.5/10	46%	34%	46%	4%
BE org. apple	9/10	32%	44%	44%	44%
NZ conv. apple	7.5/10	22%	22%	10%	−58%
Pearson Chi-square = 5.01 Pr = 0.286					
Steak	1.5/10	24%	30%	18%	−25%
Chicken	3.5/10	62%	44%	50%	−19%
Veggie burger	5/10	14%	26%	32%	129%
Pearson Chi-square = 6.62 Pr = 0.158					

EF score: Eco-Friendliness score, BE: Belgium, SP: Spain, NZ: New Zealand, conv: conventional, org: organic.

proteins to total consumption diminishes. These findings show that the animal-based protein is diluted by both plant-based protein and fruit and vegetables.

4. Discussion

Previous research has shown that the size/extent of food label impact can depend on other factors such as the price, the environmental scores (label design) and product similarity (Brouhle and Khanna, 2012; Vanclay et al., 2011; Van Amstel et al., 2008; McCluskey and Loureiro, 2003). Since the experiment is a between-subjects design, other factors would be present for both the control and treatment groups. Therefore we only draw inferences from the difference between the control and treatment groups, which is driven by the manipulation of different food labels. Besides, the experimental market exists explicitly out of three distinct food categories in which the price premium, the environmental scores and product similarity differ in order to analyze whether the food label impact is robust across different categories of food. Through this setup, we allow for considerable variation between the score, prices and product similarity. Though we vary the price premium and the environmental scores in our design, due to our limited food products range, the exact effect size is beyond the scope of our paper. Nevertheless, our experimental findings clearly show that a more easy-to-interpret environmental information food label leads to more eco-friendly consumption in every food category.

We summarize the effect of *Treatment Least* and *Most* on product choice in Table 8. In *Treatment Least*, in which we installed the label with only 'raw' information, we find no effect of the additional environmental information on the product choices in the fruit and vegetable categories compared to *Treatment Control*. The 'raw' information is not easily interpretable and for each attribute absolute differences between products are small. For the protein category, however, we find a significant substitution effect of chicken and veggie burgers. The 'raw' information is slightly more intuitive (at least in magnitude) given the more pronounced absolute differences in the attributes. For example, while the water use for the Belgian organic apple and the New Zealand conventional apple is 146 and 220 l/kg, respectively, for steak and veggie burger the water use is 11,000 and 1106 l/kg, respectively. In *Treatment Most*, we installed the label that combines information on environmental impact at attribute level with the overall environmental score at product level. We find an overall effect in favor of the most eco-friendly alternatives. But the extent, to which switching behavior demonstrates itself under the new label, depends on the specific characteristics of each product stand such as product similarity and prices.

For fresh produce, people generally buy local or organic because this information is likely used as a heuristic for the eco-friendliness of the product among other things (Tobert et al., 2011; Schumacher, 2010; Vermeir and Verbeke, 2008; Scheibehenne et al., 2007).[13] In our survey, 91% of the people indicate local produce as not or little detrimental for the environment, and 90% of the participants report organic produce as not or little detrimental for the environment. The high initial market shares for local and/or organic fruits (78%) and vegetables (82%) in *Treatment Control* confirm that people use the local-organic heuristic or are at least more attracted to products possessing these attributes in our experimental market.[14] Thus, without introducing the most effective label, both groups behave in a very similar way. With the most effective label installed in the vegetable group, people realized that the organic alternative is actually inferior in eco-friendliness (EF: 6.5/10) compared to the conventional foreign (EF: 7/10). Indeed, the results show that such a label was effective in empowering consumers to be free from a heuristic trap and to overrule their prior beliefs. We note however that the organic option for tomatoes is quite expensive

Table 4
Eco-Friendliness of Consumer Baskets per Treatment and per Product Category.

	Average eco-friendliness			Mann–Whitney–Wilcoxon test		
	Control	Least	Most	Most vs control	Most vs least	Least vs control
Tomatoes	6.59	6.56	6.75	0.0017***	0.0005***	0.8527
Apples	8.61	8.5	8.79	0.0312**	0.4329	0.2526
Protein	3.23	3.29	3.62	0.0961*	0.5210	0.3926
Total	6.57	6.69	6.93	0.0057***	0.0294**	0.4042

Note: 50 participants per treatment.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

[13] Buying local and/or organic also originates from other aspects such as health and support of the local economy. We just want to point out that organic and local are the major heuristics (beside seasonality) people use for fresh produce when they want to be more eco-friendly.

[14] Since consumers perceive organic foods to be healthier (Bravo et al., 2013) we disentangle the effect of eating green and eating healthy through our design: one food stand where the organic version is not the greenest (tomatoes) and one stand where it is (apples). Our results show that the new label makes organic consumers switch away to a conventional version. Besides, looking at the health concern of the 50% least and most green consumers in our market, we see that the effect is not driven by differences in health concerns over treatments.

Table 6
Multinomial Regression Estimates for Product Choice in Food Market.

Food products	EF score	Product choice		Log likelihood
		Treatment Least	*Treatment Most*	
BE conv. tomato	6.5/10	0.405 (0.598)	−1.407*** (0.500)	−139.31 ($\chi^2(4) = 17.59$ ***)
BE org. tomato	6.5/10	0.577 (0.627)	−1.715*** (0.582)	
SP conv. tomato	7/10	Reference category		
NZ conv. apple	7.5/10	−0.318 (0.538)	−1.107* (0.632)	−153.24 (χ^2 (4) = 5.38)
BE conv. apple	8.5/10	−0.621 (0.459)	−0.318 (0.441)	
BE org. apple	9/10	Reference category		
Steak	1.5/10	−0.396 (0.608)	−1.114* (0.632)	−150.33 (χ^2 (4) = 6.85)
Chicken	3.5/10	−0.962* (0.545)	−1.042** (0.527)	
Veggie burger	5/10	Reference category		

Note: as a rule, we choose the most eco-friendly product variety as the reference category.
Observations: 150; standard errors in parentheses.
EF score: Eco-Friendliness score, BE: Belgium, SP: Spain, NZ: New Zealand, conv: conventional, org: organic.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

which probably strengthens the impact of the label. As for the fruit, participants have the choice between one environmentally inferior (7.5/10) option, being the foreign conventional apple, and two environmentally superior options (8.5 & 9/10), i.e. the local conventional and local organic apple. One would expect the choice switch to be least likely since consumers already bought more frequently the superior alternatives in the *Treatment Control* and *Least* and the price premium to improve is the highest. Nevertheless, we see that *Treatment Most* still shifts a substantial part of the demand away from the least eco-friendly alternative towards the most eco-friendly alternative.

In the protein stand, participants can choose between (1) an evidently inferior environmental option, i.e. steak (1.5/10), (2) a less inferior option, i.e. chicken (3.5/10), and (3) a superior alternative, i.e. the veggie burger (5/10). We find that consumers choose less steak and chicken in favor of veggie burgers when effective environmental information is provided. The combined finding of choosing less steak and less chicken may indicate a trickle-down effect of steak buyers substituting steak for chicken and chicken buyers substituting chicken for veggie burgers. This finding can serve as evidence that consumers may be prepared to reduce their meat consumption (or switch to lower environmental impact meat categories) if they are informed at the point of sale through efficient environmental information.

Finally, we recognize the high initial market shares for organic produce (±30%) in the experimental food market compared with the actual market shares for organic produce (±5%) (Samborski and Van Bellegem, 2013). The experimental food market seems to introduce an upward bias in organic market shares. This is consistent with other studies (e.g. Marette et al., 2008; List and Shogren, 1998; Fox et al., 1998) showing that field valuations can be greater than laboratory valuations. The upward bias can be a result from a house money effect where the provision of an initial endowment can cause experimental subjects to make unusual choices (Clark, 2002). Next to the house money effect, priming and framing effects could have played a role in the initially high proportion of organic products (see e.g. de-Magistris et al., 2013). Some participants may infer that we test for green behavior from the experimental setup or some participants may be primed by some unknown cues. If so, they will buy the organic variants in *Treatment Control* since they use this organic information as a rule of thumb to eco-friendly behavior. As a robustness check however, we measured subjects' social desirability score which identifies the extent to which individuals like to portray themselves positively (Crowne and Marlowe, 1960). The treatment difference was not driven by the subjects with high social desirability scores.

5. Conclusion

This paper explores whether the introduction of a more complete, easily-interpretable and standardized label promotes eco-friendly consumption. Using an incentive-compatible experimental market in a Belgian supermarket with real products, we show that consumer attitudes translate into more corresponding eco-friendly behavior when the eco-friendliness information of the food products is more accessible. We find that the best environmental information label preselected in an online survey increases the overall eco-friendliness of our subjects' food consumption in the experimental market by about 5.3%. Our experiment shows that introducing a graded eco-label in consumer food markets could form a reliable standard for consumers to differentiate between dirty and green products, thereby stimulating mainstream consumer demand and urging producers to implement continuous product eco-innovations (Triguero et al., 2013; Bleda and Valente, 2009; Teisl

Table 7
Substitution Between Food Groups.

	Proportions to total consumption basket			Mann–Whitney–Wilcoxon test		
	Treatment Control	*Treatment Least*	*Treatment Most*	Most vs control	Most vs least	Least vs control
Fruits and vegetables	76.6%	78.4%	79.9%	0.0753*	0.0776*	0.7616
Animal-based proteins	21.1%	16.3%	14.8%	0.0096***	0.2544	0.1582
Plant-based proteins	2.3%	5.3%	5.3%	0.0211**	0.7492	0.0673*

Note: 50 participants per treatment.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

Table 8
Summary of Treatment Effects on Product Choice.

Food products	Product prices	EF score	Product choice	
			Treatment Least	*Treatment Most*
BE conv. tomato	€2.49/kg	6.5/10	/	−−
BE org. tomato	€5.53/kg	6.5/10	/	−−
SP conv. tomato	€2.54/kg	7/10	/	++
BE conv. apple	€2.49/kg	8.5/10	/	/
BE org. apple	€3.32/kg	9/10	/	+
NZ conv. apple	€2.43/kg	7.5/10	/	−
Steak	€2.89 (ppu)	1.5/10	/	−
Chicken	€2.71 (ppu)	3.5/10	−	−−
Veggie burger	€2.79 (ppu)	5/10	+	++

/no significant effect found, + positive significant effect found (+: $p < 0.1$; ++: $p < 0.05$; +++: $p < 0.01$), − negative significant effect found (− $p < 0.1$; −− $p < 0.05$; −−− $p < 0.01$), EF score: Environmental Friendliness score, BE: Belgium, SP: Spain, NZ: New Zealand, conv: conventional, org: organic, ppu: price per unit.

and Roe, 1998). The effect of the graded eco-label could be smaller in lower-income markets since the preference for environmental quality and the heightened consumer awareness are more present in higher-income markets (Dinda, 2004). However, due to high urbanization rates and global economic development, food consumption trends in developing countries are shifting so the label's effect can become more substantial in these future markets (Kearney, 2010).

Our findings suggest that the intensity of switching can depend on several factors such as product similarity, the price premium, the environmental score, and the accessibility of information as these relate to differences in substitutability and the cost of switching. Further research into the underlying drivers is therefore needed to be able to disentangle their interactions more clearly. We also find initial evidence that the new label can overrule often-used heuristics such as "think global, eat local" or "organic is more eco-friendly". This happens when the new label's score indicates another more eco-friendly option than the local and/or organic variety, which suggests that today consumers are sometimes misled through the use of these heuristics or labels, while they think they are doing the right thing (and are also paying the premium for it in case of organic produce). This finding can stimulate further research into the conflicting dimensions of information on food products relating to the environment, health and ethics especially when larger substitution opportunities and varying price strategies exist.

Our framed field experiment has two main design features to increase the external validity of the results namely a natural shopping environment with real food located in a supermarket with intended shoppers and the monetary incentives which are crucial for eliciting more truthful purchasing decisions. Nevertheless, our subjects could infer that they are part of a research study. Therefore the environmental information could be more salient than in actual markets (Hu et al., 2006). Besides, the findings of our experimental market stem from a snap-shot experiment and do not take into account possible learning effects and awareness creation due to the introduction of the new label which can have a positive long-term impact on the use of the environmental information (Lusk, 2014). Lastly, we only ran the experiment in one supermarket which possibly creates a sample selection bias (Harrison and List, 2004). Implementing a long-term randomized controlled field trial in multiple diverse retailers is deemed vital to accurately understand the impact and the exact effect size of efficient environmental information on actual markets. Still, implementing a framed field experiment before running a natural field experiment is helpful because it is much more cost-effective. Moreover, it allows the design of future field experiments to be more informed and targeted, as our experiment is meant to encourage follow-up studies in this direction.

Given that the process of creating and adopting a commonly applied label in all supermarkets is slow and costly (European Food SCP Round Table, 2012), it is all the more important for the relevant research to develop methods to pre-test the behavioral impacts of efficient environmental information through systematic experimentation. Our paper made such an endeavor and our experimental finding that the multi-criteria label with a standardized score as used in this paper significantly promotes eco-friendly food consumption can serve as a piece of scientific evidence for public authorities and companies to further explore and implement a new more complete, easy-to-interpret and standardized environmental information label.

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Appendix A

Table A1
Summary of the LCA Data Collected for the Nine Food Products.

LCA impact category	FU	Tomatoes			Apples			Steak	Chicken	Veggie burger
		BE conv.	BE org.	SP conv.	BE conv.	BE org.	NZ conv.			
Global warming potential	kg CO_2^-eq/t	1700	2100	1020	220	170	450	17,000	3200	1700
Primary energy use	MJ/kg	36.2	46	9.6	4.2	3.8	5.6	61.8	22.8	13.7
Water use	l/kg	39	34	53	146	146	220	11,000	3000	1106
Land use	m^2/t	19	25	89	380	494	170	17,000	5400	2100
Pesticides	kg/ha	0.5	0.2	2.2	0.6	0.1	0.3	7.1	7.7	2.5
Acidification potential	kg SO^{2-}eq/t	2.4	3.5	4.6	1.8	1.5	24.1	469	173	108
Eutrophication potential	kg PO^{3-}eq./t	0.21	0.34	0.47	0.4	0.34	3.7	157	49	36

BE: Belgium, SP: Spain, NZ: New Zealand, conv: conventional, org: organic, FU: Functional Unit.

A.1. Photo of the Experimental Food Market in the Supermarket

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