FACULTY OF
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CONSUMERS' REACTIONS TOWARDS THE ECO-SCORE FOOD LABEL

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Jeroen Berden

Abstract in English

Human activity is the primary driver of environmental damage. Among the various contributors to human activity, the food system stands out as a major one, responsible for almost one third of global greenhouse gas emissions and consuming the majority of available drinking water. These alarming effects emphasize the urgency of transitioning to a more sustainable diet. To encourage the consumption of environmentally friendly foods, different policy interventions have been devised. One notable example is the front-of-pack eco-labels, providing information about the environmental impact of food products. In recent times, France introduced the Eco-score label; however, due to its novelty and limited implementation, little research has been conducted on this tool, and no literature regarding consumer reactions is available. Therefore, this study aims to gain a better understanding of Belgian consumers' current reactions to the Eco-score label. The research examines the label's effectiveness, familiarity, current use, perceptions, and intentions to use it. Additionally, influential variables affecting the label's effectiveness and intention to use are explored. The empirical data for the study was collected through a cross-sectional online survey distributed throughout Belgium among 607 participants. Upon analysis, it was found that the Eco-score label can be effective, provided that consumers possess both environmental subjective and objective knowledge. The study also revealed that a majority of Belgian consumers were already familiar with the Eco-score label. However, the current usage remains moderate. Moreover, intentions to use the label are slightly positive, with environmental attitude, perception towards the Eco-score label, and age being identified as influencing factors. Additionally, consumers perceived discounting and suggestive campaigns as the most effective methods to promote the use of the Eco-score label. This study offers a comprehensive overview of Belgian consumers' reactions towards the Eco-score label. The positive perception among Belgian consumers, combined with the label's potential effectiveness, positions the Eco-score label as a promising tool to facilitate informed and sustainable food choices. The recommendations and limitations highlighted in this research should be carefully considered by policymakers and retail stores to further enhance the Eco-score label's use and effectiveness.

Abstract in Dutch

Menselijke activiteit behoort tot de belangrijkste oorzaak van milieuschade. Tot deze menselijke activiteiten levert het voedselsysteem de grootste bijdrage. Zo is het voedselsysteem verantwoordelijk voor bijna een derde van de wereldwijde uitstoot van broeikasgassen en verbruikt het het grootste deel van het beschikbare drinkwater. Deze alarmerende effecten benadrukken de noodzaak voor de transitie naar een duurzamer dieet. Om deze transitie te stimuleren, werden alreeds verschillende beleidsinterventies ontwikkeld. Front-of-pack Eco-labels die informatie geven over de milieu-impact van voedingsmiddelen zijn een voorbeeld van zulke interventies. Recent heeft Frankrijk een nieuw Eco-label geïntroduceerd, de Eco-score. Echter, vanwege de nieuwigheid en beperkte implementatie is er tot heden weinig onderzoek over uitgevoerd en er is slechts beperkte literatuur beschikbaar over consumentenreacties. Deze studie heeft bijgevolg als doel een beter inzicht te krijgen in de huidige reacties van Belgische consumenten over de Eco-score. Het onderzoek onderzoekt de effectiviteit, bekendheid, huidig gebruik, percepties en intenties van consumenten om het label te gebruiken. Daarnaast worden variabelen onderzocht die de effectiviteit en de intentie om het label te gebruiken beïnvloeden. Empirische gegevens voor deze studie werden verzameld via een cross-sectionele online enquête die werd verspreid onder 607 Belgische deelnemers. Na analyse werd geconcludeerd dat de Eco-score effectief kan zijn, mits consumenten zowel subjectieve als objectieve kennis over het milieu bezitten. Alsook toonde de studie aan dat een meerderheid van de Belgische consumenten alreeds bekend was met de Eco-score. Het huidige gebruik blijft echter gematigd. Bovendien zijn de intenties om het label te gebruiken licht positief, waarbij milieuattitude, perceptie van de Eco-score en leeftijd als beïnvloedende factoren werden geïdentificeerd. Alsook beschouwen consumenten kortingen en suggestieve campagnes als meest effectieve methoden om het gebruik van de Eco-score te bevorderen. Samengevat biedt deze studie een uitgebreid overzicht van de reacties van Belgische consumenten over de Eco-score. De positieve perceptie onder Belgische consumenten, gecombineerd met de potentiële effectiviteit, levert de Eco-score aan als een veelbelovend instrument om beter geïnformeerde en duurzamere voedselkeuzes te bevorderen. De aanbevelingen en beperkingen die in dit onderzoek naar voren zijn gebracht, kunnen door beleidsmakers en winkelketens zorgvuldig in overweging worden genomen om het gebruik en de effectiviteit van de Eco-score verder te verbeteren.

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List of Abbreviations and Acronyms

AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
BOP	Back-of-pack
CFI	Comparative Fit Index
EFA	Exploratory Factor Analysis
FOP	Front-of-pack
GLM	Generalized Linear Model
KMO	Kaiser-Meyer-Olkin
LCA	Life Cycle Analysis
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Model
srmr	Root Mean Square Residual
VIF	Variance Inflation Factor

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1 Introduction

For the past few decades, the impact of the human activities became of increasing concern to people all over the world. Scientific evidence indicates that human activity is the primary driver of environmental damage (Nature Human Behaviour, 2022). Major contributors to this damage include global warming caused by greenhouse gas emissions and water use (ADEME, 2022). The food system plays a significant role in emitting greenhouse gases throughout all stages of production (Garnett, 2011). On average, the food system is responsible for 28% of global greenhouse gas emissions and uses 70% of available drinking water (Gruère et al., 2020). Despite these large amounts, consumers are willing to take responsibility for the environmental impact of their food choices and are thus prepared to help counter climate change (De Bauw et al., 2022).

Consumer behavior plays a crucial role in the food production chain, making consumer involvement essential (Moran et al., 2020). To encourage more thoughtful food choices, policy measures such as food labeling, can be implemented (Lusk & McCluskey, 2018). Two main categories are often distinguished, namely Front-Of-Pack, and Back-Of-Pack labels. However, compared to Front-Of-Pack, Back-Of-Pack labels are often harder to understand, as shown by various studies (Kelly et al., 2009). As a result, the use of Front-Of-Pack labels is nowadays preferred. These labels have also proven to be more effective compared to Back-Of-Pack labels (Rønnow, 2020). In addition, multiple studies have also proven that consumers are more likely to use simplified labels in their decision-making process (Becker et al., 2015). One such example of a Front-Of-Pack label is the Nutri-score, which has been found to promote healthier food choices effectively (Egnell et al., 2020). While many Front-Of-Pack labels provide nutritional information, sustainability labels like the Rainforest Alliance or Forest Stewardship Council are becoming more prevalent (Asioli et al., 2020). These labels provide eco-related information, and their use is increasing (Ecovia Intelligence, n.d). To complement the Nutri-score and address the multitude of sustainability labels, the Eco-score label was designed to inform consumers about the environmental impact of food products (Asioli et al., 2020; De Bauw et al., 2022).

Developed by French players and launched in 2021, the Eco-score label aims to help consumers make more environmentally friendly food choices. The methodology behind the Eco-Score uses two components: the life cycle analysis and an additional scoring system (ADEME, 2022). The label categorizes five classes, distinguished by the use of different colours and characters ranging from dark green with character A to dark red with character E. In this way, the label tries to give clear information about the environmental impact of food products. Due to its promising design, similar to that of the Nutri-score, the Eco-Score can be a useful tool to steer consumers towards more sustainable food choices.

To our knowledge, consumers' reactions towards the Eco-score label have not yet been investigated. Hence, the main goal of this study is to determine consumers' reactions, i.e. effectiveness, perceptions, knowledge, and intention to use the label. First, it is examined whether the label helps people evaluate the environmental impact of foods and what factors influence this evaluation. Also participants' familiarity, current use, overall perception, and knowledge is assessed. Following, different variables are looked at, and how they influence the intention to use the Eco-score label. For this, the hierarchy of effects of eco-labels is used as a framework (Grunert, 2011). To this framework modifications are made, adapted for the Eco-score. Finally, current consumer awareness and perceived effectiveness of marketing campaigns are examined. Based on the results, limitations are discussed and recommendations are made. In the end, this research can give clarity on the Eco-score label and how it helps consumers make more informed choices when it comes to buying environmentally friendly foods.

2 Literature Review

2.1 Food and its impact on the environment

Food production has a significant impact on our planet as it is a major contributor to the deterioration of our ecosystem. Among all factors, the global food system is arguably the most influential one. Approximately one-third of global greenhouse gasses emissions produced by humans globally come from the food system (Rockström et al., 2020). However, it is essential to acknowledge that that emissions vary throughout the food supply chain's different stages. According to a study by Crippa et al. (2021), land use and agricultural production emit respectively 32% and 39% of all greenhouse gases, whereas transport only accounts for 4.8% of food emissions. Furthermore, clear differences in emissions exist among different types of food. For instance, compared to the production of peas, beef production emits 100 times more greenhouse gasses per 100 grams of protein produced. Additionally, there are significant differences in freshwater withdrawals per 100 grams of protein produced (Poore & Nemecek, 2018).

Apart from emissions and water use, anthropogenic activity is by far the largest cause of deforestation and biodiversity loss (IPBES, 2019). The combination of these factors endangers the balance of planet Earth. This not only affects the current generation but also future ones. This imbalance is a consequence of the excessive use of natural resources. A balance can only be obtained if no more resources are consumed than the planet can provide. This concept is referred to as "Earth overshoot day" (Lee et al., 2021; Earth Overshoot Day, 2022). Every year, the Earth offers a certain amount of biological resources. Whenever our consumption surpasses this bio-capacity, the remainder corresponds to the global overshoot. In the past, the demand for resources did not exceed this bio-capacity, resulting in a net positive bio-capacity at the end of the year. However, over the years, "Earth overshoot day" has been happening earlier each year and at an increasing pace (Figure 1). According to most recent data from the Global Footprint Network; "Earth overshoot day" occurred in 2022 on the 28th of July.

As the human population continues to grow, the demand for food continues to increase as well (Dijk et al., 2021). This increasing demand puts additional pressure on natural resources, resulting in exceeding the planetary boundaries even further. Consequently, this climate change not only causes harvests to fail but also exacerbates social instability (Ray et al., 2019; Rockström et al., 2020). To safeguard the well-being of future generations and remain within the Earth's boundaries, proactive measures must be taken. It is imperative to shift towards a more sustainable food system, which necessitates both innovations and effective policy interventions (Rockström et al., 2020).

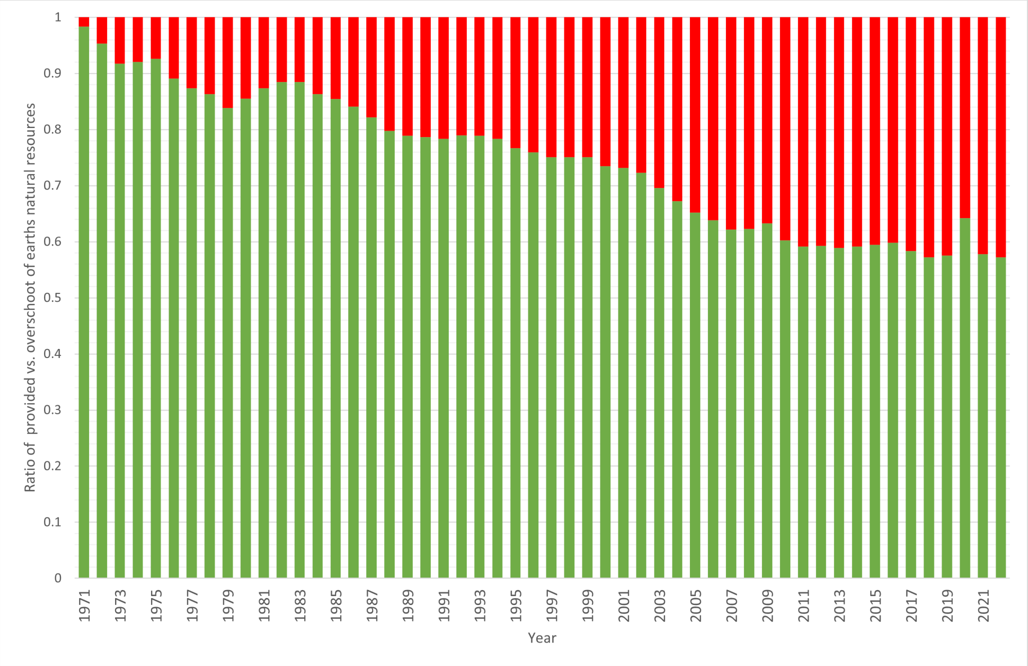


Figure 1: The evolution of Earth Overshoot Day throughout the years. The green bars represent the percentage of the year during which the Earth's annual provided resources are depleted. The red bars represent the exceeded use of the Earth's resources (Earth Overshoot Day, 2022).

2.2 Promoting sustainable diets

A sustainable diet is crucial to protect our environment. Sustainability however, encompasses both environmental and societal aspects (Reisch et al., 2013). To induce a shift towards these "Sustainable Food Systems", government policy interventions play a vital role. These interventions can be categorized into four types: (1) information-based, (2) market-based, (3) regulatory-based, and (4) nudging (Table 1). With an information-based policy interventions, an effort is made to increase individuals' awareness of specific topics. This can involve the development of food labels, general information campaigns, or advertising to reduce food waste. Market-based interventions operate at the market level and can influence both supply and demand. An example of a market-based measure is a sugar tax which may induce a reduction in sales of sugary foods. However, for these market-based interventions to be effective, price changes have to be substantial (Traill et al., 2013). Regulatory-based interventions involve introducing limits or restrictions. For instance, limiting advertising for unhealthy foods can reduce consumers' urge to consume those goods. This can thus be an effective intervention in reducing unhealthy food consumption. Additionally, Thaler & Sunstein (2008) developed a toolbox called nudging, which is nowadays also included in policy interventions. Thaler & Sunstein (2008) defined nudging as "a way to change behaviour of individuals while preserving their freedom of choice". This involves modifying the consumers decision-making environment, be it physical, social, or psychological. Nudging has already been implemented into many food and health-related policies to encourage consumers to make healthier and more sustainable choices. Three common types of nudging are distinguished being: (1) cognitively oriented interventions, (2) affectively oriented interventions, and (3) behaviourally oriented interventions (Vandenbroele et al., 2020). Information-based policies, which aims at enhancing more informed food choices, can complement these nudging approaches.

Table 1: The different types of Governmental policy interventions presented with some example. Adapted from Reisch et al. (2013).

Type of policy	Example
Information-based	Developing national organic labels
	Promoting food-waste reduction
Market-based	Increasing taxes on unhealthy foods
	Placing a tax on harmful pesticides
Regulatory-based	Limiting advertising for unhealthy foods and drinks
	Gradually reduce export subsidies
Nudging	Any products display sustainable labels on food packaging,menus in restaurants or next to the product in buffets
	Hedonic interventions trigger our senses so that products become more attractive
	Convenience enhancements

Not only local governments have the power to take action; the executive body of the European Union, the European Commission, has also introduced an initiative to address this issue. Launched in 2021, their initiative "Sustainable EU food systems" aims to establish a sustainable food system within the EU. To achieve this goal, sustainability needs to be integrated into all food-related policies. They will subjugate the member states to general principles. In addition, requirements and responsibilities for all actors in the EU food system will be set. Specifically, the European Commission will set rules regarding: (1) governance and monitoring, (2) criteria for sustainable public procurement of food, and (3) sustainability labelling of food products (Knowledge for Policy, 2023).

The information-based policies, such as the rules regarding sustainability labelling can be a powerful tool to influence consumer food purchasing behaviour. By implementing sustainability labels, consumers are empowered to make more informed choices, and counter the environmental impact of their food choices. This tool has the potential to change consumer buying behaviour significantly, as it moves beyond solely considering cost efficiency (D'Souza et al., 2006; Grunert, 2011). However, it is essential to recognize that consumers take into account a wide variety of factors in their decision-making process (Kahneman, 2013). Nevertheless, individual characteristics have to be kept in mind since these may influence the effectiveness of such interventions on oneself (De Brauw et al., 2019). Cultural background, social class, environmental factors, and other aspects can influence consumers' liking, perception, and credibility of these policies. As a result, consumer reactions towards specific policies may differ, and no uniform approach exists. To address these individual differences, a combination of policies from different pillars can be used in parallel or complement each other. However, in this study the primary focus will be sustainability food labeling as an information-based policy.

2.3 Food packaging labels

A food label is defined as "any tag, brand, mark, pictorial or other descriptive matter, written, printed, stencilled, marked, embossed or impressed on, or attached to, a food product" (FAO, n.d.). These labels convey in-formation about the products characteristics, such as its nutritional content. Labels can be present on the front, known as Front-Of-Pack (FOP) labels, and on the back, known as Back-Of-Pack (BOP) labels, of prepacked foods and beverages (Rønnow, 2020). However, as for the fact that there is not one policy intervention that is ideal, no conclusive findings regarding food labels exist (Cecchini & Warin, 2016).

Although the BOP labels provide ample information, they may result in the phenomenon of "information overload" (Jacoby, 1984). This overload can occur when other attributes of the food product have to be taken into account during the decision-making process. These attributes may include packaging, price, brand, sustainability, and nutrition information among others (Grunert et al., 2014). As a result, consumers might not be able to discern the relative importance of certain attributes, even if they initially have the willingness to do so (Jacoby, 1984).

Complementary to these BOP labels, FOP labels are designed to provide information in more simplified manner. Compared to BOP labels, FOP labels may be a more effective tool since the information is presented concisely on the front of the package, which is the first thing consumers look at. A study by Feunekes et al. (2008) found that these two characteristics of the FOP labels make them more noticeable than the regulated BOP labels. While both types of labels do not limit the consumer's freedom of choice, FOP labels have the advantage of informing consumers at a first glance when looking at a product (Coillie, 2021). For these reasons, it is primarily a tool supported by governments to increase awareness (European Commission, n.d.). Over time, this increased awareness may lead to more informed food choices (Eze et al., 2017). Nevertheless, the FOP label is not always proven to be a better tool compared to the BOP label. Compared to nutrition FOP labels, some indications show that BOP labels have a less significant effect compared to other health-related policies (Crosetto et al., 2019). However, for environmental FOP labels, there is limited literature available, and generalizations should be made with caution, as more research is needed in this area.

Most studies define FOP labels as a tool to create consumer awareness about food products' nutritional qualities of food products (Mandle et al., 2015). They serve as a tool to steer consumers toward healthier food choices (Bonsmann et al., 2020). However, it's important to note that this is not always the sole purpose of FOP labels. Apart from the multitude of FOP labels containing nutritional information, a large number of sustainability labels also exists. A FOP label should therefore be defined more generally: "trying to create consumer awareness about a certain topic by providing simplified information". In addition to creating consumer awareness, FOP labels can also exert indirect pressure organizations and food producers. It can thus be an indirect policy to change the market environment. For instance, if consumer demand for greener products increases, manufacturers may try to develop new or reformulate existing sustainable food products (Hellström, 2007). Colruyt group for example, is actively working on reducing the environmental impact of their private brands. To do so, they work closely together with their suppliers to achieve the best results (Colruyt Group, ndb). Regarding sustainability, the need for a universally implemented communication method has been addressed by the European Commission in both the 2020 Circular Economy plan and the Farm to Fork strategy (European Commission, nd..). However, no consensus has yet been agreed upon, and the debate about which approach holds the most potential is still ongoing.

2.3.1 Front-of-pack labels in Europe

Several frameworks describe all types of FOP labels on the market. However, many of these frameworks cate-gorize the labels rigidly, leaving little room for nuances (Van Kleef & Dagevos, 2015). Hamlin & McNeill (2016) developed a theoretical framework for FOP labels presenting the labels on a backbone. The FOP labels are placed on a single continuum with two ends. On the one end, FOP labels are placed that are fully reductive. On the other end of the spectrum, fully evaluative labels are placed (Hamlin & McNeill, 2016). In the be-tween these two extremes, all hybrid labels can be found, which combine characteristics of both reductive and evaluative labels. Figure 2 illustrates this theory with examples of the most common labels in the European Union. However, there is no clear evidence proving which type is the most effective. While some studies sug-gest that reductive labels are most effective (Feunekes et al., 2008), others have proven the opposite (Mandle et al., 2015).

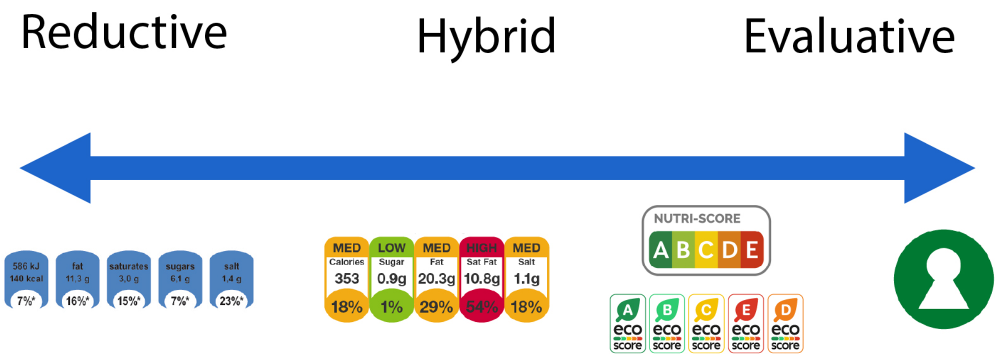

Reductive
Hybrid
Evaluative
586 kJ 140 kcal 7%*
fat 11,3 g 16%*
saturates 3,0 g 15%*
sugars 6,1 g 7%*
salt 1,4 g 23%*
MED Calories 353 18%
LOW Sugar 0.9g 1%
MED Fat 20.3g 29%
HIGH Sat Fat 10.8g 54%
MED Salt 1.1g 18%
NUTRI-SCORE
A B C D E
A eco score
B eco score
C eco score
E eco score
D eco score

Figure 2: Visualisation of the FOP label spectrum. On the left side, the fully reductive labels can be found. On the right side, the fully evaluative labels are placed. In between these two extremes, the labels are called hybrid (Hamlin & McNeill, 2016).

Reductive

“Fully” reductive FOP labels can be found at one end of the spectrum. These labels display only factual information without providing an opinion or recommendation about the food product. Consumers must use their knowledge to draw conclusions and form an opinion based on this information. The use of such labels requires cognitive processing, which may result in less effective utilization. They are also referred to as “ratio” in nature, with the information expressed in defined units with a specific zero value (Hamlin & McNeill, 2016). An example of a “fully” reductive label is the Reference Intakes label, which simplifies the representation of the BOP nutrition facts table.

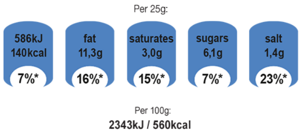
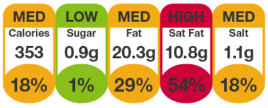
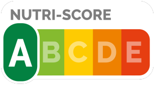
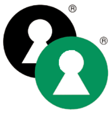
Evaluative

On the opposite end of the spectrum, there are the “fully” evaluative labels. These labels provide opinions or recommendations without presenting objective information. Consumer can use these labels directly in their decision-making process, and little to no knowledge is required. In other words, minimal cognitive processing and knowledge are needed (Hamlin & McNeill, 2016). Essentially, third-party opinions are being expressed through these evaluative labels. An example of a "fully" evaluative label is the Nordic Keyhole Reference Intakes label (Figure 2). This label merely displays if a food product is nutritionally good based on a third party decision.

Hybrid

In between these two extremes, labels are classified as hybrid labels exhibiting characteristics of both the evaluative and reductive types (Hamlin & McNeill, 2016). These hybrid labels can lean towards either the evaluative or the reductive side. One example of a label leaning more towards the evaluative extreme is the Nutri-Score. This label summarizes information into different categories, indicating how healthy a product is based on the nutrients the food contains. However, it still contains a reductive element since it only indicates if a product is (un)healthier based on its nutrients. Cognitive processing is still required, as consumers must compare products to determine their relative healthiness (Hamlin & McNeill, 2016). Another example with the same reasoning is the Eco-score. Table 2 gives an overview of the described labels in more detail.

Table 2: Examples of different types of FOP labels and what information they carry with them.

Label	Name	What
 Per 25g: 586kJ 140kcal 7%* fat 11,3g 16%* saturates 3,0g 15%* sugars 6,1g 7%* salt 1,4g 23%* Per 100g: 2343kJ / 560kcal	Reference Intakes	- Displays The Amount Of Calories, Sugar, Fat, Saturated Fat, And Salt Each Portion Of The Product Contains. - Displays How Much Each Amount Represents As A Percentage Of An Average Persons Daily Dietary Needs. - Nutrition Label
 MED Calories 353 18% LOW Sugar 0.9g 1% MED Fat 20.3g 29% HIGH Sat Fat 10.8g 54% MED Salt 1.1g 18%	Multiple Traffic Light	- Tells The Consumer By Colour Whether Food Has High, Medium, Or Low Amounts Of Calories, Fat, Saturated Fat, Sugars, And Salt. - Nutrition Label
 NUTRI-SCORE A B C D E	Nutri-Score	- It Is A Summarising Traffic-Light System With Five Levels, Each One Showing The Consumer How Nutritious A Product Is. - Nutrition Label
	Nordic Keyhole	- The Label Is On Products When, Compared To Other Foods Of The Same Type, The Products Acquired More Dietary Fiber, Less Saturated Fat, Less Salt, And/ Or Less Sugar. - Nutrition Label

2.3.2 Eco-labelling

Nowadays, FOP labels have expanded to include eco-related information. As a result, these labels are generally categorized into two groups: (1) eco-labels, and (2) eco-ratings. Both categories can also be placed on the theoretical framework of Hamlin & McNeill (2016).

Eco-labels, such as the Fairtrade and Rainforest Aliance labels, are commonly used to communicate a product's sustainability. These are examples of evaluative labels, providing a validation of the food's environmental impact. The presence of such a label indicates that a product is environmentally friendly, sustainable, and fair (GEN, 2023). However, before such eco-label is carried out, a product must meet specific criteria. If the product fails in doing so or is harmful in nature, no label will be provided (Gorissen and Weijters, 2016). Apart from this drawback, another "downside" is that these eco-labels are categorical, meaning they only represent a specific characteristic. Therefore, they limit the consumers' ability to compare products (Gorissen & Weijters, 2016). Moreover, a magnitude of evaluative eco-labels make comparing products even harder, since consumers are unaware of which label is "superior" (Coillie, 2021).

To address the shortcomings of the eco-labels, the concept of eco-ratings was introduced. These labels are a hybrid type that leans more towards the evaluative end. Unlike the categorical eco-labels, eco-ratings provide standardized scores to food products, enabling comparison (Gorissen & Weijters, 2016). This rating system therefore has the potential to increase the availability of sustainable food products (Coillie, 2021). In turn, this can simplify the process of comparison. Ultimately, if all products are provided with such a eco-rating, it could turn environmental sustainability into a common attribute (Kivetz & Simonson, 2000). The Eco-score label is such an example of an eco-rating.

2.4 Eco-score

2.4.1 Origin

What is the Eco-score?

The Eco-score, similar to the Nutri-Score, is a graded label that serves as a tool for making more sustainable food choices (Colruyt Group, n.d.). It provides consumers with straightforward information about the environmental impact of food products based on a score. The score is based on a Life Cycle Analysis (LCA) and additional indicators. Since the Eco-score is present on the front side of the package, it is classified as an FOP label. The Eco-score classifies products into five categories, each represented by different colours and characters, ranging from dark green with character A to dark red with character E. Score A corresponds to having the lowest environmental impact, while products with score E have a high environmental impact. This combination of color and characters improves the label's readability, as people unconsciously associate colors with other cues (Vandenbroele et al., 2020). In addition, the use of these categories allows consumers to compare products to make more informed food choices. Unlike the Nutri-score, the Eco-score does not highlight one score out of the five categories. Instead, it displays only the specific Eco-score class on the product (Figure 3).

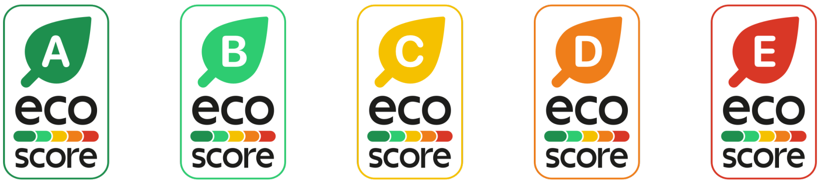


Figure 3: The five different classes of the Eco-score label how they are presented on the packaging of a food product.

Goal Eco-score

Designed in France by the collaboration of several actors like Yuka and Open Food Facts (ADEME, 2022), the Eco-score aims to present the ecological impact of specific foods to the consumer. By doing so, they aim to offer consumers a simple tool to interpret the impact of that food product on the planet. Food across the chain accounts for 28% of greenhouse gasses but also has a big impact on a lot of other areas such as biodiversity (ADEME, 2022). By calculating the ecological impact and assigning it a score out of 100, followed by classification into one of five categories, the Eco-score becomes an easy-to-interpret tool. By providing this information to consumers, retailers hope to guide them in making easier and more conscious choices regarding their purchasing behavior. This could result in an increased consumption of more eco-friendly products, thereby reducing the impact on the climate.

2.4.2 Calculation of the Eco-score

The calculation of the Eco-score is based on the LCA, which serves as a reference basis. Along with the LCA, additional indicators are also taken into account. Both components together enables a final calculation of a score out of 100 (Figure 4). The final score is obtained by adding up the values from both components.

$$\text{Eco-score} = \text{LCA} + \text{bonus} - \text{malus}$$

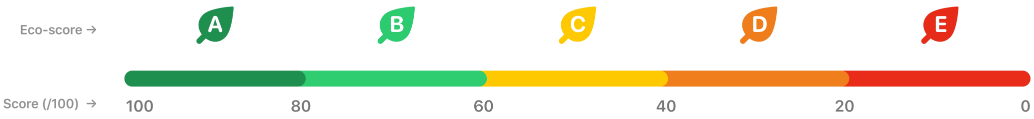


Figure 4: Eco-score formula, based on LCA and bonus-malus. The Eco-score is based on a scale from 0 to 100, on which the various scores are distributed (ADEME, 2022).

Life cycle analysis

Since the majority of a food's environmental impact occurs during the agricultural production phase, the LCA is used as a reference basis. These impacts are integrated into the Eco-score at a score of 100 (ADEME, 2022). This score reflects the production score, which is the sum of agricultural production and processing impacts. The LCA scores are calculated based on data provided by Agribalyse. The Agribalyse program is supervised by the French government and supported by ADEME, the French Environment and Energy Management Agency. LCA scores are calculated for all stages of a food product's life cycle. For this purpose, 16 indicators are taken into account Appendix A. These indicators are in turn weighted based on the significance of the environmental problems they represent. For these weightings, a method of the European commission is applied to derive a "single score".

To be able to use the LCA score within the Eco-score, standardization is necessary. The resulting single score is expressed in points per 100 grams of the finished product. A higher score indicates a higher environmental impact. One point corresponds to the average environmental impact of a European citizen over one year, and the score for a food product usually ranges between 0 and 0.004 per kilogram of the finished product (ADEME, 2022). To obtain a score per 100 grams, a conversion factor is applied.

Finally, this score must be converted to a score out of 100 to obtain the reference base. Typically, this reference base is calculated with the following normalization formula (Equation 2.1).

$$\text{Score} = 100 - \frac{\ln(10\,x + 1)}{\ln\left(2 + \dfrac{1}{100\,x^4}\right)} \cdot 20 \tag{2.1}$$

With:

x: the Single score of the concerned product, expressed in millipoints per 1 Kg

However, beverages are an exception to this formula due to their larger volume. Beverages include milk, yogurt drinks, and vegetable drinks. For soft drinks and water, no Eco-score is calculated. The standardization formula has therefore been adjusted to obtain improvements in the consistency of the classification (Equation 2.2).

$$\text{Score} = -36 \cdot \ln(100\,x + 1) + 150 \tag{2.2}$$

With:

x: the Single score of the concerned product, expressed in millipoints per 1 Kg

Additional indicators

However, the LCA alone does not encompass all environmental aspects in its calculation. Hence, additional indicators are used to complement the LCA and adjust the final score accordingly. These additional indicators can either increase or decrease the overall score, providing a more precise and comprehensive evaluation that covers a wider range of factors. It should be noted that the points for these different indicators are cumulative and can add up to a maximum additional score of 25 points (ADEME, 2022). Table 3 provides an overview of the additional indicators, what they stand for and what range of scores belong to them.

Table 3: Summary of the additional indicators and the minimal and maximal bonus-malus these can give.

Indicator	Description	Additional scores
Production system	Relates to the presence of environmental labels	[0,+20]
Seasonality	Here they look at off-season fruit and vegetable production	[-10,+5]
Environmental policies	Related to the transport and environmental practices of the country of production	[-5,+24]
Circularity of packaging	Relation to to what extent the packaging is recyclable	[-10,0]
Endangered species	Related to the survival of species	[-15,0]

These additional indicators allows for the comparison of products within the same product category. This is because the LCA scores are calculated based on the average information of a product category. As a result, two food products in the same category will have equivalent LCA scores. As a result, products from the same category cannot be compared since these have equivalent scores. However, by adding scores of additional indicators, a comparison of a product within a category becomes possible.

Production system

LCA scores on their own are not sufficient for comparing the way food is produced. However, the presence of labels indicates the environmental benefits that the production method represent. Labeled products can receive a bonus ranging from 0 to 20 points for this. It should also be noted that the bonuses given are cumulative but capped at a maximum of plus twenty. However, for recipes this principle does not apply. In cases were multiple labels are present in a recipe, a pro-rate calculation is used taking into account the amount of an ingredient that received a particular label.

Local supply

Next, it is important to note that the LCA score only takes into account the environmental impact of food production and processing, but not transportation. To address this shortcoming, a transport score is assigned to each country to encourage local sourcing. The transport score is based on the carbon impact of the route taken by the goods from their country of origin to the country of sale. Two criteria are considered to calculate the carbon impact: (1) distance between origin and destination, and (2) means of transport used.

For distance, the route is calculated for the geographical center of both countries in each case. Rail or sea routes take into account two truck journeys each time: one from the geographical center to the place of (dis)embarkation and vice versa. For countries located in Europe, the score is weighted according to the means of transport used. For countries located outside Europe, the modal mix is assumed to be 100% maritime. Using both criteria, a transport score out of one hundred is calculated, which is then converted into a bonus of up to fifteen points.

Environmental policies

This bonus-malus indicator aims to take into account the environmental policy of the producing country. This indicator is based on scores calculated using the EPI, Environmental Performance Index. This Environmental Performance Index covers a total of 180 countries, and of these, it collects 32 performance indicators which are grouped across 11 categories. The Environmental Performance Index score is then normalized on a scale from 0 to 100. Finally, this score is used to calculate the bonus-malus score. This can ultimately add up to five points more or less to the LCA score, depending on the country's environmental performance.

Circularity of the packaging

Because food packaging can have negative environmental impacts, especially when it is not recycled, an additional score is also assigned. This score aims to encourage the use of circular packaging or materials that are renewable and biodegradable. The packaging score is based on three components. The first component, the upstream score, assesses the origin of the raw materials used. A downstream score, where the different end-of-life scenarios are evaluated comprises the second component. The last component is the ratio according to the relative weight of each element. Based on these components, a packaging score is calculated on a scale of 100, which is then reduced to a malus that can go as low as -10.

Threatened species

The last indicator relates to production that poses a threat to highly endangered species. Currently, two criteria are considered: (1) depletion of fish stocks, and (2) threat to species from deforestation for palm oil cultivation.

To preserve marine species and help counteract over-fishing, the final Eco-score is strictly adhered to this indicator. A product whose total fish, crustacean, or mollusk content exceeds 30% is assessed based on two criteria: (1) the species of fish, and (2) the area where the fishing took place. If the product contains an unsustainable species, note that Eco-score E is awarded.

Where palm oil has been used in food production, a bonus-malus of -10 is applied. This is to account for biodiversity loss, as well as to promote more sustainable oil production. If a product is sustainable palm oil, i.e. Roundtable on Sustainable Palm Oil certified, this malus does not apply.

Example of the calculation of the Eco-score

To clarify the theoretical calculation of the Eco-score here is an elaboration of Tony's Chocolony milk chocolate 32% (Table 4). The unfavorable LCA already ensures a low reference score. Despite being a fair trade product, which provides a bonus score, other additional indicators further reduce the LCA score.

Table 4: Example calculation of the Eco-score. In this example the calculation is made for Tony's Chocolony milk chocolate 32%.

Life Cycle Analysis = 24/100	**Bonus-Malus = -10**
Agriculture = 84.1%	Production method = +10
Processing = 11.8%	Packaging = -15
Packaging = 1.2%	Origin:
Transport = 2.5%	Transport = 0
Verkoop = 0%	Policies = -5
Consumption = 0.4%	Biodiversity = 0
Eco-score = Life Cycle Analysis + Bonus-Malus	
Eco-score = 24/100 − 10/100 = 14/100	
Eco-score = E	

2.4.3 Use of the Eco-score in retail

In Belgium, the Colruyt Group was the first retailer to introduce the Eco-score in its product assortment. Colruyt Group envisioned that environmental impact and sustainability would become significant criteria for consumer decision-making (Veerman, 2022). In March 2021, customers of the Colruyt Group were given the chance to consult the Eco-scores of certain products in a digital way. In this first phase, the Eco-score could be accessed in specific apps using barcode scanning (Gondola, n.d.). In time, they began labelling the packaging of the house brand Boni with the Eco-score as well. At present, the Colruyt Group has already calculated the Eco-score for four out of five food and drink products (Test Aankoop, 2023). However, it is important to note that this applies to the products accessible on the app, including products that are not part of their private brands. In addition, to enhance transparency with consumers, the Colruyt Group provided the Eco-score calculations on the website of Collect & Go and the Colruyt product page (Test Aankoop, 2023). Through these efforts, they try to gain consumers' trust by being transparent with their consumers.

To promote the use of the Eco-score label, Colruyt group launched a pioneering campaign where points for the environment can be collected. For every product with Eco-score A or B, points are rewarded. Once the consumers collect one hundred points, they can exchange them to support local initiatives in favour of the environment. Due to the campaign's novelty, its effectiveness remains unknown. However, when looking at previous studies and campaigns, an expected effectiveness can be thought of. Research suggests that the most effective campaigns, from the consumers' perspective, are those offering immediate benefits. An example of this can be a price discounts. This is especially important for healthier and more sustainable food products, as price can be a major barrier for consumers (Richter, 2022; International Food Information Council, 2022). Therefore, a price discount can reduce this price barrier for the consumers. Following price-based incentives, there are suggestive campaigns, such as meal boxes or alternative product suggestions. This can be linked to convenience seeking behaviour, which ranks high in the decision-making process, but lower compared to the attribute price (Nilsson et al., 2007; Statista, 2021). On the other hand, campaigns offering longer-term or non-personal benefits, like the current Eco-score campaign, are expected to be least effective. It should be noted, however, that these outcomes may differ between participants, who all value other attributes in a different way.

Apart from Colruyt Group, other supermarket chains, Lidl and Carrefour, have also started with the usage of the Eco-score. Lidl did so on the 2nd of August 2021, in a pilot phase (Lidl België, 2021). Before expanding its implementation, Lidl wants to gain insights into consumers' and manufacturers' perception of the FOP label (Lidl België, 2021). Also, Carrefour announced in August 2021 that they were going to roll out the Eco-score, foremost on 1,500 products, on the website only (Gondola, n.d.). However, both stores are still in the experimental phase, and the future rollout is still subject to change.

Test Aankoop is critical of the Eco-score label and whether it is an effective tool for consumers. While acknowledging that it represents a step in the right direction towards achieving a sustainable food system, Test Aankoop raises doubts about certain aspects of the label's implementation. For instance, Colruyt Group is currently solely attempting to fully implement the Eco-score. This makes comparing products between su-permarkets difficult (Test Aankoop, 2023). On top of that, the French database does not provide an integral reflection of reality. Therefore corrections have to be made with the bonus-malus system. However, these corrections significantly impact the total score. In instances where a supplier is not transparent about certain information, a worst-case scenario is assumed. This creates unclear and misleading information for consumers, who think a product has a high environmental impact (Test Aankoop, 2023).

2.4.4 Earlier and future research

Despite multiple studies showing that consumers are more concerned about the environment, a study by Thøgersen (2021) has found that this does not translate into more sustainable eating habits. Yet, BEUC (n.d.) indicates that around two-thirds of consumers are willing to change. One of the biggest barriers indicated was a lack of information. This is where Eco-Labels, such as the Eco-score, can play a vital role.

Studies have shown that people are more environmentally conscious nowadays, with approximately four out of five people having some knowledge about the environment (Food Dive, 2021; Hartmann et al., 2021). However, this knowledge often pertains the product in general, overlooking other elements such as packaging or way of transport. As a result, this environmental consciousness may not necessarily translate into more sustainable eating habits. A study from BEUC (nd) highlights that even though people are aware of the impact of food habits in general, they struggle to estimate the environmental impact of their own food habits. Nevertheless, the study found a willingness to change among around two-thirds of consumers, with a lack of information being one of the biggest barriers to actually do so. Another study by Arrazat et al. (2023) reinforces the significance of information in influencing consumer behavior. Their research found that the traffic-light FOP environmental labels resulted in a lower environmental impact of everyday meals purchased. However, this study only took into account the FOP environmental labels, without taking considering price, or nutritional factors.

Regarding the evaluation of the Nutri-score label, several studies have already proven that the label is easily understood, whilst it is also one of the most preferred FOP nutrition labels. Because of these factors, an improved evaluative capacity due to the Eco-score label might be possible. However, these studies were conducted in an environment where only the Nutri-score was shown, without the inclusion of environmental FOP labels. Only one study was found, where they used the Nutri-score in combination with the Eco-score label (Dijk et al., 2021). This study found that the average shopping basket had a higher nutritional quality, but no difference in environmental impact. Lastly, studies have found that more nutritious foods tend to have a lower environmental impact, and this is also what consumers expect (Kreier, 2022; McKinsey Company, 2022).

To date, research on the Eco-score label is limited. A study by De Bauw et al. (2022) provided some evidence regarding a dual Eco-score/Nutri-score label. This study examined whether the presence of these labels steers consumers towards more nutritious and environmentally friendly food choices. However, it is not yet examined whether the presence of the Eco-score label alone enhances people's evaluative capacity. In addition, it is unknown if trade-offs between both labels occur. Apart from the study by De Bauw et al. (2022), no data is available on consumers' reactions toward the Eco-score label.

When examining Eco-labels in general, numerous studies have been conducted over the years. According to a systematic review and meta-analysis by Bastounis et al. (2021), participants were willing to pay an additional 3.79 Purchasing Power Parity Dollars/ kg for products with an Eco-label. This willingness to pay was found to be higher for organic labels and among individuals with lower levels of education, as well as among women. In a Malaysian context, it was found that multiple factors such as attitude, perceived behavioural control, as well as subjective norms mediate the association between environmental concern and the intention to purchase Eco-labeled food products (Alam et al., 2023). This highlights the importance of environmental education in promoting environmentally conscious buying behaviour (Alam et al., 2023). Regarding reactions towards Eco-labels, a study on the MSC label was conducted in Denmark, after it was only then recently implemented. Here only a limited number of people had seen the label, and an even smaller proportion took the label into consideration (Thøgersen et al., 2010). When talking about novel labels, this is consistent with the expectation that such labels are only adopted amongst the "early adopters". In that study, the adaptation of the MSC label was examined, which constitutes of a whole process, and not one event. This process is influenced by ones individual's knowledge, credibility, liking, and attitude (Thøgersen et al., 2010).

It can thus be concluded that lot of factors can influence the use of an Eco-label. As the Eco-score label is relatively new, it is essential to examine current consumers' reactions towards it. Therefore, the primary aim of this study will be to assess current consumers' reactions towards the Eco-score label. It will be examined what the effectiveness of the label is. Additionally, this study will explore familiarity, current use, and perceptions of the Eco-score. Finally, the study will research the reactions toward specific marketing initiatives. By doing so, recommendations may be made on how to enhance the Eco-score labels' use and effectiveness.

3 Study Objective

The objective of this study is to research current consumers' reactions toward the Eco-score label. To reach this objective, reactions will be measured on multiple levels. First, their evaluative capacity regarding environmental impact is tested and how the presence of the Eco-score affects this evaluation. Additionally, reactions toward the label itself will be measured after which it will be analysed what factors influence the intention to use the Eco-score. Finally, it will be examined what consumer awareness and perceived effectiveness are of marketing campaigns concerning the Eco-score.

In this study, apart from the Eco-score label, the Nutri-score label is also used in the case of the product evaluation exercise and marketing campaigns. By doing a Eco-score/Nutri-score combination, potential trade-offs with regards to the evaluation exercise can be examined. For the marketing campaigns, this approach will enable the investigation of differences between both labels.

3.1 Research questions and hypotheses

1. Do consumers evaluate the environmental impact of food products more correctly when the Eco-score label is used in comparison to the absence of the labels? Additionally, does evaluation accuracy increase among those that have (subjective) knowledge and those who value sustainability?

   Hypothesis 1: *Consumers perceive most products as environmentally less harmful than they actually are when the Eco-score is not shown. When the label is shown, people will be able to evaluate the environmental impact of food products more correctly. This evaluation may be more correct for consumers that value and have knowledge about the environment.*

2. What are familiarity, current use, and reactions towards the Eco-Score label?

   - What is the familiarity and current use?

     Hypothesis 2.1: *The familiarity and current use of the Eco-Score label is expected to be very low.*

   - What are the current reactions regarding credibility, usefulness, understandibility, and knowledge?

     Hypothesis 2.2: *Since the label is a quite new tool in the market, and not yet now among consumers, reactions are expected to be neutral.*

- What are the intention to use the Eco-score label during food shopping, and what factors influence this?

  Hypothesis 2.3: *Since people's environmental awareness has increased over the years, it is expected that intentions are moderate. Factors that could increase the intention are knowledge, a positive environmental attitude, but also a good perception of the Eco-score.*

3. What are awareness and perceived effectiveness of marketing campaigns regarding the Eco- and Nutri-score?

   - What is the awareness of different Eco- and Nutri-score campaigns, and are there differences in awareness?

     Hypothesis 3.1: *It is expected that most of the participants are not aware of the social marketing campaigns that are currently present for the Eco-score. However, for the Nutri-Score there will be a higher awareness of campaigns, but also of participation.*

   - What is the perceived effectiveness of different Eco- and Nutri-score marketing campaigns? Also, are there differences in this perceived awareness between both labels?

     Hypothesis 3.2: *No differences between the Eco- and Nutri-score campaigns are expected to be found. However, in general, the most effective campaigns according to consumers are presumed to be the ones where there is an immediate benefit such as price discounts. These campaigns will be followed by, the suggestive campaigns, like the meal boxes or alternative suggestions. The least effective campaigns to be selected are the ones where there are longer-term benefits or non-personal benefits.*

4 Methodology

To examine and answer the set research questions, data for this study was collected by the means of an online survey. Initially, the survey was drafted in English on word. The survey was revised multiple times by researchers at the University of Ghent, after which it was submitted for an ethics approval on the 8Th of February 2023. On the 8Th of March 2023, an ethics approval (ONZ-2023-0058) was granted (Appendix B). Following the approval, the survey was translated into French and Dutch, where-after it was revised by native speakers. Lastly, the survey was tested several times among colleagues, friends, and family regarding understandability, length and terminology. The study was financed by the department of Agricultural Economics, and data collection was done by the marketing agency Pureprofile between the May 2, 2023, and May 18, 2023.

4.1 Sample size calculation and data collection

To determine the required sample size needed for this study, two distinct calculations were performed. A first one, was the sample size calculation that would enable us to compare proportions. This number had to be calculated since the questionnaire contained an evaluative exercise, in which the Eco-score was present or absent (Equation 4.1). This resulted in a minimum required sample size of 11 people per treatment.

$$\begin{aligned}
\text{n} &= D \cdot \left(\frac{(Z_\alpha + Z_\beta)^2 \cdot (P_1(1-P_1) + P_2(1-P_2))}{(P_2 - P_1)^2} \right) \\
&= 2 \cdot \left(\frac{(1.96 + 0.84)^2 \cdot (0.3 \cdot 0.7 + 0.85 \cdot 0.15)}{(0.85 - 0.3)^2} \right)
\end{aligned} \tag{4.1}$$

With:

D:	Design effect
$Z\alpha$:	Critical value for a desired confidence level
$Z\beta$:	Critical value for a desired power
P_1:	Proportion of outcome in control group
P_2:	Proportion of outcome in exposed group
n:	Sample size

The second sample size calculation aimed to ensure the generalizability of the study results to the entire population. In this regard, the population size, existing of 11 584 008 people, in Belgium was considered (Statbel, 2022), leading to a minimum sample size of 385 people (Equation 4.2).

$$\begin{aligned} \text{n} &= \frac{\dfrac{z^2 \cdot p(1-p)}{e^2}}{1+\left(\dfrac{z^2 \cdot p(1-p)}{e^2 N}\right)} \\ &= \frac{\dfrac{1.96^2 \cdot 0.5(1-0.5)}{0.05^2}}{1+\left(\dfrac{1.96^2 \cdot 0.05(1-0.05)}{0.05^2 \cdot 11584008}\right)} \end{aligned} \tag{4.2}$$

With:

z: z-score
p: Expected prevalence
e: Margin of error
N: Population size
n: Sample size

In summary, when looking at both calculations, a minimum sample size of 385 people is required. However, for this study we opted for a sample size of 600 people. With this sample size, each Eco-score/Nutri-score combination for both conditions will have been evaluated 60 times, taking into account 600 participants each evaluate five products (Equation 4.3).

$$\begin{aligned} \text{Number of evaluations per product} &= \frac{\text{n} \cdot \text{Number of products to evaluate}}{\text{Number of groups} \cdot \text{Total number of products}} \\ &= \frac{600 \cdot 5}{2 \cdot 25} \end{aligned} \tag{4.3}$$

With:

n: Sample size

For the collection of the data, the market research agency Pureprofile was involved. A probabilistic sampling method was employed for data collection. and Collection of the data took place from May 2, 2023 until May 18, 2023. To get a representative sample for the Belgian population, quotas were used. These quotas were based on specific characteristics, including the province in which participants resided, gender, and age class.

4.2 Theoretical framework

In this study, the intention to use the Eco-score label is investigated by adopting the hierarchy of effects of eco-labels as theoretical framework (Grunert, 2011). First, the theoretical framework will first be thoroughly discussed. Subsequently, a modified version of the this framework will be briefly discussed, tailored to the specific requirements of this study and the Eco-score label.

4.2.1 Hierarchy of effects of eco-labels

To encourage people to increase their sustainable purchasing behavior, mere exposure to an eco-label is insufficient. A whole set of influencing factors must also come into play to potentially shape sustainable behaviour. When consumers encounter an eco-label, a step wise process follows. First, consumers have to be exposed to the label. Then, consumers also need to perceive it, attach some form of understanding to it, and decide what meaning they attach to the label. All these factors are part of the decision-making process. In turn, this entire process, along with its various factors, is affected by the consumers' awareness and perceived credibility. Additionally, does overall motivation and liking of an eco-label also influence the motivation to choose more sustainable products at the time of purchase (Grunert, 2011).

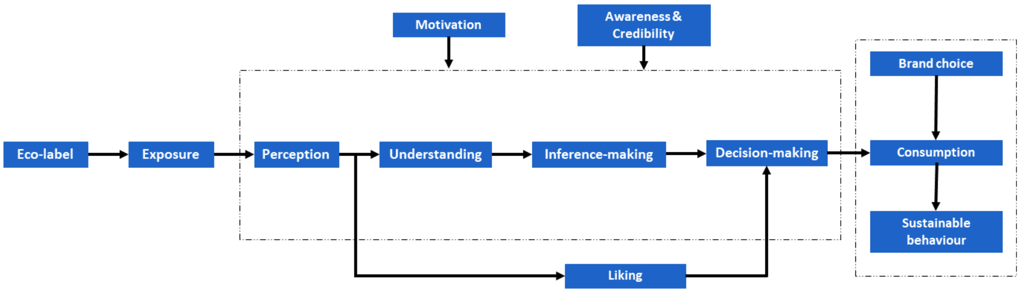


Figure 5: Visualisation of the hierarchy of effects of eco-labels theoretical framework (Grunert, 2011).

It should be noted, however, that this eco-label framework is already an adaptation of the classical hierarchy of effects model (Egan, 2007). According to this classical model, consumer behaviour comprises three stages. The initial stage is the cognitive stage, wherein awareness and knowledge play important roles. This stage then influences the affective stage, i.e. liking, preference, and conviction. In the end, this affects the behavioral stage where the eventual purchase is made (Egan, 2007). In a retail environment, when an eco-label is displayed on products, people are exposed to it. However, exposure does not necessary lead for people to perceive the label. Some consumers may fail to notice the label due to different reasons such as time pressure or purchasing habits (Grunert, 2011). Nevertheless, most people do look at the front of the product, which presents an opportunity for them to perceive the eco-label information. Once consumers perceive the label, two paths may be followed. One path is peripheral processing, where liking plays an important role. In this case, consumers may form a positive attitude towards the label without making an effort to understand the label (Grunert, 2011; Juhl and Poulsen, 2002). the second path involves consumers who perceive the label and possess knowledge about it. These consumers will try to understand the label as such. However, even with this effort, they may drawn incorrect inferences. This means that even when consumers try to understand the eco-label, this does not necessarily imply that the meaning they attach to it is correct. Ultimately, the decision-making phase brings together liking and inference-making. In this phase, trade-offs are made between different criteria, made in the mind of the consumer (Grunert, 2011).

Awareness and credibility are also important, especially for consumers with a positive attitude towards sustainability (Grunert, 2011). Consumers who are willing to make sustainable choices may face challenges in implementing them practically, and thus, awareness of sustainable products becomes crucial. This is where eco-labels play a crucial role. They provide information about the sustainability of a specific product. For an eco-label to be effective, they have to be credible. However, a label cannot be seen as credible among consumers if they are familiar with the label (Grunert, 2011). A study by Thøgersen (2002) highlights the importance of awareness and credibility in correlating intentions with actual behaviour.

Lastly, a lack of motivation at the time of choice can also have an important influence on the intention to use an eco-label. Despite having a positive attitude towards sustainability, this attitude may not always be strong enough to influence behavior in every situation (Grunert, 2011). Consumers may "forget" about their positive attitude towards sustainability when making food choices.

4.2.2 Adapted hierarchy of effects framework

In this adapted framework, additional factors specific to the Eco-score label were included to the hierarchy of effects of eco-labels model. Figure 6 illustrates this adapted framework, which takes into account the objectives of this study. Some factors were added, while others were excluded to ensure relevance to the study's goals.

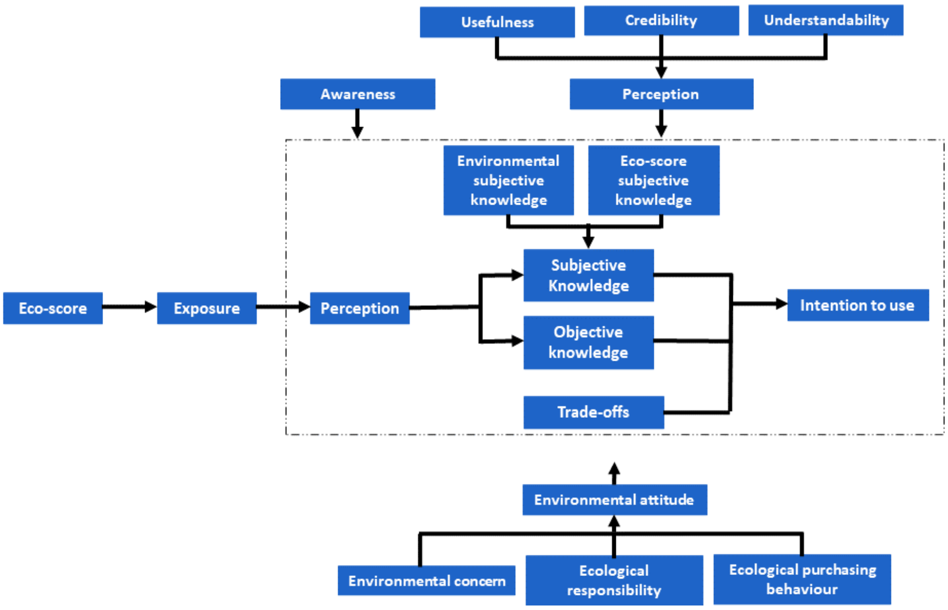

Usefulness
Credibility
Understandability
Awareness
Perception
Environmental subjective knowledge
Eco-score subjective knowledge
Subjective Knowledge
Eco-score
Exposure
Perception
Objective knowledge
Intention to use
Trade-offs
Environmental attitude
Environmental concern
Ecological responsibility
Ecological purchasing behaviour

Figure 6: Visualisation of the hierarchy of effects of the Eco-score theoretical framework, adjusted for this study. Adapted from Grunert (2011).

In essence, this adapted framework closely resembles the original one. However, the focus now lies on sustainable buying behaviour set in motion specifically by the Eco-score label. The replacement of certain variables aims to make them more tailored and relevant to this study. The newly introduced variables have been identified as factors that can influence ecological purchasing behaviour. However, it is worth noting that while most studies focus on purchasing behavior, this study centers on purchasing intention. In this study, the focus will be on purchasing intention as the study will be conducted via a questionnaire which does simulate a real-life situation. Additionally, since the Eco-score label is not yet a broadly enrolled FOP label, studying its actual use is challenging. However, existing evidence suggests that behavioural intention influences actual behaviour, implying that the variables influencing intention might also influence actual behavior (Van der Stricht, 2020).

Initially, a general variable “Perception” was constructed consisting of “Usefulness”, “Understandability”, and “Credibility”. The addition of “Usefulness” as a new variable was based on findings from several studies indicating that a high perceived usefulness impacts the intention to use labels (Ma et al., 2017; Obayashi et al., 2003). High perceived usefulness may thus result in a higher intention to use the Eco-score label. The variable “Credibility” was already present in the original framework, and is only relocated. Lastly, also “Understandability” regarding the Eco-score label is added, as it is likely to influence its usage. If consumers understand the Eco-score the likelihood of its use increases (Giró-Candanedo et al., 2022).

In a study by Ma et al. (2017), it was also found that a positive attitude towards sustainability labels increases the intention to use them. For this reason, an “Environmental attitude” was added. This construct was divided into three different variables: (1) “Environmental concern”, (2) “Ecological responsibility”, and (3) “Ecological purchasing behaviour” (Dunlap et al., 2000; Kim & Choi, 2005; Stern et al., 2010).

Next, the concept of knowledge has been added, comprising two components: (1) “Subjective knowledge”, and (2) “Objective knowledge”. Research has shown that both general environmental knowledge and eco-label knowledge have a positive influence on consumer attitudes. This leads consumers towards more ecologically conscious consumer behavior (Taufique et al., 2016). Hence, “Subjective knowledge” will refer to an individuals’ self-assessed knowledge of the Eco-score as well as the environment. “Subjective knowledge” is complemented with the “Objective knowledge”, which measures their actual knowledge of the Eco-score label. Due to this combination, inference-making can be mapped as well.

In the original framework, a trade-off component was included under the “Decision-making” variable (Grunert, 2011). The reason for separating this variable is because it is crucial point for the actual intention to use the label. A study by Blend and Van Ravenswaay (1999) has shown that price is probably the most important trade-off. However, there is limited understanding about trade-offs between sustainability and other quality aspects compared to those with price (D’Souza et al., 2006).

Next, the liking component was omitted from the framework. The reason for this is due to the fact that in this study, the focus is on non-peripheral processing. Additionally, since the familiarity of the Eco-score is expected to be low, their opinions are not anticipated to be strongly influenced.

Lastly, socio-demographic factors, were added to this framework as covariates. Examples of these factors are age, education, gender, employment, and household income. In case of employment, one study suggests that part-time employment, housewife or student activities have the highest inclination toward eco-labelling attention. The reason for this could be the fact that those groups have most time not occupied by work compared to others. In terms of education, less attention is given to eco-labelled products when an individual has a lower education (Papastefanou, 2001). However, this study only talks about attention given to the label, and not intention to use it. With regards to age, studies have found that younger individuals are more sensitive to environmental issues, thus effecting ecological purchasing behaviour (Straughan and Roberts, 1999). It is important to recognize that the age variable influences the entire decision-making process, and not solely the final intention to use the label.

4.3 Questionnaire design

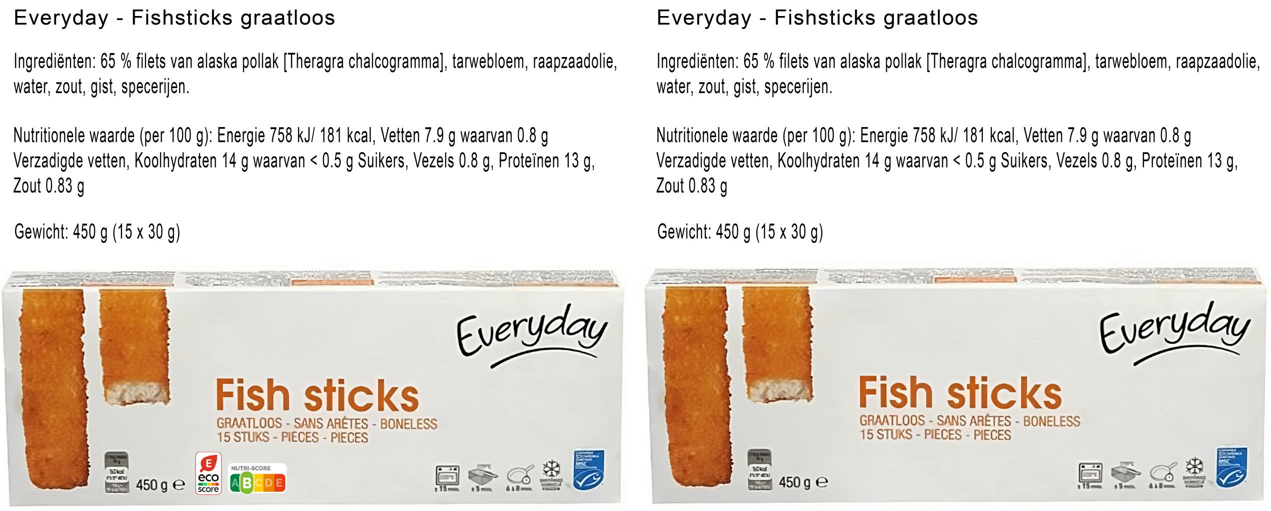
The survey itself can be found in Appendix C. First, participants were presented an informed consent, which they had to agree to before being able to proceed. After accepting the informed consent, participants were required to complete a screening block. Here four questions were asked regarding gender, age, region of living and responsibility of food shopping (Van der Stricht, 2020). To be eligible for participation, participants had to be at least 18 years old and maximum 75 years old. Regarding the responsibility of food shopping, the survey was immediately ended when "I am not responsible for any of the food shopping" was selected.

4.3.1 Product Evaluation

In the first block, participants had the task to evaluate specific food products. This evaluation exercise was done by assigning the participants to two different groups by the means of a case-control design. The difference between both groups lied in the fact that the "Condition" group would get to see both the Nutri- and Eco-score, while the "Control" group would not Figure 7. Both groups, however, would get to see the product, product name, nutritional value, ingredients, and volume, content or weight. Each participant got to see five randomly appointed products based on their condition, out of a whole product-set. In total, the item-set existed out of twenty-five products in each condition. The products were based on all different combinations of the Eco- and Nutri-score, going from A to E, which resulted in a total of 5x5 combinations. By doing this, variability in nutritional quality and environmental impact was covered. Table 5 gives an overview of the twenty-five selected products. Of the presented products, an evaluation with regards to its nutritional value was done. Scores from one to five had to be given, going from "Very poor" to "Very good". The same had to be done for the environmental impact, with a one to five scale from "Very low" to "Very high". Also general evaluation was examined on a one-to five scale ranging from "Very bad" to "Excellent". At the end of the exercise, it was assessed which information participants used to evaluate the products they had just evaluated.

Product selection was done, based on two conditions. The first condition required that the product had to be available in that specific Nutri-score/Eco-score combination. As for the second condition, the food items had to be representative for the Belgian population. Meaning all products had to be well known among the majority of the Belgian population.

Selection of the products was conducted via RStudio version 2023.03.0.. Data on available products was acquired by web scraping using a self-written script. The script was written in Python, which autonomously scraped the Colruyt product page. After collecting the data, it was stored and imported into R for necessary manipulations. Subsequently, the products were carefully selected via the data-set, after which they were verified by checking the Colruyt product page.


Everyday - Fishsticks graatloos

Ingrediënten: 65 % filets van alaska pollak [Theragra chalcogramma], tarwebloem, raapzaadolie, water, zout, gist, specerijen.

Nutritionele waarde (per 100 g): Energie 758 kJ/ 181 kcal, Vetten 7.9 g waarvan 0.8 g Verzadigde vetten, Koolhydraten 14 g waarvan < 0.5 g Suikers, Vezels 0.8 g, Proteïnen 13 g, Zout 0.83 g

Gewicht: 450 g (15 x 30 g)

Everyday - Fishsticks graatloos

Ingrediënten: 65 % filets van alaska pollak [Theragra chalcogramma], tarwebloem, raapzaadolie, water, zout, gist, specerijen.

Nutritionele waarde (per 100 g): Energie 758 kJ/ 181 kcal, Vetten 7.9 g waarvan 0.8 g Verzadigde vetten, Koolhydraten 14 g waarvan < 0.5 g Suikers, Vezels 0.8 g, Proteïnen 13 g, Zout 0.83 g

Gewicht: 450 g (15 x 30 g)

Everyday
Fish sticks
GRAATLOOS - SANS ARÊTES - BONELESS
15 STUKS - PIECES - PIECES
450 g ℮
E eco score
NUTRI-SCORE A B C D E
Everyday
Fish sticks
GRAATLOOS - SANS ARÊTES - BONELESS
15 STUKS - PIECES - PIECES
450 g ℮

Figure 7: Example of product for both the Condition group (left) and Control group (right). The product, product name, its nutritional value, ingredients, content, and in this case the labels are shown.

Table 5: Overview of all 25 products used for the evaluation exercise.

	Nutri-Score				
Eco-score	**A**	**B**	**C**	**D**	**E**
A	Soubry - Whole wheat spaghetti	Squared white bread - Daily fresh	Pur Natur - Vanilla yogurt	IJsboerke - Vanilla ice cream	Boni Bio Liege waffles
B	Boni - Semi-skimmed milk	Multigrain bread Light daily fresh	Bertoli - Basil pasta sauce	Pur Natur Strawberry jam	Everyday - Vanilla ice creams covered in milk chocolate
C	Barilla Lasagne	Boni Bio - Belgian free-range eggs	Boni Bio Orange juice	Everyday - Mayonnaise with eggs	Boni - Hazelnut spread
D	Boni - Belgian free-range eggs	Everyday - Lasagne Bolognese	Coricelli - Olive oil	Everyday - Cheese gouda young slices	Boni - Salami with garlic
E	Boni - Atlantic salmon fillet boneless	Everyday - Fish sticks boneless	Boni - Orange juice with pulp	Chipolata - Pork	Everyday Milk chocolate

4.3.2 Food-related attitude and subjective knowledge

In the following block of questions, participants were asked about their food-related attitude and subjective knowledge. First, they were asked to rank specific factors, according to their viewpoint, from least to most important when making food purchases. This was done through a ranking exercise where seven different factors had to be dragged and dropped into the consumers' preferred order. Different factors could be ranked equally important, getting the same score. All factors were adapted from a study on food choice motives (Verain et al., 2021).

After the ranking exercise, participants were asked to give their opinions on a total of thirteen statements, designed to assess three different concepts. The first concept one was "Environmental concern", which comprised four statements (e.g. "If things continue on their present course, we will soon experience a major ecological catastrophe"). The second concept assessed the "Ecological responsibility" which contained four statements (e.g. "I can learn how to improve the environment"). The last concept assessed "Ecological purchasing behaviour" which contained five statements (e.g. "I have avoided buying a product because it had potentially harmful environmental effects"). All of these statements were selected carefully based on previous research, in which they had shown internal validity (Dunlap et al., 2000; Stern et al., 2010). The statements regarding "Ecological purchasing behaviour" were adapted from Chen et al. (2022). Participants rated all statements on a 5-point Likert scale, ranging from "Strongly disagree" (1) to "Strongly agree" (5).

The next question asked participants to rate their subjective knowledge compared to others in four subjects: (1) environmental welfare, (2) Eco-score, (3) nutritional health, and (4) Nutri-Score.

At the end of this block, opinions were gathered on how the ecological footprints or environmental friendliness differs between types of brands or products in general. Four options were presented based on the combination of the variables: (1) organic or non-organic products, and (2) multinational or supermarket owned brands. Participants were asked to assign scores ranging from one to four, with one indicating "Most environmentally friendly" and four indicating "Least environmentally friendly".

4.3.3 The Eco-score label

Familiarity, current use and objective knowledge

To examine the familiarity, current use and objective knowledge of the participants regarding the Eco-score label, first an image of the Eco-score label was presented (Figure 8). By showing this image, it was clarified what the Eco-score looks like, and confusion about the label was minimized.

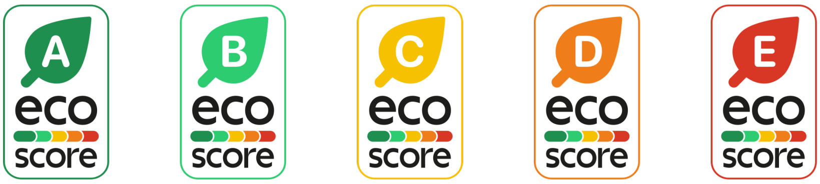


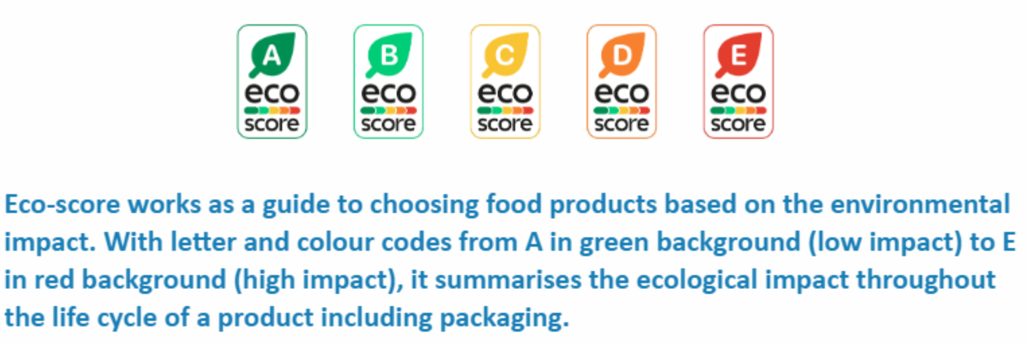
Figure 8: The way information about the Eco-score is provided, before the start of questions regarding the Eco-score label.

After giving a brief explanation of the Eco-score label, participant's familiarity and current use were assessed. First, it was checked whether participants had already seen and/or heard about the Eco-score label, and how frequently they use it. Subsequently, their objective knowledge regarding the Eco-score label was assessed. For this, six true/false statements, with an additional “I don’t know” option where presented (e.g. “Products that are packed in glass will always have a better Eco-score compared to similar products that are packed in plastic”).

Perception

To give the participants a better understanding of the Eco-score label, an explanation was provided along with the five different categories Figure 9. Following this, the participants’ perception of the Eco-score was assessed by presenting nine statements related to “Credibility”, “usefulness”, and “understandability”. All statements were presented in a random order. For “Credibility” three statements were given (e.g. “The Eco-score labels are audited with transparent environmental information”).

Also for “usefulness” three statements were presented (e.g. “The Eco-score label is not useful”). The same counted for “understandability” (e.g. “It is difficult to understand the Eco-score”). A 5-point Likert scale was used to evaluate these statements this. All statements in this question were adapted from a studly by Hung and Verbeke (2019).



Eco-score works as a guide to choosing food products based on the environmental impact. With letter and colour codes from A in green background (low impact) to E in red background (high impact), it summarises the ecological impact throughout the life cycle of a product including packaging.

Figure 9: The way information about the Eco-score is provided, before the start of questions regarding the Eco-score label.

4.3.4 Social Marketing initiatives

The following two blocks were about marketing initiatives regarding the Eco-score and Nutri-score. For both labels, various existing and non-existing initiatives were shown. Participants had to indicate whether or not they already heard about the initiatives, and if they participated accordingly. Next, the participants had to indicate, according to their point of view, which three initiatives would be most effective in promoting ecological-friendly food and promoting healthier food consumption. Before the start of the Nutri-score initiatives block, a brief explanation and visualisation of the Nutri-score label was given.

4.3.5 Socio-demographic and financial characteristics

In the final block, socio-demographic data and the participants' financial situation were collected. Participants were asked questions about the retailers from which they typically purchase their food, their level of education, and their current employment situation. Regarding the participants' financial situation, their current nett household income was asked.

4.4 Data analysis

4.4.1 Pre-analytic data cleansing, recoding, and variable creation

Statistical analyses were performed using R version 4.0.3. Data was collected in a csv format, after which the pre-analytic data manipulation was carried out. Only participants who completed all questions were included in the final data-set. As the survey was conducted in two languages, both with the same questions and answer possibilities, both data-sets could be combined.

Next, the data was recoded. All product evaluations regarding the Eco-score label were combined into one variable. A score of one was appointed for every question the participants answered correctly. A zero was appointed when the statement was answered incorrect or if “I don't know” was selected. The variable “Total score” was than created to obtain an overall objective knowledge score for each participant.

To be able to compare the product evaluation exercise between the two conditions, the variable “Condition” was added. Every participant that evaluated the products seeing the label, got appointed the level “Label”, while all other were appointed the “Control” level.

Following, in order to compare the two groups, the evaluation of the products had to be recoded. For this, the variable “Correctness” was added, where the number 1 was appointed when a product evaluation similar to the Eco- or Nutri-score, otherwise the number 0 was appointed. To enable the appointment of scores, the actual Nutri- and Eco-scores had to be converted to a 5-point scale (Table 6). All Nutri-scores were converted from A, B, C, D, E to “Very poor nutritional value” (1) up to “Excellent nutritional value” (5) respectively. The same was done for the Eco-scores, were all score A was converted to “Low environmental impact” (1) up to E,“High environmental impact” (5).

Table 6: Values for the Eco- and Nutri-score used in this study.

	Product	Eco-score	Nutri-score
Eco A	Soubry - Whole wheat spaghetti	1	5
	White bread - Squared fresh	1	4
	Pur Natur - Vanilla yogurt	1	3
	IJsboerke - Vanilla ice cream	1	2
	Boni Bio - Liege waffles	1	1
Eco B	Boni - Semi-skimmed milk	2	5
	Multigrain bread - Light daily fresh	2	4
	Bertolli - Basil pasta sauce	2	3
	Pur Natur - Strawberry jam	2	2
	Everyday - Vanilla ice cream covered in milk chocolate	2	1
Eco C	Barilla - Lasagna	3	5
	Boni Bio - Belgian free-range eggs	3	4
	Boni Bio - Orange juice	3	3
	Everyday - Mayonnaise with eggs	3	2
	Boni - Hazelnut spread	3	1
Eco D	Boni - Belgian free-range eggs	4	5
	Everyday - Lasagne bolognese	4	4
	Coricelli - Olive oil	4	3
	Everyday - Cheese gouda young slices	4	2
	Boni - Salami with garlic	4	1
Eco E	Boni - Atlantic salmon fillet boneless	5	5
	Everyday - Fish sticks boneless	5	4
	Boni - Orange juice with pulp	5	3
	Chipolata - Pig	5	2
	Everyday - Milk chocolate	5	1

4.4.2 Statistical data-analysis

For the statistical analysis, result were considered as significant when the p-values of the output were lower than or equal to 0.05.

Internal reliability

To gain a first insight into the various statements used and the factors they represent, the internal reliability of each statement was examined. To assess this, Cronbachs alpha was calculated for each factor separately. Any value above 0.7 was considered acceptable, indicating that the statements could be used together to represent the same factor (Bell et al., 2022). In the case of the three factors measuring environmental attitude, all Cronbachs alpha values were above 0.7. However, for the statements related to the perception of the Eco-score, no internal reliability was found for any of the factors (Table 7). Therefore, these factors cannot be separately utilized to construct mean scores, and for exploratory factor analysis (EFA) it is not optimal.

Table 7: Results of internal reliability analysis concerning different constructs based on Cronbachs alpha (n = 607).

	Cronbachs alpha (α)
Environmental concern	0.77
Ecological responsibility	0.76
Ecological purchasing behaviour	0.87
Credibility of Eco-score	0.58
Usefulness of Eco-score	0.59
Understandability of Eco-score	0.53

Exploratory factor analysis

To obtain an aggregated score of the different statements and to limit the number of predictor variables in the analysis, EFA was conducted. EFA were performed for the variables related to environmental attitude, as well as for the variables pertaining to perception of the Eco-score. As indicated in Table 7, since the three variables measuring environmental attitude demonstrated internal reliability, conducting separate EFA for each variable was favorable. On the contrary, for the variables related to perception of the Eco-score, this approach was not appropriate. Instead, an EFA was carried out on all statements collectively, resulting in the creation of new variables (Table 8).

Before interpreting the EFAs, three tests were conducted to verify specific assumption. The Kaiser-Meyer-Olkin (KMO) measure was employed of which no individual KMO value was less than 0.7 (Shrestha, 2021) Additionally, Bartlett's Test of Sphericity were used, which yielded significant results. Apart from that, to cross-loadings were checked and all were below 0.4 (Hair, 2010).

Table 8: Statements used for the EFA for both existing and newly created variables (n=607). For all constructs, their factor loading, Cronbach alpha and extracted variance can be found.

Variable and statements	Factors loading	Cronbach's alpha	Extracted Variance
Environmental concern		0.77	0.47
If things continue on their present course, we will soon experience a major ecological catastrophe	0.70		
Humans are severely abusing the environment	0.77		
The balance of nature is very delicate and easily upset	0.73		
Despite our special abilities, humans are still subject to the laws of nature	0.53		
Ecological responsibility		0.76	0.45
I have the power to protect the environment	0.56		
I will work to make my surrounding environment a better place	0.58		
I can learn how to improve the environment	0.72		
My actions impact the health of the environment	0.78		

Variable and statements	Factors loading	Cronbach's alpha	Extracted Variance
Ecological purchasing behaviour		0.87	0.57
I have switched products for ecological reasons	0.67		
When I have a choice between two equal products, I purchase the one less harmful to other people and the environment	0.71		
I make a special effort to buy products that are packaged with recycled materials	0.80		
I make a special effort to buy products that are environmentally friendly	0.80		
I have avoided buying a product because it had potentially harmful environmental effects	0.77		
Credibility of the Eco-score		0.85	0.29
I can make more environmental-friendly food choice by using the Eco-score label	0.75		
It is convenient to get informed about the environmental impact of a product by using the Eco-score label	0.73		
The EcoScore label is a credible source of information about the environmental impact of a food product	0.71		
I would choose a product with a better Eco-score in general	0.68		
The Eco-score labels are audited with transparent environmental information	0.61		
Attitude towards the Eco-score		0.78	0.19
I do not trust the Eco-score label	0.77		
The Eco-score label is not useful	0.75		
It is difficult to understand the Eco-Score.	0.70		
Ease of use of the Eco-score		/	0.12
The Eco-Score is easy to use	0.95		

Product evaluation exercise

Since the evaluation exercise primarily focused on assessing the evaluative capacity of participants concerning the environmental impact of food products, it was relevant to calculate Pearson correlation coefficients between the other measures as well. This analysis aims to identify potential significant relationships that could provide valuable insights into the topic.

Binary Logistic Regression

A generalized linear model (GLM) was developed to examine whether consumers' evaluative capacity increased when the Eco-score was shown. More specifically, binary logistic regression was chosen since the dependent variable, "Correctness", is dichotomous. The independent variables included the randomly assigned categorical variables "Condition", "Eco-score", and "Nutri-Score". Additionally, the aggregated variable "Objective knowledge", four constructs of "Subjective knowledge" were taken into account. The aggregate scores derived from the EFA of "Environmental attitude" were also utilized as independent variables. Since this regression type uses baseline groups based on dummy coding for categorical variables, these were selected based on its ease of interpretation (Table 9).

Table 9: Baseline groups for the categorical independent variables used in the logistic regression model.

Independent variable	Baseline level
Condition	Control
Eco-score	C
Nutri-score	C
Eco-score subjective knowledge	Very low
Environmental subjective knowledge	Very low
Nutritional subjective knowledge	Very low
Nutri-score subjective knowledge	Very low
Eco-score subjective knowledge	Very low

Initially, a full factorial design was constructed to incorporate all possible interactions between the independent variables. The designed linear model is represented by the Equation 4.4. However, the model with the best fit needed to be determined. Therefore, the Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) were utilized (Chakrabarti and Ghosh, 2011). Through a backward elimination process, Equation 4.5 was developed which showed the best fit.

$$\begin{aligned}\text{Correctness} = {} & \text{Condition} \cdot \text{Eco-score} \cdot \text{Nutri-score} \cdot \text{Eco-score subjective knowledge} \cdot \\ & \text{Environmental subjective knowledge} \cdot \text{Nutritional subjective knowledge} \cdot \\ & \text{Eco-score subjective knowledge} \cdot \text{Objective knowledge} \cdot \text{Environmental concern} \cdot \\ & \text{Ecological responsibility} \cdot \text{Ecological purchasing behaviour}\end{aligned} \tag{4.4}$$

$$\begin{aligned}\text{Correctness} = {} & \text{Condition} + \text{Eco-score} + \text{Nutri-score} + \text{Environmental subjective knowledge} + \\ & \text{Objective knowledge} + \text{Environmental concern} + \text{Ecological purchasing behaviour} + \\ & \text{Condition} : \text{Eco-score} + \text{Condition} : \text{Environmental subjective knowledge} + \\ & \text{Eco-score} : \text{Nutri-score}\end{aligned} \tag{4.5}$$

Once a suitable linear model was identified, several assumptions needed to be tested before interpreting the logistic regression model. The first step involved checking for outliers and assessing whether they influenced the outcome. It was determined that there were no outliers, and therefore no observations were removed from the analysis. The next assumption examined the absence of multicollinearity among the continuous variables. The variance inflation factor (VIF) was calculated for “Objective knowledge”, “Environmental Responsibility”, “Environmental Concern”, and “Environmental Purchasing Behaviour”. None of the main effects of these variables had a VIF greater than five. Although the interaction effect “Condition:Objective Knowledge” exceeded five, it remained below ten, and therefore still acceptable (Leung, 2022). Therefore, it can be concluded that this assumption was not violated. Next, the relationship between the logit of the outcome and each continuous independent variable was assessed to determine linearity. A Box-Tidwell test was conducted by adding log-transformed interaction terms between the continuous variables and their corresponding natural logs to the model (e.g., Environmental Attitude: log(Environmental Attitude)) (Leung, 2022). None of these interaction terms were significant, indicating that this assumption was also satisfied.

Structural equation modeling

To gain a comprehensive understanding of the variables that causally influence the intention to use the Eco-score label, a structural equation model (SEM) was constructed. The initial step involved determining the variables to be included in the model. Following this, the distributional assumptions were assessed. In this analysis, the 5-point scale of subjective knowledge concerning the environment and the Eco-score label were assumed to be continuous variables. This assumption was made to facilitate the interpretation of the resulting coefficients and provide a clearer understanding of how changes in subjective knowledge impacted the outcome in a linear trend. For all Shapiro-Wilk tests, output revealed that all observed variables exhibited significant departures from normality, with p-values less than 0.05. Given the decision to treat the 5-point scale as continuous and the violation of the multivariate normality assumption required for SEM, the lavaan package's "MLM" estimator was employed to fit the model. This estimator uses a maximum likelihood procedure and, importantly, provides robust standard errors and a Satorra-Bentler scaled test statistic (Bean, 2021). By utilizing this estimator, the issues arising from the violation of multivariate normality are addressed.

After constructing the SEM model, the overall fit of the model had to be evaluated before interpreting the results. Three different measures were utilized for this purpose. The first measure was the Satorra-Bentler scaled Chi-square test, which compares the covariance matrix reproduced by the model to the input covariance matrix. The output for our model was $X^2(df) = 253(73)$, with a p-value of < 0.05, indicating a statistically significant deviation. As the null hypothesis is rejected, the fit of the model is considered inadequate. However, it's important to note that Chi-square tests are sensitive to sample size, meaning that even small deviations can lead to significant results with large sample sizes. Therefore, additional fit measures were employed. The second measure used was the root mean square error of approximation (RMSEA), which evaluates the discrepancy between the model-based and observed correlation matrices. The point estimate of RMSEA was 0.0671, and the 90% confidence interval ranged from 0.0593 to 0.0760. As these values fall within the acceptable range of 0.05-0.08, it can be concluded that the model has a reasonable fit (Bean, 2021). The third and final measure employed was the Comparative Fit Index (CFI), which compares the model to a restricted baseline model, and the standardized root mean square residual (srmr), which reflects the discrepancies between the model-based and actual covariances. In our model, the CFI value was 0.905, and the srmr value was 0.55. As the threshold values for CFI ($\geqslant 0.90$) and srmr ($\leqslant 0.08$) were met, it indicates that the model fits the data reasonably well (Bean, 2021).

5 Results

5.1 Socio-demographic characteristics of study participants

The final sample consists of 607 participants, out of which seven participants have an unknown gender. Among the 600 remaining participants, 50.3% are male, and 49.7% are female. Appendix D shows the final sample demographics for age and region of living, which were based on the given quotas. Table 10 presents an extensive breakdown of socio-demographic and personal characteristics for Belgium as a whole, as well as for Brussels, Flanders, and Wallonie individually. This ensures that the sample is representative of the Belgian population, aligning with the quotas provided by Pureprofile.

When analyzing the distribution of the age categories, it is evident that most groups were more or less similarly represented. However, the age groups of 18-24 years and 65-75 years were presented to a lesser extent, comprising only 12.0% and 10.5% of the sample, respectively. Regarding education, the highest frequency corresponds to individuals holding a secondary school degree, accounting for 40.6% of participants, followed by those with an academic bachelor (21.1%) and professional bachelor (19.4%). The employment status analysis reveals that almost half of the participants are engaged in full-time employment (45.0%), while a substantial number of individuals (15.4%) are retired. All other employment statuses combined represent less than ten percent of the sample. Furthermore, nearly half of the participants (44.6%) report an average net household income falling between 2000 and 3999. Notably, almost a tenth chose not to disclose their income, indicating a choice to keep their income confidential.

Table 10: Socio-demographic characteristics of the total sample in Belgium (n=607) dived over Brussels (n=61), Flanders (n=341) and Wallonie (n=205).

		Belgium	**Brussels**	**Flanders**	**Wallonie**
Gender	Male	302	43	159	100
	Female	298	18	175	105
	Other/ Prefer not to say	7	0	7	0
Age	$[18, 24]$	73	6	33	34
	$[25, 34]$	116	17	64	35
	$[35, 44]$	119	10	65	44
	$[45, 54]$	117	10	66	41
	$[55, 64]$	118	11	73	34
	$[65, 75]$	64	7	40	17

The age groups were constructed after the collection of the data.

		Belgium	Brussels	Flanders	Wallonie
Education	Primary education	23	2	13	8
	High school	246	17	141	88
	Professional bachelor	118	7	83	28
	Academic bachelor	128	17	59	52
	Master or PhD	92	18	45	29
Employment	Student	60	6	27	27
	Full time employed	273	31	159	83
	Part-time employed	56	5	35	16
	Self-employed	39	3	25	11
	Unemployed	28	1	15	12
	Housewife, houseman	57	6	27	24
	Retired	94	9	53	32
Income	<1000	15	2	3	10
	$[1000, 1999]$	109	13	49	47
	$[2000, 2999]$	141	20	69	52
	$[3000, 3999]$	130	11	75	44
	$[4000, 4999]$	81	7	60	14
	$[5000, 5999]$	45	2	31	12
	>6000	26	3	16	7
	Other/ Prefer not to say	60	3	38	19

The age groups were constructed after the collection of the data.

To compare the socio-demographic and personal characteristics between the three regions, as presented in Table 10, chi^2-tests were conducted. These tests aimed to provide a comprehensive understanding of the differences among the regions, revealing valuable insights into their compositions. The analysis yielded significant results in various aspects, such as gender, age, and education, as highlighted in Table 11. Specifically, significant differences were found in gender between Flanders and Brussels, indicating distinctive gender distributions within these regions. Similarly, significant disparities were observed in gender between Wallonie and Brussels, further emphasizing the diverse composition across regions. When examining age, the Chi^2-Tests revealed significant variations between Flanders and Wallonie, as well as Flanders and Brussels. These findings shed light on age-related differences and suggest distinct age distributions among the regions. The same pattern emerged in terms of education, with significant differences detected between Flanders and Brussels, as well as Flanders and Wallonie. These results underscore the presence of unique educational profiles within each region, potentially impacting various socio-economic and cultural aspects. However, it is worth noting that no significant differences were found in employment and income across any of the regions. This suggests that the composition regarding employment status and income distribution is relatively similar among Flanders, Wallonie, and Brussels.

Table 11: The relationship between participants' region of residence and multiple socio-demographic and personal characteristics.

	Flanders and Wallonie			Flanders and Brussels			Wallonie and Brussels		
Variable	χ^2	**df**	**p**	χ^2	**df**	**p**	χ^2	**df**	**p**
Gender	43.3	2	0.115	12.2**	2	0.00219	80.6**	1	0.00452
Age	92.5**	57	0.00203	84.5*	57	0.0104	57.7	54	0.342
Education	11.4*	4	0.0220	18.1**	4	0.00118	93.1	4	0.0538
Employment	87.6	6	0.188	2.32	6	0.888	35.0	6	0.745
Income	28.4	6	0.0783	10.6	6	0.100	35.2	6	0.741

* Significance at the 0.05-level; **Significance at the 0.01-level.

5.2 Product evaluation exercise

5.2.1 Correlations

Spearman correlation coefficients were calculated between the measures of “Nutritional value”, “Environmental impact”, and “Overall liking” of the products shown to the participants. Looking at “Nutritional value” and “Environmental impact” a positive correlation was found of r(607) = +0.015, proving these evolve in the same direction. However, this coefficients lies so close to zero that it can be assumed the correlation is negligible. The same goes for “Environmental Impact” and “Overall liking”, which were negatively correlated, but in a negligible manner (r(607) = -0.0050). Thus, no association between the way people evaluate a products “Environmental impact” and how much their “Overall liking” towards that product is found. Lastly, looking at “Nutritional value” and “Overall liking”, a positive and strong correlation can be found (r(607) = +0.72).

5.2.2 GLM - Evaluative capacity

Looking at Table 12 an overview of main effects potentially influencing variables on participants’ probability to correctly evaluate the environmental impact of food products can be found. Here it was found that all Eco-score levels were statistically significant compared to their reference level “Eco-score C”. Concerning the reference level, only “Eco-score B” and “Eco-score E” had a significant influence on the probability of correctly evaluating products. In terms of “Environmental subjective knowledge”, all levels differed significantly from the reference level “Very low environmental subjective knowledge”. Similarly, “Eco-score subjective knowledge” showed significant differences, however, only at the “Very high Eco-score subjective knowledge” level.

However, it is important to consider the interaction effects included in this GLM model Table 13. When variables are present in both the main and interaction effects, relying solely on the main effects is insufficient. In both conditions, certain levels between the Eco-score and Nutri-score variables were found to influence each other, namely “Eco-score B: Nutri-score A”, “Eco-score D: Nutri-score A”, “Eco-score E: Nutri-score A”, “Eco-score B: Nutri-score E”, and “Eco-score D: Nutri-score A”. Additionally, the label condition was found to have an impact on other variables, including “Label: Objective” and all levels between “Environmental subjective knowledge” and the “Label” condition.

Table 12: Resulting main effect output of the binary generalized linear model, testing the effect of different levels of independent variables probability of correctly evaluating a products environmental impact (n=607)

Variable	Coefficient	Std. Error	Lower	Upper
Intercept	-0.0499	0.432	-0.906	0.792
Label***	-1.66	0.455	-2.57	-0.778
Eco-score A***	-1.82	0.376	-2.58	-1.11
Eco-score B**	-1.02	0.328	-1.66	-0.392
Eco-score D**	-0.925	0.314	-1.55	-0.316

* Significance at the 0.05-level; **Significance at the 0.01-level; SE: standard error; Coefficient: standardized coefficient estimate. The AIC of this model equals 3048.437.

Variable	Coefficient	Std. Error	Lower	Upper
Eco-score E***	-2.22	0.403	-3.05	-1.46
Nutri-score A	-0.113	0.265	-0.634	0.406
Nutri-score B***	-0.996	0.288	-1.57	-0.440
Nutri-score D	0.0802	0.263	-0.437	0.597
Nutri-score E*	-0.630	0.273	-1.17	-0.0989
Objective knowledge	-0.0169	0.0472	-0.110	0.0753
Low environmental subjective knowledge*	-0.786	0.310	-1.38	-0.166
Average environmental subjective knowledge*	-0.790	0.308	-1.39	-0.173
High environmental subjective knowledge**	-0.871	0.333	-1.52	-0.209
Very high environmental subjective knowledge	0.431	-0.00730	-1.20	0.495
Low Eco-score subjective knowledge	0.268	0.186	-0.0903	0.638
Average Eco-score subjective knowledge	0.243	0.188	-0.119	0.617
High Eco-score subjective knowledge**	0.661	0.214	0.245	1.08
Very high Eco-score subjective knowledge	0.0946	0.312	-0.525	0.670
Environmental concern***	0.240	0.0719	0.0996	0.382
Environmental purchasing behaviour***	-0.222	0.0698	-0.359	-0.0855

* Significance at the 0.05-level; **Significance at the 0.01-level; SE: standard error; Coefficient: standardized coefficient estimate. The AIC of this model equals 3048.437.

The variable level with the strongest positive effect on the probability of correctly evaluating a product's environmental impact was "Label: Average environmental subjective knowledge". Compared to the reference level, having average environmental subjective knowledge was found to be beneficial when the labels were shown, resulting in a significantly increased probability of success. Similar positive effects were observed for other levels of environmental subjective knowledge. Conversely, the factors contributing to the highest decrease in the probability of success were the "Label" condition, "Eco-score A", and "Eco-score E", However, it is worth noting that the main effect of the "Label" condition alone is insufficient, as its interaction effects often counteract this decrease in the probability of success.

Moreover, the "Label" condition had only a limited effect on the Eco-score variables of the product. This suggests that the presence of Eco-score labels alone does not adequately facilitate people's final evaluation regarding environmental impact. Finally, only a few combinations between Eco-score and Nutri-score were found to be significant, and no three-way interaction term involving the "Label" condition, Nutri-score, and Eco-score was found to be significant, leading to its exclusion from the model."

Table 13: Resulting interaction effect output of the binary generalized linear model, testing the effect of different levels of independent variables probability of correctly evaluating a products environmental impact (n=607).

Variable	Coefficient	Std. Error	Lower	Upper
Label:Objective***	0.222	0.0646	0.0950	0.348
Label:Eco-score A*	0.634	0.316	0.0202	1.26
Label:Eco-score B	-0.205	0.262	0.719	0.309
Label:Eco-score D	-0.173	0.256	-0.675	0.328
Label:Eco-score E	0.468	0.311	-0.138	1.09
Label:Low environmental subjective knowledge**	1.41	0.444	0.551	2.30
Label:Average environmental subjective knowledge***	1.53	0.432	0.693	2.40
Label:High environmental subjective knowledge**	1.32	0.464	0.418	2.24
Label:Very high environmental subjective knowledge*	1.18	0.554	0.102	2.28
Eco-score A: Nutri-score A	0.0478	0.460	-0.857	0.950

* Significance at the 0.05-level; **Significance at the 0.01-level; SE: standard error; Coefficient: standardized coefficient estimate.

Variable	Coefficient	Std. Error	Lower	Upper
Eco-score B: Nutri-score A*	-0.0290	0.430	-0.877	0.814
Eco-score D: Nutri-score A***	0.0663	0.411	-0.740	0.873
Eco-score E: Nutri-score A**	0.338	0.505	-0.654	1.34
Eco-score A: Nutri-score B	1.09	0.466	0.174	2.01
Eco-score B: Nutri-score B	1.54	0.421	0.723	2.38
Eco-score D: Nutri-score B	1.31	0.417	0.502	2.14
Eco-score E: Nutri-score B	0.954	0.523	-0.0732	1.99
Eco-score A: Nutri-score D	-0.946	0.511	-1.98	0.0372
Eco-score B: Nutri-score D	0.334	0.409	-0.465	1.14
Eco-score D: Nutri-score D	0.568	0.393	-0.199	1.34
Eco-score E: Nutri-score D	0.890	0.462	-0.00245	1.82
Eco-score A: Nutri-score E	0.264	0.482	-0.691	1.21
Eco-score B: Nutri-score E**	1.07	0.412	0.264	1.88
Eco-score D: Nutri-score E**	1.06	0.409	0.261	1.87
Eco-score E: Nutri-score E	0.591	0.508	-0.406	1.59

* Significance at the 0.05-level; **Significance at the 0.01-level; SE: standard error; Coefficient: standardized coefficient estimate.

To gain a deeper understanding and identify the combinations of elements that have the highest likelihood of success, all possible combinations were inserted into the model. Table 14 presents the results, which reveals the top five probabilities of success, consistently featuring the "Label" condition. Additionally, the Eco-score consistently corresponds to products with a score of C. In contrast, the Nutri-score demonstrates a wider range of levels, indicating that it has a less significant impact on the success rate. Higher subjective and objective knowledge are positively correlated with success probability, as higher knowledge leads to better evaluative capacity. Notably, environmental purchasing behavior consistently exhibits the lowest values among the combinations. Furthermore, the results indicate that higher levels of environmental concern contribute to improved probabilities of success.

Table 14: Combinations of all possible levels of variable to obtain the five highest probabilities of success, based on the GLM model.

Variable					
Condition	Label	Label	Label	Label	Label
Eco-score	C	C	C	C	C
Nutri-score	D	C	D	C	A
Subjective knowledge environment	5	5	5	5	5
Subjective knowledge Eco-score	4	4	4	4	4
Objective knowledge	6	6	6	6	6
Environmental purchasing behaviour	1	1	1	1	1
Environmental concern	5	5	5	5	5
Probability of success	89%	88%	88%	87%	87%

Attributes

After the evaluation exercise, attribute analysis was conducted. The attributes relevant to all three evaluation measures were compared between the two conditions to determine significant differences in attribute selection (Table 15). Chi-square tests yielded a significant result (χ^2 = 197.19; df = 5, p < 0.01), indicating significant differences in attribute usage between both groups.

Notably, some participants who did not have access to any labels still reported using the Eco-score (19.6%) and Nutri-score (28.4%) for their evaluation. However, in the "Label" condition, there was an increase in the usage of these scores compared to the "Control" condition. For the Nutri-score this increase was 28.0%, also showing significant differences (χ^2 = 26.8, df = 1, p < 0.0100), while for the Eco-score this was 13.3% with a significant difference as well (χ^2 = 9.57, df = 1, p = 0.00198). Additionally, participants in the "Label" group indicated less frequent use of "Nutritional value" and "Ingredients" attributes compared to the "Control" group, with a decrease of 11.7% and 12.2%, respectively. This might be a trade-of of convenience since the "Label" group could more easily assess the environmental impact and nutritional quality by looking at the Eco- and Nutri-score. However, the usage of the "Packaging" attribute remained more or less consistent across both conditions. In both groups, some alternative attributes were given which the participants used for the evaluation exercise. Appendix E gives an overview of the number of times other attributes or elements were used to evaluate their given products.

Table 15: Number (n) of participants using different attributes for evaluating food products across the two conditions. Control(n=306), Label (n=301).

Attribute	Control (n)	Label (n)	χ^2	df	p
Eco-score	60	99	9.57*	1	<0.01
Nutri-score	87	170	26.8**	1	<0.01
Ingredients	197	157	4.52*	1	0.0335
Nutritional value	166	128	4.91*	1	0.0267
Packaging	135	126	0.310	1	0.578

* Significance at the 0.05-level; **Significance at the 0.01-level.

5.3 Consumers' attitude and subjective knowledge

In order to get a better insight into consumers' environmental, food-related attitude and their subjective knowledge, in what follows descriptive results regarding these topics will be discussed. When talking about their environmental attitude, items constructed with EFA will be used.

5.3.1 Attitude towards the environment

When looking at Table 16, it can be seen that the mean is between three and four for all constructs. However, looking at the standard deviations, the different observations in the sample are quite dispersed from the mean, suggesting some variability in the data set. Looking at "Environmental responsibility", 28.5% had a score below two and above four. For "Environmental concern" this was 43.2% of which 40.7% had a score above four. The mean of 3.83 therefore is influenced by the more extreme values above 4. For "Environmental purchasing behaviour" this value was 28.3%. When looking at the 95% confidence intervals, these are quite narrow. Meaning that we can be 95% confident that the true population mean falls within this interval. Projecting this to the whole Belgian population, it can be concluded that the true population mean lies slightly above average environmental responsibility, concern, and purchasing behaviour.

Looking at Table 16, the means for all constructs fall between three and four. However, looking at the standard deviations, the different observations in the sample are quite dispersed from the mean, suggesting some variability in the data set. Regarding “Environmental responsibility”, 28.5% had scores below two or above four. Similarly, for “Environmental concern”, 43.2% had scores exceeding four, with 40.7% above that threshold. The mean of 3.83 is influenced by these extreme values. For “Environmental purchasing behavior”, the corresponding percentage was 28.3%. The 95% confidence intervals are narrow, providing 95% confidence in the true population mean. Extrapolating to the entire Belgian population, the conclusion is that the mean lies slightly above average for environmental responsibility, concern, and purchasing behavior.

Table 16: Environmental attitude of Belgian (n=607) consumers regarding responsibility, concern and purchasing behaviour.

	Mean	SD	CI Lower	CI Upper
Environmental responsibility	3.68	0.853	3.62	3.73
Environmental concern	3.83	0.794	3.76	3.89
Environmental purchasing behaviour	3.49	0.853	3.43	3.56

5.3.2 Attribute importance towards food products

In the study, participants’ attribute importance for daily food consumption was assessed. Figure 10 revealed that health (58.8%), price (23.8%), and sensory appeal (4.42%) were most frequently ranked in the first position. Notably, the health attribute stood out with a substantial proportion. The remaining attributes had varying levels of selection, with a minimum of (2.72%) and a maximum of (3.91%). In the second position, price was most frequently chosen (27.4%), followed by health (20.6%) and convenience (16.7%). From the third position onward, the relative importance of other attributes increased, but the variations across ranks were relatively consistent. This suggests that there is considerable variability among participants in how they prioritize different attributes. The attribute importance on the last rank was dominated by familiarity (30.8%), along with local and seasonal production (22.1%) and sensory appeal (18.5%). However, it remains unclear which attributes are considered most and least important overall. In addition, it can be seen that fewer and fewer people selected “Health” as importance decreased. Health emerged as the attribute of highest importance for most participants, while familiarity was perceived as least important. In general, “Familiarity” was selected more often as importance decreased. When examining the attribute of environmental welfare, it can be seen that in the first three ranks, their proportion was rather small. While for lower importance ranks, this was more ore less the same, showing variability between participants. This is in line with Table 16, where the assessed construct of environmental purchasing behaviour got a mean value of 3.49 with quite some variability (SD = 0.853). Lastly, the proportion of local and seasonal production increased as attribute importance decreased. This figure shows that people still don’t value sustainability as most important when they have to be traded off against other attributes.

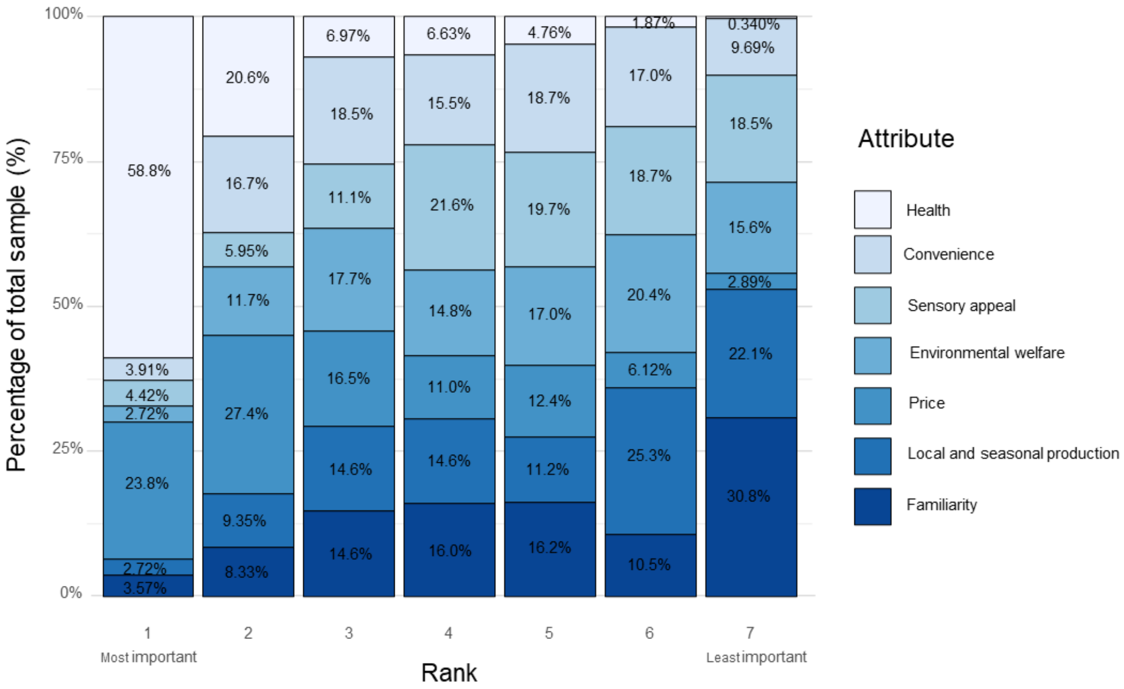


Figure 10: Percentage of each attribute ranked from most important to least important (n=607).

5.3.3 Consumers' subjective knowledge

Looking at Table 17, it can be seen that the means are slightly below "Average subjective knowledge". When computing t-tests, no significant differences were found between the "Label" and "Control" group. This indicates that, overall, participants' subjective knowledge levels across these aspects exhibit moderate consistency, with slight variations observed between subjective knowledge of the environment (mean = 2.75, SD = 0.974), nutrition (mean = 2.93, SD = 1.02), Eco-score (mean = 2.75, SD = 0.974), and Nutri-score (mean = 2.94, SD = 1.01). Furthermore, looking at the different confidence intervals, these values lie below three, indicating that we can be 95% confident that the true population mean regarding these subjects lies within these intervals. This suggests that, on average, people rate their own subjective knowledge slightly below "Average subjective knowledge".

Table 17: Subjective knowledge scores regarding environment, Eco-score, nutrional health, and Nutri-score, participants (n=607) gave themselves. This rating was on a scale from one to five.

	Mean	SD	CI Lower	CI Upper
Subjective knowledge environment	2.89	0.947	2.86	2.93
Subjective knowledge Eco-score	2.75	0.974	2.71	2.78
Subjective knowledge nutritional health	2.93	1.02	2.89	2.96
Subjective knowledge Nutri-score	2.94	1.01	2.91	2.98

Next, the participants were asked to rank different types of food products based on their perceived environmental friendliness (Figure 11). Among the non-organic products from supermarket brands, 28.2% of participants ranked them as “Most environmentally friendly”, while the same percentage was observed for organic products from supermarkets. For non-organic products from multinational companies, 16.8% of participants considered them as “Most environmentally friendly”. In contrast, 26.9% of participants ranked organic products from multinational companies as “Most environmentally friendly”. However, there only seems to be a difference between the different products compared to “Non-organic products from multinational companies”. This equal distribution suggests peoples opinions regarding “Most environmentally friendly” products differ quite a lot. Nevertheless, products being organic were selected by the majority of the participants. Looking at the last two columns “Less environmentally friendly”, and “Least environmentally friendly”, an increased proportion of multinational products, both organic and non-organic, was selected. However, in the “Least environmentally friendly” category, a vast majority (53.1%) selected “Non-organic products from multinational companies”. Here it is clear that multinational brands are thought of of being most harmful, with a total of 68.6%.

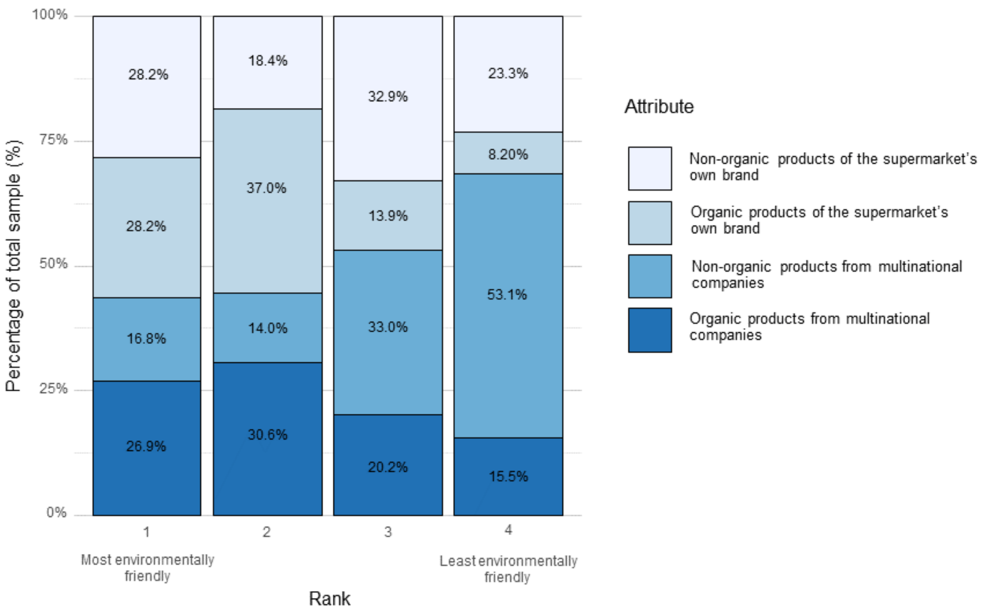


Figure 11: Ranking exercise concerning four product types going from most to least environmentally friendly (n = 607).

5.4 Familiarity and current use of the Eco-score label

Regarding familiarity, in total, 87.8% of the total sample had already heard about the Eco-score before. Looking Figure 12 presenting current use, on top of the 12.2% of people that have not heard about the Eco-score before, 28.3% have heard about the label but have never used it during food shopping. One fourth of the participants indicated they use the Eco-score sometimes during food shopping. Furthermore 17.6% indicated they use it most of the time, while even 16.1% says they use it all the time when buying food.

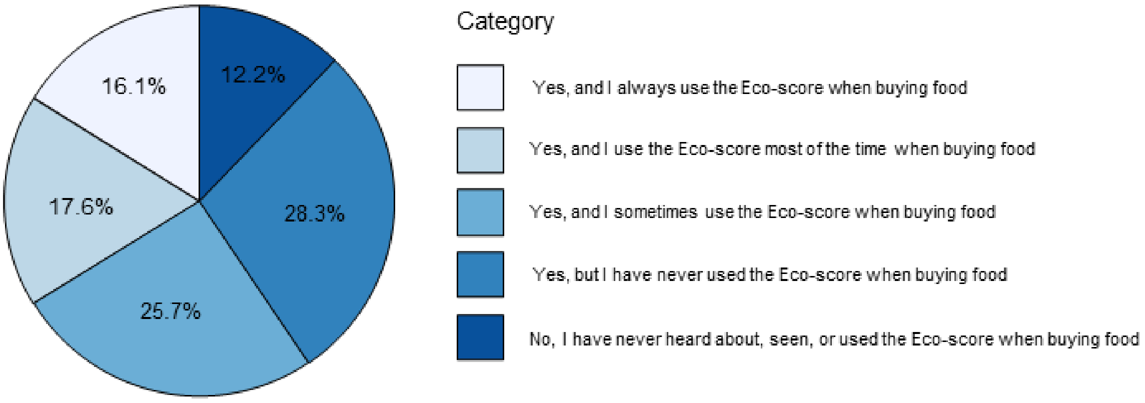


Figure 12: Current use of the Eco-Score (n = 607).

5.4.1 Most visited retail stores

To gain insights into the monthly retail locations frequented by participants for their food shopping, we refer to Table 1 (retailers). The data reveals that the most frequently visited store is Colruyt (55%) togheter with Aldi (52.6%), Delhaize (46.3%), Carrefour (45.3%), and Lidl (41.9%). The popularity of these stores is understandable, given their widespread geographic presence in Belgium. Following, Albert Heijn also attracts a substantial proportion of consumers (25.2%). In contrast, all other stores are visited by a maximum of 9.73% of participants.

Among all stores implementing the Eco-score label, namely: Colruyt, Bio-Planet, Okay, and Spar, the majority of participants shop there at least once a month. Looking at Figure 12, were 59.4% indicated they make use of the label, 64.7% of those shop at one of these four stores. This supports the reliability of the current use.

Table 18: Percentage of participants that go food shopping in the according retail stores at least once a month (n=607).

Retailer	Percentage (%)
Colruyt	55.0
Aldi	52.6
Delhaize	46.3
Carrefour	45.3
Lidl	41.9
Albert Heijn	25.2
Bio-Planet	9.73
Okay	8.90
Spar	8.73
Match	4.61
Smatch	2.97
Cru	2.14
Other	6.75

5.5 Consumers′ reactions towards the Eco-Score label

When talking about consumers' reactions, items constructed with EFA will be discussed based on credibility, usefulness and understandability. The Objective knowledge will also be discussed by means of descriptive results and visualisation.

5.5.1 Credibility, positive attitude, and ease of use of the Eco-score

Looking at Table 19, the following results can be described. Regarding "Credibility", the mean value is 3.54. The standard deviation of 0.647 indicates a moderate level of variability in the responses regarding credibility, showing that opinions regarding credibility vary to some extent. The confidence interval of 3.49 and 3.60, provides a range within which the true population mean of is likely to fall with a confidence of 95%.

Regarding "Attitude towards the Eco-score", the mean value is 3.39, which is slightly above an the average value of three. The standard deviation of 0.747 indicates a higher level of variability in the responses compared to credibility. The confidence interval of 3.33 and 3.45, provide a range within which the true population mean of "Positive attitude" is likely to fall.

Furthermore, in terms of "Ease of use of the Eco-score", the mean value is 3.55, indicating a moderately high perception of ease of use. The standard deviation of 0.687 indicates a moderate level of variability in the responses. The lower and upper confidence intervals of 3.50 and 3.61, respectively, provide a plausible range for the true population mean of "ease of use".

All together, it can be noticed that in general the overall reactions, based on a scale of one to five, are all slightly above average. However, for all three constructs, the standard deviation can be considered moderate. This means there is some diversity in how participants perceive credibility, positive attitude, and ease of use. Some people therefore feel slightly negative towards these aspects as well. However, the overall responses tend to cluster around the mean values. None of the constructs had a substantial proportion which was very low or very high. Looking at the confidence intervals, these values lie above three. Therefore, it can be said that with 95% confidence, the true population mean lies withing these intervals. Based on this, the Belgian populations' mean attitude would lie between "Neither agree nor disagree", and "Agree", showing positive results.

Table 19: Current Belgian consumers' reactions (n=607) towards the Eco-score label in terms of credibility, attitude, and ease of use, and objective knowledge.

	Mean	SD	CI Lower	CI Upper
Credibility of the Eco-score	3.54	0.647	3.49	3.60
Attitude towards the Eco-score	3.39	0.747	3.33	3.45
Ease of use of the Eco-score	3.55	0.687	3.50	3.61

5.5.2 Objective knowledge regarding the Eco-score

Regarding objective knowledge, the mean value for objective knowledge is 2.18 indicating that most of the participants answered approximately two out of the six questions correctly. However, the standard deviation of 1.45 indicates a significant variability in the participants' total objective knowledge scores, reflecting a wide range of objective knowledge levels. Looking at the lower and upper confidence intervals of 2.06 and 2.20, a range within which the true population mean of objective knowledge is likely to fall is given. This range indicates that there is a probability that the true population mean could be slightly higher or lower than the reported mean of 2.18. Figure 13 gives a visualisation of these objective knowledge scored regarding the Eco-score. Here it can be seen that only 12.9% answered four questions correctly, while only 5.43% answered five or all question correct. Also, more than half of the participants answered less than half of the questions correct (57.0%), showing a lack of objective knowledge.

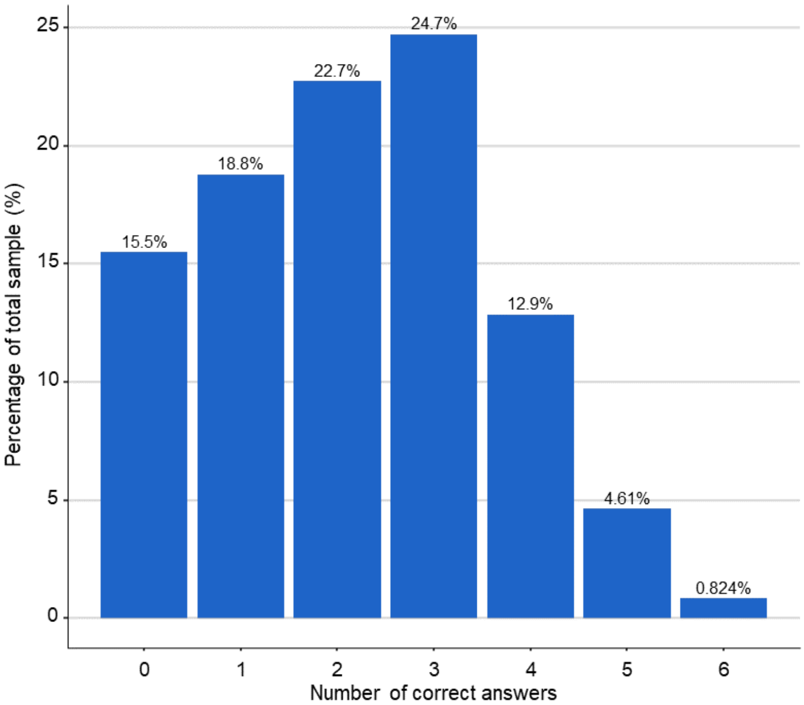


Figure 13: Percentages of participants in the total sample (n=607) and the number of correct answers they have given.

From Figure 14, it is clear that a significant proportion of the total sample, ranging from 46.5% to 80.2%, were unable to respond correctly to the given statements. Notably, the statements "When a producer reformulated a product, the Eco-score can change. E.g. from Eco-score B to A." (53.5%) and "Products can receive a higher Eco-score if they are accompanied by a third-party sustainability certification, such as an organic or fair trade label" (52.6%) were most frequently answered correctly. Conversely, the statement "Glass-packaged products always have a better environmental assessment than similar plastic-packaged products" had the lowest rate of correct answers (19.8%).

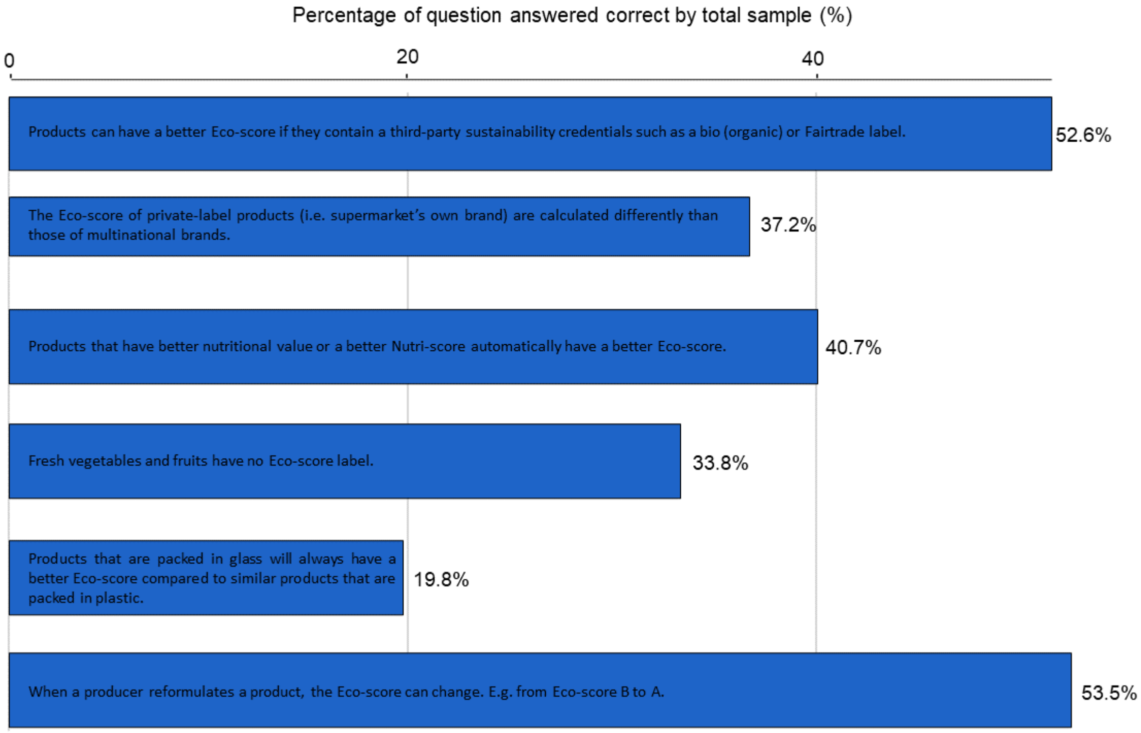


Figure 14: Percentages of participants of the total sample (n=607) that answered each question correct.

These results, derived from both Figure 13 and Figure 14, underscore the importance of educating individuals about the Eco-score label.

5.6 Intention to use the Eco-score

For the intentions to use the Eco-score label, descriptive results are provided (Table 20). Looking at the mean value for intention to use the Eco-score, a value of 3.49 was found. This indicates a moderate to high level of intention among the participants. However, the standard deviation indicated some variability in the responses (SD = 1.00). This implies that while a significant proportion of participants expressed a strong intention to use the Eco-score, some exhibited a low level of intention. Looking at a standard deviation of 1.00 indicates moderate level of variability in participants' responses, also highlighting the diversity of responses. Lastly, looking at the confidence interval of 3.41 and 3.57, a range within which the true population mean lies is provided.

Table 20: Intention to use the Eco-score label (n = 607).

	Mean	**SD**	**CI Lower**	**CI Upper**
Intention to use the Eco-score	3.49	1.00	3.41	3.57

5.6.1 Influencing variables on the intention

Furthermore, to assess which variables influence the intentions to use the Eco-score, an SEM was performed. Looking at Figure 15, the different potential influencing variables, based on the hierarchical framework are shown.

“Perception towards Eco-score”, and “Environmental attitude” showed to have positive significant influence on the intention, with a standardized value of 0.449 and 0.244 respectively. This indicates that when people have a higher environmental attitude, and have a better perception towards the Eco-score, the intention to use the label increases. However, having a positive attitude towards the Eco-score shows to have the biggest influence others. In contrast, objective knowledge of the Eco-score and overall subjective knowledge showed no significant results. Therefore, these variables do not affect the intention of using the Eco-score label.

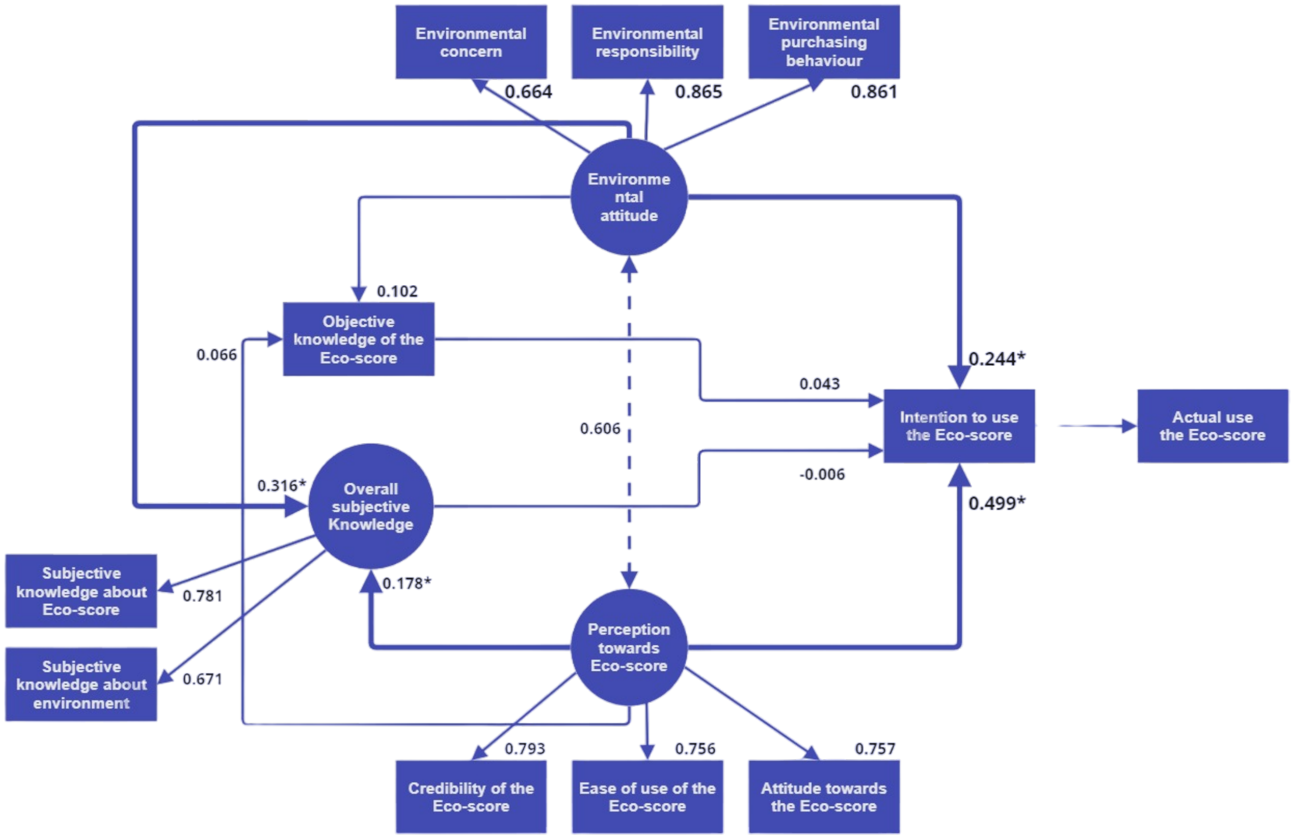

Environmental concern
Environmental responsibility
Environmental purchasing behaviour
0.664
0.865
0.861
Environme ntal attitude
0.102
Objective knowledge of the Eco-score
0.066
0.244*
0.043
Intention to use the Eco-score
Actual use the Eco-score
0.606
-0.006
0.316*
Overall subjective Knowledge
0.499*
Subjective knowledge about Eco-score
0.781
0.178*
Perception towards Eco-score
Subjective knowledge about environment
0.671
0.793
0.756
0.757
Credibility of the Eco-score
Ease of use of the Eco-score
Attitude towards the Eco-score

Figure 15: Diagram of the influencing variables on the intention to use the Eco-score label, derived from the SEM model. *Significance at the 0.05-level; **Significance at the 0.01-level.

Lastly, to see if there are significant association between specific socio-demogrphic characteristic and the independent variables, Table 21 is shown. Looking at “Intention”, only “Age” emerged as a significant predictor, indicating a meaningful association between age and the outcome variable. The negative coefficient suggests that as age increases, intention tends to decrease. Regarding “Subjective knowledge” both “Employment” and “Income” showed significant results. From the “Employment” coefficient, no direction can be deduced since it is a categorical variable. On the other hand, the “Income” coefficient hows a positive relationship, indicating that higher income is associated with higher levels of “Subjective knowledge”. Looking at “Objective knowledge”, “Gender” is shown to be significant, as well as “Age”, which is also decreases “Intention” when people are older. Furthermore, “Environmental attitude” differs significantly between “Gender”, “Region”, “Education”, and “Employment”. Lastly, “Perception toward Eco-score” differs between “Gender”, and “Employment”, but also an increasing “Income” has a significant effect on “Perception toward Eco-score”.

Table 21: Resulting covariance output of the structural equation model, testing the effect of different socio-demographic characteristics on the different variables used (n=607).

	Covariant	**Std. coefficient**	**Coefficient**	**Std.Err**	**p-value**
Intention to use the Eco-score	Gender	-0.0443	-0.0175	0.0174	0.331
	Age	-0.124**	-1.358	0.496	0.00521
	Region	-0.046	-0.0217	0.0215	0.327
	Education	-0.0291	-0.0332	0.0472	0.486
	Employment	-0.0632	-0.0662	0.0502	0.182
	Income	-0.0342	-0.0364	0.0502	0.473
Subjective knowledge	Gender	-0.0572	-0.0301	0.0318	0.342
	Age	-0.0495	-0.736	0.800	0.357
	Region	-0.0293	-0.0181	0.0325	0.565
	Education	-0.0635	-0.0932	0.0837	0.262
	Employment	-0.121*	-0.184	0.0754	0.0126
	Income	0.145**	0.211	0.0767	0.00532
Objective knowledge	Gender	-0.0832*	-0.0632	0.0306	0.0372
	Age	-0.146**	-3.14	0.918	0.001
	Region	-0.0275	-0.0249	0.0372	0.515
	Education	-0.0662	-0.148	0.0925	0.104
	Employment	-0.0538	-0.116	0.0935	0.211
	Income	0.0513	0.107	0.0877	0.216
Environmental attitude	Gender	0.101*	0.0535	0.0247	0.0302
	Age	0.0445	0.666	0.636	0.296
	Region	0.113*	0.0712	0.0298	0.0143
	Education	-0.139**	-0.217	0.0745	0.00321
	Employment	0.119**	0.181	0.0606	0.00215
	Income	-0.0122	-0.0178	0.0678	0.796
Perception towards Eco-score	Gender	0.102*	0.0548	0.0252	0.0308
	Age	0.0654	0.972	0.684	0.156
	Region	0.0775	0.0484	0.0318	0.114
	Education	-0.0715	-0.112	0.0728	0.122
	Employment	0.124**	0.188	0.0687	0.00532
	Income	0.0977*	0.141	0.0675	0.0342

* Significance at the 0.05-level; **Significance at the 0.01-level.

5.7 Marketing initiatives

5.7.1 Awareness of Eco-score campaigns

Looking at Table 22, between 42.3% and 53.9% have never heard about any of the campaigns except for “Discount on selected products with approaching expiry day” which only 22.9% had never heard of. Looking at the existing Eco-score campaigns “Collecting points by purchasing products with Eco-score A or B to support good causes for the environment.” (12.2%), and “Collecting points by purchasing products with Eco-score A or B to join workshop about environmental sustainability”(13.0%), only a small proportion indicated they already participated in those campaigns. In contrast, only one campaign, namely “Discount on selected products with approaching expiry day.” was known by 77.1% of which 44.8% made purchases accordingly. In addition, it stands out that a proportional amount of participants indicated they heard of and/ or participated in campaigns that do not yet exist for the Eco-score.

Table 22: The different (Eco-score) campaigns with their according awareness and participation, in percentage (n = 607).

Campaign	I actively participated and/ or made purchases (%)	I've heard of it, but never actively participated (%)	I've never heard of it (%)
Existing Eco-score campaigns			
Collecting points by purchasing products with Eco-score A or B to support good causes for the environment.	12.2	34.8	53.0
Collecting points by purchasing products with Eco-score A or B to join workshop about environmental sustainability.	13.0	34.1	52.9
Non-existing Eco-score campaigns			
Discount on selected products with Eco-score A or B.	18.1	37.1	44.8
Recipes using products with better Eco-score in promotional material.	12.2	41.8	46.0
Suggestions about alternative products with a better Eco-score in a personalised mailshot.	12.4	33.8	53.9
Suggestions about alternative products with a better Eco-score on a digital app.	11.7	34.4	53.9
Meal kits or recipe boxes containing products with better Eco-score.	13.2	37.6	49.3
Campaigns unrelated to the Eco-score			
Discount on selected products with approaching expiry day.	44.8	32.3	22.9
A very low-priced food box filled with products looking less fresh but still suitable for consumption.	18.3	39.4	42.3

5.7.2 Effectiveness of Eco-score campaigns

Based on the previously given marketing campaigns, participants were asked to rank the three most effective ones according to their opinion. Figure 16, indicates that “Discount on selected products with Eco-score A or B” (26.0%) would be most the effective campaign related to the Eco-score. In addition, almost one fifth selected “Collecting points by purchasing products with Eco-score A or B to join workshop about environmental sustainability” (9,90%) and “Collecting points by purchasing products with Eco-score A or B to support good causes for the environment”. All other initiatives were selected only between 3.29% and 7.08%. On the second place the same campaigns were selected most often with 16.6%, 12.0% and 10.2%. On the third place the "Collecting points by purchasing products with Eco-score A or B to join workshop about environmental sustainability" campaign made place for "Collecting points by purchasing products with Eco-score A or B to support good causes for the environment" with 19.6%. Over all three ranks, the same most effective campaigns appeared, showing consistency in the effectiveness between these campaigns amongst consumers. In total 26.0% selected a discount campaign, 18.3% selected a social marketing campaign, and 21.1% selected suggestive campaigns as being most effective for the Eco-score.

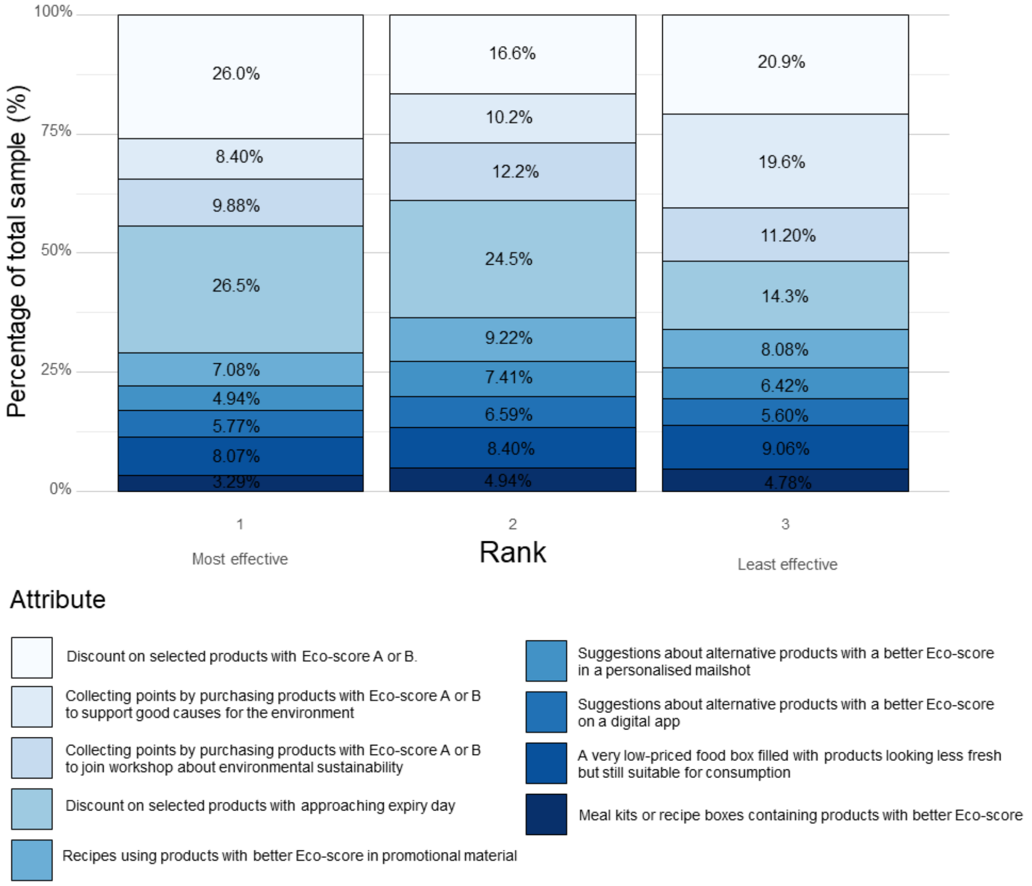


Figure 16: Ranking exercise of the different (Eco-score) campaigns, and their according percentage of how many people ranked them as most effective (n = 607).

5.7.3 Awareness of Nutri-score campaigns

Looking at Table 23, fewer people have never heard about any of the campaigns, with a range between 36.2% and 42.0%. When looking at the different existing Nutri-score campaigns, only a maximum of 26.5% participated. This despite the fact that more than half of the participants indicate they know all campaigns. Lastly, it can be seen that more than half of the participants indicated they heard or participate in non-existing Nutri-score campaigns.

Table 23: The different (Nutri-score) campaigns with their according awareness and participation, in percentage (n = 607).

Campaign	I actively participated and/ or made purchases (%)	I've heard of it, but never actively participated (%)	I've never heard of it (%)
Existing Nutri-score campaigns			
Discount on selected products with Nutri-score A or B.	26.5	36.7	36.7
Recipes using products with better Nutri-score in promotional material.	15.8	42.2	42.0
Suggestions about alternative products with a better Nutri-score in a personalised mailshot.	14.3	46.3	39.4
Suggestions about alternative products with a better Nutri-score on a digital app.	17.0	47.1	35.9
Meal kits or recipe boxes containing products with better Nutri-score.	16.6	44.8	38.6
Non-existing Nutri-score campaigns			
Collecting points by purchasing products with Nutri-score A or B to support good causes promoting nutritional health.	16.3	47.8	35.9
Collecting points by purchasing products with Nutri-score A or B to join workshop about nutritional health.	14.5	48.9	36.6
Campaigns unrelated to the Nutri-score			
Discount on selected products with approaching expiry day.	39.2	24.5	36.2

5.7.4 Effectiveness of Nutri-score campaigns

Here, participants also got the task to rank the three most effective ones according to their opinion. Figure 17, indicates that "Discount on selected products with Nutri-score A or B" (34.9%) would be most the effective campaign related to the Nutri-score. In addition, almost one fifth selected "Collecting points by purchasing products with Nutri-score A or B to join workshop about nutritional health " (9.56%) and "Collecting points by purchasing products with Nutri-score A or B to support good causes promoting nutritional health" (9.39%). The other Nutri-score initiatives were selected between 2.47% and 8.73%. Ranked secondly, the same Nutri-score campaigns were selected most often with 15.3%, 13.8% and 13.7%. On the third place the "Collecting points by purchasing products with Nutri-score A or B to support good causes promoting nutritional health" received the highest score (21.9%). Over all three ranks, the same most effective campaigns appeared, showing consistency in the effectiveness between these campaigns amongst consumers. Looking at the most effective campaigns, 34% selected discount campaigns, 18.9% selected social marketing campaigns and 21.6% selected suggestive campaigns.

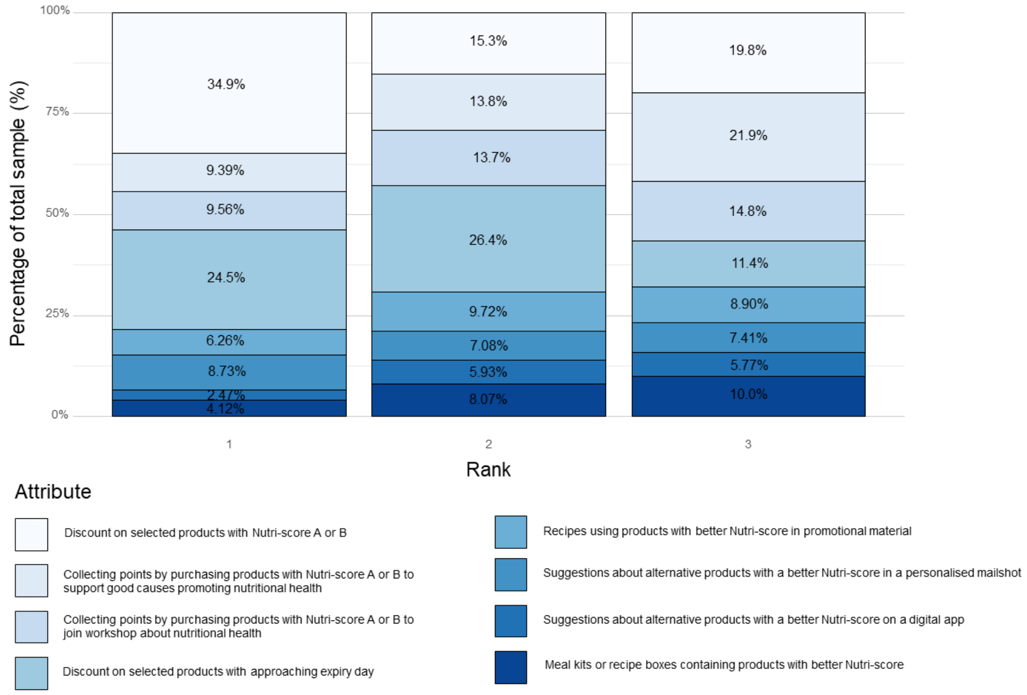


Figure 17: Ranking exercise of the different (Nutri-score) campaigns, and their according percentage of how many people ranked them as most effective (n = 607).

5.7.5 Differences between Eco- and Nutri score campaigns

To compare the awareness of existing Nutri- and Eco-score campaigns, a chi-square test of the averages of existing campaigns was performed (Table 24). From this it can be derived that there are significant differences for all three categories between the existing Eco- and Nutri-score campaigns. For the Nutri-score campaigns overall awareness was higher as well as participation in these campaigns. Logically, this increase in awareness leads to a decrease in being unaware of these campaigns.

Table 24: Chi-square test to compare awareness and participation between Eco-score and Nutri-score campaigns (n = 607).

	Eco-score (n)	Nutri-score (n)	X	df	p
I actively participated and/or made purchases	76	110	6.22*	1	0.0127
I have heard of it, but never actively participated	209	264	6.40*	1	0.0114
I have never heard of it	321	234	13.6**	1	<0.01

* Significance at the 0.05-level; **Significance at the 0.01-level.

Lastly, differences on effectiveness of different types of campaigns are examined. Resulting from Chi-square tests, several differences were found both for the Eco- and Nutri-score campaigns (Table 25). Looking at the Eco-score campaigns, only a significant difference was found between the discount and social marketing campaigns. In contrast, looking at the Nutri-score campaigns the discount campaigns were significantly different from both the suggestive and social-marketing campaigns. For both labels, no differences were found between the effectiveness of social marketing and suggestive campaigns.

Table 25: Chi-square test to compare the effectiveness of different types of marketing campaigns for both the Eco-score and Nutri-score campaigns (n = 607).

	Eco-score			Nutri-score		
	X	**df**	**p**	**X**	**df**	**p**
Discount vs Social marketing	8.21**	1	<0.01	28.8**	1	<0.01
Discount vs suggestive	3.15	1	0.0761	19.1**	1	<0.01
Social marketing vs suggestive	1.21	1	0.2715	1.04	1	0.308

* Significance at the 0.05-level; **Significance at the 0.01-level.

6 Discussion

This thesis aimed to describe the current reactions of Belgian consumers towards the Eco-score label. Different aspects were explored, such as whether the label helps people evaluate the environmental impact of foods and the factors influencing this evaluation. Next, apart from familiarity and current use, also usefulness, credibility, understandability and knowledge were examined. Furthermore, by employing a SEM, intentions to use the Eco-score label were explored, as well as which variables influences this intention. Lastly, awareness and perceived effectiveness of several marketing campaigns were investigated. In what follows, a qualitative analysis of this study's findings will be discussed, on which recommendations will be based. Furthermore, limitations of the study will be thoroughly addressed.

6.1 Effectiveness of the Eco-score label on the evaluative capacity of food products

Hypothesis 1 stated that consumers perceive most products as environmentally less harmful than they actually are when the Eco-score label was not shown. When the label was shown, people would be able to evaluate the environmental impact of food products more correctly. This evaluation might have been more correct for consumers that value and have knowledge about the environment.

Results showed that in general, participants in the "Label" condition more often evaluated products correct compared to the "Control" condition. For this reason, the first part of hypothesis 1 can be accepted. This finding aligns with previous research indicating that the FOP labels indeed facilitates the assessment of food products' environmental impact (Heeremans et al., 2019; Egnell et al., 2020).

The second part of hypothesis 1 is partially accepted. It was found that only "Environmental subjective knowledge" and "Objective knowledge" led to a significant increase in correct evaluations when the labels were presented, as opposed to their absence. This was not the case for "Environmental concern" and "Environmental purchasing behaviour".

Looking at "Environmental subjective knowledge", a possible explanation for this resulting in an increase in correctly evaluation a foods' environmental impact might be due to the fact that consumers with "Environmental subjective knowledge" generally exhibit greater awareness and engagement with environmental issues. When people have "Environmental subjective knowledge", this might reflect their overall "Environmental attitude" (Aertsens et al., 2011). In case of the "Label" condition, the Eco-score label might acts as a reinforcement of their existing beliefs and engagements. The same can be thought of for "Objective knowledge". In addition, it was found that the presence of nutrition knowledge moderates effects on the accuracy of use (Andrews et al., 2021). However, no study was found of how "Objective knowledge" of an Eco-label influences its correct assessment. Nevertheless, it can be theorized that people that do have "Objective knowledge" about the Eco-score label understand its methodology and possess critical thinking abilities.

Regarding "Environmental purchasing behaviour",subjectivity could be contributing to this negative relationship. It is possible that participants think their purchasing habits are environmentally friendly, even though the reality might differ. Assessing the environmental impact of food products requires understanding the food chain. Therefore, participants indicating environmentally friendly purchasing behavior might not have the knowledge of the food supply chain, resulting in a less accurate evaluation of environmental impact (Nittala & Moturu, 2021). Biased perceptions could also be at play, where consumers have a positive attitude towards a specific brand or product. An alternative explanation could be that consumers with "Environmental purchasing behaviour" might prioritize certain environmental attributes that align with personal values (Caniëls et al., 2021). Although these personal values can play a role, they might overshadow or lead to the underestimation of other environmental impacts as perception does not equal reality (Publishers, n.d.).

The positive relationship between "Environmental concern" and the correct evaluation of the environmental impact of food products, regardless of the condition, aligns with various studies. For instance, a study by Chen et al. (2022), found that "Environmental concern" fosters an increased intention for ecological purchasing behavior. A similar observation was made in a study by Schultz and Oskamp (1996), where a positive relationship between "Environmental concern" and effort was found on undergraduates participating in a recycling program. Here, the meta-analysis found that effort is a strong moderator of the attitude-behaviour relationship. Regarding the evaluation, people that have a higher "Environmental concern", could put more effort in correctly evaluation a product, resulting in this positive relationship. However, although "Environmental concern" might motivate consumers, a combination of this concern with knowledge and understanding is needed to ensure a better assessment of the environmental impact of food products (Hartmann et al., 2021).

It is notable that in general people evaluated products with Eco-score A and E most often incorrect. This indicates that evaluating correctly becomes more challenging when products have the highest or lowest environmental impact. Another explanation could be that people don't want to choose extremes when filling in a questionnaire, known as a moderacy response bias (Bogner & Landrock, 2016).

6.2 Consumers' attitude and subjective knowledge

In general, environmental attitudes, i.e. "Responsibility", "Concern" and "Purchasing behaviour", were slightly positive. Its mean values range between three and four out of five. However, given the subjective nature of this scale, the actual values might be lower due to a social desirability bias that some consumers exhibit (Nederhof, 1985).

Looking at the attribute importance, some notable insights can be drawn. The high importance of health, and low importance of familiarity shows that a big proportion values health above familiarity. Also, the proportion of local and seasonal production increased as attribute importance decreased. This observation could be attributed to individuals' limited understanding of product origins and production times, leading to a lower perceived importance of this attribute. Furthermore, the variance in the importance of the environmental welfare attribute suggests that individuals' evaluations of environmental welfare diverge. Its importance can therefore be said to differ between individuals.

Next, looking at consumers' subjective knowledge, it becomes apparent that their overall scores for all four topics fell below three out of five. This suggests that most consumers perceive their knowledge as below average across these domains. Interestingly, no significant differences in mean values were found between any of the topics. Moreover, it can be deduced that the duration of the existence of the Nutri-score compared to the Eco-score does not seem to affect how people rate their own subjective knowledge. These findings show that participants think they have relatively similar levels of knowledge in environmental and nutritional aspects, while their knowledge of specific scoring systems (Eco-score and Nutri-score) may exhibit slight variations.

Finally, looking at how people rate specific types of products, it is clear that in the first two ranks, products from supermarket brands were seen as most environmentally friendly, as well as organic products. This is in line with several studies, which also found that organic products are perceived as more sustainable (Becker et al., 2015; Lee and Yun, 2015). Moreover, multinational brand products were frequently rated as least environmentally friendly, in contrast to their supermarket brand counterparts. This perception could be attributed to the belief that supermarket products are produced with greater local emphasis compared to those of multinational companies (Cappelli et al., 2022). Another explanation might lie in the heightened scrutiny or media attention directed toward multinational corporations, potentially leading to more attention if accused of green-washing (Barkemeyer et al., 2020).

6.3 Familiarity and current use of the Eco-score label

Hypothesis 2.1 states that the familiarity and current use of the Eco-Score label was expected to be very low.

This hypothesis can be rejected, as the majority of the participants were indeed familiar with the Eco-score label. A possible explanation for this high familiarity, might be because Colruyt group advertises the Eco-score both on television, radio an social media. Next, current use didn't align with the hypothesis either, as only four out of ten reported never having used the Eco-score label before. However, regarding a current use, only three out of five stated they do their grocery shopping at one of the stores employing the Eco-score label.

6.4 Current consumers' reactions towards the Eco-score label

Hypothesis 2.2 states that, since the Eco-score label is a quite new tool in the market, and not yet now among consumers, reactions are expected to be neutral.

The overall perception, i.e. "Credibility", "Attitude" and "Ease of use", ranged from average to slightly positive. This contradicts with hypothesis 2.2, where neutral reactions were expected. As a result, hypothesis 2.2 is rejected.

Looking at "Credibility" of the Eco-score label, its slightly positive rating can be explained by multiple reasons. Despite its novelty, which was thought of to lead to neutral reactions, the perceived "Credibility" of an eco-label is influenced by the reputation of the company issuing the label (Carmona, 2011). It can therefore be that among consumers, Colruyt group is seen as the issuing company, or the brands of the food products on which the Eco-score is present. Furthermore, the study found that signaling "Credibility" isn't only achieved by presenting the label itself, but also through advertising efforts. Additionally, the positive "Credibility" could also be explained by the fact that it is endorsed by a third party, i.e. the Colruyt Group, rather than a private product brand (D'Souza et al., 2007).

Consumer "Attitude" towards eco-labels is strongly linked to its "Credibility" (Riskos et al., 2021). This could explain why the value for "Attitude" is similar to that of "Credibility". By providing clear and transparent information, i.e. showing both products with high and low environmental impact, consumer information needs are better satisfied. This results in positively influencing consumer attitude (Sharma & Kushwaha, 2019).

The slightly positive mean value of "Ease of use" can be attributed to the hybrid nature of the type. While it offers simplified information, a certain level of cognitive effort is still necessary (Hamlin et al., 2015). Also the fact, that the visualisation of the Eco-score is similar to that of the Nutri-score could explain this positive value. Since people are already familiar with the Nutri-score label, which they find easy to use, it might be easier for consumers to interpret and use the Eco-score as well (Van der Stricht, 2020).

Looking at "Objective knowledge" concerning the Eco-score label, a slightly negative mean value was found. This is in line with hypothesis 2.2, which postulated that consumers' overall objective knowledge would be limited. Although there is variability in the percentage of correctly answered questions, it's generally evident that knowledge was lacking across all facets. A possible reason for these low scores can be due to the labels' novelty which could result in a lack of awareness about its calculation. It might also be possible that people lack knowledge about environmental impact of the food chain in general. However, "Objective knowledge" plays an essential role in the effective utilization of an eco-label. It enables consumers to realize the purpose of eco-labels and positively influences consumer attitudes towards ecologically conscious consumer behavior (Taufique et al., 2016).

6.5 Intention to use the Eco-score and its influencing factors

Hypothesis 2.3. states that since peoples environmental awareness has increased over the years, it was expected that intentions are moderate. Factors that could increase the intention were knowledge, a positive environmental attitude, but also a good perception of the Eco-score.

The findings on the "Intention to use the Eco-score" among consumers indicate a slightly positive intention to use the Eco-score label. Hence, this part of hypothesis 2.3 can be accepted, where on average, moderate intentions were expected.

Next, based on the constructed SEM, results showed that solely the dependent variables “Environmental attitude” and “Perception towards the Eco-score” significantly influences the intention in addition to certain socio-demographic factors. However, neither subjective and objective knowledge exhibited any significant influence. As a consequence, it can be said that this part of hypothesis 2.3 is rejected.

Looking at “Perception towards the Eco-score”, this positive influence is in line with previous studies. For instance, a study by Van der Stricht (2020), found similar results regarding the Nutri-score food label. Other studies also found that a higher perceived credibility, and ease of use could also increase the use of food labels (Ma et al., 2017).

Regarding “Environmental attitude”, this significant influence on the “Intention to use the Eco-score” can be explained by several factors. First, “Environmental concern” is related to green purchasing intention in general (Zhuang et al., 2021). This intention can be strengthened by providing a label that makes this green purchasing intention easier. The same goes for “Environmental purchasing behaviour”, where people indicating they already do efforts in buying more environmentally friendly products, experience an easier way to carry out this behaviour. Furthermore, consumers who acknowledge their environmental responsibilities, i.e. “Environmental responsibility”, might feel obligated in using this label to do better for the environment (Granzin & Olsen, 1991). In addition, it might even increase their willingness to pay (Lee and Ju, 2020).

Looking at both “Subjective knowledge” and “Objective knowledge”, no significant influence on the intention to use the Eco-score label was found. A low variation in these variables might explain these outcomes. Furthermore, the fact that this study looked at conceptual knowledge with regards to “Objective knowledge”, might explain this outcome as this is different from a real life situation. In previous research it has been shown that consumers have more difficulties in understanding a concept compared to the practical understanding and thus usage of the Nutri-score (Grunert et al., 2010). It’s conceivable that a similar scenario holds true for the Eco-score label.

Also socio-demographical influences were examined in this model. The findings revealed variations in the “Intention to use the Eco-score” based on “Age”, while also influencing “Objective knowledge”. This can be explained by the fact that younger people are more concerned about the environment. However, age did not significantly influence “Environmental attitude”. Furthermore, “Employment” was found to influence “Subjective knowledge”, “Environmental attitude”, as well as “Perception towards the Eco-score”. It can be thought of that people who have more time, feel more knowledgeable and have time to prioritize environmental concerns. In addition, they might also invest more effort in comprehending the label compared to people facing time pressure (Ikonen et al., 2019).

Regarding “Income”, it was found that there were differences for “Subjective knowledge” and “Perception towards the Eco-score”. This could be due to consumers with higher income having increased exposure to media, leading to differing perceptions and knowledge (Pew Research Center, 2021). In addition consumers with higher “Income” are exert different consumption patterns and can thus make specific lifestyle choices (Learning, nd). However, “Income” showed no significant influence on “Intention to use the Eco-score”. This is not in line with a study from Grunert & Wills (2007), which reported that consumers with a higher income reported higher food label use.

It is also notable that “Education” had no influence on the “Intention to use the Eco-score”. This suggests that the label is easy to use, allowing all consumers to take the label into consideration at a first glance (Nayga, 2000). Lastly, there seem to be differences between Flanders, Wallonie, and the Brussels capital region regarding “Environmental attitude”. A possible explanation for this might be due to differences in socio-demographic factors within those regions.

Lastly, the low R^2 value suggests that the model accounts for a moderate amount of variance based on the independent variables. Although this value is only moderate, the model still shows explanatory value. This implicates that the model still shows space for improvement, in order to get yet better insights in consumers intentions to use the Eco-score.

6.6 Marketing campaigns

6.6.1 Awareness and participation

Hypothesis 3.1 stated that it was expected that most of the participants were not aware of the social marketing campaigns that are currently present for the Eco-score. However, for the Nutri-Score a higher awareness of campaigns was expected, but also of participation.

It is notable that a substantial proportion of consumers reported awareness of and even participation in Eco-score campaigns that don’t (yet) exist. Looking at the Nutri-score campaigns, more people had heard about any of the existing campaigns before. Nevertheless, still more than three out of five indicated they were aware of and/or participated in non-existing Nutri-score campaigns. These high numbers of people indicating their awareness and participation of non-existing campaigns may be explained by consumers confusing some of these campaigns with existing Eco-score campaigns or vice versa.

Looking at differences between existing Eco- and Nutri-score campaigns, significant differences were found regarding awareness and participation. Reasons for these differences may lie in the fact that the Eco-score is only recently introduced compared to the Nutri-score. Moreover, variations in campaign types and the quantity of distinct campaigns might elucidate these distinctions. As a result, hypothesis 3.1 is accepted.

6.6.2 Perceived effectiveness

Hypothesis 3.2. stated that no differences between the Eco- and Nutri-score campaigns were expected to be found. However, in general, the most effective campaigns according to consumers were presumed to be the ones where there is an immediate benefit such as price discounts. These campaigns will be followed by, the suggestive campaigns, like the meal boxes or alternative suggestions. The least effective campaigns to be selected are the ones where there are longer-term benefits or non-personal benefits.

Differences in perceived effectiveness showed that discounting campaigns would be more effective compared to social marketing campaigns, but not compared to suggestive campaigns regarding the Eco-score. Conversely, analyzing the Nutri-score campaigns, discounting campaigns appeared to be more effective than both suggestive and social marketing campaigns.

This delineates a distinction in perceived effectiveness between the Eco-score and Nutri-score campaigns. This results in the rejection of hypothesis 3.2 as differences between both labels' campaigns perceived effectiveness were found. Additionally, also the indifference between suggestive and social marketing campaigns makes us reject hypothesis 3.2. Once more, the novelty of the Eco-score and its campaigns might explain this difference. Also, for the Eco-score less campaigns do exist, and therefore, people might have not yet been able to experience the effects of the different campaigns compared to the Nutri-score.

6.7 Recommendations concerning the Eco-score label

Based on the discussed results, general recommendations can be proposed for the implementation, utilization, and promotion of the Eco-score label. One of the most important recommendations centers on communicating and informing consumers.

Although, the majority of the consumers had already heard about the Eco-score label before, nearly half of the consumers does not yet incorporate the Eco-score label. Consequently, it might be good for retailers to increase their communication, advertisement and/ or their marketing endeavors. However, which actions will be most effective on increasing its awareness and use might depend on the reasons of participants not using the Eco-score at the moment. Nonetheless, this study points to the potency of discounting campaigns as a particularly effective avenue. In turn, this can amplify the overall adoption of the Eco-score label. For consumers unfamiliar with the Eco-score label, informing them is key. Here, the focus should center on conveying what the Eco-score label stands for, and providing guidance on its utilization (Ducrot et al., 2019). However, given the novelty of the label, it's reasonable to expect that over time, overall awareness will still increase. Nevertheless, after efforts to enhance awareness, the potential for current usage can be extended only to those who shop at Colruyt group stores. Consequently, considering a voluntary implementation of the Eco-score label, similar to the Nutri-score's current practice, could prove beneficial (Vandevijvere and Berger, 2021). This implementation might also incentivise producers to reformulate their products toward more environmentally friendly alternatives.

To increase the intention to use the Eco-score label, two overarching recommendations can be proposed. First, a focus on people that have a positive environmental attitude can be key. This segment has demonstrated a greater likelihood of intending to use the Eco-score label. For this group expanding the product assortment that uses the Eco-score label could offer a valuable opportunity. Secondly, improving the perception of the Eco-score can increase intentions to use the label as well. Increasing "Credibility of the Eco-score" and "Attitude towards the Eco-score" can be achieved through transparent information dissemination about the label. Therefore, it might be useful to educate consumers about the fact that the Eco-score label was developed by scientists as well as by multiple stakeholders. "Ease of use of the Eco-score" might be increased by educating the consumers about the Eco-score label by means of guidelines or advertising.

In addition to considering recommendations for increasing the use of the Eco-score label, focusing on enhancing its accurate usage is equally crucial. Here, it is notable that consumers objective knowledge plays a significant role when the Eco-score label is used. It's important to highlight the remarkably low mean scores in objective knowledge. This emphasizes the importance of properly informing what the Eco-score stands for, and how it is calculated once more. However, subjective knowledge, both regarding the environment and the Eco-score label have also been shown to increase a correct evaluation. Making people feel knowledgeable, due to education emphasis its importance even more. In contrast, "Environmental purchasing behaviour" has shown a negative influence on correct evaluation. This might be due to the fact that people lack knowledge on what determines the environmental impact, and due to absence of the label. Both the implementation of the label, as well as properly informing them on what determines the environmental impact of their food is therefore key.

Lastly, awareness and participation between the Eco- and Nutri-score campaigns differed significantly. Additional advertisement can increase this awareness, but also looking at the type of marketing campaigns can be an important factor. Since discounting campaigns are indicated to be most effective, and the fact that social marketing campaigns are thus far the only ones implemented, changing the type of campaign might also increase overall use.

6.8 Study limitations

Although this study tried to be as correct as possible, some limitations should be acknowledged. Looking at the study design, having a questionnaire existing out of two languages might create subtle nuances, resulting in different interpretations among participants. Furthermore, within the context of the theoretical framework used, not all original factors could be assessed due to limitations in time and size of the questionnaire. Consequently, some gaps might exist in the overall picture.

Looking at the sampling method, the utilization of quotas might result in not reaching the most vulnerable consumers. This approach might yield notable variations in outcomes when compared to the utilization of random sampling (Guignard et al., 2013). Additionally, the fact that the survey was conducted in an online environment, could have resulted in the exclusion of individuals without internet access (Bigot et al., 2010). As a results, the sample might not offer a complete representation of the Belgian population.

It should also be kept in mind that the way of conducting a survey does not reflect a real-life situation. When evaluating environmental attitudes, a social-desirability bias might occur, where people imply they do more effort compared to their real life situation. Also, looking at the intention to use the Eco-score label during food shopping, a considerable discrepancy is likely to exist between intentions and actual usage of the label (Tao, 2009). To address this shortcoming and better simulate real-life situation, an online shopping experiment could've been used instead.

During the data-analysis, some limitation of the study design were noticed. When talking about the Eco- and Nutri-scores in the GLM, it's important to note that the model used the products carrying those scores, rather than the scores themselves. Additionally, due to a dual label approach, the evaluation may be less correct. The reason for this could be the potential occurrence of an information overload (Jacoby, 1984). Furthermore, when dealing with two extremes, i.e. a high Eco-score, but a low Nutri-score, consumers may face difficulties in their evaluation. In addition, despite efforts to use products that are known for the overall Belgian population, some might still be unknown to the participants. The use of different and more diverse products, might have yielded different and better results. Although these are clear limitations, in this study it was not feasible to cover and use more products due to the size of the study and the sample sizes needed per product. Lastly, the SEM provided indications of potential differences between intentions to use the label and specific socio-demographic characteristics. However, it did not give us any insights in the nature of these differences. Nonetheless, by the means of i.e. post-hoc tests, this could be determined.

7 Conclusion

This master's dissertation provides a comprehensive analysis of the Eco-score label's effectiveness in influencing purchasing behaviour and the corresponding reactions from consumers. The Eco-score label shows to be a promising tool for steering consumers towards more environmentally responsible food choices, eliciting positive reactions from consumers.

The study underscores the promising role of the Eco-score label in aiding consumers' assessment of the environmental impact of food products. However, this influence is contingent upon consumers' understanding the Eco-scores purpose and the amplitude to which the consumers are informed about the environment. Additionally, crucial preconditions for the label to be effective are a positive perception among consumers as well as environmental concern. This condition holds true as the Eco-score's alignment with consumers' favorable "Environmental concern" further reinforces its potential. Nevertheless, The complexities involved in making trade-offs between attributes, such as weighing "Environmental welfare" and "Local and seasonal production" against "Health" and "Price", reveal the complex nature of the consumers' decision-making process. Despite consumers positive "Environmental attitude", overall, subjective knowledge scores regarding the Eco-score and the environment were below average.

This positive perception extends to consumers' "Intention to use the Eco-score". This intention is significantly influenced by factors including "Environmental attitude", "Perception of the Eco-score", and "Age". "Objective knowledge" and "overall subjective knowledge" showed no influence. Furthermore, no differences were found for "education", suggesting the labels' ease of use.

Next, a comparative examination of marketing campaigns highlights the need to enhance awareness and participation regarding the Eco-score, particularly when comparing both with Nutri-score campaigns. Consumers' preference for price discounts as effective incentives underscores their absence in current Eco-score campaigns and can be useful to increase the Eco-scores use. Familiarity with the Eco-score is notable, yet a significant portion of consumers do not use the label. This emphasizes the urgency of strengthening awareness campaigns, supplemented by informative strategies and compelling incentives like price discounts. Consumers' favorable perceptions of the Eco-score's credibility, ease of use, and attitude towards the label validate its potential.

In conclusion, this work provides clear insights in the effectiveness and consumers′ reactions of the Eco-score label. The Eco-score's potential as a tool to guide consumers towards more environmentally friendly food choices is validated by its recognition and positive reception among a substantial proportion of the Belgian population. Recommendations arising from this study emphasize comprehensive communication strategies encompassing widespread awareness initiatives and in-depth consumer education. Ensuring transparency in the Eco-score's calculation process remains a cornerstone, while the incorporation of marketing campaigns featuring tangible incentives, such as price discounts, could significantly augment its adoption.

Further research is needed to understand the intricate decision-making processes behind the Eco-scores usage. Additionally, examining consumer attitudes towards voluntary Eco-score implementation may offer valuable insights. Lastly, assessing how consumers perceive and respond to a dual-label approach, combining the Eco-score with the Nutri-score, can provide valuable insights in the future.

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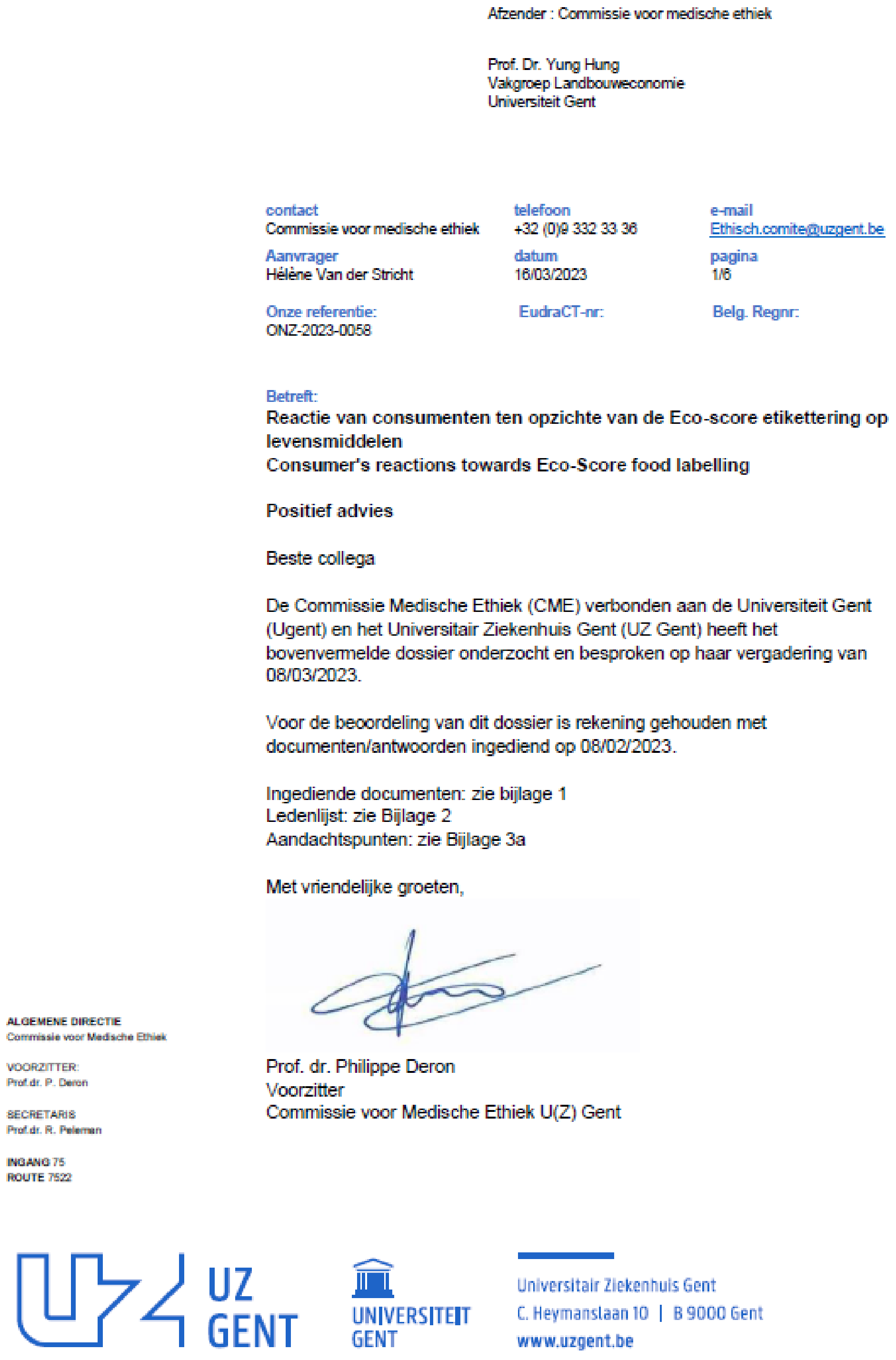
A Life cycle analysis - Indicators

Table 26: Summary of the indicators on which the LCA is based.

Medium	Indicator	Description
Air	Climate Change (CO_2)	Corresponds to climate change, with impacts on the global ecosystem (expressed in (CO_2)equivalent)
Air	Fine particles	Fine particles enter organisms, especially through the lungs. They have an effect on human health.6
Air	Depletion of the ozone layer	The ozone layer is located at a high altitude in the atmosphere and protects from the sun's ultraviolet rays. Its depletion increases the exposure of all living things to this negative radiation (particularly carcinogens).
Air	Photochemical ozone formation	This leads to a deterioration of air quality, especially through the formation of low-level fog called "smog"". It has harmful effects on health.
Air	Acidification	The result of chemical emissions into the atmosphere that re-enter ecosystems. This problem is particularly well known due to the phenomenon of acid rain.
Air, water, soil	Ionizing radiation	Corresponds to the effects of radioactivity. This effect corresponds corresponds to the radioactive waste generated in the production of nuclear energy.
Water	Depletion of the water resources	Corresponds to the consumption of water and its depletion in certain regions. This category takes into account scarcity (it has more impact to consume a liter of water in Morocco than in Brittany).
Water	Marine eutrophication	Corresponds to excessive enrichment of natural environments with nutrients, leading to proliferation and suffocation (dead zone). It is this phenomenon that is at the origin of green algae.
Water	Freshwater eutrophication	Corresponds to excessive enrichment of natural environments with nutrients, leading to proliferation and suffocation (dead zone). It is this phenomenon that is at the origin of green algae. It can also be found in rivers and lakes.
Land	Terrestrial eutrophication	As in water, terrestrial eutrophication corresponds to an excessive enrichment of the environment, particularly with nitrogen, which leads to an imbalance and an impoverishment of the ecosystem. This mainly concerns agricultural land.
Land	Use of land	Land is a finite resource, divided between "natural" (forest) productive (agriculture) and urban environments. Use of land and habitats largely determine biodiversity. This category therefore reflects the effect of an activity on land degradation, with reference to the "natural condition."
Land	Depletion of energy resources	Corresponds to the depletion of non-renewable energy sources: coal, gas, oil, uranium, etc.

Medium	Indicator	Description
Land	Depletion of mineral resources	Corresponds to the depletion of non-renewable mineral resources: copper, potassium, rare earths, sand, etc.
Air, Water, soil	Toxicities (3 species)	Freshwater ecotoxicity, Carcinogenic and non-carcinogenic toxicity to humans. Indicators of toxicity via environmental contamination. These humans indicators are currently not very robust.

B Ethics approval



Afzender : Commissie voor medische ethiek

Prof. Dr. Yung Hung
Vakgroep Landbouweconomie
Universiteit Gent

contact	**telefoon**	**e-mail**
Commissie voor medische ethiek	+32 (0)9 332 33 36	Ethisch.comite@uzgent.be
Aanvrager	**datum**	**pagina**
Hélène Van der Stricht	16/03/2023	1/6
Onze referentie:	**EudraCT-nr:**	**Belg. Regnr:**
ONZ-2023-0058		

Betreft:
Reactie van consumenten ten opzichte van de Eco-score etikettering op levensmiddelen
Consumer's reactions towards Eco-Score food labelling

Positief advies

Beste collega

De Commissie Medische Ethiek (CME) verbonden aan de Universiteit Gent (Ugent) en het Universitair Ziekenhuis Gent (UZ Gent) heeft het bovenvermelde dossier onderzocht en besproken op haar vergadering van 08/03/2023.

Voor de beoordeling van dit dossier is rekening gehouden met documenten/antwoorden ingediend op 08/02/2023.

Ingediende documenten: zie bijlage 1
Ledenlijst: zie Bijlage 2
Aandachtspunten: zie Bijlage 3a

Met vriendelijke groeten,

Prof. dr. Philippe Deron
Voorzitter
Commissie voor Medische Ethiek U(Z) Gent

ALGEMENE DIRECTIE
Commissie voor Medische Ethiek

VOORZITTER:
Prof.dr. P. Deron

SECRETARIS
Prof.dr. R. Peleman

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CC: FAGG
Cc: HIRUZ_CTU (Clinical Trial Center UZ Gent)

Unofficial translation in English:

Positive advice

The Ethics committee (EC) of University Ghent (Ugent) and Ghent University Hospital (UZ Gent) has examined and discussed the above mentioned dossier at its meeting of 08/03/2023.

For the assessment of this dossier, documents/answers submitted on 08/02/2023, have been taken into account.

Submitted documents: see Annex 1
List of members: see appendix 2
Points of concern: see appendix 3b

Bijlage 1: Documenten

Categorie: CV
- hoofdonderzoeker Christine Yung Hung, versie 1 dd. 18/01/2023 (English)

Categorie: GCP certificaat
- hoofdonderzoeker Christine Yung Hung, versie 1 dd. 18/01/2023 (English)

Categorie: Gegevensverwerkingsregister
- DMP plan voor eco-score, versie 1 dd. 18/01/2023 (English)

Categorie: Informatie- en toestemmingsformulier
- ICF formulier voor Eco-Score, versie 1 dd. 18/01/2023 (Nederlands)

Categorie: Vragenlijsten
- Vragenlijst Eco-Score EN, versie 1 dd. 18/01/2023 (English)
- Vragenlijst Eco-Score NL, versie 1 dd. 18/01/2023 (Nederlands)

Bijlage 2: Overzicht leden CME U(Z) Gent

voorzitter: Prof. dr. P. Deron
Secretaris: Prof. Dr. R. Peleman

Effectief lid	Plaatsvervangend lid
Dr. G. VAN LANCKER (UZ GENT – klinisch farmacoloog, ♀)	Prof. dr. S. ROTTEY (UZ GENT – klinisch farmacoloog, ♀)
Prof.dr. D. DE BACQUER (UGENT - statisticus, ♂)	Prof. dr. P. COOREVITS (UGENT - statisticus, ♂)
Dr. J. VAN ELSEN (huisarts, ♂)	Dr. M. COSYNS (huisarts, ♂)
Prof. dr. K. DE GROOTE (UZ GENT – kindercardioloog, ♀)	Prof. dr. P. SCHELSTRAETE (UZ GENT – kinderpneumoloog/infectioloog, ♀)
Prof. dr. W. NOTEBAERT (UGENT – psycholoog, ♂)	Mr. W. SCHRAUWEN (UZ GENT – psycholoog, ♂)
Mevr. M. FOUQUET (UZ GENT – verpleegkundige, ♀)	Mevr. I. VLERICK (UZ GENT – verpleegkundige, ♀)
Dhr. C. DEMEESTERE (UZ GENT – verpleegkundige, lic. Medisch sociale wetenschappen, ♂)	Dhr. G. DE SMET (UZ GENT – verpleegkundige, - lic. Medisch sociale wetenschappen ♂)
Mevr. K. KINT (UZ GENT – apotheker, ♀)	Mevr. L. HUYS (UZ GENT – apotheker, ♀)
Dhr. B. VANDERHAEGEN (UZ GENT - moraaltheoloog, ♂)	Prof. dr. S. STERCKX (UGENT - moraalfilosoof, ♀)
Prof. Dr. T. GOFFIN (UGENT - jurist, ♂)	
Mevr. C. VANCAENEGHEM (patiëntvertegenwoordiger, ♀)	Mevr. S. DE GROOTE (patiëntvertegenwoordiger, ♀)
Prof. dr. P. DERON (UZ GENT – chirurg, ♂)	Prof. dr. W. CEELEN (UZ GENT – chirurg, ♂)
Prof. dr. R. PELEMAN (UZ GENT - internist/pneumoloog, ♂)	Prof. dr. H. VERSTRAELEN (UZ GENT – Vulva-arts, ♂)
Prof. dr. J. DECRUYENAERE (UZ GENT – internist/intensivist, ♂)	Dr. N. PETERS (UZ GENT – fertiliteitsarts, ♀)
Prof. dr. R. RUBENS (UZ GENT – internist/endocrinoloog, ♂)	Prof. dr. W. VAN BIESEN (UZ GENT – nefroloog, ♂)
Prof. dr. M. De MUYNCK (UZ GENT – arts fysische geneeskunde en revalidatie, ♀)	Dr. S. JANSSENS (UZ GENT – geneticus, ♀)
Prof. dr. K. DHONDT (UZ GENT – (kinder)psychiater, ♀)	Dr. L. GOOSSENS (UZ GENT – neonatoloog, ♀)

Appendix 3a: Aandachtspunten (indien van toepassing)

De CME heeft geen bezwaar tegen het project op voorwaarde dat de gegevens vertrouwelijk worden beheerd en in overeenstemming met de Belgische wetgeving inzake privacy.

De CME benadrukt de verantwoordelijkheid van de PI/promotor van dit onderzoek met betrekking tot de privacy van de persoons-/patiëntgegevens in contact met patiënten, of bij de toegang tot patiëntgegevens, inclusief de juiste implementatie hiervan door collega's en studenten. De PI/promotor is verantwoordelijk voor de uitvoering van het projectvoorstel in overeenstemming met de toepasselijke wet- en regelgeving waaronder, maar niet beperkt tot, de EU-verordening 2016/679 (Algemene Verordening Gegevensbescherming), de Belgische Wet op de patiëntenrechten van 22/ 8/2002, het reglement van het ziekenhuis inzake weefselbeheer en het reglement van de wet van 19 december 2008.

De CME verwijst naar de ICH/GCP-richtlijnen op haar website en bevestigt dat van elke onderzoeker een GCP-training vereist is. Het is de verantwoordelijkheid van de hoofdonderzoeker dat elk lid van het onderzoeksteam een geldig GCP-certificaat heeft.

Dit project valt niet onder de bevoegdheid van de wet van 7/5/2004.

De CME bevestigt te werken in overeenstemming met de ICH-GCP-principes (International Conference on Harmonization Guidelines on Good Clinical Practice), de nieuwste versie van de Verklaring van Helsinki, het Oviedo-verdrag inzake mensenrechten en biogeneeskunde en toepasselijke wet- en regelgeving.

De CME bevestigt dat - in geval van belangenverstrengeling - betrokken leden niet deelnemen aan de stemming over het onderzoek.

De conformiteit van vertaalde documenten ten opzichte van de Nederlandse documenten is de verantwoordelijkheid van de opdrachtgever.

Mits er een Clinical Trial Agreement is, kan de studie pas starten wanneer de Clinical Trial Agreement werd goedgekeurd en ondertekend door de CEO van het UZ Gent (en/of door een gemachtigde vertegenwoordiger van de UGent).

Dit advies van de CME houdt niet in dat zij de verantwoordelijkheid voor het geplande onderzoek op zich neemt. U blijft verantwoordelijk voor het onderzoek. Daarnaast dient u ervoor te zorgen dat uw mening als betrokken onderzoeker wordt weergegeven in publicaties, rapporten voor de overheid etc. die het resultaat zijn van dit onderzoek.

De CME-goedkeuring die voor een specifiek project wordt gegeven, is één jaar geldig. Wij verzoeken u ons te informeren als het onderzoek niet wordt gestart of als het onderzoek niet binnen 1 jaar na goedkeuring start.

Appendix 3b: Points of concern (if applicable)

EC has no objection to the project provided that the data is managed confidentially and in compliance with the Belgian legislation on privacy.

The EC emphasizes the responsibility of the PI/promotor of this study concerning the privacy of the person/patient data in contact with patients, or when accessing patient data, including the correct implementation thereof by coworkers and students. The PI/promotor is responsible for the implementation of the project proposal in accordance with applicable laws and regulations including, but not limited to, the EU regulation 2016/679 (General Data Protection Regulation), the Belgian Law on patients' rights of 22/8/2002, the regulations of the hospital concerning tissue management and the regulations of the law of December 19, 2008.

The EC refers to the ICH/GCP guidelines on its website, and confirms that a GCP-training is required from each investigator. It is the responsibility of the principal investigator that each member of the study team has a valid GCP-certificate.
This project does not fall within the scope of the Law of 7/5/2004.

The EC confirms working in accordance with the ICH-GCP principles (International Conference on Harmonization Guidelines on Good Clinical Practice), the latest version of the Declaration of Helsinki, the Oviedo Convention on Human Rights and Biomedicine and applicable laws and regulations.

The EC confirms that - in case of conflict of interest - involved members do not take part in the vote concerning the study.

The conformity of translated documents compared to the Dutch documents, is the responsibility of the sponsor.

Provided that there is a ***Clinical Trial Agreement****, the study can only start when the Clinical Trial Agreement has been approved and signed by the CEO of UZ Gent (and/or by an authorized representative of UGent).*

This advice of the EC does not imply that it will assume responsibility for the planned study. You will remain responsible for the study. In addition, you should ensure that your opinion as an involved researcher is reproduced in publications, reports for the government, etc. which are the result of this study.

The EC approval given for a specific project, is valid for one year. We request you to inform us if the study will not be initiated or if the study does not start within 1 year after approval.

C Survey

Start of Block: Informed consent

IC1 **A. Information about the study**

Dear participant,

You are invited to participate in a study at Ghent University. Before deciding on your participation in this study, we ask you to take sufficient time to read this information page. Do not hesitate to ask questions to the researcher if you are unclear or would like additional information. Once you have decided to take part in this study, you will be asked to agree to participate at the end of this information page.

The Department of Agricultural Economics at Ghent University is conducting a study on consumers' reactions towards the Eco-Score food label on food products. Participation in this study will take about 25 minutes of your time.

Ethical approval

This study was approved by the Ethics Committee of Ghent University on 16 March 2023. The study is conducted in accordance with the guidelines of "good clinical practice" (ICH/GCP) as well as the "Helsinki Declaration", established to protect those involved in this study. Under no circumstances should you consider approval by the Ethics Committee as an inducement to participate in this study. This data collection is conducted under the supervision of Prof Dr. Christine Yung Hung.

B. Information regarding participation

What does participating in this study involve?

Your participation in this study is completely voluntary and there can be no coercion in any way. You may refuse participation in this study and you may withdraw from the study at any time without any required reason. If you refuse to participate, or if you decide to withdraw from an ongoing study, this will in no way affect your continued relationship with the researcher, your evaluation, and/or study supervision (if you are a student).

What are the risks and benefits of participating in this study?

There are no known risks associated with this study. The same applies to the benefits. However, the results obtained through this study can be used to apply improvements to the implementation of Eco-Score labels.

Is there any compensation or reward provided when participating in this study?

Your participation in this study does not involve any additional costs or fees.

C. Information regarding Privacy and Personal Data

Under the European General Data Protection Regulation (AVG) (EU) 2016/679 on the protection of personal data (AVG, 27 April 2016), your privacy will be respected. Researchers must comply with Ghent University's generic code of conduct for processing personal data. The processing of the data is provided for by law based on Article *, § 1, (b), (e), or (f) and Article 9, § (j) of the European General Data Protection Regulation.

The information collected during this study and linked to your participation will be pseudonymized. During pseudonymization, a key allows the code assigned to your participation to be consulted again. This key is only available to the researcher in question, or the assigned replacement. This study collects data via an electronic questionnaire.

Only the pseudonymized data will be used for the analysis of the research questions, the study report, and for publications.

Your personal data will be processed and kept for at least 20 years.

Your explicit consent will be requested for the processing of your personal data. This is done by giving consent at the end of this information page. Consent can be withdrawn at any time by notifying the principal investigator.

Only pseudonymized data will be used for analysis and in any type of documentation, reports, or publications concerning this study. Personal data will be processed and stored for at least 20 years. The data controller is the study's principal investigator, Prof Dr. Christine Yung Hung (Yung.Hung@UGent.be). Her research team will have access to your personal file.

For data protection reasons, your pseudonymized data may be disclosed after the study. These data may also still be useful in answering other research questions. The reuse of the research data can be done both within the in-house research team and by external researchers within and outside the European Union.

Representatives of the promoter, the Medical Ethics Committee, and competent authorities, all bound by professional secrecy, may have direct access to your data under the responsibility of the researcher (or one of his/her collaborators) to study procedures and/or the data, without violating their confidentiality. This is only possible within the limits of the relevant legislation. By agreeing to the information and having received the prior explanation, you consent to this access. You have the right to file a complaint about the processing of your data with the Data Protection Authority.

In accordance with European and Belgian privacy legislation, your privacy is respected. As already indicated, you can withdraw your consent at any given moment and without giving any reason. This means that your data will not be further processed from the moment of withdrawal.

You have the right to inspect the data collected about you and you may also request a copy, provided this does not infringe the rights and freedoms of others, including those of Ghent University. Any inaccurate data about you can be corrected at your request. Furthermore, you have the right to oblivion: this means that, after withdrawing your consent, you may ask for your personal data to be deleted.

To exercise any of the above rights, please contact the researchers concerned at Yung.Hung@UGent.be

Do you have a complaint?

If you would like to make a complaint about the way your personal data is handled or if you have any questions regarding your personal data in the context of this research, you may contact the Data Protection Officer of Ghent University at privacy@ugent.be or T 09 264 95 17.

You can also contact the "Data Protection Authority" (DPA):

"Data Protection Authority" (DPA)
Rue de la Presse 35, 1000 Brussels
Tel: +32 2 274 48 00
Email: contact@apd-gba.be
Website www.dataprotectionauthority.be

IC2 **I have read the information form and received sufficient explanation about the nature, purpose, and duration of the study, and what is expected of me.**

○ Yes (1)

○ No (2)

IC3 **I agree to participate in this study.**

○ Yes (1)

○ No (2)

IC4 **I consent to the researchers collecting, processing, storing, analysing and reporting (personal) data about me for the purposes of this study. I know that I have rights to safeguard my privacy (including inspection, correction, deletion) and to whom I should address myself to exercise these rights.**

○ Yes (1)

○ No (2)

IC5 **I consent to the researchers sharing my data for further similar scientific research and this within and outside the European Economic Area. In doing so, all necessary measures will be taken to protect the confidentiality of my personal data.**

○ Yes (1)

○ No (2)

IC6 **I give permission to researchers of the research group to reuse my data for further similar scientific research.**

○ Yes (1)

○ No (2)

End of Block: Informed consent

Start of Block: Screening

Q1 **What is your gender?**

○ Male (1)

○ Female (2)

○ Other / Prefer not to say (3)

*

Q2 **What is your age?**

____

Q3 **In which region do you live?**

○ Antwerp (1)

○ Limburg (2)

○ East Flanders (3)

○ West Flanders (4)

○ Flemish Brabant (5)

○ Brussels Capital Region (6)

○ Hainaut (7)

○ Brabant Wallon (8)

○ Namur (9)

○ Liège (10)

○ Luxembourg (11)

Q4 **Which of the following statements describes best the level of your responsibility for food shopping in your household?**

○ I am responsible for all or most of the food shopping. (1)

○ I am responsible for food shopping occasionally. (2)

○ I am not responsible for any of the food shopping. (3)

Skip To: End of Survey If Q4 = I am not responsible for any of the food shopping.

End of Block: Screening

Start of Block: Product 1

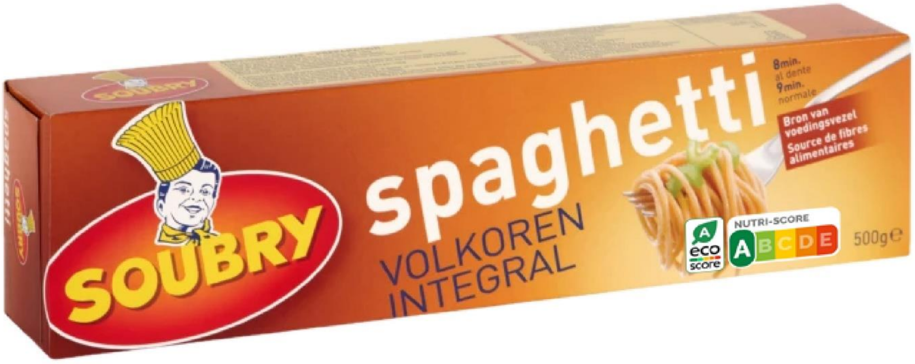
P1

Soubry - Spaghetti volkoren

Ingrediënten: 100% volkoren griesmeel van hoogwaardige harde tarwe

Nutritionele waarde (per 100 g): Energie 1446 kJ/ 342 kcal, Vetten 2 g waarvan 0.1 g Verzadigde vetten, Koolhydraten 64 g waarvan 3.5 g Suikers, Vezels 6.8 g, Proteïnen 13.5 g, Zout 0.25 g

Gewicht: 500 g


SOUBRY
spaghetti
VOLKOREN
INTEGRAL
8min. al dente
9min. normale
Bron van voedingsvezel
Source de fibres alimentaires
eco score A
NUTRI-SCORE
A B C D E
500g ℮

P1.1 **Based on the provided information of the product shown above. How would you rate the nutritional value on a scale from 1 to 5?**

	Very poor (1) (1)	(2) (2)	(3) (3)	(4) (4)	Excellent (5) (5)
Nutritional value (1)	○	○	○	○	○

P1.2 **Based on the provided information of the product shown above. How would you rate the environmental impact on a scale from 1 to 5?**

	Low (1) (1)	(2) (2)	(3) (3)	(4) (4)	High (5) (5)
Environmental impact (1)	○	○	○	○	○

P1.3 **Based on the provided information of the product shown above. How would you rate the overall liking on a scale from 1 to 5?**

	Extremely dislike (1) (1)	(2) (2)	(3) (3)	(4) (4)	Extremely like (5) (5)
Overall liking (1)	○	○	○	○	○

End of Block: Product 1

Start of Block: Post evaluation

✱ ⤮

Q5 **What information did you use to evaluate the products that were just shown?**
More than one answer can be selected.

☐ Nutritional value (1)

☐ Ingrediënts (2)

☐ Nutri-Score (3)

☐ Eco-Score (4)

☐ Packaging material of the products (5)

☐ Other (6) ____

End of Block: Post evaluation

Start of Block: Food-related attitude and subjective knowledge

✱

Q6 **How important are the following factors when you choose the food that you eat on a typical day?**
Rank the items by dragging them into the table at the right, where number 1 is most important, number 7 least important.

Importance

______ Health (1)

______ Convenience (2)

______ Sensory appeal (3)

______ Environmental welfare (4)

______ Price (5)

______ Local and seasonal production (6)

______ Familiarity (7)

Page Break

Q7 **To what extent do you agree with the following statements?**
Mark one answer per row.

	Strongly agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Strongly disagree (5)
If things continue on their present course, we will soon experience a major ecological catastrophe. (1)	○	○	○	○	○
I have switched products for ecological reasons. (2)	○	○	○	○	○
I have the power to protect the environment. (3)	○	○	○	○	○
Humans are severely abusing the environment. (4)	○	○	○	○	○
I will work to make my surrounding environment a better place. (5)	○	○	○	○	○
The balance of nature is very delicate and easily upset. (6)	○	○	○	○	○

Page Break

Q8 **To what extent do you agree with the following statements?**
Mark one answer per row.

	Strongly agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Strongly disagree (5)
When I have a choice between two equal products, I purchase the one less harmful to other people and the environment. (1)	○	○	○	○	○
I make a special effort to buy products that are packaged with recycled materials. (2)	○	○	○	○	○
I make a special effort to buy products that are environmentally friendly. (3)	○	○	○	○	○
Despite our special abilities, humans are still subject to the laws of nature. (4)	○	○	○	○	○

I have avoided buying a product because it had potentially harmful environmental effects. (5)	○	○	○	○	○
I can learn how to improve the environment. (6)	○	○	○	○	○
My actions impact the health of the environment. (7)	○	○	○	○	○

Page Break

Q9 **Compared to most people, how knowledgeable do you feel regarding the following subjects?**
Mark one answer per row.

	Not at all (1)	Slightly (2)	Moderately (3)	Very (4)	Extremely (5)
Environment welfare (1)	○	○	○	○	○
Eco-score (2)	○	○	○	○	○
Nutritional health (3)	○	○	○	○	○
Nutri-score (4)	○	○	○	○	○

Page Break

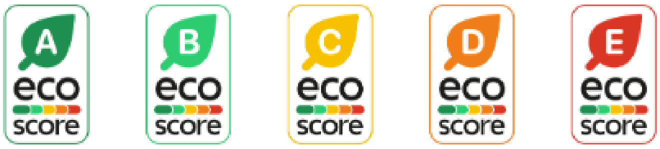
Q10 **In your opinion, how do the ecological footprints or environmental friendliness differ between the types of brands or products in general?**
Mark one answer per row.

	Most environmentally friendly (1)	Environmentally friendly (2)	Less environmentally friendly (3)	Least environmentally friendly (4)
Non-organic products from supermarket's own brand (1)	○	○	○	○
Organic products from supermarket's own brand (2)	○	○	○	○
Non-organic products from multinational company's brand (3)	○	○	○	○
Organic products from multinational company's brand (4)	○	○	○	○

End of Block: Food-related attitude and subjective knowledge

Start of Block: Eco-Score familiarity and objective knowledge

I.1
The following questions are about the food label "Eco-score" as shown below:



Q11 **Have you already seen, heard of or used the Eco-Score before this survey?**

○ Yes, and I always use the Eco-Score when buying food. (1)

○ Yes, and I often use the Eco-Score when buying food. (2)

○ Yes, and I sometimes use the Eco-Score when buying food. (3)

○ Yes, but I have never used the Eco-Score when buying food. (4)

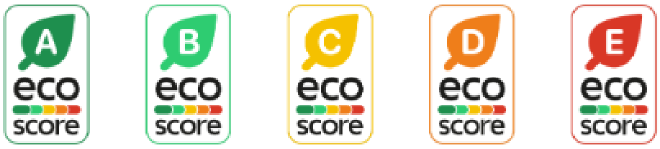
○ No, I have never seen or used the Eco-Score. (5)

Skip To: End of Survey If Q11 = No, I have never seen or used the Eco-Score.

Page Break

I.1

The following questions are about the food label “Eco-score” as shown below:



Q12 **Please indicate if the following statements are true or false in relation to Eco-score based on your personal opinion.**

Mark one answer per row.

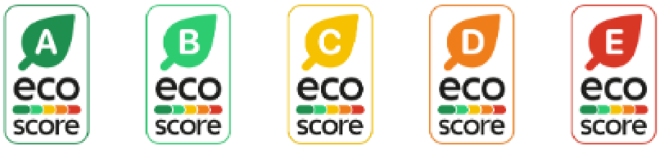
	True (1)	False (2)	I don 't know (3)
Products can have a better Eco-score if they contain a third-party sustainability credentials such as a bio (organic) or Fairtrade label. (1)	○	○	○

The Eco-score of private-label products (i.e. supermarket’s own brand) are calculated differently than those of multinational brands. (2)	○	○	○
Products that have better nutritional value or a better Nutri-score automatically have a better Eco-score. (3)	○	○	○
Fresh vegetables and fruits have no Eco-score label. (4)	○	○	○
Products that are packed in glass will always have a better Eco-score compared to similar products that are packed in plastic. (5)	○	○	○
When a producer reformulates a product, the Eco-score can change. E.g. from Eco-score B to A. (6)	○	○	○

End of Block: Eco-Score familiarity and objective knowledge

Start of Block: Perception Eco-Score

I.2
The Eco-score serves as a guide for choosing food products based on environmental impact. Using letter and color codes ranging from an A on a green background (low impact) to an E on a red background (high impact), it summarizes the environmental impact of a product's life cycle, including its packaging.


A eco score
B eco score
C eco score
D eco score
E eco score

Q13 **To what extent do you agree with the following statements regarding the Eco-score label?**
Mark one answer per row.

	Strongly agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Strongly disagree (5)
The Eco-Score label is a credible source of information about the environmental impact of a food product. (1)	○	○	○	○	○
The Eco-score labels are audited with transparent environmental information. (2)	○	○	○	○	○
I do not trust the Eco-score label. (3)	○	○	○	○	○

I can make more environmental-friendly food choice by using the Eco-score label. (4)	○	○	○	○	○
The Eco-score label is not useful. (5)	○	○	○	○	○
I would choose a product with a better Eco-score in general. (6)	○	○	○	○	○
It is convenient to get informed about the environmental impact of a product by using the Eco-score label. (7)	○	○	○	○	○
The Eco-Score is simple. (8)	○	○	○	○	○
It is difficult to understand the Eco-Score. (9)	○	○	○	○	○
The next time I do my groceries, I will use the Eco-score. (10)	○	○	○	○	○

End of Block: Perception Eco-Score

Start of Block: Social marketing initiatives Eco-Score

Q14 **There are different initiatives taken by the supermarkets to promote ecological-friendly food consumption. Have you heard of or participated in any of the following initiatives before this survey?** Mark one answer per row.

	I have not heard about it (1)	I have heard about it but never purchased anything accordingly (2)	I have participated and made purchases accordingly (3)
Discount on selected products with Eco-score A or B. (1)	○	○	○
Collecting points by purchasing products with Eco-score A or B to support good causes for the environment. (2)	○	○	○
Collecting points by purchasing products with Eco-score A or B to join workshop about environmental sustainability. (3)	○	○	○
Discount on selected products with approaching expiry day. (4)	○	○	○
Recipes using products with better Eco-score in promotional material. (5)	○	○	○

Suggestions about alternative products with a better Eco-score in a personalised mailshot. (6)	○	○	○
Suggestions about alternative products with a better Eco-score on a digital app. (7)	○	○	○
A very low-priced food box filled with products looking less fresh but still suitable for consumption. (8)	○	○	○
Meal kits or recipe boxes containing products with better Eco-score. (9)	○	○	○

Page Break

*

Q15 **Please select and rank the three most effective initiatives to promote ecological-friendly food consumption according to your personal opinion.**

Move and rank your three most effective initiatives into the box.

Most effective initiatives

______ Discount on selected products with Eco-score A or B. (1)

______ Collecting points by purchasing products with Eco-score A or B to support good causes for the environment (2)

______ Collecting points by purchasing products with Eco-score A or B to join workshop about environmental sustainability (3)

______ Discount on selected products with approaching expiry day (4)

______ Recipes using products with better Eco-score in promotional material (5)

______ Suggestions about alternative products with a better Eco-score in a personalised mailshot (6)

______ Suggestions about alternative products with a better Eco-score on a digital app (7)

______ A very low-priced food box filled with products looking less fresh but still suitable for consumption (8)

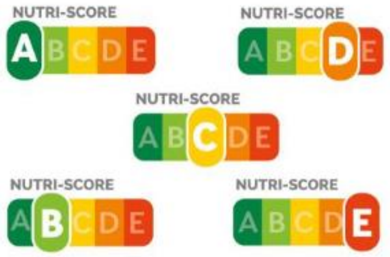
______ Meal kits or recipe boxes containing products with better Eco-score (9)

End of Block: Social marketing initiatives Eco-Score

Start of Block: Social marketing initiatives Nutri-Score

I.3

The Nutri score serves as a guide for choosing food products based on nutritional value. Using letter and color codes ranging from an A on a green background (better in nutritional value) to an E on a red background (worse in nutritional value), the score is calculated based on positive points (fiber content, protein, vegetables, fruits and nuts) and negative points (energy content, fat, saturated fatty acids, sugar and salt).



Q16 **There are different initiatives taken by the supermarkets to promote healthy (nutritional) food consumption. Have you heard of or participated in any of the following initiatives before this survey?**

Mark one answer per row.

	I have not heard about it (1)	I have heard about it but never purchased anything accordingly (2)	I have participated and made purchases accordingly (3)
Discount on selected products with Nutri-score A or B (1)	○	○	○
Collecting points by purchasing products with Nutri-score A or B to support good causes promoting nutritional health (2)	○	○	○
Collecting points by purchasing products with Nutri-score A or B to join workshop about nutritional health (3)	○	○	○
Discount on selected products with approaching expiry day (4)	○	○	○
Recipes using products with better Nutri-score in promotional material (5)	○	○	○
Suggestions about alternative products with a better Nutri-score in a personalised mailshot (6)	○	○	○
Suggestions about alternative products with a better Nutri-score on a digital app (7)	○	○	○
Meal kits or recipe boxes containing products with better Nutri-score (8)	○	○	○

Page Break

*

Q17 **Please select and rank the three most effective initiatives to promote healthy (nutritional) food consumption according to your personal opinion.**

Move and rank your three most effective initiatives into the box.

Most effective initiatives

_______ Discount on selected products with Nutri-score A or B (1)

_______ Collecting points by purchasing products with Nutri-score A or B to support good causes promoting nutritional health (2)

_______ Collecting points by purchasing products with Nutri-score A or B to join workshop about nutritional health (3)

_______ Discount on selected products with approaching expiry day (4)

_______ Recipes using products with better Nutri-score in promotional material (5)

_______ Suggestions about alternative products with a better Nutri-score in a personalised mailshot (6)

_______ Suggestions about alternative products with a better Nutri-score on a digital app (7)

_______ Meal kits or recipe boxes containing products with better Nutri-score (8)

End of Block: Social marketing initiatives Nutri-Score

Start of Block: Sociodemographic and personal characteristics

*

Q18 **In which of the following supermarkets / retailers do you purchase food products at least once a month?**

Select all that apply.

☐ Albert Heijn (1)

☐ Aldi (2)

☐ Bio-Planet (3)

☐ Carrefour (4)

☐ Colruyt (5)

☐ Cru (6)

☐ Delhaize (7)

☐ Lidl (8)

☐ Match (9)

☐ Okay (10)

☐ Smatch (11)

☐ Spar (12)

☐ Other (13) ____

Page Break

Q19 **Are you currently following any dietary regime?**

○ No (1)

○ Yes, I try to limit my meat intake (flexitarian diet) (2)

○ Yes, I do not eat meat, but I eat fish and/or seafood (pescatarian diet) (3)

○ Yes, I do not eat meat or fish, but I eat eggs and/or dairy products (vegetarian diet) (4)

○ Yes, I do not eat meat, fish or any animal products, I only eat plant-based foods (vegan diet) (5)

Page Break

Q20 **What is the highest level of education you have completed?**

○ Primary school (1)

○ Secondary education (2)

○ Professional bachelor (3)

○ Academic bachelor (4)

○ Master or PhD (5)

Page Break

Q21 **Which of the following best describes your current employment situation?**

○ Student full-time (1)

○ Employed full-time (2)

○ Employed part-time (3)

○ Self-employed (4)

○ Unemployed (5)

○ Housewife / Househusband (6)

○ Retired (7)

Q22 **Is your (past or current) education or job related to food?**

○ Yes (1)

○ No (2)

Q23 **Is your (past or current) education or job related to environmental sustainability?**

○ Yes (1)

○ No (2)

Page Break

Q24 **Please indicate your total monthly net household income range.**

○ < 1000 EUR (1)

○ 1000 – 1999 EUR (2)

○ 2000 – 2999 EUR (3)

○ 3000 – 3999 EUR (4)

○ 4000 – 4999 EUR (5)

○ 5000 – 5999 EUR (6)

○ > 6000 EUR (7)

○ Prefer not to answer / I do not know (8)

Q25 **In general, how would you describe the financial situation of your household nowadays?**

○ Have severe financial difficulties (1)

○ Have some financial difficulties (2)

○ Get by alright (3)

○ Manage quite well (4)

○ Manage very well (5)

○ Prefer not to say / Do not know (6)

Page Break

Q26 **Over the next 12 months, how do you think the cost of living will change in general?**

○ Prices will rise at a fast rate (higher inflation rate) (1)

○ Prices will rise at a slow rate (lower inflation rate) (2)

○ Prices will remain more or less the same (3)

Q27 **Have your financial planning and purchase behaviour changed due to the recent events?**
For example, coronavirus outbreak, energy crisis, fertilizer shortage, etc.

○ Increase personal saving and reduce consumption (1)

○ Increase personal saving but consumption remains unchanged (e.g. income indexation) (2)

○ Decrease personal saving but consumption remains unchanged (e.g. inflation) (3)

○ Decrease personal saving and increase consumption (4)

End of Block: Sociodemographic and personal characteristics

Start of Block: End

End Thank you very much for your participation! Please press the following button to complete the survey.

End of Block: End

D Sample

Table 27: Final sample demographics for gender.

	% of total sample	N of total sample
Male	50.3%	302
Female	49.7%	298

Table 28: Final sample demographics for region of living.

	% of total sample	N of total sample
Antwerp	16%	95
Limburg	8%	50
East Flanders	11%	68
West Flandersn	11%	68
Flemish Brabant	10%	60
Hainaut	8%	74
Liège	10%	62
Luxembourg	3%	16
Namur	5%	28
Walloon Brabant	4%	25
Brussels Capital Region	10%	61

E Additional attributes

Table 29: Other attributes participant's used to evaluate their given products.

Alternative attribute	**n**
Overall image of the product	3
Knowledge and own evaluation	4
Way of production	5
Nothing	2