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Article

Effects of eco-labels on the product evaluation of meat and meat alternatives – a discrete choice experiment

Anna Kolber and Oliver Meixner *

Institute of Marketing & Innovation, Department of Economics and Social Sciences, University of Natural Resources and Life Sciences, Vienna, Feistmantelstrasse 4, A-1180 Vienna, Austria; a.kolber@hotmail.com

* Correspondence: oliver.meixner@boku.ac.at; Tel.: +43-1-47654-73515

Abstract: Eco-labels are an instrument for enabling informed food choices and supporting a demand-sided change towards a more and urgently needed sustainable food system. Lately, novel eco-labels that depict a product's environmental life-cycle assessment on a multi-level scale are being tested across Europe's retailers. This study elicits consumers preferences and willingness to pay (WTP) for a multi-level eco-label. A Discrete Choice Experiment was conducted in Austria. Individual partworth utilities were estimated by means of Hierarchical Bayes. Results show higher WTP for a positive evaluated multi-level label, revealing consumers' perceived benefits of colorful multi-level labels over binary black-and-white designs. Even a negative evaluated multi-level label showed higher WTP compared to no label, pointing towards limited effectiveness of eco-labels. Respondents' preferences for eco-labels were independent from their subjective eco-label knowledge, health consciousness, and environmental concern. The attribute "protein source" was most important, and preferences for animal-based protein source (beef) was strongly correlated with consumers' meat attachment, implying that a shift towards more sustainable protein sources is challenging and sustainability labels have only a small impact on the meat product choice of average consumers.

Keywords: Multi-level labels; Eco-labels; Sustainability; Willingness to pay; Choice Experiment; Meat attachment; Hierarchical Bayes

1. Introduction

The environmental sustainability of the food system has a crucial role in stabilizing the earth system [1], in mitigating climate change [2], and in reaching the UN sustainable development goals [3]. The latest IPCC report stresses the high potential of demand-side actions fostering sustainable healthy diets that will contribute to "nutrition, health, biodiversity and other environmental benefits" [4]. A transformation towards more sustainable food consumption patterns can be supported by various instruments including information provision, pricing, accessibility, and regulation of the food environment [5,6]. Providing information by labels schemes stands out as low-cost, easy-to-implement, and non-intrusive policy measures and enables consumers to identify the sustainability of products, to support purchase decisions [7] as well as to encourage companies to improve their environmental standards [8].

In this study, the term "sustainability label" is used as an umbrella and refers to four dimensions: environmental friendliness (such as organic or carbon footprint labels), ethics (such as animal welfare labels), social aspects (such as fair-trade labels), and health aspects (such as nutrient-depicting labels) [9,10]. This study will focus on environmental aspects and defines the term "eco-label" as "a sign or logo that is intended to indicate an environmentally preferable product (…) based on defined

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standards or criteria" [11]. Currently, Ecolabel Index [11] registers a total of 456 eco-labels in 199 countries. Whereas binary labels guarantee a certain standard or not (label or no label), multi-level labels bring advantages as such designs display intermediate qualities and hence provide more differentiated information in a simplified manner [12,13]. According to online consumer information platforms such as Standardsmaps.org or the German language platforms Bewusstkaufen.at [14,15], most prevalent sustainability labels on the European food market are binary labels. Examples are EU organic, Marine Steward Ship (MSC), Rainforest Alliance, Fairtrade and Carbon Trust Label [16]. Eco-labels prevalent on the empirical field of this study, the Austrian food market, are for instance Climate Partner, Carbon Trust and various organic labels such as the EU organic label, the German organic label, and private associations (e.g., Demeter, Bioland) and manufacturers brands (such as the Austrian private organic label "Zurück zum Ursprung", i.e. "Back to the Origin", which identifies the sustainability performance of producers based on a sustainability assessment by the Research Institute of Organic Agriculture FiBL [17]). Metric-labels or claims depict absolute values such as CO_2-equivalents (in kg) challenging consumers in interpreting the numbers. Only few examples are available on the market [18].

The EU has now a clear focus on sustainability claims and labels. As part of the EU Green Deal, the European Commission has announced the Farm-to-Fork-strategy (F2F) in 2019 and currently works on guidelines for establishing a fair and sustainable food system [19]. Two ongoing workstreams, the green claims directive [20] and the sustainable food labelling framework [19], aim to ensure transparent communications on environmental claims across the EU and to harmonize on how sustainability information of food products is provided for consumers [19]. Already in use is a standardized approach developed by the European Commission for conducting life cycle assessments, the so-called product environmental footprint (PEF). In total, 16 criteria on the environmental performance of a good or service are included in the calculations of the PEF [21].

As a reaction to the EUs endeavors, European countries have started to develop and test eco-labels on the food market. Examples are the Enviroscore, the Eco-Impact, the Eco-Score, and the Planet Score [22]. These eco-labelling initiatives are based on PEF, but differ in calculation methodologies. They all have in common that the data is normalized, weighed, and then aggregated to a single score. The score is then translated into a multi-level design with an ABCDE scheme. This design resembles the earlier developed multi-traffic label on food's nutritional benefits, the so-called "Nutri-Score" [23]. The French Planet Score is especially interesting to this study, because its design is extended by the score for the three subcategories biodiversity, climate, and pesticides—which are issues the French population is in particular concerned with, according to a representative survey [24]. Therefore, the label provides comprehensive information on a product's environmental impact. It was developed because the French Eco-Score approach was not precise enough. Thus, the Planet Score tries to enhance methodologies aiming to include environmental benefits of organic farming production methods. It was founded by the French Organic Food and Farming Institute and the two research organizations Very Good Future and Sayari. Currently, the Planet Score is being tested in selected French retail outlets and in Spanish Eroski stores. Further eco-label initiatives (such as Enviroscore etc.) are currently tested in retailers all over Europe at Lidl, Colruyt, Migros Switzerland, Coop Switzerland, Coop Sweden, and Carrefour [22].

Whereas research has focused on consumer preferences for binary labels in the past, few insights exist on consumers perception of multi-level labels [16]. Since providing information on food products depend on consumer's reaction and preferences [5,25] this paper aims to investigate consumer's preferences for multi-level label on food products in Austria. This study will examine how traffic light eco-labels (using the example of the Planet Score label) compared to binary labels (using the example of the Carbon Trust Label) impact consumer's perceived utility of and willingness to pay (WTP) for products with environmental benefits.

Research on visual sustainability labelling focused on the effects that binary labels have on consumer's psychological dimension. The results show higher WTP for food labelled, amongst others, with USDA organic, EU organic, animal welfare, fairtrade, lower carbon footprint label or fictional

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sustainability labels [26–29]. Studies show positive utility of binary labels for consumers [30–32]. Grunert et al. [33] investigated consumer preferences in six European countries for multiple product categories including coffee, chocolate and ready meals and found products that are labelled with fairtrade, animal welfare approved, rainforest alliance, and carbon footprint result in higher utility than non-labelled. Sustainability labels can lead to greater product acceptance, as it was for chocolate with rainforest alliance and Brazilian Organic seal [34]. Also, sustainability labels lead to changed relevance of price in both directions. Price was less important than organic and animal welfare label attribute for beef products in Germany and the US [26,29]. However, price is often a significant constraint in the effectiveness of labels. Importance of the price attribute was perceived higher than for eco-labels in the numerous studies [30,31,35–37]. High prices were especially restrictive on repeat purchases of organic food items, as retail panel data revealed [38]. Additionally, sustainability labels increased perceived healthiness and environmental friendliness of the product. This effect was found by Lazzarini et al. [39] for nutrition claims, country of origin and organic label on different protein sources including chicken breasts.

Consumer research on multi-level labels is quite new, yet there is a tendency for their potential in contributing to more sustainable food choices. Using colors play an important role in the effectiveness of eco-labels according to Thøgersen and Nielsen [40]. When using traffic light colors for a carbon footprint design compared to black-and-white, the label's effect on respondents choosing the more sustainable coffee was intensified [40]. Products marked with green colored eco-scores led to higher utility and more sustainable choices [41–43]. Red colored eco-labels decreased purchase intentions and prevented environmental-harmful choices on tested products including pizza margherita [42], meat balls and lasagna [44]. Red as a warning color showed stronger effect intensity than green color [42]. Label preferences resulted in higher WTP [45,46] for instance in the study of Sonntag et al. [9], out of several tested sustainability labels (Nutri-Score, animal welfare, organic) participants showed highest WTP for whole milk labelled with low climate impact.

A successful impact of eco-labels would be in preventing consumption of foods that are especially harmful to the environment. For instance, global consumption of animal-based food has a major impact on the earth system and climate change. The livestock sector accounts for 14.5% of all anthropogenic emissions [47]. Scholars and policymakers therefore advocate for a reduction in meat consumption [1,6] especially in Western countries [48] where meat consumption is deeply rooted in society [49] Eco-labels can draw attention to the more sustainable "meat alternatives", products that try to imitate animal-based products in all sensory aspects based on environmental-friendly sourced proteins [50,51]. Shifting from niche to mainstream, the meat alternatives market in Europe is predicted to grow from 1.5€ bn in 2018 to €2.4bn by 2025 [52].

Hybrid meats are a compromise as they reduce meat consumption by adding vegetables to the product [43]. Since meat reduction plays an essential role for adapting a sustainable food system, the present study tests how consumers react to eco-labels depicted on minced meat products, with different protein sources: meat-based, plant-based and hybrid (meat & vegetables).

The effectiveness of sustainability labels depends on multiple factors ranging from individual factors including altruism [53], environmental attitudes, environmental concern (EC) [54], sociodemographic factors (gender, age), etc. to label characteristics to context factors such as product type, origin, and price [16]. Another individual factor is consumer understanding of the presented information [55,56]. Whereas general environmental knowledge was in some studies found to be relevant for predicting green consumer behavior [57], context-specific knowledge on environmental performance of products and labels seems to be a fundamental requirement allowing reasoned and well-informed choices [58]. Taufique et al. [56]support the importance of specific knowledge and found perceived eco-label knowledge (ELK) having an indirect positive effect on pro-environmental consumer behavior. Also, in the study of Grunert et al. [33] label effectiveness of the fairtrade and a Carbon footprint label depended on consumers' understanding. The objective of testing the Planet Score's effectiveness (positive vs. negative evaluation) leads to hypothesis H1a (preference) and H1b (importance).

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- H1a: Planet Score B (vs. Planet Score D) is more preferred from respondents who perceive having higher eco-label knowledge.
- H1b: Higher eco-label knowledge positively influences the importance of eco-labels.

Furthermore, label effects can be explained by consumers' attitudes towards sustainability issues. Ghvanidze et al. [59] show that consumers' attitudes are in line with their preferences, as highly environmentally conscious people in particular value ecologically and socially-responsible produced food. Thøgersen and Nielsen [40] found consumers with high EC to be more prone to choosing the "responsible" product (in their study coffee with low carbon footprint). The more respondents were concerned about the environment, the higher the probability for choosing coffee labelled with green (vs. red) colored footprint. Similarly, the authors suppose that EC influences positively the preferences for a positive evaluated Planet Score [40]. Therefore, we developed H2a to see if more environmental conscious respondents prefer Planet Score B (environmental impact is rather low) over Planet Score D (environmental impact is rather high) and H2b to see if the importance of eco-labels is also depending on EC.

- H2a: The Planet Score B (vs. Planet Score D) is more preferred from respondents who are more concerned about the environment.
- H2b: Higher environmental concern positively influences the importance of eco-labels.

Health of the environment is interconnected with health of human being [4]. Research found, the more respondents were health concerned, the more they would choose products with environmental benefits. For instance, organic food consumers are relatively more concerned about their health than consumers buying conventional food [60]. Health-conscious respondents were prone to choosing products with sustainability labels such as sustainable palm oil (RSPO) [61], palm-oil free [62], as well as health and nutrition claims [59,63]. Therefore, H3a will investigate if health consciousness (HC) is affecting the preference for Planet Score B vs. Planet Score D and H3b in accordance with above considerations the importance of HC.

- H3a: The Planet Score B (vs. Planet Score D) is more preferred from respondents who are more concerned about their health.
- H3b: Higher health consciousness positively influences the importance of eco-labels.

Protein source for meat products (e.g., beef, pork vs. plant-based meat alternatives) [64] is next to other factors such as price [29,59], national or local origin [36,64], and quality labelling (i.e., USDA) [29] most relevant for food choices in discrete choice experiments. The protein source is relevant to this study because plant-based or hybrid meat could contribute to a transition towards a more sustainable food system. Whereas food neophobia and familiarity have stronger impact on acceptance of novel products such as cultured meat or insect-based products [65,66], meat attachment—describing a respondent's emotional bond towards meat consumption—seems to be more relevant concerning the adoption of plant-based meat alternatives [67,68]. Meat consumption is deeply rooted in European society [69], leading to H4.

- H4: The higher the meat attachment of respondents is, the lower their preference for meat alternatives will be.

2. Materials and Methods

The objective of this study is to test consumer preferences and WTP for specific sustainability labels. Because there is no multi-level eco-label on the Austrian food market available yet, potential effects of such a label were tested on the Austrian population. An online survey was conducted in March 2023, collecting data through a professional online panel provider that allows anonymous recruitment of participants according to preselected criteria. The Austrian population was represented by applying a selection filter with the quota parameters "age", "gender" and "education". Before launching the survey, a pre-test has been conducted testing internal validity of the empirical design

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(n = 50). At the final survey, a total of 632 respondents have participated, 23 had to be excluded for incomplete responses and 73 for failing the attention check, leaving a final sample of n = 536 (response rate = 84.8 %). Table 1 provides an overview of the participant's socio-demographic data in comparison to the Austrian population. The sample structure is very close to the structure of the Austrian population, even the proportion of meat eaters vs. vegetarians/vegans is close to the overall distribution. Thus, we are convinced that results are transferable to the overall Austrian population.

Table 1. Socio-demographic characteristics of the sample (n= 536) and Austria.

		N	Sample%	Austria% [a]
Consumption group	Meat eaters	510	95.9	94.0
	Vegetarian or Vegan	22	4.1	6.0
Gender	Female	275	51.8	51.2
	Male	256	47.2	48.8
Age	18-25	22	4.1	10.6
	26-35	91	17.1	16.4
	36-45	88	16.5	16.0
	46-55	89	16.7	17.6
	56-65	104	19.5	17.2
	>65	139	26.1	22.0
Residence	Rather urban	212	40.2	53.7
	Rather rural	315	59.8	46.3
Highest Education	Mandatory school	112	21.0	21.4
	Apprenticeship, VET school (BMS)	259	48.6	47.1
	High school, college	94	17.6	15.7
	University, academy	68	12.8	15.8
Household Income	Up to 2000 €	155	35.7	30.0
	2001 – 4000 €	167	38.5	40.0
	More than 4000 €	112	25.8	30.0

[a] Source: Statistics Austria [70–74.]

The online survey had the following structure: After an introduction page including data protection notice, participants were asked about their food consumption of meat and meat alternatives. An information part followed shortly explaining the three labels, which are in accordance with real life labels, but self-designed; the Eco-score label (comparable with the designs of the French Planet Score) and the Climate Protection label (which is close to the Carbon Trust label). Although not being part of the discrete choice experiment (DCE), a further existing eco-label was included in the explanation part (the Austrian "PrüfNach" label) in order to prevent attention bias. The DCE was introduced with the explanation of a hypothetical shopping situation with the following wording: "Imagine you are grocery shopping and standing in front of the refrigerated counter. You want to buy minced meat and see available products. We ask you to choose your preferred product in each of multiple rounds. If you normally do not buy minced meat for yourself, imagine choosing for someone else. It is also possible to make no choice."

Based on the product attributes, a reduced study design was calculated by means of the Microsoft Excel add-in XLSTAT (Version 2018.1.1.). Respondents passed 12 choice sets (example Figure A1 in Appendix), each presenting three items and a no-choice option allowing choices to be closer to true preferences [75]. In addition, a 13th choice set was included in the study design which was not used to approximate partworth utilities, but to see if the choice in the 13th set can be replicated by using the approximated partworth utilities (i.e., the "hit rate" [76]). Based on the max utility choice rule [76], the choice of each respondent between the alternatives of the 13th choice set and the no-

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choice option can be predicted. If the hit rate is much lower than one (and close to the random probability of 0.25), the test design is invalid. Moore [76] identified max hit rates around 0.7 from literature which will be a threshold for our study.

Subsequently, the participant's knowledge and motives are surveyed using 7-point response scale ranging from 1= "I totally disagree" to 7 = "I totally agree". Respondents answered four items on subjective ELK [56,77,78] and five items on environmental concern (EC) [79,80] adapted from the New Ecological Paradigm Scale developed by Dunlap et al. [81]. For measuring meat attachment, one to two item(s) of each factor (hedonism, affinity, entitlement, and dependence) were extracted from confirmatory analyses tested by Graca et al. and Kühn et al. [82,83] resulting in a seven-item scale. An attention check was integrated within the last scale on HC, a six-item scale basing on general health index scale from Roininen et al. [84]. To check the attention of respondents, one item asked them to choose the answer "totally disagree". Finally, socio-demographic variables gender, age, residence, education, and household income were asked. The subsequent analyses were conducted in XLSTAT (Version 2018.1.1.) and the software solution SPSS (Statistical Package for Social Sciences, version 26).

Experimental design and Estimation of WTP: A common approach for evaluating consumer preferences and WTP on food attributes is the application of a DCE [85]. Numerous studies used DCE, amongst others focusing on meat attributes [29,36], type of protein [64,86], country-of-origin [87], and label preferences [9,28]. Advantages of DCEs are that realistic buying situations are simulated, "where consumers choose between one or more products from a restricted product set (evoked set)" [88]. Respondents are supposed to choose the most beneficial product for them. They are caused to tradeoff between desirable and undesirable attributes which makes the results strongly related to actual market shares [89]. Furthermore, DCEs can provide results with high external validity as they reduce respondents hypothetical bias (i.e. deviation between stated and actual behavior) [90].

The following attributes were included in the study: eco-labels, production condition, protein source, origin, and price (Table 2). Minced meat as product category was chosen because unlike whole meat cuts, there is a reasonable product depth of both, meat-based and plant-based products prevalent at Austrian retailers. The product category is well-known and accessible for all population groups [43,64,91]. To rebuild products with realistic prices according market conditions, a store check was conducted on the 21st and 22nd of December 2022 in Vienna. Therefore, the three main retailers, representing around 90% of the Austrian retail market share were visited [92,93]. Price attributes and protein sources base on product range from the store check are defined between 3.59€ and 5.99€ per 400g and include the protein sources—beef, hybrid, and plant-based with pea protein [43,86]. Up to now, hybrid meat is offered in Austria online only, (beef & pea protein 50/50). It makes meat reduction gradually more accessible to consumers [64] and is thus part of this study. Two eco-labels have been included in the experimental design, the binary label "Carbon Trust", with the claim "CO2 Reduced" referring to the company measuring and reducing the product's carbon footprint [33,94,95]. For the study we used a self-designed Climate Protection label in the style of and therefore refer to it as "Carbon Trust label". Second, as a comprehensive multi-level label, an adapted design of the French Planet Score label was used [96], in this study referred to as "Planet Score". The Eco-Score includes multi-traffic light (MTL) scores ranging from A-E: an overall score and ratings for the three subcategories: climate, water protection and biodiversity [1]. Also, these issues are more tangible to consumers compared to more complex topics such as eutrophication [97,98]. The Planet Score is either shown with a relatively good (B) or a relatively bad (D) overall-rating, comparable to the study of Sonntag et al. [9]. To fulfill the DCE requirement of independent attributes [99], Planet Score grades are not linked to actual product's environmental impact, which is a slight deviation from objective grading of food products; beef, for instance, would rather not be graded with the Score B, as GHG emissions are in general quite large for producing beef [97]. Ratings of the sub-categories are with small deviations in accordance with the overall-rating found in literature [98]. Further relevant product attributes for consumers are the production conditions organic and conventional [36,64,94] and the origin of production, "Austria" and "within the EU" in this study [31,37].

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Table 2. Attributes and attribute levels tested in the choice experiment.

Attribute	Level	Description
Eco-label	Planet Score B Planet Score D	Fictional comprehensive multi-level label in the style of Planet Score including sub-categories: climate, water protection, biodiversity
	Carbon Trust – CO2 Reduced No label	Fictional binary label "Climate protection" in the style of Carbon Trust label
Origin	Austria EU	Geographical Origin
Protein type	Beef Beef & pea protein (50/50) Plant-based (peas)	Protein source of minced meat
Production method	Organic Conventional	Most prominent production methods in Austria
Price	3.59 € 4.79 € 5.99 €	Price per 400g; based on store check in four major supermarket retailers in Austria

This study refers to the Random Utility Theory (RUT) which was first proposed by [100] as theory of paired comparisons (comparing pairs of choice alternatives) and was later extended by [101] to a theory of multiple comparisons. The RUT calls "utility" a latent construct, saying that utility for each choice alternative exists in consumers heads, but cannot be "seen" for researchers. More concrete, the total utility U_{in} that the individual n associates with the alternative i, is the sum of the systematic (observable) V_{in} and random (unobservable) utilities (ε_{in}) as in formula 1.

$$U_{in} = V_{in} + \varepsilon_{in} \quad (1)$$

The deterministic component is assumed to be linear $V_{in} = \beta \cdot X_{in}$, whereas X_{in} is the vector of observable product attributes, β represents the mean preferences of respondents for each attribute [45]. For this study, the utility V_{in}, is assumed as the linear function [64] of protein type, eco-labels, origin, production method and price. Integrating the selected product attributes, the following utility function of a consumer n for alternative i is approximated according to the additive model in formula 2.

$$U_{in} = \beta 1_{protein\ type} + \beta 2_{eco-label} + \beta 3_{production\ method} + \beta 4_{price} + \varepsilon_{in} \quad (2)$$

Based on the results of the respondents' DCE choices, both are approximated, part-worth utilities of the attribute levels and the relative importance of each of the attributes. For hypothesis testing, Hierarchical Bayes (HB) estimation is used to approximate individual partworth utilities [102,103]. Considered as state of the art in food research, the HB approach allows statistical efficiency in data processing [85]. Quality loss during the process of estimation including local optima and convergence problems is avoided [104].

Rooted in welfare economics, the WTP is a concept describing marginal rate of substitution of certain attributes for price levels [105]. That is, how much consumers are willing to pay for a particular product attribute, if all the other attributes remain constant. With reference to the additive compensatory decision rule in formula 2 [106], WTP can be expressed as ratio between utility per attribute level $\beta_{attribute}$ and utility per money unit β_{price} [106,107] (formula 3). Any change in U_{in} due to a variation in the attribute levels can be substituted by adapting the price accordingly.

$$WTP = \frac{\beta_{attribute}}{\beta_{price}} \quad (3)$$

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Using DCE for the approximation of WTP is a common approach in consumer research [106] and was applied within a vast scientific body of comparable food studies before [29,32,35,94,108].

3. Results

3.1. Results of the DCE

The validity of the DCE is assumed to be very high. After approximating the attribute utilities, the mentioned 13th choices were replicated on the basis of the max utility theory. It was expected that the choice with the highest overall utility—incl. the no-choice option —will be selected. The hit rate amounted to 0.801, which is much higher than threshold we defined confirming Moore [76] with 0.7. It means that 80% of all choices were predicted correctly. The most frequently chosen product card (837 times; only regular choices 1-12 are analyzed here) was minced meat with beef from Austria, conventionally produced and at the cheapest price (Table A1 in Appendix). The no-choice option was used frequently (1148 times) which might be due to the fact that most of the respondents clearly prefer meat, as we will see in the following. Out of the choices, the partworth utilities u_i were approximated by means of HB estimation confirming Formula 3 (additive model). The results from the conjoint analysis include partworth utilities and relative importance of the attributes (Table 3), the latter, the significance of the attribute level for a stimulus' total utility, can be specified by means of the partworth utilities. A partworth utility itself does not indicate relative importance of the attribute and whether an attribute would contribute to a change of preference or not [99]. It is the difference between min and max utilities per attribute that matters; the higher the difference is, the more importance the relevant attribute will get.

Consumers highly valued the protein source beef (u_i = 3.381), followed by the lowest price 3.59 € (u_i = 1.765) and the eco-label "Planet Score B" (u_i = 1.128). Positive partworth utilities were also approximated for Austrian origin (u_i = 0.573) and organic production (u_i = 0.261). As expected, price had a negative influence on the simulated buying-decision as high prices (u_i = -1.858) are usually less attractive to consumers than low prices (u_i = 1.765). The price function amounts to β_{price} = -1.488, which means that an increase in the price by one Euro reduces the utility of the alternative by -1.488. Regarding eco-labels, highest u_i was approximated for label "Planet Score B" (u_i = 1.128), followed by the label "climate protection – CO2 reduced" (u_i = 0.216). Remarkably, a product labelled with the Planet Score D label (u_i = -0.431)—signaling a negative environmental impact—has higher partworth utility than a product without any sustainability certification (u_i = -0.915). Compared with the beef attribute (u_i = 3.381), the protein-source "plant-based (peas)" resulted in particular low utility (u_i = -2.836), whereas the hybrid product beef and plant-based (50/50) showed intermediate, negative average utility (u_i = -0.545).

Table 3. Results from conjoint analysis (n=501).

Attribute	Variable	Partworth Utility u_i [a]	SD	95% confidence interval		Mean relative importance
				lower	upper	
Eco-label	Planet Score B	1.128	**0.818**	1.057	1.201	17.7%
	Planet Score D	-0.431	0.826	-0.503	-0.358	
	Climate Protection – CO_2 Reduced	0.217	0.605	0.164	0.270	
	No label	-0.915	0.636	-0.970	-0.859	
Origin	Austria	0.573	0.517	0.528	0.619	8.7%
	EU	-0.573	0.517	-0.619	-0.528	
Protein type	Beef	3.381	3.862	3.042	3.720	44.7%
	Beef & pea protein (50/50)	-0.545	1.529	-0.679	-0.410	
	Plant-based (peas)	-2.836	3.115	-3.110	-2.563	

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Production method	Organic	0.261	0.344	0.231	0.291	4.6%
	Conventional	-0.261	0.344	-0.291	-0.231	
Price	3.59 €	1.765	1.335	1.647	1.882	24.4%
	4.79 €	0.094	0.484	0.051	0.136	
	5.99 €	-1.858	1.142	-1.959	-1.758	
	β_{price}	-1.488				
No choice		0.894	2.829	0.646	1.142	

[a] All partworth utilities $p \leq 0.001$.

The attribute with the highest relative importance is the protein type (44.7%), followed by price (24.4%) and eco-labels (17.7%). The importance of protein source is undeniable when it comes to choosing between animal-based and alternative-protein-based meat. Austrians obviously still prefer meat which makes the other product features much less important. Altogether, our results show highest importance for intrinsic attributes (protein source, price) and lowest for extrinsic attributes (origin, production condition, sustainability) of minced meat products.

3.2. Willingness to pay (WTP)

The WTP was derived showing consumers' readiness to pay an average premium of +1.37 € for a Planet Score B labelled over a non-labelled product. Even a negative impact on the environment is more worth in the eyes of the consumers +0.33 € compared to no certification. For an average consumer, plant-based pea protein as protein source would need a discount of -4.18 € compared to its beef equivalent. Table 4 summarizes WTP for minced meat attributes.

Table 4. WTP for minced meat attributes.

Attribute	WTP in €
No label (baseline)	
Planet Score B	+1.37
Planet Score D	+0.33
Climate Protection – Reducing CO_2	+0.76
Origin EU (baseline)	
Origin AT	+0.77
Protein source beef (baseline)	
Beef & plant-based 50:50	-2.64
Plant-based	-4.18
Conventional (baseline)	
Organic	+0.35

The mean, however, is not telling the whole story. Obviously, the majority of consumers prefer beef. The average WTP of -4.18 € simply tells us that, in average, Austrian consumers are not willing to switch away from meat to plant-based alternatives. They are still carnivores. But there is a significant proportion of consumers who are preferring plant-based alternatives, at least to some extent. The proportion of respondents with a positive partworth utility for beef sums up to around 80% which more or less corresponds to the negative for a plant-based meat substitute. Likewise, there is a proportion of about 20% with a negative partworth utility for beef and a positive for plant-based meat substitute (and, therefore, a positive WTP). If we only consider those respondents with $u_{beef} \leq 0$ (n = 107), WTP is positive for plant-based (+3.03 €) and 50:50 (+1.97 €) meat alternatives. For this group of consumers, WTP for Planet Score B increased to +1.59 €. For Climate Protection – Reducing CO_2 WTP amounts to +0.35 € and, again, even for Planet Score D WTP is positive (+0.34 €).

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For both groups, those with a very high preference for meat ($u_{meat} \geq 2$; $u_{plant\text{-}based} \leq -2$) and those preferring plant-based alternatives ($u_{meat} \leq -2$; $u_{plant\text{-}based} \geq 2$), the importance of the product attribute "protein type" is of highest importance with an average importance rate beyond 50%. All differences between these groups are highly significant ($p < 0.001$), the effect size is, in particular for the attribute protein source, very high ($\eta^2 = 0.629$ and 0.595, respectively; Table A2 in Appendix).

Table 5. Distribution of utilities of protein sources (in %).

	$u_i \leq -2$	$-2 < u_i \leq -1$	$-1 < u_i \leq 0$	$0 < u_i \leq 1$	$1 < u_i \leq 2$	$u_i \geq 2$
Beef (baseline)	9.6	3.0	8.8	9.8	10.6	58.3
Beef & plant-based 50:50	26.3	17.8	14.6	24.8	11.8	4.8
Plant-based	62.1	12.4	9.4	6.2	1.8	8.2

3.3. Hypotheses testing

The reliability of the hypothetical constructs ELK, EC, MA and HC was tested by means of Cronbach's alpha (CA). All items were kept in the relevant scale due to excellent internal reliability [109] (Table A3 in the Appendix). New parameters were created by calculating mean values, excluding respondents that missed one or more items out. Table 6 contains descriptive statistics for all explanatory variables including CA, Mean, Median, Standard Deviation (SD), Min, Max, and N.

Table 6. Explanatory variables and descriptive statistics.

	CA	Mean	Median	SD	Min	Max	N
Subjective Eco-Label Knowledge (ELK)	0.787	5.285	5.5	1.152	1	7	531
Environmental Concern (EC)	0.912	4.943	5.2	1.525	1	7	536
Meat Attachment (MA)	0.843	4.740	5	1.414	1	7	531
Health Consciousness (HC)	0.826	4.969	5	1.244	1	7	533

Scale 1="totally disagree", 7= "totally agree".

For proofing hypotheses H1-4, correlation analyses were conducted between the explanatory variables and the results from conjoint analysis. First of all, we can see that the factors ELK, EC HC, and MA are interrelated (Table 7). Usually, Pearson's correlation coefficient *r* is quite high. On the one side, EC and HC are significantly positively correlated ($r = 0.576$). Respondents which have higher awareness of environmental issues, also tend to have a healthier lifestyle. The attachment to meat consumption (MA), on the other side, significantly correlates with the other factors negatively ($r = -0.428$); respondents who are very much attached to meat tend to be less cautious in view of ecology and health. This is in particular relevant for our study as we assume that MA might have an influence on the preference for meat alternatives (H4).

Table 7. Correlation matrix and descriptive statistics ELK, EC, HC, MA.

	ELK	EC	HC	MA
ELK	1			
EC	0.523***	1		
HC	0.391***	0.576***	1	
MA	-0.134**	-0.393***	-0.428***	1
Mean	5.29	4.94	4.97	4.74
SD	1.15	1.53	1.24	1.41
N	531	536	533	531

Scale: 1 = low perceived ELK, EC, HC, MA to 7 = high perceived ELK, EC, HC, MA
Significance: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

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Contrary to our hypothesis H1a, H2a, H3a, higher utility for the multi-level label Planet Score B compared to Planet Score D cannot be explained by the tested constructs; *r* is insignificant for all constructs in Table 8. The respondents' preference for the Planet Score B label is independent from their eco-label knowledge, environmental concern, and health consciousness. Thus, the hypotheses H1a, H2a, H3a are rejected.

Table 8. Correlation matrix ELK, EC, HC, MA and utilities of attributes Protein source and Eco-labels.

Utility u_i	ELK	EC	HC	MA
Beef	-0.168***	-0.384***	-0.294***	0.514***
Beef & plant based	0.170***	0.262***	0.141**	-0.112*
Plant-based	0.125**	0.347***	0.295***	-0.582***
Planet Score B	0.050	0.032	-0.043	0.042
Planet Score D	0.139**	0.187***	0.198***	-0.180***
Reducing CO2	-0.154***	-0.251***	-0.163***	0.299***
No label	-0.098*	-0.044	-0.048	-0.103*

Significance: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The further analysis clearly shows that preferences for animal-based protein sources are strongly influenced by MA. The personal emotional bond towards meat consumption drives preferences for beef and aversion to plant-based protein, leading to acceptance of hypothesis 4: The more respondents are attachment to meat, the less they prefer meat alternatives ($r = -0.582$***) and the higher is their preference for meat ($r = 0.514$***). This relation is the strongest within all constructs. MA obviously has the highest impact on the consumers' decision to accept or reject meat alternatives. In particular, Figure 1 visualizes these relationships: A positive correlation between (a) MA and the utility of beef and a negative between (b) MA and the utility of plant-based alternatives. There are some exceptions from these overall tendencies—upper left side in (a) and lower left side in (b)—, but in general, the assumption holds.

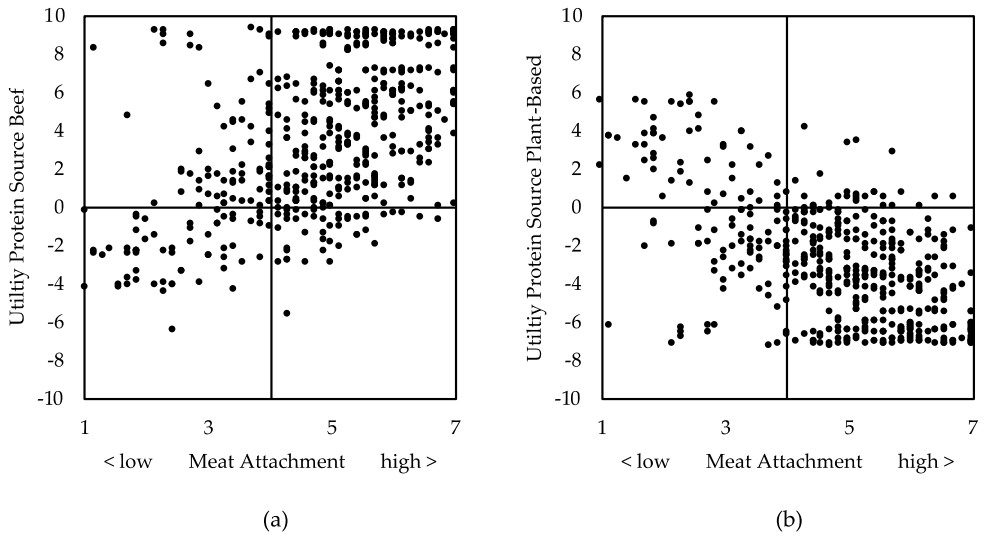

Figure 1. Relationship between MA and utilities of (a) beef and of (b) plant-based alternatives.

As to the preferences for different protein sources, we can see that there is also an influence of EC and HC on the preference for plant-based protein ($r = 0.347$ and 0.295); by contrast, the preference for meat is decreasing with higher HC almost to in almost the same extent ($r = -0.384$*** and -0.294***; see Table 8).

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Concerning H1b, H2b, and H3b, perceived importance of the attribute eco-label is significantly correlated with the tested constructs on respondents' motives and knowledge ELK, EC and HC. In particular, EC (H2b) seems to have a higher impact on the importance of eco-labels with $r = 0.346^{***}$ (Table 9). These hypotheses are therefore confirmed even though Pearson's correlation coefficient r is rather low. Eco-labels gain importance the higher perceived ELK, EC, and HC are. The constructs are able to explain (at least to some extent) why eco-labels are preferred and are perceived as more important for some respondents compared to other beef attributes (production condition, origin; for the latter attributes, correlations are low and, in most cases, not significant). In addition, MA is obviously a significant construct that is capable to explain why consumers are rejecting meat alternatives, as we showed above.

Table 9. Correlation matrix ELK, EC, HC, MA and importance of attributes.

Importance of attributes	ELK	EC	HC	MA
Eco-label	0.221***	0.346***	0.194***	-0.188***
Origin	0.055	0.111*	0.107*	-0.045
Protein source	-0.074	-0.164***	-0.038	0.097*
Production method	0.074	0.154***	0.130**	-0.068
Price	-0.107*	-.0130**	-0.175***	0.050

Significance: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

4. Discussion

Our results shed new light on consumer preferences and WTP for multi-level vs. binary eco-labels. To our knowledge, it is the first study with a multi-level label that comprises sub-dimensions—in our study climate change, biodiversity and water usage. Especially, when consumers lack in time in shopping situations, comprehensive multi-level labels (such as the Planet Score) can reduce confusion and information overload by bundling information and presenting it in an easy and self-explaining manner [45]. The implementation of novel labels such as the Planet Score strongly depend on consumers' preferences and reactions to the label [25]. In line with previous studies, our results reveal that eco-labels can effectively influence consumers' choices, at least to some extent. In our study, an environmentally friendly produced product was preferred over an environmental harmful one. This is consistent with what has been found in previous studies on comparable eco-labels [41,42,64]. The multi-level label Planet Score B was preferred over the binary Carbon Trust label which indicates that colorful designs with scores rating from A to E bear certain advantages to consumers. This is supported by the study of Thøgersen and Nielsen [40] showing that using traffic light colors for a multi-level carbon footprint design improves the label's effect in comparison with a simple black-and-white footprint design. Choices for sustainable products were intensified. In line with the studies of Carlsson et al. [44], and Rizov and Marette [42], the respondents of our study tended to avoid red light eco-labels. Contrary to the argument of Sonntag et al. [9], arguing that manufacturers and retailers cannot afford negative sustainability labels, our results show that even a negative Planet Score is preferred over no eco-label. This could be an incentive for manufacturers and retailers to enhance environmental sustainability throughout the life cycle of food products and communicate transparently their progress.

Despite respondents' preferences for eco-labels, our results point out that other product attributes such as type of meat (beef, plant-based) and price are more decisive over labels on environmental sustainability. This is in accordance with literature [33,64] and emphasizes the limitations of labelling as a policy measure. In view of the huge importance of the attribute level "meat", the results from this study are supported by [64] which examined consumer preferences for minced meat and found the attribute protein source having the highest relative importance (as in our study), and "meat-free" being the least preferred attribute among other attribute levels of protein sources (i.e., beef, pork, etc.). For consumers who are expecting real meat if they buy minced meat products, plant-based

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alternatives are not a real alternative which also explains the high proportion of no-choices in our data. Whenever only plant-based choices (or mixed meat) were offered (and/or the meat alternative did not correspond to the expectations of the respondents), the no-choice option was selected. However, we also identified an important target group within the sample preferring plant-based alternatives; in contrast to the overall result of the study, plant-based alternatives are gaining a positive, significantly higher partworth utility compared to minced meat from beef (and, of course, the protein source is very much more important for this group). We have to consider this result when interpreting the overall (negative) partworth utility of plant-based alternatives.

Previous studies found other attributes, such as nutritional information [33], fat content [64] and animal welfare [45], being more important over comparable environmental sustainability claims. We found eco-labels to be more valued than country of origin—a clear contradiction to literature [46,64]—and production condition to be more valued when it comes to food choices, which is inconsistent with Feucht and Zander [46], but in line with Sonntag et al. [9]. Despite consumers showing high awareness for organic production in Sonntag et al. [9], and potentially because of the fact that organic products are well established and available in every supermarket, Janßen and Langen [110] argue that organic claims and labels cannot compete to the attractiveness of novel and colorful eco-labels. This may be one reason for eco-labels outperforming country of origin, too.

The effectiveness of eco-labels is strongly related to consumers' WTP a premium for eco-labelled food, which are in general more expensive [25]. In our study, price had a significant impact on product choice with a negative price function implying shrinking utility for higher prices. Highest WTP regarding the studied eco-labels was identified for a positive evaluated Planet Score (B) (+1.37€), medium high for Carbon Trust (+0.76€) and lowest for negative evaluated Planet Score (D) (+0.33€) compared to no label. The WTP for Planet Score B even increased if we only consider the group of consumers with less preference for beef (+1.59). This result ties well with previous studies [7,9,45,46] wherein a high WTP for food products was associated with a similar positive eco-label (climate label). Compared to a non-labelled product, respondents of this study were willing to pay a price surplus even for an environmental harmful labelled product (Planet Score D). This finding may be explained by a positive association with eco-labels (independent from their message) or not focused processing of the provided information. A similar conclusion was made by Janßen et al. [110] and Loo et al. [111]. It could be due to a lack of understanding of the respective label that respondents show higher preference for depicting both labels together (in this case, organic and GMO free or animal welfare) even though information of both labels might be redundant.

Red as a warning color can have stronger effect intensity than green colored eco-labels on purchase intentions [42]. Our results show that the red-light Planet Score attribute decreased a product's utility. Furthermore, the analysis found clear evidence in perceived importance of the attribute eco-label correlating with respondents' ELK, EC, and HC. Consequently, if the Planet Score will be introduced in the Austrian market, it may become successful if targeted at consumers being highly aware of environmental and health issues in their food choices.

Results from our study provide relevant insights in consumer preferences and WTP for a multi-level eco-label (on the example of the Planet Score). The effectiveness of eco-labels faces certain challenges. On the consumption level there are doubts about the real effectiveness of eco-labels and few evidence on changes in food behavior patterns [8,112]. Consumers' lack of awareness of and knowledge about eco-labels is due to insufficient promotion [94,113], and consumers green skepticism (not trusting information on a product's sustainability) [56,114,115]. These assumptions from literature, such as the prioritization of other product attributes over eco-labels such as price [16], are in line with our results.

Our study clearly reflects the importance of meat consumption in Western societies as choosing beef as protein source was strongly correlated with respondents' meat attachment. As expected from Graça et al. [82], the emotional bond towards meat consumption reduces choices for plant-based alternatives and is a barrier in shifting towards more sustainable diets. Other reasons for approximating low utility for plant-based alternatives may be lack of familiarity, food neophobia, or lower

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perceived quality [65,66]. In line with the study of Edenbrandt et al. [43], the utility for hybrid products containing beef and pea protein lies in between beef and plant-based alternatives and may be a compromise and mean to overcome meat attachment (at least in the long ran). Changing individual behavior towards eating less environmentally harmful protein sources appears to be challenging as meat consumption is deeply rooted in Western society and is largely perceived as "nice, necessary, natural, and normal" [49]. Also in our study, the majority of the respondents' have to be classified as carnivores. These consumers will hardly change their diet patterns, at least in the short run.

The interpretation of our results has to consider several limitations. One concern about our study design is that the opt-out option obviously had a positive utility for respondents, revealing that the no-choice option was often preferred over the presented choice alternatives (in particular, if the 100% meat alternative was not part of the choice set). As a consequence, the attribute "protein source" had a very high importance. Including only meat in the experimental study design (e.g., beef, pork, mixed) could probably have a significant influence on the importance of the other attributes, which would rather gain importance.

Furthermore, the study design contained a few rather unrealistic options (such as organic and cheapest price or plant-based and Eco-Score D). This limitation was not a big issue, because although these combinations are no products consumers would expect in their everyday shopping behavior, they are still possible. The results should however be interpreted carefully as the restricted choice set of our DCE can hardly be compared with a supermarket's wide product range and multiple different attributes [5].

The Planet Scores were not based on life-cycle assessment due to aspired independency of attribute groups. There is yet a lack in publicly available information on each product's supply chain. Retail settings require dependable life cycle assessment and product ingredient data for implementation [41]. However, these inaccuracies would not affect this study's key findings, they seem to be quite realistic; the importance of eco-labels is not predominating other, for consumers more relevant product features, such as product source or price.

As the Planet Score is not and the Carbon Trust not widely available on the Austrian food market and the choice situation is not a real purchasing situation, hypothetical bias such as respondents overstating their WTP may appear [116]. Also, attention bias may arise from explaining the meaning of the two labels at the beginning of the study. Because this experiment focused on minced meat, future studies may explore the effects of a multi-level eco-label on other product categories such as staple food, convenience food, snacks, or beverages. It remains unclear how far the sub-dimensions of the Planet Score are relevant to consumers' food choices. And future research is also needed in real-world settings comparing directly different label formats to guarantee more robust evidence of their effectiveness. We have to consider that, on an organization level, constraints are cost and time for implementation, in particular for SMEs [8], while perceived benefits (such as increased competitiveness, benefits for consumers) might not be high enough. And there is the need for international harmonization standards on eco-labelling calculation [8]. This issue is still unresolved.

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Appendix A

Figure 1. Choice set example with no-choice option.

Table 1. Choice alternatives, descending frequencies.

Profile	Sustainability label	Origin	Protein Source	Production Condition	Price (€/kg)	n
12	No label	Austria	Beef	Conventional	3.59	837
9	Planet Score D	EU	Plant-based Pea Protein	Organic	4.79	809
3	Planet Score D	EU	Beef & Pea Protein (50/50)	Conventional	3.59	597
8	Planet Score B	EU	Beef	Organic	3.59	440
11	CT - Reducing CO_2	Austria	Plant-based Pea Protein	Organic	3.59	404
4	No label	EU	Plant-based Pea Protein	Conventional	5.99	304
2	CT - Reducing CO_2	EU	Beef	Conventional	4.79	284
6	Planet Score B	Austria	Plant-based Pea Protein	Conventional	4.79	272
7	CT - Reducing CO_2	Austria	Beef & Pea Protein (50/50)	Conventional	5.99	235
1	Planet Score B	EU	Beef & Pea Protein (50/50)	Organic	5.99	230
10	Planet Score D	Austria	Beef	Organic	5.99	227
5	No label	Austria	Beef & Pea Protein (50/50)	Organic	4.79	69
No Choice						1148

Table 2. Group differences of importance of attributes.

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	N		Eco label	Country of origin	Protein source	Production condition	Price
Total	501	mean (%)	17.66	8.67	44.75	4.57	24.35
		SD	9.49	7.62	17.41	3.32	13.80
Protein source beef							
$u_i \leq -2$	48	mean (%)	16.93	5.21	55.46	4.39	18.01
		SD	8.59	4.07	13.31	3.21	9.02
$-2 < u_i \leq -1$	15	mean (%)	22.88	13.00	32.33	6.14	25.66
		SD	15.16	11.14	11.20	4.62	9.38
$-1 < u_i \leq 0$	44	mean (%)	27.50	12.22	19.75	5.19	35.33
		SD	12.04	9.80	12.67	3.22	17.34
$0 < u_i \leq 1$	49	mean (%)	27.00	13.29	21.64	6.01	32.06
		SD	10.71	10.89	11.69	5.37	16.12
$1 < u_i \leq 2$	53	mean (%)	21.06	9.28	30.96	5.22	33.48
		SD	10.00	9.61	8.56	4.16	15.40
$u_i \geq 2$	292	mean (%)	13.84	7.60	53.77	4.07	20.72
		SD	5.11	5.58	9.97	2.46	10.81
	F		43.95	10.62	167.74	4.76	23.74
	Sig.		≤ 0.001	≤ 0.001	≤ 0.001	≤ 0.001	≤ 0.001
	ETA		0.31	0.10	0.63	0.05	0.19
Plant-based alternative							
$u_i \leq -2$	311	mean (%)	14.05	7.60	52.52	4.06	21.76
		SD	5.49	5.82	11.03	2.36	11.82
$-2 < u_i \leq -1$	62	mean (%)	23.22	12.98	30.60	5.51	27.69
		SD	9.86	10.76	10.75	4.77	14.84
$-1 < u_i \leq 0$	47	mean (%)	29.07	9.95	23.18	6.50	31.30
		SD	12.26	8.51	13.33	4.52	14.79
$0 < u_i \leq 1$	31	mean (%)	27.97	12.14	13.99	5.18	40.72
		SD	10.02	12.74	8.27	4.46	15.84
$1 < u_i \leq 2$	9	mean (%)	23.18	6.06	33.64	4.94	32.18
		SD	14.54	5.09	6.93	4.67	16.26
$u_i \geq 2$	41	mean (%)	14.49	6.76	57.57	4.28	16.90
		SD	7.25	4.61	12.23	3.08	8.06
	F		54.79	8.00	145.66	6.25	20.26
	Sig.		≤ 0.001	≤ 0.001	≤ 0.001	≤ 0.001	≤ 0.001
	ETA		0.36	0.07	0.60	0.06	0.17

Table 3. Explanatory variables: internal reliability, measurement items.

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	α	Measurement Item	Mean [a]	SD
Subjective Eco-Label Knowledge (ELK) [56,78]	0.787	EKL index	5.26	1.152
		EKL1. I know the meaning of the term eco-friendly food.	5.51	1.363
		EKL2. I know the meaning of the term eco-labeled food.	5.16	1.522
		EKL3. I know the meaning of the term organic food.	5.95	1.159
		EKL4. I usually pay attention to information about eco-labeled food.	4.50	1.789
Environmental Concern (EC) [117–120]	0.912	EC index	4.94	1.525
		EC1. When I buy foods, I try to consider how my use of them will affect the environment.	4.43	1.824
		EC2. I am extremely worried about the state of the world's environment and what it will mean for my future.	4.87	1.862
		EC3. I think we should care about environmental problems.	5.51	1.613
		EC4. I am willing to pay a bit more for products that do not harm the environment.	4.50	1.956
		EC5. It is important that the food I eat on a typical day has been prepared in an environmentally friendly way.	5.43	1.584
Meat Attachment (MA) [82,83]	0.843	MA index	4.74	1.414
		MA1. I love meals with meat.	5.06	1.818
		MA2. I don't picture myself without eating meat regularly.	4.41	2.217
		MA3. By eating meat I'm reminded of the death and suffering of animals. [b]	5.05	2.012
		MA4. If I couldn't eat meat, I would feel weak.	3.74	1.991
		MA5. To eat meat is disrespectful towards life and the environment. [b]	5.44	1.854
		MA6. To eat meat is an unquestionable right of every person.	5.03	1.915
		MA7. To eat meat is one of the good pleasures in life.	4.47	1.946
Health Consciousness (HC) [84,117,121,122] [b]	0.826	HC index	4.97	1.244
		HC1. A healthy and balanced diet plays an important role in my life.	5.59	1.391
		HC2. I eat what I like and I do not worry much about the healthiness of food. [b]	3.90	1.905
		HC3. The healthiness of food has little impact on my food choices. [b]	4.25	1.919
		HC4. I am very particular about the healthiness of food.	5.54	1.327
		HC5. I prefer natural rather than processed food.	5.54	1.450

[a] response scale ranging from 1= "totally disagree", 7 = "totally agree"; [b] reversed item; [c] Attention check (AC) was placed between HC3 and HC4, attentive reading is required to accomplish the AC within a scale with the wording: "This question serves as attention check, please click 'totally disagree'".

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