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Does the Eco-Score lead to a halo effect? Influence of a sustainability label on product perceptions and purchase intention

Verena Büttner[a,1], Birgit Gassler[a,1], Ramona Teuber[a,b,*]

[a] Institute for Agricultural Policy and Market Research, Faculty of Agricultural Sciences, Nutritional Sciences and Environmental Management, Justus Liebig University, Giessen, Germany

[b] Center for Sustainable Food Systems, Justus Liebig University Giessen, Germany

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ABSTRACT

The Eco-Score is an approach to make the environmental impact of a food product visible using color-coded labeling. Previous research has shown the potential of organic and ethical labels to influence consumers' perceptions of other product features – what is called the halo effect. Using an online questionnaire with a between-subject design and a representative sample for Germany (N = 1010), we examined whether the Eco-Score might also induce halo effects. Therefore, we evaluated how consumers assess the perceived environmental friendliness, expected tastiness, and perceived healthiness of packaged foods with or without an Eco-Score. We consider three different products (spaghetti, yoghurt, and crisps) in three treatment groups (Eco-Scores A, C, and E) and one control group (no label). For our statistical analyses, we employed repeated-measures ANOVAs and regression-based mediation analyses. Our results show that products are perceived as more (Eco-Score A) or less (Eco-Score E) environmentally friendly when labelled with the Eco-Score and this perception mediates the purchase intention positively or negatively, respectively. Furthermore, our results suggest that the Eco-Score can bias consumer perceptions of other food product characteristics. In particular, the Eco-Score E negatively influences expected tastiness and perceived healthiness, which lowers purchase intention. Regression-based moderation analyses show further that participants with high environmental or health concern are in part more susceptible to positive halo effects. However, overall, the moderator effects are small. The paper extends the literature on halo effects related to food labeling and hence provides important insights on perceptions of food products labelled with a color-coded scoring system. Theoretical and practical implications as well as avenues for future research are discussed.

1. Introduction

In recent decades, numerous labels have been introduced to address various dimensions of sustainability and promote changes in consumption patterns (e.g., Asioli et al., 2020; Canavari & Coderoni, 2020). However, previous studies have shown that many consumers find sustainability labels often difficult to understand (e.g., Gröfke et al., 2021; Lanero et al., 2021; Tseng et al., 2021). Alternative labeling systems, especially scoring systems, have become popular to reduce confusion among consumers and help them identify environmentally friendly products (Hallez et al., 2021). These systems provide comprehensive information on the entire environmental footprint of products, rather than focusing on just one environmental factor (Hallez et al., 2021; Gröfke et al., 2021).

An example of a scoring system that visualizes the ecological footprint of a product is the Eco-Score, developed in France by the Eco2 initiative in early 2021 (foodaktuell 2021). The Eco-Score uses a front-of-pack label with a five-point letter scale and color-coding, following a similar principle to the Nutri-Score (e.g. Campillo-Lundbeck, 2021; de Bauw et al., 2021). Research on the Nutri-Score indicates that color-coded labeling can positively influence consumers' understanding of a product's healthiness (e.g., De Temmermann et al. 2021; Egnell et al., 2018) and promote healthier food choices (e.g., Gassler et al., 2023; Folkvord et al., 2021; Song et al., 2021). Several studies have found that color-coded CO_2 footprint labels have a signaling effect that facilitates food differentiation and reduces complexity in decision-making (e.g.,

* Corresponding author.
E-mail address: ramona.teuber@agrar.uni-giessen.de (R. Teuber).
[1] First authorship is equally shared.

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Rondoni & Grasso, 2021; Carrero et al., 2021; Panzone et al., 2020).

Although sustainability labels are designed to inform about specific product attributes, studies have shown that the presence of such a label can influence the assessment of product attributes unrelated to the label's message (e.g., Sörqvist et al., 2015; Von Meyer-Höfer et al., 2013). This cognitive bias is known as the halo effect. Halo effects have been observed across different food labels (e.g., organic, ethical, animal welfare) and across different evaluation dimensions (Faure-Ferlet et al., 2020; Piqueras-Fiszman & Spence, 2015; Fernqvist & Ekelund, 2014). Regarding organic and ethical labels, research has shown that they can influence how consumers perceive a product's taste (e.g., Gassler et al., 2019; Teuber et al., 2016; Sörqvist et al., 2015), healthiness (e.g., Apoalaza et al., 2017; Lazzarini et al., 2016;), and nutritional values, including fat, calories, vitamins (e.g., Besson et al., 2019; Lee et al., 2013). In addition, several studies suggest that consumers' values, beliefs, and attitudes may moderate perceptions of sustainably labeled food products. The induced halo effect may then mediate downstream consumption decisions (Berry & Romero, 2021; Faure-Ferlet et al., 2020; Schuldt et al., 2012).

Against this background, our study has three main objectives. First, we investigate the effect of the Eco-Score on different evaluation dimensions, specifically perceived environmental friendliness, expected tastiness and perceived healthiness, by having participants provide ratings for a fictitious product packaging for three food products: spaghetti, strawberry yogurt, and crisps. As participants did not actually taste the products, we study the expected tastiness of the products based on the visual stimuli. We chose these three products because they cover a wide range from staple foods to snacks, allowing us to investigate possible product-specific effects. The selection was further based on current consumption data in Germany from the Federal Statistical Office (Statista 2021a; Statista, 2020). Second, we analyze to which extent certain consumer characteristics (health and environmental concerns) moderate the impact of the Eco-Score on expected tastiness and perceived healthiness. Currently, the empirical evidence regarding moderating effects remains inconclusive. Third, we investigate the mediating role of perceived environmental friendliness, expected tastiness, and perceived healthiness on purchase intention. Thus, our research contributes to a better understanding of how the Eco-Score and similar scoring systems influence product perceptions and subsequently purchase intention. This provides valuable insights for policy makers, food industry stakeholders and food marketers.

2. Theoretical background

2.1. The halo effect in the context of sustainability labels

Originally identified in the field of person perception (Thorndike, 1920), the halo effect is a systematic cognitive bias where a positive perception of one characteristic leads to positive evaluations of unrelated characteristics. Furthermore, the literature reports different forms of a negative halo effect: if a positively perceived characteristic (e.g., a Fairtrade label) leads to negative conclusions about unrelated characteristics (e.g., taste), the halo effect is also referred to as a reverse halo effect. Another form of a negative halo is the horns (or devil's horns) effect, in which one negatively perceived characteristic results in negative perceptions of unrelated characteristics or an overall negative perception (Forgas & Laham, 2017). In this paper, the term (positive or negative) halo effect is used consistently to refer to both positive and negative effects.

Sustainability labels can lead consumers to perceive identical products as tastier and of higher quality when carrying such a label (e.g., Gassler et al., 2019). Labels and claims can also reinforce consumer's positive beliefs about the environmental and nutritional properties of sustainable food (e.g., Lanero et al., 2021; Neuhofer et al., 2023). Dual-process theories of social cognition may explain the halo effects linked to sustainability labels (e.g., Lanero et al., 2021; Asioli et al., 2017). For most consumers, grocery shopping is a habitual, routine decision-making process that involves little cognitive effort (Lee et al., 2013; Park et al., 1989). As a result, consumers tend to process food information automatically (Gawronski & Creighton, 2013: 282). Extrinsic cues, such as sustainability labels, serve as mental shortcuts for consumers to make quick and easy inferences about product attributes with minimal cognitive effort (Lanero et al., 2021; Amos et al., 2019; Asioli et al., 2017). However, this can lead to relevant product information on the packaging (e.g., nutrition facts) being ignored, resulting in a halo effect (Lanero et al., 2021; Lee et al., 2013).

Most empirical research on the halo effect has focused on organic and ethical labeling (e.g., Richetin et al., 2021; Ellison et al., 2016). Study findings indicate that products with an organic or ethical label are perceived as healthier (Ellison et al., 2016; Apoalaza et al., 2017; Beckman, 2005; Berry & Romero, 2021). Sörqvist et al. (2015) find that consumers perceive organically labeled grapes and raisins as healthier, richer in vitamins and minerals, more beneficial for mental performance, and lower in calories. Lee et al. (2013) reached similar conclusions, focusing on cookies, potato crisps, and yogurt, which were rated as lower in fat, higher in fibre, lower in calories, and more nutritious. Schuldt et al. (2012) find that participants perceive fairly labeled chocolate as lower in calories. However, Schouteten et al. (2021) were unable to confirm these findings for nuts, juice, and chocolate.

Moreover, previous research has shown that the halo effect occurs also in judgments of perceived and expected taste (Nadricka et al., 2020; Apoalaza et al., 2017). Several studies showed that organically labeled products are perceived as tastier and more appetizing compared to unlabeled ones (e.g., Gassler et al., 2019; Sörqvist et al., 2015; Hemmerling et al., 2013) and that fair trade labeling positively influences the taste perception of coffee, chocolate, and green tea (Lotz et al., 2013; Tang et al., 2016). However, some studies have found reverse halo effects, where organically labeled products are rated as less palatable and tasty (Schuldt & Hannahan, 2013; Rousseau, 2015). In addition, the effects on taste perception and expectations seem to depend on the type of food studied (Ellison et al., 2016; Lee et al., 2013; Toschi et al., 2012; Poelman et al., 2008;). Given that the literature remains ambiguous on the direction of the effect of sustainability labels on various product characteristics, we formulate the following hypothesis:

H1.1 The Eco-Score influences the perceived environmental friendliness (H1.1a), expected tastiness (H1.1b), perceived healthiness (H1.1c), perceived content of fat (H1.1d), calories (H1.1e), and vitamins (H1.1f), and perceived nutritiousness (H1.1 g) of foods.

The Eco-Score uses letters and color-coding to mark a products' level of environmental friendliness (Fig. 1).

The mechanism underlying behavioral responses to color-coding is related to an associated stop-and-go logic (Richetin et al., 2022, Song et al., 2021). Studies on nutrition labels suggest that the color green is associated with positive (healthy) attributes and encourages the choice, whereas the color red acts as a warning and could lead to avoidance of such foods (e.g., Goodman et al., 2018; Reutner et al., 2015; Rohr et al., 2015). Research has shown that labeling less sustainable options is more effective in changing intended consumer behavior than positive labeling of environmentally friendly products (Van Dam & De Jonge, 2015; Grankvist et al., 2004). Based on these findings, we propose a second hypothesis regarding the potential for both a positive and negative halo effect in relation to the color-coded Eco-Score:

H1.2 The direction of the halo effect depends on the respective Eco-Score level, such that perceptions are positively biased when foods are labeled with Eco-Score A and negatively biased when foods are labeled with Eco-Score E.

2.2. Influence of consumer characteristics and product type on the halo effect

Research has identified the moderating role of both product type and various consumer attitudes for the occurrence of halo effects due to

Fig. 1. Eco-Score levels from A (very low) to E (very high ecological footprint) (Sia Partners, 2021).

labelling.

Nadricka et al. (2020) have demonstrated that organic labelling enhances the perceived taste of healthy foods (including apples, almonds, orange juice, wholemeal bread) but not of unhealthy foods (including crisps, ice cream, chocolate cookies, and cornflakes). Similarly, Ellison et al. (2016) conclude that organic labelling positively influences the expected taste rating for healthy, unprocessed food (strawberries), but not for processed, unhealthy food (cookies). Conversely, organic labelling only has a positive effect on the expected nutritional value of the unhealthy food (ibid.). In a further study, Prada et al. (2017) compared different organically labelled unprocessed and processed foods. They found that the unprocessed products were perceived as tastier, healthier and lower in calories, while a positive halo effect was less clear for processed foods. In contrast, Sörqvist et al. (2015) also examined processed and unprocessed products and observed more favourable ratings regardless of the product type. Furthermore, they observed that organic labelling was ineffective if the production process had no influence on taste (bottled water).

Studies on attitudinal moderators showed that participants with higher environmental concern and more environmental-friendly behavior are more susceptible to halo effects in their perceptions of taste and calories of organic products (Laureati et al., 2013; Sörqvist et al., 2013; Schuldt & Schwarz, 2010). In contrast, Lee et al. (2013) reported that individuals who engage in environmentally friendly activities are less susceptible to biased perceptions. Schuldt & Hannahan (2013) found that the relationship between organic labeling and taste perceptions is moderated by environmental concern, such that expecting a worse taste is particularly common among low concerned participants. At the same time, there was no moderating effect on perceived health. Apoalaza et al. (2017), however, identified an interaction between participants' health concerns and the effect of an eco-label on the perception of taste, healthiness, and texture of wine. Accordingly, the halo effect was strongest among the least health-conscious participants and not significant among very health-conscious participants (Apoalaza et al., 2017). Schuldt & Schwarz (2010) as well as Lee et al. (2013) reported that neither participants' health concern nor body mass index (BMI) had a moderating effect.

Given the ambiguous findings on how consumer attitudes influence product perceptions across product types, we formulate the following hypothesis with the aim to assess product-specific differences:

H2.1 and H2.2 (Overall) Environmental concern (H2.1) and health concern (H2.2), respectively, moderate expected tastiness (a) and perceived healthiness (b) of food products labeled with an Eco-Score.

2.3. Influence of product perceptions on purchase intention

Some studies have investigated how perceived product characteristics mediate the relationship between a label and purchase intention. Positive mediation effects have been demonstrated for binary eco-labels. Apoalaza et al. (2017) showed that more favourable perceptions of taste, texture, and health explain a stronger purchase intention for organically labeled wine. Gassler et al. (2019) found that consumers perceive organically labeled wine to have a better taste, which was driven by their perception of quality, and this positively affected their willingness to pay. This effect was especially pronounced for consumers with lower environmental concerns. For the color-coded Nutri-Score, De Temmermann et al. (2021) were able to show positive and negative mediation effects. Participants in their study perceived foods with a better Nutri-Score (A and B) to be healthier and were thus more willing to buy them. Conversely, the presence of Nutri-Score D or E decreased their perceived healthiness, which made them less willing to purchase the products.

Therefore, our third hypothesis is:

H3 Perceived environmental friendliness (H3a), expected tastiness (H3b), and perceived healthiness (H3c) mediate the effect of the Eco-Score on purchase intention.

3. Material and methods

3.1. Experimental design

To test whether individuals exposed to different Eco-Score categories exhibit differences in how they perceive a food product, a between-subjects design with four levels was chosen. Each participant was randomly assigned to one of three treatment groups, namely Eco-Score A (TGA), Eco Score C (TGC), Eco Score E (TGE) or to the control group (CG), i.e. no Eco-Score. Moreover, we introduced a within-subject factor: food product. In each condition, participants saw images of three food product packages (for spaghetti, strawberry yogurt, and crisps), shown in random order, with the respective Eco-Score or without. The selected food products are frequently consumed in Germany and represent different food categories (i.e., pasta, dairy, and salty snacks) and foods of differing tastes (savory, sweet, and salty). Specifically, they differ in their vice/virtue nature including both relatively healthy (i.e., yogurt, spaghetti) and less healthy (i.e., crisps) foods Thus, we developed a 3 (Product: spaghetti vs. yoghurt vs. crisps) x 4 (Eco-Score category: A vs. C vs. E vs. none) mixed design.

3.2. Participants

We recruited 1,284 individuals via a German online access panel to participate in an online survey between May and June 2022. The questionnaire study was approved by the Ethics Committee of the Justus Liebig University Giessen (AZ 67/22). Quotas were set for gender, age, regional origin, and net household income (Statistisches Bundesamt–DESTATIS 2020, 2022). To qualify for the survey, participants had to be at least partially responsible for food purchases in their household. Furthermore, the survey included attention checks and participants who failed the attention checks were excluded from the dataset (n = 274). In total, the final sample comprised 1,010 participants.

Descriptive statistics of the total sample and the four conditions are shown in Table 1. The sample corresponds to the German population with respect to the quota characteristics and we find no statistically significant differences across the experimental groups.

3.3. Procedures: Visual stimuli and questionnaire

Participants in the treatment groups received information on the Eco-score, introducing it as a new label, visualized on a leaf symbol, that evaluates the environmental properties of a food product and ranks it on

Table 1
Descriptive statistics of the total sample and the experimental groups.

Quota subgroup	Characteristics	Quota proportion [%]	Total sample (n = 1,010) [%]	Experimental groups			
				TGA (n = 242) [%]	TGC (n = 241) [%]	TGE (n = 223) [%]	CG (n = 304) [%]
Gender[a]	Female	49.7	52.9	52.1	54.2	52.3	53.1
	Male	50.3	47.1	47.9	45.8	47.7	46.9
Age	16–29 years	20.9	16.7	14.0	19.1	17.0	16.8
	30–39 years	17.5	18.0	17.8	18.3	21.5	15.5
	40–49 years	16.5	17.0	19.4	13.7	16.1	18.4
	50–59 years	21.9	23.4	25.6	24.1	20.2	23.4
	60 years and older	23.1	24.9	23.1	24.9	25.1	26.0
Region	North	18.0	18.0	14.0	19.5	18.4	19.7
	West	35.4	35.7	35.1	36.5	33.2	37.5
	East	17.3	16.1	14.0	16.2	18.8	15.8
	South	29.4	30.1	36.8	27.8	29.6	27.0
Net household income	under 2,000 EUR	38.5	35.9	35.5	34.9	33.6	38.8
	2,000 EUR to < 4,000 EUR	30.7	32.5	30.6	34.4	30.9	33.6
	4,000 EUR and more	23.1	24.7	27.7	26.1	26.0	20.1
	not specified	7.7	6.9	6.2	4.6	9.4	7.6

TGA = treatment group Eco-Score A; TGC = treatment group Eco-Score C; TGE = treatment group Eco-Score E; CG = control group.
[a] Three participants indicated "diverse" as their gender. This information was not taken into account for the quota gender. The percentages for gender therefore refer to a sample of n = 1,007.

a color-coded scale with 5 levels from A/dark green (very low environmental impact) to E/red (very high environmental impact). The full set of instructions is given in the Supplementary Material, which also provides a summary of the questionnaire.

Based on their treatment assignment, each participant was presented with a fictitious product packaging for plain spaghetti, strawberry yoghurt, and crisps in random order. The focus in the design of the products was on a realistic appearance, whereby certain packaging features (e.g., further labels, claims) were omitted to avoid possible confounding (see Fig. 2 for a design example with Eco-Score A).

Participants were asked to rate each of the three products on several rating scales:

Perceived environmental friendliness was measured on a seven-point scale (1="strongly disagree", 7="strongly agree") using the following three items adapted from Lindeman & Väänänen (2000): "The [product] shown has been prepared in an environmentally friendly way", "[…] has been produced in a way which has not shaken the balance of nature", and "[…] was packaged in an environmentally friendly way" ($\alpha_{spaghetti}$ = 0.924, α_{yogurt} = 0.934 and α_{crisps} = 0.932). We averaged these scores to obtain a general perceived environmental friendliness score for each product.

To measure *expected tastiness*, the seven-point multi-item scale by Folkvord et al. (2021) was used, ranging from "1 = strongly disagree" to "7 = strongly agree." The construct comprised the items "I think the [product] shown looks tasty," "I think I can enjoy the taste of the [product] shown" and "I think the [product] shown are more tasty than other [product]". Based on the analyses, one item ("The health quality […] is more important to me than the taste") was dropped. Reliability of the items for the three products was good, with $\alpha_{spaghetti}$ = 0.835, α_{yogurt} = 0.858 and α_{crisps} = 0.878, respectively. We averaged these scores for each participant to obtain a general expected tastiness score for each product.

Perceived healthiness was measured using a seven-point semantic differential scale from De Temmerman et al. (2021). The bipolar item pairs were "1 = unhealthy–7 = healthy", "1 = low in fat–7 = high in fat", "1 = low in calories–7 = high in calories", "1 = low in vitamins–7 = high in vitamins" and "1 = not nutritious–7 = nutritious" (De Temmerman et al., 2021). The items measuring perceptions of fat and calories were recoded before analysis so that all items have the same directional relationship. As the Cronbach's alpha was not satisfactory for all three products, the five items were not averaged into an overall perceived healthiness score ($\alpha_{spaghetti}$ = 0.377, α_{yogurt} = 0.706, α_{crisps} = 0.769), but were used individually in the subsequent analyses to ensure consistency and comparability across products. Thus, the single bipolar item pair "1 = unhealthy–7 = healthy" served as a measure of perceived healthiness in the subsequent analyses. As a robustness check, we additionally used the averaged score in the moderation and mediation analyses for yogurt and crisps. Results are displayed in Appendix F and support our central findings presented in the main part of the paper.

We measured participants' *purchase intention* for each product on a seven-point scale (1="strongly disagree", 7="strongly agree") based on Folkvord et al. (2021) with five items: "I would like to try the [product] shown," "I would like to buy the [..] shown, if I see it in a supermarket," "I would actively seek out to buy the [..] shown in the supermarket", "I would recommend the […] shown to others", and "I would be willing to buy the […] shown" ($\alpha_{spaghetti}$ = 0.934, α_{yogurt} = 0.946, α_{crisps} = 0.955). Again, we averaged these scores for a general purchase intention score for each product.

After evaluating the three products, the participants answered questions about their general health and environmental concerns on

Fig. 2. Product stimuli – Example with Eco-Score A.

seven-point scales (1="strongly disagree", 7="strongly agree"). We measured *health concern* with five items ($\alpha_{health\ concern} = 0.841$): "I do everything I can to stay healthy.", "Living life in the best possible health is very important to me" and "I actively try to prevent disease and illness.", "Eating right, exercising, and taking preventive measures will keep me healthy for life.", "My health depends on how well I take care of myself." (Dutta-Bergman, 2004).

Environmental concern was measured with the revised New Environmental Paradigm Scale (NEP) from Dunlap et al. (2000). The scale comprises 15 items, e.g., "Humans are severely abusing the environment" and "We are approaching the limit of the number of people the earth can support" ($\alpha_{environmental\ concern} = 0.856$). We averaged the scores for each construct to obtain a general health concern and a general environmental concern score.

3.4. Data analysis

To determine whether the Eco-Score influences product perceptions across food categories (H1.1 – H1.2), we performed a 3 (Product: spaghetti vs. yoghurt vs. crisps) x 4 (Eco-Score category: A vs. C vs. E vs. none) repeated measures ANOVA for each evaluation dimension (perceived environmental friendliness, expected tastiness, perceived healthiness, perceived level of fat, calories, and vitamins, perceived nutritiousness) as the dependent variable. For participants, who reported following a "vegan" (n = 19), "gluten-free" (n = 3), and "lactose-free and wheat-free" (n = 1) diet, the respective product evaluations of the spaghetti (wheat product) and strawberry yogurt (dairy product) were not included in the analyses.

For analyzing whether participants' health or environmental concerns moderate expected tastiness and perceived healthiness (H2.1 – H2.2), moderation analyses employing the PROCESS macro version 4.1 of Hayes (2022) were used. Regression coefficients were estimated with robust standard errors using the HC3 estimator. In each analysis, one Eco Score dummy variable was included as the independent variable, while the other two Eco score dummy variables as well as age and gender were included as covariates. The control group served as the reference category in all moderation analysis. The Johnson-Neyman technique was used to identify the significance regions for the effect of each moderation (Igartua & Hayes, 2021). This approach identifies the value(s) of the moderator variable at which point (or points) its effect transitions between statistically significant to not significant (Hayes, 2013, S. 429). Three categories of concerns were defined for interpreting the significance regions of the scale values with respect to moderation effects for this study: low (1.0–3.49), indifferent (3.5–4.49), and high (4.5–7.0).

To determine whether perceived environmental friendliness, expected tastiness or perceived healthiness mediates the relationship between Eco-Score and purchase intention, mediation analyses were performed. Bootstrapping was used for testing indirect effects, with 10,000 bootstrap samples and a random number seed specified for each run of PROCESS (Hayes, 2013). Other settings (HC3 estimators, age and gender as covariates) remained the same.

4. Results

4.1. Effects of the Eco-Score on product perceptions

The 3 x 4 repeated measures ANOVAs with the respective product perception as the dependent variable revealed the following:

Perceived environmental friendliness. There were significant main effects of food product ($F[1.99,1952.45] = 66.272$, $p < 0.001$) and Eco-Score category ($F[3,983] = 172.462$, $p < 0.001$) and also a significant interaction effect of the two IVs ($F[5.96,1952.45] = 3.138$, $p < 0.01$). Fig. 3 shows that all foods were perceived as more environmentally friendly in the presence of Eco-Score A (spaghetti: $M_{TGA} = 5.13$ $SD_{TGA} = 1.25$; yogurt: $M_{TGA} = 5.08$, $SD_{TGA} = 1.20$; crisps: $M_{TGA} = 4.95$, $SD_{TGA} = 1.26$) and less environmentally friendly in the presence of Eco-Score E

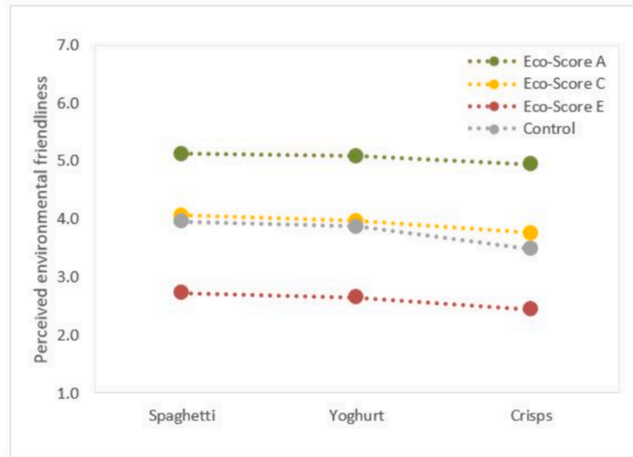

Fig. 3. Effect of the Eco-Score category and food product on perceived environmental friendliness.

(spaghetti: $M_{TGE} = 2.73$, $SD_{TGE} = 1.39$; yogurt: $M_{TGE} = 2.65$, $SD_{TGE} = 1.36$; crisps: $M_{TGE} = 2.44$, $SD_{TGE} = 1.39$) compared to the control group (spaghetti: $M_{CG} = 3.96$, $SD_{CG} = 1.22$; yogurt: $M_{CG} = 3.87$, $SD_{CG} = 1.32$; crisps: $M_{CG} = 3.49$, $SD_{CG} = 1.34$) and Eco-Score C (spaghetti: $M_{TGC} = 4.07$ $SD_{TGC} = 0.97$; yogurt: $M_{TGC} = 3.97$, $SD_{TGC} = 1.14$; crisps: $M_{TGC} = 3.76$, $SD_{TGC} = 1.12$). Thus, all Eco-Score categories differed significantly from each other. Across Eco-Score categories, crisps were perceived as less environmentally friendly than the spaghetti and yoghurt (Appendix A and B provide details on the post hoc tests). Fig. 3 illustrates these results.

Expected tastiness. We found significant main effects of food product ($F[2,1966] = 103.767$, $p < 0.001$) and Eco-Score category ($F[3,983] = 10.871$, $p < 0.001$). The interaction effect (Fig. 4) was not significant ($F[6,1966] = 1.446$, $p = 0.193$). For all foods, Eco-Score E significantly decreased the expected tastiness of a product (spaghetti: $M_{TGE} = 3.71$, $SD_{TGE} = 1.23$; yogurt: $M_{TGE} = 3.69$, $SD_{TGE} = 1.30$; crisps: $M_{TGE} = 3.03$, $SD_{TGE} = 1.36$) compared to the control group (spaghetti: $M_{CG} = 4.02$, $SD_{CG} = 1.33$; yogurt: $M_{CG} = 4.07$, $SD_{CG} = 1.32$; crisps: $M_{CG} = 3.53$, $SD_{CG} = 1.46$). Moreover, all products with Eco-Score A (spaghetti: $M_{TGA} = 4.09$, $SD_{TGA} = 1.27$; yogurt: $M_{TGA} = 4.25$, $SD_{TGA} = 1.42$; crisps: $M_{TGA} = 3.77$, $SD_{TGA} = 1.34$) were rated more favorably than their counterparts with Eco-Score E. For spaghetti and yoghurt, we found no significant differences in expected tastiness between Eco-Score A, Eco-Score C, and an unlabeled product. For crisps, although constantly rated the lowest, those with Eco-Score A were expected to taste better than those with Eco-Score C; and those with Eco-Score C were rated more favorably than those with Eco-Score E (Appendix A and B).

Perceived healthiness. There were significant main effects of food product ($F[1.98,1941.77] = 527.935$, $p < 0.001$) and Eco-Score category ($F[3,983] = 39.903$, $p < 0.001$), but Fig. 4 shows no significant interaction effect ($F[5.93,1941.77] = 1.413$, $p = 0.206$). All products were perceived as significantly healthier with an Eco-Score A (spaghetti: $M_{TGA} = 4.81$, $SD_{TGA} = 1.35$; yogurt: $M_{TGA} = 4.78$, $SD_{TGA} = 1.48$; crisps: $M_{TGA} = 3.56$, $SD_{TGA} = 1.62$) compared to Eco-Score C (spaghetti: $M_{TGC} = 4.32$, $SD_{TGC} = 1.01$; yogurt: $M_{TGC} = 4.32$, $SD_{TGC} = 1.24$; crisps: $M_{TGC} = 2.86$, $SD_{TGC} = 1.33$), which in turn were perceived as healthier than products with Eco-Score E (spaghetti: $M_{TGE} = 3.87$, $SD_{TGE} = 1.27$; yogurt: $MTGE = 3.85$, $SD_{TGE} = 1.41$; crisps: $M_{TGE} = 2.35$, $SD_{TGE} = 1.38$). All foods with Eco-Score E were perceived as significantly less healthy than the unlabeled controls (spaghetti: $M_{CG} = 4.44$, $SD_{CG} = 1.32$; yogurt: $M_{CG} = 4.60$, $SD_{CG} = 1.40$; crisps: $M_{CG} = 3.03$, $SD_{CG} = 1.48$). The perceived healthiness of unlabeled products was similar to that of the products with Eco-Score C, but significantly lower than that of the products with Eco-Score A (spaghetti and crisps). Overall, crisps were perceived as less healthy than spaghetti and yoghurt in all conditions

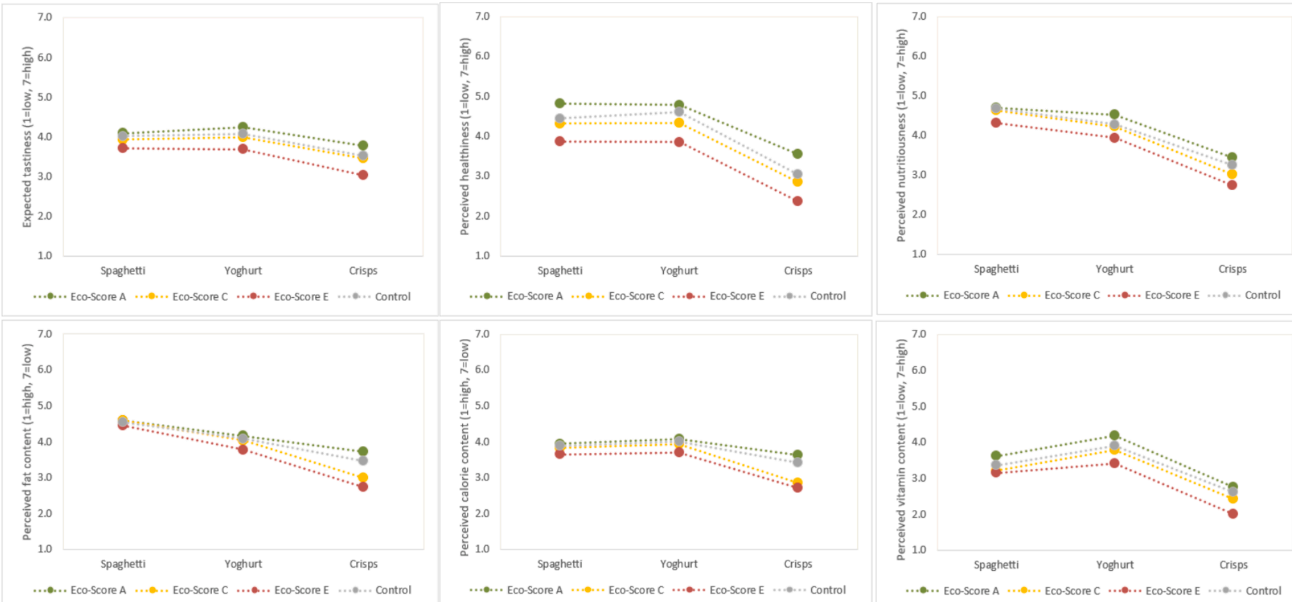

Fig. 4. Effect of the Eco-Score category and food product on the other evaluation dimensions.

(Appendix A and B).

Perceived nutritiousness. There were significant main effects of food product ($F[1.97,1938.34] = 383.587$, $p < 0.001$) and Eco-Score category ($F[3,983] = 11.057$, $p < 0.001$), but no significant interaction effect ($F[5.92,1938.34] = 1.274$, $p = 0.266$) in Fig. 4. All foods were perceived as less nutritious with an Eco-Score E (spaghetti: $M_{TGE} = 4.32$, $SD_{TGE} = 1.30$; yogurt: $M_{TGE} = 3.94$, $SD_{TGE} = 1.34$; crisps: $M_{TGE} = 2.75$, $SD_{TGE} = 1.67$) compared to the control group (spaghetti: $M_{CG} = 4.68$, $SD_{TGE} = 1.43$; yogurt: $M_{CG} = 4.28$, $SD_{CG} = 1.35$; crisps: $M_{CG} = 3.27$, $SD_{CG} = 1.61$). In turn, products with Eco-Score A (spaghetti: $M_{TGA} = 4.71$, $SD_{TGA} = 1.38$; yogurt: $M_{TGA} = 4.53$, $SD_{TGA} = 1.37$; crisps: $M_{TGA} = 3.46$, $SD_{TGA} = 1.68$) were perceived as more nutritious than those with Eco-Score E, but products labelled with Eco-Score A or C (spaghetti: $M_{TGC} = 4.65$, $SD_{TGC} = 1.38$; yogurt: $M_{TGC} = 4.23$, $SD_{TGC} = 1.30$; crisps: $M_{TGC} = 3.03$, $SD_{TGC} = 1.62$) were not perceived differently than those without a label (i.e., in the control group). Overall, spaghetti was perceived as more nutritious than yoghurt, which was in turn perceived as more nutritious than crisps. This relationship held true for all conditions except Eco-Score A, where spaghetti and yoghurt were perceived as equally nutritious (Appendix A and B).

Perceived fat content. There were significant main effects of food product ($F[1.81,1778.26] = 224.735$, $p < 0.001$) and Eco-Score category ($F[3,983] = 12.025$, $p < 0.001$), and a significant interaction effect ($F[5.43,1778.26] = 5.506$, $p < 0.001$) as shown in Fig. 4. For spaghetti, the perception of fat content was independent of the Eco-Score (spaghetti: $M_{TGA} = 4.59$, $SD_{TGA} = 1.45$; $M_{TGC} = 4.60$, $SD_{TGC} = 1.42$; $M_{TGE} = 4.44$, $SD_{TGE} = 1.38$; $M_{CG} = 4.54$, $SD_{CG} = 1.45$). Yogurt and crisps were perceived as significantly higher in fat when Eco-Score E (yogurt: $M_{TGE} = 3.77$, $SD_{TGE} = 1.26$; crisps: $M_{TGE} = 2.74$, $SD_{TGE} = 1.73$) was shown on the packaging compared to when Eco-Score A was shown (yogurt: $M_{TGA} = 4.16$, $SD_{TGA} = 1.30$; crisps: $M_{TGA} = 3.72$, $SD_{TGA} = 1.71$) or to unlabeled products in the control group (yogurt: $M_{CG} = 4.09$, $SD_{CG} = 1.31$; crisps: $M_{CG} = 3.47$, $SD_{CG} = 1.72$). However, while perceptions of fat content did not differ between the unlabeled yoghurt and crisps and those labelled with Eco-Score A, crisps with an Eco-Score C were perceived to be higher in fat (crisps: $M_{TGC} = 2.99$, $SD_{TGC} = 1.64$) in comparison to the control condition. In all conditions, crisps were perceived as the product with the highest fat content, followed by yoghurt and spaghetti (Appendix A and B).

Perceived calorie content. There were significant main effects of food product ($F[1.89,1858.16] = 109.986$, $p < 0.001$) and Eco-Score category ($F[3,983] = 13.285$, $p < 0.001$) and a significant interaction effect ($F[5.67,1858.16] = 5.272$, $p < 0.001$) as shown in Fig. 4. For spaghetti, the perceptions of calorie content were independent of the Eco-Score (spaghetti: $M_{TGA} = 3.94$, $SD_{TGA} = 1.34$; $M_{TGC} = 3.82$, $SD_{TGC} = 1.17$; $M_{TGE} = 3.65$, $SD_{TGE} = 1.31$; $M_{CG} = 3.88$, $SD_{CG} = 1.24$). Yoghurt and crisps were perceived as significantly higher in calories with Eco-Score E (yogurt: $M_{TGE} = 3.70$, $SD_{TGE} = 1.26$; crisps: $M_{TGE} = 2.70$, $SD_{TGE} = 1.78$) compared to Eco-Score A (yogurt: $M_{TGA} = 4.08$, $SD_{TGA} = 1.27$; crisps: $M_{TGA} = 3.62$, $SD_{TGA} = 1.70$) or the control group (yogurt: $M_{CG} = 4.00$, $SD_{CG} = 1.33$; crisps: $M_{CG} = 3.42$, $SD_{CG} = 1.78$). For crisps, calories were also perceived to be higher when they were labelled with Eco-Score C than when unlabelled (crisps: $M_{TGC} = 2.86$, $SD_{TGC} = 1.60$). Across all conditions, crisps were perceived as having a higher calorie content than yoghurt, followed by spaghetti (Appendix A and B).

Perceived vitamin content. There were significant main effects of food product ($F[1.99,1960.87] = 404.819$, $p < 0.001$) and Eco-Score category ($F[3,983] = 15.293$, $p < 0.001$) and a marginally significant interaction effect ($F[5.98,1960.87] = 1.932$, $p = 0.073$). Fig. 4 shows that yogurt and crisps were perceived as lower in vitamins with Eco-Score E (spaghetti: $M_{TGE} = 3.14$, $SD_{TGE} = 1.355$; yogurt: $M_{TGE} = 3.41$, $SD_{TGE} = 1.29$; crisps: $M_{TGE} = 2.01$, $SD_{TGE} = 1.29$) compared to the control group (spaghetti: $M_{CG} = 3.36$, $SD_{CG} = 1.34$; yogurt: $M_{CG} = 3.92$, $SD_{CG} = 1.38$; crisps: $M_{CG} = 2.62$, $SD_{CG} = 1.51$). Perceived vitamin contents in all other treatment conditions and across foods did not differ significantly from those in the control group. Significant differences were only detected between several treatment groups. Yoghurt and crisps were perceived as having significantly more vitamins when labelled with Eco-Score C (spaghetti: $M_{TGC} = 3.21$, $SD_{TGC} = 1.35$; yogurt: $M_{TGC} = 3.79$, $SD_{TGC} = 1.28$; crisps: $M_{TGC} = 2.43$, $SD_{TGC} = 1.40$) than with Eco-Score E. The vitamin content of all food products was perceived more favorably with Eco-Score A (spaghetti: $M_{TGA} = 3.61$, $SD_{TGA} = 1.50$; yogurt: $M_{TGA} = 4.19$, $SD_{TGA} = 1.38$; crisps: $M_{TGA} = 2.76$, $SD_{TGC} = 1.57$) than with Eco-Score C or E. Across all conditions, yoghurt was perceived as having a higher vitamin content than spaghetti, followed by crisps (Appendix A and B).

Fig. 4 illustrates the results regarding the effects of the Eco Score and food product on the different evaluation dimensions.

4.2. Moderation analysis

The detailed results of the moderation analyses for the moderator environmental concern and health concern are presented in Appendix C and D, respectively.

Moderator Environmental concern. The only significant moderation was found for Spaghetti with Eco-Score A. The interaction term, and thus moderation, explains an additional 1.2 % of the variance in perceived healthiness ($\Delta R^2 = 0.012$, $F(1, 995) = 10.582$, $p = 0.001$). According to the significance regions of the Johnson-Neyman technique, spaghetti with Eco-Score A are perceived to be less healthy by participants with a low environmental concern (scale value (sv): 2.40–2.86), with only 0.5 % of the sample residing in this significance region. With high environmental concerns (sv: 4.92–7.00), the healthiness of the spaghetti is perceived to be better, in a significance region in which 69 % of the sample resides.

Moderator Health concern. Several significant interaction effects were found, which are described in the following.

For spaghetti, strawberry yogurt and crisps, the effect of Eco-Score A on expected tastiness is significantly moderated by participants' health concerns (spaghetti: b3 = 0.236, p = 0.013; strawberry yogurt: b3 = 0.389, p = 0.011; crisps: b3 = 0.316, p = 0.516). Here, moderation can explain an additional 0.7–1.6 % of the variance in expected tastiness (spaghetti: $\Delta R^2 = 0.007$, $F(1, 995) = 6.153$, $p = 0.013$; strawberry yogurt: $\Delta R^2 = 0.016$, $F(1, 979) = 11.938$, $p = 0.001$; crisps: $\Delta R^2 = 0.010$, $F(1, 999) = 9.076$, $p = 0.003$). Using the Johnson-Neyman technique, two significance regions are identified in each case. The lower significance regions, in which 1.79 % (crisps), 6.18 % (spaghetti) or 8.51 % (strawberry yoghurt) of the sample reside, include low to indifferent health concern (sv: 1.00–3.89), for which a negative moderation effect on expected tastiness is present. The upper significance regions, with 8.28 % (spaghetti), 46.40 % (strawberry yoghurt) or 46.87 % (crisps) of the sample, include high health concern (sv: 5.21–7.00). Here, given an Eco-Score A is present, expected tastiness becomes increasingly positive as health concern increases.

In the case of strawberry yogurt, a significant moderation effect also occurs with Eco Score C with regard to the expected tastiness ($b_3 = -0.243$, $p = 0.018$), which can explain an additional 0.6 % of the variance ($\Delta R^2 = 0.006$, $F(1, 979) = 5.570$, $p = 0.018$). In the lower significance region lie 1.01 % and in the upper significance region lie 23.30 % of the sample. In contrast to the results for Eco-Score A, participants with low health concern (sv: 1.00–2.60) perceive the strawberry yogurt with Eco-Score C to be tastier, and participants with high health concern (sv: 5.93–7.00) perceive it to be less tasty.

Finally, for the strawberry yogurt with Eco-Score A and C, participants' health concern also moderates the yoghurts' perceived healthiness (Eco-Score A: $b_3 = 0.490$, $p = 0.000$; Eco-Score C: $b_3 = -0.271$, $p = 0.008$). The interaction effect models can explain an additional 2.2 % and 0.6 % of the variance in health perception (Eco-Score A: $\Delta R^2 = 0.022$, $F(1, 979) = 17.980$, $p = 0.000$; Eco-Score C: $\Delta R^2 = 0.006$, $F(1, 979) = 7.006$, $p = 0.008$). The significance regions of the Johnson-Neyman technique show the same pattern as for the expected tastiness of strawberry yogurt (lower significance region Eco-Score A: 17.02 %, upper significance region Eco-Score A: 46.40 %; lower significance region Eco-Score C: 0.10 %, upper significance region Eco-Score C: 61.70 % of the sample respectively). When labeled with Eco-Score A, participants with low to indifferent health concern (sv: 1.00–4.25) perceive the strawberry yogurt to be less healthy and those with high health concern (sv: 5.8–7.00) perceive it to be healthier. In contrast, the strawberry yogurt with Eco-Score C is perceived healthier by participants with low health concern (sv: 1.00–1.22) and less healthy by participants with high health concern (sv: 4.95–7.00).

4.3. Mediation analysis

We also analyzed whether perceived environmental friendliness, expected tastiness and perceived healthiness mediates the relationship between the Eco-Score category and purchase intention. Table 2 provides a summary of the path coefficients and the confidence intervals of the indirect effects.

Mediator perceived environmental friendliness. With perceived environmental friendliness as mediator, Eco-Score A has a significantly positive indirect effect on purchase intention for all food products (spaghetti: ab = 0.711, BootSD = 0.076, 95 % CI [0.563; 0.860]; yogurt: ab = 0.858, BootSD = 0.087, 95 % CI [0.689; 1.034]; crisps: ab = 0.911, BootSD = 0.085, 95 % CI [0.749; 1.085]). Conversely, for all food products, the perceived environmental friendliness as a mediator leads to a significantly negative indirect effect of Eco-Score E on purchase intention. For the crisps, the perceived environmental friendliness also significantly positively mediates the relationship between Eco-Score C and purchase intention (ab = 0.161, BootSD = 0.067, 95 % CI [0.031; 0.296]). The corresponding mediation models are shown in Appendix E (Figure A5).

Mediator expected tastiness. With expected tastiness as a mediator, a significant negative indirect effect of Eco-Score E on purchase intention is found across all three products (spaghetti: ab = -0.245, BootSD = 0.085, 95 % CI [-0.412; -0.080]; yogurt: ab = -0.346, BootSD = 0.101, 95 % CI [-0.544; -0.153]; crisps: ab = -0.429, BootSD = 0.104, 95 % CI [-0.635; -0.230]). Moreover, the expected tastiness significantly positively mediates the relationship between Eco-Score A and purchase intention for crisps (ab = 0.203, BootSD = 0.100, 95 % CI [0.003; 0.396]). The corresponding mediation models are shown in Appendix E (Figure A6).

Mediator perceived healthiness. Analyses with perceived healthiness as a mediator also identify significant negative indirect effects of Eco-Score E on purchase intention for all food products (spaghetti: ab = -0.276, BootSD = 0.061, 95 % CI [-0.402; -0.162]; yogurt: ab = -0.451, BootSD = 0.083, 95 % CI [-0.617; -0.293]; crisps: ab = -0.358, BootSD = 0.069, 95 % CI [-0.495; -1.085]) and, for the strawberry yogurt, additionally with Eco-Score C (ab = -0.168, BootSD = 0.071, 95 % CI [-0.313; -0.035]). In contrast, the perceived healthiness positively mediates the relationship between Eco-Score A and purchase intention for the spaghetti and the crisps (spaghetti: ab = 0.173, BootSD = 0.058, 95 % CI [0.061; 0.287]; crisps: ab = 0.245, BootSD = 0.070, 95 % CI 0.111; 0.383]). The corresponding mediation models are shown in Appendix E (Figure A7).

5. Discussion

The results of our repeated-measures ANOVAs confirm partially our first hypothesis (H1.1a-g) that the presence of an Eco Score on a food product influences different evaluation dimensions. The hypothesis with regard to perceived environmental friendliness (H1.1a) could be confirmed across all three products for Eco Score A, which led to a more favourable evalution, and for Eco Score E, which led to a less favourable evaluation, in comparison to the no labeling situation. No significant effect was found for Eco Score C. These results also confirm H1.2 and highlight that the major idea of the Eco Score was understood by participants and they formed an opinion on product's perceived environmental friendliness. This is an important finding since only if they indeed formed such an opinion, a halo effect bias can occur.

Our mediation analyses for perceived environmental friendliness support these conclusions, since the perceived environmental friendliness was higher in case of Eco-Score A, which in turn increased purchase intentions. Conversely, Eco-Score E led to significantly negative indirect effects on purchase intentions across all products (i.e., supporting H3a for all products with Eco-Score A(+) and E(−)). Furthermore, the path coefficients show that the impact of the Eco-Score on perceived environmental friendliness is the strongest among the evaluation dimensions considered. This demonstrates the effectiveness of the color-coded Eco-Score label in guiding consumers' purchase intentions towards more environmental friendly foods, and is consistent with findings on the effect of the color-coded Nutri-Score (e.g., De Temmermann et al. 2021; Egnell et al., 2018; Gassler et al., 2023; Folkvord et al., 2021; Song et al., 2021; De Bauw 2021).

At the same time our results show that the presence of an Eco-Score E

Table 2
Summary of the mediating effects of perceived environmental friendliness, expected tastiness and perceived healthiness on the relationship between the Eco-Score and purchase intentions by product.

Mediator (Hypothesis)	Eco-Score	Indirect effect (ab) [95 % CI]			effect[a]	Confirmation (√) or rejection (×) of the hypothesis		
		spaghetti	strawberry yoghurt	crisps		spaghetti	strawberry yoghurt	crisps
perceived environmental friendliness (3a)	A	0.711 [0.563; 0.860]	0.858 [0.689; 1.034]	0.911 [0.749; 1.085]	positive	√	√	√
	C	0.057 [-0.058; 0.172]	0.063 [-0.083; 0.212]	0.161 [0.031; 0.296]	positive	×	×	√
	E	-0.769 [-0.931; -0.611]	-0.872 [-1.066; -0.690]	-0.667 [-0.843; -0.499]	negative	√	√	√
expected tastiness (3b)	A	0.043 [-0.123; 0.209]	0.165 [-0.044; 0.368]	0.203 [0.003; 0.396]	positive	×	×	√
	C	-0.082 [-0.238; 0.074]	-0.085 [-0.271; 0.102]	-0.064 [-0.253; 0.120]	n. s.	×	×	×
	E	-0.245 [-0.412; -0.080]	-0.346 [-0.544; -0.153]	-0.429 [-0.635; -0.230]	negative	√	√	√
perceived healthiness (3c)	A	0.173 [0.061; 0.287]	0.104 [-0.042; 0.252]	0.245 [0.111; 0.383]	positive	√	×	√
	C	-0.062 [-0.165; 0.035]	-0.168 [-0.313; -0.035]	-0.099 [-0.224; 0.021]	negative	×	√	×
	E	-0.276 [-0.402; -0.162]	-0.451 [-0.617; -0.293]	-0.358 [-0.495; -0.288]	negative	√	√	√

n. s. = not significant.

[a] Influence of the mediator on the direction (positive or negative) of the effect of the Eco-Score on the purchase intention. The effect relates either to all products or only to the products for which the hypothesis was confirmed. The listed effects of the Eco-Score are to be interpreted in relation to the control group (without Eco-Score).

significantly reduces the expected tastiness (H1.1b), perceived healthiness (H1.1c), and perceived nutritiousness (H1.1 g) across all three products. These findings can be interpreted as a negative halo effect and is in line with prior work on the stigmatizing effects of unfavorable traffic light labeling (e.g., Gassler et al., 2023; De Temmermann et al. 2021; Richetin et al., 2021; Sundar et al., 2014,2020;). Overall, our findings show that the Eco-Score E had a negative indirect effect on purchase intention via expected tastiness and perceived healthiness across all products (i.e., supporting H3b-c for all products with Eco-Score E).

The effect of Eco-Score A on product evaluations was more heterogeneous. We found a positive effect of Eco-Score A on perceived healthiness. We can interpret this as a positive health halo effect. However, this does not apply to all three products considered, as we only find this positive health halo in the ANOVA results for spaghetti and crisps. This is also reflected in the positive indirect effects of Eco-Score A on purchase intention via perceived healthiness for both foods (i.e. supporting H3c for crisps and spaghetti with Eco-Score A(+)). This positive effect turned also significant for strawberry yoghurt when perceived healthiness was measured using the average score (Appendix F).

The presence of Eco-Score C had in most cases no effect on product perceptions in comparison to the control group. However, there are some exceptions. For crisps, the least healthy product studied, we found a significant negative effect on the perceived fat and calorie content in the ANOVA. Thus, a negative indirect effect of Eco-Score C on purchase intention via perceived healthiness seems plausible, but was only significant when perceived healthiness was measured using the average score (Appendix F). Overall, our results indicate that the Eco-Score label has a greater influence on the evaluation of crisps, as more evaluation dimensions were influenced than, for example, for spaghetti. This seems plausible as plain spaghetti (without seasoning) is a much more homogeneous product e.g. in terms of calorie and fat content than crisps. So, for crisps, being a more “sensitive” product in terms of calories, the uncertainty about the nutritional content seems to be much greater and participants relied more on the Eco-Score to infer other product attributes. In fact, only for crisps did we find a positive indirect effect of Eco-Score A on purchase intention via expected tastiness (i.e. supporting H3b for crisps with Eco-Score A). Moreover, a positive indirect effect of Eco-Score C on purchase intention via perceived environmental friendliness was also present for crisps only (i.e., supporting H3a for crisps with Eco-Score C(+)).

Our moderation analyses yielded several clear (non–)effects across products and Eco-Scores, but also some ambiguous findings. First, environmental concern did not moderate expected tastiness, i.e., our results do not support H2.1a across all three products and Eco-Scores. The only significant moderation effect was found for perceived healthiness of spaghetti labelled with Eco-Score A. Thus, the effect of a favorable Eco-Score on perceived healthiness was stronger for consumers with higher environmental concern (i.e., supporting H2.1b for spaghetti with Eco-Score A). A potential negative halo effect of Eco-Score E was neither amplified nor reduced by environmental concern.

Second, health concern did not moderate perceived healthiness of spaghetti and crisps, i.e., our results do not support H2.2b for these two products across Eco-Scores. For strawberry yoghurt, however, moderating effects on perceived healthiness were less clear-cut. While health concern significantly moderated the perceived healthiness of strawberry yoghurt labeled with Eco-Score A (i.e., supporting H2.2b for yoghurt with Eco-Score A), no final conclusion can be drawn for Eco-Score C and E since changes in the significance of effects were found depending on whether perceived healthiness was measured using the single item or the average score (Appendix F). Overall, health-conscious consumers perceived the A-labeled strawberry yoghurt as relatively healthier, which is consistent with the logic of halo effects. Prada et al. (2016) reported a similar relationship between environmental concern and a product’s health score given an organic label. Moreover, health concern significantly moderated the expected tastiness of spaghetti, strawberry yogurt, and crisps labeled with Eco-Score A. For strawberry yoghurt, a significant moderating effect was also found for Eco-Score C (i.e., supporting H2.2a for all products with Eco-Score A and for strawberry yoghurt with Eco-Score C). Health-conscious participants rate the expected tastiness of the spaghetti or strawberry yoghurt significantly more positive with an Eco-Score A compared to the control group, and significantly more negative with an Eco-Score C. This is in line with Schuldt & Hannahan (2013), who also found negative effects of an organic label on taste perception among individuals with low environmental concern.

Overall, our results confirm previous studies, which observed that negative labels, in our case Eco-Score E, might be more effective in influencing consumer choices than positive ones (e.g. Van Dam & De Jonge, 2015; Grankvist et al., 2004). The underlying mechanism of the behavioral reactions to traffic light systems is associated with color coding and an underlying stop-and-go logic (Richetin et al., 2022, Song et al., 2021). Studies indicate that the color red acts as a warning and leads to a more negative assessment and avoidance (e.g., Goodman et al., 2018; Reutner et al., 2015; Rohr et al., 2015; Schuldt, 2013; Balcombe et al., 2010) which might explain why we find more significant effects for Eco Score E than for Eco Score A.

5.1. Implications

Theoretical implications. This study builds on research on halo effects of sustainability labels in the food context and contributes to a better understanding of consumer perceptions of scoring systems as follows. First, our research findings suggest that consumers tend to generalize from the Eco Score label, a label designed to specifically communicate information about environmental properties, to form more general health perceptions. This is an important finding as the Eco-Score does not convey any nutritional or health-related information. Our results also show that the health halo effect is particularly pronounced for the outer levels and especially for Eco-Score E. It seems that, from the consumer's perspective, a product that is not perceived as environmentally friendly cannot be healthy. Therefore, our results confirm previous findings that there seems to be a strong positive relationship between perceived environmental friendliness and perceived healthiness from a consumer perspective (e.g. Lazzarini et al., 2016). Second, our results indicate that participants with high environmental or health concerns are more susceptible to positive halo effects and evaluate products (albeit slightly) more heuristically. However, it also needs to be stressed that these moderation effects are relatively small. Third, our results show that the effect of the Eco-Score differs across product categories with the product that is considered at least environmentally friendly and least healthy, i.e. crisps, exhibiting halo effects in more evaluation dimensions than spaghetti.

Practical and policy implications. Sustainability is an important issue for the food industry and for policy makers. On the one hand, the results show that the Eco-Score functions as a sustainability label and that the perceived environmental friendliness correctly and effectively mediates purchase intention. On the other hand, the results provide evidence for the occurrence of both positive and negative halo effects that also influence purchase intention. If consumers perceive food products labeled with a positive Eco-Score as better, food manufacturers and retailers may benefit from higher purchase intentions. However, food manufacturers are unlikely to voluntarily label their products with a negative Eco-Score (e.g., Eco-Score E highlighted in red) if such labeling leads to systematic and undesirable judgements. In that case, action by policymakers or food retailers may be needed "to prevent halo effects that may lead to consumer confusion" (Amos et al., 2017). Mandatory labeling also makes it easier for consumers to compare within and across food groups (De Bauw et al., 2021; Rondoni & Grasso, 2021; Hagmann & Siegrist, 2020). In addition, mandatory implementation incentivizes sustainable product innovation and potentially drives less environmentally friendly product alternatives out of the market if consumers avoid purchasing them (Gröfke et al., 2021; Amos et al., 2017).

5.2. Limitations

Some limitations of the experiment need to be mentioned. First, participants only saw images of food packaging. Although there is an increasing trend toward online grocery shopping in Germany, the market share is still very small, and groceries are purchased primarily through stationary retailers (Statista, 2022; Statista 2021b). Product evaluations tend to be more informed when the product can be touched (Peck & Childers, 2003). Follow-up studies could provide touchable packaging to increase participants' confidence in their perceptions and evaluations. Second, the food packages used were fictional examples without brands depicted. This may also have made it more difficult to assess products and purchase intentions. Moreover, the design of the food packaging was kept simple to eliminate possible confounding factors. However, there are usually several labels on a packaging, which consumers do not consider and process independently of each other, and the brand can also play a role in product selection (Richetin et al., 2022; De Bauw et al., 2021;). For this reason, it would be interesting to investigate the robustness of the effect of the Eco-Score in combination with other labels and brands on actual food packaging. Third, the present work examined environmental and health concerns as potential moderators. Studies show that other consumer characteristics, such as attitudes toward organic food or frequency of food consumption, also influence perceptions (e.g., Bernard & Liu, 2017; Prada et al., 2017; Lee et al., 2013). The inclusion of other consumer characteristics in future studies may help to better understand the different modes of action of the Eco-Score and similar scoring systems.

6. Conclusion

This study shows that food products labeled with an Eco-Score are perceived differently in their environmental friendliness. Hence, the basic idea of the Eco-Score is understood by consumers. Products with an Eco-Score A were perceived to be more environmentally friendly, which in turn increased purchase intentions. Conversely, Eco-Score E led to significantly negative indirect effects on purchase intentions. Thus, the analyses confirm the effectiveness of the Eco-Score in guiding consumers' purchase intentions towards more environmentally friendly food products.

At the same time, the presence of an Eco-Label does also alter a product's perceived healthiness and expected tastiness. In principle, this occurs at every Eco-Score level studied. However, it is mainly the Eco-Score E, which is highlighted in red and indicates a high environmental impact that negatively influences perceived healthiness and expected tastiness across food categories. Although environmental and health concerns have a moderating effect on the effect of Eco-Score A and C on perceived healthiness and expected tastiness, this effect is small. Overall, it can be proposed that color-coded scoring systems – such as the Eco-Score – are an effective approach to motivate and enable consumers to act more sustainably but can also lead to undesirable consequences that need to be further investigated and taken into account when using scoring systems.

Ethical statement

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the Justus Liebig University Giessen (AZ 67/22).

CRediT authorship contribution statement

Verena Büttner: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Birgit Gassler:** Writing – review & editing, Visualization, Supervision, Methodology, Conceptualization. **Ramona Teuber:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A

Table A1
Results of the repeated-measures ANOVA – means and paired comparisons across treatments (experimental groups).

dependentvariable	spaghetti (S)						strawberry yoghurt (Y)						crisps (C)					
	EG I	mean (I)		EG J	mean (J)	I-J	EG I	mean (I)		EG J	mean (J)	I-J	EG I	mean (I)		EG J	mean (J)	I-J
perceived environmental friendliness	TGA	5.13	>	TGC	4.07	1.06**	TGA	5.08	>	TGC	3.97	1.11**	TGA	4.95	>	TGC	3.76	1.19**
			>	TGE	2.73	2.39**			>	TGE	2.65	2.43**			>	TGE	2.44	2.50**
			>	CG	3.96	1.16**			>	CG	3.87	1.21**			>	CG	3.49	1.46**
	TGC	4.07	>	TGE	2.73	1.34**	TGC	3.97	>	TGE	2.65	1.32**	TGC	3.76	>	TGE	2.44	1.31**
				CG	3.96	0.10				CG	3.87	0.10				CG	3.49	0.27
	TGE	2.73	<	CG	3.96	-1.23**	TGE	2.65	<	CG	3.87	-1.23**	TGE	2.44	<	CG	3.49	-1.07**
expected tastiness	TGA	4.09		TGC	3.93	0.16	TGA	4.25		TGC	3.98	0.27	TGA	3.77	>	TGC	3.46	0.31‘
			>	TGE	3.71	0.38**			>	TGE	3.69	0.56**			>	TGE	3.03	0.74**
				CG	4.02	0.08				CG	4.07	0.18				CG	3.53	0.25
	TGC	3.93		TGE	3.71	0.22	TGC	3.98		TGE	3.69	0.30	TGC	3.46	>	TGE	3.03	0.43**
				CG	4.02	-0.09				CG	4.07	-0.08				CG	3.53	-0.06
	TGE	3.71	<	CG	4.02	-0.31*	TGE	3.69	<	CG	4.07	-0.38**	TGE	3.03	<	CG	3.53	-0.49**
perceived healthiness	TGA	4.81	>	TGC	4.32	0.50**	TGA	4.78	>	TGC	4.32	0.46**	TGA	3.56	>	TGC	2.86	0.69**
			>	TGE	3.87	0.94**			>	TGE	3.85	0.93**			>	TGE	2.35	1.20**
			>	CG	4.44	0.37**				CG	4.60	0.18			>	CG	3.03	0.53**
	TGC	4.32	>	TGE	3.87	0.45**	TGC	4.32	>	TGE	3.85	0.48**	TGC	2.86	>	TGE	2.35	0.51**
				CG	4.44	-0.13				CG	4.60	-0.28				CG	3.03	-0.17
	TGE	3.87	<	CG	4.44	-0.57**	TGE	3.85	<	CG	4.60	-0.76**	TGE	2.35	<	CG	3.03	-0.68**
perceived nutritiousness	TGA	4.71		TGC	4.65	0.06	TGA	4.53		TGC	4.23	0.29	TGA	3.46	>	TGC	3.03	0.43*
			>	TGE	4.32	0.39*			>	TGE	3.94	0.58**			>	TGE	2.75	0.71**
				CG	4.68	0.03				CG	4.28	0.24				CG	3.27	0.19
	TGC	4.65	>	TGE	4.32	0.33‘	TGC	4.23		TGE	3.94	0.29	TGC	3.03		TGE	2.75	0.28
				CG	4.68	-0.03				CG	4.28	-0.05				CG	3.27	-0.24
	TGE	4.32	<	CG	4.68	-0.36*	TGE	3.94	<	CG	4.28	-0.29*	TGE	2.75	<	CG	3.27	-0.52**
perceived fat content	TGA	4.59		TGC	4.60	-0.01	TGA	4.16		TGC	4.03	0.13	TGA	3.72	>	TGC	2.99	0.73**
				TGE	4.44	0.15			>	TGE	3.77	0.39**			>	TGE	2.74	0.97**
				CG	4.54	0.05				CG	4.09	0.07				CG	3.47	0.25
	TGC	4.60		TGE	4.44	0.16	TGC	4.03		TGE	3.77	0.26	TGC	2.99		TGE	2.74	0.25
				CG	4.54	0.06				CG	4.09	-0.05			<	CG	3.47	-0.48**
	TGE	4.44		CG	4.54	-0.10	TGE	3.77	<	CG	4.09	-0.31*	TGE	2.74	<	CG	3.47	-0.73**
perceived calorie content	TGA	3.94		TGC	3.82	0.11	TGA	4.08		TGC	3.94	0.14	TGA	3.62	>	TGC	2.86	0.76**
			>	TGE	3.65	0.29‘			>	TGE	3.70	0.38**			>	TGE	2.70	0.92**
				CG	3.88	0.06				CG	4.00	0.08			>	CG	3.42	0.20
	TGC	3.82		TGE	3.65	0.18	TGC	3.94		TGE	3.70	0.24	TGC	2.86	>	TGE	2.70	0.16
				CG	3.88	-0.05				CG	4.00	-0.06			<	CG	3.42	-0.56**
	TGE	3.65		CG	3.88	-0.23	TGE	3.70	<	CG	4.00	-0.30*	TGE	2.70	<	CG	3.42	-0.72**
perceived vitamin content	TGA	3.61	>	TGC	3.21	0.40**	TGA	4.19	>	TGC	3.79	0.40**	TGA	2.76	>	TGC	2.43	0.33‘
			>	TGE	3.14	0.47**			>	TGE	3.41	0.78**			>	TGE	2.01	0.75**
				CG	3.36	0.26				CG	3.92	0.28				CG	2.62	0.14
	TGC	3.21		TGE	3.14	0.07	TGC	3.79	>	TGE	3.41	0.38*	TGC	2.43	>	TGE	2.01	0.43*
				CG	3.36	-0.15				CG	3.92	-0.12				CG	2.62	-0.19
	TGE	3.14		CG	3.36	-0.21	TGE	3.41	<	CG	3.92	-0.50**	TGE	2.01	<	CG	2.62	-0.61**

TGA = treatment group A; TGC = treatment group C; TGE = treatment group E; CG = control group
EG I, J = respective experimental group, I-J = the mean difference (MD) of the compared experimental groups, > (<) = the mean of EG I is higher (lower) than the mean of EG J
Significance levels: ** $p < 0.01$, * $p < 0.05$, ‘ $p < 0.10$

Appendix B

Table A2
Results of the repeated-measures ANOVA – means and paired comparisons across products.

dependent variable	CG						TGA						TGC						TGE					
	P I	Mean (I)		P J	Mean (J)	I-J	P I	mean (I)		P J	mean (J)	I-J	P I	mean (I)		P J	mean (J)	I-J	P I	mean (I)		P J	mean (J)	I-J
perceived environmental friendliness	S	3.96		Y	3.87	0.09	S	5.13		Y	5.08	0.04	S	4.07		Y	3.97	0.10	S	2.73		Y	2.65	0.08
	S	3.96	>	C	3.49	0.48**	S	5.13	>	C	4.95	0.18*	S	4.07	>	C	3.76	0.31**	S	2.73	>	C	2.44	0.29**
	Y	3.87	>	C	3.49	0.39**	Y	5.08	>	C	4.95	0.13‘	Y	3.97	>	C	3.76	0.21**	Y	2.65	>	C	2.44	0.20**
expected tastiness	S	4.02		Y	4.07	-0.05	S	4.09		Y	4.25	-0.16	S	3.93		Y	3.98	-0.05	S	3.71		Y	3.69	0.02
	S	4.02	>	C	3.53	0.49**	S	4.09	>	C	3.77	0.32**	S	3.93	>	C	3.46	0.47**	S	3.71	>	C	3.03	0.68**
	Y	4.07	>	C	3.53	0.54**	Y	4.25	>	C	3.77	0.48**	Y	3.98	>	C	3.46	0.52**	Y	3.69	>	C	3.03	0.66**
perceived healthiness	S	4.44		Y	4.60	-0.16	S	4.81		Y	4.78	0.03	S	4.32		Y	4.33	-0.01	S	3.87		Y	3.85	0.02
	S	4.44	>	C	3.03	1.41**	S	4.81	>	C	3.56	1.26**	S	4.32	>	C	2.86	1.46**	S	3.87	>	C	2.36	1.52**
	Y	4.60	>	C	3.03	1.57**	Y	4.78	>	C	3.56	1.22**	Y	4.33	>	C	2.86	1.46**	Y	3.85	>	C	2.36	1.49**
perceived nutritiousness	S	4.68	>	Y	4.28	0.40**	S	4.71		Y	4.53	0.19	S	4.65	>	Y	4.23	0.42**	S	4.32	>	Y	3.95	0.38**
	S	4.68	>	C	3.27	1.41**	S	4.71	>	C	3.46	1.25**	S	4.65	>	C	3.03	1.62**	S	4.32	>	C	2.75	1.57**
	Y	4.28	>	C	3.27	1.02**	Y	4.53	>	C	3.46	1.07**	Y	4.23	>	C	3.03	1.20**	Y	3.95	>	C	2.75	1.19**
perceived fat content	S	4.54	>	Y	4.09	0.46**	S	4.59	>	Y	4.16	0.43**	S	4.60	>	Y	4.03	0.57**	S	4.44	>	Y	3.77	0.67**
	S	4.54	>	C	3.47	1.07**	S	4.59	>	C	3.72	0.88**	S	4.60	>	C	2.99	1.61**	S	4.44	>	C	2.74	1.70**
	Y	4.09	>	C	3.47	0.62**	Y	4.16	>	C	3.72	0.45**	Y	4.03	>	C	2.99	1.05**	Y	3.77	>	C	2.74	1.03**
perceived calorie content	S	3.88		Y	4.00	-0.13	S	3.94		Y	4.09	-0.15	S	3.82		Y	3.94	-0.12	S	3.65		Y	3.70	-0.06
	S	3.88	>	C	3.42	0.45**	S	3.94	>	C	3.62	0.31*	S	3.82	>	C	2.86	0.96**	S	3.65	>	C	2.70	0.95**
	Y	4.00	>	C	3.42	0.58**	Y	4.09	>	C	3.62	0.46**	Y	3.94	>	C	2.86	1.08**	Y	3.70	>	C	2.70	1.00**
perceived vitamin content	S	3.36	<	Y	3.92	-0.56**	S	3.61	<	Y	4.19	-0.58**	S	3.21	<	Y	3.79	-0.58**	S	3.14	<	Y	3.44	-0.27*
	S	3.36	>	C	2.62	0.74**	S	3.61	>	C	2.76	0.85**	S	3.21	>	C	2.44	0.78**	S	3.14	>	C	2.01	1.13**
	Y	3.92	>	C	2.62	1.30**	Y	4.19	>	C	2.76	1.43**	Y	3.79	>	C	2.44	1.36**	Y	3.44	>	C	2.01	1.41**

TGA = treatment group A; TGC = treatment group C; TGE = treatment group E; CG = control group
P I, J = respective products (S = spaghetti, Y = strawberry yoghurt, C = crisps), I-J = the mean difference (MD) of the compared products, > (<) = the mean of P I is higher (lower) than the mean of P J
Significance levels: ** $p < 0.01$, * $p < 0.05$, ‘ $p < 0.10$

Appendix C

Table A3
Results of the moderation models with environmental concern as moderator, controlling for age and gender.

moderator: environmental concern				
model[a] for spaghetti (n = 1003)	coefficients of the model (DV: expected tastiness)			
	b	SE (HC3)	t[b]	P
(constant)	4.452	0.149	29.947	0.000
Eco-Score A[d] (b_1)	0.039	0.111	0.350	0.726
environmental concern[e] (b_2)	−0.221	0.056	−3.945	0.000
interaction effect (b_3)	0.152	0.118	1.290	0.197
Eco-Score C	−0.098	0.105	−0.934	0.351
Eco-Score E	−0.302	0.111	−2.718	0.007
model[a] for spaghetti (n = 1003)	coefficients of the model (DV: expected tastiness)			
	b	SE (HC3)	t[b]	P
(constant)	4.454	0.149	29.968	0.000
Eco-Score C[d] (b_1)	−0.103	0.105	−0.988	0.323
environmental concern[e] (b_2)	−0.203	0.057	−3.599	0.000
interaction effect (b_3)	0.078	0.116	0.670	0.503
Eco-Score A	0.015	0.110	0.135	0.893
Eco-Score E	−0.304	0.111	−2.73	0.006
model[a] for spaghetti (n = 1003)	coefficients of the model (DV: expected tastiness)			
	b	SE (HC3)	t[b]	P
(constant)	4.451	0.148	30.001	0.000
Eco-Score E[d] (b_1)	−0.297	0.111	−2.674	0.008
environmental concern[e] (b_2)	−0.165	0.057	−2.903	0.004
interaction effect (b_3)	−0.095	0.114	−0.829	0.407
Eco-Score A	0.023	0.110	0.206	0.837
Eco-Score C	−0.100	0.105	−0.956	0.339
model[a] for strawberry yoghurt (n = 987)	coefficients of the model (DV: expected tastiness)			
	b	SE (HC3)	t[b]	P
(constant)	4.596	0.155	29.734	0.000
Eco-Score A[d] (b_1)	0.158	0.123	1.292	0.197
environmental concern[e] (b_2)	−0.234	0.061	−3.852	0.000
interaction effect (b_3)	0.098	0.134	0.730	0.466
Eco-Score C	−0.086	0.108	−0.791	0.429
Eco-Score E	−0.368	0.114	−3.227	0.001
model[a] for strawberry yoghurt (n = 987)	coefficients of the model (DV: expected tastiness)			
	B	SE (HC3)	t[b]	P
(constant)	4.599	0.155	29.713	0.000
Eco-Score C[d] (b_1)	−0.091	0.108	−0.844	0.399
environmental concern[e] (b_2)	−0.235	0.063	−3.725	0.000
interaction effect (b_3)	0.099	0.123	0.801	0.423
Eco-Score A	0.142	0.120	1.179	0.239
Eco-Score E	−0.368	0.114	−3.227	0.001
model[a] for strawberry yoghurt (n = 987)	coefficients of the model (DV: expected tastiness)			
	B	SE (HC3)	t[b]	P
(constant)	4.596	0.154	29.766	0.000
Eco-Score E[d] (b_1)	−0.364	0.114	−3.199	0.001
environmental concern[e] (b_2)	−0.195	0.063	−3.095	0.002
interaction effect (b_3)	−0.075	0.120	−0.623	0.534
Eco-Score A	0.149	0.120	1.241	0.215
Eco-Score C	−0.087	0.108	−0.806	0.421
model[a] for crisps (n = 1007)	coefficients of the model (DV: expected tastiness)			
	B	SE (HC3)	t[b]	P
(constant)	4.257	0.162	26.203	0.000
Eco-Score A[d] (b_1)	0.206	0.119	1.728	0.084
environmental concern[e] (b_2)	−0.332	0.064	−5.202	0.000
interaction effect (b_3)	0.178	0.131	1.354	0.176
Eco-Score C	−0.062	0.115	−0.540	0.589
Eco-Score E	−0.479	0.118	−4.048	0.000
model[a] for crisps (n = 1007)	coefficients of the model (DV: expected tastiness)			
	B	SE (HC3)	t[b]	P
(constant)	4.259	0.162	26.232	0.000
Eco-Score C[d] (b_1)	−0.069	0.115	−0.601	0.548
environmental concern[e] (b_2)	−0.316	0.065	−4.835	0.000

(continued on next page)

Table A3 (*continued*)

moderator: environmental concern								
interaction effect (b_3)	0.111	0.129	0.866	0.387				
Eco-Score A	0.177	0.118	1.497	0.135				
Eco-Score E	−0.480	0.118	−4.057	0.000				
model[a] for crisps	coefficients of the model							
(n = 1007)	(DV: expected tastiness)							
	B	SE (HC3)	t[b]	P				
(constant)	4.252	0.162	26.227	0.000				
Eco-Score E[d] (b_1)	−0.463	0.118	−3.908	0.000				
environmental concern[e] (b_2)	−0.242	0.065	−3.755	0.000				
interaction effect (b_3)	−0.226	0.127	−1.781	0.075				
Eco-Score A	0.192	0.118	1.624	0.105				
Eco-Score C	−0.065	0.115	−0.57	0.569				
model[a] for spaghetti	coefficients of the model(DV: perceived healthiness)				significance region(s) (SR) of the			
(n = 1003)					Johnson-Neyman technique[c]			
	C	SE (HC3)	t[b]	P	value	% below	% above	effect direction
(constant)	4.273	0.159	26.838	0.000	−2.411	0.499*	99.501	Negative
Eco-Score A[d] (b_1)	0.378	0.117	3.238	0.001	−0.346	31.007	68.993*	Positive
environmental concern[e] (b_2)	−0.255	0.055	−4.649	0.000	conditional effect lower SR:		−0.617to −0.805	
interaction effect (b_3)	0.413	0.127	3.253	0.001	conditional effect upper SR:		0.235 to-1.093	
Eco-Score C	−0.116	0.101	−1.158	0.247	$\Delta R^2 = 0.012$ (1.2 %)			
Eco-Score E	−0.542	0.114	−4.737	0.000				
model[a] for spaghetti	coefficients of the model							
(n = 1003)	(DV: perceived healthiness)							
	B	SE (HC3)	t[b]	P				
(constant)	4.280	0.159	26.852	0.000				
Eco-Score C[d] (b_1)	−0.110	0.101	−1.088	0.277				
environmental concern[e] (b_2)	−0.107	0.062	−1.715	0.087				
interaction effect (b_3)	−0.199	0.102	−1.945	0.052				
Eco-Score A	0.333	0.117	2.848	0.004				
Eco-Score E	−0.554	0.115	−4.831	0.000				
model[a] for spaghetti	coefficients of the model							
(n = 1003)	(DV: perceived healthiness)							
	B	SE (HC3)	t[b]	P				
(constant)	4.275	0.160	26.787	0.000				
Eco-Score E[d] (b_1)	−0.540	0.116	−4.671	0.000				
environmental concern[e] (b_2)	−0.131	0.058	−2.259	0.024				
interaction effect (b_3)	−0.122	0.120	−1.013	0.311				
Eco-Score A	0.328	0.117	2.808	0.005				
Eco-Score C	−0.122	0.101	−1.204	0.229				
model[a] for strawberry yoghurt	coefficients of the model							
(n = 987)	(DV: perceived healthiness)							
	B	SE (HC3)	t[b]	P				
(constant)	4.344	0.171	25.404	0.000				
Eco-Score A[d] (b_1)	0.160	0.131	1.221	0.222				
environmental concern[e] (b_2)	−0.144	0.066	−2.182	0.029				
interaction effect (b_3)	0.084	0.141	0.592	0.554				
Eco-Score C	−0.274	0.115	−2.377	0.018				
Eco-Score E	−0.738	0.125	−5.918	0.000				
model[a] for strawberry yoghurt	coefficients of the model							
(n = 987)	(DV: perceived healthiness)							
	B	SE (HC3)	t[b]	P				
(constant)	4.346	0.171	25.425	0.000				
Eco-Score C[d] (b_1)	−0.283	0.116	−2.451	0.014				
environmental concern[e] (b_2)	−0.170	0.067	−2.524	0.012				
Interaction effect (b_3)	0.183	0.129	1.423	0.155				
Eco-Score A	0.141	0.128	1.103	0.270				
Eco-Score E	−0.736	0.125	−5.906	0.000				
model[a] for strawberry yoghurt	coefficients of the model							
(n = 987)	(DV: perceived healthiness)							
	B	SE (HC3)	t[b]	P				
(constant)	4.338	0.171	25.403	0.000				
Eco-Score E[d] (b_1)	−0.722	0.125	−5.788	0.000				
environmental concern[e] (b_2)	−0.082	0.066	−1.242	0.214				
interaction effect (b_3)	−0.203	0.134	−1.512	0.131				
Eco-Score A	0.157	0.128	1.231	0.219				
Eco-Score C	−0.276	0.115	−2.401	0.017				
model[a] for crisps	coefficients of the model							
(n = 1007)	(DV: perceived healthiness)							
	B	SE (HC3)	t[b]	P				
(constant)	3.066	0.181	16.904	0.000				
Eco-Score A[d] (b_1)	0.459	0.141	3.262	0.001				
environmental concern[e] (b_2)	−0.330	0.066	−4.994	0.000				
interaction effect (b_3)	0.279	0.166	1.685	0.092				
Eco-Score C	−0.178	0.120	−1.477	0.140				
Eco-Score E	−0.664	0.124	−5.352	0.000				

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Table A3 (*continued*)

moderator: environmental concern				
model[a] for crisps (n = 1007)	coefficients of the model (DV: perceived healthiness)			
	B	SE (HC3)	t[b]	P
(constant)	3.070	0.182	16.884	0.000
Eco-Score C[d] (b_1)	−0.176	0.121	−1.457	0.146
environmental concern[e] (b_2)	−0.245	0.075	−3.267	0.001
interaction effect (b_3)	−0.073	0.134	−0.548	0.584
Eco-Score A	0.426	0.137	3.114	0.002
Eco-Score E	−0.671	0.124	−5.398	0.000
model[a] for crisps (n = 1007)	coefficients of the model (DV: perceived healthiness)			
	B	SE (HC3)	t[b]	P
(constant)	3.063	0.182	16.850	0.000
Eco-Score E[d] (b_1)	−0.652	0.125	−5.205	0.000
environmental concern[e] (b_2)	−0.221	0.071	−3.092	0.002
interaction effect (b_3)	−0.203	0.143	−1.422	0.155
Eco-Score A	0.431	0.137	3.153	0.002
Eco-Score C	−0.182	0.120	−1.510	0.131

DV = dependent variable; SE = heteroskedasticity-consistent standard error (HC3); SR = significance region.
ΔR^2 = proportion of variance that the model can additionally explain with the interaction effect.
* significant at the 0.05 level.
[a] In all models, age and gender were statistically controlled
[b] df1 = 7, df2 = 995 (spaghetti); df1 = 7, df2 = 979 (strawberry yogurt); df1 = 7, df2 = 999 (crisps).
[c] The values are to be interpreted starting from the mean value of the variable for environmental concern (M = 5.26). Effect direction: environmental concern influences perception positively or negatively.
[d] reference category: control group.
[e] mean centered.

Appendix D

Table A4
Results of the moderation models with health concern as the moderator, controlling for age and gender.

moderator: health concern								
model[a] for spaghetti (n = 1003)	coefficients of the model (DV: expected tastiness)				significance region(s) (SR) of the Johnson-Neyman technique[c]			
	b	SE (HC3)	t[b]	p	value	% below	% above	effect direction
(constant)	4.624	0.144	32.191	0.000	−1.526	6.181*	93.819	negative
Eco-Score A[d] (b_1)	0.032	0.107	0.303	0.762	1.347	91.725	8.275*	positive
health concern[e] (b_2)	0.225	0.050	4.464	0.000	conditional effect lower SR:		−0.328to −0.954	
interaction effect (b_3)	0.236	0.095	2.480	0.013	conditional effect upper SR:		−0.350 to-0.461	
Eco-Score C	−0.1.70	0.103	−1.031	0.303	$\Delta R^2 = 0.007$ (0.7 %)			
Eco-Score E	−0.320	0.110	−2.916	0.004				
model[a] for spaghetti (n = 1003)	coefficients of the model (DV: expected tastiness)							
	b	SE (HC3)	t[b]	p				
(constant)	4.635	0.144	32.300	0.000				
Eco-Score C[d] (b_1)	−0.108	0.104	−1.038	0.300				
health concern[e] (b_2)	0.320	0.050	6.436	0.000				
interaction effect (b_3)	−0.123	0.100	−1.222	0.222				
Eco-Score A	0.038	0.108	0.357	0.721				
Eco-Score E	−0.319	0.110	−2.896	0.004				
model[a] for spaghetti (n = 1003)	coefficients of the model (DV: expected tastiness)							
	b	SE (HC3)	t[b]	p				
(constant)	4.627	0.143	32.252	0.000				
Eco-Score E[d] (b_1)	−0.321	0.110	−2.905	0.004				
health concern[e] (b_2)	0.300	0.047	6.325	0.000				
interaction effect (b_3)	−0.064	0.113	−0.567	0.571				
Eco-Score A	0.040	0.108	0.368	0.713				
Eco-Score C	−0.106	0.104	−1.024	0.306				
model[a] for strawberry yoghurt (n = 987)	coefficients of the model (DV: expected tastiness)				SR of the Johnson-Neyman technique[c]			
	b	SE (HC3)	t[b]	P	value	% below	% above	effect direction
(constant)	4.775	0.149	32.017	0.000	−1.284	8.511*	91.489	negative
Eco-Score A[d] (b_1)	0.156	0.114	1.371	0.171	0.195	53.597	46.403*	positive
health concern[e] (b_2)	0.172	0.053	3.229	0.001	conditional effect lower SR:		−0.343to −1.466	
interaction effect (b_3)	0.389	0.113	3.455	0.001	conditional effect upper SR:		−0.232 to 0.866	
Eco-Score C	−0.095	0.108	−0.883	0.377	$\Delta R^2 = 0.016$ (1.6 %)			
Eco-Score E	−0.392	0.114	−3.434	0.001				

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Table A4 (*continued*)

moderator: health concern								
model[a] for strawberry yoghurt	coefficients of the model				SR of the Johnson-Neyman technique[c]			
(n = 987)	(DV: expected tastiness)							
	b	SE (HC3)	t[b]	P	value	% below	% above	effect direction
(constant)	4.793	0.149	32.245	0.000	−2.577	1.013*	98.987	positive
Eco-Score C[d] (b_1)	−0.099	0.109	−0.912	0.362	0.758	76.697	23.303*	negative
health concern[e] (b_2)	0.340	0.340	6.153	0.000	conditional effect lower SR:		−0.527to-0.915	
interaction effect (b_3)	−0.243	−0.243	0.103	0.018	conditional effect upper SR:		−0.283 to −0.542	
Eco-Score A	0.165	0.115	1.430	0.153	$\Delta R^2 = 0.006$ (0.6 %)			
Eco-Score E	−0.392	0.115	−3.421	0.001				
model[a] for strawberry yoghurt	coefficients of the model							
(n = 987)	(DV: expected tastiness)							
	b	SE (HC3)	t[b]	P				
(constant)	4.780	0.148	32.205	0.000				
Eco-Score E[d] (b_1)	−0.393	0.114	−3.438	0.001				
health concern[e] (b_2)	0.293	0.052	5.619	0.000				
interaction effect (b_3)	−0.094	0.118	−0.793	0.428				
Eco-Score A	0.168	0.116	1.453	0.147				
Eco-Score C	−0.095	0.109	−0.873	0.383				
model[a] for crisps	coefficients of the model				SR of the Johnson-Neyman technique[c]			
(n = 1007)	(DV: expected tastiness)							
	b	SE (HC3)	t[b]	P	value	% below	% above	effect direction
(constant)	4.449	0.160	27.791	0.000	−2.268	1.787*	98.213	negative
Eco-Score A[d] (b_1)	0.218	0.115	1.892	0.059	0.028	53.128	46.872*	positive
health concern[e] (b_2)	0.129	0.055	2.350	0.019	conditional effect lower SR:		−0.499to −1.104	
interaction effect (b_3)	0.316	0.105	3.013	0.003	conditional effect upper SR:		−0.226 to 0.792	
Eco-Score C	−0.075	0.116	−0.650	0.516	$\Delta R^2 = 0.010$ (1.0 %)			
Eco-Score E	−0.510	0.120	−4.235	0.000				
model[a] for crisps	coefficients of the model							
(n = 1007)	(DV: expected tastiness)							
	b	SE (HC3)	t[b]	P				
(constant)	4.464	0.159	28.023	0.000				
Eco-Score C[d] (b_1)	−0.077	0.116	−0.665	0.506				
health concern[e] (b_2)	0.264	0.054	4.857	0.000				
interaction effect (b_3)	−0.193	0.108	−1.791	0.074				
Eco-Score A	0.226	0.116	1.942	0.052				
Eco-Score E	−0.508	0.121	−4.215	0.000				
model[a] for crisps	coefficients of the model							
(n = 1007)	(DV: expected tastiness)							
	b	SE (HC3)	t[b]	P				
(constant)	4.455	0.160	27.814	0.000				
Eco-Score E[d] (b_1)	−0.509	0.121	−4.21	0.000				
health concern[e] (b_2)	0.218	0.053	4.147	0.000				
interaction effect (b_3)	−0.020	0.118	−0.174	0.862				
Eco-Score A	0.228	0.116	1.962	0.050				
Eco-Score C	−0.074	0.116	−0.642	0.521				
model[a] for spaghetti	coefficients of the model							
(n = 1003)	(DV: perceived healthiness)							
	b	SE (HC3)	t[b]	P				
(constant)	4.399	0.162	27.145	0.000				
Eco-Score A[d] (b_1)	0.340	0.114	2.974	0.003				
health concern[e] (b_2)	0.120	0.053	2.279	0.023				
interaction effect (b_3)	0.172	0.107	1.611	0.108				
Eco-Score C	−0.127	0.102	−1.250	0.212				
Eco-Score E	−0.564	0.115	−4.918	0.000				
model[a] for spaghetti	coefficients of the model							
(n = 1003)	(DV: perceived healthiness)							
	b	SE (HC3)	t[b]	P				
(constant)	4.407	0.162	27.182	0.000				
Eco-Score C[d] (b_1)	−0.128	0.102	−1.254	0.210				
health concern[e] (b_2)	0.190	0.053	3.562	0.000				
interaction effect (b_3)	−0.091	0.105	−0.870	0.384				
Eco-Score A	0.344	0.115	2.995	0.003				
Eco-Score E	−0.562	0.115	−4.906	0.000				
model[a] for spaghetti	coefficients of the model							
(n = 1003)	(DV: perceived healthiness)							
	b	SE (HC3)	t[b]	P				
(constant)	4.405	0.162	27.146	0.000				
Eco-Score E[d] (b_1)	−0.562	0.115	−4.876	0.000				
health concern[e] (b_2)	0.163	0.050	3.247	0.001				
interaction effect (b_3)	0.022	0.117	0.190	0.849				
Eco-Score A	0.346	0.115	3.006	0.003				
Eco-Score C	−0.127	0.102	−1.246	0.213				

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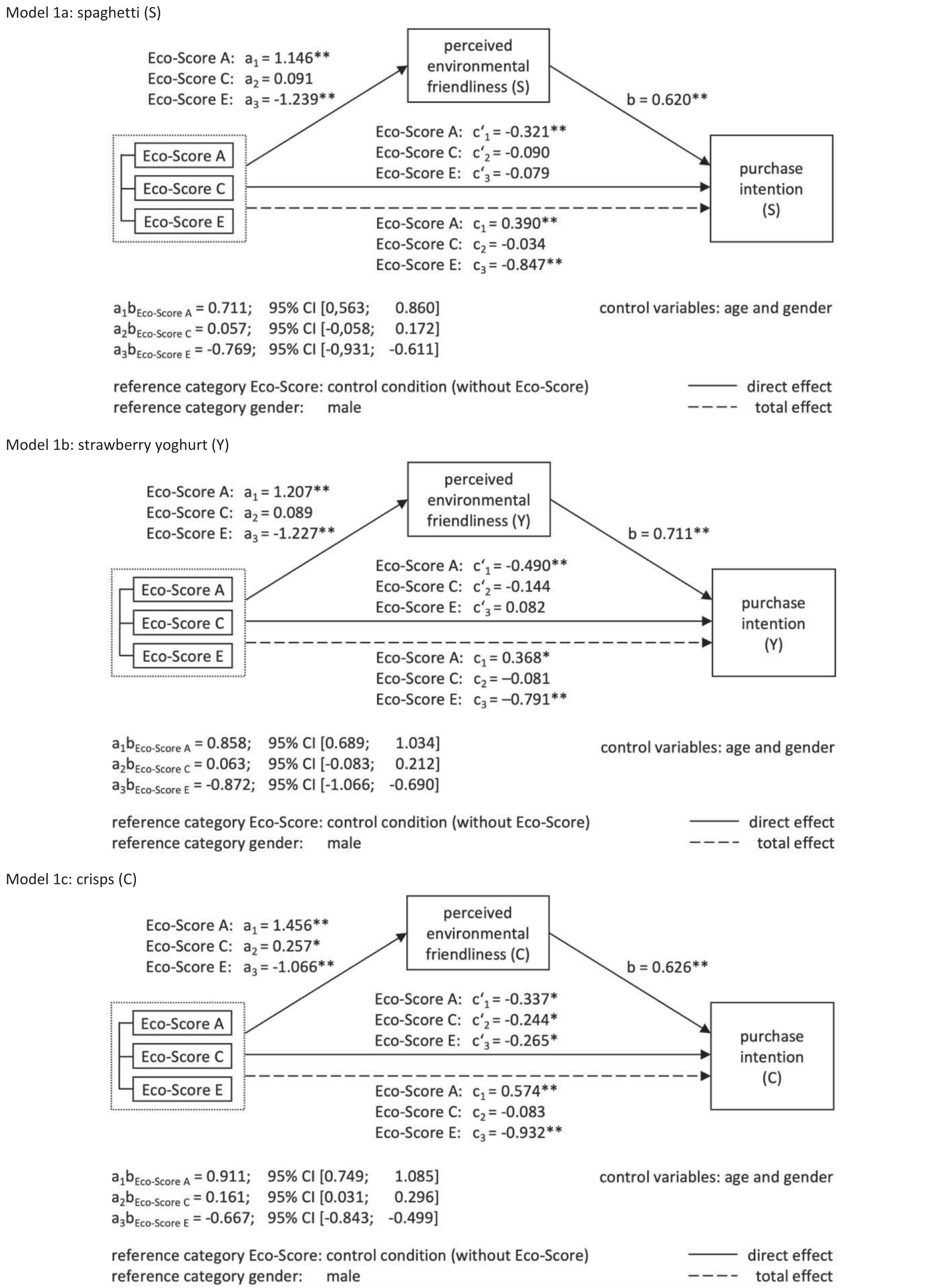
Table A4 (*continued*)

moderator: health concern								
model[a] for strawberry yoghurt (n = 987)	coefficients of the model (DV: perceived healthiness)				SR of the Johnson-Neyman technique[c]			
	b	SE (HC3)	t[b]	P	value	% below	% above	effect direction
(constant)	4.424	0.170	25.970	0.000	−0.925	17.021*	82.979	negative
Eco-Score A[d] (b_1)	0.151	0.123	1.230	0.219	0.201	53.597	46.403*	positive
health concern[e] (b_2)	−0.029	0.052	−0.553	0.580	conditional effect lower SR:		−0.302to −1.894	
interaction effect (b_3)	0.490	0.116	4.240	0.000	conditional effect upper SR:		−0.249 to-1.045	
Eco-Score C	−0.280	0.115	−2.441	0.015	$\Delta R^2 = 0.022$ (2.2 %)			
Eco-Score E	−0.752	0.126	−5.985	0.000				
model[a] for strawberry yoghurt (n = 987)	coefficients of the model (DV: perceived healthiness)				SR of the Johnson-Neyman technique[c]			
	b	SE (HC3)	t[b]	P	value	% below	% above	effect direction
(constant)	4.446	0.172	25.891	0.000	−3.957	0.101*	99.899	positive
Eco-Score C[d] (b_1)	−0.284	0.115	−2.462	0.014	−0.225	38.298	61.702*	negative
health concern[e] (b_2)	0.175	0.059	2.943	0.003	conditional effect lower SR:		−0.788to-0.846	
Interaction effect (b_3)	−0.271	0.102	−2.647	0.008	conditional effect upper SR:		−0.223 to −0.778	
Eco-Score A	0.162	0.125	1.302	0.193	$\Delta R^2 = 0.006$ (0.6 %)			
Eco-Score E	−0.752	0.126	−5.948	0.000				
model[a] for strawberry yoghurt (n = 987)	coefficients of the model (DV: perceived healthiness)							
	b	SE (HC3)	t[b]	P				
(constant)	4.429	0.171	25.854	0.000				
Eco-Score E[d] (b_1)	−0.754	0.126	−5.971	0.000				
health concern[e] (b_2)	0.132	0.055	2.396	0.017				
interaction effect (b_3)	−0.161	0.122	−1.325	0.185				
Eco-Score A	0.165	0.125	1.322	0.187				
Eco-Score C	−0.279	0.116	−2.415	0.016				
model[a] for crisps (n = 1007)	coefficients of the model (DV: perceived healthiness)							
	b	SE (HC3)	t[b]	p				
(constant)	3.180	0.185	17.17	0.000				
Eco-Score A[d] (b_1)	0.470	0.135	3.482	0.001				
health concern[e] (b_2)	−0.054	0.058	−0.944	0.345				
interaction effect (b_3)	0.170	0.130	1.299	0.194				
Eco-Score C	−0.192	0.122	−1.576	0.115				
Eco-Score E	−0.695	0.126	−5.52	0.000				
model[a] for crisps (n = 1007)	coefficients of the model (DV: perceived healthiness)							
	b	SE (HC3)	t[b]	p				
(constant)	3.190	0.185	17.233	0.000				
Eco-Score C[d] (b_1)	−0.193	0.122	−1.586	0.113				
health concern[e] (b_2)	0.027	0.064	0.428	0.669				
interaction effect (b_3)	−0.141	0.111	−1.263	0.207				
Eco-Score A	0.474	0.135	3.502	0.000				
Eco-Score E	−0.694	0.126	−5.509	0.000				
model[a] for crisps (n = 1007)	coefficients of the model (DV: perceived healthiness)							
	b	SE (HC3)	t[b]	P				
(constant)	3.182	0.185	17.195	0.000				
Eco-Score E[d] (b_1)	−0.696	0.127	−5.49	0.000				
health concern[e] (b_2)	0.000	0.059	0.000	1.000				
interaction effect (b_3)	−0.050	0.133	−0.373	0.709				
Eco-Score A	0.476	0.135	3.514	0.000				
Eco-Score C	−0.191	0.122	−1.572	0.116				

DV = dependent variable; SE = heteroskedasticity-consistent standard error (HC3); SR = significance region.
ΔR^2 = proportion of variance that the model can additionally explain with the interaction effect.
* significant at the 0.05 level.
[a] In all models, age and gender were statistically controlled.
[b] df1 = 7, df2 = 995 (spaghetti); df1 = 7, df2 = 979 (strawberry yogurt); df1 = 7, df2 = 999 (crisps).
[c] The values are to be interpreted starting from the mean value of the variable for health concern (M = 5.18). Effect direction: health concern influences perception positively or negatively.
[d] reference category: control group.
[e] mean centered.

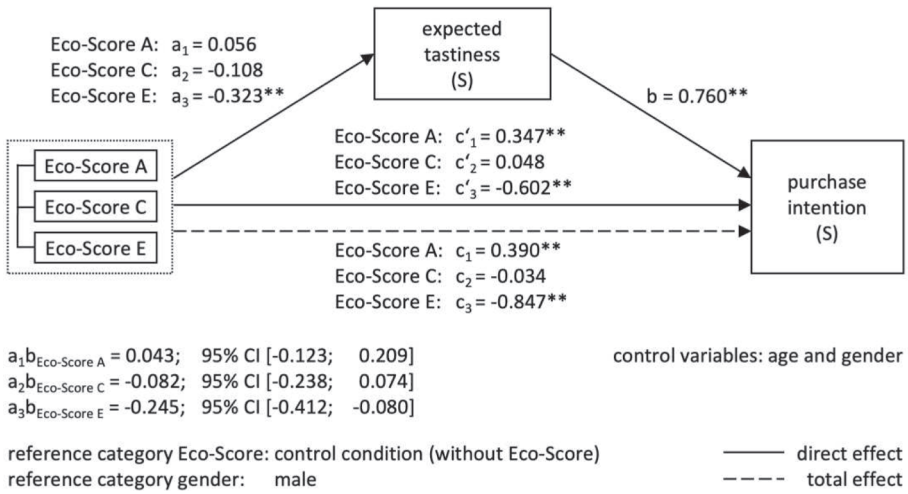
Appendix E



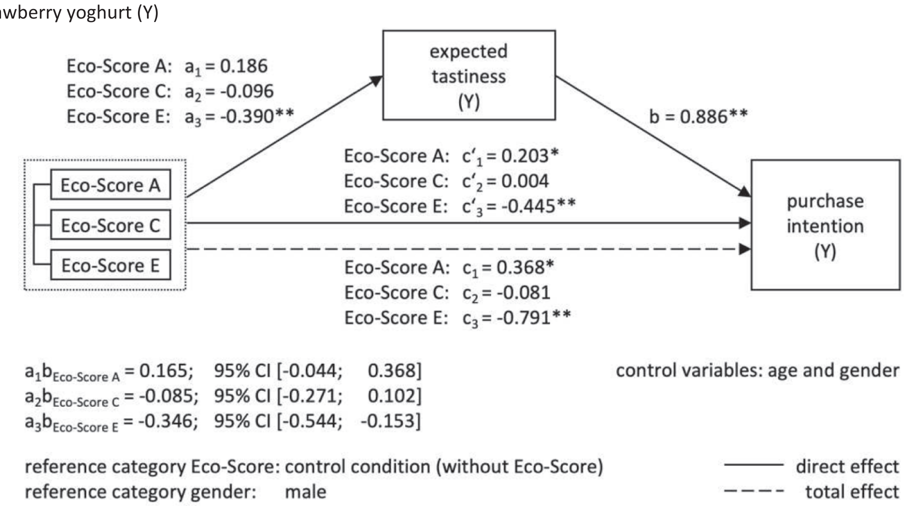
* significant at the 0.05 level; ** significant at the 0.01 level

Fig. A5. Mediation models (1a–1C) with perceived environmental friendliness as mediator. * significant at the 0.05 level; ** significant at the 0.01 level

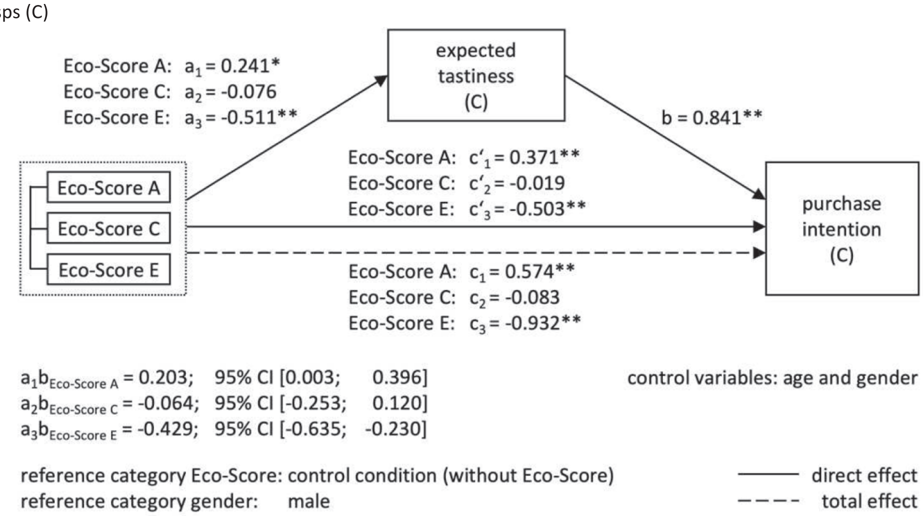
Model 2a: spaghetti (S)



Model 2b: strawberry yoghurt (Y)

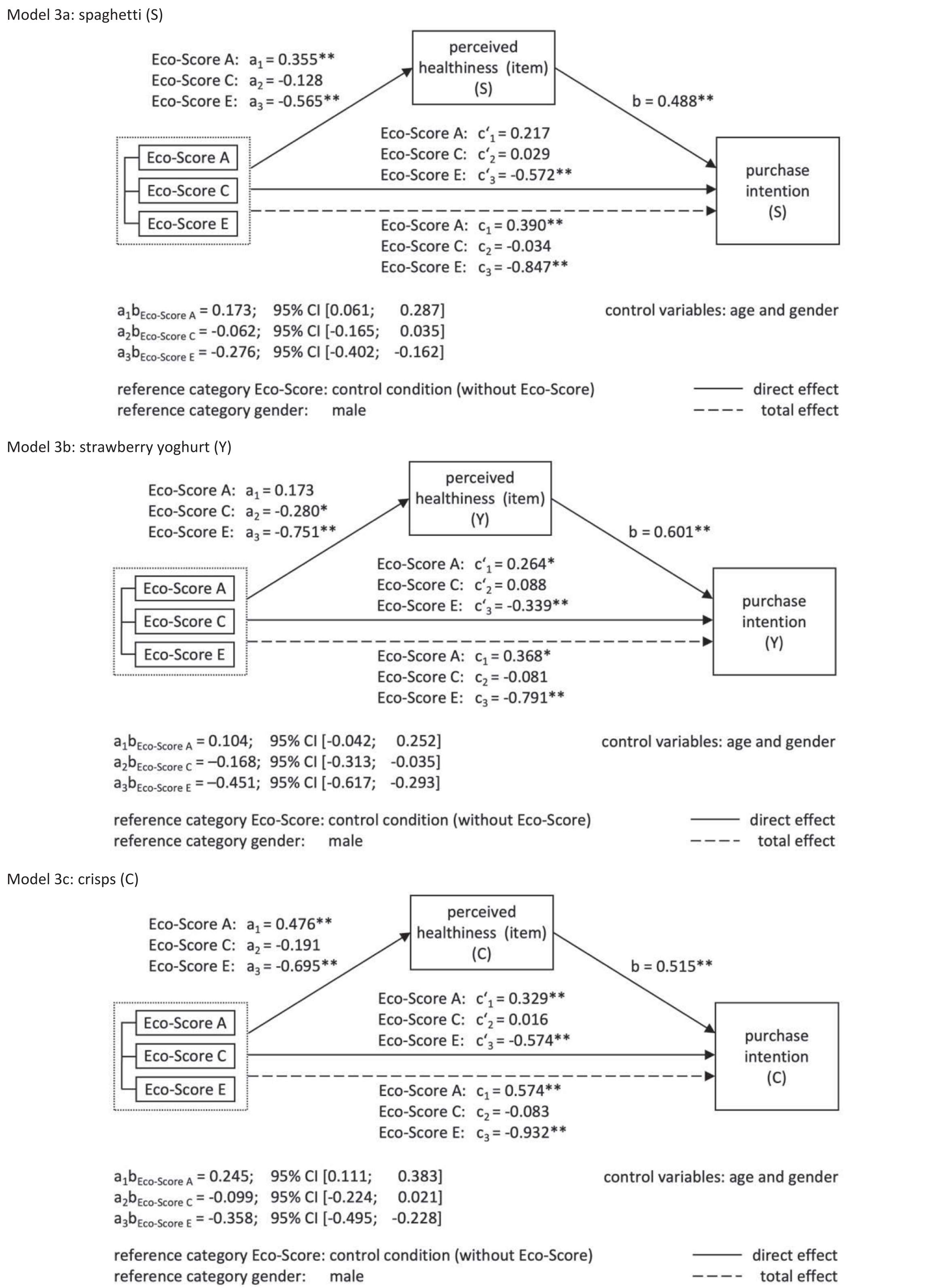


Model 2c: crisps (C)



* significant at the 0.05 level; ** significant at the 0.01 level

Fig. A6. Mediation models (2a–2C) with expected tastiness as mediator. * significant at the 0.05 level; ** significant at the 0.01 level



* significant at the 0.05 level; ** significant at the 0.01 level

Fig. A7. Mediation models (3a–3C) with perceived healthiness as mediator. * significant at the 0.05 level; ** significant at the 0.01 level

Appendix F

Table A8
Contrasting results of the repeated-measures ANOVA for perceived healthiness (item vs. score) – means and paired comparisons across treatments (experimental groups).

DV: perc. healthiness	spaghetti (S)						strawberry yoghurt (Y)						crisps (C)					
	EG I	mean (I)		EG J	mean (J)	I-J	EG I	mean (I)		EG J	mean (J)	I-J	EG I	mean (I)		EG J	mean (J)	I-J
item	TGA	4.81	>	TGC	4.32	0.50**	TGA	4.78	>	TGC	4.32	0.46**	TGA	3.56	>	TGC	2.86	0.69**
			>	TGE	3.87	0.94**			>	TGE	3.85	0.93**			>	TGE	2.35	1.20**
			>	CG	4.44	0.37**				CG	4.60	0.18			>	CG	3.03	0.53**
	TGC	4.32	>	TGE	3.87	0.45**	TGC	4.32	>	TGE	3.85	0.48**	TGC	2.86	>	TGE	2.35	0.51**
				CG	4.44	-0.13				CG	4.60	-0.28				CG	3.03	-0.17
	TGE	3.87	<	CG	4.44	-0.57**	TGE	3.85	<	CG	4.60	-0.76**	TGE	2.35	<	CG	3.03	-0.68**
averaged score							TGA	4.35	>	TGC	4.07	0.28**	TGA	3.42	>	TGC	2.84	0.59**
									>	TGE	3.74	0.61**			>	TGE	2.51	0.91**
										CG	4.18	0.17			>	CG	3.16	0.26‘
							TGC	4.07	>	TGE	3.74	0.33**	TGC	2.84	>	TGE	2.51	0.32**
										CG	4.18	-0.11			<	CG	3.16	-0.33**
							TGE	3.74	<	CG	4.18	-0.44**	TGE	2.51	<	CG	3.16	-0.65**

TGA = treatment group A; TGC = treatment group C; TGE = treatment group E; CG = control group.
EG I, J = respective experimental group, I-J = the mean difference (MD) of the compared experimental groups, > (<) = the mean of EG I is higher (lower) than the mean of EG J.
*Significance levels: ** $p < 0.01$, * $p < 0.05$, ‘ $p < 0.10$.*

Table A9
Contrasting significant moderation effects for perceived healthiness (item vs. score).

moderator (hypothesis)	dependent variable	Eco-Score	moderator effect[a]			Decision on the confirmation (√) or rejection (×) of the hypothesis		
						spaghetti	strawberry yoghurt	crisps
environmental concern (H2.1b)	perceived healthiness (item)	A	low	→	negative	√	×	×
			high	→	positive			
		C	n. s.			×	×	×
		E	n. s.			×	×	×
	perceived healthiness (averaged score)	A	n. s.				×	×
		C	n. s.				×	×
		E	n. s.				×	×
health concern (H2.2b)	perceived healthiness (item)	A	low to ind.	→	negative	×	√	×
			high	→	positive			
		C	low	→	positive	×	√	×
			high	→	negative			
		E	n. s.			×	×	×
	perceived healthiness (averaged score)	A	low	→	negative		√	×
			high	→	positive			
		C	n.s.				×	×
		E	ind. to high	→	negative		√	×

n. s. = not significant, ind. = indifferent.
[a] Three categories of concern were defined for the interpretation of the significance regions: low (1.0–3.49), indifferent (3.5–4.49) and high (4.5–7.0). Column “moderator effect” shows the Influence of the moderator or the moderator category (low, indifferent (ind.), high) on the direction (positive or negative) of the effect of the Eco-Score on the dependent variable). The effect relates either to all products or only to the products for which the partial hypothesis was accepted. The listed effects of the Eco-Score are to be interpreted in relation to the control group (without Eco-Score).

Table A10
Contrasting mediation model results with different measures of perceived healthiness (item vs. score) as mediator (H3c).

mediator	dependent variable	Eco-Score	indirect effect (ab) [95 % CI]			effect[a]	Confirmation (√) or rejection (×) of the hypothesis		
			spaghetti	strawberry yoghurt	crisps		spaghetti	strawberry yoghurt [b]	crisps [b]
perceived healthiness (item)	purchase intention	A	0.173 [0.061; 0.287]	0.104 [-0.042; 0.252]	0.245 [0.111; 0.383]	positive	√	×	√
		C	-0.062 [-0.165; 0.035]	-0.168 [-0.313; -0.035]	-0.099 [-0.224; 0.021]	negative	×	√	×
		E	-0.276 [-0.402; -0.162]	-0.451 [-0.617; -0.293]	-0.358 [-0.495; -0.288]	negative	√	√	√
perceived healthiness (averaged score)	purchase intention	A		0.147 [0.004; 0.290]	0.132 [0.017; 0.247]	positive		√	√
		C		-0.100 [-0.230; 0.028]	-0.190 [-0.306; -0.081]	negative		×	√

(*continued on next page*)

Table A10 (*continued*)

mediator	dependent variable	Eco-Score	indirect effect (ab) [95 % CI]			effect[a]	Confirmation (√) or rejection (×) of the hypothesis		
			spaghetti	strawberry yoghurt	crisps		spaghetti	strawberry yoghurt [b]	crisps [b]
		E		-0.384 [-0.532; −0.247]	-0.376 [-0.507; -0.257]	negative		√	√

n. s. = not significant.
[a] Influence of the mediator on the direction (positive or negative) of the effect of the Eco-Score on the purchase intention. The effect relates either to all products or only to the products for which the hypothesis was accepted. The listed effects of the Eco-Score are to be interpreted in relation to the control group (without Eco-Score).
[b] Although differences or varying significance are found for strawberry yoghurt, it should be noted that the observed effects are only just significant, as indicated by the confidence intervals.

Appendix G. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2024.105246.

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