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Effects of nutrition and sustainability claims on attention and choice: An eye-tracking study in the context of a choice experiment using granola bar concepts

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ABSTRACT

This research utilizes eye-tracking measures to quantify the visual attention paid to claims for nutrition and sustainability on food concepts. It analyzes whether and to what extent the attention to voluntary nutrition and sustainability claims affects choices. A choice experiment was designed using granola bar concepts where each alternative was described by four attributes for claims related to sustainability, genetic modification, sweetener content, antioxidant content, and price. During the choice experiment, the visit duration was measured using an eye-tracking device as proxy for visual attention. Findings show that sweetener content and genetic modification claims were attended to the most, followed by sustainability claims, antioxidant content claims and price. Results indicate that visual attention to nutrition and sustainability claims affects product choice. More visual attention is associated with a higher choice likelihood. Insights from this study can inform future research on attention and choice in particular with regards to healthy and sustainable food choices. Managerial findings related to the claims tested can be used by practitioners to efficiently and effectively promote the choice of healthy and sustainable food products.

1. Introduction

The current overweight and obesity issues combined with extreme temperatures and other stresses on the climate have tremendous societal and economic impacts that leave governments and societies searching for solutions to encourage individuals to make healthier and more sustainable food choices. In fact, even though evidence is growing that an integrated dietary approach is needed that aligns health and sustainability objectives, only few countries have included sustainability in their official dietary guidelines (Gonzalez Fischer and Garnett, 2016). Achieving a more sustainable and healthy lifestyle is of great importance to society and to the individual. Nutrition- and sustainability-related labels and claims serve as tools that may assist consumers in making healthy and sustainable food choices (e.g., Antúnez et al., 2013; Antúnez et al., 2015, Barreiro-Hurle et al., 2010; Bialkova and van Trijp, 2010; Bialkova et al., 2014, 2016; Graham et al., 2012; Graham et al., 2015; Grebitus et al., 2015; Van Loo et al., 2015). However, studies have shown that the actual use of the information by consumers is often limited (e.g., Cowburn and Stockley, 2005; Grunert et al., 2010a). That said, most of this body of literature employs self-reported measures on use of nutrition or sustainability information when examining the effect on food choices.

This research extends previous literature by moving beyond self-reported measures of information use, and instead quantifies the visual attention to labels and claims using eye-tracking. Whether consumers are using the offered information depends on their attention. If they do not attend to the presented information, it will not be available for guiding their product choice (Grebitus et al., 2015; Grebitus and Davis, 2017), i.e. information will only enable the individual to make an informed choice if it is attended to (van Trijp, 2009; Orquin and Mueller Loose, 2013). More specifically, only information that an individual fixates their gaze on will be recognized, processed and available for shaping product choice (Orquin and Mueller Loose, 2013). In this study, we use eye-tracking to measure visit duration as a proxy for visual attention. Visit duration is the amount of time an individual spends looking at a particular area, e.g., nutrition and sustainability claims on

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packages or labels. Through eye-tracking, consumers' attention to product attributes and their relevance when making choices can be identified (e.g., Russo, 2011). While eye-tracking technology has led to useful insights into consumers' use of mandatory nutrition information on food packages, e.g., the Nutrition Facts Panel, it has not been applied to a combination of voluntary nutrition and sustainability labels or claims, and research on attention to sustainability labeling is sparse in general. Using consumer data collected through a laboratory study, this research analyzes the impact of both voluntary nutrition and sustainability claims on consumers' visual attention and how it relates to food choices.

2. Study background

2.1. Sustainability in dietary guidelines

In the past, the majority of food-based dietary guidelines focused exclusively on achieving specific health goals but more recent policy initiatives have started to embed sustainability goals (Capacci et al., 2012; Gonzalez Fischer and Garnett, 2016; Lang and Barling, 2013; Stehfest, 2014). Despite the growing evidence for the need of integrated dietary approaches aligning health and sustainability objectives, only a few countries have integrated sustainability in their official national food-based dietary guidelines, among them, Brazil, Sweden, Qatar and Germany (Gonzalez Fischer and Garnett, 2016). In some European countries, such as the UK, France, the Netherlands, Estonia, and the Scandinavian countries, 'quasi-official' guidelines from government agencies or government-funded entities have been emerging (Gonzalez Fischer and Garnett, 2016). Those guidelines incorporate sustainability and could inform public policy-making. In the U.S., attempts to incorporate environmental considerations have not yet achieved government endorsement. Among others, the 2015 advisory report for Dietary Guidelines for Americans (Dietary Guidelines Advisory Committee, 2015) argued that governmental guidelines should promote food security of Americans, and suggested for sustainability to be an essential element of food security. In addition, a substantial and growing body of evidence shows that a healthy and food-secure future will require the establishment of sustainable food consumption patterns. For policies that aim to achieve integrated health and sustainability outcomes, approaches that increase awareness, concern and engagement are recommended, in the early stages of policy implementation (Garnett et al., 2015). Such approaches target informed choices through information provision using public campaigns, education and voluntary food labeling, ultimately striving for increased consumer awareness regarding sustainable food consumption (European Commission, 2012). However, for labels or claims to be effective they need to be attended to. Hence, we test in this study how much attention consumers pay to voluntary nutrition and sustainability claims.

2.2. Effect of nutrition and sustainability information on attention and choice

While search and experience attributes can be evaluated before or after buying and consuming food (Nelson, 1970), credence attributes need to be communicated to consumers to give them the opportunity to consider these product- or process-related characteristics (Darby and Karni, 1973). One of the major instruments to inform consumers is food labeling, such as nutrition panels, health- and sustainability related symbols and claims. Food labeling is a promising tool because (1) it supports the goal of healthy and sustainable eating while retaining consumer freedom of choice, and (2) it reduces information search costs for consumers (Grunert and Wills, 2007). Examples of nutrition information are mandatory nutrition panels and voluntary simple front-of-pack and back-of-pack nutrition labels, as well as voluntary nutrition-related claims and symbols (e.g., Balcombe et al., 2015; Colson and Grebitus, 2017; Hung and Verbeke, 2019; Mueller and Umberger, 2010; Sacks et al., 2009; van Camp et al., 2012). Several voluntary sustainability labels exist, such as, labels on animal welfare (e.g., Certified Humane), fair trade (e.g., U.S. Fair Trade), carbon footprint (e.g., Carbon Trust), food miles or sustainable fisheries (e.g., Marine Stewardship Council) (e.g., Van Loo et al., 2015; Grebitus et al., 2013a, 2013b).

With regards to nutrition labels, many studies have evaluated factors influencing the use of such information (Grebitus and Davis, 2017; Grunert and Wills, 2007; Grunert et al., 2010a, 2010b, 2012; Hieke and Taylor, 2012; Hieke and Newman, 2015; Siegrist et al., 2015; van Herpen and van Trijp, 2011; Visschers et al., 2010), as well as, the use of sustainability food labels (Grunert et al., 2014; Peschel et al., 2016; Van Loo et al., 2014, 2015). One challenge is that most consumers do not attend to labels such as nutrition information when grocery shopping (Grunert and Wills, 2007; Grunert, 2008; Grunert et al., 2010a). In fact, an early review of more than 100 studies showed that consumers choosing food rarely use nutrition labeling (Cowburn and Stockley, 2005). A European study showed that less than a third of consumers pay attention to nutrition information (Grunert et al., 2010a). Ultimately, it will be challenging to improve food choices towards healthy choices if no attention is paid to nutrition labels (van Trijp, 2009), since, naturally, they can only be used if they have been attended to. This was found, for example by Bialkova and van Trijp (2011) who stated that attention could be a limiting factor when making healthy food choices. Also, van Herpen and van Trijp (2011) found that consumers rarely attend to nutrition information, such as nutrition tables, color-coded nutrition labels and health ticks, even if they value it. When consumers attend to nutrition information, their interest is mainly focused on calories (Grunert, 2008). More generally, placing nutrition facts at the top of the package increases attention (Graham and Jeffery, 2011), and so does increasing surface size and element saliency (Orquin et al., 2012).

While paying attention to nutrition information is the first step, it is also important to consider whether the information is used, in other words, whether the healthier option is finally also chosen by consumers. In the past, several studies utilized self-reported measures to research the use of labels (e.g., Grunert et al., 2010a; Leek et al., 2015; Diekman et al., 2016). However, this likely causes consumers to over-report their use due to social desirability, hence leading to biased measures. As pointed out by Grunert et al. (2010b) the use of labels is over-reported by an estimated 50%. Only in the last decade some studies have gone beyond self-reported measures and have used eye-tracking to evaluate peoples' visual attention to labels.

In this regard, eye-tracking studies have evaluated the use of nutrition information and its relation to choice. Orquin et al. (2012) found a lower probability for consumers to choose a product if they had attended to the related nutrition information (GDA label, Nordic keyhole label) more. Balcombe et al. (2015), studying attention to nutrition content of food via eye-tracking, reported limited evidence for longer fixation duration (more attention) relative to importance attached to attributes. Grebitus and Davis (2017) investigated differences in consumers' attention towards the modified Nutrition Facts Panel (NFP), a mandatory label, to measure if the change to key elements on the label (e.g., larger type for calorie information) would affect eye fixations in a purchase situation. They found that the new NFP decreased attention to unhealthy products like chips but increased attention to healthy products like salad. Ballco, Caputo and de-Magistris (2020) reported that consumers' yogurt choices depend on the type of nutrition and health claims, as well as, on the visual attention to these claims.

While there is a large body of literature evaluating attention to nutrition labeling using eye-tracking (Antúnez et al., 2013, 2015; Balcombe et al., 2015, Bialkova and van Trijp, 2010; Bialkova and van Trijp, 2011; Bialkova et al., 2013, 2014, 2016), research on the attention to sustainability labels, and its relation to choice is scarce. For a review on the relation between visual attention and choice for both, nutrition and sustainability labeling, we refer to Van Loo et al. (2018). Van Loo et al. (2015) reported a relation between attention to sustainability labels and food choice, in particular, the attention paid to USDA organic,

and Fair Trade when choosing coffee. However, attention to Rainforest Alliance and carbon footprint did not affect the choice of coffee. Using eye-tracking glasses in a naturalistic shopping environment, Song et al. (2019) found that ecolabels received little attention and were never fixated on the longest when compared to other packaging information. This indicates that consumers did not actively look for these labels during their shopping experience. Interestingly, Song et al. (2019) reported also that only 110 of the 1544 (7%) purchased food products carrying ecolabels. Of the purchased products with ecolabels, more than six out of ten had a USDA Organic (62%) or a non-GMO (60%) label. This indicates that organic and non-GMO are among the most popular sustainability labels in U.S. supermarkets. Studying the effect of label education on visual attention to sustainability labels on chicken (including "Animal Welfare Approved", "Non-GMO Project Verified", "Certified Organic (USDA)", and "Certified Humane") and related food choice, Samant and Seo (2016) found that consumers who were educated about the sustainability labels looked at the labels more often and longer than those who were not educated about the labels. Among consumers educated about the labels, looking longer at the label was indicative for a more positive purchase intention and overall liking.

Overall, there is a lack of studies regarding the role of attention to voluntary sustainability and nutrition-related information in food decision-making situations where both types of information are present. With the increasing trend of food policies integrating sustainability into nutrition policies, it is important to study these two issues simultaneously (Aschemann-Witzel, 2015). Meanwhile, Van Loo et al. (2017) also reported that the images of a healthy and sustainable diet among European consumers are highly compatible based on a strong match between perceptions of both concepts. Our research extends the current literature where only few studies have considered both, voluntary nutrition and sustainability claims, simultaneously in an eye-tracking study combined with choice experiments.

3. Objectives and hypotheses

The overall goal of this study is to examine the role of nutrition- and sustainability-related information presented as claims on food labels in consumer food choice. The focus is on how attention to such information – communicated through food claims and intended to aid consumers in making healthy and sustainable choices – is related to food choice. Choice is examined through a choice experiment integrating eye-tracking measures to quantify the visual attention given to claims.

This research aims to answer the following research questions: To what extent does more attention to the entire product concept or to its voluntary nutrition and sustainability claims increase the choice likelihood of a product concept? Succinctly stated, are there differences in attention between voluntary nutrition and sustainability claims, and how does attention affect related choice? Against the background sketched in the previous section, we developed the following four hypotheses to investigate the relationship between visual attention and choice.

H1: A higher visual attention for a product concept alternative results in a higher choice likelihood for this alternative.

H2: A higher visual attention for a voluntary nutrition claim on a product concept alternative results in a higher choice likelihood for the related alternative.

H3: A higher visual attention for a voluntary sustainability claim on a product concept alternative results in a higher choice likelihood for the related alternative.

H4: Participants who pay more attention to a certain attribute value that attribute more.

To test our hypotheses, we conducted an eye-tracking study in the context of a laboratory choice experiment. Findings can provide policy makers, as well as stakeholders from food industry and food retailing with insights into the potential effectiveness of nutrition and sustainability claims ultimately fostering healthier and more sustainable dietary choices. Knowing how much attention consumers pay to such claims, and whether attention affects choice likelihood might assist governments and industry in developing efficient and effective communication approaches and assist in stimulating the adoption of healthy and sustainable diets.

Table 1
Attributes and attribute levels used for the granola bar concepts in the choice experiment.

Attribute	Attribute levels
Price	$0.49, 0.99, 1.49, 1.99
Genetic modification claim	Non-GMO
	Not genetically engineered
	No claim
Sweetener content claim	50% less sugar
	25% less sugar
	No sugar alcohols
	No claim
Antioxidant content claim	High in antioxidants
	Good source of antioxidants
	No claim
Sustainable production claim	Rainforest Alliance
	Fair Trade
	No claim

4. Methods

4.1. Experimental design

A choice experiment was designed in which respondents were asked to select their preferred granola bar concept from four alternatives and a no buy option. We refer to the study object as 'granola bar concept' since we did not present participants with real food products, i.e., real granola bars. Each granola bar concept alternative was described by five attributes: genetic modification, sustainable production claim, sweetener content claim, antioxidant content claim and price (Table 1) based on voluntary claims commonly seen on granola bars in the grocery store. For the price attribute, four levels were selected to reflect the price range of granola bars in the grocery store. The choice experiment with 12 choice sets was generated using a D-efficient Bayesian design with NGene (ChoiceMetrics, 2018). The priors were determined in a pre-test. Each of the 12 choice sets contained two product concept alternatives and a no buy option. Hence, each participant answered 12 choice sets.

An example of a choice set is presented in Fig. 1. Before the choice experiment questions, participants read instructions including a cheap talk script highlighting that they should make the choices assuming that they are really in the supermarket and facing these exact choices. Participants were also reminded of their budget constraints. Further, we listed the features of the granola bar concepts (Table 1), and gave a concrete example of a choice set (Fig. 1). We also explained that an empty cell in the choice set (Fig. 1) refers to the claim not being present.

4.2. Eye-tracking

During the choice task, the visual attention of participants was measured using an eye-tracking device (Tobii® X2-60) connected to a high-resolution computer screen. The twelve choice sets (stimuli) (Fig. 1) were randomly presented in the Tobii software. Participants were able to look at the stimuli as long as needed to make their choice. During the inter-stimulus interval, participants viewed a mask image to clear the visual palate. The eye-tracking device was individually calibrated using the nine-point calibration method. In total, 117 participants enrolled for the study at Arizona State University. For two participants, calibration was not possible and therefore no recordings were made. The choices and visual attention of 115 participants were recorded. A tracking ratio of less than 75% of the total recording time was considered incomplete and consequently 10 recordings were

Please look at these options of granola bars (1.2 ounces each). Choose your preferred option or "none of these."

	Option A	Option B	Option C	Option D	
Genetic modification		Non-GMO	Not genetically engineered	Not genetically engineered	None of these
Sustainable production	Fair Trade	Rainforest Alliance	Fair Trade	Rainforest Alliance	
Sweetener content	25% less sugar	50% less sugar	No sugar alcohols		
Antioxidant content	High in antioxidants		High in antioxidants	Good source of antioxidants	
Price	$1.49	$0.49	$1.49	$1.49	
I choose	☐	☐	☐	☐	☐

Fig. 1. Example of a choice set containing four alternatives of granola bar concepts.

omitted resulting in 105 valid observations.

Various areas of interest (AOIs) were defined for which the visit duration was calculated by Tobii Studio™. Firstly, AOIs for each presented alternative were created (Appendix Fig. A1) allowing to measure the total visit duration for each concept alternative. As indicated in the eye-tracking software user manual: "Total Visit Duration is defined as the sum of visit durations of an active AOI. An individual visit is defined as the time interval between the first fixation on the active AOI and the end of the last fixation within the same active AOI where there have been no fixations outside the AOI" (Tobii, 2016, p 110). Secondly, AOIs were created for each attribute of each product concept alternative (Appendix Fig. A.2). Thirdly, AOIs were created for each attribute in a choice set for all product concept alternatives combined (Appendix Fig. A.3). The visit durations based on this third series of AOIs were combined for all of the 12 choice sets. This yielded the visit duration for each attribute summated for the whole choice task sequence resulting in the summated total visit duration for a particular attribute for each participant.

4.3. Data analysis of the choice experiment

Based on random utility theory (McFadden, 1974), choice experiments follow the assumption that the utility of individual i of choosing an alternative j in choice situation t can be presented as:

$U_{ijt} = \beta_i' x_{ijt} + \varepsilon_{ijt}$, where x_{ijt} is a vector of observed variables that relate to alternative j and individual i; β_i is a vector of taste parameters that characterize the choices; ε_{ijt} is an unobserved error term, which is assumed to be independent of β and x.

With the five attributes included in the study, the utility that individual i obtains from alternative j at choice situation t takes the following form:

$$U_{ijt} = \beta_0\, No\_Buy_{ijt} + \beta_1 NonGM_{ijt} + \beta_2\, NotGE_{ijt} + \beta_3\, Rainforest_{ijt} + \beta_4\, Fairtrade_{ijt} + \beta_5\, Sugar50_{ijt} + \beta_6\, Sugar25_{ijt} + \beta_7\, NoSugarAlcohol_{ijt} + \beta_8\, HighAntioxidant_{ijt} + \beta_9\, SourceAntioxidant_{ijt} + \beta_{10}\, Price_{ijt} + \varepsilon_{ijt},$$

where j pertains to alternatives A, B C, D and E. No_Buy_{ijt} is an indicator variable that takes the value of 1 when the no-buy alternative is chosen, and 0 otherwise. β_0 is an alternative-specific constant representing the no-buy choice alternative. Each claim (e.g., *NonGM*, *FairTrade*) enters the model as dummy variables, and takes the value of 1 if present in alternative j, and 0 otherwise. Price is the price of one granola bar (1.2 oz). ε_{ijt} is the unobserved random error term.

To test *H1* that a higher visual attention for a product concept alternative results in a higher choice likelihood for that alternative, the visit duration of the alternative *VisitDurAlt* is included in the estimated utility function:

$$U_{ijt} = \beta_0\, No\_Buy_{ijt} + \beta_1 NonGM_{ijt} + \beta_2\, NotGE_{ijt} + \beta_3\, Rainforest_{ijt} + \beta_4\, Fairtrade_{ijt} + \beta_5\, Sugar50_{ijt} + \beta_6\, Sugar25_{ijt} + \beta_7\, NoSugarAlcohol_{ijt} + \beta_8\, HighAntioxidant_{ijt} + \beta_9\, SourceAntioxidant_{ijt} + \beta_{10}\, Price_{ijt} + \beta_{11}\, VisitDurAlt_{ijt} + \varepsilon_{ijt}$$

To test *H2* and *H3* that a higher visual attention for nutrition or sustainability claims of a particular product concept alternative results in a higher choice likelihood for that alternative, the visit durations of the attribute for each alternative (*VisitDurGM, VisitDurSus, VisitDurAntiOx, VisitDurSweet, VisitDurPrice)* are included in the estimated utility function, following Grebitus, Roosen and Seitz (2015):

$$U_{ijt} = \beta_0\, No\_Buy_{ijt} + \beta_1 NonGM_{ijt} + \beta_2\, NotGE_{ijt} + \beta_3\, Rainforest_{ijt} + \beta_4\, Fairtrade_{ijt} + \beta_5\, Sugar50_{ijt} + \beta_6\, Sugar25_{ijt} + \beta_7\, NoSugarAlcohol_{ijt} + \beta_8\, HighAntioxidant_{ijt} + \beta_9\, SourceAntioxidant_{ijt} + \beta_{10}\, Price_{ijt} + \beta_{11}\, VisitDurGM_{ijt} + \beta_{12}\, VisitDurSus_{ijt} + \beta_{13}\, VisitDurAntiOx_{ijt} + \beta_{14}\, VisitDurSweet_{ijt} + \beta_{15}\, VisitDurPrice_{ijt} + \varepsilon_{ijt}$$

To test *H4* that participants who pay more attention to a certain attribute value the attribute more, we followed the same procedure as described by Van Loo et al. (2015). The visit duration for each attribute was summated over the twelve choice sets. As a result, for each

Table 2
Visit duration over the 12 choice sets combined.

Attribute	Mean visit duration (seconds) (SD)
Price	2.83 (3.73)
Genetic modification claim	12.01 (10.50)
Sweetener content claim	11.18 (10.66)
Antioxidant content claim	5.34 (6.49)
Sustainability claim	10.17 (8.70)

Table 3
Empirical results for the MXL model including total visit duration to the product concept alternative.

	Mean		Standard deviations	
	Coefficient	SE	Coefficient	SE
NON-GM	0.54***	0.11	0.477***	0.143
NOT-GE	0.59***	0.12	0.203	0.171
RAINFOREST	0.56***	0.15	0.814***	0.147
FAIR TRADE	0.45***	0.13	0.583***	0.141
SUGAR 50%	1.15***	0.18	1.202***	0.170
SUGAR 25%	0.81***	0.14	0.626***	0.148
NO SUGAR ALCOHOLS	0.07	0.18	1.157***	0.176
HIGH ANTIOXIDANT	1.16***	0.12	0.399***	0.129
GOOD ANTIOXIDANT	0.90***	0.12	0.087	0.172
NO BUY	−2.58***	0.71	2.582***	0.507
PRICE	−1.25***	0.09		
TVD_ALTERNATIVE[1]	0.80***	0.08	0.608***	0.075

[1] TVD stands for total visit duration (in seconds).

participant the total visit duration summated over the twelve choice sets was obtained for each of the four claims (GM, sustainability, sweetener, antioxidant) and price. Next, these variables were re-scaled to have a zero mean. These mean-centered variables were obtained by subtracting the overall mean from each participant's value. As a result, these variables become relative to their mean. This means that variables with positive values have values above the mean, and variables with negative values have values below the mean. When attributes and visual attention are interacted, we are able to detect if preferences differ based on differences of visual attention from the mean. The mean-centering of the eye-tracking variables facilitates the interpretation of the coefficients. For instance, the parameter estimates for the main effects can then be simply interpreted as the marginal utility for that attribute at the mean visit duration.

Accordingly, the utility that individual *i* obtains from alternative *j* at choice situation *t* takes the following form:

$$U_{ijt} = \beta_0\, No\_Buy_{ijt} + \beta_1 NonGM_{ijt} + \beta_2\, NotGE_{ijt} + \beta_3\, Rainforest_{ijt} + \beta_4\, Fairtrade_{ijt} + \beta_5\, Sugar50_{ijt} + \beta_6\, Sugar25_{ijt} + \beta_7\, NoSugarAlcohol_{ijt} + \beta_8\, HighAntioxidant_{ijt} + \beta_9\, SourceAntioxidant_{ijt} + \beta_{10}\, Price_{ijt} + \beta_{11} NonGM_{ijt} * VA\_GM_i + \beta_{22}\, NotGE_{ijt}\, VA\_GM_i + \beta_{33}\, Rainforest_{ijt}\, VA\_Sus_i + \beta_{44}\, Fairtrade_{ijt}\, VA\_Sus_i + \beta_{55}\, Sugar50_{ijt}\, VA\_Sweet_i + \beta_{66}\, Sugar25_{ijt}\, VA\_Sweet_i + \beta_{77}\, NoSugarAlcohol_{ijt}\, VA\_Sweet_i + \beta_{88}\, HighAntioxidant_{ijt}\, VA\_AntiOx_i + \beta_{99}\, SourceAntioxidant_{ijt}\, VA\_AntiOx_i + \beta_{101}\, Price_{ijt}\, VA\_Price_i + \varepsilon_{ijt},$$

with *VA_GM, VA_Sus, VA_Sweet, VA_AntiOx, VA_Price* being the mean-centered visit duration for the claims related to GM, sustainable production, sweetener content, antioxidant content and price.

To test the hypotheses, we estimate mixed logit models in NLogit.

5. Results

5.1. Descriptive statistics on attention

The sweetener content and genetic modification claims are attended to the most, followed by the sustainability claims, for 12, 11 and 10 s, respectively. The antioxidant claims and price were visited for the shortest time for 5 and 3 s, respectively (Table 2). These results are consistent with Grebitus et al. (2015) who also reported the lowest visit duration for price.

Table 4
Empirical results for MXL model including total visit duration to the attributes and attribute levels.

	Mean		Standard deviations	
	Coefficient	SE	Coefficient	SE
NON-GM	0.72***	0.12	0.47***	0.138
NOT-GE	0.80***	0.13	0.18	0.209
RAINFOREST	0.78***	0.16	0.92***	0.145
FAIR TRADE	0.62***	0.13	0.52***	0.145
SUGAR 50%	1.39***	0.19	1.37***	0.180
SUGAR 25%	0.94***	0.15	0.73***	0.168
NO SUGAR ALCOHOLS	−0.03	0.21	1.33***	0.205
HIGH ANTIOXIDANT	1.34***	0.13	0.21	0.176
GOOD ANTIOXIDANT	1.09***	0.13	0.12	0.138
NO BUY	−2.39***	0.72	2.98***	0.548
PRICE	−1.41**	0.09		
TVD_PRICE[1]	2.28***	0.48	1.75***	0.410
TVD_SUSTAINABLE	1.07***	0.18	0.77***	0.188
TVD_ANTIOXIDANT	1.55***	0.39	1.70***	0.382
TVD_GM	0.95***	0.16	0.84***	0.157
TVD_SWEETENER	1.26***	0.22	0.83***	0.255

[1] TVD stands for total visit duration (in seconds).

Table 5
Empirical results for MXL model including interaction between the attribute and the mean-centered total visit duration to the attributes summated over tasks.

	Mean		Standard deviations	
	Coefficient	SE	Coefficient	SE
NON-GM	0.80***	0.12	0.63***	0.12942
NOT-GE	0.84***	0.12	0.36**	0.17076
RAINFOREST	0.79***	0.15	0.84***	0.14215
FAIR TRADE	0.63***	0.12	0.12	0.15247
SUGAR 50%	1.29***	0.19	1.21***	0.1665
SUGAR 25%	0.98***	0.15	0.87***	0.1542
NO SUGAR ALCOHOLS	0.65***	0.16	1.21***	0.19633
HIGH ANTIOXIDANT	1.30***	0.12	0.28**	0.13806
GOOD ANTIOXIDANT	1.06**	0.12	0.33**	0.1387
NO BUY	−5.33***	0.75	3.28***	0.38
PRICE	−1.98***	0.15	–	–
VA_gm*NON-GM[1]	0.02	0.01	0.03*	0.02
VA_gm*NON-GE	0.04***	0.01	0.02	0.01
VA_sus*RAINFOREST	0.06***	0.02	0.09***	0.02
VA_sus*FAIR TRADE	−0.02	0.01	0.06***	0.02
VA_sweetner*SUGAR50%	0.04**	0.02	0.14***	0.03
VA_sweetner*SUGAR25%	0.03**	0.01	0.03*	0.02
VA_sweetner*NO SUGAR ALCOH	0.04***	0.02	0.03	0.02
VA_antiox*HIGH ANTIOXIDANT	0.03	0.02	0.05**	0.02
VA_antiox*GOOD ANTIOXIDANT	0.03	0.02	0.00	0.02
VA_price*PRICE	−0.14***	0.03	0.98	***

[1] VA stands for mean-centered visit duration (in seconds) using mean values from Table 2.

5.2. Choice models relating attribute, attention and choice

Results show that visual attention and choice are related, and that higher attention leads to a higher choice likelihood. More specifically, more attention to a product concept alternative (Table 3) and more attention to the attributes of a product concept alternative (Table 4) increase the probability of the product concept alternative to be chosen. Table 5 also shows that for some of the attributes there is a relation between the visit duration and the valuation, indicating that spending more time to a certain attribute during the whole sequence, relates to higher valuation.

Results in Table 3 show that the coefficient for price is significant and negative as expected. The higher the price the lower the probability to choose the respective product. The coefficient of No_Buy is significant and negative indicating that participants rather chose a granola bar concept than no granola bar concept at all. Except for the No Sugar Alcohol claim, all other claims are significant and positive, with

nutrition claims (Sugar reduction and Source of antioxidants) having larger coefficients compared to the sustainability (Fair Trade and Rainforest Alliance) and GM claims. Looking at total visit duration for a product concept alternative, which can be considered as a proxy for attention to the alternative, results show a significant and positive coefficient suggesting that the more attention is paid to a product concept alternative the more likely it is that the individual choses that alternative over other options available.

Table 4 displays findings for attention, measured as visit duration, specific to the different attribute categories. The results show, first of all, that main results for price, 'No_Buy' and other claims are similar to those in the model for attention to product concept alternatives. When testing the effect for attention to specific attributes we find that all coefficients are significant and positive, suggesting that more attention to an attribute of a certain product concept alternative increases the likelihood to choose that product concept alternative. This is the case for all attributes (price, sustainability, antioxidant, GM and sweetener content claims), however, we observe differences in the magnitude of the coefficients. The attention to the price of an alternative (TVD_PRICE) has the largest impact with the more attention paid to the price of a particular product concept alternative, the more likely the product concept alternative is to be chosen. The coefficients for attention to the claims related to nutrition (antioxidant and sweetener content) are smaller indicating that attention to these nutrition claims has a smaller impact on choice. Finally, the coefficients for the visual attention to sustainability and GM claims are the smallest. These results indicate that paying attention to nutrition information increases the probability to choose a product more than paying attention to sustainability-related information.

At the final stage, we interact the respective attributes and visual attention to the attributes summated over all choice tasks. Table 5 shows that the results for the main variables are again similar to the base model, except in this case the coefficient for 'No sugar alcohols' is also significant and positive. The findings herewith reveal that paying more attention specifically to Not-GE, Rainforest Alliance, and attribute information related to sweetener content significantly and positively affects attribute valuation. This suggests that spending more time on a certain attribute during the whole choice sequence relates to a higher valuation for that attribute, i.e., a preference for that attribute. Looking at the attribute levels reveals that participants do, in fact, process the information differently across attribute levels. The impact of the attention paid to an attribute on choice depends on the attribute level. These results suggest that attention analysis needs to be attribute-level specific.

6. Discussion

In this study, we analyze how a variety of voluntary nutrition and sustainability claims as commonly seen in the market affect attention and related choice. To do so, we combine a choice experiment for granola bar concepts with eye-tracking to measure visual attention to product attributes. We test visit duration towards specific voluntary sustainability claims, genetic modification claims, sweetener content claims and antioxidant content claims.

With regards to preferences per se, our results show that all claims except for the 'no sugar alcohol' claim had a significant and positive effect on choosing granola bar concepts. Comparing voluntary nutrition claims to sustainability claims suggests that information on sugar reduction and source of antioxidants is deemed more important by consumers than Fair Trade and Rainforest Alliance claims, or GM claims. This is in line with our expectations as previous research indicated that ego-centered motivations related to an individual's self-interest such as one's own personal health is often a stronger driver for consumer decision-making as compared to altruistic motivations related to sustainability (Birch et al., 2018). In terms of the effect of visual attention on choice, paying more attention to a product concept alternative led to a higher likelihood of the respective product being chosen. This result is in line with Bialkova et al. (2014) who found that a higher visual attention is related to a higher choice likelihood. Similarly, Jantathai et al. (2013) and Danner et al. (2016) showed that fixation counts and dwell duration are positively correlated with choice, and Behe et al. (2015) reported that total visit duration is the best predictor of choice.

When modeling visit duration for the different attribute categories rather than a whole product concept alternative, results indicate that a higher visual attention to an attribute increases the likelihood to choose that product concept alternative. Again, this supports findings by Jantathai et al. (2013), Bialkova et al. (2014), and Danner et al. (2016) in that more attention has a positive effect on product choice. Also, Behe et al. (2014) demonstrated that higher visual attention is associated with higher importance, which is in line with choosing a product that provides more utility. Furthermore, Van Loo et al. (2015, 2018) found that visual attention to price and sustainability information affects choice, and in the case of sustainability information leads to higher valuation. This is in part similar to our results. While we find that attention to all attributes, price, sustainability claims, nutrition claims and GM claims is related to choice, the effects of attention on preference differs between attributes. The coefficient estimates of the MXL models suggest that attention to the price has the largest impact on choice, similar to Van Loo et al. (2015, 2018). However, attention to nutrition claims has a stronger effect on choice than attention to sustainability and GM claims. Though we did not investigate participants' health goals, these might be underlying reasons for this, as stated in van Herpen and van Trijp (2011) who found that attention to nutrition information and related choice is stronger for participants with stronger health goals. With regards to the impact of price on choice, our findings could be explained with higher involvement as was found by Behe et al. (2015) who highlighted that higher involvement is related with paying more attention to price information. Overall, our findings suggest that attention to nutrition information increases the likelihood to choose a product, here granola bar concepts, more than paying attention to sustainability information.

We also analyzed how paying attention specifically to not-GE, Rainforest Alliance, and attribute information related to sweetener content affects choice over all choice sets. Results indicate that paying more attention to an attribute during the whole choice sequence in most cases leads to a higher valuation for that attribute level, while more attention to price related to being more price sensitive. This is in line with findings by Van Loo et al. (2015). However, Balcombe et al. (2015) did not find a relationship between values and attention for attributes.

Finally, we show that the relation between attention to attribtes and choice depends on the specific attribute levels, which indicates that attention ultimately needs to be analyzed at attribute-level. In sum, our findings suggest that visual attention and choice are related with more visual attention being associated with a higher choice likelihood—even though in our study we cannot distinguish between the mere exposure effect where more attention leads to choice and the utility effect where goal-driven attention leads people to attend more to information they think is important. Overall, our study can herewith inform future research on attention and choice.

7. Limitations and future research

This research is not without limitations. The use of granola bar concepts, a healthy food product, as food stimuli might influence the visual attention to nutrition claims because the visual attention to such claims on healthy food may differ from attention to nutrition claims on less healthy or hedonic foods (Motoki et al., 2019). Future research could look into how the food category may affect the attention to voluntary nutrition claims or sustainability claims. Furthermore, our study investigated voluntary claims, and as a result included only positive claims. It remains to be investigated whether these results hold when negative claims are included. Another limitation of the present study relates to its use of descriptors instead of real labels. While this is consistent with much of the choice experiment literature, future research could investigate whether real labels evoke a different level of

attention from participants. Since we used a table format for the choice sets we did not randomize the location of the claims. Possible effects of this could be tested by future research using shelf-simulation. Finally, this study is of a hypothetical nature, meaning there was no real purchase based on the chosen product, and thus no money exchange. While we can show that attributes that are more attended to are preferred, it might be worthwhile to study whether a non-hypothetical study leads to differing results in terms of actual choice of a product.

8. Conclusion

This research investigates the relationship between attention and choice using eye-tracking in the context of a choice experiment. This allows to include visit duration in the choice modeling rather than relying on participants stating whether they paid attention to certain attributes or alternatives. While a number of studies have investigated attention to nutrition claims, only few studies have researched attention to sustainability claims. In this study we combine voluntary nutrition and sustainability claims to test whether more attention increases the likelihood to choose a product concept alternative.

Applied to the case of granola bar concepts, our results show that visual attention and choice are related and that higher attention yields a higher choice likelihood. More specifically, more attention to a product concept alternative and more attention to the attributes of an product concept alternative lead to a higher likelihood of the alternative to be chosen. In addition, spending more time on certain attributes during the whole sequence relates to higher valuation. It is important to note that our findings depend on the product and the attributes used. Thus, they are based on the use of a healthy food product as food stimulus. Furthermore, both the implemented nutrition and sustainability information were positive voluntary claims.

With respect to implications, this study shows from a theoretical standpoint that attention as the precursor of choice is indeed related to the choice decision made by a participant. From a methodological point of view this means that not all attributes might be paid attention to equally; those that are valued more by participants are looked at for longer periods of time. This can ultimately lead to an imbalance when considering alternatives and making trade-offs between them. This warrants further research given that the underlying theory of choice experiments is compensatory decision making based on the assumption that participants will spend time visiting all attributes and trading them off to maximize utility. Finally, from a managerial perspective spending more time attending to an attribute increases the choice likelihood. If the goal is to stimulate healthy and sustainable food choices the respective claims need to be designed in a way that consumers pay more attention to them.

CRediT authorship contribution statement

Ellen J. Van Loo: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review & editing. **Carola Grebitus:** Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing. **Wim Verbeke:** Writing - review & editing.

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Appendix

Fig. A.1. AOI for each concept alternative to obtain visual attention to the *alternative* in the task.

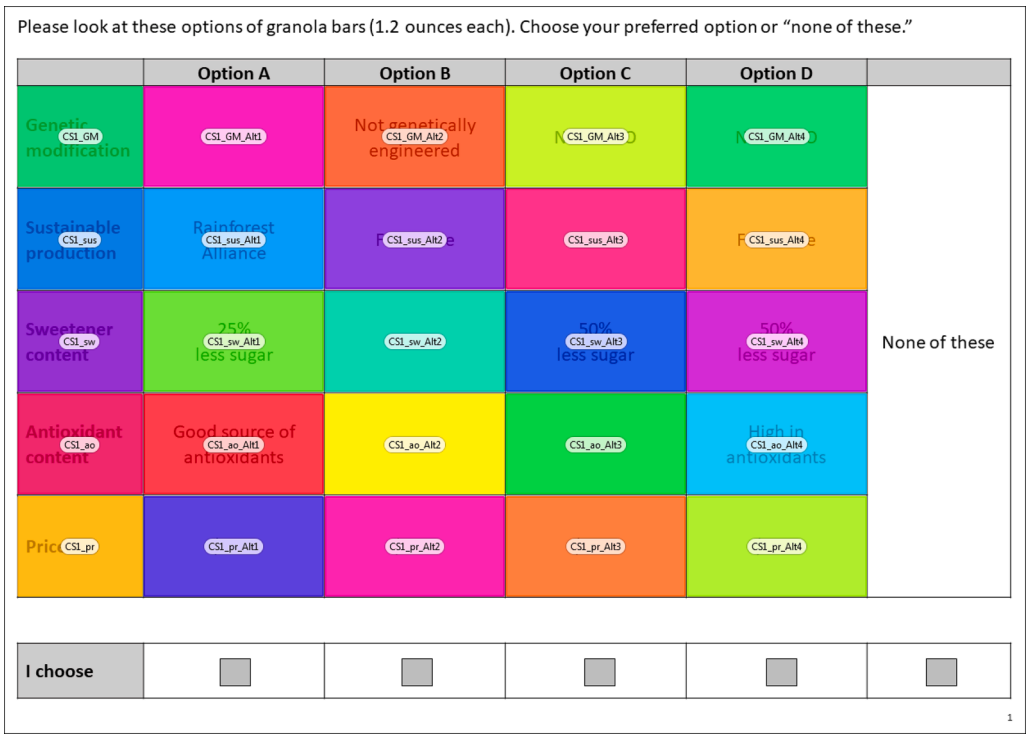

Fig. A.2. AOI for each attribute for each concept alternative to obtain the visual attention to an attribute in a particular alternative.

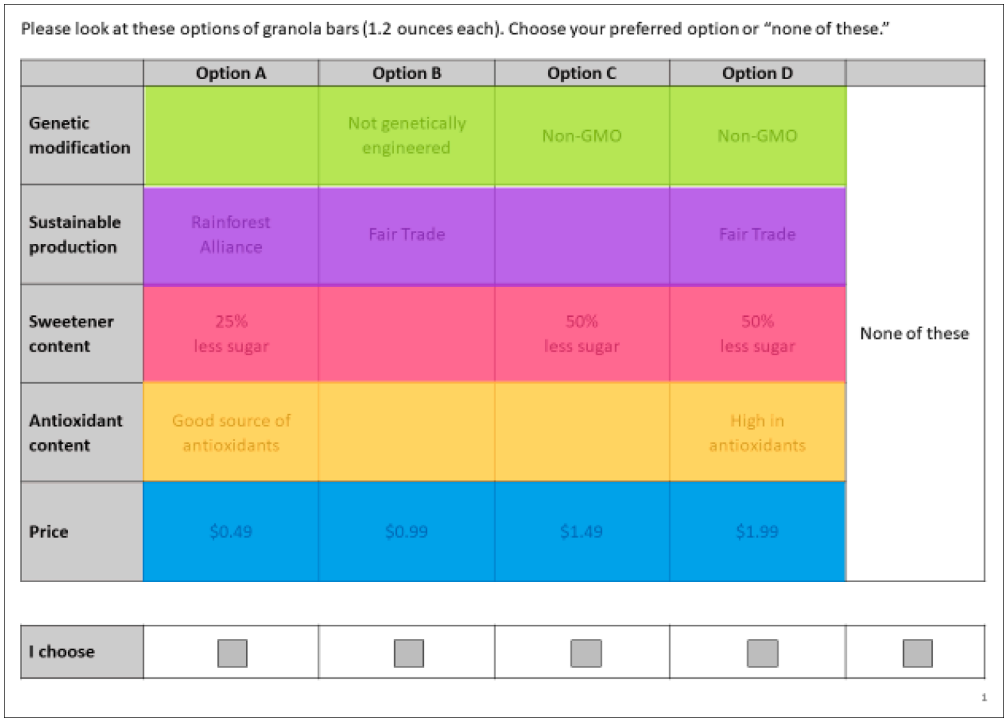

Fig. A.3. AOI for each attribute for all concept alternatives combined.

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