PERCEPTUAL EVALUATION AND WILLINGNESS TO BUY OF GLUTEN-FREE LABELLED FOOD AMONG WESTERN-EUROPEAN CONSUMERS

by

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Abstract

This study aimed to find out how gluten-free (GF) labelling shapes consumers' perception of food products and whether these are indicators for willingness to buy (WTB), among different groups of consumers. An online survey was conducted and data from western-European countries was used in the analysis. The effect of GF labelling was tested on bread packages by comparing nearly identical bread packages without such a label. Perception of healthiness, caloric content, tastiness and processed character were evaluated. Moderators accounted for were celiac disease, nutritional knowledge, health consciousness and attitude. Overall, bread labelled GF increased WTB among all participants ($p = .015$). GF was perceived as healthier ($p < .001$) and less tasty ($p < .001$). Healthiness was the main predictor for buying GF, especially among health conscious consumers. The present study highlights the difficulty to communicate GF labelling information as intended to the consumer. This concern between consumers and marketers should be regulated by policies to avoid unintended consequences in consumption behaviour.

Keywords: gluten-free, gluten, healthiness, tastiness, food, celiac disease, labelling

Perceptual Evaluation and Willingness to Buy of Food Labelled Gluten-Free among Western-European Consumers

Food labelling constitutes an important strategy to influence peoples' food consumption behaviour. It creates expectations about the food, which in turn influence people's sensory perception, hedonic evaluation, and eventually willingness to buy (Bandara, De Silva, Maduwanthi & Warunasinghe, 2016; Piqueras-Fiszman & Spence, 2015). Labelling information is often presented as a symbol or simplified text (Ni Mhurchu, Eyles, Jiang, & Blakely, 2018). In contrast to nutrition tables, consumers do not have to invest a lot of time and effort to process the given information on labels (Hartmann, Hieke, Taper, & Siegrist, 2018). According to the European Union (EU) 'regulation on nutrition and health claims', there are three categories of claims that may be used on foods: *health claims*[1], *nutrient content claims*[2], and *structure/function claims*[3] (European Commission, 2015; Sanco, 2001).

Among those existing types of labels, free-from labels (i.e. nutrient content claims) are relevant for consumers who have a high need of accuracy for this kind of information due to allergies, intolerances and/or dietary habits (e.g. wheat allergy, lactose intolerance or veganism) (Hartmann et al., 2018). However, the question has emerged whether these free-from labels may also affect consumers who are not required to check their diet for these ingredients. When shaping consumers' food consumption behaviour using certain food labels, it is important to understand how consumers interpret those labels. A false interpretation of labels might lead to unintended changes in consumer purchasing behaviour. Previous research has shown that free-

[1] *Health claims* describe a relationship between a food substance and reduced risk of a disease or health-related condition (e.g. fruit and vegetables support good health)
[2] *Nutrient content claims* describe the level of a nutrient in the product, using terms such as free, high, and low (e.g. free from gluten)
[3] *Structure/function claims* may describe the role of a nutrient or dietary ingredient intended to affect the normal structure or function of the human body (e.g. calcium builds strong bones).

from labels are often misunderstood or misinterpreted (Provencher & Jacob, 2016). The current study focuses on the effect of gluten-free labelling.

Gluten-free (GF) food represent a rapidly expanding category of food products in the market place (Dunn, 2014; Hyun-seok et al., 2016). Gluten is a protein present in food products mostly from wheat, rye and barley. It has viscoelastic properties and makes dough elastic. People who show an abnormal immune reaction to the ingestion of gluten are diagnosed with Coeliac Disease (CD), which has an estimated worldwide prevalence of 1% (Singh et al., 2018). Currently, the only effective treatment for CD is a life-long adherence to a gluten-free diet (GFD), compromising naturally GF food products and/or substitutes of gluten-based products (e.g. products manufactured with ingredients specially processed to replace gluten).

Nevertheless, the growth of the GF market is not solely accounted by an increase in the prevalence of CD. This increase in prevalence is due to public perception that the GFD promotes general health and is therefore becoming a popular lifestyle choice (Reilly, 2016). Past research comparing nutrients in gluten-containing and GF replacement products suggests that on average the GFD contained more saturated fat, sodium and sugar, and may lead to possible nutrient deficiences resulting in improper nutritional quality of the diet (Dennis, Lee, & McCarthy, 2019; Fry, Madden, & Fallaize, 2018; Melini & Melini, 2019; for an extended review see Vici, Belli, Biondi, & Polzonetti, 2016). Because the GFD is becoming more popular among people without CD it is crucial to get a better understanding how consumers evaluate GF products and how this may influence purchase behaviour. Filling this gap in literature may help policy makers and marketers to develop information remedies to help consumers make better-informed choices about products and to avoid unintended consequences. The purpose of this study was firstly, to examine the effect of a GF label on willingness to buy (WTB) and healthiness, caloric content, tastiness and processed character evaluation. Secondly, to identify groups of consumers who give different relative importance to a GF label and WTB.

Theoretical Background

The response to GF labelling has gained particular interest last decennia and has been increasingly researched (Hartmann et al., 2018; Prada, Godinho, Rodrigues, Lopes, & Garrido, 2019; Priven, Baum, Vieira, Fung, & Herbold, 2015; Shin & Mattila, 2018). Most studies, among which, Hartmann et al., (2018) and Priven et al., (2015), focused on perceptional evaluations of GF labels, in particular they focused on 'healthiness evaluation'. Very few studies have elaborated on other perceptual factors in addition to healthiness (Prada et al., 2019). Nor, many studies combined perceptual evaluations in relation to actual purchase intentions. For example, Shin & Mattila (2018) concluded that negative expectations about the taste decreased WTB of GF meals in restaurants. To build upon previous research and extend knowledge, this study focused on four categories that are expected to mediate consumers' WTB regarding GF labelled products: 1) perceived healthiness, 2) tastiness, 2) caloric content and 4) processed character. To identify consumers who gave a different relative importance to a GF label, multiple moderators were taken into consideration. *From this point on 'people with CD' will be referred to as 'CD-people' and, 'people without CD' will be referred to as 'nCD-people' (non-CD).*

Healthiness

Previous research has shown that labelling information on food products is a strong indicator of consumers' healthiness perception. Hartman and colleagues (2018), who examined the effect of several free-from labels (e.g. free-from gluten, palm oil, GMOs) on healthiness evaluation, concluded that products with a free-from label were considered healthier than products without such a label. A different kind of labelling that has been recently introduced in Australia is Traffic-Light Labelling (e.g. health claims). A higher score on the Traffic-Light Label was positively associated with increased healthiness perception and products purchased (Ni Mhurchu et al., 2018). In one study about healthiness perception of free-from labelling

information, the researchers added a designed factitious 'MUI-free' label. The results showed that 22% of the participants selected MUI-free labelled products as healthier compared to the same product without such a label, even when a majority of the participants indicated having no idea what 'MUI' stands for (Priven et al., 2015). Increased healthiness evaluation has also been observed for a GF label. This effect is due to a growing public perception that GF food products are healthier than their gluten containing counterparts, and that the GFD is an adequate diet to lose and maintain weight (Capili, Chang, & Anastasi, 2014; Christoph, Larson, Hootman, Miller, & Neumark-Sztainer, 2018; Prada, Godinho, Rodrigues, Lopes, & Garrido, 2019; Mintel, 2016; Rathi & Zanwar, 2016; Virta, Saarinen, & Kolho, 2017).

The positive belief about healthiness is likely to be associated with the acceptance of GF products among nCD-consumers (Prada et al., 2019). However, public perception contradicts outcomes of studies who have thoroughly investigated the GFD. According to research, the GFD may lead to possible nutrition imbalance as result of improper nutritional quality of the GFD (Dennis et al., 2019; Fry et al., 2018; Wu et al., 2015). Following a GFD has been observed to decrease vitamins and minerals with an increase of obesity risk due to a high content of sugar and saturated fats. Furthermore, low levels of fiber, folate, vitamin B12, Vitamin D, calcium, iron, zinc and magnesium are observed (Vici, Belli, Biondi, & Polzonetti, 2016). It is broadly advised by registered dietitians and health professionals to follow a strict GFD for treatment of gluten-related disorders (Dennis et al., 2019). In addition patients should be encouraged to discuss their dietary choices with their providers, as well as seek out guidance from registered dietitians to confirm that they meet their nutritional goals (Newberry, McKnight, Sarav, & Pickett-Blakely, 2017)

In agreement with Priven et al., (2015), we could say that labelling is considered a powerful method of communication with consumers. Labelling can be misunderstood and lead to unintended consumption behaviour and consequences to ones' health status (Faulkner et al.,

2014; Wansink & Chandon, 2006). Product labelling is also at risk of being exploited by food manufacturers and marketers to their benefit sales of sales outcomes (Nestle & Ludwing, 2010). [h1a (hypothesis 1a, see Table 1.)]

Caloric Content

When food products are perceived as healthy, individuals are more likely to underestimate the caloric content of those food products. This is also known as the health-halo effect: consumers form biased impressions of a product (e.g. low caloric content) from limited information that may not always be objectively correct (Burton, Cook, Howlett, & Newman, 2014; Chandon & Wansink, 2007). Chandon and Wansink (2006) examined that snacks, perceived as healthy, labelled 'low fat' (e.g. nutrient content claim) increased food intake up to 50% for both normal and overweight people. In addition, low-fat labels reduced guilt with eating among overweight people (Wansink & Chandon, 2006). A more recent study from Faulkner and colleages (2014) confirms these findings. They found that if food had a reduced-fat label, people would eat a larger portion, by assuming that it had a lower caloric content.

Since research has shown that GF foods are believed to be healthier, GF food items are prone to the above explained health-halo effect. Therefore, it is to be expected that foods labelled GF may contribute to overeating due to consumers perception of lower caloric content and, reduced guilt associated with eating (Chandon & Wansink, 2007; Ni Mhurchu et al., 2018; Prada et al., 2019; Wansink & Chandon, 2006). [h2a, h2c]

Tastiness

People may have unconsciously learned to associate unhealthiness with tastiness. A study conducted by Raghunathan, Naylor, and Hoyer (2006) showed that foods perceived as less healthy are inferred to a better taste, increased enjoyment during consumption. Even those who disagreed with the unhealthy=tasty association (UTA), behaved as if they did. According to the UTA, GF products (often perceived as healthier, see previous sections) are more likely

to be evaluated worse in taste (Raghunathan et al., 2006). Furthermore, gluten largely contribute to the sensory profile of food products (Hüttner & Arendt, 2010b). Currently, no direct substitute for gluten is available. A combination of refined unfortified cereal flours (e.g., maize, rice and nut), hydrocolloids (substitutes that provide the right viscosity, texture or structure e.g., guar gum and xanthan) and proteins (e.g., egg white) are used to make GF products (Hüttner & Arendt, 2010b; Sabanis & Tzia, 2011). However, processed GF products are often characterized by low nutritional quality, as well as poor mouthfeel and flavor. The development of good quality GF products remains a challenge (El Khoury, Balfour-Ducharme, & Joye, 2018; Hüttner & Arendt, 2010b; Shin & Mattila, 2018). [h1c, h3a, h3c]

Processed character

Romn, Sánchez-Siles, & Siegrist., (2017) show that for the majority of consumers food naturalness and unprocessed character is crucial. Theoretically, participants indicate they prefer natural- and unprocessed food, however in practice they want to save cooking time and buy convenient, often processed food products (Román et al., 2017). Gluten free products are either naturally GF (e.g. potatoes and beans) or processed GF substitutes for gluten-based products (e.g. bread and pasta). As mentioned before, currently no direct substitute for gluten is available. To reach better quality GF products, they must undergo intense processing with a variety of substances compared to their gluten containing counterparts (El Khoury et al., 2018; Hüttner & Arendt, 2010b). Nonetheless, due to health halos, individuals are more likely to consider GF foods as unprocessed if interpreted as healthy (Burton et al., 2014; Prada et al., 2019). [h4a, h4c]

Individual characteristics

Research has shown that consumers are genuinely interested in nutritional labels (Nocella & Kennedy, 2012; Žeželj, Milošević, Stojanović, & Ognjanov, 2012). However, nutrition information on food labels is complex and does not always live up to its potential to

communicate effectively. Previous research has shown that consumers' ability to understand food labelling information entails many different factors, such as socio-demographic characteristics, nutritional knowledge, familiarity and others (Nocella & Kennedy, 2012). In the present study, we included the following individual characteristics: age, gender, education, CD, nutritional knowledge, health consciousness, attitude towards the GFD and processed foods.

Celiac disease

People who follow a GFD either because they have CD, gluten intolerance, non-celiac gluten sensitivity (NCGC) or for other health reasons (e.g. Paleo Diet). Patients often self-report gluten intolerance or sensitivity and adhere a GFD without a medical diagnoses (Capili et al., 2014). Following a strict GFD will be referred to as 'CD'. CD-consumers are restricted to GF products, regardless better perceptual evaluations of gluten containing products. Furthermore, CD-consumers are familiar with the GFD and, expected to evaluate the GFD distinctively from nCD-consumers. [h2b, h3b, h4d, h1d, h2d, h3d, h4d]

Nutritional knowledge

GF labels (i.e. nutrition claims) convey the nutrient content without explaining the relation to the health function or outcome. In comparison, health claims link the product with specific health-related functions. Even though nutrition and health claims are theoretically different, for some consumers this distinction may not be clear or even very meaningful. Nutritional knowledge has been found to increase consumers' understanding and interpretation of nutritional information on food labels as intended (Miller & Cassady, 2015). Findings from Burton et al., (2014) and Lawson, (2002) are in line with Miller & Cassady (2015), they conclude that low nutritional knowledge may lead to misinterpretations of GF labels and in turn contribute to health halos (Burton et al., 2014; Lawson, 2002). [h1b, h2b, h3d]

Attitude towards the gluten-free diet and processed foods

Attitudes refer to a set of emotions, beliefs, and behaviors towards a particular subject (Trendel & Werle, 2015). Attitudes are often the result of experiences and/or upbringing and they may have a powerful effect on behaviour (Lähteenmäki, 2013; Trendel & Werle, 2015). Attitude towards food corresponds to the affective component (hedonic reaction of the item e.g., palatability, liking) and the cognitive component (beliefs about the item e.g., perceived healthiness, calories) (Trendel & Werle, 2015). In the matter of GF and processed food items, accumulating experiences create a positive or negative attitude towards a particular food item, which in turn positively or negatively influences people's purchase intention (Ajzen, 1991; Lawson, 2002; Shin & Mattila, 2018). [h3b, h4d]

Health consciousness

Health consciousness is defined as the degree to which people are interested in their health and motivated to engage in preventative behaviors and healthcare strategies (Chandon & Wansink, 2007). Numerous studies illustrated that health consciousness influences purchase decisions of food items (Gámbaro, Ellis, & Prieto, 2013; Hoque, Nurul Alam, & Nahid, 2018). For example, it was found that consumers with low health consciousness are likely to avoid food labels and vice versa, high health conscious consumers are more likely to actively search for food labels (Hartmann et al., 2018; Raghunathan et al., 2006). According to Mai and Hoffmann, (2015) the moderating effect of health consciousness on purchase decision might be explained by people's rational and controlled decision making during food shopping. [h1d, h2d, h4d]

Objective and hypotheses

The evidence described above emphasize the importance of better understanding how GF labels are perceived and influences consumers' consumption behaviour in order avoid miscommunication about GF products. In this context, the aim of the present work was (a) to

examine the effect of a GF label on WTB and, its influence on perceived healthiness, caloric content, tastiness and processed character evaluation and, (b) to identify groups of consumers who give different relative importance to a GF label. Hypotheses are stated in Table 1.

Table 1.

Formulation of hypotheses

	Hypotheses 1abcd
h1a	Gluten-free labelling will increase perceptions of healthiness
h1b	This anticipated evaluation of healthiness will be attenuated among people with a high nutritional knowledge
h1c	Healthiness perception of a GF label will show a negative mediating effect on willingness to buy
h1d	Such a tendency will be offset by people with celiac disease and attenuated among high health conscious people
	Hypotheses 2abcd
h2a	Gluten-free labelling will decrease perceptions of caloric content
h2b	This anticipated evaluation of caloric content will be attenuated among people with a high nutritional knowledge
h2c	Increased caloric content perception of a GF label will show a negative mediating effect on willingness to buy
h2d	Such a tendency will be attenuated among people with celiac disease and a high health consciousness
	Hypotheses 3abcd
h3a	Gluten-free labelling will decrease perceptions of tastiness
h3b	This anticipated evaluation of tastiness will be reversed among people with celiac disease and positive attitudes towards a gluten-free diet
h3c	Tastiness perception of a GF label will have a positive mediation effect on willingness
h3d	This effect will enhance among people with celiac disease
	Hypotheses 4abcd
h4a	Gluten-free labelling will decrease perceptions of processed character
h4b	This anticipated evaluation of processed character will be weakened by people with celiac disease and a high nutritional knowledge

h4c	Processed characters of a GF label will have a positive mediating effect on willingness to buy
h4d	This effect will be attenuated among people with celiac disease, a high health consciousness and positive attitudes towards processed character

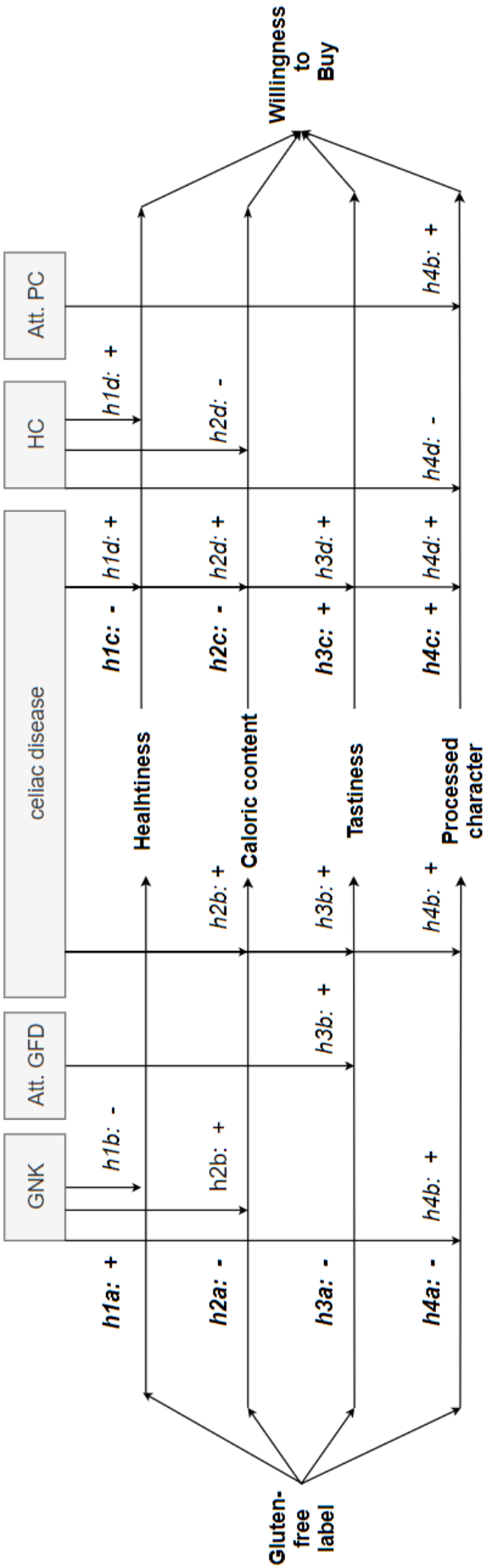

Figure 1.

Conceptual framework

Note. GNK=general nutritional knowledge; CD=people with celiac disease; no CD=people without celiac disease; HC=health consciousness; Att.= attitude towards a) GFD= gluten-free diet and, b) PC=Processed character. (+) = positive interaction; (-) = negative interaction.

Method

Participants and recruitment

Data collection took place in October and November 2019. Study participants were recruited online using social networks (e.g. Instagram, Facebook and WhatsApp) and an E-mail Panel from Wageningen University and Research. Participants were asked to collaborate in a consumer behavior web survey (hosted by Qualtrics) about the perceptional evaluation of bread images. The survey was carried out internationally and inclusion criteria required participants to be aged 16 years or older and proficient in the English or Dutch language.

In total 516 participants completed the survey. Incomplete and inaccurate responses were removed from the dataset. Only west-European participants were included, since they represented a majority of the participants (93%). All so was done to improve the overall quality of the data. In total 433 participants were included in the data analysis.

Materials and procedures

In the present study a GF label was investigated compared to a similar product without such a label. The product labels were designed with an online tool and based on images of existing bread labels available on the Dutch market. Two different bread images were used to increase reliability. Overall bread information was similar for both labels. In the experimental condition, a GF symbol and ‘’gluten-free’’ written text was included. The control condition indicated ‘’regular’’ bread (e.g. containing gluten) and did not have any additional labelling (Figure 2.).

Figure 2. This figure shows bread images used in the GF and control condition.

At the beginning of the survey, each participant was presented with two images showing one of each label and one of each bread, in randomized order among all participants. For every image presented, participants expressed their willingness to buy, perceived healthiness, caloric content, tastiness and processed character. Subsequently, continued by questions to assess people's health consciousness, general nutritional knowledge and attitude towards GF and processed food items. Gluten related dietary habits and basic socio-demographic questions were placed at the end of the survey. The survey was written in English and Dutch.

Measures

Perceptual evaluation

WTB and perceived healthiness, caloric content, tastiness, and processed character was measured using a Visual Analogue Scale (VAS): *"How likely would you be to purchase this*

food item?'' and *"in my opinion, this food item is likely to be healthy/high in calories/tasty/highly processed''* (the anchors at both ends define the extreme limits of intensity to be measured orientated from left (very unlikely) to right (very likely)).

Health consciousness

Health consciousness was measured using four items from 'health consciousness' 5-point Likert scale (Hong, 2009). Hong (2009) conceptualized that one's level of health consciousness is comprised of three elements: self-health awareness, personal responsibility, and health motivation: 1*) "I am very self-aware about my health"*, 2) "*I am concerned about my health all the time"*, 3) "*I take responsibility for the state of my health"* 4), and "*I only worry about my health when I get sick"* (recoded) (1 = strongly disagree, 5= strongly agree). The Cronbach's alpha of all four items was .61. To increase the reliability of the factor 'health consciousness', only the first question: *"I am very self-aware about my health",* was included in data analyses (Cronbach's alpha > .7).

General nutritional knowledge

General nutritional knowledge was measured using the Consumer oriented Nutritional Knowledge Scale (CoNKS) by Dickson-Spillmann, Siegrist and Keller (2011); a shortened validated version of the General Nutrition Knowledge Questionnaire (GNKQ) by Parmenter and Wardle (2000). The CoNKS measured nutritional knowledge with 20 questions in a true-false format. An example for an item used in this scale is: "*Fat contains fewer calories than the same amount of fiber*." A sum score was calculated based on correct answers (range 0–20, *M*=10.25, *SD*=5.00). In contrast to the CoNKS, the present study presented a true-false-not sure format to avoid guessing behaviour and increase precision of the test (Baker et al., 2000). For scale construction and evaluation in terms of reliability and validity, correct responses were scored as one, while incorrect responses or not sure-answers were scored as zero.

Attitude

Attitude towards GF and processed character was measured using four semantic differential scales of which two reflect affective attitude and two to reflect cognitive attitude (Mcleod, 2018). Affective attitude was measured with the statement: *"Buying gluten-free food products/processed food products would make me feel (...)(1=not contented to 7=contented, and 1=not pleased to 7=pleased)"*. Cognitive attitude was measured with the statement: *"I think that going strictly gluten-free/eating only processed foods is (...)(1=harmful to 7=beneficial, and 1=foolish to 7=wise)"*.

Data analyses

Analysis of Variance (ANOVA) was used to evaluate the influence of the GF label on perceived healthiness, caloric content, tastiness and level of processing. The factors of the experimental design and all their interactions were considered as fixed sources of variation in the model. Consumer was considered as random effect. Linear regression was conducted to find out which factors significantly predict willingness to buy. For every model, the following variables were tested for their predictive power: perception of healthiness, caloric content, tastiness and processed character.

A cluster analysis was carried out in order to identify groups of consumers who gave different relative importance to the factors of the ANOVA and regression. A cluster analysis was performed on the following individual characteristics: general nutritional knowledge, health consciousness and attitude towards gluten-free and processed character. The ANOVA and regression model described in the previous sections were used separately for each cluster. We used an alpha level of .05 for all statistical tests. All statistical analyses were performed using RStudio Version 1.2.5019.

Results

Summary statistics of sample characteristics are presented in Table 2. Females represented a majority of the sample (80%). Nearly one fourth of the participants followed a strict GFD (23%). The average age of participants was 40.22 years (*SD* = 16.59).

Table 2.
Socio-demographic factors of sample population

Variable		***N*=433**	**Frequency**
Gender	Female	348	80.4
	Male	84	19.4
	other	1	0.2
Age	< 20	22	5.1
	20 - 29	156	36.0
	30 - 39	53	12.2
	40 - 49	72	16.6
	50 - 59	69	15.9
	60 - 69	82	9.5
	> 70	20	4.6
Residence	The Netherlands	408	94.2
	Belgium	16	3.7
	United Kingdom	5	1.2
	Germany	4	0.9
Education	Primary School	1	0.2
	High School	75	17.3
	Vocational	69	15.9
	Undergraduate	187	43.2
	Postgraduate	101	23.3
			0.0
Celiac	No	332	76.7
	Yes	101	23.3
Diagnosis	Medical diagnosed gluten intolerance	89	88.1
	Self-diagnosed gluten intolerance	9	8.9
	Other	2	2.0

Influence of a gluten-free label on willingness to buy and, moderators

An ANOVA showed a positive significant effect of a GF label on WTB, $F(1,864) = 5.89$, $p = .015$. A positive significant interaction effect was observed for CD-participants, $F(3,862) = 152.96$, $p < .001$, indicating that both CD- and nCD-participants were willing to buy a GF label. However, CD-participants showed a higher WTB compared to nCD-participants. Participants with a positive attitude towards the GFD were increasingly willing to buy $F(3,478) = 32.09$, $p < .001$, compared to participants with a negative attitude.

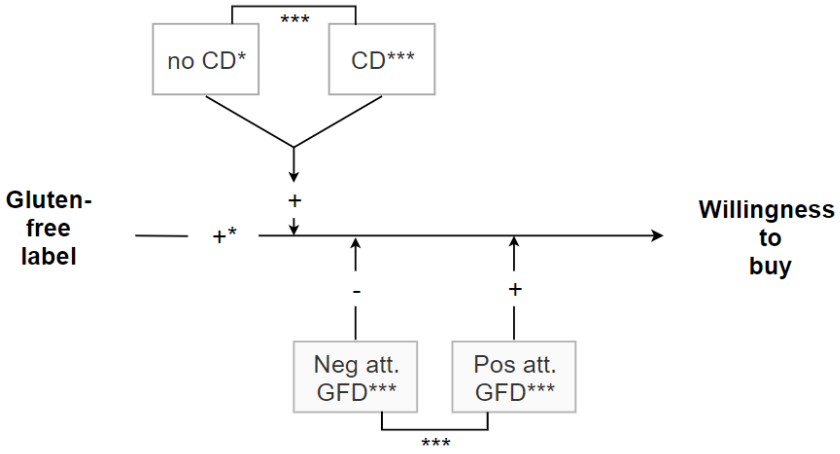

Figure 3. Significant relationships between factors. This figure shows the effect of a gluten-free label on willingness to buy moderated by celiac disease and attitude
*Note. CD=people with celiac disease; no CD=people without celiac disease; Neg att.=negative attitude towards the GFD; Pos att.=positive attitude towards the GFD. (+) = positive interaction; (-) = negative interaction *p<0.05; **<0.01;***<0,001.*

Factors influencing perceived healthiness, tastiness, caloric content and processed character

A one-way ANOVA was conducted to examine the effect of a GF label on perceived healthiness, tastiness, caloric content and processed character (compared to control). A positive statistical significance was indicated for the effect on healthiness evaluation, $F(1,864) = 15.849$, $p < .001$, and negative significance for tastiness evaluation was indicated, $F(1,864) = 22.32$, $p < .001$ (Figure 4.). Results indicated no significant interactions between CD- and nCD-

participants nor different levels of general nutritional knowledge (GNK) in terms of healthiness perception. Neither did differences between CD- and nCD-participants nor, participants with a positive or negative attitude towards the GFD. interact with tastiness perception. Increased healthiness- and decreased tastiness perception was the same among all groups of participants.

No significant differences were found for the effect of a GF label on caloric content and processed character. However, the interaction effect of CD-participants on caloric content evaluation was positive significant (p = .002) , indicating that the celiac effect was greater in GF label evaluation compared to control; CD-participants evaluated bread labelled GF higher in calories compared to nCD-participants, nonetheless a GF label did not differ significant with the control. No other effect were observed.

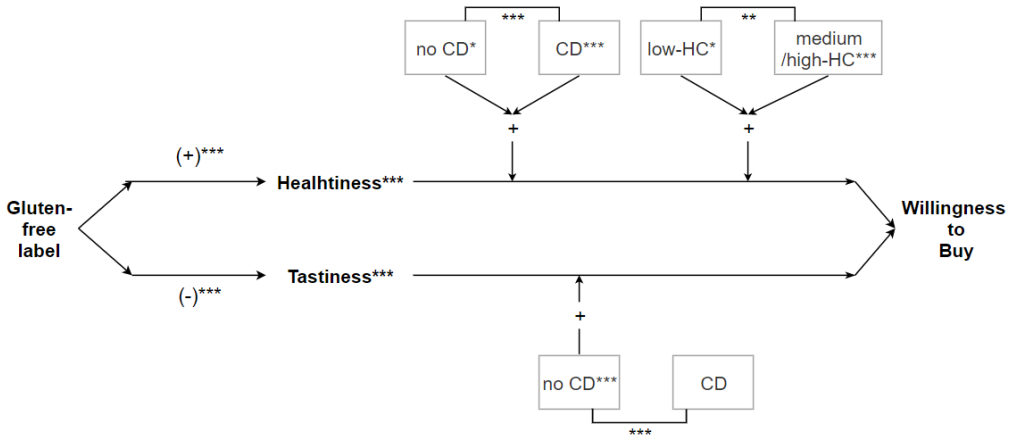

Figure 4. Significant relationship between factors. This figure shows the effect of a gluten-free label on willingness to buy and significant mediators and moderators.
Note.CD=people with celiac disease; no CD=people without celiac disease; HC=health consciousness (low-medium-high); (+) = positive interaction; (-) = negative interaction
p<0.05; **<0.01;*<0,001.*

Factors influencing willingness to buy

A simple linear regression was conducted to predict WTB based on perceptual evaluations of healthiness, tastiness, caloric content, and processed character. All variables explained a significant proportion of variance in WTB scores. However, results showed

(previous section) that caloric content and processed character did not differentiate between type of label (GF and control), and will therefore be excluded from further analyses.

Results indicated that healthiness significantly predicted WTB, $b = .05$, $t(863) = 12.99$, $p = .001$. Healthiness also explained a significant proportion of variance in WTB, $R^2 = .17$, $F(2,863) = 87.85$, $p < .001$ and WTB, regardless of type of label. Indicating that healthiness strongly influences participants WTB. Healthiness is a predictor for WTB for both CD- and nCD-participants, however CD-participants showed a negative interaction effect, $F(4,861) = 50.25$, $p < .001$, indicating that CD-people were less likely to buy products they perceived as healthier compared to nCD-people. The same was observed for levels of health conscious (HC). Increased healthiness perception for Low-HC ($p = .012$), medium-HC ($p < .001$) ,and high-HC ($p < .001$) –participants increased WTB. The interaction effect showed that Low-HC participants were significantly less likely to buy products perceived as healthier compared to medium- and high-HC participants $F(6,859) = 31.59$, $p < .018$.

Our data showed that tastiness significantly predicted WTB, $b = .06$, $t(863) = 16.27$, $p < .001$. Tastiness also explained a significant proportion of variance in WTB, $R^2 = .24$, $F(2,863) = 136.3$, $p < .001$. The interaction effect for CD-participants is negative significant, $F(4,861) = 106.2$, $p < .001$, tastiness perception by CD-participants ($p = .49$) is not a predictor of WTB in contrast to nCD-participants for whom it is a strong positive predictor of WTB ($p < .001$). These findings may be partly explained by the fact that type of label showed significance in the model ($p < .001$). Indicating that type of label has an influence on WTB that is not accounted for in the model. Part of the effect on WTB is through tastiness, and part is driven by type of label itself.

Discussion

In the present study, the specific objectives were (a) to examine the effect of a gluten-free (GF) label on willingness to buy (WTB), perceived healthiness, -tastiness, -caloric content

and -processed character, and, (b) to identify groups of consumers who give different relative importance to a GF label and WTB. In order to reach the objectives a questionnaire was developed using various scales supported by previous literature and carried out internationally. However, only western-European countries were included. To address the research objectives, a total of 16 hypotheses were formulated (see Appendix 1. for an overview of all hypothesis and outcomes) and analyzed using RStudio.

To our knowledge, the combined effect of a GF label on consumer perception and purchase intention is not well established. A majority of existing research focused on healthiness perception of a GF label (Christoph et al., 2018; Hartmann et al., 2018; Prada et al., 2019; Rathi and Zanwar, 2016; Virta et al., 2017). Fewer studies have elaborated the perceptional evaluation of GF labelling (e.g. caloric content) or focused on factors influencing WTB of GF products (Prada et al., 2019; Shin & Mattila, 2018). The present study distinguished itself by combining consumer perception and purchase intention.

GF labels are supposed to guide consumers' choice process during food shopping by reducing information-processing demands, initially intended for those who have to avoid gluten due to allergy (Hartmann et al., 2018; Piqueras-Fiszman and Spence, 2015). However, GF labelling might lead to unrealistic expectations and unintended consumer behaviour.

In the present study, an overall positive effect of a GF label on WTB was found for both CD- and nCD-participants. This finding is in line with past research indicating that an increasing demand for GF food in the market place is not solely accountable by CD-people (Dunn, 2014; Hyun-seok et al., 2016). In previous research it has been indicated consumers are at risk to misconstrue GF status as an indicator of healthiness (Christoph et al., 2018; Hartmann et al., 2018; Priven et al., 2015). This is in agreement with our findings. Namely bread labelled GF was perceived more healthful compared to the control condition. In the current model,

healthiness perception has been extended with other perceptional evaluations; caloric content, tastiness and processed character.

Previous work suggested that healthiness perception inferred other positive attributes regarding a GF label. This has also been referred to as the health-halo effect (Chandon & Wansink, 2007; Faulkner et al., 2014). For example, Prada et al., (2019) showed that GF bread was not only perceived as more healthful but also less caloric and less processed. However, none of those results were observed in the current study, participants did not associate higher perceptions of healthiness with lesser calories nor less processed character in term of bread labelled GF. Tastiness perception deceased in the presence of a GF label, this finding is once more in line with our hypothesis, since GF bakery products are known for their reduced sensory quality (Hüttner and Arendt, 2010a; Wu et al., 2015). Differences between groups of consumers in perceptional evaluations were not found. CD-diagnosis, nutritional knowledge nor attitude towards the GFD showed noticeable differences. Indicating there might be an undefined group of consumers who perceive GF food differently. Further research should extend the literature to better understand what individual characteristics define groups of consumers in a GF label evaluation.

Burton, Cook, Howlett, and Newman (2015) explain that healthiness evaluation of some consumers might be based on the simple heuristic that the category membership of the products (i.e., food label/claim) indicates the healthier option. In turn, consumers' nutritional knowledge has been examined a moderator of the effect of misperceptions of general health claims, such as healthiness evaluation (Burton et al., 2014; Lawson, 2002; Nocella & Kennedy, 2012). Contrary to previous work and, our hypothesis, results of the present study did not show differences in perceptional evaluations for people with different levels of nutritional knowledge. Indicating that ones' general nutritional knowledge might be inaccurate to measure ones' knowledge of the GFD. Combined with the outcome that no moderator was clearly distinctive

in GF label evaluation, our findings may express that consumers understanding of GF labels is a difficult construct.

Correct evaluation of labels may be influenced by several other factors, such as socio-demographic characteristics and familiarity (Nocella & Kennedy, 2012). For example, age is expected to influence consumers ability to read nutrition labels correctly (Higgins, Wolf, & Wolf, 2016; Küster, Vila, & Sarabia, 2019). Research has shown that younger customers are more engaged with products and information technologies than older consumers (Higgins et al., 2016). In addition, newer generations (e.g. millennials) are more interested in health and nutrition compared to older generations (Küster et al., 2019). In the present study, socio-demographic factors are not included in the analysis, however in further research inclusion is recommended. A last explanation may be the shortcoming of the CoCNK-questionnaire to determine ones' accurate nutritional knowledge. Further research is recommended to use the General Nutrition Knowledge Questionnaire (GNKQ) by Parmenter and Wardle (2000) or to assess participants' knowledge about GF products only (for an example see, Prada et al., 2019).

It is often suggestested that misinterpretations about healthiness perception, in turn, might result in unfavourable consumption of GF products (Hartmann et al., 2018). The present study confirms those suggestestions; healthiness perception was a predictor for WTB for the overall sample. However, the effect was less dominant for CD-participants and low-HC participants. According to Hartmann and colleagues (2018), health concious people who are interested in and frequently look for food labels and health claims across product categories, but who are not necessarily well-informed about the meaning of the labels are more likely to buy labelled foods, such as GF. Taking this into consideration, more highly health concious people might be considered a risk group for unfavourable consumption of GF products. One may assume that health consciousness people invest time in nutrition and have increased nutritional knowledge and awareness of food. Nevertheless, there might be a disrepancy

between people who think they make healthy dietary decisisons and people who actually make healthy dietary decisions.

Limitations. A limitation of the present study is that it focussed on the effect of GF labelling on bread products only, while GF labels are found on all types of food. Ares et al. (2008a) and Verbeke (2005) showed that perceived healthiness of food products presented with health claims differentiate for type of food. Sensory quality of bread is very dependent on gluten and therefore considerably different in sensory experience compared to other GF manufactured food products (Wu et al., 2015). It has also been noticed that a large number of discretionary products that do not naturally contain gluten (e.g. processed meats and corn and potato chips) now carry a GF label (Nestle & Ludwing, 2010). Nestle and Ludwig (2010) suggest that food manufacturers employ GF labelling as a tool to promote sales of discretionary food items. Thus, further research should extend current literature with the effect of GF labelling information on a variety of manufactured- and naturally GF products available in the marketplace.

Tastiness is a strong predictor of WTB, however GF bread is perceived as less tasty. First of all, this might be explained by peoples own experience with the GFD confirming that GF bread is poor in sensory quality compared to gluten-bread. Second, the GFD is prone to social dietary stigma and is negatively depict in society (Jones, 2017; Olsson, Lyon, Hörnell, Ivarsson, & Sydner, 2009). Last, GF labelled bread is considered healthier; many people, consciously or unconsciously, expect a decrease in taste when the health benefits of the product are improved (Raghunathan, Naylor, & Hoyer, 2006, Werle, Trendel, & Ardito, 2013,).

There is one more factor that should be included in future studies, namely, the price. The assumption that the price of the products are equal, resulted from the desire to facilitate participants' decisions and make it easier to determine the importance of nutrition claims in the choice of the product (Halimic, Gage, Raats and Williams, 2018). However, consumer behaviour may also be strongly influenced by the price and its perception. Stevens (2008)

concluded that GF products were 242% more expensive than standard products and it is suggested that this difference may have a strong influence in decision making. Considering price may indicate consumers' importance of the GF health claim when it comes to actual purchase.

Directions for further research. Finally, the present study highlights the importance of developing regulations that avoid unintended consequences as a result of GF labelling. Further research on consumer understanding and its underlying mechanisms is needed for policy makers and marketers to communicate the GF label in a better way to ensure that messages are trustworthy and not misleading. In addition, policy makers and marketers should develop information remedies for groups of consumers who have lower understanding of GF labelling information and/or are more likely to buy GF labelled food products, to help consumers make better-informed choices about products, and ultimately facilitate healthier food choices.

Conclusion

This study showed that consumers may prefer a product labelled GF compared to its gluten-containing counterpart. GF labelling can generate perceptions of higher healthiness and lower tastiness evaluation. Both factors are predictors for WTB. Among consumers, knowledge about the GFD is low and cannot be related to one's general nutritional knowledge. Highly health conscious consumers are more willing to buy GF labelled products, and are therefore considered a risk group when it comes to unintended consumption behavior. In specific, more research is needed to understand consumers' assumptions about healthiness when a food is labelled GF and what individual characteristics increase WTB. In practice, policies and marketers should aim to develop interventions, such as information remedies, to raise consumers' awareness about the GFD and increases well-informed consumption behavior.

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Appendices

Appendix 1: Formulation of hypotheses and outcomes (yes/no)

	Hypotheses 1abcd	Outcome: Yes/No
h1a	Gluten-free labelling will increase perceptions of healthiness	Yes
h1b	This anticipated evaluation of healthiness will be attenuated among people with a high nutritional knowledge	No
h1c	Healthiness perception of a GF label will show a negative mediating effect on willingness to buy	No
h1d	Such a tendency will be offset by people with celiac disease and attenuated among high health conscious people	Yes
	Hypotheses 2abcd	
h2a	Gluten-free labelling will decrease perceptions of caloric content	No
h2b	This anticipated evaluation of caloric content will be attenuated among people with a high nutritional knowledge	No
h2c	Increased caloric content perception of a GF label will show a negative mediating effect on willingness to buy	-
h2d	Such a tendency will be attenuated among people with celiac disease and a high health consciousness	-
	Hypotheses 3abcd	
h3a	Gluten-free labelling will decrease perceptions of tastiness	Yes
h3b	This anticipated evaluation of tastiness will be reversed among people with celiac disease and positive attitudes towards a gluten-free diet	No
h3c	Tastiness perception of a GF label will have a positive mediation effect on willingness	No
h3d	This effect will enhance among people with celiac disease	No
	Hypotheses 4abcd	
h4a	Gluten-free labelling will decrease perceptions of processed character	No
h4b	This anticipated evaluation of processed character will be weakened by people with celiac disease and a high nutritional knowledge	No
h4c	Processed characters of a GF label will have a positive mediating effect on willingness to buy	-
h4d	This effect will be attenuated among people with celiac disease, a high health consciousness and positive attitudes towards processed character	-