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Relationship between objective and perceived sugar content on consumers perceptions about breakfast cereals

Marília Prada [a,*], Magda Saraiva [a], Cláudia Viegas [b], Bernardo P. Cavalheiro [a], Margarida Vaz Garrido [a]

[a] Iscte - Instituto Universitário de Lisboa, CIS_Iscte, Lisboa, Portugal
[b] H&TRC—Health & Technology Research Center, ESTeSL— Escola Superior de Tecnologia da Saúde, Instituto Politécnico de Lisboa, Portugal

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ABSTRACT

In Portugal, about one-fourth of the adult population exceeds the recommended daily amount of free sugars intake. This excessive consumption may be due to a lack of awareness of the sugar content of commonly available processed products. In two studies, we explored this assumption by asking participants (convenient samples) to evaluate the sugar content of breakfast cereals based on the front-of-packaging images and analyzed the correspondence between subjective and objective sugar content. In Study 1 ($n = 90$), all the exemplars were high in sugar, whereas in Study 2 ($n = 85$), exemplars contained low, moderate, or high sugar content.

Study 1 revealed that participants accurately perceived all exemplars as containing high sugar. Study 2 showed that participants were able to distinguish between different levels of sugar content, which impacted how they evaluated the products in other dimensions. Specifically, besides being rated as having more sugar, products with objective high (vs. moderate or low) sugar content were perceived as tastier, as having more fat and calories, but also as less healthful. Notably, participants who perceived the exemplars as containing more sugar also reported using nutritional information more often and consuming these products less frequently.

These findings suggest that awareness of products' sugar content may not be sufficient to address the problem of excessive sugar intake. Intervention should also focus on building up consumers' knowledge about sugar intake guidelines and its negative health outcomes.

1. Introduction

Excessive sugar intake has been linked with multiple negative health outcomes, namely overweight and obesity, and their associated comorbidities (WHO, 2015). To address this problem, the World Health Organization (WHO, 2015) recommends reducing free sugars (i.e., all sugars added to foods by the manufacturer or consumers, except those naturally occurring in dairy products and intact fruit and vegetables) consumption throughout the life course to less than 10% (ideally 5%) of total daily energy intake. However, excessive sugar consumption remains highly prevalent in numerous countries (e.g., varying between 7 and 17% of total energy intake in Europe). In Portugal, for example, despite the several measures implemented by the government (for a review, see Prada et al., 2020), the estimated average intake of free sugars is 35 g /day (i.e., 7.5% of the total daily energy consumption; (Lopes et al., 2017). Critically, 24.3% of the adult population, 48.7% of adolescents, and 40.7% of children exceed the 10% WHO recommendation regarding sugar intake (Lopes et al., 2017). Moreover, a recent study with a sample of Portuguese participants showed that the majority were unaware of the WHO's sugar intake guidelines and revealed difficulties in identifying some ingredients in processed foods (e.g., honey in cookies) as added/free sugars (Prada, Saraiva, et al., 2020).

To promote a healthier diet, the Portuguese government implemented an Integrated Strategy for the Promotion of Healthy Eating (Dispatch No 11418, 2017), including the active monitoring of sugar content in various food categories, such as cookies, ice cream, non-alcoholic drinks, and breakfast cereals. Specifically, and following the Regulation (EC) No. 1924/2006, this strategy prioritizes the availability of foods with low sugar (i.e., less than 5 g of sugars per 100 g for solids, or 2.5 g of sugars per 100 ml for liquids). However, a recent study analyzing the nutritional profile of a sample of 289 breakfast cereals available in the Portuguese market showed that less than 9% of products comply with these guidelines. Moreover, although the range of sugar

* Corresponding author at: Iscte- Instituto Universitário de Lisboa, Av. das Forças Armadas, Office AA110, 1649-026 Lisboa, Portugal.
E-mail address: marilia_prada@iscte-iul.pt (M. Prada).

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content was wide (from 0.5 up to 48 g of sugar per 100 g of product), on average, the sugar content was high ($M = 19.9$g), particularly in cereals marketed to children (Prada, Saraiva, Viegas, et al., 2021).

Considering that the products available in the market often contain more sugar than recommended, it is essential to understand whether consumers can effectively evaluate the nutritional profile of a product based on the information provided on the packaging. Although presenting information about energy value and macronutrients is mandatory (EC 1169/2011), not all consumers have the resources or motivation to analyze this information (WHO, 2017). Still, the credibility of the product and its manufacturer may be conveyed to consumers by other types of information presented in food packaging (for a review, see Fernqvist & Ekelund, 2014). Besides the brand and descriptive food names, fronts of packages may include labels or claims related to a myriad of aspects such as the origin of the product (e.g., "British oats") or the nutrients it contains (e.g., "with 12 vitamins"). Based on such cues, consumers often infer intangible attributes of the product (e.g., its healthfulness), influencing their purchase or consumption decisions (for a review, see Talati et al., 2017). Specifically, regarding sugar content, Haasova and Florack (2019) tested how numerical information about sugar content presented in the package of desserts influences consumers' expectations about the healthfulness and taste of the product. The results revealed that participants perceived the products with lower sugar content (i.e., a value corresponding to less than 30% of the original sugar content) to be healthier than those with higher sugar content (i.e., original content as well as>30% sugar of the original content), whereas no significant differences emerged for taste expectations. Recently, Prada, Saraiva, Sério, et al. (2021) also showed that products containing sugar-related claims (e.g., "sugar-free", "no added sugars") were rated as healthier, less caloric, and less tasty than products without such claims.

However, not all food packaging presents claims (or other cues) about sugar content. Hence, it becomes relevant to investigate whether consumers are able to estimate the amounts of sugar in a given food when nutritional information is not presented (e.g., when choosing the popcorn portion size at the movie theater). However, studies using this type of paradigm are scarce, and the results are mixed. For instance, König et al. (2019) asked participants to estimate the sugar content of a set of six savory and sweet foods (e.g., quiche or muffin, respectively) and found that most participants overestimated the number of grams of sugar contained in each portion. In contrast, Dallacker et al. (2018) found that parents largely underestimated the number of sugar cubes contained in their child(ren) food and beverages (e.g., yogurt). Saint-Eve et al. (2016) used a more ecological approach to this issue, asking participants to sweeten plain yogurt and observed that their estimates were, on average, half of what they actually added. Hence, underestimation is observed even when sugar was added by the participant. Considering the methodological differences between studies (e.g., specific food exemplars, sugar content estimation measure used), the results should be compared with caution. Still, investigating how consumers perceive sugar content is highly relevant as they may use it to infer the healthiness of a product (e.g., Haasova et al., 2019; Prada, Saraiva, Sério, et al., 2021) and sugar underestimation may be associated with overconsumption (e.g., König et al., 2019) and a higher risk for weight gain. For example, Dallacker et al. (2018) study showed that parental sugar underestimation was associated with a higher risk of their child being overweight or obese.

Given the mixed evidence regarding consumers' perceptions about sugar content, we designed two studies examining whether consumers are able to identify the amount of sugar in exemplars of a single food category – breakfast cereals. We selected this category because of its diversity in terms of flavors, packaging features, and nutritional profile (Prada, Saraiva, Viegas, et al., 2021) and because breakfast cereals are among the food groups that most contribute to the daily intake of free sugars in the Portuguese population. For example, Portuguese adults who consume breakfast cereals report eating on average about 45 g/day (e.g., Lopes et al., 2017). Previous research has also revealed that consumers of these products had a higher intake of total sugars than non-consumers (Fayet-Moore et al., 2017). Moreover, Portuguese consumers attribute the highest importance to nutritional information in breakfast cereals (along with food products for children and pre-packaged meals, Gomes et al., 2017).

Study 1 examines how participants perceive the amount of sugar in 50 breakfast cereals selected based on their objective high sugar content. In the first stage, we analyzed the extent to which the perceived sugar content corresponded to the objective one. Subsequently, we examined how sugar content ratings were related to the general perception of the food category (e.g., healthfulness, expected taste). In Study 2, we adopted a more systematic approach by presenting breakfast cereals exemplars varying on objective sugar content (low, moderate, or high) and examined whether participants were able to detect those differences. Moreover, we also examined how objective sugar content may impact how consumers perceive the exemplars (and the overall product category) in other evaluative dimensions (i.e., healthfulness, caloric content, expected taste, and fat content). In both studies, we also explored if sugar content ratings varied according to individual characteristics (e.g., frequency of consumption of breakfast cereals; frequency of use of nutritional information).

2. Study 1

2.1. Method

2.1.1. Participants

The sample included 90 Portuguese volunteers (75.6% women), with age ranging from 18 to 73 ($M = 29.98$, $SD = 9.73$). Participants were recruited through social network websites (convenience sampling) to collaborate in a web survey about consumers' perception of the amount of sugar of a set of products. The eligibility criteria were being of Portuguese nationality and over 18 years old.

2.1.2. Materials

We selected 50 images of breakfast cereals available in the Portuguese market from the set of 289 analyzed in Prada, Saraiva, Viegas, et al. (2021). These images were presented in color and depicted the front of the package of the breakfast cereals. All the exemplars contained high levels of sugar – that is, over 22.5 g of sugar (but $\leq$ 28 g) per 100 g of product.

2.1.3. Procedure and measures

This study was part of a broader project about eating behavior and was reviewed and approved by the Ethics Committee of Iscte - Instituto Universitário de Lisboa (approval #22/2019). After giving informed consent, participants indicated their age and gender and proceeded to evaluate the images of breakfast cereals. Specifically, their task was to indicate the perceived sugar content (1 = *Low sugar content* to 7 = *High sugar content*) of each of the 50 high-sugar breakfast cereals. Each exemplar was presented on a single screen in random order (see Fig. 1).

Next, we asked participants to indicate how frequently their consumption decisions are influenced by nutritional information in general (i.e., the information presented in the nutritional table) and specifically by sugar content (1 = *Never* to 7 = *Always*). Then, participants were asked to indicate their evaluation of the overall breakfast cereals category (i.e., "In my opinion, breakfast cereals are…") in five evaluative dimensions presented in random order (1 = *Not at all healthful* to *7 = Very healthful;* 1 = *Not at all tasty* to 7 = *Very tasty*; 1 = *Not at all caloric* to *7 = Very caloric;* 1 = *Not at all natural* to *7 = Very natural;* 1 = *Not at all sweet* to *7 = Very sweet,* see Prada et al., 2019, for a similar procedure), and frequency of consumption (1 = *Less than once a month* to 7 = *More than once a day*). At the end of the survey, participants were thanked and debriefed.

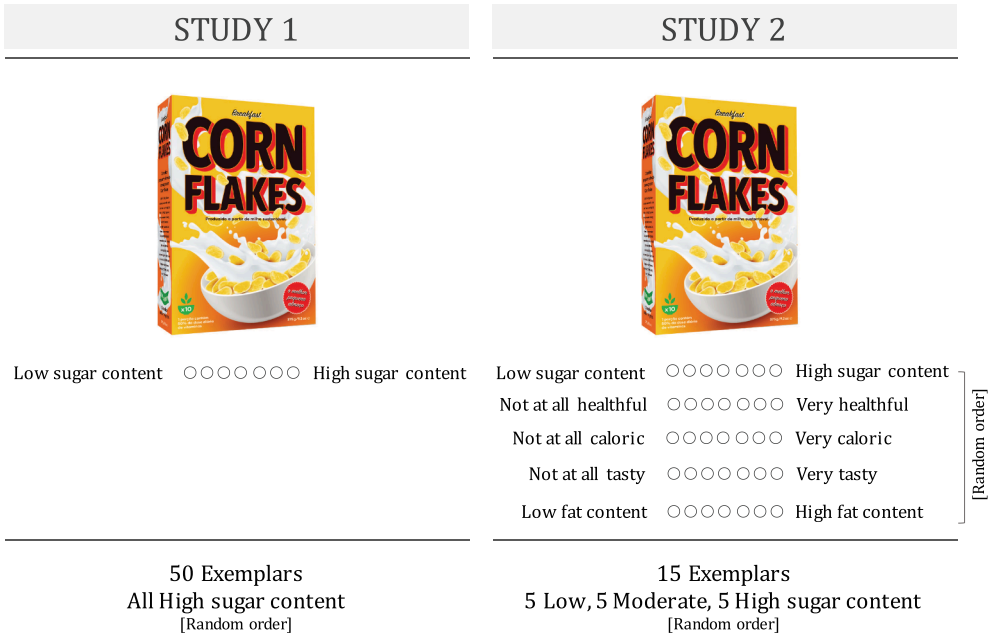

Fig. 1. *Product Evaluation trial (Study 1 and Study 2).*

2.1.4. Data analytic plan

Next, we present descriptive results for the perceived sugar content task, test for gender differences in such data, and describe associations (Pearson's correlations coefficient) between exemplars' perceived sugar content, category perception, and individual characteristics.

2.2. Results

Overall, participants evaluated the exemplars as containing a high sugar content ($M = 5.36$; $SD = 0.72$) with mean ratings of breakfast cereals varying between 3.62 and 6.62. Women rated the cereals as containing more sugar ($M = 5.47$, $SD = 0.69$) than men ($M = 5.01$, $SD = 0.73$), $t(88) = 2.68$, $p = .009$, $d = 0.70$, 95%CI [0.17, 1.15].

Table 1 presents descriptive results and correlations. Overall, participants perceived the category of breakfast cereals as high in sweetness, caloric content, and expected taste dimensions and as low in healthfulness and naturalness. They also reported consuming these products frequently. Participants' frequency of use of nutritional information (in general and about sugar) did not differ from the scale midpoint.

As shown in Table 1, participants who rated the product exemplars as containing higher sugar content also rated the overall category of breakfast cereals as sweeter and more caloric, as well as less healthful and natural, $ps < .001$. Participants who perceived the exemplars as containing higher sugar content also reported using nutritional information (in general and about sugar in particular) more often and consuming these products less frequently, $p < .050$. Ratings about exemplars' sugar content were not associated with their overall perception of the tastiness of breakfast cereals. Age was only associated with the frequency of use of information about sugar, $p = .010$.

Study 1 showed that participants were quite able to recognize the high sugar content of the presented exemplars. However, it is possible

Table 1
Descriptive Results (*M*, *SD*) and Correlations Between Exemplars' Perceived Sugar Content, Category Perception, and Individual Characteristics.

	M (*SD*)	1	2	3	4	5	6	7	8	9
1. Exemplars: Mean perceived sugar content[a]	5.36$^{\neq}$ (0.73)	–								
2. Category: Sweetness[b]	5.87$^{\neq}$ (1.28)	.50***	–							
3. Category: Healthfulness[b]	3.00$^{\neq}$ (1.60)	−.49***	−.33***	–						
4. Category: Calories[b]	5.68$^{\neq}$ (1.51)	.51***	.68***	−.42***	–					
5. Category: Taste[b]	5.25$^{\neq}$ (1.65)	.16	.23*	−.01	.25*	–				
6. Category: Naturalness[b]	2.60$^{\neq}$ (1.43)	−.39***	−.26*	.53***	−.40***	−.01	–			
7. Frequency of consumption	6.22$^{\neq}$ (1.45)	−.25*	−.17	.38***	−.25*	.07	.33***	–		
8. Use of nutritional information (general)	4.09 (1.74)	.21*	.09	−.05	.08	.24*	−.02	.12	–	
9. Use of nutritional information (sugar)	4.34 (1.89)	.21*	.25*	−.01	.20	.22*	−.09	−.08	.64***	–
10. Age	29.9 (9.73)	−.02	−.10	.06	−.11	−.26*	.01	−.11	.20	.29*

Note. [a] Mean perceived sugar content for the 50 exemplars per participant (Cronbach's alpha = .926). [b] Ratings for the overall breakfast cereals category. $^{\neq}$ Different from the scale midpoint (one-sample *t*-tests, 4), $p < .050$.
$^{***}p < .001$, $^{**}p < .010$, $^{*}p < .050$.

that this correspondence between perceived and actual sugar contents only emerged because all the presented exemplars contained a high sugar level. In other words, because of their homogeneity in high sugar content, all the exemplars might have concurred to activate the overall category. Therefore, in Study 2, we selected breakfast cereals varying on objective sugar content (low, moderate, or high) to explore whether participants are able to recognize those differences. Besides assessing perceived sugar content using a rating scale, we also asked participants to categorize each exemplar using a nutritional traffic light labeling system, which allows to directly compare perceived and objective sugar contents. Portuguese consumers are familiar with this system and report to like using it and understand the information it conveys, facilitating decision-making at points of sale (Gomes et al., 2017). Moreover, we also aimed to examine how the objective sugar content of the exemplars may impact other evaluative dimensions (healthfulness, caloric content, expected taste, and fat content).

3. Study 2

3.1. Method

3.1.1. Participants and design

The sample included 85 undergraduate students (85.9% women), with ages ranging from 18 to 35 ($M = 19.44$, $SD = 2.85$), who received partial course credit for their participation. The objective sugar content of product exemplars was manipulated within participants and included three levels (low, moderate, or high).

3.1.2. Materials

As in Study 1, we selected images of breakfast cereals exemplars from Prada et al. (2021). The 15 exemplars varied regarding sugar content (one-third each): low sugar (<5g per 100 g), moderate sugar (5 to 22.5 g per 100 g), high sugar (>22.5 g per 100 g).

3.1.3. Procedure and measures

This study was part of a broader project about eating behavior and was reviewed and approved by the Ethics Committee of Iscte - Instituto Universitário de Lisboa (approval #22/2019). Participants were invited to respond to a survey about the eating preferences of Portuguese consumers. After providing written informed consent, participants were asked to rate each of 15 products regarding the perceived sugar content (1 = *Low sugar content* to 7 = *High sugar content*), healthfulness (1 = *Not at all healthful* to 7 = *Very healthful*), caloric content (1 = *Not at all caloric* to 7 = *Very caloric*), expected taste (1 = *Not at all tasty* to 7 = *Very tasty*), and perceived fat content (1 = *Low fat content* to 7 = *High fat content*). Both the images and the six rating scales were presented in random order (see Fig. 1). Next, as an additional measure of perceived sugar content, participants were asked to use the nutritional traffic light system to categorize each product. The 15 products were presented on a single screen (randomized order), and three response options were provided (i.e., green, yellow, or red). Subsequently, as in Study 1, participants were asked about their frequency of breakfast cereals consumption and use of nutritional information. The general perceptions regarding breakfast cereals were assessed using the same rating scales used for evaluating the exemplars. Finally, participants were thanked and debriefed.

3.1.4. Data analytic plan

Next, we present descriptive results regarding the exemplars' evaluation task; test for gender differences in such data across evaluative dimensions; examine differences in the rating of exemplars according to objective sugar content by computing a repeated measures ANOVA (sugar content: low; moderate; high) for each evaluative dimension; examine accuracy traffic-light labeling system task, and describe associations (Pearson's correlations coefficient) between exemplars' perceived sugar content, category perception, and individual characteristics.

3.2. Results

3.2.1. Impact of sugar content on exemplars evaluation and nutritional traffic light categorization

Overall, participants evaluated the breakfast cereals exemplars as containing a high sugar content ($M = 4.36$; $SD = 0.85$). We did not observe gender differences for overall sugar content ratings ($M_{Women} = 4.40$, $SD = 0.08$; $M_{Men} = 4.10$, $SD = 0.65$), $t(83) = 1.14$, $p = .258$. Overall, participants rated the exemplars as above average in all evaluative dimensions, except for perceived fat content that was not significantly different from the scale midpoint, $p = .053$ (see Table 2).

As shown in Table 2, participants were able to differentiate the objective sugar content levels as the subjective sugar content ratings corresponded to the objective ones (Bonferroni pairwise comparisons, $ps \leq .001$). Moreover, sugar content level influenced ratings for the remaining evaluative dimensions. Specifically, the sub-sample of breakfast cereals with objective high sugar content obtained the highest ratings regarding perceived calories, fat content, and expected taste, followed by those with moderate sugar content and then those with low sugar content (Bonferroni pairwise comparisons, $ps \leq .012$). In other words, breakfast cereals high in objective sugar content were indeed perceived as containing the highest sugar content, as well as the most caloric, fat, and tasty. In contrast, we observed the reverse pattern for the healthfulness dimension, such that participants rated the cereals with low sugar content as the most healthful, followed by the ones with moderate sugar content and then those with high sugar content, $ps \leq .002$.

Moreover, we calculated hits in the categorization of breakfast cereals exemplars according to sugar content in the traffic-light labeling system (see Fig. 2).

Overall, accuracy rates were high. Products with moderate sugar content obtained a 56.2% hit rate (i.e., yellow responses), followed by-products with low sugar with 59.1% (i.e., green responses) and products with high sugar content with 61.6% (i.e., red responses).

Taken together, the results from the two measures assessing perceived sugar content (i.e., exemplars' ratings and categorizing according to the nutritional traffic light) suggest that participants were able to differentiate the breakfast cereals according to their level of sugar content.

3.2.2. Correlations

Table 3 presents descriptive results and correlations. Overall, participants perceived the category of breakfast cereals as high in sugar, fat, and caloric content and expected taste and as low in healthfulness. The frequency of consumption and the use of nutritional information (in general and about sugar in particular) did not differ from the scale midpoint. Participants who rated the product exemplars as higher in sugar content also rated the overall category of breakfast cereals as having more sugar, fat, and calories, as well as less healthful, $ps \leq .014$. Participants who perceived the product exemplars as containing higher sugar content also reported using nutritional information (in general and about sugar) more often and consuming these products less often also, $p \leq .019$.

4. General discussion

Inadequate eating habits, including excessive sugar consumption, are a major health concern since they contribute to the increased risk of non-communicable diseases such as obesity (WHO, 2015). Despite the several measures that have been adopted to reduce sugar intake in Portugal, sugar consumption is still high, especially among the younger population (e.g., one in two Portuguese teenagers exceeds the maximum daily intake of sugar recommended by the WHO, Lopes et al., 2017). Critically, previous studies revealed that consumers are not aware of the

Table 2
Impact of Sugar Content Level (Low, Moderate, High) on Exemplars' Perception Across Evaluative Dimensions.

	Overall		Low		Moderate		High		Within-Subjects Effects[a]
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	
Sugar	4.36*	0.85	3.23	1.01	4.30	1.13	5.55	0.73	$F(2,168) = 351.68$, $p < .001$, $\eta_p^2 = 0.870$
Healthfulness	4.27*	0.73	5.13	0.82	4.45	0.95	3.23	0.75	$F(2,168) = 276.20$, $p < .001$, $\eta_p^2 = 0.767$
Calories	4.32*	0.85	3.44	0.97	4.14	1.09	5.38	0.78	$F(2,168) = 297.85$, $p < .001$, $\eta_p^2 = 0.780$
Taste	4.75*	0.91	4.30	1.17	4.81	1.03	5.14	1.16	$F(1.88,158.08) = 23.76$, $p < .001$, $\eta_p^2 = 0.220$
Fat	3.80	0.93	3.04	0.99	3.63	1.17	4.73	1.03	$F(1.89,156.09) = 153.97$, $p < .001$, $\eta_p^2 = 0.647$

Note. * Different from the scale midpoint (i.e., 4). [a]Repeated measures ANOVA with Huynh-Feldt correction whenever sphericity assumptions were not verified.

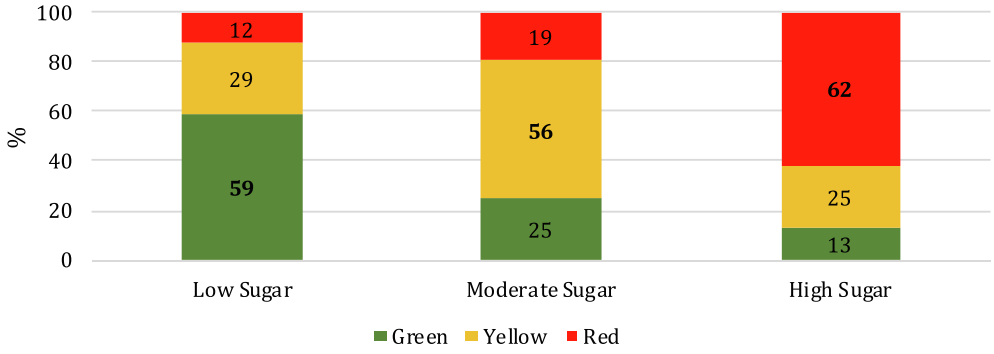

Fig. 2. *Low, Moderate, and High Sugar Content Exemplars Traffic-Light Labeling. Note.* Values in bold represent hits (i.e., low sugar/green < 5gr; moderate sugar/yellow > 5 and < 22.5; high sugar/red > 22.5gr per 100 g of product). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 3
Descriptive Results (*M*, *SD*) and Correlations Between Exemplars' Perceived Sugar Content, Category Perception, and Individual Characteristics.

	M (*SD*)	1	2	3	4	5	6	8	9	10
1. Exemplars: Mean perceived sugar content[a]	4.36≠ (0.85)	–								
2. Category: Sugar[b]	5.41≠ (1.09)	.54***	–							
3. Category: Healthfulness[b]	3.59≠ (1.37)	−.27*	−.53***	–						
4. Category: Caloric[b]	5.19≠ (1.17)	.48***	.60***	−.48***	–					
5. Category: Taste[b]	5.89≠ (1.40)	−.07	.26*	.01	.12	–				
6. Category: Fat[b]	4.47≠ (1.30)	.56***	0.42***	−.43***	.37***	−.01	–			
7. Frequency of consumption	4.27 (2.14)	−.25*	−.20	.16	−.22*	.36***	−.25*	–		
8. Use of nutritional information (general)	4.32 (2.03)	.38***	.17	−.06	.10	−.12	.27*	−.16	–	
9. Use of nutritional information (sugar)	4.14 (1.74)	.34**	.21	−.02	.10	−.08	.26*	−.07	.83***	–
10. Age	19.44 (2.85)	.09	.14	−.11	.11	.04	.04	−.02	−.17	-.19

Note. [a] Mean perceived sugar content for the 15 exemplars per participant (Cronbach's alpha = .894). [b] Ratings for the overall breakfast cereals category. ≠ Different from the scale midpoint (one-sample *t*-tests, 4), $p < .050$.
*** $p < .001$, ** $p < .010$, * $p < .050$.

WHO guidelines regarding sugar intake (e.g., Prada, Saraiva, et al., 2020; Tierney et al., 2017) and that their estimates about sugar content are not very accurate, which may contribute to overconsumption and weight gain (e.g., Dallacker et al., 2018; König et al., 2019). However, these studies are still scarce, their methods are not comparable, and their results are mixed, with evidence of both under and overestimation of perceived sugar content.

The current studies focused on how consumers perceive the sugar content of exemplars of a single product category (i.e., breakfast cereals) while controlling for objective sugar content. Overall, the results suggest that participants were quite able to recognize the sugar content of the products, not only when the exemplars were all high in sugar (Study 1) but also when the sugar content level varied (Study 2). Notably, we asked participants to rate the perceived sugar content of each product using a rating scale and not to estimate how many grams (or sugar cubes) they contained. As argued by König et al. (2019), the quantification of macronutrients may constitute a very challenging task for consumers. This methodological difference could explain why we observed a higher correspondence between perceived and objective sugar content than previous studies. In Study 2, participants were also fairly accurate (around 60% of hits) in categorizing the products using the nutritional traffic light system. These results converge in suggesting that a large proportion of consumers can recognize the sugar content of this type of product based on the exposure to front-of-packaging without

having access to other sources of information (e.g., nutritional fact panel). Because exemplars in both studies were selected based on objective sugar content, the set of breakfast cereals was heterogeneous regarding their packaging features (e.g., branding, colors, claims, ingredients depicted, etc.). These elements may act as cues to infer sugar content and other product proprieties (e.g., a product "with stevia" is perceived as healthier and less caloric than regular products, Prada, Saraiva, Sério, et al., 2021). The contribution of these features for sugar content perception could be further explored in future studies.

Additionally, exemplars with high (vs. low and moderate) objective sugar content were also perceived as having more fat and calories and as being tastier. It is noteworthy that consumers related sugar and fat content, given that previous research has suggested that these nutrients are not associated (e.g., a sample of breakfast cereals, Prada, Saraiva, Viegas, et al., 2021) or its relationship is negative (e.g., low or non-fat products often contain more sugar than their regular versions, Nguyen et al., 2016). At the same time, products with high levels of sugar were also deemed the least healthy. This seems to reflect a health-pleasure trade-off effect (e.g., Raghunathan et al., 2006), suggesting that consumers tend to believe that unhealthy food is tastier.

Regarding perceptions about the overall product category, results from both studies converged in showing that, in general, participants rated breakfast cereals high in sugar, fat, caloric content, and expected taste but low on healthiness and naturalness. Moreover, we also observed that participants who reported higher sugar content ratings also were the ones using general and sugar-related nutritional information more often and those who consume breakfast cereals less frequently. Yet, this frequency of consumption measure was self-reported, and future studies could use additional measures to characterize breakfast cereals consumption (e.g., portion size, type of cereals, etc.). Future studies could also seek to examine whether accuracy in estimated sugar content impacts food decision-making and intake (e.g., sugar underestimation may be related to overconsumption both in terms of consumption frequency or larger portion sizes).

Finally, overall, we did not observe any impact of age and gender on perceived sugar content (except for women perceiving the products as having higher sugar content in Study 1). However, because both our studies use convenience samples that were imbalanced regarding gender, these results should be interpreted with caution. Nevertheless, some studies point that women tend to pay more attention to nutritional information and be more concerned about health (WHO, 2017), which may explain why women seem to perceive the high sugar content more accurately. Furthermore, some consumers are more concerned with nutritional issues than others. For instance, Gomes et al. (2017) describe "concerned consumers" as those who actively search for nutritional information, are usually able to understand it and use it to evaluate products and inform purchase decisions. In contrast, the "non-concerned consumers" are not interested in nutrition and do not seek or use nutritional information. Because they reported disliking nutrition labels, products' evaluation and decision-making are based on personal preferences. Future studies should test whether perceived sugar content and its impact on food choice may depend on the characteristics of the consumers.

Overall, when instructed to do so, consumers seem to have the ability to recognize the sugar content of the product exemplars, even when they consider that they belong to a category that is typically high in sugar. However, this does not guarantee that participants understand how much sugar they are ingesting per portion of a given product (e.g., on average Portuguese consumers of breakfast cereals eat 1.5 portions daily, Lopes et al., 2017) nor how that portion contributes to the total daily sugar intake. Indeed, previous studies suggest that knowledge about sugar sources and sugar intake guidelines is low (Prada, Rodrigues, et al., 2020; Prada, Saraiva, et al., 2020). Notably, as our results suggest, knowledge may not be the only factor to consider when addressing the problem of excessive sugar intake (for a review, see Gupta et al., 2018). Future studies should also explore the motivations for consuming these products (e.g., hedonic or convenience aspects) and consider these motivations when designing interventions to empower consumers to make healthier food choices (e.g., providing alternatives that are equally tasty and accessible).

CRediT authorship contribution statement

Marília Prada: Conceptualization, Formal analysis, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing. **Magda Saraiva:** Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Cláudia Viegas:** Formal analysis, Writing – original draft, Writing – review & editing. **Bernardo P. Cavalheiro:** Data curation, Writing – original draft, Writing – review & editing. **Margarida Vaz Garrido:** Conceptualization, Funding acquisition, Writing – original draft, Writing – review & editing.

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