A bittersweet taste

The effects of visual and tactile stimuli on the sweetness, bitterness and hedonic taste perception as well as the perceived healthfulness and overall product liking of soft drinks

Master Thesis

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Abstract

Purpose – The consumption of soft drinks is considered a global public health concern. However, when faced with the choice between healthy or unhealthy drinks, consumers often perceive healthier options (e.g. reduced sugar) as less tasty compared to their regular counterparts and thus may experience a trade-off between health and pleasure. However, previous research has shown that it is possible to influence the consumer's taste perception and product evaluation by manipulating the packaging design. Hence, the focus of the present study is on reducing the sugar intake from soft drink consumption by influencing the taste perception and product evaluations through manipulating the colour saturation and texture of drinking cups, focussing on the sweetness, bitterness, and hedonic taste perception, as well as the perceived healthfulness and overall product liking.

Method – A 2 x 2 x 2 between-subjects experimental design was conducted, in which packaging colour saturation (low vs. high), 3D printed textures (microstructural shape textures; circular vs. angular) and the amount of sugar in green iced teas (low-sugar vs. high-sugar) were manipulated. Effects on sweetness perception, bitterness perception, hedonic taste perception, perceived healthfulness, overall product liking, and purchase intentions were measured by means of ANCOVA with the general health interest as a covariate. Participants (N = 175) were approached at a Dutch grocery store to participate in a taste test for a new green iced tea. The participants were handed one of the manipulated cups containing either the low- or high-sugar green iced tea. After tasting the green iced tea, the participants completed the questionnaire, which consisted of the dependent measures.

Findings – Results showed an interaction effect between colour saturation and texture for perceived healthfulness. It appears that the combination of low colour saturation and the circular (compared to low colour saturation and the angular) texture increase the perceived healthfulness of both green iced teas. However, no main effects of colour saturation and texture on perceived healthfulness were found. Furthermore, no significant main or interaction effects were found for colour saturation and texture on the sweetness, bitterness, and hedonic taste perceptions as well as on the overall product liking and purchase intentions.

Conclusion – This study shows that colour saturation and 3D printed microstructural shape textures can influence the consumer's perceived product healthfulness. However, at the same time, little evidence is found that these packaging features may boost the sweetness (or bitterness) and hedonic evaluations of more hedonic products such as soft drinks.

Keywords – *Cross-modal correspondents, colour saturation, 3D printed microstructural shape textures, sweetness, perceived healthfulness*

1. Introduction

The consumption of soft drinks (i.e. all beverages containing added sugar) is considered a global public health concern (Vartanian, Schwartz, & Brownell, 2007). Several studies indicate that the consumption of soft drinks with high sugar content can have negative health effects, such as obesity (e.g. Malik, Pan, Willett, & Hu, 2013; Vartanian et al., 2007). Hence, several initiatives aim to move soft drink manufacturers to reformulate their products by reducing the sugar content, including, among others, the introduction of a sugar tax (Briggs et al., 2017) or the European voluntary 10 per cent added sugar reduction target by 2020. However, when confronted with the choice between healthy or unhealthy drinks, consumers often believe they have to sacrifice part taste when selecting healthier options (Raghunathan, Walker, & Hoyer, 2006) and thus may experience a trade-off between health and pleasure (i.e. hedonic taste) when selecting drinks (Nørgaard & Brunsø, 2009).

Interestingly, one of the possibilities to reduce sugar intake through soft drink consumption and overcome the health-pleasure trade-off is the packaging design. In fact, various studies have indicated that different visual and tactile design features on packaging can influence basic taste (e.g. sweetness or bitterness), hedonic taste, and healthfulness evaluations of drinks/foods (e.g. Biggs, Juravle, & Spence, 2016; Huang & Lu, 2015; Ngo, Misra, & Spence, 2011; Van Rompay, Finger, Saakes, & Fenko, 2017; Van Rompay & Groothedde, 2019). For example, it is reported that the colour and colour saturation on the packaging can influence the taste intensity (e.g. sweeter taste experience) and the perceived healthfulness (e.g. Huang & Lu, 2015; Tijssen, Zandstra, de Graaf, & Jager, 2017). Huang and Lu (2015) have demonstrated this effect of colour and found that drinks/foods in a red package are perceived as sweeter but less healthful than the same products in a green or blue package. Moreover, Tijssen et al. (2017) demonstrates that increasing the saturation of the colour on the packaging of a low-sugar dairy drink generates sweeter taste expectations and perceptions, but lower perceived healthfulness.

In addition to the effects of colour and colour properties, Schifferstein and Cleiren (2005) emphasise the importance of tactile stimuli, since consumers perceive the most detailed information about a product from their tactile sense alongside their visual sense. Hence, various studies indicate that tactile stimuli on the packaging can influence the basic and hedonic taste evaluations (e.g. Biggs et al., 2016; Van Rompay et al., 2017; Van Rompay & Groothedde, 2019). For example, Tu, Yang, and Ma (2015) found that the sweetness perception of iced tea was enhanced when consumed out of a glass, as opposed to a plastic, cup. Furthermore, Van Rompay et al. (2017) showed that the sweetness perception of a chocolate drink and coffee were enhanced when consumed from a cup made from a 3D-printed circular microstructural texture, while the angular microstructural texture enhanced the bitterness perception of coffee.

Taken together, these findings suggest that the visual and the tactile design of the packaging could increase basic taste evaluations, such as sweetness, without increasing the actual sugar content. Specifically, it is important to investigate how colour saturation and 3D printed microstructural shape textures could enhance the hedonic evaluation for healthier options (i.e. soft drinks with reduced sugar) and by this overcome the health-pleasure trade-off (Van Rompay & Groothedde, 2019), which could make these healthier options more attractive to consumers. Furthermore, colour is mainly studied with the focus on hue (i.e. red, blue), and to a lesser extent, with the understanding that colour saturation and brightness could have on the consumer's evaluation of drinks and food (Spence, 2019). In addition, limited studies systematically assess the influence of 3D printed textures on consumer taste evaluation, and in particular, the perceived healthfulness of drinks and food. Hence, the following research question is formulated: *"What is the relative influence of colour saturation (i.e. low vs. high) and tactile stimuli (i.e. 3D printed microstructural shape textures; circular vs. angular) on the sweetness, bitterness, and hedonic taste perception, as well as the perceived healthfulness and overall product liking, and to what extent does this influence depend on the amount of sugar (i.e. low-sugar vs. high-sugar) in the product?"*

2. Theoretical framework

2.1. Cross-modal correspondence

When, two sensory modalities match, such as the colour of the packaging and the actual taste of the product, people will experience a good fit through two different sensory modalities, vision and taste, also known as 'cross-modal correspondence' (Spence, 2011). This cross-modal correspondence appears to be an implicit process that can positively affect the overall multi-sensory experience of consumers (Spence, 2011; Spence, 2012). Thus, consumers may explicitly see, hear, smell, or feel a product but they might be not consciously aware of how this can shape their actual taste perceptions of the product itself (Spence, 2011).

In fact, a large body of research indicates that people have the tendency to intuitively make associations between the different sensory modalities (e.g. Biggs et al., 2016; Spence, 2012; Van Rompay, Kramer, Saakes, 2018). For instance, research demonstrates the existence of a cross-modal correspondence between colour and basic tastes (see Spence et al., 2015 for review). Huang and Lu (2015) showed participants twelve pictures of packaging for food and drinks in the colours red, green, or blue. They found that red (as opposed to green and blue) enhanced the perceived sweetness of those foods and drinks. Furthermore, a cross-modal correspondence seems to exist between shapes and basic tastes (e.g. Ngo et al., 2013; Stewart & Goss, 2013; Van Rompay et al., 2017). For example, in the study of Velasco, Salgado-Montejo, Marmolejo-Ramos, and Spence (2014), participants had to rate whether they thought that the virtually designed round or angular package was more appropriate for sweet or sour-tasting products. They found that round shapes were associated with sweet tastes and angular shapes with sour tastes. Hence, basic taste evaluations appear to be influenced by the packaging design.

2.2. Effects of colour saturation

Colour may be one of the most potent packaging design cues that could influence consumer taste evaluation (e.g. Deliza, Macfie, & Hedderley, 2003; Hutchings, 2003) or healthfulness perception of a product (e.g. Huang & Lu, 2015; Schuldt, 2013). In a recent literature review on the cross-modal correspondence between colours (or colour words) and basic tastes (or taste words), Spence et al. (2015) show that people, across different cultures, tend to consistently associate particular colours with the five basic tastes. They found that sweetness is associated with red or pink, sourness with green or yellow, saltiness with white or blue, and bitterness with black or possibly with brown, purple, or green. Furthermore, research shows that the package colour can activate associations about the healthfulness of the drink/food inside (e.g. Huang & Lu, 2015; Schuldt, 2013). For example, Huang and Lu (2015) found that drinks/foods in a red package are perceived as sweeter, but less healthful than the same drinks/foods in a green or blue package.

However, the cross-modal correspondence between colours and basic tastes is not a straightforward relation, since colour can be described in terms of different properties such as hue, brightness, and saturation and tastes have a perceived intensity and hedonic value (Spence et al., 2015). Therefore, different correspondences or a complex network of correspondences may exist between colour or colour properties and basic tastes, in other words, between colour saturation (i.e. intensity of the colour) and taste intensity (i.e. more sweet or bitter). For example, Tijssen et al. (2017) reported that the taste intensity of a low-sugar dairy drink was influenced by the colour saturation on the package (see Spence & Velasco, 2018 for review). In the first experiment, they manipulated the colour saturation on the packaging (low, high) using 2D packaging images for expected sweetness, attractiveness, and healthfulness. In the second experiment, they transformed the 2D images into 3D 360-degree rotating animations to test for sweetness perceptions. Their results reveal that increasing the saturation significantly increased the taste intensity for expected and perceived sweetness. This increased taste intensity for sweetness by means of increasing the colour saturation is of particular interest since reducing the amount of sugar in soft drinks, for example, green iced tea could trigger the perception of a bland taste. On the other hand, reducing the amount of sugar in green iced tea could also trigger the perception of a bitter taste since tea could have an inherently slightly bitter taste. Hence, it is expected that:

H1: High, as opposed to low, colour saturation results in a more (a) sweet and (b) bitter taste experience.

Furthermore, it is also found that colour saturation on the packaging may trigger associations about the healthfulness of drinks/foods (Mead & Richardson, 2018; Tijssen et al., 2017). According to Mead and Richardson (2018), it is common practice to use highly saturated colours on the packaging of unhealthful food and less saturated colours for healthful food. As a result, it is possible that consumers, because of repeated exposure, associate high colour saturation with unhealthful foods and low colour saturation with healthful foods. In fact, Mead and Richardson (2018) found that increasing the colour saturation on the packaging increased the unhealthfulness perceptions for foods. They refer to this as the vivid (i.e. high saturation) packaging = unhealthful heuristic. Similarly, Tijssen et al. (2017) show that a low-sugar dairy drink is perceived as less healthful when presented in a package with high (as opposed to low) colour saturation. However, emphasising the healthfulness may lead consumers to expect that the drink is less pleasantness and therefore has a lower hedonic value (e.g. hedonic taste or overall product liking) (Fenko, Lotterman, & Galetzka, 2016), known as the health-pleasure trade-off. Hence, it is expected that:

H2: Low, as opposed to high, colour saturation results in a higher perceived healthfulness, but a lower hedonic taste perception and overall product liking.

2.3. Effects of tactile stimuli

The consumer's tactile sense (i.e. touching the product or the product package), appears to play an important role in their product experience. Schifferstein and Cleiren (2005) emphasise the importance of tactile stimuli in that consumers will perceive the most detailed information about a product from their tactile sense alongside their visual sense. Moreover, several studies indicate that tactile stimuli, such as materials or textures, trigger different taste evaluations (e.g. Biggs et al., 2016; Van Rompay et al., 2017; Van Rompay & Groothedde, 2019; Van Rompay et al., 2018; Tu et al., 2015). For example, Biggs et al. (2016) show that biscuits sampled from a smooth, as opposed to a rough, plate are perceived as tasting sweeter. Furthermore, and of particular interest for this recent study, the research of Rompay et al. (2017) tested the bitterness and the sweetness ratings for a coffee and a hot chocolate drink using cups with 3D circular or 3D angular microstructural textures. They found that, regardless of the drink type, the cup with the circular texture led to higher sweetness ratings, whereas the angular texture led to higher bitterness ratings for only the coffee. Hence, based on the above evidence that tactile stimuli, for example, the microstructural shape textures that we feel on our skin, can translate into enhanced evaluations of taste intensity such as sweetness or bitterness, it is expected that:

H3a: A circular, as opposed to an angular, microstructural texture results in a sweeter and less bitter taste experience.

H3b: An angular, as opposed to a circular, microstructural texture results in a more bitter and less sweet taste experience.

The embodied cognition framework can explain the theoretical basis underlying circularity and angularity effects (Van Rompay et al., 2017) in which concrete bodily interactions (e.g. packaging in the shape of a fat or a slim human body) with our environment are associated with abstract meanings attributed to objects (e.g. perceived product healthfulness) (Barsalou, 2008; Van Rompay & Ludden, 2015). For example, Fenko et al. (2016)

found that participants infer, based on a circular, thick-shaped package that mimics a fat, heavy human body, that the cookie inside is less healthful, opposed to the same cookie in an angular, thin-shaped package that mimics a slim, thin human body. According to Festila and Chrysochou (2016), the shape of the packaging may serve as a healthfulness cue for consumers when it mimics the shape of a healthy body. For example, products in a wider or convex (i.e. curved outward, like a football) package are perceived to be less healthy than products in a slim or concave (i.e. curved inward, like an hourglass) package (Festila & Chrysochou, 2016; Van Ooijen, Fransen, Verlegh, & Smit, 2017).

However, with respect to the question if and how perceived product healthiness can be traced to tactile stimuli, specifically to microstructural textures, research is scanty. Hence, based on the above findings regarding the association between the visual package shape and the human body, it is expected that the angular (rather than the circular) microstructural texture inspires association with a healthy body and therefore enhances the perceived healthfulness. Furthermore, and as previously mentioned, emphasising the healthfulness of a product may lead to lower expected pleasantness and, subsequently, consumers may believe the product has a lower hedonic value (Fenko et al., 2016). Hence, based on the above, the following hypothesis is formulated:

H4: An angular, as opposed to a circular, microstructural texture, results in a higher perceived healthfulness, but a lower hedonic taste perception and overall product liking.

2.4. Assimilation-contrast effects

Aforementioned results show that the visual and tactile packaging design can influence consumers' taste perception. However, what happens when the consumer expects to consume a soft drink high in sugar but subsequently tastes a soft drink low in sugar? The assimilation-contrast theory may explain these effects of expectations on perceptions (e.g. Anderson, 1973; Piqueras-Fiszman & Spence, 2015). Whenever we encounter a soft drink, our brain will interpret and integrate prior (and stored) experiences with any new cues presented in that situation (Piqueras-Fiszman & Spence, 2015). When we then consume the soft drink, we may experience a discrepancy between our expectations and our actual perception. In an attempt to correct for this discrepancy, our brain will assimilate our perception in line with our expectation when the discrepancy is small enough (Deliza & MacFie, 1996). If the discrepancy is too large, we experience a contrast, and we distance our evaluation from our expectation (e.g. Deliza & MacFie, 1996; Schifferstein, 2001; Yeomans, Chambers, Blumenthal, & Blake, 2008).

These expectations very often will anchor our actual sensory perception (Piqueras-Fiszman & Spence, 2015) and, therefore, they may play an important role, because when they fall within our limits of acceptance they may improve our sensory perception. For example, Deliza and MacFie (2001) found that an orange (compared to a white) package enhances the sweetness expectation for a fruit juice, which leads to a higher sweetness perception, clearly demonstrating an assimilation effect. However, when these expectations fall within our rejection zone, it may degrade our sensory perception about the product. For example, Yeomans et al. (2008) found that when consumers are shown a food label that generates strong expectations of a sweet taste, but they subsequently taste a salty ice cream, their sweetness ratings for the ice cream decreased, showing a contrast-effect.

As pointed out by Van Rompay and Groothedde (2019), these findings are highly relevant to the health context, because taste experiences of foods with low levels of, for example, sugar may diverge from taste experiences of foods with high levels of sugar, a 'gap' that may further be enhanced by packaging properties suggestive of high levels of sweetness. For example, in their study, Van Rompay and Groothedde (2019) manipulate the surface texture (uneven/rough vs. even/smooth) and the actual saltiness of three potato-chip variants (no-salt, medium-salt, and high-salt). They found that the uneven/rough (as opposed to the even/smooth) surface texture enhanced the saltiness perception for both the medium- and high-salt chips, but not for the no-salt potato chips. They, reasons that, for the latter, the expected taste triggered by the surface texture deviated too far from the actual taste, which may have resulted in contrast, rather than assimilation, effects.

Because of these effects of expectations on the subsequent taste experience, this research will manipulate the visual packaging cue (i.e. high vs. low colour saturation), the tactile packaging cue (i.e. circular vs. angular microstructural textures), and the actual amount of sugar in the soft drinks (i.e. low-sugar vs. high-sugar) to study these assimilation-contrast effects. Hence, the following hypotheses are formulated:

H5: High, as opposed to low, colour saturation results in enhanced (a) sweetness and (b) bitterness evaluations for a high-sugar, as opposed to a low-sugar, soft drink.

H6a: A circular, as opposed to an angular, microstructural texture results in enhanced sweetness evaluations for a high-sugar, as opposed to a low-sugar, soft drink.

H6b: An angular, as opposed to a circular, microstructural texture results in enhanced bitterness evaluations for a low-sugar, as opposed to a high-sugar, soft drink.

3. Methods

3.1. Pre-test

3.1.1. Stimulus material: colour saturation, microstructural textures, and green iced teas

The meaning of colour can vary by product category (Wan et al., 2014). Therefore, it is interesting to assess the influence of an appropriate colour for a product category. Therefore, this study will focus on the colour green, since our observation of the Dutch market regarding the packaging colour of green iced tea indicates that green is the dominant colour. In order to decide on the appropriate colour saturation, a set of four green colour-saturations were pre-tested for looking natural, realistic, and beautiful on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). The green colour-saturations were created using the green colour 100% eucalyptus from Flexa and the colour neutral grey from Amsterdam All Acrylics. The high colour saturation is labelled A and B: A consists solely of the 100% eucalyptus and B contains 2,5 grams neutral grey on 10 ml 100% eucalyptus. The low colour saturation is labelled C and D: C contains 5 ml neutral grey and D 7,5 ml neutral grey on 10 grams 100% eucalyptus. See Appendix I for the samples of the green colour saturation.

To ensure that the circular and the angular microstructural textures were perceived differently, a white circular (A) and angular (B) 3D printed cup (Van Rompay et al., 2017) were pre-tested for the concepts round, angular, soft, sharp, and pleasant on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). The stimuli cups were manufactured from polylactic acid with a Fused Deposition Modelling (FDM) 3D-printer using the Ultimaker 2 3D-printer at the Design Lab of the University of Twente (Van Rompay et al., 2017). The cups were designed to fit like a sleeve around a small paper cup for hygiene purposes (i.e. the paper cup was replaced after each participant). See figure I. for detailed rendering and specifications.

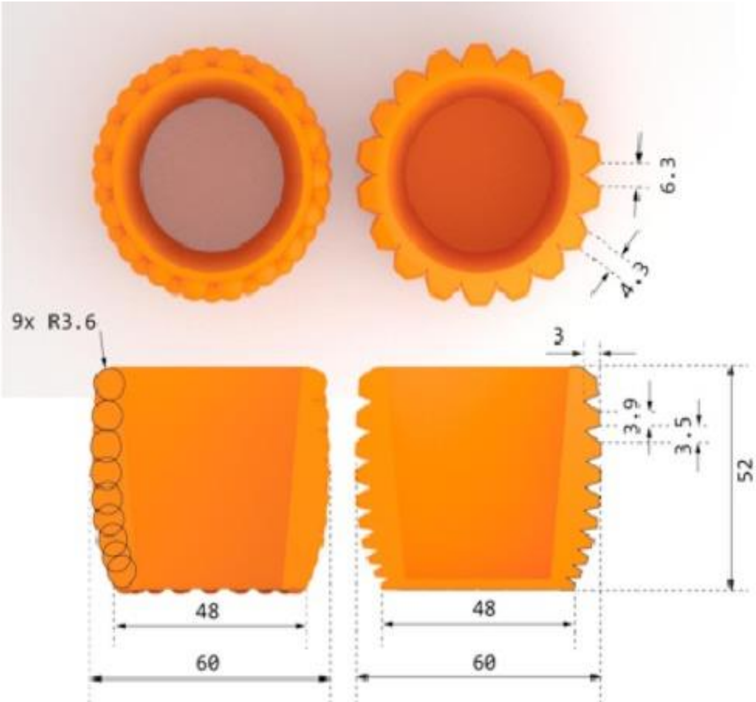

Fig. 1. Detailed rendering and specifications of microstructural textures in millimetres (Van Rompay et al., 2017).

Finally, to ensure that the two types of green iced tea were perceived as different from each other, a high-sugar (45 grams per 1000 ml) and a low-sugar (22,5 grams per 1000 ml) green iced tea, they were pre-tested on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) for perceived sweetness, perceived bitterness, and taste liking. The amount of sugar added to the green iced teas is based on the amount of sugar that a famous brand of iced tea on the Dutch market added to their iced tea: 4.5 grams of sugar in 100 ml. The high-sugar iced tea is labelled type A and contains 4.5 grams of sugar in 100 ml. The low-sugar iced tea is labelled type B and the amount of sugar is halved: 2.25 grams of sugar in 100 ml. Furthermore, the sugar is first dissolved in 125 ml of hot water, after which 875 ml of cold water is poured in (i.e. the green iced teas were made in 1000 ml batches to ensure that every batch has the same taste). Then 7 grams of the freshly dried green tea leaves were added and the glass teapots were stored for 4 hours in the refrigerator to cold-brew the green iced teas. Thereafter, 500 ml of each of the green iced teas was subsequently poured into high-quality thermos flasks of the same brand and the remaining 500 ml was kept in the sealed glass teapots in the refrigerator. Prior to the main study, during the pre-test, a test was conducted to determine how long the temperature of the drinks remained constant. Based on this, the duration of a data collection session was set at a maximum of four hours. See Appendix II for the English questionnaire that was translated into Dutch for the pre-test of all three stimuli.

3.1.4. Pre-test procedure

The pre-test was conducted at a restaurant in Gorinchem, The Netherlands. The participants (already inside the restaurant) were seated at a table and informed about the questionnaire. First, the respondents assessed the cups. They were asked to close their eyes and were handed cup A or B in random order, after which they completed the questionnaire. While filling in the questionnaire, the participant had the opportunity to assess the cups again with their eyes closed. The same procedure was repeated for the remaining cup. Second, they assessed the colour saturation. The participants were presented with four cards with the letters A, B, C, and D in random order. They were asked to fill in the answer option that corresponded with the letter on the card. Finally, the participants tasted the green iced teas in random order. In front of them, three plastic cups were placed with the letter A (high-sugar) or B (low-sugar) and one with water. They were asked to first rinse their mouth with water before tasting the green iced tea that corresponded with the letter in the questionnaire. After tasting the first iced tea, they rinsed their mouth again and tasted the second iced tea, after which they filled in the questionnaire where they had the opportunity to taste the green iced teas again in the same order, after rinsing their mouth. In total 20 participants completed the questionnaire.

3.1.5. Pre-test results and final stimuli

A Wilcoxon matched-pairs test was conducted to compare colour A and B (high saturation) and colour C and D (low saturation) for looking natural, realistic, and beautiful. This test was chosen because the data was not normally distributed and only 20 participants completed the questionnaire. The results indicate a significant difference between colour A and B ($Z = -3{,}02$, $P = .001$) and colour C and D for looking natural ($Z = -2{,}91$, $P = .002$). Where colour A (*Mdn* = 3.00) was ranked as looking significantly less natural than colour B (*Mdn* = 6.00), colour C (*Mdn* = 5.00) was ranked as looking significantly more natural than colour D (*Mdn* = 4.00). Furthermore, no significant differences were observed for the concepts looking realistic and beautiful between A (*Mdn* = 5.50, *Mdn* = 6.00) and B (*Mdn* = 6.00, *Mdn* = 6.00) and C (*Mdn* = 4.00, *Mdn* = 4.50) and D (*Mdn* = 3.00, *Mdn* = 4.00) ($p = ns$). Based on these findings, colour A was chosen as the high colour saturation and colour B as the low colour saturation since the median of the concepts realistic and beautiful are closer to each other than for the colours C and D. However, after painting two sample cups in the colours A and B, it turned out that they did not differ enough from each other. Hence, it was decided to use colour C instead of B for the low colour saturation.

To analyse the outcomes of the cups, a Wilcoxon matched-pairs test was conducted to compare cup A and cup B for the concepts round, angular, soft, sharp, and pleasant. This test was chosen for the same reasons as described above. The results indicate a significant difference in how the participants ranked cup A and B for the concepts round ($Z = -3{,}64$, $P < .001$), angular ($Z = -3{,}94$, $P < .001$), soft ($Z = -3{,}27$, $P < .001$), sharp ($Z = -3.09$, $P = .001$), and pleasant ($Z = -2{,}97$, $P = .002$). Cup A was ranked significantly rounder (*Mdn* = 7,00), softer (*Mdn* = 5.00), and more pleasant (*Mdn* = 5,50)) than cup B (*Mdn* = 2,50, *Mdn* = 2.00, *Mdn* = 3,50), whereas cup B was ranked significantly more angular (*Mdn* = 6.00) and sharper (*Mdn* = 4.00) than cup A (*Mdn* = 3.00, *Mdn* = 2.00). Thus, both cup A and cup B were perceived as intended, in that cup A was rated rounder and softer, and cup B more angular and sharper.

Finally, to analyse the outcomes of the drinks, the scales of the second condition (i.e. iced tea B vs. A) was re-coded to the same scales of the first condition (i.e. iced tea A vs. B), after which the scales were transformed to one scale measuring iced tea A vs. B for perceived sweetness, perceived bitterness, and taste liking. For all three variables, a one-sample Wilcoxon signed-ranks test was conducted, since the data was skewed. The results for perceived sweetness indicate that the iced tea A scores were significantly higher than the scores of iced tea B ($Z = 195.00$, $p = .001$). For perceived bitterness, the reversed pattern was observed in that the iced tea A scores were significantly lower than the scores of iced tea B ($Z = 26.50$, $P = .009$). Therefore, both iced teas are perceived as different from each other for the taste concepts of sweetness and bitterness. Finally, for taste liking, no significant differences were found between the scores of iced tea A and iced tea B ($Z = 108.00$, $P = .321$).

Based on the pre-test, no adjustments were made to the cups and the drinks since they were perceived as significantly different from each other. For the colour saturation, colour B was replaced with colour C, since the differentiation in saturation between A and B on the sample cups was not striking enough. Therefore, colour A was chosen as the high colour saturation and colour C as the low colour saturation. In total, four white cups were 3D-printed, two cups with the circular and two with the angular microstructural texture, and they were provided with two layers of either the high or the low colour saturated paint after which they were spray-painted with a transparent semi-gloss varnish, see figure 2 for the finalised cups

Fig. 2. Finalised sample cups (upper panel: high colour saturation; lower panel: low colour saturation)

Table 1.

2 x 2 x 2 between-subjects design

Conditions (n = 175)	*Colour saturation*	*Microstructural texture*	*Type of soft drink*
1 (*n = 23*)	Low	Circular	Low-sugar
2 (*n = 22*)	High	Circular	Low-sugar
3 (*n = 23*)	Low	Angular	Low-sugar
4 (*n = 21*)	High	Angular	Low-sugar
5 (*n = 20*)	Low	Circular	High-sugar
6 (*n = 23*)	High	Circular	High-sugar
7 (*n = 21*)	Low	Angular	High-sugar
8 (*n = 22*)	High	Angular	High-sugar

3.2. Main study

3.2.1 Research design

For the main study, a 2 (colour saturation: low vs. high) x 2 (3D printed microstructural shape textures: circular vs. angular) x 2 (type of soft drink: low-sugar vs. high-sugar) between-subjects design was constructed, resulting in eight conditions, see table 1.

3.2.2. Procedure and participants

In total, 175 people (57 males and 118 females; mean age: 43.54; age range: 18-70 years), participated in the experiment. Analyses of variance confirmed that age and gender were equally distributed (both *F*’s < 1, ns), see table 2 for age and gender distribution. Participants were approached at the Albert Heijn in Gorinchem the Netherlands and asked if they would like to taste a new green iced tea. Upon agreement, participants were asked if they had any allergies or intolerances and if they were colour blind (no respondents were excluded based on these screening questions). Thereafter, the participants were randomly assigned to one of the eight experiment conditions, see table 1, and handed a plastic cup of water to rinse their mouth. Then the participants were clearly instructed to look at and pick up one of the four sample cups (see figure 2) to taste either the high-sugar or the low-sugar green iced tea. After tasting, participants completed the questionnaire, which consisted of the dependent measures, age, and gender. Finally, they were thanked for their participation.

Table 2.

Age and gender distributions over the eight conditions

		Age		Gender	
Condition	N	*M*	*SD*	*Male*	*Female*
1	23	43.87	15.57	34.8%	65.2%
2	22	37.41	13.26	31.8%	68.2%
3	23	46.57	14.96	43.5%	56.5%
4	21	40.38	11.82	19.0%	81.0%
5	20	42.10	11.74	15.0%	85.0%
6	23	47.09	13.71	43.5%	56.5%
7	21	42.90	12.77	47.6%	52.4%
8	22	47.36	14.56	22.7%	77.3%
Total	175	43.54	13.80	32.6%	67.6%

3.2.3. Measurements

All items were measured on a 7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). See Appendix III for the complete survey.

Taste perceptions

The sweetness, bitterness, and hedonic taste perceptions were measured with a single item ‘‘This iced tea has a sweet taste”, ‘‘This iced tea has a bitter taste”, and “I like the taste of this iced tea”, based on Van Rompay et al. (2017) and slightly adapted to fit this study.

Perceived healthfulness

The perceived healthfulness was measured with five items based on the scales of Fenko et al. (2016) and slightly adapted to fit this study (α = .86). Example items include “I think this iced tea is healthy” and “I think this iced tea is low in calories”.

Overall product liking

The overall product liking was measured with four items based on the Hirschman and Solomon’s (1984) brand evaluation scale and was slightly adapted to fit this study (α = .96). Example items include “I am positive about this iced tea” and “I like this iced tea”.

Table 3.

The two selected components with component loadings after rotation

Items		Component loadings	
		Low health interest	High health interest
1 R	The healthfulness of food has little impact on my food choices	.70	
2	I am very particular about the healthiness of food I eat		.62
3 R	I eat what I like and I do not worry much about the healthiness of food	.73	
4	It is important for me that my diet is low in fat		.65
5	I always follow a healthy and balanced diet		.80
6	It is important for me that my daily diet contains a lot of vitamins and minerals		.78
7 R	The healthiness of snacks makes no difference to me	.83	
8 R	I do not avoid foods, even if they may raise my cholesterol	.66	

Note. Reversed-code items are marked with an "R" and were recode for further analyses.

Additional variables

The ultimate aim of soft drink manufactures is to sell their products to consumers. Therefore, this study also measures the purchase intentions for the green iced teas. The purchase intention is measured with two items: "I would seriously consider buying this iced tea" and "I would buy this iced tea", based on Fenko et al. (2016) and slightly adapted to fit this study (α = .97). Furthermore, the general health interest (GHI) is used as a covariate to control for the personal interest of consumers in maintaining a healthy diet since consumers with a high GHI tend to choose food based on their health benefits rather than on their hedonic benefits (Lähteenmäki, 2013). The general health interest was measured using the eight items from the GHI scale, see table 3 for all items (Roininen, Lähteenmäki, & Tuorila, 1999). A principal component analysis (PCA) with varimax (orthogonal) rotations and the eight items was performed. The Kaiser-Meyer-Olkin test shows that the sample is adequate to perform a PCA (KMO = .79). Bartlett's test of sphericity was significant ($p < 0.01$), which indicates that the correlations were sufficiently large for a PCA. Two components had an eigenvalue above the Kaiser's criterion of 1 and explained a total of 57.82% of the variance. Table 3 shows the component loadings after rotation. The first component represents the 'Low health interest' (LHI) and the second component the 'High health interest' (HHI). Both groups of items achieved satisfactory internal consistency (LHI α = .743, HHI α = .719). For the analysis, only the LHI scale was used.

4. Results

To test the hypotheses, analyses of covariance were performed with colour saturation (high or low), microstructural textures (circular or angular), and drink type (high or low-sugar) as independent factors and GHI as covariate on the dependent variables' sweetness, bitterness, hedonic taste perception, perceived healthfulness, and overall product liking. Pairwise comparisons with Bonferroni correction of significant interaction effects were performed using tests of simple main effects.

4.1. Taste perception: sweetness

An ANCOVA with sweetness as the dependent variable revealed a main effect of drink type ($F(1, 166) = 8.73$, $p = .004$, $\eta 2 = .050$), demonstrating that the high-sugar green iced tea was experienced as significantly sweeter than the low-sugar green iced tea ($M = 4.53$, $sd = 1.58$, vs. $M = 3.80$, $sd = 1.77$). However, no significant main effects of colour ($F(1, 166) = 2.23$, $p > .137$, $\eta 2 = .013$) and texture ($F < 1$, *ns*) were observed. Likewise, no significant interaction effects were found (colour x drink: $F(1, 166) = 1.51$, $p = .222$, $\eta 2 = .009$; texture x drink: $F < 1$, *ns;* colour x texture: $F < 1$, *ns*; colour x texture x drink: $F < 1$, *ns)*. Finally, the covariate, GHI, was not significantly related to the sweetness perception ($F < 1$, *ns*). Therefore, these findings do not support hypothesis 1a, 3a, 5a, and 6a.

4.2. Taste perception: bitterness

For bitterness, an ANCOVA revealed a marginally significant main effect of colour ($F(1, 166) = 2,74$, $p = .100$, $\eta 2 = .016$). This may suggest that low colour saturation ($M = 3.10$, $sd = 1.66$) compared to high colour saturation ($M = 2,67$, $sd = 1.59$) enhances the bitterness perception of the green iced teas. However, no significant main effects of texture and drink type (all $F < 1$, *ns*) were revealed, as were none of the interaction effects (colour x drink: $F < 1$, *ns;* texture x drink: $F < 1$, *ns;* colour x texture*:* $F < 1$, *ns*; colour x texture x drink: $F < 1$, *ns*). Again, the covariate, GHI, was not significantly related to the bitterness perception ($F < 1$, *ns*). As a result, hypotheses 1b, 3b, 5b, and 6b have to be rejected.

4.3. Hedonic taste perception

An ANCOVA with the hedonic taste perception as the dependent variable showed no main effects of colour ($F(1, 166) = 1.43$, $p = .233$, $\eta 2 = .009$), texture ($F < 1$, *ns*), and drink type ($F < 1$, *ns*). Likewise, the analysis revealed no significant interaction effects (colour x drink: $F < 1$, *ns;* texture x drink: $F < 1$, *ns;* colour x texture*:* $F < 1$, *ns*; colour x texture x drink: $F < 1$, *ns)*. Finally, the covariate, GHI, again did not significantly relate to the hedonic taste perception ($F < 1$, *ns*). Therefore, these findings do not support hypotheses 2 and 4.

4.4. Perceived healthfulness

The main effect of drink type is again significant ($F(1, 166) = 5.36$, $p = .022$, $\eta 2 = .031$), demonstrating that the high-sugar green iced tea was experienced as significantly less healthy than the low-sugar variant ($M = 4.71$, $SD = 1.16$, vs. $M = 5.05$, $SD = .93$). Furthermore, the analysis revealed no significant main effects of colour ($F < 1$, *ns*) and texture ($F(1, 166) = 1.28$, $p = .260$, $\eta 2 = .008$). However, the covariate, GHI, was marginally significantly related to perceived healthfulness ($F(1, 166) = 3.13$, $p = .080$, $\eta 2 = .019$). There is a small negative relation, which means that when GHI increases, the perceived healthfulness decreases. Together, these findings do not support hypotheses 2 and 4.

More interestingly, the ANCOVA showed a significant interaction effect between colour and texture for perceived healthfulness ($F(1, 166) = 4.68$, $p = .032$, $\eta 2 = .027$). Pairwise comparisons demonstrated a significant difference between the microstructural textures when combined with the low colour saturation ($p = .021$). The circular texture ($M = 5.13$, $sd = 1.09$) compared to the angular texture ($M = 4.63$, $sd = 1.14$) combined with the low colour saturation induced the perceived healthfulness (see figure 1). However, no significant differences for perceived healthfulness were found for the circular ($M = 4.84$, $sd = .97$) and the angular ($M = 4.95$, $sd = 1.02$) texture combined with the high colour saturation. Finally, no other significant interaction effects (colour x drink: $F < 1$, *ns;* texture x drink: $F < 1$, *ns;* colour x texture x drink: $F < 1$, *ns)* were revealed.

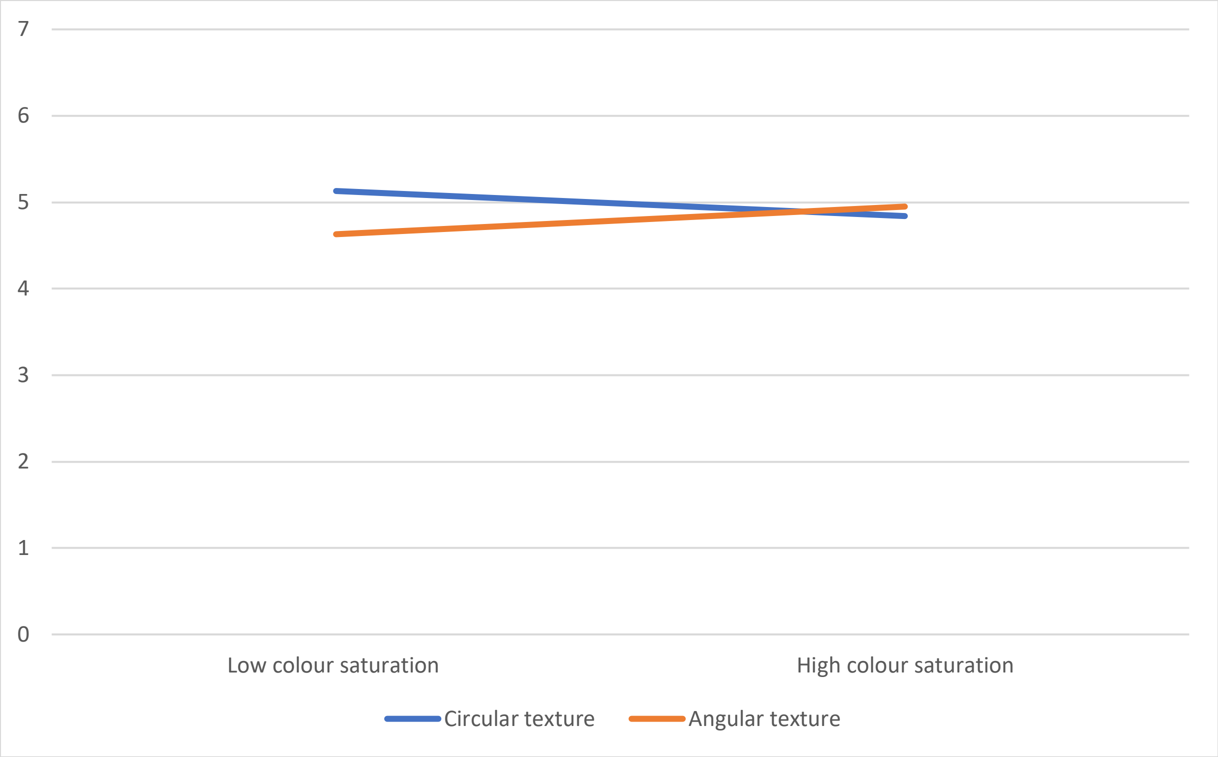

Figure 1. Interaction effect colour saturation and microstructural textures for perceived healthfulness

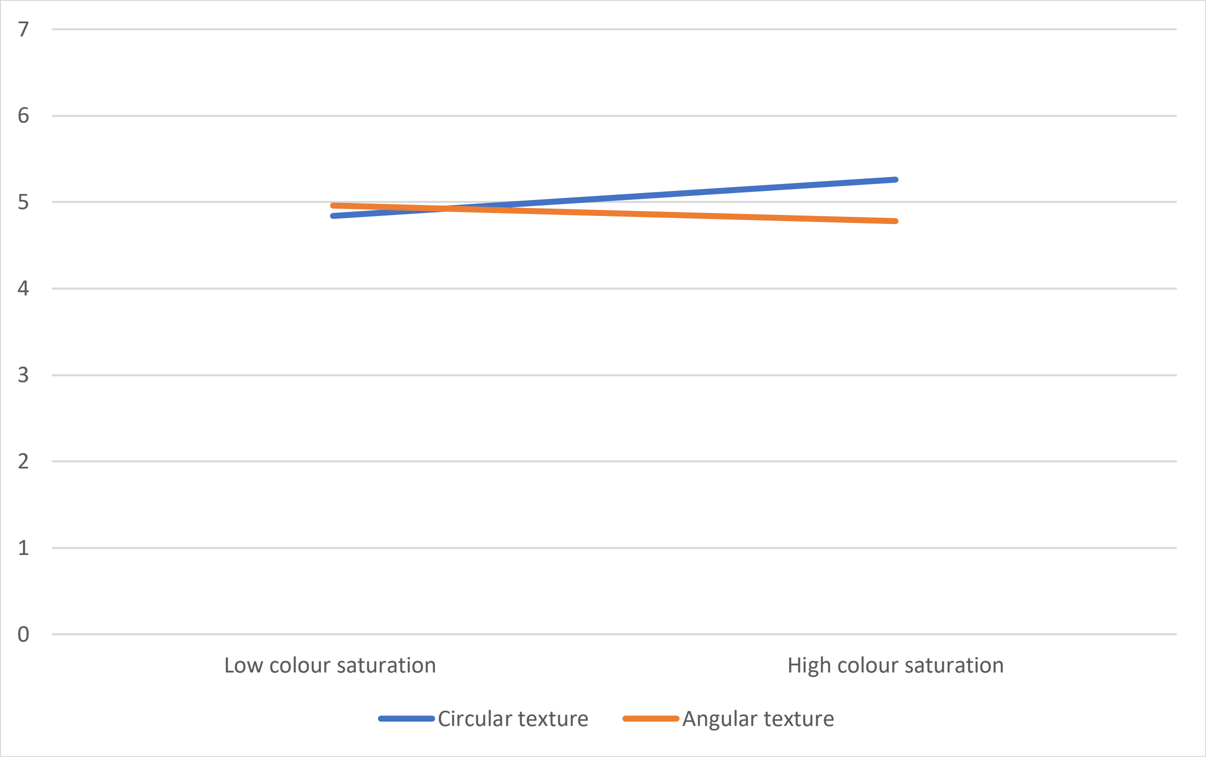

Figure 2. Interaction effect low-sugar, colour saturation, and microstructural textures for overall product liking

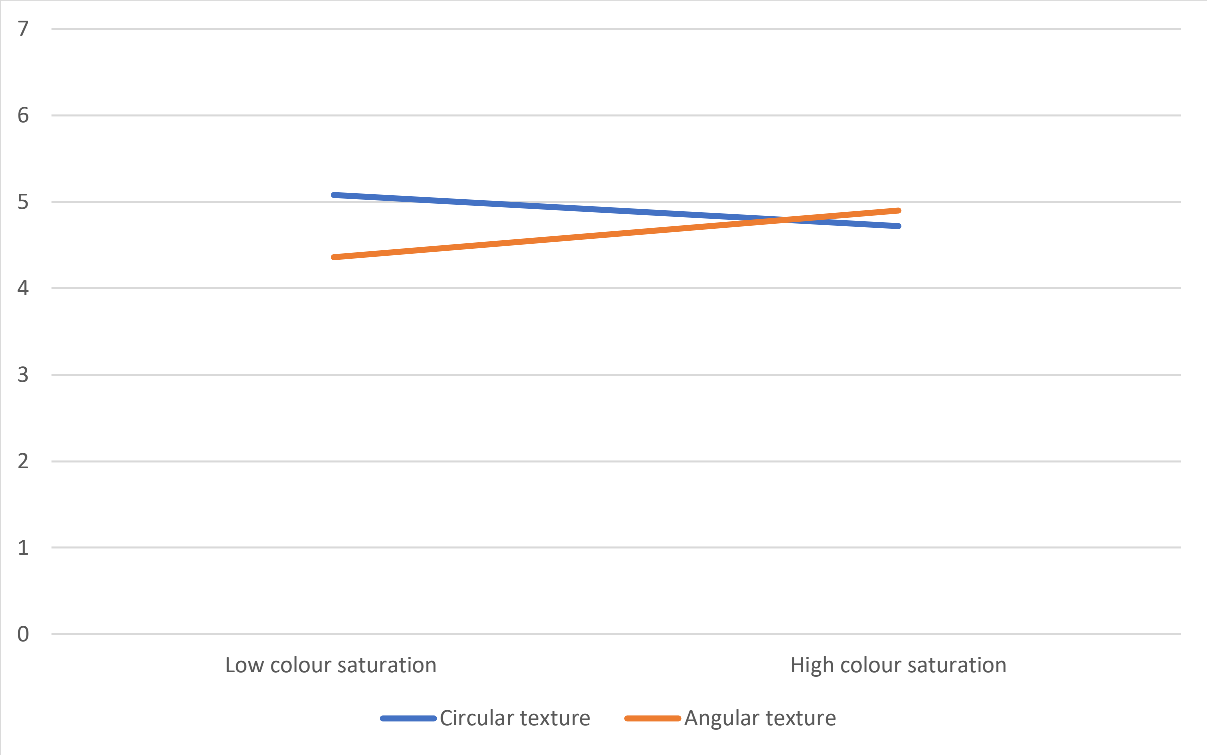

Figure 3. Interaction effect high-sugar, colour saturation, and microstructural textures for overall product liking

4.5. Overall product liking

An ANCOVA with overall product liking as dependent variable revealed no main effect of colour, texture, and drink type (all $F < 1$, *ns*), neither were the two-way interaction effects (colour x drink: $F < 1$, *ns;* texture x drink: $F < 1$, *ns;* colour x texture*:* $F < 1$, *ns*). However, there is a marginal significant three-way interaction effect between colour, texture, and drink type ($F(1, 166) = 2.91$, $p = .090$, $\eta 2 = .017$). Pairwise comparisons (not significant $p = .113$) show that, in the case of the high-sugar green iced tea, the overall product liking increases when consumed from the cup with the circular texture and the low colour saturation ($M = 5.09$, $sd = 1.60$), whereas it decreases when consumed from the cup with the angular texture and low colour saturation ($M = 4.36$, $sd = 1.47$) (see figure 2). In the case of the low-sugar green iced tea, pairwise comparisons (not significant $p = .296$) show that the overall product liking increases when consumed from the cup with the circular texture and the high colour saturation ($M = 5.09$, $sd = 1.60$), whereas it decreases when consumed from the cup with the angular texture and high colour saturation ($M = 4.36$, $sd = 1.47$). Furthermore, there are no other significant differences between combinations of stimuli (all $P > .678$). Finally, the covariate, GHI, again did not significantly relate to the overall product liking ($F < 1$, *ns*). Based on these findings, hypotheses 2 and 4 need to be rejected.

4.6. Purchase intentions

Finally, for purchase intention, an ANCOVA revealed no significant main effects of colour, texture, and drink type (all $F < 1$, *ns*), as well as no significant interaction effects (colour x drink: $F < 1$, *ns;* texture x drink: $F(1, 167) = 1.12$, $p = .291$, $\eta 2 = .007$*;* colour x texture*:* $F < 1$, *ns*; colour x texture x drink: $F < 1$, *ns*). In addition, the covariate, GHI, did not significantly relate to the purchase intentions ($F < 1$, *ns*).

5. Discussion

The aim of this study was to examine the possible effects of colour saturation (high versus low) in combination with 3D printed microstructural shape textures (circular versus angular) and two types of green iced teas (high-sugar versus low-sugar) on the sweetness perception, bitterness perception, hedonic taste perception, perceived healthfulness, overall product liking, and purchase intentions. Although none of the formulated hypotheses are confirmed, there are interesting results regarding perceived healthfulness.

It appears that the combination of low colour saturation and the circular microstructural texture increase the perceived healthfulness of both green iced teas, whereas the combination of low colour saturation and the angular microstructural texture decrease the perceived healthfulness. Concerning the effect of the low colour saturation, it is in line with previous findings of Mead and Richardson (2018) and Tijssen et al. (2017) who also show that consumers appear to associate low colour saturation on the packaging of drinks and food with healthfulness. Therefore, in addition to the vivid packaging = unhealthful heuristic (Mead & Richardson, 2018), it appears that consumers through repeated exposure to healthy drinks and food in muted, low colour saturated packaging (Kahneman & Frederick, 2005) may develop the muted packaging = healthful heuristic.

Furthermore, with regard to the effect of the microstructural shape textures, it appears that the circular, rather than the angular, microstructural texture (in combination with the low colour saturation) enhanced the perceived healthfulness of both green iced teas. It is possible that, because circular (or rounded or curved) shapes symbolise harmony (Berlyne, 1971; Zhang, Feick, and Price, 2006), which may refer to nature or naturalness (e.g. food without artificial ingredients), consumers infer that products are more healthful when offered in a packaging with circular aspects (e.g. round logos or a circular microstructural texture), rather than with angular aspects (e.g. angular logos or an angular microstructural texture).

Moreover, the naturalness of food products is closely linked to perceived healthfulness (Margetts, Martinez, Saba, Holm, & Kearney, 1997) and because of this link, it is possible that consumers will determine whether a product is healthy based on the naturalness of the product. In addition to harmony, circular (rather than angular) shapes are also perceived as gentler (Zhang et al., 2006). Hence, it is possible that circular microstructural textures generate a gentler, more natural impression on our skin (Van Rompay et al., 2017), which subsequently may leave the impression that the product is healthful. Furthermore, the results imply that when evaluating the healthfulness of a product, consumers draw inference from both the visual and the tactile stimuli, underlining the notion of Krishna (2006) that we use our visual and our tactile senses when evaluating a product's concepts.

Additionally, the results demonstrate little evidence that the colour saturation and the microstructural shape textures influence the sweetness, bitterness, and hedonic taste perception, the overall product liking, and purchase intention for the low-sugar and the high-sugar soft drink. Specifically, the high colour saturation did not result in sweeter, more bitter, or hedonic taste perceptions, whereas the low colour saturation inspired a marginally more bitter taste for both soft drinks. A potential explanation could be the statistical account that suggests that cross-modal correspondences are learned environmental conventions between properties of objects, such as colour and taste (Spence, 2011; Spence et al., 2015). Thus, for example, when we encounter a soft drink, we might base our colour-taste judgment on the colour of the most frequently encountered and consisted taste-object (i.e. strawberry = red-sweet or lime = green-sour) (Saluja & Stevenson, 2018). For example, Tijssen et al. (2017) found that the *sweetness* expectation and perception for a low-sugar *red fruit* (e.g. strawberry) dairy drink were enhanced when presented in the highly saturated *red* (compared to the blue and purple) packaging, which may suggest that participants had a red fruit = red-sweet judgment. Hence, the correlations between colour saturation and basic tastes could depend on these learned conventions between colour (e.g. red or blue) and taste. Specifically, the green colour used in this study may have led to a contrast (as opposed to assimilation) effect because the expectations based on the used colour may have deviated too far from these learned conventions (i.e. green generally associated with a sour taste), which may have degraded the sensory perception, the hedonic taste perception, and overall product liking.

Furthermore, the findings also show that both cups (i.e. circular and angular microstructural textures) fail to boost the sweetness, bitterness, and hedonic perception of both green iced teas. This is not in line with Van Rompay et al. (2017), who shows that circular microstructural textures that we feel on our skin translate into enhanced sweetness and hedonic evaluations, whereas angular microstructural textures translate into enhanced bitterness and hedonic evaluations. However, it is unclear how prominent the influence of the microstructural shape textures may have been on the tactile feedback. Therefore, we may not exclude the possibility that packaging with shape aspects (i.e. the visual shape of the packaging or microstructural shape textures) may only elicit certain taste associations when the consumer is actively engaged in taste (or flavour) searching (Machiels, 2018). Hence, it is possible, because soft drinks are mostly purchased for their hedonic value, that shape aspects on the packaging may only affect consumers with a hedonic (rather than a utilitarian: consuming soft drinks to quench thirst) goal of sensory pleasure because they are actively engaged in taste (or flavour) searching (i.e. consuming soft drinks to satisfy their sugar craving). Moreover, the effect of tactile stimuli may depend on the product category, in that consumers may not consider the tactile stimuli on the packaging to be relevant for their evaluation (Skaczkowski, Durkin, Kashima, & Wakefield, 2016) of products that are more hedonic (rather than utilitarian) in nature, such as soft drinks.

Taken together, to answer the research question, the findings indicate that colour saturation and tactile stimuli (i.e. 3D printed microstructural shapes; circular vs. angular) only affected the perceived healthfulness of both types of green iced tea. However, no effects were found for the sweetness, bitterness, and hedonic taste perception, as well as for the overall product liking and purchase intentions. Finally, the findings also indicate that varying the amount of sugar in the green iced tea did not influence the effect of the visual and the tactile stimuli on the aforementioned concepts.

5.1. Limitations, implications, and further research

Clearly, several limitations deserve attention. First, in this study, two homemade green iced teas were used, and the sugar content of the high-sugar variant was based on a famous Dutch green iced tea brand. However, it is not possible to rule out that, because the green iced teas were homemade, the participants found it difficult to identify them as such. That is, during the experiment, some participants indicated that they thought the soft drink tasted like a normal iced tea (i.e. made with black tea), although it was announced beforehand that they were going to taste a new green iced tea variant. For follow-up research, it could be considered to use soft drinks that are easier to identify and are more familiar, such as Coca-Cola/Pepsi-Cola or Orange Fanta.

Furthermore, green iced tea on the Dutch market, as compared to, for example, Cola, contains almost half the amount of sugar (i.e. green iced tea: around 3.5/4.5 grams of sugar 100 ml versus Cola: around 9.5/11 grams of sugar in 100 ml, based on Coca-Cola, Pepsi-Cola and a private label cola). Arguably, the null-results for the microstructural shape textures could relate to the amount of sugar used in the green iced teas. For example, Rompay et al. (2017) used a hot chocolate drink from the famous Dutch brand 'Chocomelk', which contains 11.8 grams of sugar in 100 ml and found that the circular microstructural texture enhanced the sweetness perception. Hence, it could be researched whether a taste intensity threshold is present (i.e. the product must contain a certain amount of sugar) that needs to be overcome in order for tactile stimuli to influence the consumers' drink/food experience, for example, by using a low-sugar, medium-sugar, and high-sugar soft drink.

With respect to the colour saturation, it is important to note when it comes to the packaging design, that single colours are rarely seen in isolation (Orth & Malkewitz, 2008). For example, it is arguable that the interaction between the colour saturation and the microstructural shape texture may have influenced the way in which the participants perceived or interpreted the colour saturation. Future research, therefore, could address this possible interaction between colour properties (i.e. hue, brightness, or saturation) and tactile stimuli to gain a better understanding in how particularly design aspects work together to influence the consumers' impression about drink/food products and confirm the results regarding the perceived product healthfulness. In addition, future research could also investigate if the correspondences between colour saturation and basic tastes, may depend on the learned conventions consumers may hold between colour (e.g. red or blue) and taste and if the expectations created by these learned conventions lead to assimilation-contrast effects for the actual taste perception.

Finally, another shortcoming is that the microstructural shape textures used in this study were embedded on the surface of a sample cup, as well as the colour saturation, instead of a realistic drinking vessel. Moreover, the microstructural textures on the sample cups are more extreme, compared to the subtler textures used by soft drink manufactures (Rompay et al., 2017). However, these extreme textures could differentiate a brand that, for example, wants to introduce a healthier soft drink by embedding a circular microstructural texture (in combination with low colour saturation) in their packaging, from other similar brands at the point of purchase, because it is possible they are more attention-grabbing, which future research could investigate (Van Rompay et al., 2017). Finally, as already pointed out by Van Rompay et al. (2017), Van Rompay and Groothedde (2019), and Van Rompay et al. (2018) the texture manipulation of the sample cup did not only influence the tactile sensation, but also the visual appearance. Hence, this study cannot separately assess the relative influence of vision and touch to the perceived healthfulness evaluations. Clearly, this calls for research to explore the effects of visual and tactile stimuli separately.

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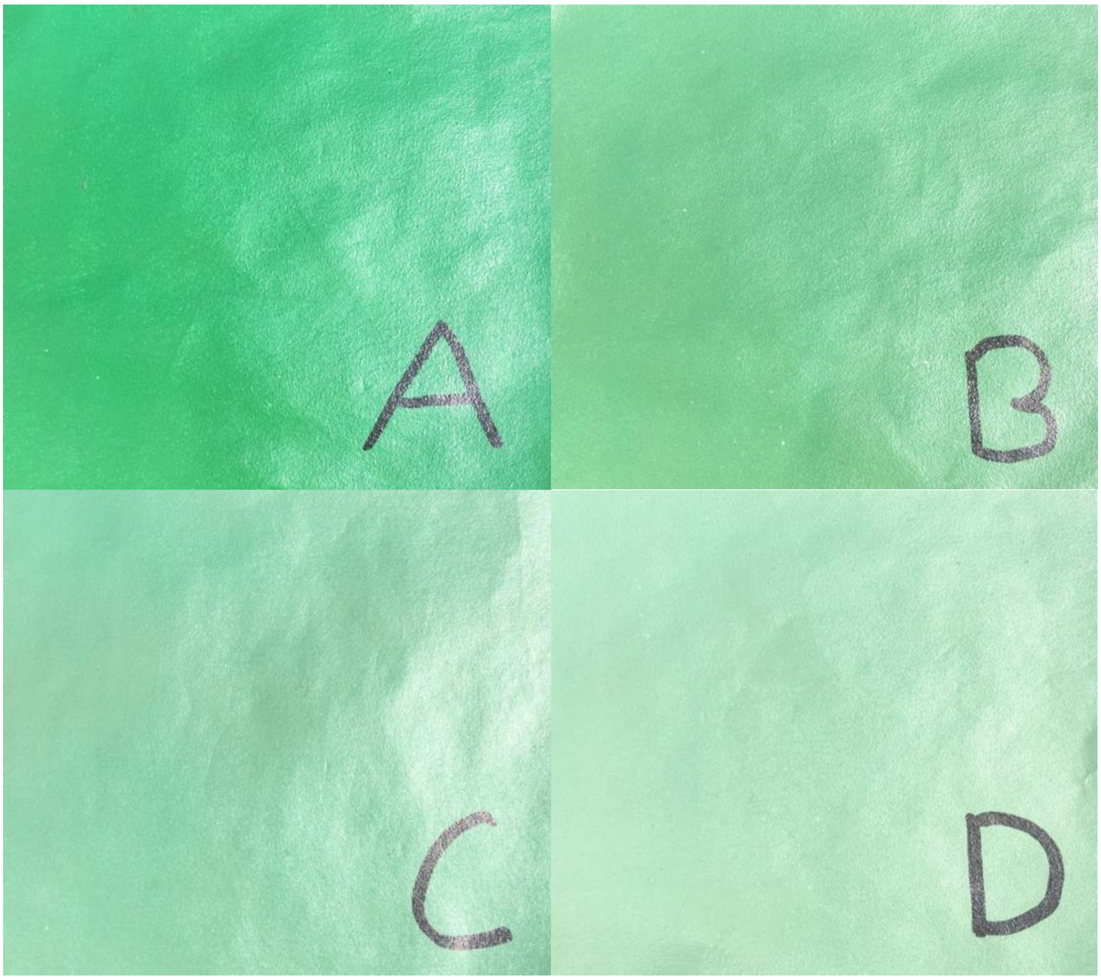
Appendix I Pre-test colour saturation



Appendix II Full English questionnaire pre-test

3D-printed cups

You are going to assess two cups with your eyes closed. Keep in mind that you are judging the surface of the cups, therefore, move your fingers over the surface. You may judge the cups multiple times while answering the questions.

Cup A

"When I feel this cup, I think the surface feels ......"

	Strongly disagree						Strongly agree
Round	0	0	0	0	0	0	0
Angular	0	0	0	0	0	0	0
Soft	0	0	0	0	0	0	0
Sharp	0	0	0	0	0	0	0
Pleasant	0	0	0	0	0	0	0

Cup B

"When I feel this cup, I think the surface feels ......"

	Strongly disagree						Strongly agree
Round	0	0	0	0	0	0	0
Angular	0	0	0	0	0	0	0
Soft	0	0	0	0	0	0	0
Sharp	0	0	0	0	0	0	0
Pleasant	0	0	0	0	0	0	0

Green colour saturation

You are going to assess the colour green for the packaging for a green iced tea. In front of you are four cards with the letters A, B, C, and D (not necessarily in this order). Indicate by the letter in the questionnaire that corresponds to the letter on the card to what extent you agree with the question.

"Please indicate to what extent you think colour ...... looks natural"

	Strongly disagree						Strongly agree
A	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0

"Please indicate to what extent you think colour ...... is a realistic colour for the packaging of green iced tea"

	Strongly disagree						Strongly agree
A	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0

"Please indicate to what extent you think colour ...... is beautiful"

	Strongly disagree						Strongly agree
A	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0

Green iced tea

In this short questionnaire, you will assess the taste of two green iced teas. In front of you are two cups with the letters A or B. Be the first to taste the green iced tea corresponding to the letter on the screen. Then rinse your mouth with water and taste the other iced tea. You can taste the iced tea several times, but rinse your mouth with water after tasting each iced tea before answering the questions.

"When I taste iced tea A, I think it is …. than iced tea B"

	Strongly disagree						Strongly agree
Sweeter	0	0	0	0	0	0	0
More bitter	0	0	0	0	0	0	0
More delicious	0	0	0	0	0	0	0

"When I taste iced tea B, I think it is …. than iced tea A"

	Strongly disagree						Strongly agree
Sweeter	0	0	0	0	0	0	0
More bitter	0	0	0	0	0	0	0
More delicious	0	0	0	0	0	0	0

Appendix III Main study questionnaire

Taste perception ratings

	Strongly disagree						Strongly agree
“This iced tea has a sweet taste”	0	0	0	0	0	0	0
“This iced tea has a bitter taste”	0	0	0	0	0	0	0
“I like the taste of this iced tea”	0	0	0	0	0	0	0

Perceived healthfulness

	Strongly disagree						Strongly agree
“I think this iced tea is healthy”	0	0	0	0	0	0	0
“I think that this iced tea is good for me”	0	0	0	0	0	0	0
“I think this iced tea is low on calories”	0	0	0	0	0	0	0
“I think this iced tea looks healthy”	0	0	0	0	0	0	0
“I think this iced tea is healthier than similar ice teas”	0	0	0	0	0	0	0

Overall product liking and purchase intention

	Strongly disagree						Strongly agree
“I am positive about this iced tea”	0	0	0	0	0	0	0
“I like this iced tea”	0	0	0	0	0	0	0
“This iced tea is pleasant”	0	0	0	0	0	0	0
“This iced tea is appealing”	0	0	0	0	0	0	0
“I would seriously consider buying this iced tea”	0	0	0	0	0	0	0
“I would buy this iced tea”	0	0	0	0	0	0	0

General health interest

	Strongly disagree						Strongly agree
“The healthiness of food has little impact on my food choices” (R)	0	0	0	0	0	0	0
“I am very particular about the healthiness of food I eat”	0	0	0	0	0	0	0
“I eat what I like and I do not worry much about the healthiness of food” (R)	0	0	0	0	0	0	0
“It is important for me that my diet is low in fat”	0	0	0	0	0	0	0
“I always follow a healthy and balanced diet”	0	0	0	0	0	0	0
“It is important to me that my daily diet contains a lot of vitamins and minerals”	0	0	0	0	0	0	0
“The healthiness of snacks makes no difference to me” (R)	0	0	0	0	0	0	0
“I do not avoid foods, even if they may raise my cholesterol” (R)	0	0	0	0	0	0	0

Note. Reversed-code items are marked with an “(R)” after the item.