Colour is to flavour as shape is to texture: A choice-based conjoint study of visual cues on chocolate packaging

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Abstract

The effect(s) of visual cues and their crossmodal correspondences in the context of food packaging have been increasingly researched over the last two decades. This study contributes to the subject by integrating four visual variables into a choice-based conjoint analysis test. The contribution of colour (pink/black), typeface (rounded/angular), ingredient image (milk/chocolate), and chocolate shape (curved/flat) on milk chocolate packaging are evaluated. All 16 possible combinations were evaluated online by a total of 480 Brazilian chocolate consumers for preference, expected sweetness, and expected creaminess. The participants also listed the first three words that came to mind for a subset of four of the samples. The results were statistically analysed by mixed logit model and correspondence analysis. It was found significant effects of colour, typeface, and ingredient on preference, of colour and shape on sweetness, and of shape on creaminess. Except for ratings of expected creaminess, colour was the most relevant attribute on all independent variables.

Pratical applications

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These results further our understanding on ~~concerning~~ how multiple visual cues may combine to influence consumer preference and crossmodal correlations with taste and texture. It indicates that companies and researchers may use choice-based conjoint analysis to evaluate crossmodal effects of visual aspects, making the test faster, more spontaneous, and intuitive. Although this research was conducted on the packaging of bars of chocolate, the consistency of the results with those studies that have used other products should encourage designers and manufacturers ~~of most food and beverage~~ to take these findings into account when creating packaging for food and beverage in general.

Keywords

Crossmodal; Consumers; Expectation; Preference; Design; Word Association.

1. Introduction

Until the second half of the 20th Century, food and beverage packaging was primarily regarded as ~~little more than~~ a tool for the transportation and preservation of ~~the~~ contents (see Hine, 1995; Velasco & Spence, 2019a, for historical reviews). It was the increasing popularity of supermarkets in the West that made marketers pay attention to its role in capturing the consumer's attention and influencing their preferences (Favre & November, 1979; Stern, 1981; Velasco & Spence, 2019b). More recently, designers and scientists have also grown increasingly interested in how packaging, more than standing-out and being visually attractive, contributes to the multisensory experience of consumption from visual inspection on the shelf ~~through~~ to eventual disposal (Schifferstein et al., 2013). Part ~~Certain~~ of its contributions comes from visual aspects, such as colours, images, typefaces, and shapes, that have been shown to influence people's preferences,

expectations and perceptions of healthiness, quality, value, liking, as well as tastes, aromas, and texture (see Velasco & Spence, 2019a; Wheatley, 1973, for reviews).

~~A few recent studies tested two or more visual variables combined, usually colour, shape, background patterns, and/or typeface, on a food or beverage packaging (for reviews: Matthews et al., 2019; Velasco & Spence, 2019a). With regards to interactions between different visual treatments, such as colour and shape, Deliza and MacFie (2001) reported interactions between colour, picture, and shape. Piqueras-Fiszman et al. (2013), meanwhile, reported an interaction between the texture of a jam jar and the presence of a fruit picture. Velasco et al. (2014) found multiple interactions between shape, typeface, and name on participants' reaction times (RTs) and their ratings of the expected sweetness and sourness of the product. Many of the studies that have tested for two or more visual cues on packaging did not analyse for interactions (Ares & Deliza, 2010; Ares et al., 2016; Kovač et al., 2019; da Rosa et al., 2019; Sousa et al., 2020a; van Lith, 2015) or else reported null results (Becker et al., 2011; Heartherly et al., 2019; Matthews et al., 2019; Piqueras-Fiszman et al., 2012).~~

The objective of the present study was to understand how much each visual cue in a packaging contributes to the consumers' preference, expected sweetness, and expected creaminess of a milk chocolate as well as if the various effects interact. Chocolate was chosen as the food product in this research for its appropriateness to evaluate crossmodal effects of packaging features, as it is so often consumed directly from the packaging, thus likely increasing the influence of visual aspects on consumer perception (Spence & Velasco, 2019). Specifically, the hypotheses were:

H1: Pink packaging, rounded typeface, milk splash, and curved shape will increase expected preference, sweetness, and creaminess.

H2: Colour is the most important attribute on all dependable variables and the word association task.

H3: Congruent attributes (e.g., pink, rounded, milk, and curved vs. black, angular, chocolate, and flat) will mutually enhance each other's effects whereas incongruent attributes will possibly cancel each other out.

H4: Results from this choice-based test will be similar to those from rating evaluations ~~from~~reported in previous studies.

~~These hypotheses were chosen because chocolate is an appropriate product to evaluate crossmodal effects of packaging features, as it is so often consumed directly from the packaging, thus likely increasing the influence of visual aspects on consumer perception (Spence & Velasco, 2019).~~

The first hypothesis is based on ~~S~~studies that have already shown that the colour of chocolate packaging can influence healthiness, naturalness, and perceived tastiness (van Lith, 2015), expected sweetness, bitterness, creaminess, and liking (Baptista et al., 2021), and expected and perceived bitterness and sweetness (Sugimori & Kawasaki, 2022). Furthermore, background patterns, illustration, and colour saturation have also been shown to influence consumer preference (Kovač et al., 2019). The shape of chocolate has already been shown to affect people's expectations of sweetness, bitterness, and creaminess in chocolate (Baptista et al., 2022; Wang et al., 2017; cf. Juravle, Olari, & Spence, 2022), and also perceived creaminess (Baptista et al., 2022; see also Spence, 2014). No previous study on the effects of a milk or liquid chocolate splash on chocolate packaging has been published, although the presence, or nature, of images on packaging have been shown to influence willing to buy and expected freshness, naturalness, novelty

and tastes (Machiels & Karnal, 2016; Pantin-Sohier & Miltgen, 2012; Rebollar et al., 2017; Smith et al., 2015).

The second hypothesis relates to previously published research indicating that colour is the most important visual aspect of a packaging or plates of passion fruit juice (Deliza & MacFie, 2001), milk desserts (Ares & Deliza, 2010), strawberry mousse (Piqueras-Fiszman et al., 2012), wine (Heatherly et al., 2019), juice, sorbet, and gum (Matthews et al., 2019), savoury and sweet cookies (da Rosa et al., 2019) and coffee (Sousa et al., 2020a). This will be the first study to combine four visual variables at the same time, making it closer to a real packaging in which multiple cues interact. As two of the variables are shape related (i.e. chocolate shape and typeface), there could be a synergy effect between them to overcome colour dominance of effect. Also, illustrations or ingredient photos have been shown to influence consumer preference (Ares et al., 2016; Deliza & MacFie, 2001; Gvili et al., 2015; Kovač et al., 2019; Piqueras-Fiszman et al., 2012; Piqueras-Fiszman et al.'s, 2013) but none of the previous studiesy tested colour and illustrated ingredient at the same time.

The third hypothesis addresses gaps in the few recent studies that tested two or more visual variables combined, usually colour, shape, background patterns, and/or typeface, on a food or beverage packaging (for reviews: Matthews et al., 2019; Velasco & Spence, 2019a). First, most of the studies that have tested for two or more visual cues on packaging did not analyse for interactions (Ares & Deliza, 2010; Ares et al., 2016; Kovač et al., 2019; da Rosa et al., 2019; Sousa et al., 2020a; van Lith, 2015) or else reported null results (Becker et al., 2011; Heartherly et al., 2019; Matthews et al., 2019; Piqueras-Fiszman et al., 2012). Second, none went as far as evaluating four different visual variables together in athe same test (Piqueras-Fiszman et al., 2013, tested four variables, but not all of them were visual in nature), so the interactions between them and hierarchy

among them have not been thoroughly studied yet. Third, despite evidence of crossmodal interactions between visual aspects and texture attributes (Ares & Deliza, 2010; Baptista et al., 2021; Baptista et al., 2022), no study tested quantitatively the effects and interactions of more than one visual attribute on texture.

~~To test these hypotheses, t~~To the best of the authors' knowledge, this research was the first ~~chose~~ to use a choice-based task ~~conjoint analysis~~instead of a rating task to measure crossmodal effects on taste and texture expected intensity, which lead to the fourth hypothesis ~~complemented by a word association task~~. According to Almli and Naes (2018), the term conjoint analysis is a generic expression for those experimental studies that are designed to better understand the consumer's preferences amongst products that combine specific attributes manipulated in different levels. The choice-based method was chosen over the rating-based because the first allows the participants to evaluate pictorial stimuli in a quick, impulsive, and holistic manner, thus making it possible to combine a full-factorial sample design and a complete block set design (for more on their differences, see Almli & Naes, 2018; Ares et al., 2016). This method is appropriate for those products, such as chocolate, that are typically bought without much thought, or rational comparison, between different product offerings.

Traditionally, conjoint analysis has been used to assess preference or willingness to pay and so better mimic the situation found in the marketplace (Rao, 2014). The result is usually the measure of utility, or how much each attribute contributes to the consumers' overall acceptability or willingness to purchase (WTP) a product. In the present research, conjoint analysis was used to measure not only the preference but also the crossmodal influence of visual cues on taste and texture expectations. It has been suggested that crossmodal correspondences can be considered as arbitrary statistical correlations in the marketplace between stimuli from different senses, such as a specific colour (e.g., pink)

and a particular taste (e.g., sweet), a shape and a sound (e.g., see Spence, 2011; Spence & Levitan, 2021).

While choice-based conjoint analysis has already been used to assess healthiness (Annunziata & Vecchio, 2013) and emotional responses (Jervis et al., 2014), it has not been used to evaluate crossmodal effects. Sensory attributes were assessed in choice-based conjoint studies as treatments, for example, with samples varying in sweetness, seasoning, or flavour intensity (de Andrade et al., 2016, Endrizzi et al., 2011; Enneking et al., 2007, Hoppert et al. 2012). It has also been used by Velasco et al. (2014)~~, as already mentioned,~~ to measure how long participants took to make a decision of the appropriateness of the taste, and by Wan et al. (2014) to assess colour-taste crossmodal correspondences (i.e., participants consciously and inductively are asked to match taste and colours), but not effects (i.e., visual aspects likely unconsciously affects taste intensity expectation). The use of a choice-based task to measure crossmodal effects was deemed valid as traditional methods such as paired comparison, triangle tests, or ranking also require the participants to assess sensory intensity through choice (Lawless & Heymann, 2010). ~~Consequently, a fourth hypothesis was added to the study:~~

H4: Results from this choice-based test will be similar to those from rating evaluations from previous studies.

Finally, ~~T~~this research also used a qualitative method to enrich the results and further explore the quantitative data concerning preference, as did Ares and Deliza (2010) in a very similar study with the shape and colour of milk dessert packaging. Open text analysis has already been shown to deliver comparable results to internal preference mapping (ten Kleij & Musters, 2003), helping researchers to identify and understand the drivers for consumers' preferences in the context of complex products. In a word association task, participants write a few words that first come to mind when prompted with

a verbal and/or visual stimulus (Mesías & Escribano, 2018). Just as the choice-based task, word association is supposed to be fast, instinctive, and spontaneous, thus providing 'relatively unrestricted access to mental representations of the stimulus' (Ares & Deliza, 2010, p. 930), again appropriate for chocolate purchase decisions.

2. Material and methods

2.1 Ethics

This study was approved by the University of Campinas' Ethic in Research Ethics Committee of the University of Campinas (protocol 20489019.4.0000.5404). All of the participants were asked to read and sign an informed consent form prior to taking part in the research.

2.2 Stimuli

Following Ares et al. (2011), ~~a~~ market research was undertaken co~~f~~ncerning commercial packaging features ~~was created by surveying.~~ Specifically, milk chocolate bars that were available in the four main supermarkets in Campinas, Brazil were surveyed. To narrow the research in the biggest and most common market segment (Sebrae, 2018), only industrial chocolates made in Brazil and available in more than one supermarket chain were included. Six different brands were found and an analysis of their packaging revealed five visual design elements, as shown in **Table 1**. They were all horizontal, metallic packaging, full coloured, with brand on the left upper corner, 90 g weight, chocolate picture, milk/melted chocolate splash etc.

Two levels for each of the four attributes were chosen: colour (pink/black), typeface (angular/round), ingredient (milk/melted chocolate), and chocolate shape (straight top/curved top). Because background patterns were present in only one of the packaging exemplars, and in order to limit the number of variables to four, this was not included as a variable in the study. An earlier study with chocolate packaging and Brazilian consumers (Baptista et al., 2021) had already revealed that pink packaging elicited the sweetest taste expectations, while black elicited the least sweet expectations. Another previous test (Baptista et al., 2022) found that Brazilian consumers not only expected, ~~and~~but also perceived, rounded chocolates to be creamier than squared chocolates. Angular and rounded typefaces on packaging have also been shown to influence participants' coffee taste expectations in Brazil (see Sousa et al., 2020b). Finally, no study on the presence of ingredients images in chocolate packaging has been published to date, so the two options found in the benchmark were used, milk or melted chocolate.

A design studio (Atucana, Porto Alegre, Brazil) created 16 mock-ups that covered all possible combinations of the four key attributes and their two levels each, as shown in **Table 2**. The pictorial stimuli emulated the typical industrial Brazilian chocolate bar and the attributes and levels were carefully designed to look natural to a Brazilian consumer and to be as equivalently visible as possible (Almli & Naes, 2018).

2.3 Participants

The participants were recruited through posts on social media groups related to the University of Campinas (Unicamp) and emails to staff and students from Unicamp's School of Food Engineering. The respondents were also encouraged to share the research invitation with their friends and relatives. The invitation only explained that participants had

to be chocolate consumers over 18 years old and that they were going to 'answer a questionnaire about chocolate'. During the last two weeks of October 2021, 507 chocolate consumers answered the online questionnaire using their own devices (i.e., smartphones, tablets, or computers), but to keep the sample design balanced only the first 480 respondents were considered.

2.4 Data collection

The questionnaire was designed and hosted on Compusense Cloud (Compusense, Guelph, Canada) and had four sections in the following order: preference, word association task, sweet/creaminess evaluation, and participant demographics. This order was chosen so preference was unbiased by rationalisations derived from asking for associated-words, sweetness, and creaminess. For the same reason, word association tasks were presented prior to the sweetness and creaminess evaluations. The pair-choice task was chosen over a rating task, both because it is faster and more instinctive, thus keeping the full-factorial design and the expected time of participation ~~down~~ to under five minutes.

In the first section, in a pair-choice task (Almli & Naes, 2018), the participants were shown four pairs of samples, one pair at a time, and asked to imagine that they would eat one of them and to answer the following question: 'Which of the two would you choose?'. Subsequently, the participants were monadically shown two packages of chocolate and asked to 'write the first three words that come to mind when you see this chocolate' (Rodrigues et al., 2020). Only four out of the 16 packages were evaluated in this task (see **Figure 1**), ~~S~~since it ~~i~~was deemed a ~~a~~ complementary task designed to offer some qualitative interpretation of the answers to the hypothesis of this study, ~~O~~only ~~four out of~~

~~the 16 packages were evaluated in this task (see **Figure 1**)~~. Samples 2, 7, 12, and 13 (see **Table 2)** were chosen so each level of each treatment appeared in half of them.

In the third step of the test, the participants were shown another set of four pairs of stimuli, one pair at a time. They were asked 'Which one do you think is the sweetest?' and 'Which one do you think is the creamiest?'~~.~~ Choice was mandatory in both Sections 1 and 3, because we were not interested in market penetration, all participants confirmed that they were chocolate consumers (Asioli et al., 2016), and they were asked for a hypothetical preference or an instinctive guess concerning the sensory profile of the chocolate.~~-~~

The sample set was designed to show all 16 samples to all participants (complete block design), eight in the first section and the other eight in the third section. It was also designed to balance the pairing between samples, showing each of the 240 possible pairs twice. However, as 240 is not divisible by eight, the pairs could not be balanced in each of the eight positions. Following the informal statement 'block what you can, randomise what you cannot' (Medeiros et al., n.d.), the position was randomised and the order of the pairs were folded over for the second half (241-480) of the sets, generating a choice design without overlaps (Johnson et al., 2006) to reduce any order effects.

In the fourth and final section of the questionnaire, personal information was collected~~.~~ ~~This~~ includ~~ed~~ing the participant's frequency of chocolate consumption ~~frequency~~ (monthly, biweekly, weekly, or daily), the usual type of chocolate eaten (white, milk, semisweet, and/or dark), as well as their age, gender, and education level.

2.5 Statistical analysis

Statistical analysis was conducted on R 4.1.2 (R Core Team, 2021) and RStudio 2021.09.0 (RStudio Team, 2021), unless otherwise stated.

2.5.1 Choice-based analysis

Data from the choice-based task was analysed through Mixed Logit (ML) Model, a discrete choice model (DCM) that allows the inclusion of 'random parameters of any distribution and also correlations between random factors' which 'intrinsically models preference heterogeneity, i.e., interindividual preference variations' (Asioli et al., 2016, p. 177). The ML Model was run by the mlogit package (Croissant, 2020) with adapted scripts from Feit et al. (n.d.). The analysis checked for individual and interaction effects of colour, typeface, ingredient, and shape. It also checked for individual effects of age, gender, educational level, type of chocolate usually consumed, and frequency of chocolate consumption of the participants. The utility ML model chocolate j for individual i in choice occasion t is written:

$$U_{ijt} = \beta_{1i}Colour_{ijt} + \beta_{2i}Face_{ijt} + \beta_{3i}Ingredient_{ijt} + \beta_{4i}Shape_{ijt} + \beta_{5i}(Colour*Face)_{ijt} + \beta_{6i}(Colour*Ingredient)_{ijt} + \beta_{7i}(Colour*Shape)_{ijt} + \beta_{8i}(Face*Ingredient)_{ijt} + \beta_{9i}(Face*Shape)_{ijt} + \beta_{10i}(Ingredient*Shape)_{ijt} + \beta_{10i}Age_{ijt} + \beta_{11i}Gender_{ijt} + \beta_{12i}Educ_{ijt} + \beta_{13i}Type_{ijt} + \beta_{13i}Freq_{ijt} + \varepsilon_{mjt}$$

~~The relative importance of the attributes (Hair et al., 2019) was calculated using Google Sheets (Google, MountView).~~

2.5.2 Word association analysis

The data from the word association task were stemmed by the package tm (Feinerer et al., 2018). As in Symoneaux et al. (2012), there were many synonyms that expressed essentially the same, or similar, meanings, so three researchers independently grouped the stemmed words according to their semantic and contextual understanding of them. To evaluate their reliability (Hallgreen, 2012), Fleiss' kappa scale of agreement (Fleiss, 1971) was run by the package irr (Gamer et al., 2019). The three researchers then gathered to discussed their groupings disagreements and converged to a consensus on the final groups (Rodrigues et al., 2020). The final list of grouped words was then ordered by frequency using the dplyr package (Wickham et al., 2021). Correspondence analysis (CA) was run on the contingency table (stimuli x categories) using the package FactorMineR (Lê et al., 2008). Only those groups appearing more than 27 times (1% of total entries) across the stimuli were included in the analysis.

3. Results

3.1 Participants

The 480 participants were all between 18 and 69 years old of age (mean = 31.54 y.o., s.d. = 10.54 y.o.). As shown in **Table 3**, they were mostly highly educated, ate chocolate weekly or daily, and preferred milk or semisweet chocolate. Mixed logit revealed some significant correlations between age and preference (older participants preferred the chocolate splash, estimate = 0.50±0.19, $p < .01$), frequency of consumption and sweetness (participants that eat chocolate once a month evaluated chocolates packed in pink as sweeter, estimate = -0.37±0.13, $p < .01$), education level (postgraduates thought pink was sweeter, estimate = 0.88±0.28, $p < .01$). No difference between gender was

found, nor for creaminess. **Figure 2** shows a CA factor map of demographic groups and preference for treatments. Group age between preferred the chocolate splash, participants that eat chocolate less regularly (monthly) preferred the black packaging, participants that usually eat white and milk chocolate preferred more the pink packaging.

3.2 Choice-based results

The Mixed Logit Model indicated significant effects of colour, typeface, and ingredient on preference; colour and chocolate shape on sweetness; and chocolate shape on creaminess, as shown on **Table 4**. Participants preferred the chocolate in black packaging, rounded typeface, and with a chocolate splash. They also expected a sweeter and creamier chocolate when the shape of the chocolate was curved. They also expected a sweeter product when the packaging was coloured pink (see **Figure 3** for main effects). Only two significant interactions between attributes were found, colour:ingredient and colour:shape, both on sweetness. When the packaging was pink, participants chose the milk splash and the rounded shape more often. ~~**Table 4** also shows the relative importance of attributes indicating that while chocolate shape was the main attribute for creaminess, colour was the most important attribute for sweetness and preference.~~

3.3 Word association results

The word association task collected 2,781 entries that were stemmed into 332 stems. ~~and grouped into 133 different word groups.~~ Three researchers grouped the stems independently and Fleiss kappa indicated a fair agreement between the researchers ($\kappa = .683$) that was not reached by chance ($p < 0.001$). The researchers then gathered to discuss the grouping differences and consensually decided to ~~keep some words in unitary~~

~~groups, for instance, 'cocoa' (as an ingredient), instead of grouping this word with 'chocolate' (as a product), despite the semantic proximity. On the other hand, words expressing a very similar meaning were grouped together. The aim was to~~ avoid overgrouping and ~~an ultimate~~ loss of information. Therefore, most from the 133 final word groups ~~most groups~~, such as 'sweet', 'milk', 'strawberry', 'bitter', 'creamy', 'mild', 'dark', and 'chocolate', ~~have~~ comprise a small or non-existent ~~word~~ diversity of words. A few groups have some word diversity, as examples: 'tasty' includes 'flavourful', 'delicious', and 'pleasant'; 'attractive' includes '[I] want [it]', '[I] desire [it]', '[it] stands out', '[I] wish [it]', '[I'd] eat [it]', and '[I'd] buy [it]'; 'strong' includes 'intense'; and 'hard' also includes 'firm', 'resistant', and 'rigid'.

Table 5 shows the 10 most used words for each sample and **Figure 4** shows the correspondence analysis factor map. The first dimension accounted for 81.28% of the data and the y-axis for 10.71%, combining to explain 91.99% together. The x-axis separates samples by colour, pink samples on the left and black samples on the right. The pink packaging samples were strongly associated with the terms 'pink', 'strawberry', and 'childish'; the black packaging samples were strongly associated with the terms 'strong', 'bitter', and 'dark'. The y-axis separates samples by ingredient and shape, the two samples with chocolate splash and flat shape are above, while the two samples with milk splash and curved shape are below. While the words 'sugar', 'chocolate', and 'attractive' are related to the two first, the words 'milk' and 'simple' were associated with the last two.

4. Discussion

Regarding the first hypothesis, the results confirmed that: the participants expected the chocolate packaged in pink to be significantly sweeter than the chocolate presented in

the black packaging; the chocolate in the packaging with the rounded typeface was significantly preferred over the one with angular typeface; and the curved chocolate shape made the samples look significantly sweeter and creamier than the samples displaying a flat-shaped chocolate. In addition, it was rejected that the pink packaging and the milk splash would be preferred over the black packaging and the chocolate splash, respectively.

Previous studies reported that black packaging (Ares & Deliza, 2010) and –black plateware (Piqueras-Fiszman et al., 2012) may significantly reduce people's preference for desserts. Nevertheless, black packaging has already been shown to increase the expected liking of milk chocolate among participants with a similar profile to those tested here (Baptista et al., 2021). Interestingly, the latter study also found that the same black packaging was the least preferred when the chocolate was dark, showing that the effect of packaging colour on preference depends on the type of chocolate. They argued that the black packaging might make the milk chocolate look richer in cocoa and not too sweet (Baptista et al., 2021). The preference for the chocolate in black packaging might also be explained by the profile of the participants, as they were mostly highly-educated and preferred semisweet chocolate, not reflecting the typical Brazilian preference for milk chocolate (Sebrae, 2018). These consumers might as well be influenced by the general association that has been shown to exist between black packaging and luxury/premium products (Velasco & Spence, 2019c).

The lack of significant effect of chocolate shape on expected preference contrasts with a previous study by Wang et al. (2019). Together with the significant effect of shape on creaminess and sweetness, it indicates that the participants did not initially pay attention to the shape of the chocolate (in amongst the other, possibly more salient, visual design cues). Only after they had been asked specific questions about the sensory

attributes of the chocolate (creaminess and sweetness), did they instinctively search for direct cues about it and paid attention to the image of the chocolate on the front of the packaging. This behaviour contrasts with Piqueras-Fiszman et al.'s (2013) suggestion that food images draw most of a consumer's visual attention. Maybe this effect is true only for fresh/moving food or ingredients (Gvili et al., 2015; Kovač et al., 2019), but then, the milk/chocolate splash should have had a more important effect in the present study (for another null effect, see Mulier et al., 2021).

An alternative explanation for the results might be linguistic, as 'chocolate' may refer just to the foodstuff but also to the package (packaging + foodstuff). In this way, when asked 'which of the two [chocolate] would you choose?' participants evaluated which package they preferred based on packaging aesthetics. This scenario is even more probable in a completely online test, as the participants only have the packaging design as stimuli. It is relevant to note that none of the previous studies asked participants how much they liked the packaging design or even discussed the influence of aesthetics on preference.

If it is understandable that participants who like darker chocolate preferred the chocolate splash over the milk splash, it is against the authors' expectations that the milk splash did not increase the expected sweetness and creaminess, since the addition of milk normally results in a milder, creamier, and sweeter chocolate. Yet, the preference for a chocolate splash might not be specific for the consumers that prefer darker chocolate, since a market study of mainstream brands (see **Table 1**) showed that three of them display a chocolate splash and only one displays a milk splash. The CA (**Figure 4**) may help understand why, as it indicates that the milk splash was associated with 'simple', while the chocolate splash was related to terms like 'creamy' and 'attractive'.

As for the second hypothesis (**H2**), colour was ~~the~~ a major influence on participants' preference and sweetness expectations, adding evidence to the understanding that colour is the main attribute in a packaging (see Spence & Velasco, 2019, for a review). In this experiment, the background color fills a larger area than the other variables individually, ~~Many~~ but many experiments that tested effects of colour hue and shape (either shape of the packaging, the background pattern or the typeface) also found similar results (Ares & Deliza, 2010; Deliza & MacFie, 2001; Matthews et al., 2019; da Rosa et al., 2019; Sousa et al., 2020a). It is interesting to note that, although tests were independent, Kovač et al. (2019) found a slightly stronger effect of image (photograph or illustration) than of colour saturation, so the dominance of colour might be more a dominance of colour hue, but not necessarily of saturation or brightness.

Regarding the word association task, the participants correlated colour with flavours ('strawberry', 'chocolate'), tastes ('sweet', 'bitter'), ingredients ('sugar', 'cocoa'), intensity ('mild', 'strong') and other concepts ('childish'). Another similar study (Ares & Deliza, 2010) has shown a stronger dominance of flavour words ('chocolate', 'vanilla', 'dulce de leche') associated to milk dessert packaging colour, possibly because their product (milk dessert) can be found with different flavours in the marketplace. Along with the results on colours and odours from Heatherly et al. (2019), it is possible to hypothesise that colour, more than correlated to tastes, is correlated to flavours. As most studies did not assess tastes and aromas together (one exception is Baptista et al., 2021), future research could evaluate how much each contributes to the crossmodal correspondence of flavour with colours.

The clear dominance of colour on preference, sweetness expectation, and word association turns the lack of significant effect of hue on expected creaminess even more interesting. This finding contributes to the idea that there may be a halo effect when the

colour of a chocolate packaging affects the expected texture and when the chocolate shape affects the expected taste (see Baptista et al., 2021; Baptista et al., 2022; Wang et al. 2019). So, a ‘sweet’ colour may well result in a chocolate that looks creamier because participants correlate sweetness with creaminess, a rounded chocolate looks sweeter because it is expected to be creamier (Ngo & Spence, 2011). Velasco et al. (2015) already discussed the indirect nature of taste and shape correspondences, arguing it could be mediated by hedonics: the rounded shapes and sweet tastes are preferred, therefore associated. This relationship might not be specific for chocolate, as Ares and Deliza (2010) also showed that the shape of milk dessert packaging was more strongly correlated with texture on the word association while the colours were more correlated to flavours.

It is possible that the presence of both independent variables (colour and shape) and both dependent variables (sweetness and creaminess) in the present study cancelled the halo effect. This would also explain why colour muffled the effects of the angular/rounded background patterns on sweet and sour taste on Matthews and colleagues’ (2019) second test. Maybe, if they (and other studies such as Ares and Deliza, 2010; Becker et al., 2011; Fairhust et al., 2015; Piqueras-Fiszman et al., 2012; da Rosa et al., 2019; Sousa et al., 2020a; Velasco et al., 2014) had also evaluated a texture attribute, the shape would not significantly affect tastes, but would influence expected texture. Contributing to this idea is that when Cadbury changed the shape of its milk chocolate from angular to rounded, one of the top complaints from consumers was that it became creamier than it used to be (Spence, 2014).

The idea that ‘colour is to taste’ what ‘shape is to texture’ could explain why packaging colour is consistently more relevant to preference than shape (see Spence & Velasco, 2019, for a review). One exception is Tijssen et al. (2017), in one of their tests the packaging colour influenced only dairy drink creaminess. One explanation is that colour

had great effect on taste and liking expectations that were cancelled by contrast of two identical products. Then, if the flavour is more important for the consumer than texture in most food and beverage products (Delwiche, 2003), it is natural that the visual aspect related to flavour (colour) is more relevant to preference than the one associated with texture (shape). In the present study, it would mean that consumers are more concerned about the chocolate being filled/flavoured with strawberry or strongly bitter than if the chocolate is a bit more, or less, creamy. That is corroborated by the spontaneous association of the pink packaging with ‘strawberry’ and the black packaging with ‘bitter’ and ‘strong’.

It would be interesting to check if these results would be reproduced in other cultures, since there is a learned dimension to the meaning of colour (Spence & Velasco, 2019; Wheatley, 1973) and Wan et al. (2014) demonstrated how taste correspondences with shapes and colours vary between cultures. Perhaps the effects of the visual variables in different cultures could be correlated to the design of popular brands in each country. As examples, the distinctive purple colour of Cadbury may have a specific effect in United Kingdom, while the angular and retro design may be more appealing for those who grew up eating Hershey’s bars in the USA, and the milk splash and curved typeface might be more important for continental Europeans used to Lindt packaging design.

The third hypothesis was mostly rejected as there were only two interactions between attributes: colour*ingredient and colour*shape, both on sweetness. Their specificity indicates that they might be more related to visibility than to integration of crossmodal effects. That is, by colour contrast, the brighter pink background makes the chocolate splash more visible and highlights the chocolate shape than the dark black packaging. Therefore, in general, participants made independent evaluations of visual cues and the global effect was a mere sum of effects (Jonas et al., 2017). This is relatable

to the findings from Piqueras-Fiszman et al. (2013), since they found only one interaction, between the berry picture and the jar surface in their study. They also hypothesised that this interaction was due to attention/visibility, arguing that the ridged surface disputed the attention with the berry picture and decreased the latter's effect.

The fourth hypothesis was confirmed, as the results found by the choice-based task were similar to previous studies that used rating tasks, indicating that the method can be used to evaluate not only preference, but also crossmodal effects of visual cues on expected taste and texture. Similar effects of colour on expected sweetness were reported by both Baptista et al. (2021) and Sugimori and Kawasaki (2022). The shape of chocolate was already shown to affect expectations of sweetness and creaminess in chocolate in studies by Wang et al. (2017) and Baptista et al. (2022). Besides the similarities already discussed with studies that tested for packaging colour and shape in other food products such as Ares and Deliza (2010), Matthews et al. (2019), da Rosa et al. (2019), and Sousa et al. (2020a). Finally, it would be relevant to test the effects reported here on actual tasting, since packaging colour and chocolate shape have already been shown to influence post-tasting ratings of 'tastiness' (van Lith, 2015), tastes (Sugimori & Kawasaki, 2022; though see also Wang et al., 2017), and texture (Baptista et al, 2022).

This study was limited to popular Brazilian milk chocolate packaging, its variables and treatments, expectations stated ~~through~~ via an online questionnaire, and mostly highly educated female Brazilian chocolate consumers. Yet, the results are relatable to similar studies condonucted with milk desserts in Uruguay (Ares & Deliza, 2010), yoghurt in Germany (Becker et al., 2011), jam jars in Spain (Piqueras-Fiszman et al., 2013), chocolate in the Netherlands (van Lith, 2015), Belgium (Wang et al., 2017), Croatia (Kovač et al., 2019), and Japan (Sugimori & Kawasaki, 2022), cookies in Brazil (da Rosa et al., 2018), wine in the USA (Heatherly et al., 2019), juice, gum and soda in the U.K. (Matthews

et al., 2019), coffee in Brazil (Sousa et al., 2020a; Sousa et al., 2020b), so they might be useful for food and beverage packaging in general.

Conclusions

This research presents three main new contributions to the literature on the visual aspects of packaging design. First, the inclusion of a texture descriptor as a dependent variable strengthened the discussion on colours being more crossmodally linked to flavours, while shapes were linked to texture. The combination of four treatments with two levels each highlights that the crossmodal effects of visual cues in chocolate packaging are mostly independent of one another, unless they happen to influence visibility. Finally, the results encourage the use of choice-based tasks to test crossmodal effects, particularly of products bought impulsively with a fast decision making process. Besides better emulating a real market situation, it requires less time and less effort from participants, allowing more complex stimuli with more variables, without giving up on a full factorial design. Further studies could include chocolate type as an independent variable, aromas as a dependent variable, test other food and beverage products and other cultures, and research how much of these effects on expectations are carried over to actual perception when consumers taste the product.

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Tables

Table 1 - Market research of visual elements in industrial chocolates found in supermarkets from Barão Geraldo, Campinas, Brazil.

	Brand 1	Brand 2	Brand 3	Brand 4	Brand 5	Brand 6
Colour	Red	Blue	Yellow	Brown	Blue	Orange
Chocolate shape	Rounded	Rounded	Rounded	Angular	Rounded	Rounded
Typeface	Rounded	Angular	Rounded	Angular	Angular	Rounded
Splash Patterns	Milk None	None Angular	Chocolate None	None None	Chocolate None	Chocolate None

Table 2 - Full factorial design of the four treatments and the two levels associated with each.

Sample #	Colour	Typeface	Splash	Shape
1	Pink	Rounded	Milk	Flat
2	Pink	Rounded	Milk	Curved
3	Pink	Rounded	Chocolate	Flat
4	Pink	Rounded	Chocolate	Curved
5	Pink	Angular	Milk	Flat
6	Pink	Angular	Milk	Curved
7	Pink	Angular	Chocolate	Flat
8	Pink	Angular	Chocolate	Curved
9	Black	Rounded	Milk	Flat
10	Black	Rounded	Milk	Curved
11	Black	Rounded	Chocolate	Flat
12	Black	Rounded	Chocolate	Curved
13	Black	Angular	Milk	Flat
14	Black	Angular	Milk	Curved
15	Black	Angular	Chocolate	Flat
16	Black	Angular	Chocolate	Curved

Table 3 - Demographic and chocolate consumption profile of the 480 participants. Type of chocolate usually consumed sums to more than 100% because participants could check all that applied.

Gender		
	n	%
Female	350	72.92%
Male	129	26.88%
Non-binary	1	0.21%
Education level		
High School	22	4.58%
Graduate	205	42.71%
Postgraduate	253	52.71%
Frequency of chocolate consumption		
Monthly	8	1.67%
Biweekly	87	18.13%
Weekly	257	53.54%
Daily	128	26.67%
Type of chocolate consumed (CATA)		
White	117	24.38%
Milk	244	50.83%
Semisweet	281	58.54%
Dark	141	29.38%

Table 4 - Estimated parameters, standard error, and p-value for ML model with main effects and interactions, and the relative importance of the four conjoint variables on expected creaminess, sweetness, and preference. p-values followed by * were significant at 5%, ** at 1%, and *** at 0.1%, respectively.

	Estimate	Std. Error	p-value
Main effects - Preference			
Pink colour	-1.41	0.20	1.79e-12 ***
Rounded type	0.56	0.20	5.73e-03 **
Milk splash	-0.41	0.19	0.03 *
Curved shape	0.25	0.19	0.19
Main effects - Sweetness			
Pink colour	1.51	0.21	1.56e-12 ***
Rounded type	0.04	0.21	0.85
Milk splash	-0.27	0.21	0.20
Curved shape	0.78	0.23	5.69e-04 ***
Main effects - Creaminess			
Pink colour	-0.10	0.18	0.59
Rounded type	0.35	0.19	0.06
Milk splash	-0.26	0.18	0.15
Curved shape	0.80	0.19	2.16e-05 ***
Interactions - Preference			
Colour*Type	0.02	0.28	0.92
Colour*Splash	0.46	0.28	0.10
Type*Splash	0.00	0.28	0.99
Colour*Shape	0.13	0.28	0.64
Type*Shape	0.13	0.29	0.65
Splash*Shape	0.10	0.27	0.73
Interactions - Sweetness			
Colour*Type	0.48	0.30	0.11
Colour*Splash	0.92	0.30	0.02 **
Type*Splash	0.55	0.29	0.06
Colour*Shape	0.66	0.30	0.03 *
Type*Shape	0.50	0.30	0.11
Splash*Shape	0.28	0.32	0.38
Interactions - Creaminess			
Colour*Type	0.04	0.26	0.87
Colour*Splash	0.18	0.26	0.50
Type*Splash	0.06	0.26	0.81
Colour*Shape	0.24	0.26	0.36
Type*Shape	0.03	0.26	0.93

	Splash*Shape	0.30	0.27	0.25

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Table 5 - The 10 most used groups and their frequencies for the samples 2 (pink, rounded typeface, milk splash, curved shape), 7 (pink, angular typeface, chocolate splash, flat shape), 12 (black, rounded typeface, chocolate splash, flat shape), and 13 (black, angular typeface, milk splash, curved shape).

Sample 2	n	Sample 7	n	Sample 12	n	Sample 13	n
Sweet	114	Sweet	110	Tasty	105	Tasty	69
Milk	86	Strawberry	75	Bitter	63	Milk	68
Strawberry	77	Tasty	58	Creamy	59	Bitter	65
Tasty	48	Creamy	53	Sweet	53	Sweet	54
Creamy	47	Chocolate	43	Strong	45	Creamy	42
Mild	30	Milk	33	Chocolate	40	Hard	28
Soft	24	Attractive	24	Milk	28	Chocolate	26
Pink	24	Pink	21	Cocoa	27	Strong	25
Chocolate	23	Hard	19	Soft	22	Attractive	18
Childish	16	Soft	17	Dark	21	Dark	16

Figure legends

Figure 1: Packages presented in the word association task depicting all visual features used in the study: pink and black colours, rounded and angular typefaces, milk and chocolate splash, curved and flat chocolate shape.

Figure 2: Correspondence analysis factor map of the number of times each treatment (colour: “Pink” “Black”, typeface: “Rounded” or “Angular”, ingredient: “Milk” or “Chocolate”, and chocolate shape: “Curved” or “Flat”) was chosen by each demographic group (frequency of chocolate consumption: “Monthly”, “Bwe” = biweekly, “Weekly”, or “Daily”; preferred percentage of cocoa: “Low”, “Npref”, or “High”; Education: “HS” = high school, “Grad” = graduate, or “Post” = postgraduate; Gender: “Fem” or “Male”; Age groups: “Age1” = 18-25 y.o., “Age2” = 26-35 y.o., “Age3” = 36-45 y.o., “Age4” = over 46 y.o.).

Figure 3: Estimated parameters and standard error for main effects of colour, typeface, ingredient, and shape on expected preference, sweetness, and creaminess. Variables followed by * were significant at 5%, ** at 1%, and *** at 0.1%, respectively.

Figure 4 - Correspondence analysis factor map of the words cited at least 27 times (1% of the total entries) and the four samples evaluated on word-association task: 2 (pink/rounded/milk/curved), 7 (pink/angular/chocolate/flat), 12 (black/rounded/chocolate/curved), and 13 (black/angular/milk/flat).