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RUNNING HEAD: ON THE TASTE OF TYPEFACE

The role of typeface curvilinearity on taste expectations and perception

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ABSTRACT

People associate specific shape properties with basic taste attributes (such as sweet, bitter, and sour). It has been suggested that more preferred visual aesthetic features are matched to sweetness whereas less-preferred features are matched with tastes such as bitter and sour instead. Given the range of visual aesthetic features that have been shown to be associated with typeface designs, it would seem reasonable to suggest that typefaces might therefore be associated with specific taste properties as well. Should that be the case, one might then wonder whether viewing text presented in, say, a rounder typeface would also potentially influence the perception of sweetness, as compared to viewing the same information when presented in a more angular typeface. Here, we summarize the latest findings supporting the existence of a crossmodal correspondence between typeface features, in particular curvilinearity, and basic tastes. Moreover, we present initial evidence that suggests that, under certain circumstances, typeface curvilinearity can influence taste ratings. Given such evidence, it can be argued that typeface may well be an important, if often neglected, aspect of our everyday lives which can be potentially useful in the design of food and drink product and brand experiences.

KEYWORDS: CROSSMODAL CORRESPONDENCES; TYPEFACE; TASTE; DESIGN; PRODUCT.

> "*…the type faces, by their shape, size, texture and the character of their lines may carry a certain atmosphere about them...*" (Poffenberger & Franker, 1923, p. 328)

1. Introduction

We are frequently exposed to different kinds of typefaces and fonts[1] in our everyday lives, though rarely do we give it a second thought. In fact, one need only note that whenever we read something we will likely have been exposed to a specific typeface (see **Figure 1** for examples). However, the possible influence of different typeface, and their respective connotations, on those who see/read them has garnered surprisingly limited attention from researchers to date (McCarthy & Mothersbaugh, 2002). In fact, up until very recently, only a handful of studies had attempted to assess the connotations of specific typefaces as well as their impact on people's behaviour (e.g., Burt, Cooper, & Martin, 1955; Davis & Smith, 1933; Kastl & Child, 1968; Morrison, 1986; Poffenberger & Franke, 1923; Tannenbaum, Jacobson, & Norris, 1964, for early research; and Childers & Jass, 2002; Doyle & Bottomley, 2009; Walker, 2008, 2016a, for some more recent developments).

INSERT FIGURE 1 ABOUT HERE

Even in the absence of extensive research, however, historically it has been acknowledged that specific typeface can convey meaning over-and-above the words that are seen (Garfield, 2011). For example, in her famous 1930 essay 'The Crystal Goblet', Beatrice Warde compares typeface readability to the human voice and suggests that if three pages were set in

[1] According to Brownlee (2014), the difference between the words "typeface" and "font" goes back to the days of analog printing. In those days, a typeface referred to all the metal blocks that followed the same design principles (e.g., Arial) and which were needed to print any given text. A font, on the other hand, referred to specific sub-blocks of a typeface. For example, Arial 12pt in italics would be a different font from Arial 10 without italics, and Arial would be a different typeface relative to Times New Roman. Notably, whilst both professionals and experts seem to use the terms interchangeably, in some expert contexts the difference is still noted (Brownlee, 2014). At the outset, it is important to clarify that in the present article, we focus on typefaces and as such, we will stick to the term.

Fournier, Caslon, and Plantin typefaces it would be like: *'three different people delivering the same discourse—each with impeccable pronunciation and clarity, yet each through the medium of a different personality.'* (Warde, 1956, p. 138).

Importantly, almost any kind of written communication is now mediated by typeface (cf. Garfield, 2011; Hyndman, 2015). Indeed, since the arrival of the printer, laser printer, and personal computers, there are now a wide range of typeface designs (perhaps more than 100,000 according to Garfield, 2011), and many more under development, that are available and used by consumers, designers, artists, and marketers in order to communicate (even if based on intuition) specific meanings (Henderson, Giese, & Cote, 2004). In the context of advertising, for instance, McCarthy & Mothersbaugh (2002) suggested that typefaces can influence consumers' semantic associations, message legibility, and ad look and feel through their aesthetic dimensions (style, size, x-height, weight, etc.), spacing (between letters and words), and layout (positioning of words and text blocks), which in turn can impact ad persuasiveness.

Perhaps unsurprisingly, then, a growing number of marketers and designers have become increasingly interested in the potential impact of carefully chosen typeface, as, for example, when deciding how to present the brand name, and other relevant information, on different marketing communications (e.g., see Batra, Seifert, & Brei, 2015; Celhay, Boysselle, & Cohen, 2015; see also Anon., 2012; https://www.daltonmaag.com/; www.typetasting.com; Larson, 2015; Setalvad, 2015). Crucially, the evidence published to date suggests that the physical attributes of a given typeface (e.g., whether it is more rounded or angular, light or heavy, etc., see **Figure 2** for examples of typeface attributes; see also Van Leeuwen, 2006) can prime certain notions in the mind of whoever happens to be reading, or even just viewing, the text (e.g., Grohmann, Giese, & Parkman, 2013; Gump, 2001; Henderson et al., 2004; Juni & Gross, 2008; Karnal, Machiels, Orth, & Mai, 2016).

INSERT FIGURE 2 ABOUT HERE

Researchers have even started to look at the consistency (or congruency) between design elements, and their connotations, such as the curvilinearity of the typeface and a brand's logo, and its consequences for the evaluation of a brand by the customer (e.g., see Klink, 2001,

2003; Van Rompay & Pruy, 2011; see also Poffenberger & Franken, 1923; Walker, Smith, & Livingston, 1986, for the appropriateness of typeface to a given brand concept). Certainly, typeface can convey meaning, no matter whether in a business-to-business or business-to-consumer interaction (e.g., Salgado-Montejo, Velasco, Olier, Alvarado, & Spence, 2014; see also Doyle & Bottomley, 2004, 2006, 2011).

The psychological effects of typeface on perception and behaviour have been a topic of scientific interest for almost a century now (e.g., see Davis & Smith, 1933; Morrison, 1986; Poffenberger & Franken, 1923, for some early examples). Nevertheless, to the best of our knowledge, the study of whether specific typeface could be used to convey taste information is something that has only been investigated recently. For that reason, in the present research we focus specifically on the ability of typeface to influence consumers' taste expectations and perception, something that is crucial in the context of food and drink-related marketing communications. In many circumstances, before people taste a food or drink product, they are exposed to the product's associated colours, shapes, pictures, words, and typefaces. These features play a critical role in setting consumer expectations about product qualities and can exert an effect on consumer behaviour (Machiels & Karnal, 2016; Mackey & Metz, 2009; Piqueras-Fiszman & Spence, 2015; Yiannas, 2015).

Here, we argue that there are systematic associations between typeface features and tastes. Moreover, we suggest that given that consumers often buy foods/drinks without tasting them first (at least on the first purchase), typeface can perhaps be one of the elements that helps to disambiguate which taste to expect when consuming a particular food or drink (cf. Walker, 2016). We also argue that under certain circumstances, typefaces can also guide the perception of a given taste. Think, for example, when a novel product is launched into the market (thus, a new product name with its corresponding typeface) or when an existing product changes the typeface of its logo/name. The different features of the typeface may contribute to create an overall sense of what taste to anticipate (as well as other product attributes), therefore, filling the missing information about the taste, which is not available until the product itself has been sampled (see **Figure 3**). With that in mind, we critically assess the existence of crossmodal correspondences (i.e., or association between features across the senses, see Marks, 1978; Spence, 2011) between both typeface features, in particular curvilinearity, and taste attributes (see Velasco, Woods, Hyndman, & Spence, 2015b, for an example).

INSERT FIGURE 3 ABOUT HERE

In this article, we begin by presenting a short overview of the available literature on taste/shape correspondences (e.g., see Spence & Deroy, 2013; Velasco, Woods, Petit, Cheok, & Spence, 2016c, for recent detailed reviews on the topic). We then move on to review the research that has been conducted in order to assess the association between typeface curvilinearity and gustatory (i.e., basic) tastes. Having established the existence of such taste-typeface associations, we then discuss whether viewing specific typeface also influences people's rating of that which they taste. We summarize the results of three recent studies conducted at different public events that were designed to assess the influence of typeface curvilinearity on taste ratings[2]. Finally, we draw some general conclusions and directions for future research. In particular, we refer to other crucial design elements, such as colour and symbolism of brand names, which may interact with typeface when it comes to the communication of taste information.

2. The taste of shape curvilinearity and other shape aesthetic features

A growing body of empirical research now demonstrates the widespread crossmodal correspondences that exist between curvilinearity and basic taste properties (e.g., Velasco, Salgado-Montejo, Marmolejo-Ramos, & Spence, 2014; Velasco, Woods, Deroy, & Spence, 2015a). In particular, a number of recent studies have highlighted the fact that if asked to rate taste words or a range of basic tastes in solution (and sometimes, more complex foods having a specific dominant taste, such as the sweetness of milk chocolate, say, the bitterness of dark chocolate, or the sourness of cranberry juice; e.g., see Becker, van Rompay, Schifferstein, & Galetzka, 2011; Ngo, Misra, & Spence, 2011; Spence, 2014; Spence & Deroy, 2013; Spence

[2] Note that while our focus, at least in the first instance, is on taste (meaning the gustatory properties of sweet, sour, and bitter), there is no reason why the same approach shouldn't be extended to the perception of fragrance, aroma, flavour, or for that matter, any other food or beverage with specific taste attributes. In fact, given that olfaction contributes the majority of what most people categorize as the taste experience (which is more precisely referred to as favour, see Spence, 2015, for a recent review) then there are good reasons for trying to convey and/or modify olfactory experience through typeface. In fact, the reason for starting with taste in our own research has simply been the wider agreement when it comes to the most obvious basic tastes. There is currently no such agreement when it comes to the classification of smells/aromas, say.

& Gallace, 2011) along a line scale anchored by a round cloud-like shape at one end and an angular star-like shape at the other (such as the traditional 'bouba' and 'kiki' shapes, see **Figure 4**), then most people will generally associate sweet with rounder shapes and bitter, sour and, to a lesser extent, salty with a shape that is more angular instead (see Velasco et al., 2016c, for a recent review)[3].

INSERT FIGURE 4 ABOUT HERE

The intensity and the hedonic value associated with a taste, have both been shown to relate with the aforesaid crossmodal mapping, however, these factors may not entirely explain the basic crossmodal matching phenomenon (e.g., Velasco et al., 2015a; Velasco, Woods, Liu, & Spence, 2016a). Nevertheless, research has also provided support for the idea that other aesthetic features that influence visual preference, such as symmetry and the number of elements in a shape (Palmer, Schloss, & Sammartino, 2013; Turoman et al., in press) can also influence taste/shape matches (e.g., Salgado-Montejo et al., 2015), which suggests that affect can correlate with taste/shape matches.

3. On the taste of typeface

Given that different typeface designs can also be categorized in terms of their curvilinearity, symmetry, orientation, and so on, one might consider the design of typeface specifically to convey taste as a natural progression of this growing body of published research on the topic of taste-shape correspondences. Note, however, that whilst this is a natural progression, there is also a key difference between typeface and more abstract shapes, that is, typefaces adorn written language, and therefore, they tend to involve semantic meaning. Moreover, while forcing people to pay attention to arbitrary shapes, as has been the case in some of the laboratory research (e.g., see Gal, Wheeler, & Shiv, 2007, for an example), can be seen as a somewhat unnatural situation, it is possible that people pay much closer attention to the

[3] One gets similar results if 'round' words, such as "Bouba" are used at one end of the scale and angular words, such as "Kiki", at the other (see Gallace, Boschin, & Spence, 2011; Ngo et al., 2011; Spence & Gallace, 2011).

typeface when reading text. That said, one might well consider whether, when reading, people are capable of focusing solely on the meaning of the text and somehow ignoring the specifics of the typeface used to communicate a given message (Gauthier, Wong, Hayward, & Cheung, 2006; Walker, 2008).

Whilst the research that has been published to date on the crossmodal correspondence between taste and typeface features is not extensive, it has been suggested that certain typefaces may be more appropriate for some products, or product categories, than others (Davis & Smith, 1933; Doyle & Bottomley, 2006; Poffenberger & Franken, 1923). Therefore, one may wonder whether specific products (e.g., chocolate or simply sugar) may be more strongly associated with a specific typeface than another (e.g., coffee or perhaps salt). This is important given that products and product categories (e.g., candies) tend to use specific typeface features or even specific lettering styles (e.g., just think of Coca-Cola's signature logo type, which belongs to the script style known as Spencerian).

Crossmodal correspondences are, however, somewhat different in that the correspondence between a visual feature (e.g., symmetry) and a taste (e.g., sweetness) may not necessarily apply to a single object, or object category, only, but rather to many objects and categories (cf. Deroy & Spence, 2016). That is, crossmodal correspondences may represent some more fundamental compatibility between features (Velasco et al., 2016c). With this idea in mind, it is worth noting that the study of the semantic connotations of typeface has provided indirect support for the correspondence of typeface features with taste. Given that this research may involve taste scales (e.g., anchored with sweet and bitter), closer inspection of the ratings of typeface reveals a possible tendency for people to associate round typefaces more strongly with dimensions aligned with sweetness (not surprisingly, perhaps, dimensions such as evaluation or emotional valence) as compared to angular typefaces (e.g., Doyle & Bottomley, 2010; Karnal et al., 2016; Kastl & Child, 1968).

Consistent with the aforementioned ideas, some of the first research to extend the idea of shape-taste correspondences from abstract shapes to the design of typeface was reported by Velasco et al. (2014). These researchers reported that a rounder typeface (e.g., Swis721 B1kRnd BT – Black, 44 pt, see **Figure 5A**) was judged as being more consistent with sweet-tasting products than with sour-tasting products and a more angular typeface (e.g., Hollywood Hills—Regular, 53 pt, see **Figure 5B**) as more consistent with sour-tasting products than with sweet-tasting products. On the basis of this work, it is possible to conclude

that, at least when judging the likely taste of a product, the curvilinearity of a typeface can modify the expected taste. This study only included two typefaces, which also differed in terms of other spatial properties such as the space between letters. However, as we will see below, these results have been replicated with a larger number of typefaces, and in several different languages and countries.

INSERT FIGURE 5 ABOUT HERE

To the best of our knowledge, only a few studies have evaluated the association between typeface curvilinearity and taste. In perhaps the first study of its kind, Velasco et al. (2015b) evaluated the basic taste association that people had with a range of round and angular typefaces, either presented in isolation, or else on the front of what looked like a Styrofoam hot drinks cup (see **Figure 6**, for a summary of the results associated with the typefaces presented on their own, which were largely similar to those including the cups). Again, rounder typefaces were found to be more strongly associated with sweet tastes than angular typefaces and angular typefaces with the other tastes when compared with round typefaces.

INSERT FIGURE 6 ABOUT HERE

Having demonstrated consistency in a varied sample of participants in terms of the taste associations with typeface (the majority of the participants in Velasco et al.'s, 2015b, study were recruited on Amazon's Mechanical Turk, which typically involves participants from the United States and India, see Woods et al., 2015), researchers recently went on to assess whether the curvilinearity of the typeface would carry the same taste connotation in different languages and cultures (see Velasco et al., in press). In this study, the aim was to test whether the association between taste and typeface curvilinearity would be consistent across countries and languages. If this was the case, it would possibly suggest that other properties of the words written (for example, their sound symbolic meaning or identity) would not necessarily be responsible for the crossmodal correspondence between taste and curvilinearity. In addition, Bremner et al. (2013) provided initial evidence for the idea that the Himba tribe of

rural Namibia were shown to express different carbonation-angularity and bitter taste-angularity associations than the Western participants tested in the majority of other studies (cf. Henrichs et al., 2010). Other research, however, has suggested that round shapes can similarly influence taste detection thresholds in different countries (e.g., Liang et al., 2016; Liang, Roy, Chen, & Zhang, 2013).

In Velasco et al.'s (in press) study, participants from South America (Colombia), China, and the UK were all presented with the phrase "eat me" in angular versus rounded and bold vs. regular typeface in three different languages, namely, Spanish, Chinese, and English (see **Figure 7**). Using an online testing platform (see Woods et al., 2015), the participants were requested to associate a specific taste with the various exemplars of their own typeface that were shown on the screen. The results demonstrated that regardless of the first language spoken by the participants, the curvilinearity of the typeface was distinctively associated with specific tastes; that is, round typefaces were more strongly associated with sweet taste and angular typefaces were more strongly associated with the other tastes. Whether a typeface used bold or not only had an effect on the Chinese participants' ratings with bold typefaces being rated as significantly more bitter, salty, and sweet than the regular typefaces.

INSERT FIGURE 7 ABOUT HERE

How should the aforementioned findings be explained? Velasco et al. (2015b) provided evidence suggesting that rounder typefaces may, overall, be easier to process and liked more than the angular typefaces. In line with Velasco et al. (2016c), it was also suggested that people may associate preferred typefaces (e.g., round) with preferred tastes (e.g., sweet) and less preferred typefaces (e.g., angular) with less preferred tastes (e.g., bitter), something that is correlated with the ease with which typefaces are processed.

Importantly, however, Velasco et al. (in press) also had their participants rate the typefaces in terms of liking, familiarity, and clarity. Whereas the results revealed a similar pattern of results for the participants from Colombia, China, and the UK, when the typefaces were written in Spanish and English, such a pattern was not necessarily consistent for the Chinese language typefaces. That is, the participants liked the round typefaces more, and evaluated them as more familiar and clear than the angular typefaces in English and Spanish, but not in

Chinese. Yet, the round typefaces were evaluated as sweeter than the angular typefaces in the three languages and three countries. In other words, when round and angular typefaces are matched in terms of liking, familiarity, and clarity (e.g., when written in Chinese), people still associate them differently with sweetness. Although a non-significant value does not necessarily mean the absence of an effect, it is possible to hypothesize that valence may not, by itself, account for the entirety of taste/typeface associations.

Further research will be needed to test the various possible mechanisms that may explain the association between tastes and features of typeface. For example, it becomes clear after going to the sweets section in the supermarket that many confectionary products use round typefaces (just try searching for the terms "supermarket+sweets+section" in Google Images, and see the typefaces of the products that show up). Is this a result of a more general principle of taste/shape matching, a moderating variable, or perhaps both? One possibility is that a more general mechanism of vision/taste association has been adopted by the marketplace and it expresses itself in the way in which shape features are selected for specific product tastes. For example, it may be the case that we learn to encode the transformation of foods in time, which involves their shape, but also their taste, and as such, we create stronger associations between foods, their tastes, and the associated shape features (Velasco et al., 2016c; cf. Maga, 1974). Another alternative is that a visual attribute becomes norm in a product category as a result of the visual attribute/product category congruency (Dell'era & Verganti, 2007). Notably, whereas the studies reviewed above provide an interesting initial attempt to study the topic, future research may also manipulate the physical (not only the perceptual) dimensions that determine, for example, the curvilinearity of typeface. What is more, future research on the association between taste and typeface may look to other features of typeface (such as orientation, italics, spacing, and so on). In the end, typeface designs are multi-featured and many of their component features can influence their connotation and preference (Henderson et al., 2004).

4. Does typeface influence taste perception?

Next, we investigate whether specific typeface designs can actually be used to change people's ratings of the taste of a given standardized food. Below, we present an overview of the results of three experiments conducted at different events and designed to address the aforementioned question. To the best of our knowledge, no studies have yet been conducted

on this specific topic. One can think of this as analogous to the recent line of studies demonstrating changes in people's ratings of various foodstuffs (e.g., cheese, basic tastants in solution, and café latte) following their visual inspection of round versus angular shapes that were more, or less, unconnected to what they were tasting (e.g., see Gal et al., 2007; Liang et al., 2013, 2016; Spence, 2014; Van Doorn, Colonna-Dashwood, Hudd-Baillie, & Spence, 2015).

4.1. Tasting typefaces I

In an event held at the Victoria & Albert Museum in London for the London Design Festival (Experiment 1) on 14th September 2014, 80 members of the audience rated two jelly beans (Kingsway jelly beans sorted into matching pairs according to their flavour), a candy in which both sweet and sour are generally present, one while looking at jagged style lettering (Modified London 2012) and the other while viewing round lettering instead (VAG Rounded, see **Figure 8**). This experiment, as well as the subsequent experiments, were reviewed and approved by the Central University Research Ethics Committee at the University and was carried out in accordance with the World Medical Association Helsinki Declaration.

INSERT FIGURE 8 ABOUT HERE

Each participant was given a plastic bag containing two identical jelly beans, from a selection of flavours/colours. The participants were given a score sheet in which they were asked to rate the sweetness, sourness, and intensity of the jelly bean while viewing the words "eat me" shown as a slide projected on a screen in one of the typefaces and then the other (with the order counterbalanced across participants). The ratings were performed on Likert scales ranging from not at all (0) to very much (10). Although 80 participants took part in this study, not all questionnaires were filled-in. In total, the ratings for the sweet, sour, and intensity dimensions while looking at the round typeface were responded to by 80, 78, and 72, participants, respectively. The ratings for these same dimensions but looking at the angular typeface were responded to by 79, 79, and 70 participants, respectively. These make it difficult to match the data of those participants who responded to more than one typeface condition, hence these analyses should be treated as primarily descriptive.

INSERT FIGURE 9 ABOUT HERE

The results are represented in **Figure 9**. As expected, at the descriptive level, the sweetness ratings were higher for the jelly beans rated while looking at the round typeface (M = 7.04, SD = 2.31) than those rated while looking at the angular typeface (M = 5.38, SD = 2.45). In contrast, the jelly beans were rated as more sour (M = 3.73, SD = 2.68) when the participants looked at the angular typeface than when they looked at the round typeface (M = 2.63, SD = 2.49). The results on the intensity ratings only indicate a subtle difference, with the angular (M = 5.62, SD = 2.72) typeface evoking higher intensity ratings than the round typeface (M = 5.24, SD = 3.04). The results of Experiment 1 indicate that the sweetness ratings of the jelly beans are somewhat higher when presented together with a round typeface than an angular one and, in contrast, that sourness ratings are somewhat higher for the jelly beans that are presented together with the angular typefaces, than those which are presented with the round typefaces.

4.2. Tasting typefaces II

Experiment 2 was conducted at the Science Museum Lates evening event held in London on Wednesday 30th September 2015 (http://www.sciencemuseum.org.uk/visitmuseum/plan_your_visit/lates.aspx). Given the nature of the public event, it was not possible to collect demographic details (e.g., sex, age, nationality), though based on informal observation of those attending, the majority were young adults. Three different pairs of typefaces were presented over the course of the evening (see **Figure 10**), one pair per participant. In all cases, the phrase “eat me” was printed in black ink on a laminated A4 piece of white paper.

INSERT FIGURE 10 ABOUT HERE

Visitors who were wondering around the Science Lates event were encouraged to stop at the table manned by a number of experimenters. The participants were on one side of the table

and the experimenters on the other. There were two sets of small paper dispensing cups on the table. Those individuals who agreed to take part in the study were given one paper cup, asked to rate the jelly bean inside in terms of its sweetness and sourness, entering their responses on a tablet computer. Given the dynamics of the social event, it was difficult to guarantee that the same participant would respond to the two pairs of typefaces. Therefore, the analysis of the data is, once again, mainly descriptive.

The interface screen is shown in **Figure 11**. Note that separate ratings of sweetness and sourness were required. All of the participants tasted two identical lemon/lime flavoured jelly beans (Jelly Belly jellybeans in lemon/lime flavour). This flavour was chosen since it is both sweet and sour. Our intuition being that it is easier to modulate a pre-existing taste or flavour using crossmodal correspondences than it is to create the impression of a taste or flavour that is not, in fact, present. The experimenters said nothing to the participants about the identity of the jelly beans (i.e., whether they were the same or different).

INSERT FIGURE 11 ABOUT HERE

A summary of the mean sweetness and sourness ratings, and their corresponding standard deviations, as a function of typeface pair, curvilinearity, and specific typeface is presented in Table 1. At a descriptive level, it would appear that, although a certain degree of variability can be found between typefaces, the presentation of the round typefaces from the three pairs resulted in higher sweetness ratings than the presentation of the angular typefaces, in the same pairs, respectively. In contrast, the angular typefaces yielded higher sourness ratings than their round counterparts in each pair of typefaces. Once again, the results of this experiment provide complementary evidence for the idea that typefaces may be able to influence taste perception.

INSERT TABLE 1 ABOUT HERE

4.3. Tasting typefaces III

Experiment 3 was conducted at The Stoke Newington Literary Festival, London (2-4 June, 2017). This experiment, in contrast with the others, involved new variable controls. 188 participants took part in the experiment (110 females, 78 males, most participants being 20-60 years old). 83 participants (45 females, 38 males) were exposed to thick typefaces and 105 (65 females, 40 males) to thin typefaces.

Each group of participants was given a sheet of paper with two sides, each containing the instructions in either a round or angular typeface (see **Figure 12**). The thick typefaces with stroke contrast included a typeface with angles and no curves based on the proportions of Bodoni Poster Italic designed, by Sarah Hyndman, as the angular typeface and Bodoni Poster Italic as the round typeface. On the answer sheets the letters had an x-height of 14mm, on the boxes containing the jelly beans the letters had an x-height of 18mm. The thin typefaces with little contrast included a redrawn version of Foundry Gridnik with sharper angles and a single-storey ‘a’ as the angular typeface and a modified version of VAG Rounded as the round typeface. On the answer sheets, the type had x-height of 14mm, on the A4 panels the letters had an x-height of 34mm.

INSERT FIGURE 12 ABOUT HERE

The order of presentation of the round and angular typefaces was counterbalanced in each group (e.g., the order of the jelly bean boxes, and therefore typeface order, was alternated every 1 to 2 hours).

The thick typefaces with stroke contrast were presented to groups of 1-5 participants, who stood at a table at a time. They were instructed to take a jelly bean from a box with the words ‘tastes like?’ in one of the typefaces printed on the lid, but to close their eyes while they put it in their mouth so they could not see its colour. Then, they completed the instructions on the appropriate side of the answer sheet. Each participant had his/her own answer sheet and completed the task in silence After that, they completed another short unrelated task in which they compared the scent in two glass jars and evaluated the key notes they could smell, along with how masculine/feminine and how expensive they estimated each to be. Then, they moved onto the other end of the table, where they repeated the procedure with a second jelly bean and the second side of the answer form, which included the second typeface. Note that

the participants were instructed to look at just one side of the response sheet whilst doing each task. The jelly beans were all the same flavour (sour cherry), although many participants reported that they tasted different.

The thin typefaces with little contrast were presented to groups of 1-5 participants, who stood at the table at a time. They were all instructed to close their eyes as they were given a jelly bean. Then, they opened their eyes and looked at an A4 panel with the words ‘tastes like?’ in one of the typefaces from pair B. They filled in the side of the answer sheet with the typeface that matched the panel, each had their own answer sheet and they completed the task in silence. They were then given a second jelly bean straight away, when they opened their eyes they looked at an A4 panel with the words ‘tastes like?’ in the second typeface and completed the second side of the answer form. The typeface order was alternated continually for each group. The jelly beans were all the same flavour (sour apple).

All of the participants were asked to evaluate the jelly beans in terms of their sweetness, sourness, intensity, and liking, in 10-point Likert scales. The data were analysed by means of a mixed-design analysis of variance (ANOVA), with typeface curvilinearity (round vs. angular) as within-participant factor and contrast (thick vs. thin) as the between-participants factor. The results are summarized in Table 2.

INSERT TABLE 2 ABOUT HERE

The results provide evidence to suggest that both typeface curvilinearity and contrast influenced the perception of sweetness and sourness of the jelly beans. In particular, participants rated the jelly beans as sweeter and less sour after being exposed to the round typefaces, relative to the angular typefaces. Moreover, the participants rated the jelly beans as sweeter after being presented with the thick typefaces (less sour), relative to the thin typefaces. Notably, no evidence was found to suggest that typeface curvilinearity influenced the hedonic and sensory-discriminative responses to jelly beans.

INSERT TABLE 3 ABOUT HERE

4.5. So, can typefaces really influence taste perception? Summary of results from the three experiments

The three experiments reported here point to the idea that typeface curvilinearity can influence taste perception. The results presented here are consistent with the results of previous studies suggesting that the curvilinearity of typeface differentially corresponds to tastes (Velasco et al., 2015b), and that shape curvature can influence the evaluation of taste information (Liang et al., 2013, 2016; van Rompay, Finger, Saakes, & Fenko, 2017; Velasco, Woods, Marks, Cheok, & Spence, 2016b).

However, before jumping to such a conclusion, it is important to highlight a couple of caveats/limitations associated with the results that have been presented here. First, it is as yet unclear how long-lasting are the effects of (the curvilinearity of) typeface on taste perception. While the present results demonstrate that they operate the first time that someone looks at typeface, one would probably want to know that such crossmodal effects last into the longer-term before changing the typeface of a commercial product in order to convey sweetness/sourness, say. Alternatively, a long-term association between sweet-tasting foods with rounder typeface may indicate that this association, and crossmodal effect, actually gets stronger over time.

Second, it is important to highlight the slightly contrived nature of the experimental set-up, staring at the phrase ‘eat me’ written in what were obviously very different typefaces. The worry about the kind of experimental design used in the different experiments is that it might well inadvertently have drawn the participants’ attention to the typeface, and any differences between the one or two exemplars of typeface that they saw (since that was all that obviously differed), in a way that might not necessarily match our everyday experience when reading the label/logo on the front of product packing, say. After all, normally when we read, our attention is focused on the content of the message, and not on the typeface in which it is conveyed (note, however, that distinctive typefaces might nevertheless capture people’s attention). Future research using between-participant experimental designs will certainly help to address this particular issue. In addition, it is worth mentioning that, although we also manipulated contrast in Experiment 3, it might not be possible to conclude that the effect of such a variable on taste ratings represents a true effect in that there were some differences in

the procedure that both groups, those presented with thick and those with thin typefaces, went through.

5. General discussion

The research reviewed here shows that typefaces can convey taste attributes (at least when people are thinking about taste), independently of the words that happen to be written in a given typeface. Although research on typeface/taste associations has been rather scarce, the different studies assessing the crossmodal correspondence between shape features have provided some insights that may well extend to typeface/taste associations. This research points to the idea that different visual aesthetic features of shapes, which influence preference, may explain (at least in part) why people match a taste with a shape. For example, people match curved or symmetrical shapes (preferred) with sweetness and angular or asymmetrical shapes with the other tastes (less preferred).

Research assessing typeface/taste relationships demonstrates that people really can 'taste typeface' in at least two ways. First, they associate round typeface with sweet taste, while associating bitter, salty, and sour with angular, across cultures. Second, based on the data presented from different experiments, we provide evidence for the idea that viewing specific typefaces influences taste ratings (at least under certain circumstances). That is, it appears that round typefaces enhance sweetness perception and angular typefaces enhance the perception sourness. Another way of looking at this phenomenon though is that round typeface may diminish the perception of tastes such as sourness whereas angular typefaces may diminish the perception of sweetness. As Warde (1930) suggested almost a century ago: *"The type which, through any arbitrarily warping of design or excess of "colour", gets in the way of the mental picture to be conveyed, is a bad type".* That is, typeface may not only facilitate the associations with a given concept but also disrupt them depending on the aim of the designer.

5.1. On the different effects of typeface

If one looks in the marketplace, it is clear that distinctive typeface is a key part of the branding of many products. That is, typeface can play a signature role: Take, for example, Coca-Cola. The brand identity of this global giant in the marketplace is undoubtedly closely tied to the traditional red and white colour scheme (not to mention the signature shape of the

traditional bottle; see Gallace & Spence, 2014; Prince, 1994). Moreover, given the distinctly sweet taste of the drink, it is noticeable how the company use a very round typeface (i.e., as part of a category of script, namely, Spencerian script). Should the company, for whatever reason, suddenly decide to change to a much more angular typeface instead, one could imagine that it might have a significant impact on people's perception of the taste (e.g., Salgado-Montejo et al., 2015; see also Kastl & Child, 1968; Tannenbaum, Jacobson, & Norris, 1964, for studies on typeface connotations). Based on the evidence reviewed here, it would certainly be easy to imagine how it might perhaps affect the taste of the drink too.

Crucially, a company may have various different objectives in mind, when it comes to choosing a particular typeface for their product or brand: Some might, for instance, want to maximize the processing fluency (i.e., the easy at which an object is process) in the mind of their consumer (e.g., Song & Schwarz, 2010; Westerman, Lanska, & Olds, 2014; Winkielman & Cacioppo, 2001; Winkielman, Schwarz, Fazendeiro, & Reber, 2003). It can be argued that increasing processing fluency is likely advantageous for a brand no matter whether or not there is also a knock-on effect on the product's taste (e.g., Novemsky, Dhar, Schwarz, & Simonson, 2007).[4] Other brands, by contrast, might wish to convey notions of authority, or of being trendy/novel (see Batra et al., 2015).[5] Relevant to the present review, typeface may be used to 'season' specific products. For instance, if one is interested in enhancing the sweetness of a product whilst lowering the sugar content, a rounder typeface may be of help to this aim. From another point of view, one might perhaps mask the bitterness of a healthy salad (think rocket) by using a round typeface.

Nevertheless, conveying notions of sweetness is but one of the objectives when it comes to choosing typeface. In addition, it is also important to highlight that not all consumers look for the same information when buying a product. Indeed, much of the research on taste/shape and taste/typeface correspondences has explicitly asked participants to estimate the likely taste of a product, possibly making this a salient aspect of the experience for the participant (Velasco

[4] Some companies might actually wish to make the text harder to read, that is, to reduce processing fluency – to perhaps convey notions of a more complex tasting product (e.g., Gmuer, Siegrist, & Dohle, 2015; Song & Schwarz, 2008; though see also Gump, 2001).

[5] And yet others might rather less prosaically simply want on save on their ink costs (see http://www.fastcodesign.com/3028436/why-garamond-wont-save-the-government-467-million-a-year; see also http://www.creativereview.co.uk/cr-blog/2014/april/ryman-eco-grey-london-and-ryman-launch-sustainable-free-font/). The Garamond study has been questioned because Garamond has very small x-height so in reality it would generally be used a point size larger to be readable, thus using the same amount of ink.

et al., 2016c). Furthermore, for companies like Coca-Cola, for whom their distinctive typeface has become an integral part of their brand identity, the potential costs in terms of lost brand recognition associated with changing their typeface might well outweigh any benefits of enhanced sweetness perception that they could obtain. That said, it is presumably not a coincidence that the distinctive typeface is round.

5.2. Future research: The role of colour and sound symbolism

It is currently an open question as to whether it is really possible to design typeface that are associated with each one of the basic tastes (instead of just round for sweet and angular for the other tastes), and are sufficient to discriminate between sour, bitter, and salty, say. One of the ways in which to enhance the signalling potential of a specific typeface (Lee & Pai, 2012) might be to combine it, say, with text (and possibly also background) colours that are uniquely associated with each one of the four basic tastes. Indeed, in the context of food and drink products, several other multisensory elements, in addition to typeface, are also part of the overall consumer experience. For example, Spence et al. (2015) reviewed three decades of research on crossmodal correspondences between colour (hue) and basic tastes, as well as presenting their own research showing that red and pink are the two colours that would appear to be most strongly associated with sweetness, white and blue with salty, green and yellow with sour taste, and browny-black and purple with bitterness.[6]

Moreover, those wishing to optimize the taste connotation of their text designs may also want to consider which speech sounds to use, for example, in a brand name in order again to prime certain taste expectations (e.g., see Abel & Glinert, 2008; Fenko, Lotterman, & Galetzka, 2016; see also Van Doorn, Paton, & Spence, 2016). Indeed, the research demonstrates that speech sounds convey meaning in-and-of-themselves, a phenomenon that is known as ‘sound symbolism’ (Köhler, 1929; Lockwood & Dingemanse, 2015). For instance, Fónagy (1963) long ago suggested that there might be a crossmodal correspondence between bitter-sweet tastes and front/back vowel sounds (e.g., an example of a frontal vowel sound is the ‘i’ sound in ‘hit’ whereas a back vowel sound examples is the ‘o’ in ‘home’). However, as far as we are aware, no empirical research has been conducted to follow-up on these intuitions. It has, though, been shown that ‘round’ brand names such as ‘Blum’ constitute a much better match

[6] Here one can think of the analogous work combining colour-taste correspondences with shape-taste correspondences that led to a range of ‘tasty’ plateware designs from designer Jialing Deng of London (see Spence et al., 2015).

for a sweet-tasting product than others, such as ‘Clax’, which are better matches for sour-tasting product instead (e.g., Velasco et al., 2014).

The appropriateness (e.g., the extent to which it is a good match) of a typeface, shape features, and other design elements which are used in relation with food and drink products can add or subtract value to the communication of specific meanings. Currently, most of the research on crossmodal correspondences associated with tastes has focused on a pair of sensory features, such as a shape curvature and taste (e.g., Velasco et al., 2016c, for a review), colour hue and taste (e.g., Spence et al., 2015), or pitch and taste (e.g., Crisinel & Spence, 2010). Nevertheless, in our everyday lives, we experience several cues at a time. Think again, for example, of the case of Coca-Cola. The typeface is curvy and the words are sometimes presented in white or in red, with red or white backgrounds, respectively. Moreover, the sound associated with the words ‘Coca-Cola’ may convey a specific meaning, independently of the colour or the typefaces which they use. The combination of multiple sensory features, as captured in typefaces, undoubtedly represents an interesting opportunity for future research.

As an additional note on possible future research, and as indicated by a reviewer, it would be interesting for research to explore the extent to which taste/shape correspondences differ from taste/typeface correspondences. For example, are packaging/taste or typeface/taste (in)congruency effects similar when it comes to taste expectations and perception? As suggested, multiple design elements are associated with food and drink products, all of which might, or might not, contribute to the overall perception of a product.

5.3. Conclusions

Typeface is a ubiquitous element of design, one that, as demonstrated throughout this review, can influence people’s taste expectations and experience. One of the hope for the future is that, by giving the typeface in which the text and/or brand name of a commercial food or beverage product is written, a ‘sweeter’ association (or connotation; Doyle & Bottomley, 2009; Walker, 2008), it might just be possible to modify the actual sweetness of the product ever so slightly, while keeping the impression in the mind of the consumer the same (i.e., constant). Further research will be undoubtedly needed to clarify under which circumstances the studies reviewed here replicate in more ecologically-valid settings (e.g., mass

consumption products). Nevertheless, we believe that designers, food and drink companies, but also for those who regulate what is shown and what is shown in different marketing communication associated with food and drink products, should think twice before selecting the typefaces associated with such products. In the end, changing a small detail such as the typeface of any message included in a package of, for example, a mass consumption product can impact the behaviour of a large group of people.

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Table 1. Results for each pair of typefaces presented individually in Experiment 2.

Pair	Typeface curvilinearity	Typeface	N	Sweet ratings		Sour ratings	
				Mean	SD	Mean	SD
1	Round	VAG Rounded	106	5.88	2.12	3.66	2.13
	Angular	Onyx slanted	93	5.30	1.94	4.47	2.14
2	Round	Flemish Script	166	6.19	2.03	3.77	2.14
	Angular	Klute	166	5.07	2.10	4.58	2.50
3	Round	Candice	135	5.45	2.54	3.83	2.18
	Angular	Engraver’s MT slanted	128	5.23	2.15	4.73	2.06

Table 2. Mixed design ANOVAs for each of the variables in Experiment 3.

Variable	Sweetness			Sourness			Intensity			Liking		
	F	p	*partial* η^2	F	p	*partial* η^2	F	p	*partial* η^2	F	p	*partial* η^2
Curvilinearity	**7.98**	**.005**	**.041**	**5.33**	**.022**	**.028**	1.31	.255	.007	0.39	.533	.002
Contrast	**4.25**	**.041**	**.022**	**10.30**	**.002**	**.052**	0.85	.357	.005	0.03	.869	<.001
Curvilinearity * Contrast	1.50	.222	.008	0.15	.699	.001	2.02	.157	.011	1.70	.195	.009

Table 3. Descriptive statistics for each font and variable included in Experiment 3.

Contrast	Curvilinearity	Sweetness		Sourness		Intensity		Liking	
		M	SD	M	SD	M	SD	M	SD
Thick	Round	6.40	2.12	2.55	2.46	5.18	2.10	5.88	2.73
	Angular	5.75	2.13	3.17	2.49	5.07	2.23	5.55	2.75
Thin	Round	5.66	2.11	3.57	2.51	5.11	2.20	5.71	2.53
	Angular	5.40	2.06	4.01	2.56	5.56	2.04	5.83	2.17

FIGURE LEGENDS

Figure 1. Which of these typefaces would you associate with a sweet-tasting product? Examples of typeface having different connotations: (A) Dampfplatz, (B) Helvetica ultra-light, (C) Bodoni Poster Italic, (D) Lazybones, (E) VAG Rounded, (F) Klute. While the same word is presented in each case, the connotations differ (see Hyndman, 2015).

Figure 2. Examples of different typeface demonstrating some of the characteristics that are taken into consideration by the designer during the process of typeface design. The yellow shaded areas highlight different widths of typeface, differing x-heights, and the contrast between thick and thin strokes.

Figure 3. If these jams differed in terms of their level of sweetness, which do you think would be sweeter? Panels A and B present the same jam packaging with a round and an angular typeface, respectively.

Figure 4. Example of scale used in taste/shape and flavour/shape association studies. People are asked question such as: "To what extend do you associate the taste with the shapes? Mark an X anywhere on the line, where you think best represents your association."

Figure 5. Round (A) and angular (B) typefaces used by Velasco et al. (2014).

Figure 6. The rounded and angular typeface used in Velasco et al.'s (2015b) recent study of the taste associations that people hold with typeface. In summary, sweet taste was associated with the rounder typefaces, whereas the other tastes (bitter, sour, and salty) were <u>all</u> associated with the more angular typeface [Figure adapted and reprinted from *i-Perception, 41*, Carlos Velasco, Andy T. Woods, Sarah Hyndman, & Charles Spence, Copyright (2015)].

Figure 7. The various typefaces used in Velasco et al.'s (in press) recent cross-cultural study of the taste associations with angular and rounded typeface. The expression "eat me" is written in Spanish, English, and Chinese (from top to bottom), respectively, in round and angular typefaces and their regular and bold versions. The typefaces used for the Spanish and English words include the following (from left to right): Eras Light ITC, Jasmine UPC, Segoe script, Bell MT, Nueva Std, and メイリオ. The typefaces used for the Chinese words comprise (also from left to right): Round sans, SimYou, SimLi, Simsun, SlimSimsun,

Imitated Simsun. A general finding from this study was that rounder typefaces were more strongly associated with sweet, whereas angular typefaces were more strongly associated with the other tastes.

Figure 8. Typefaces used in Experiment 1 at the Victoria & Albert Museum for the London Design Festival on 14th September 2014: A) Modified London 2012 and B) VAG Rounded.

Figure 9. Boxplots representing the results of Experiment 1. Boxplots for the different ratings as a function of group. Boxplots visualize the distribution of the data based on the minimum value, first quartile, median, third quartile, and maximum value. The points that are shown individually are those which fall in the lower or upper percentiles. These kinds of figures can provide the reader a better representation of the distribution of the data (see Weissgerber, Milic, Winham, & Garovic, 2015).

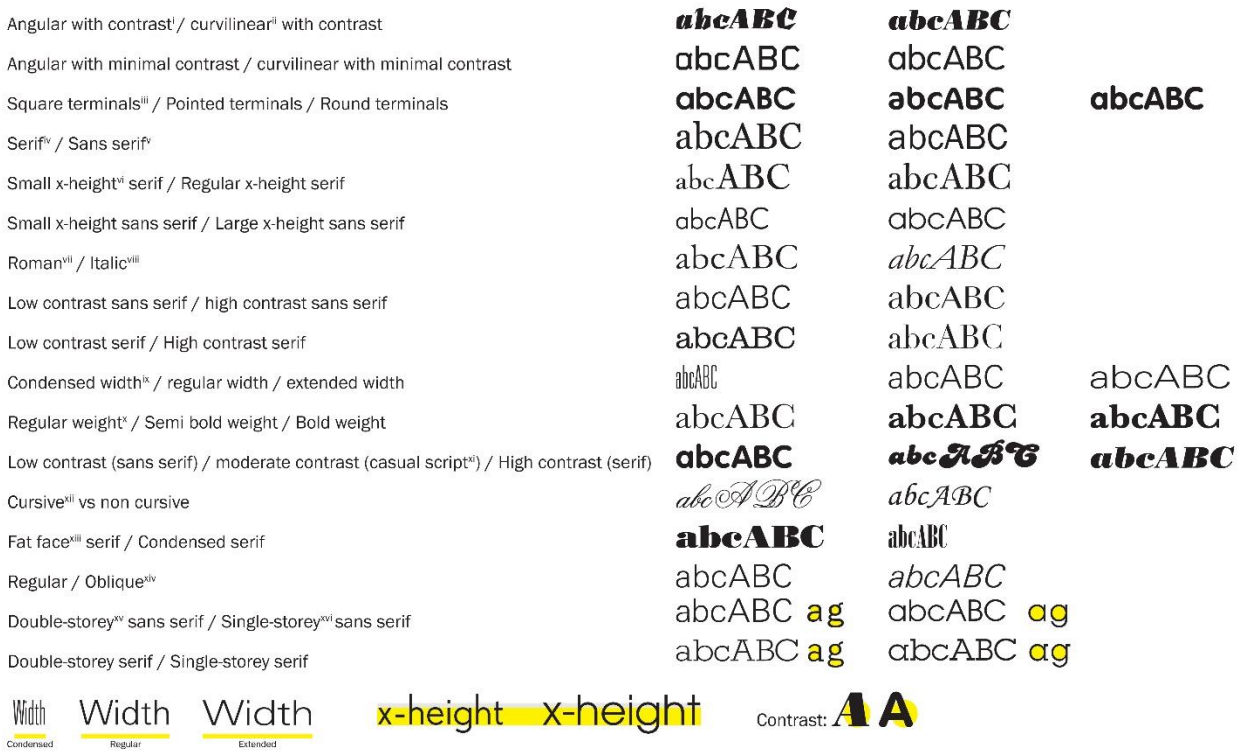
Figure 10. The three pairs of rounded vs. angular typeface that were used in Experiment 2. A) VAG Rounded and Onyx slanted, upper case; B) Flemish Script and Klute; C) Candice and Engraver's MT slanted, upper case. Each of the typefaces was typeset to sit within a central area on an A4 page so that they appeared visually balanced (based on the suggestions of the designer). For example, the more condensed typefaces are shown a larger point size so that they appear equally prominent and it is therefore the typeface and not the scale being compared.

Figure 11. The response screen on the tablets used by participants to enter their responses in Experiment 2.

Figure 12. Questionnaire used in Experiment 3. Note that one group of participants started with A and then B, and the other with B and then A.

Figure 1.

Figure 2.



Notes:

i Contrast: The variation in width of the thick and thin strokes in a letter (Bringhurst, 1972).
ii Curvilinear: Consists of curved lines, curvilinear typefaces are considered to feel "friendly" (Amare & Manning, 2012).
iii Terminal: The end of a stroke (curved or straight) without a serif (Garnham, 2016).
iv Serif: A short cross stroke at either end of the main stroke of a letter (Catich, 1968).
v Sans serif. A typeface without serifs (Baines & Haslam, 2005).
vi X-height: Height of the lowercase letters, represented by the letter 'x', this is taken as a guideline for the height of unextended lowercase letters (Garnham, 2016)
vii Roman: Letters that are upright, in contrast to sloped italic letters (Baines & Haslam, 2005).
viii Italic: Letters that slant to the right, in contrast to roman typefaces which are upright (Garnham, 2016).
ix Condensed: Letters compressed to narrow width proportions than normal. (Garnham, 2016).
x Weight: How thick or heavy the stroke is (Coles, 2013); in traditional printing a heavier stroke requires more ink to print and appears darker on the page (Bringhurst, 1972).
xi Casual script: Informal script style that often gives the appearance of being painted with a wet brush and that retains the spontaneity of handwriting (Spiekermann & Ginger, 1993)
xii Cursive: Letters that flow, giving the appearance of joined-up writing, as opposed to non cursive italic letters that are separate (Baines & Haslam, 2005).
xiii 'Fat face' A display or decorative letter with exaggerated bold vertical strokes and contrasting hairline thin strokes (Baines & Haslam, 2005).
xiv Oblique (Slanted): Mechanically sheared letters, often sans serif, in contrast to italic letters that are drawn separately (Garnham, 2016).
xv Double-storey: Letters 'a' and 'g' with two counters (McNeil, 2017).
xvi Single-storey: Letters 'a' or 'g' with one counter (McNeil, 2017).

Figure 3.

Figure 4.

Figure 5.

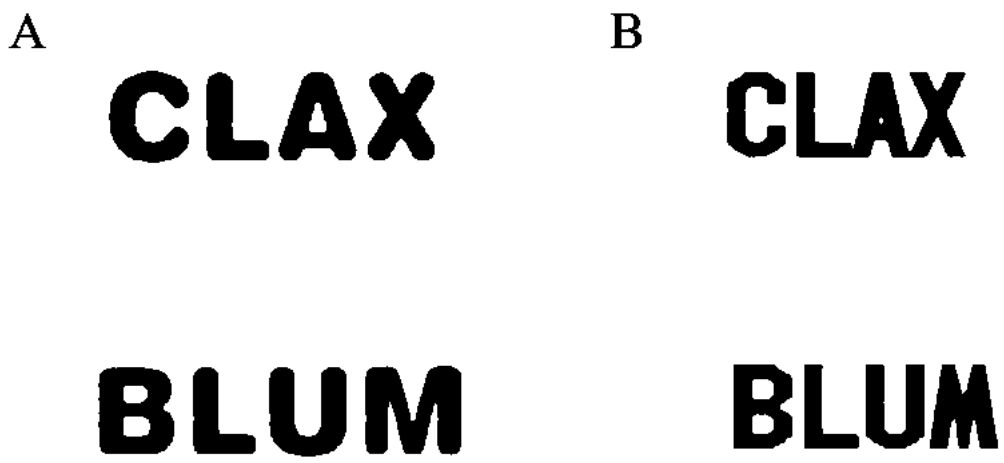


Figure 6.

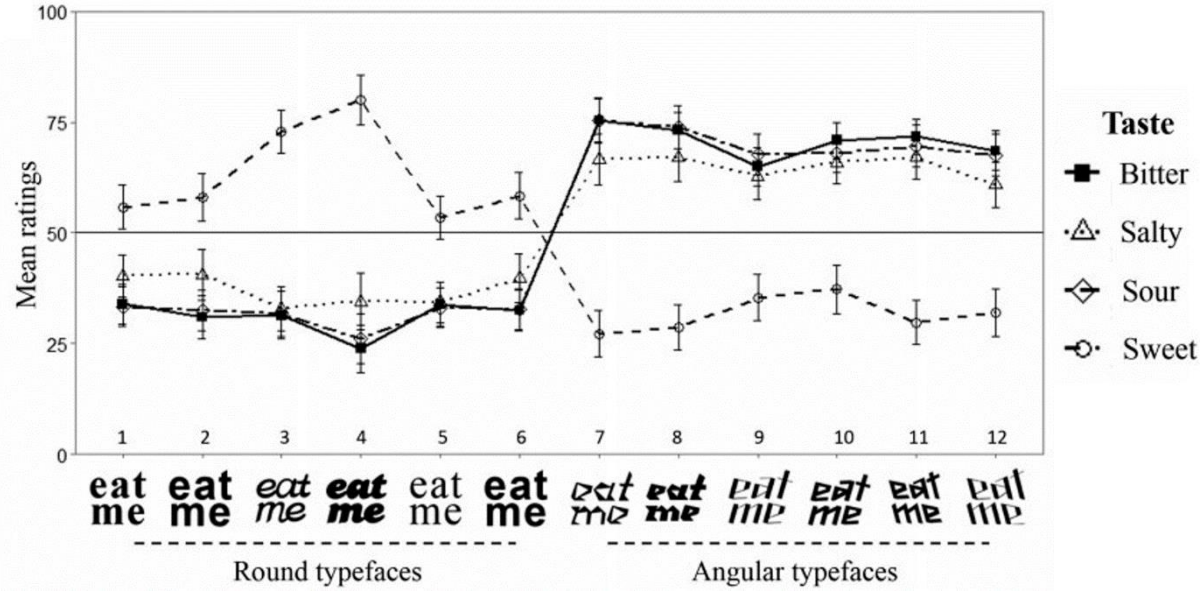

Mean ratings
100
75
50
25
0
1
2
3
4
5
6
7
8
9
10
11
12
Round typefaces
Angular typefaces
Taste
Bitter
Salty
Sour
Sweet

Figure 7.

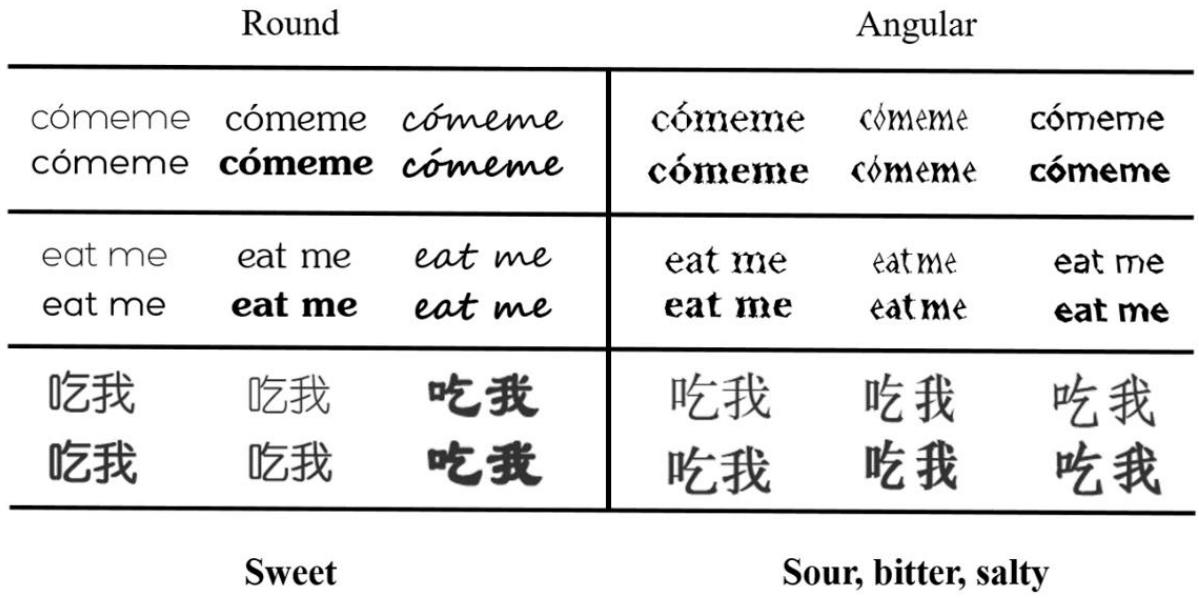

Round
Angular
cómeme cómeme cómeme cómeme cómeme cómeme
cómeme cómeme cómeme cómeme cómeme cómeme
eat me eat me eat me eat me eat me eat me
eat me eat me eat me eat me eat me eat me
吃我 吃我 吃我 吃我 吃我 吃我
吃我 吃我 吃我 吃我 吃我 吃我
Sweet
Sour, bitter, salty

Figure 8.

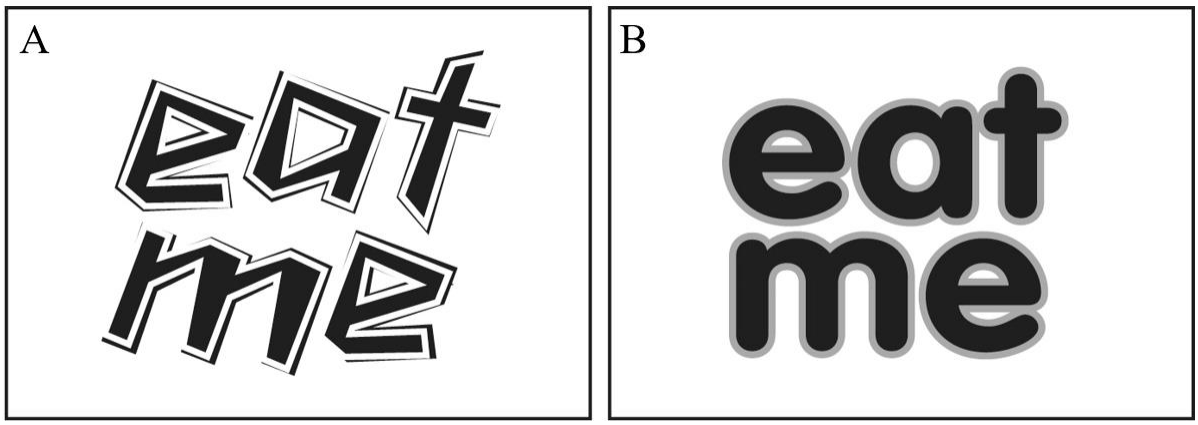


Figure 9.

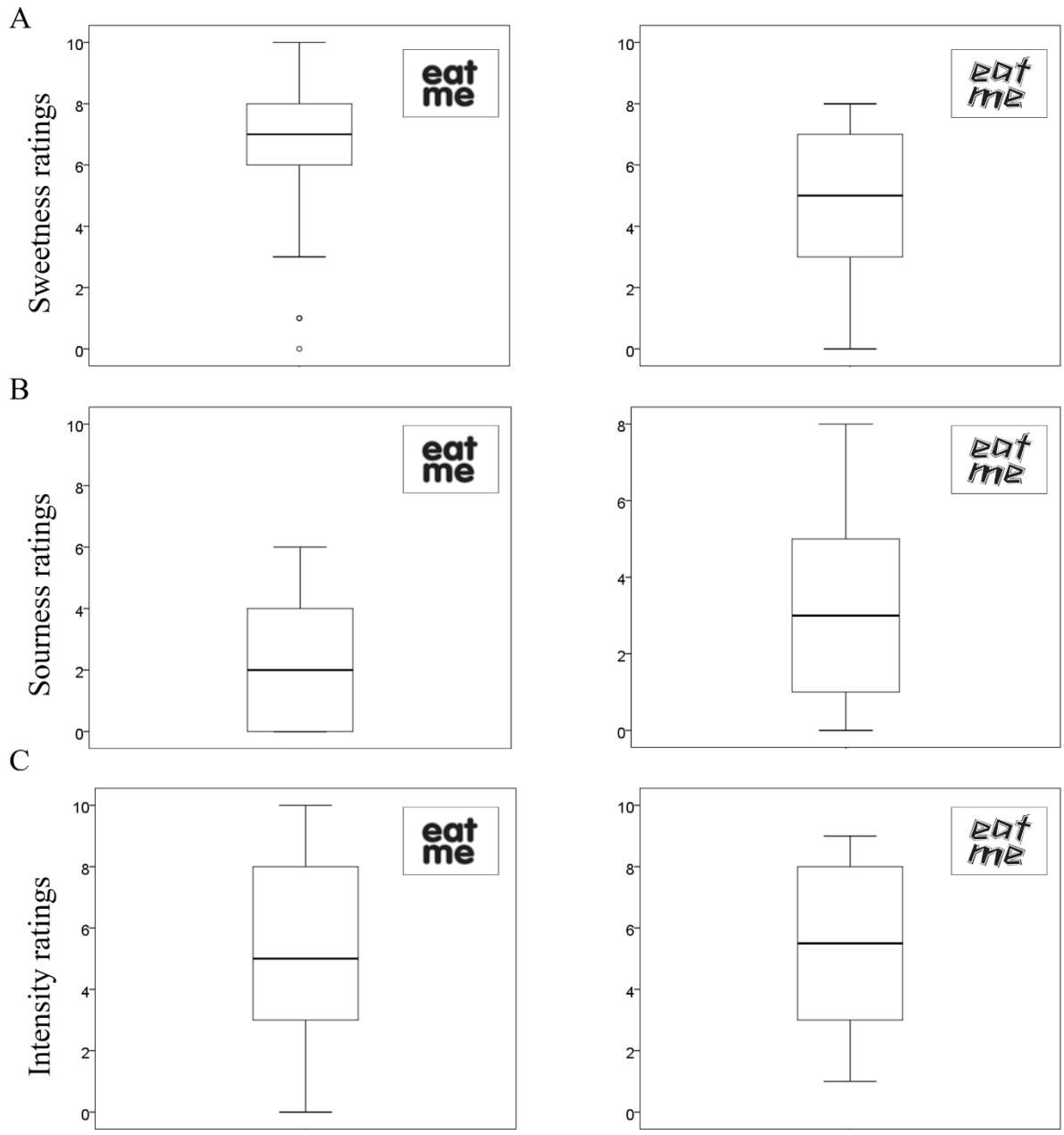

A
Sweetness ratings
eat me
eat me
B
Sourness ratings
eat me
eat me
C
Intensity ratings
eat me
eat me

Figure 10.

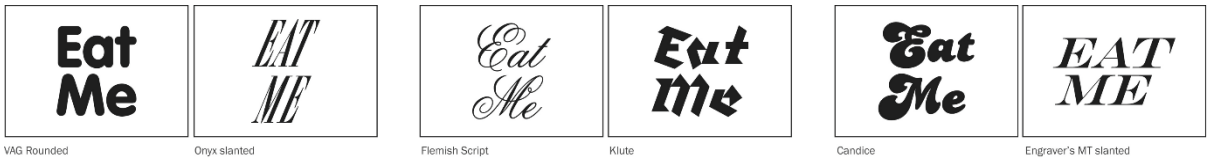

Eat Me
VAG Rounded
EAT ME
Onyx slanted
Eat Me
Flemish Script
Eat Me
Klute
Eat Me
Candice
EAT ME
Engraver's MT slanted

Figure 11.

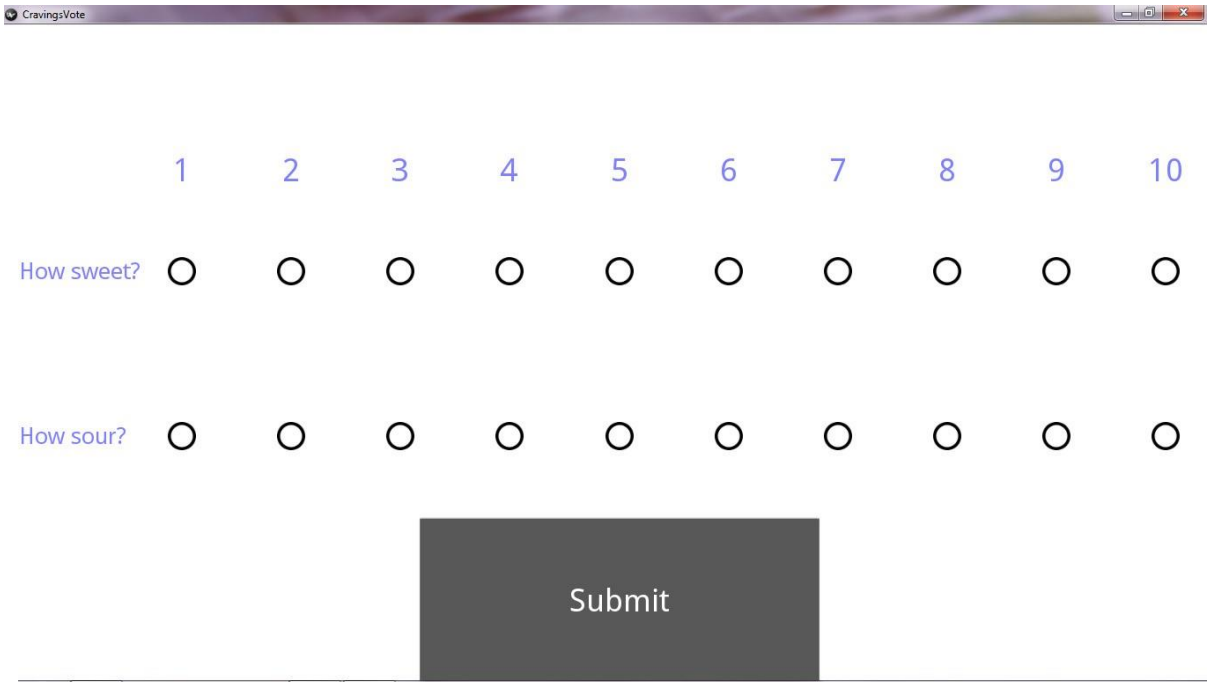
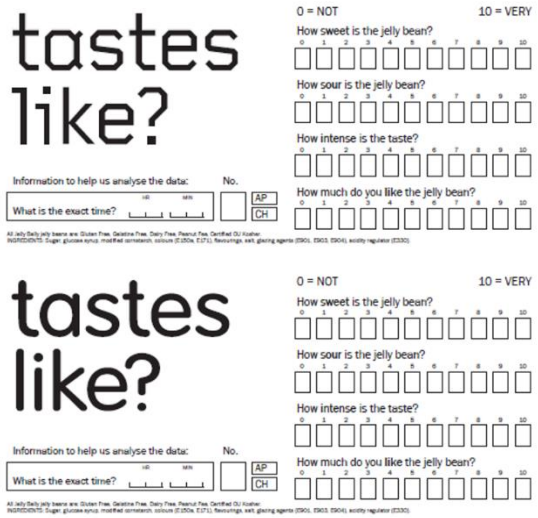


Figure 12.

A


tastes like?
0 = NOT
10 = VERY
How sweet is the jelly bean?
How sour is the jelly bean?
How intense is the taste?
How much do you like the jelly bean?
Information to help us analyse the data:
No.
What is the exact time?
HR
MIN
AP
CH
tastes like?
0 = NOT
10 = VERY
How sweet is the jelly bean?
How sour is the jelly bean?
How intense is the taste?
How much do you like the jelly bean?
Information to help us analyse the data:
No.
What is the exact time?
HR
MIN
AP
CH

B


tastes like?
0 = NOT
10 = VERY
How sweet is the jelly bean?
How sour is the jelly bean?
How intense is the taste?
How much do you like the jelly bean?
Information to help us analyse the data:
No.
What is the exact time?
HR
MIN
AP
CH
tastes like?
0 = NOT
10 = VERY
How sweet is the jelly bean?
How sour is the jelly bean?
How intense is the taste?
How much do you like the jelly bean?
Information to help us analyse the data:
No.
What is the exact time?
HR
MIN
AP
CH