Universiteit Leiden

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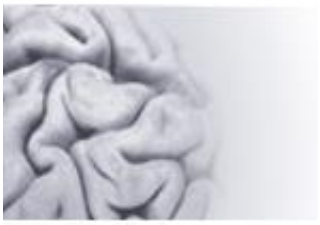

Is it the Taste that Tells the Tale? The Effect of Packaging on the Taste Perception of Beverage Flavors

Running Head: IS IT THE TASTE THAT TELLS THE TALE? THE EFFECT OF PACKAGING ON THE TASTE PERCEPTION OF BEVERAGE FLAVORS

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Master thesis Psychology, specialization Economic and Consumer Psychology
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Abstract

Packaging evokes taste expectations during initial product evaluation. Understanding the potential effects of packaging on actual perception can offer new opportunities in the consumer field. The aim of the current study was to examine the effect of congruent and incongruent packaging on the perceived taste intensity, tastiness and healthiness of flavored beverages. 170 participants from Leiden University were asked to evaluate two beverages in a mixed design. Taste expectations were generated by the label and color of two cups (e.g. associated with sweet versus sour flavors), and could either be confirmed or disconfirmed by the corresponding flavor of the drink. The results demonstrated that taste intensity was not affected by the (mis)match between flavor and packaging, nor by packaging itself. However, tastiness ratings of sour drinks were higher when the packaging was in line with the sour flavor. Furthermore, drinks were perceived as healthier in sweetness-associated packaging than in sourness-associated packaging, whereas healthiness ratings were higher for sweet drinks than for sour drinks. These findings indicate that packaging can influence taste perception on certain aspects, but that it is important to consider individual expectations and perceptual integration as well.

Keywords: Taste, Flavor, Color, Perception, Expectation, Packaging, Enjoyment, Healthiness

"Taste in variety, variety in taste" - *Nicaraguan*

The food and drink industry is currently one of the largest household expenditures in Europe (FoodDrinkEurope, 2017). Contemporary retailing environments offer a tremendous diversity of foods and drinks, varying in all types of packaging that consumers use to infer sensory attributes such as taste (Deliza & MacFie, 1996; May, Symmank, & Seeberg-Elverfeldt, 2016). Packaging can influence the behavior and decisions of consumers in a shopping environment (Krishna, Cian, & Aydinoglu, 2017). Packaging attracts and directs attention, enables product identification, and persuades the consumer to purchase the product by generating positive expectations of the sensory attributes (Krishna et al., 2017; Schifferstein et al., 2013; Van Ooijen, Fransen, Verlegh & Smith, 2016). With this idea, product manufacturers use packaging to evoke certain expectations about their product (Huang & Lu, 2016). Products can also have deviating

packaging that has been deliberately used to gain competitive advance by surprising the consumer (Schifferstein et al., 2013; Schoormans & Robben, 1997; Van Ooijen et al., 2016). This raises the question what effect the confirmation or disconfirmation of expectations will have on taste experience and judgment. The present research aims to find out if the flavor associations of packaging can affect the taste perception of flavored beverages. Before presenting the study, this paper will give a theoretical background about the emergence of taste perception and the manifestation of expectations.

Taste perception, preferences and expectations

Flavor sensation arises from a complex collaboration of our five senses (Yeomans, Chambers, Blumenthal, & Blake, 2008), with taste and odor as guiding components (Delwiche, 2004). Taste-receptor cells, situated in taste buds on the tongue, play a pivotal role in the perception of taste (Small, 2012). Each taste bud is specialized in sensing either sweet, salt, bitter, sour, or umami tastes. The tastes we like are partly determined by innate taste biases (Rozin & Vollmecke, 1986; Stevenson, 2009). These inflexible likes and dislikes are important for survival, ensuring the intake of sufficient nutrients and avoidance of harmful goods (Prescott, 2015). Humans have an adaptive preference for sweet and aversion for bitter and sour foods and drinks. Sweet tastes often indicate the presence of sugars, which are sources of energy (Stevenson, 2009). Sour and bitter tastes, on the other hand, are signs of potential harmfulness. Taste preferences are also defined by experience and learning. Shaped by confirming messages in everyday life, people for example unconsciously learn to believe that tastiness corresponds with unhealthiness (Raghunathan, Nayor Walker & Hoyer, 2006). Raghunathan et al. (2006) call this the ‘unhealthy = tasty intuition’. The authors found that even without available information about tastiness, people perceive unhealthier products as tastier than less unhealthy ones. The consequence of this intuition is a tendency to choose unhealthy foods and to enjoy these products more. Such beliefs and expectations strongly affect product evaluation (Norton, Fryer, & Parkinson, 2012). After ingestion, the brain compares unfamiliar taste sensations with earlier experiences (Piqueras-Fiszman & Spence, 2015). Recurrent experiences with foods and drinks have given us extensive knowledge about their corresponding tastes (Stevenson, 2009), leading to two types of expectations. Sensory-based expectations are based on visual information and focus of

attention (Deliza & MacFie, 1995; Stevenson, 2009). These expectations emphasize the presumable sensory features of a food or drink, thereby affecting the perception of this product (Liem, Aydin & Zandstra, 2012). Hedonic expectations, on the other hand, are based on an affective learning process called flavor-flavor learning and emphasize the pleasure aspect of a food or drink (Deliza & MacFie, 1995). Finally, utilitarian expectations are driven by rational considerations on cognitive information such as healthiness (Huang & Lu, 2015).

Hence, taste expectations are crucial in selecting and ingesting the intended product. Even without actually consuming the product, the perception of a food or drink is greatly influenced by the expectation of its taste. In what follows, we will first elaborate on the general effects of expectation on taste perception. After this, we will discuss how these expectations can be generated by product labeling and coloring, and how these visual stimuli can influence sensory and hedonic experience.

Assimilation and Contrast

Sensory-based expectations are usually correct, but can also differ from the experienced taste (Piqueras-Fiszman & Spence, 2015). When there is a mismatch with preexisting beliefs, the unexpected experience will evoke a feeling of surprise (Reisenzein, 2000). Discrepant information can lead to two possible effects, that both affect liking and perception of a food or drink (Anderson, 1973; Yeomans et al., 2008). When there is a small discrepancy between the stimulus and expectations, our brain will try to fix the inconsistency by aligning the new experience with pre-existing expectations (Anderson, 1973; Piqueras-Fiszman & Spence, 2015; Schoormans & Robben, 1997; Schulte-Holierhoek et al., 2017; Yeomans et al., 2008). This categorization of discrepant information is called ‘assimilation’. However, when the disparity between the actual and expected experience is large enough, our brains will react by emphasizing the ‘contrast’ between the two experiences (Anderson, 1973; Yeomans et al., 2008; Piqueras-Fiszman & Spence, 2015). After a large discrepancy, the contrast effect will lead to a stronger experience of the unexpected taste and a negative affective reaction and rejection of the food or drink. Being uncertain will increase one’s attention toward taste sensation during consumption, which results in a quicker detection of the discrepancy between the expected and actual taste sensation, making a contrast effect more likely to occur

(Stevenson, 2009). The effect of congruent versus incongruent expectations was tested in a study by Noordewier and Van Dillen (2016). Participants tasted either a sour or a sweet beverage from a closed cup, and were asked to rate how intense and surprising the taste was to them. When participants expected a sweet drink but encountered a sour drink, the taste experience was more intense and more surprising than when an expected sour taste was followed by an actual sweet taste. In both cases, the taste was experienced as more intense and more surprising then when the expected sensation was in line with the actual sensation. These studies show that assimilation and contrast are triggered by the amount of difference between expected and ongoing taste experiences, leading to different affective responses after ingestion. Assimilation and contrast will create new expectations that will, in turn, affect future taste experiences (Deliza & MacFie, 1995).

Learned Associations

Consumption-related expectations are generated by learned associations between intrinsic and extrinsic product elements (Delwiche, 2012; Husić-Mehmedović, Omeragić, Batagelj & Kolard, 2017; Piqueras-Fiszman & Spence, 2015). Intrinsic features are physical components of a product, such tastiness and healthiness. Packaging, for instance, consists of extrinsic features that only partly pertain to a product (Delwiche, 2012; Husić-Mehmedović et al., 2017; Piqueras-Fiszman & Spence, 2015). When packaging repeatedly co-occurs with certain stimuli, people can use this bottom-up information to make top-down inferences about the intrinsic properties of a food or drink (Becker et al., 2011; Husić-Mehmedović et al., 2017; Schulte-Holierhoek et al., 2017).

Extrinsic features are usually an accurate sign of a product's actual taste. This similarity will increase enjoyment of the sensation (Deliza & MacFie, 1995; Silva et al., 2017). Yet, perception can become disorganized when packaging elements diverge from those that normally correspond with a certain taste. This violation of expectation leads to a change in the actual sensory experience: after ingestion, one will rely more on visual information than taste sensation (Stevenson, 2009). In case of a minor difference, flavor experience will assimilated into a familiar category to match the stimuli (Piqueras-Fiszman & Spence, 2015; Schoormans & Robben, 1997). A large difference between the prior expectation and sensory experience will result in a contrasting experience that intensifies the disparity between the taste and visual stimuli (Deliza & MacFie, 1995).

Greatly disconfirmed expectations will lead to dissatisfaction and rejection of the food or drink that is consumed. Earlier studies have shown that enjoyment decreases when the contrast between the presumed and actual taste is consciously noticed (Deliza & MacFie, 1995; Silva et al., 2017).

Taken together, packaging is an important factor in product evaluation, even before actual taste sensation. Two extrinsic sources of product information that are indispensable in daily life are labels and color. In the next part, we shall focus on how these particular elements influence taste experiences.

Textual and graphic labels. Descriptions of foods and beverages automatically evoke expectations about a product's taste (Piqueras-Fiszman & Spence, 2015). Product labels direct the attention of the consumer to a certain taste aspect of the product, which will make this feature more salient than others. Such labeling-induced expectations can affect actual taste perception, as was found by Yeomans et al. (2008). In three experiments, participants had to evaluate the flavor of an unknown savory ice-cream. When labelled as 'frozen savory mousse', the food was rated as having an enjoyable flavor. Yet the same food was greatly disliked and rejected when labelled as 'ice-cream', and rated as having a stronger and saltier flavor. With the 'ice-cream' label, the food was expected to have a sweet flavor, so participants were unpleasantly surprised by the salty flavor. Because of this contrast effect, the flavor was perceived as more intense and strongly disliked by the participants. An assimilation effect, in turn, was demonstrated by Woods et al. (2011). Participants had to rate drinks in terms of sweetness. Drinks with the label 'Very Sweet' were given higher sweetness ratings than equal-tasting drinks labelled as 'Less Sweet'. In other words, the sweetness intensity was assimilated in the direction of the label-induced expectation. Taken together, assimilation and contrast effects result from a deviation between intrinsic product features and extrinsic labels, each with distinct consequences.

Another visual characteristic of textual labels that is associated with taste is a packaging's font style. In a study by Velasco, Woods, Hyndman and Spence (2015), participants had to indicate which taste word they would match with different typefaces. Round typefaces were associated with sweet tastes, and angular typefaces where associated with sour, salty and bitter tastes. Round typefaces were also liked more than

angular typefaces. This can be explained by the fact that sweet tastes are considered pleasurable and preferred tastes are associated with round shapes, while disliked tastes are matched to angular shapes.

Besides taste intensity, packaging labels automatically evoke expectations about hedonic and utilitarian features by using visuals that are generally associated with tastiness or healthiness (Benn et al., 2015; Huang & Lu, 2015; Stevenson, 2009). Liem et al. (2012) asked participants to rate soup with different labels before and after tasting. Soups with healthy labeling - a health logo, a 'reduced salt' claim, or the two combined - were expected to have a less intense and less enjoyable taste than soups with a neutral label. Yet actual perceived saltiness intensity and liking remained unaffected by labeling. The same was found by Norton et al. (2012). In their study, chocolates were labelled either as 'milk chocolate' or as 'reduced-fat'. Although the 'reduced fat' label decreased expected liking, actual liking and taste intensity were not affected by labelling.

Altogether, these studies show that personal associations, framed by prior experiences with foods and drink labels, will generate unique taste expectations that have the potential to influence the experience of taste.

Color. Color is another visual element that provides information about a food or drink before it is consumed (Stevenson, 2009). Color is a feature that can be perceived before all other design elements (Mai, Symmank, & Seeberg-Elverfeldt, 2016). Specific colors are repeatedly associated with specific products and corresponding tastes, depending on their co-occurrence in the environment (Shankar, Levitan, & Spence, 2010; Stevenson, 2009). In the natural environment, red and rich colors signify "the optimal development of sweetness" (Johnson & Clydesdale, 1982, pp. 749) and therefore a higher sugar content (Kostyla, 1978; Levitan & Spence, 2009). Lighter color tones are generally associated with a reduced wholesomeness of nutrients (Mai et al., 2016), and consequently interpreted as "less heavy on the stomach" (p. 428). Schulte-Holierhoek and colleagues (2017) found that products with highly saturated, dark red packaging were expected to taste more intense and sweet than low saturated, bright blue packaging. Yet actual taste intensity and sweetness remained unaffected.

When products are colored appropriately (i.e. congruent with expectations), flavor experience becomes more intense (Zampini, Wantling, Phillips, & Spence, 2008), and

product satisfaction will increase (Deliza & MacFie, 1995). Miscolored products, on the other hand, will lead to disconfirmed expectations. Small deviations from normality will lead to an assimilation effect. DuBose et al. (1980) found that "atypical colors have the effect of inducing flavors characteristically associated with that color" (p. 1399). Yet because people are intuitively guided by packaging color, strong incongruencies can lead to confusion (Piquaras-Fiszman & Spence, 2011) which will, in turn, evoke a contrast effect.

Colors are not only used to predict flavor, but tastiness and healthiness as well. In fact, research shows that products with cooler, pale and bright-colored packaging are perceived as healthier while simultaneously having a less sweet and less intense flavor (Tijssen et al., 2017). Products with warmer, high saturated, and dull-colored packaging are considered less healthy and expected to have a sweeter and more intense flavor.

In summary, the color of a product has a powerful effect on the perception of taste. Color tells us what characteristics to expect of a particular food or drink. In this way, color stimuli play an important role in the sensory experience and acceptability or rejection of a food or drink that is consumed.

Other influences on taste perception

The perception of taste is not only influenced by packaging features, but by many other factors as well. These factors can confound experimental results by altering the relationship between packaging elements and taste perception. In exclude this possibility, several influential extraneous variables are discussed below and added in a separate analysis.

External stimuli can generate different taste expectations, due to individual associations that arise from differences in experience and background (Mai et al., 2016; Spence, Levitan, Shankar, & Zampini, 2010). First, as already been noted in the above, consumers have different goals and beliefs when it comes to consumption, affecting the interpretation of packaging stimuli. Health goals are often subordinate to taste (Raghunathan et al., 2006). Yet when people are motivated by a healthiness, they will choose a less tasty product over a tastier one (Norton et al., 2013). Taste-focused individuals will respond negatively to health-related packaging, while this is not the case for health-focused individuals (Mai et al., 2016; Wansink, Park, Sonka, & Morganosky,

2009). Moreover, although people generally love sweet tastes (Spence, 2009), individuals differ in sweetness liking (Kim, Prescott, & Kim, 2014) and some people don't even like sweet tastes at all (Kim, Prescott, & Kim, 2017).

Packaging elements can also be interpreted differently because of physical differences between individuals. When people are hungry or thirsty, they react more strongly and more favorable towards food stimuli (Stevenson, 2009). For example, hungry individuals attend more to images of high-calorie foods than they would normally do (Spence et al., 2016). It is therefore also important to note when people last ate or drank something. This is done in other studies as well, for example by recording the consumption history of participants (Norton et al., 2012). Dieting is another factor that can influence attitudes towards foods and actual taste perception as well. The avoidance of sweet foods in particular, which is more common with a low food intake, leads to a higher sensitivity to sweet tastes (Lacey, Stanley, Crutchfield, & Crisp, 1976). Taste abilities can also be weakened by the common cold or smoking. Having a cold impairs smelling because the nose becomes inflamed by the illness (Alt, Wu, & Patel, 2015). This will reduce the sense of taste, considering that smell is an important element of flavor perception (Delwiche, 2004; Small, 2012). Taste sensitivity can be decreased by smoking as well. For example, Pavlos and colleagues (2009) showed that young smokers have more elevated taste thresholds than non-smokers.

Besides personal factors, the order in which experimental objects are presented can influence the evaluations of participants in taste perception research (Hottenstein, Taylor, & Carr, 2008). For instance, Schulte-Holierhoek et al. (2017) found an interaction effect between packaging color and the position of the question block. The effect of coloring was thus dependent on the experimental sequence.

The influence of external stimuli on individual expectation and perception can thus be moderated by many internal and external attributes. It is important to keep these moderators in mind in the experimental design.

Overview, research question and hypotheses

The experience of taste is not an fixed phenomenon, but rather a complex interaction of perception and expectation. Early encounters with foods and drinks and their common tastes forge associations in the brain that will ultimately lead to particular

expectations. Differences in taste experiences, personal characteristics and environmental aspects can lead to varying responses to visual stimuli (Johnson & Clydesdale, 1982; Shankar et al., 2009). Labels and color are visual sources of information that indicate the likely characteristics of a particular food or drink. Repeated associations between these stimuli and their matching tastes will automatically engender inferences about product characteristics such as taste. After ingestion, the combination of visual information and prior expectations will shape the intensity perception and corresponding hedonic and utilitarian judgments of a product's taste.

Consumers often have to infer sensory properties by relying on the packaging stimuli such as labeling and coloring (Deliza & MacFie, 1996; Mai et al., 2016; Simmonds & Spence, 2017). Such design elements have the potential to affect consumers' expectations (Johnson & Clydesdale, 1982; Wansink et al., 2000) and possibly even their perception of taste (Piqueras-Fiszman & Spence, 2015). Extending this thought, the current study investigated the effect of packaging on taste perception. More specifically, by altering the labeling and coloring of two different types of cups, the aim was to find out how congruent and incongruent packaging affects the taste intensity of sweet and sour beverage flavors. Building on the study by Noordewier and Van Dillen (2016), the following hypotheses were drawn:

Hypothesis 1: Expected tastes will be rated as less intense than the unexpected tastes.

Hypothesis 2: Unexpected tastes will be rated as more intense than the expected tastes.

Moreover, because of our innate preference for sweetness aversion for sourness (Stevenson, 2009; Rozin & Vollmecke, 1986), this contrast effect was predicted to be most potent for unexpected sour tastes.

The effect of packaging is mostly studied by focusing on a single product feature. One exception is Shankar (2009), who simultaneously manipulated the label and color of chocolate M&Ms. Brown M&Ms and M&Ms with a 'dark chocolate' label were rated as having a more intense chocolate flavor than their green-colored and 'milk chocolate'-labeled counterparts. In the present study, we examined the impact of both labeling and coloring to provide a more realistic representation of actual beverage packaging.

As discussed, flavor is not a unilateral but rather multifaceted sensation, arising from the combination of different sensory input (Yeomans et al., 2008). Because flavor

consists of a combination of senses, people rarely notice the difference between taste and olfactory elements (Stevenson, 2009). Confusing taste and olfaction would obscure the effect of packaging. For this reason, we impeded the ability to smell.

Alongside intensity, tastiness and healthiness are important classes of taste evaluation as well. Therefore, the second goal of this research was to examine the effect of packaging on the perception of tastiness and healthiness. Due to diverging evidence on the connection between packaging, tastiness and healthiness, sound predictions could not be made. For this reason, an exploratory approach was taken to investigate the effect of packaging on the perceived healthiness and liking of sweet and sour drinks. Furthermore, we wanted to investigate whether the influential factors as discussed earlier would affect the results. Prior to the current study, a pilot study was conducted to examine the effectiveness of the packaging manipulation.

Pilot Study

A pilot study was performed to check the direction of packaging-induced expectations. The preliminary study was designed to test the effect of packaging label and color on sweetness, sourness, tastiness and healthiness expectations. For this study, participants from Leiden University were asked to answer a short set of questions about two cup designs using a tablet computer. They were informed that the pilot study would take approximately five minutes. The participants had to indicate the expected intensity, sweetness, sourness, tastiness and healthiness of cup designs that were presented in pairs on a Likert scale ranging from 1 (not at all) to 7 (extremely). Besides mentioning gender and age, participants had to indicate their concern for tastiness and healthiness, their current degree of appetite, and to which extend they had a sweet tooth, all on a Likert scale ranging from 1 (not at all) to 7 (extremely). Furthermore, the last time since their last drink or meal could be indicated on a four-point scale (respectively 0 to 1 hour, 1 to 2 hours, 2 to 3 hours, and more than 3 hours ago). In the dichotomous questions (yes/no), participants were asked if they had a serious cold, if they smoked regularly, and if they were currently dieting. The last questions intended to check if participants knew what the goal of the study was and if they had any comments or remarks. The questionnaire ended with a short debriefing about the manipulation, in which participants were also asked to not inform others about the real purpose of this study.

Two different cup designs were presented at the same time in randomized order on the tablet screen. A paired-samples *t*-test was conducted to compare taste expectations between the different packaging. After several comparisons, the pilot testing revealed a significant difference in taste expectation between the red-colored cup with a red strawberry icon and a 'Drink' label in round typeface and the yellow-colored cup with an orange icon and a 'Drink' label in basic typeface. There was a significant difference between the red and yellow cup in terms of sourness ratings ($t(13) = -11.85$, $p < .001$) and sweetness ratings ($t(13) = 8.13$, $p < .001$). Sourness expectations were highest for the yellow cup ($M = 5.50$: $SD = .76$) compared to the red cup ($M = 1.86$: $SD = .86$), while sweetness expectations were highest for the red cup ($M = 5.93$: $SD = 1.27$) compared to the yellow cup ($M = 3.29$: $SD = .91$). There was a near significant difference between the red and yellow cup in healthiness rating ($t(13) = -2.12$, $p = .054$) and enjoyment rating ($t(13) = -2.05$, $p = .06$). Compared to the red cup, enjoyment expectations were higher for the yellow cup ($M = 4.79$: $SD = 1.85$ versus $M = 3.29$: $SD = 1.33$). Healthiness expectations were also higher for the yellow cup than for the red cup ($M = 3.57$: $SD = 1.09$ versus $M = 2.64$: $SD = 1.28$), albeit non-significant in both cases. The red and yellow cup did not differ in intensity rating, $t(13) = -0.13$, $p = .90$. It was therefore decided to leave out this item in the main analysis and to keep only the sweetness and sourness variables.

Final decisions

Given the apparent sweetness association of the red-colored cup and the sourness association of the yellow-colored cup, it was decided to use these two designs in the main study. Based on the results of this pilot study, the previously formulated hypotheses were specified as follows. The first hypothesis is that sweet flavors will be rated as less intense in the red cup than in the yellow cup, and that sour flavors will be rated as less intense in the yellow cup than in the red cup. The second hypothesis is that sweet flavors will be rated as more intense in the yellow cup than in the red cup, and that sour flavors will be rated as even more intense in the red cup than in the yellow cup.

Method

Participants

For the main study, 170 participants (99 female, 71 male) ranging from 16 to 52 years old (M = 22.4: SD = 4.8) were recruited at Leiden University. A group of four researchers conducted the study over a period of two weeks, in order to collect data as part of their Economic and Consumer Psychology thesis project. Random students were asked if they wanted to participate in a short study about taste in which they had to taste two different drinks and answer a corresponding questionnaire using a tablet computer. Incidentally, employees participated in the study as well. Participants who were not proficient in English were excluded from the study. Since the study took approximately six minutes, credits or a financial compensation were not assigned.

Design

It was predicted that the match or mismatch between the expected and actual taste would influence the intensity perception of sweet and sour flavors. The study had a mixed design, with packaging as the between-subjects factor, and flavor as the within-subjects factor. All participants had to evaluate two cups that were designed in accordance with flavor-packaging associations mentioned in earlier research. The first cup was designed in red-colored packaging, with a strawberry icon and a curly 'Drink' typeface, intended to evoke the expectation of a sweet taste (Appendix A, *figure 1*), from now on mentioned as 'red packaging'. The second cup was designed in yellow-colored packaging with an yellow icon and a basic typeface, intended to evoke the expectation of a sour taste (Appendix A, *figure 2*), from now on mentioned as 'yellow packaging'. For each participant, both cups contained either a sweet drink or a sour drink. There were two 2-level factors: the cup design and that evoked either a sweet or sour expectation, and the sweet or sour flavor of the drink. The dependent variables were perceived sweetness and sourness of the drink. The exploratory dependent variables were perceived tastiness and healthiness of the drink.

The order in which the cups and their corresponding questions were presented was randomized to control for common order effects. The first order of the questionnaire was to start with the red-colored cup and fill in the questionnaire, and then to first taste yellow-colored cup and fill in the questionnaire. The second order was the reverse of the

first one. Which cup had to be tasted from first was randomly determined by the survey. The two different packaging always contained the same (sweet or sour) flavor.

Procedure

The recruited participants were first provided with practical information about the experiment. Thereafter, they were instructed to open an online questionnaire using the tablet. The researchers were present to provide assistance when needed. In the first part of the questionnaire, participants were informed about the course and duration of the experiment, and were presented with an informed consent. Thereafter, participants were instructed to take the cup that corresponded to the picture on the tablet screen and to drink the whole content of the cup. This tasting session was followed by a short questionnaire about the experience of the drink. This process was repeated for the second drink. Items about extraneous variables - duplicated from the pilot study - were asked as well. In the final part of the questionnaire, participants were asked about their expectations concerning the goal of the study, after which they were provided with a short debriefing.

Materials

Taste-test. The beverages were created by two types of mixtures. The sweet solution consisted of 100 ml of water and 30 ml of glucose. The sour solution consisted of 100 ml of water and 30 ml of lemon juice. The cups were covered by a lid that prevented participant from seeing or smelling the drink. The participants were asked to consume the drink, and to indicate how they experienced the taste intensity in terms of sweetness and sourness, their perceived level of healthiness, and how much they liked the drink, all on Likert scales ranging from 1 (not at all) to 7 (very much).

Control variables. The selection of control variables was based on literature mentioned earlier. Participants were asked if they were on a diet, had a serious cold, and smoked regularly. It was important to take these dichotomous questions (yes/no) into consideration, given the possible bias of the experimental results. The other control questions included the importance of tastiness, importance of healthiness, current degree of appetite, and having a sweet tooth. These questions had to be answered on a Likert scale ranging from 1 (not at all) to 7 (extremely). Finally, the amount of time since the last food or drink intake could be indicated by 1 (0-1 hours), 2 (1-2 hours), 3 (2-3 hours)

or 4 (3+ hours). The questionnaire proceeded by asking participants if they drunk the whole content at once and did not open the lid during the experiment. This information was essential for checking the validity of the tasting sessions.

Analysis

The data was analyzed in SPSS by performing a Repeated Measures ANOVA, as the study uses both a between-groups and a within-subjects design. In all analyses, packaging (red versus yellow) was used as between-groups variable and flavor (sweet versus sour) was used as within-subjects variable. Since flavor and packaging were expected to interact, an interaction effect of flavor and packaging was added to the model. Before starting the analysis, assumptions of multivariate normality, independence and sphericity were checked.

The first round of analysis was designed to test the hypothesized and exploratory effects. Two separate Repeated-Measures ANOVAs, grouped by flavor and packaging, were performed to assess sweetness and sourness. For the exploratory variables, two additional Repeated-Measures ANOVAs were performed to assess tastiness and healthiness as dependent variables.

The second round of analysis tested an order effect of the tasting sessions. An One-Way ANOVA was performed including only the first measurement of each participant. The assumptions of normality, homogeneity of variance and independence were tested beforehand. The data was first restructured by combining the two separate red/yellow ratings of each dependent variable into one single variable. The first measurement of each participant - either the yellow cup or the red cup that had been presented first - was denoted as ‘packaging order’ in a new variable.

The third round of analysis included the selected extraneous variables as control variables. Prior eating or drinking, importance of tastiness, importance of healthiness, having a sweet tooth, hungriness were added as covariates in a Repeated-Measures ANCOVA. The binary variables - dieting, having a serious cold, and smoking - were included as factors in a Repeated-Measures ANOVA. Given the absence of high intercorrelations for the two sets of variables, it was decided to include all covariates at once in each analysis.

Results

Impact of packaging on flavor intensity

Sweetness perception. To answer the first research question, a Repeated-Measures ANOVA was conducted to test the effect of packaging and flavor on sweetness. It was hypothesized that sweet tastes would be rated as less intense in the red cup than in the yellow cup, and that sweet tastes would be rated as more intense in the yellow cup than in the red cup. In other words, it was expected that these variables would interact. The predicted interaction between packaging and flavor was not significant, $F(1, 168) = 0.56$, $p = 0.45$. The effect of packaging on sweetness did not depend on the flavor of the drink. The main effect of packaging was also not significant, $F(1, 168) = 0.09$, $p = 0.76$. Red and yellow packaging did not differ on ratings of sweetness. There was a significant main effect of flavor ($F(1, 168) = 218.85$, $p = <.001$). Sweet drinks ($M = 5.12$) were rated as sweeter than sour drinks ($M = 2.42$).

Sourness perception. Also concerning the first research question, a new Repeated-Measures ANOVA was conducted to test the effect of packaging and flavor on sourness. It was hypothesized that sour tastes would be rated as less intense in the yellow cup than in the red cup, and that sour tastes will be rated as more intense in the red cup than in the yellow cup. In addition, taste intensity was expected to be highest for sour drinks in the red cup. The predicted interaction between packaging and flavor was not significant, $F(1, 168) = 1.66$, $p = 0.20$. The effect of packaging on sourness did not depend on the flavor of the drink. The main effect of packaging was also not significant, $F(1, 168) = 0.09$, $p = .76$. Red and yellow packaging did not differ on ratings of sourness. There was a significant main effect of flavor ($F(1, 168) = 485.70$, $p = <.001$). Sour drinks ($M = 5.28$) were rated as more sour than sweet drinks ($M = 1.79$).

Impact of packaging on tastiness and healthiness

Tastiness perception. The third Repeated-Measures ANOVA was performed to explore the effects of packaging and flavor on tastiness. There was a significant interaction between packaging and flavor, $F(1, 168) = 9.29$, $p = .03$. To further examine this interaction effect, the data was split into a ‘Sweet’ and ‘Sour’ part. After re-running the Repeated-Measures ANOVA for tastiness, packaging had a non-significant effect on tastiness of the sweet solution, $F(1, 84) = .725$, $p = .397$. However, packaging did

significantly affect tastiness of the sour solution, $F(1, 84) = .11.38$, $p = .001$. Sour drinks were rated as more enjoyable in the flavor-congruent yellow cup ($M = 3.24$) than in the flavor-incongruent red cup ($M = 2.84$). The main effect of packaging was not significant ($F(1, 168) = 3.56$, $p = .06$). Red and yellow packaging did not differ on ratings of tastiness. Finally, there was no significant effect for flavor ($F(1, 168) = .20$, $p = .66$). Sweet and sour drinks did not differ on ratings of tastiness.

Healthiness perception. The fourth Repeated-Measures ANOVA aimed to explore the effect of packaging and flavor on healthiness. There was a non-significant interaction between packaging and flavor, $F(1, 168) = 0.01$, $p = 0.93$. The effect of packaging on healthiness did not depend on the flavor of the drink. There was a significant main effect of packaging ($F(1, 168) = 12.12$, $p = .001$). Drinks from the yellow cup ($M = 3.24$) were rated as healthier than drinks from the red cup ($M = 3$). Finally, flavor had a significant main effect on healthiness ($F(1, 168) = 78.55$, $p < .001$). Sour drinks ($M = 3.89$) were rated as healthier than sweet drinks ($M = 2.35$).

An overview of the interaction effects of packaging and flavor for the four dependent variables are shown in Table 1.

Table 1
Means, SE (in parentheses) and F values of the Packaging and Flavor interaction

	Sweet drink		*Sour drink*			
	Red cup	*Yellow cup*	*Red cup*	*Yellow cup*	*F*	*p*
Sweetness rating	5.17 (.14)	5.08 (.14)	2.40 (.14)	2.44 (.14)	.56	0.45
Sourness rating	1.72 (.12)	1.87 (.14)	5.33 (.12)	5.24 (.14)	1.66	0.20
Enjoyment rating	3.00 (.14)	2.91 (.15)	2.84 (.14)	3.24 (.15)	9.29	0.03
Healthiness rating	2.22 (.13)	2.47 (.13)	3.78 (.13)	4.01 (.13)	.01	0.93

Impact of order effects

A new analysis of variance was performed for all dependent variables by using the packaging (red or yellow) that appeared during the first taste session of each participant as factor - denoted as ‘packaging order’. There was a non-significant interaction between packaging order and flavor for sweetness, sourness and healthiness (p’s >.21). In other words, ratings of sweetness, sourness and healthiness were not dependent on the order in which the cups were presented. Only for tastiness, the interaction between packaging order and flavor was significant ($F(1, 166) = 4.09$, $p = 0.045$), that is to say the effect of flavor on enjoyment rating depended on the order in

which the cup designs were presented. When sweet drinks were tasted first (M = 3.17), they were rated as more enjoyable than when they are tasted second (M = 3). When sour drinks were tasted second (M = 3.32), they were rated as more enjoyable than when they were tasted first (M = 2.66). Since the majority of dependent variables remained unaffected, it was decided not to control for order effects in the final analysis.

Impact of control variables

It is conceivable that the effect of packaging and flavor had been obscured by extraneous variables. Therefore, a final step was to include the selected control variables into the analysis. Sweetness, sourness, tastiness and healthiness were studied in four separate Repeated-Measures ANCOVAs with packaging as between-subject variable and taste as within-subject variable. Importance of healthiness, importance of tastiness, having a sweet tooth, hungriness, and prior eating or drinking were included as covariates. The descriptive statistics for these control variables are shown in Table 2. For sweetness, sourness, tastiness and healthiness, no significant effect of the covariates could be obtained.

Table 2

Means, SE (in parentheses) and Range of the control variables

	Descriptives	
	Mean (*SD*)	Range
Importance of tastiness	5.69 (*1.09*)	1-7
Importance of healthiness	5.13 (*1.09*)	1-7
Having a sweet tooth	4.14 (*1.62*)	1-7
Hungriness	2.97 (*1.48*)	1-6
Prior eating or drinking	1.58 (*.90*)	1-4

Four additional Repeated-Measures ANOVAs were performed on all factors with packaging as between-subject variable. The within-subject variables were flavor, having a serious cold, smoking and dieting. The descriptive statistics for these control variables are shown in Table 3. Having a serious cold had a statistically significant impact on sweetness ($F(1, 160) = 14.92$, $p < .01$). Put differently, ratings of sweetness were higher for participants with a serious cold (M = 5.63) than for participants without this

impediment (M = 3.53). Smoking had a statistically significant impact on sweetness as well ($F(1, 160) = 3.99$, $p = .05$), in that sweetness ratings were lower for participants who smoked regularly (M = 3.48) than for participants who did not (M = 4.28). However, it should be noted that despite these significant effects, as a set, the control variables did not affect the coherence between variables. That is, the main and interaction effects of packaging and flavor on sweetness, sourness, tastiness and healthiness remained unchanged.

Table 3

Descriptive statistics of the binary control variables

	Percentage	
	Yes	No
Cold	1.76%	98.24%
Smoke	10%	90%
Diet	4.12%	95.88%

Discussion

The present study was designed to test the influence of packaging on the flavor perception of sweet and sour drinks. We extended the research by Noordewier and Van Dillen (2016) on the effect of expected and unexpected beverage flavors on taste by manipulating actual packaging stimuli. Specifically, we tested if the experience of flavor intensity was affected by the design of the cup from which a sweet or sour drink was consumed. In addition, an explorative approach was taken regarding tastiness and healthiness perception.

It was hypothesized that sweet flavors would taste less sweet in the red cup (with an yellow icon and a basic typeface) than in the yellow cup (with strawberry icon and a round-shaped typeface), and that sour flavors would taste less sour in the yellow cup than in the red cup. Moreover, it was expected that sweet flavors would taste sweeter in the yellow cup than in the red cup, and that sour flavors would taste more sour in the red cup than in the yellow cup due to a contrast effect, which was predicted to be most intense for the sour drink in the red cup. None of the hypotheses was supported. Against expectations, participant's ratings of sweetness and sourness intensity were not

significantly affected by packaging (i.e. flavor-congruent versus flavor-incongruent), even after controlling for the effects of presentation order and extraneous variables.

Two components determine if an assimilation or contrast effect will emerge. First, the magnitude of the discrepancy between expectation and actual experience, and second, the strength and certainty of the expectation (Yeomans et al., 2008; Shankar et al., 2010). Recall that assimilation occurs when the expectation strongly resembles the actual quality, while large differences between expected and actual qualities lead to a contrasting experience. Against this background, it could be argued that in the present study, the packaging manipulations may have been too ambiguous or meaningless to generate clear expectations (Schulte-Holierhoek et al., 2017; Yeomans et al., 2008). The pilot study only assessed the visual appearance of the beverages by showing digital previews of the cups, though exposure to the real-life beverages may have generated different expectations. An alternative explanation is that the taste intensity of the mixtures might have been too weak to produce a contrast effect. Taken together, it is possible that the taste-related expectations where not thoroughly formed, so differences between expected and actual taste were too small to affect taste perception (Becker et al., 2011; Liem et al., 2012). To validate the intended effect of the visual stimuli, it is important to assess packaging expectations as well, for example by asking participants about their expectations before and after tasting the drink. Furthermore, since this study included sweet and sour flavors, it might be possible that other flavor pairs would have contrasted more strongly. Compared to sour flavors, bitter flavors may evoke a stronger aversive post-consumption response, and together with their distinct taste, could thus be experienced as more intense. A replication of this study could use bitter flavors and bitterness-associated packaging as an alternative for sour flavors. Carlsmith and Aronson (1963) already gave a first move by showing that a bitter solution is experienced as more bitter when expecting a sweet taste. Naturally, replication studies require extensive research into bitterness-related expectations.

Studies on the effect of sensory-based expectations on taste perception often focus on one single product element in a controlled lab environment (see for instance the review by Spence et al., 2010). We manipulated both color and label of a three-dimensional cup in a field study to provide a more accurate representation of real-life

packaging. Using real food products in a realistic setting provides more external validity, but the lack of control for extraneous variables is at the expense of internal validity. The influence of additional cues - with respect to both product and environment - may explain why we did not find differences in taste intensity. People automatically integrate different sensory perceptions of a stimulus (Lavin & Lawless, 1998). Shankar et al. (2009) even argue that different components of packaging have additive effects on perception. In the current study, participants' attention could have momentarily strayed from the target stimuli and drawn to other product or environmental attributes, in such a way that all these detected elements *together* determined the interpretation of the visual cue. Closer inspection of the research design shows various factors that could have confounded the results. For reasons of efficiency, different participants were tested side by side at the same time. So although the drinks were intended to be shown separately from each other, it is plausible that participants already got an impression of all cups by observing other subjects. In this way, the surrounding objects could have impeded distinct attention to the primary cup and biased the evaluation of the cups. Another unintended consequence of this setup was that participants were able to hear the responses of neighboring subjects, which could have influenced their own response to the drinks. When observing the reactions of others, people can take this behavior as an example to guide their own evaluation - a phenomenon known as 'observational learning' (Bandura, Grusec, & Menlove, 1966). Consequently, participants' responses might have been more genuine when regarded individually.

Altogether, it cannot be excluded that the individual evaluation of the drinks was not influenced in any way by the presence other factors. Knowing that so many different elements of a product interact in generating taste expectations (Tijssen et al., 2017), it is important to incorporate multiple packaging attributes into a more controlled environment. Such an experiment, that enables the researcher to control all factors involved, has yet to be conducted.

Given the absence of prior expectations, the effect of packaging on tastiness and healthiness perception was studied exploratively. In the present study, drinks were enjoyed more when there was a match between flavor and packaging, and enjoyed less in case of a mismatch. This is in line with the research by Anderson (1973) and Piqueras-

Fiszman and Spence (2015), showing that hedonic evaluation is more positive when there is a congruence between expected and actual taste, but more negative in case of an incongruent experience. The fact that we did not find a contrast effect for intensity evaluation but only for tastiness evaluation suggests that hedonic differences are stronger than sensory differences, which was also found in the study of Yeomans et al. (2008). Perhaps it is harder to reflect on sensory responses than hedonic responses, meaning that it is easier for people to estimate tastiness than intensity qualities. From an evolutionary point of view, people should be more wary of tastiness qualities given that the (un)pleasantness of a food or drink signals if the product is potentially harmful and needs to be rejected or not (Johnson & Clydesdale, 1982; Stevenson, 2009). Future studies may assess taste perception by using more elaborate items so that it possible to check if this will eliminate differences in the top-down accessibility of hedonic versus sensory intellect.

An interesting finding was that tastiness perception was affected packaging and flavor, but only for the sour drinks. A similar effect could not be obtained for sweet beverages, which were equally liked regardless of the cup in which they were served. This makes sense, considering that the expectation of a positive sensation (i.e. a sweet taste) followed by a negative sensation (i.e. a sour taste) will be more likely to result in an aversive response due to a strong contrast effect (Deliza & MacFie, 1995; Silva et al., 2017; Yeomans et al., 2008). On top of that, sweet drinks were rated as tastier during the first compared to the second tasting session. Sour drinks, on the other hand, were rated as tastier during the second compared to the first tasting session. It could be argued that the sour drink had a dominant aftertaste, making the subsequent sweet drink less enjoyable. The aftertaste of the sweet drink, in turn, could have made the subsequent sour drink more enjoyable. Although participants had the opportunity to rinse their mouths by drinking plain water, only a few actually took this opportunity. After the first tasting, participants shortly continued with the second session. In future research, participants should be explicitly asked to drink water and to insert a mandatory break in between the tasting sessions to ensure that the different flavors are not mixed up.

The perception of healthiness was affected by packaging and flavor independently. Recall that the yellow cup was characterized by a lemon logo and an

angular label typeface. The red cup, in turn, had a strawberry logo and a curly label typeface. In terms of packaging, both sweet and sour drinks were rated as healthier when coming from the yellow cup, while beverages in the red cup were rated as unhealthier. These findings are in line with earlier studies on color and taste, bright colors are associated with healthiness, while warmer colors are linked to indulgence (Liem et al., 2012; Mai et al., 2016; Tijssen et al., 2017). Besides the color correspondence, the lemon icon may have reminded participants of citrus fruits that are commonly known as healthy due to the high amount of vitamin C. Somewhat less straightforward, but nonetheless reasonable, is that the strawberry icon could have activated a link with sweet products such as candy and lemonade, that often portray a strawberry image on the packaging. Research clearly shows that learned associations such as these tend to influence perceptions throughout life (Delwiche, 2012; Husić-Mehmedović et al., 2017; Piqueras-Fiszman & Spence, 2015; Shankar et al., 2009; Spence et al., 2010; Stevenson, 2009). As to confirm the assumed packaging-healthiness linkages, future studies should elucidate such healthiness-related associations, for example by asking participants whether they want to argue their judgment of (un)healthiness. Moreover, the question remains if the sweetness-priming round shape of the logo and the sourness-priming angular shape of the logo has had an (additional) effect on the (un)healthiness priming as well. Coming back to the plausible interaction between different elements of packaging, the effect of aggregated packaging attributes could be included in future research to see differences in effect.

Flavor had an unexpected effect on packaging, in that participants rated sweet drinks as healthier and sour drinks as less healthy. According to Stevenson (2009), there is an inherent cognitive link between sweet tastes - that signify a build-up of sugars - and unhealthiness on the one hand, and between sour tastes - that signify a reduction of sugars - and healthiness on the other. The current study found opposite associations, which implies that the sweet and sour flavors did prime other concepts of healthiness. This occurrence could be attributed to the specific mixtures that were used to create the drinks. It is possible that participants were used to different types of sweet and sour flavors and thus interpreted the mixtures as an opposite paradigm. In other words, participants could have perceived the sweet flavor as an indicator for healthiness and the sour flavor as a

marker for unhealthiness merely because of their unfamiliarity. Future research needs to pretest the experimental solutions in a preliminary study to be sure that the effects of the manipulation are as intended.

Strengths and limitations

This research has several strengths and limitations. The present study extended the well-established link between packaging and expectations by focusing on actual taste perception. Research on the effects of packaging on product perception has hitherto been narrowed to one packaging feature, most often by showing participants pictures or descriptions of a product and then asking them to evaluate the taste of an unidentifiable good in front of them (e.g. Huang & Lu, 2016; Woods et al., 2011). To our knowledge, this is the first study that examined the joint effect of packaging label and color on the perceived taste intensity of beverages flavors. Existing studies that incorporate multiple packaging cues have only been focused on food products (e.g. Shankar, 2009; Schulte-Holierhoek et al., 2017; Yeomans et al., 2008). Furthermore, we took a different approach to provide a more realistic representation of everyday products. Yet, this was at the expense of controllability over external and distracting factors.

Another limitation of the current study was the absence of a control group. By comparing flavor-congruent and flavor-incongruent packaging, it was only possible to demonstrate differences in impact strength on taste perception. Yet since the packaging conditions could not be compared to a baseline condition, the direction of effects remained unclear. When designing a similar study, it is advisable to add a control condition to better understand the findings.

A strong point of this research was the within-subjects design that eliminated differences between individuals. Knowing that taste is formed by personal experiences and subjective appraisals, a within-subjects design was a very suitable choice. Furthermore, we controlled for a large amount of influential extraneous variables that were demonstrated to have an effect on taste perception. This research showed that, in conjunction, the extraneous variables affected neither taste intensity nor tastiness and healthiness perception. It should be noted that each influential concept was assessed by merely one (non-validated) questionnaire item, which casts doubt on the construct validity of this particular measurement. Researchers are encouraged to make a considered

choice between using complete scales as a high-quality measure of a few constructs on the one hand, and a selection of items as a more superficial measure of multiple constructs on the other.

Implications

The results of the present study suggest that packaging can have an effect on how much a product is seen as tasty or healthy. This denotes that successful packaging adjustments could work as a profitable strategy for marketers. More specifically, designing a product's packaging in line with its flavor will strengthen conceptions of tastiness and healthiness. Yet caution is needed with healthy-looking products, considering that these foods and drinks are thought to be less enjoyable than their less healthy counterparts (Raghunathan et al., 2006). To persuade consumers to buy healthy products, it is rather advisable to use packaging that will evoke positive taste associations (Liem et al., 2012; Raghunathan et al., 2006). Such packaging adjustments can be of great use in fighting major health problems and helping to improve consumer choice by making the product more appealing (Mai et al., 2016; Tijssen et al., 2017). The current research can also be regarded as a stepping stone to future research on determinants of packaging effects in alternative contexts. For example, it would be interesting to assess the impact of packaging in a physical versus digital environment, were products are evaluated in a different way (Benn et al., 2015; Krishna et al., 2017).

Besides labeling and coloring, there are many other packaging features that can shape taste perception. Knowledge of packaging-induced expectancies on taste experience can be used to optimize product appearance. Packaging can serve as an important sales tool, knowing that product evaluation can change dramatically by transforming the packaging design. Insomuch as each (un)conscious adjustment can produce a different effect, research should shed light on the expectations of consumers before packaging changes are implemented (Piqueras-Fiszman & Spence, 2011). Both researchers and retailers should bear in mind that consumers operate in sophisticated environments consisting of visually and cognitively taxing stimuli (Gidlöf, Anikin, Lingonblad, & Wallin, 2016). Studying the interconnections between cognitive associations and visual cues is therefore a prerequisite for selecting the most appropriate product packaging to satisfy consumers.

Conclusion

This study demonstrated that packaging with label and color properties has the potential to affect the evaluation of sweet and sour beverages by means of packaging-flavor congruence, at least for tastiness and healthiness. Against expectations, the effect of packaging on taste intensity could not be validated. Nevertheless, the present study was able to provide a nudge in the right direction by proposing a holistic approach to the influence of packaging on taste perception. For each type of packaging, it is important to consider the unique interplay between internal and external factors and the experience-based expectations about the multidimensional aspects of the product.

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Appendix A

Figure 1. Sweetness-inducing red cup design

Figure 2. Sourness-inducing yellow cup design