Establishing boundary conditions for multiple

design elements congruent with taste expectations

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ABSTRACT

Over the past two decades, a burgeoning literature has demonstrated the robust associations that exist between visual elements ('cues') on product packaging in the food and beverage category and consumer expectations regarding the taste of a product. However, to date, little research has examined if/how the individual effects demonstrated for such visual cues combine when multiple cues are presented together. Therefore, two experiments were designed to investigate whether manipulating the number (Experiment 1), and congruency (i.e., an association with a particular taste as identified by previous literature; Experiment 2) of word, colour, and background pattern angularity cues would influence people's taste expectations and associated evaluations. The results of Experiment 1 demonstrated that increasing the number of congruent cues on product packaging increased the strength of people's expectations concerning the relevant basic taste, with an apparent 'ceiling effect' hinted at. Experiment 2 extended this novel empirical finding by demonstrating that when colour and background pattern cues were associated with different basic tastes (i.e., the cues were, in some sense, 'incongruent'), rather than counteracting one another, colour tended to dominate over background pattern in terms of determining the expected taste of the product. Taken together, these results suggest that stronger, or at least more salient, design cues dominate over weaker ones when they conflict in terms of their meaning (or corresponding taste).

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KEYWORDS: PACKAGING COLOUR; TASTE EXPECTATIONS; COMBINING CORRESPONDENCES; CONGRUENCE; VISION.

Introduction

The consumer's experience of the taste/flavour of food and beverage products cannot simply

be understood on the basis of gustatory information alone, nor even from the action of the

chemical senses more broadly. From the moment a consumer encounters a product (e.g., on a

supermarket shelf or in an advertisement), their brain uses all available information about the

product/packaging in order to make predictions about the taste/flavour (see Piqueras-Fiszman

& Spence, 2015, for a review). These predictions may then alter the subsequent taste

experience on sampling the product in a number of different ways: (1) *assimilation*

(Anderson, 1973), a form of cognitive dissonance (cf. Festinger, 1957) in which the taste

experience is shifted *towards* the expectation, resulting from any discrepancy between

expected and experienced values, (2) *contrast,* in which the difference between expected and

experienced values is magnified, or (3) *assimilation-contrast,* whereby small discrepancies

between expected and experienced values result in assimilation, but contrast is seen when the

discrepancy becomes too large (e.g., Becker, Van Rompay, Schifferstein, & Galetzka, 2011;

Wang, Carvalho, Persoone, & Spence, 2017; see Okamoto & Dan, 2013; Piqueras-Fiszman &

Spence, 2015, for reviews).

One particular influence on people's taste expectations may result from the influence of the

various 'crossmodal correspondences' that have been uncovered by researchers in recent

years: that is, the tendency for elements in one sensory modality to correspond to, or to be

associated with, elements in another (see Spence, 2011, 2012; Spence & Ngo, 2012; Velasco,

Salgado-Montejo, Marmolejo-Ramos, & Spence, 2014, for reviews). Such crossmodal

correspondences can therefore lead to a perceptual element (or cue) in one modality (e.g.,

vision) leading to the generation of an expectation that a corresponding element will be (or

even, actually is) subsequently experienced in another sensory modality (e.g., taste/flavour) (Ludden, Schifferstein, & Hekkert, 2007), thereby biasing evaluations towards this expectation (see Spence, 2018, for a review). However, since we rarely eat food without seeing it and/or its packaging first, and given that producers can often control the environment in which their food products are presented with relative ease by means of making changes to the design of packaging, perhaps the most important correspondences in these instances are between vision and taste/flavour. As a natural interface of the two senses,[1] product packaging provides a valuable context in which to explore these crossmodal correspondences between vision-taste empirically. Online methodologies provide an effective means of manipulating the visual environment easily and at minimal cost (for a discussion of the benefits of online methodologies, see Woods, Velasco, Levitan, Wan, & Spence, 2015).

To date, a number of crossmodal correspondences have been documented between discrete visual elements on product packaging (i.e., 'product-extrinsic cues'; Okamoto & Dan, 2013) and discrete expectations (and perceptions) of tastes (i.e., 'product-intrinsic cues'). For example, across the literature, rounder shapes or forms reliably correspond with sweeter tastes while more angular shapes have been shown to correspond to sourer and bitterer tastes (i.e., these are referred to as shape-taste correspondences). The effect of curvilinearity would appear to be replicable with basic shapes (e.g., Salgado-Montejo et al., 2015), typeface (e.g., Velasco, Woods, Hyndman, & Spence, 2015), background shape (e.g., Westerman et al.,

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[1] The interested reader may also wish to consider other contexts with certain parallels, such as with food plating (e.g., Fairhurst, Pritchard, Ospina, & Deroy, 2015), or even, the design of foods themselves (e.g., e.g., Spence, Arume, & Youssef, 2019). Though not the substantive topic of discussion here, one may notice how similar correspondences can be identified across many of these different contexts (e.g., how curvilinearity is associated with sweetness/sourness). Given the existence of such varied real-world applications, and repeatable and robust effects, one should be satisfied that these (often surprising) correspondences do exist, and indeed, are likely to have a pervasive effect on our everyday perception of food and drink.

2013), and even with the shape of the food itself (e.g., Wang et al., 2017; though see also Spence, Corujo, & Youssef, 2019).

Separately, robust colour-taste correspondences have also been demonstrated, in which pinkish-red hues are most strongly associated with sweetness, and yellow/green colours with sourness (e.g., Woods & Spence, 2016; see Spence et al., 2015, for a review). Recently, other vision-taste correspondences have also been described. Researchers have, for instance, shown, an influence of symmetry (e.g., Turoman, Velasco, Chen, Huang, & Spence, 2018), position (e.g., Simmonds et al., 2018), and foreground-background colour pairs (Woods, Marmolejo-Ramos, Velasco, & Spence, 2016) on taste expectations/associations. However, for the purposes of the present research, our focus will be on the former two (i.e., colour-taste and shape-taste correspondences), which have attracted the most research support to date (see **Tables 1** and **2** for a summary of the literature on such correspondences).

INSERT TABLES 1 & 2 ABOUT HERE

Here, it is important to note that when viewing product packaging, consumers rarely experience one such product-extrinsic cue in isolation; that is, packaging designs typically include shapes, colours, typefaces, and so on in conjunction, each of which presumably have their own independent associations with particular tastes. Therefore, the congruency between cues with regards to these associations may play an important role in determining the taste expectations that are set-up by the product packaging. Indeed, the congruency of vision-taste cues has been shown to influence the taste experience; for example, Fairhurst, Pritchard, Ospina and Deroy (2015) reported that the perception of sweetness in a complex dish was

driven by the congruency between the shape of the plate and the shape of the food itself (i.e., dishes with a rounded presentation on a rounded plate were rated as sweeter than dishes with an angular presentation on an angular plate). Only recently, however, have researchers begun to investigate the effects of several congruent, or incongruent product-extrinsic cues on consumers' expectations, and these results, it should be stressed, have been mixed (see **Table 3**). Furthermore, these studies have failed to systematically manipulate the number of cues independently from their congruency in order to isolate the effects of adding congruent versus adding cues that are incongruent on people's taste expectations. This makes it difficult to draw any firm conclusions from the research published to date.

INSERT TABLE 3 ABOUT HERE

In their recent review, Velasco and Spence (2019b) suggest that greater congruency (as opposed to incongruency) between multiple cues on product packaging might increase the strength of sensory (taste) expectations by enhancing the noticeability of the corresponding attribute. Moreover, the theory of processing fluency postulates that those stimuli that are more easily processed confer positive affect (e.g., Reber, Schwarz, & Winkielman, 2004). Thus, when product-extrinsic cues generate expectations that are consistent, or congruent, with one another (and/or with the subsequent taste experience), greater fluency in processing of the product packaging may, in turn, lead to the more positive evaluation of the product contained within (see Winkielman, Ziembowicz, & Nowak, 2015, for a review). For example, Salgado-Montejo, Velasco, Olier, Alvarado, and Spence (2014) were able to demonstrate that

greater congruency in the shape symbolism of different components of a logo led to more positive ratings than those logos that were rated as being incongruent.

Nevertheless, it remains possible that the combined effect of multiple visual cues might be different to that of the individual cues in certain situations. For example, Woods et al. (2016) demonstrated that a white square (white typically being associated with saltiness) with a thin pink border (pink normally being associated with sweetness) resulted in strong 'sweet' expectations, when 'salty' may have been expected due to the prominence of the white element in the design. Here, it is perhaps worth noting that the presentation of many different stimuli in this study on a background screen of a different colour means that the border colour (pink in this case) was likely to be treated as part of the stimulus itself rather than as part of the background.

Similarly, Gil-Pérez et al. (2019) have reported that the strength of the spice-angularity correspondence in fire icons displayed on the packaging of nuts was mediated by the perceived aggressiveness of the stimulus, showing that the meaning of crossmodal correspondences may be changed by the presence of other information/cues. Furthermore, it should be noted that these effects may also sometimes differ between individuals: For example, Becker et al. (2011) reported that angular packaging designs were rated as more intense than their rounder counterparts, but only by those individuals with a high 'sensitivity to design'; a measure of how important design features are in consumers' evaluations of products.

Aims and hypotheses

The aim of the research reported in the present study was to explore (using a careful selection of vision-taste correspondences, in the context of product packaging) how systematically varying the number (Experiment 1), and congruency (Experiment 2) of colour, pattern (shape), and word cues on product packaging would influence the strength of taste expectations and evaluations. Although the nature of this research is exploratory, based on the literature discussed so far, the proposed hypotheses are that:

1. A greater number of 'congruent' cues on product packaging will result in a greater effect on the relevant expected basic taste (sweetness or sourness; i.e., congruent cues will have an additive effect in the presence of otherwise congruent cues), and the overall expected tastiness, than fewer 'congruent' cues, such that:

    a. Displaying multiple cues that are congruent with expected sweetness will produce a greater effect than single cues on expected sweetness and expected tastiness.

    b. Displaying multiple cues congruent with expected sourness will produce a greater effect than single cues on expected sourness and expected tastiness.

2. Cues associated with different expected basic tastes (i.e., incongruent cues) will counteract one another, resulting in a reduced expectation for those basic tastes than when the cues are associated with the same expected taste (i.e., congruent cues).

3. Through an effect of processing fluency:

a. Designs in which all of the cues are 'congruent' with the same expected taste will produce a greater score for design attractiveness and expected tastiness than when the cues are 'incongruent'.

b. These more favourable evaluations will then have a positive impact on broader product appraisals and intentions (i.e., willingness to purchase).

Experiment 1

Experiment 1 tested H1 by examining the effect of varying the number of 'congruent' cues on the strength of participants' taste expectations and evaluations.

Method

Participants. A total of 302 individuals (109 identifying as male, 192 female, and 1 other) with an age range of 18–74 years ($M = 36.41$, $SD = 13.53$) took part in the experiment. Sample size was determined using power analysis, anticipating small to medium effect sizes (in agreement with the previously-reported effect sizes in relevant research), based on *a priori* one-way (comparing stimuli with differing number of cues) between-participants ANOVAs for perceptions of each basic taste. Participants were recruited from Prolific Academic (http://prolific.ac) and were reimbursed £1.30 for their time (average time to complete the study = 440 s, $SD = 203$ s, average reward/hour = £10.64/hr). All of the participants reported normal or corrected-to-normal colour vision and were UK residents (the latter criterion was included in order to control for international differences in packaging design experience). All of the participants were shown an on-screen information sheet and

consented to take part in the study. The experiment was approved by Oxford University's

Medical Sciences Inter-Divisional Research Ethics Committee (R59374/RE001).

Stimuli. Rather than using known brands, which might influence participants' evaluations

due to prior experience, mock-up brands were created (i.e., 'faux-brands') using Adobe

Photoshop CS6 software. Three different product categories were chosen, with products

chosen so that they could feasibly be sour- and/or sweet-tasting: specifically, juice, sorbet,

and gums.

Within each product category, the stimuli were created to display either one, two, or three

cues from the following set: background pattern of the packaging (P; angular vs. rounded),

background colour of the packaging (C; yellow vs. pink), and content of an explicit claim (E;

sour vs. sweet). Each of these cues have been shown to exhibit some correspondence with

expected sourness and sweetness, respectively (see Piqueras-Fiszman & Spence, 2015;

Velasco et al., 2014, for reviews), and were validated for the present designs by means of a

pre-test (see Appendix A). Where multiple cues were used, all were 'congruent' (i.e., most

strongly associated) with either sweetness or sourness. Cues were always combined in

ascending order of effect size from the pre-test (i.e., one cue: pattern cues only, P; two cues:

pattern and colour cues, PC; three cues: pattern, colour, and explicit claim cues, PCE). For

those stimuli where the background colour was not one of the manipulated cues, a blue

colour was used as a 'neutral' condition, which has previously been identified as having no

strong association with either sweetness or sourness (e.g., Spence et al., 2015; Woods &

Spence, 2016). When explicit claims were not manipulated, these were absent from the

design. Other features were included in order to increase the ecological validity of the design,

such as graphics and barcode, but were held consistent across stimuli. With all possible

combinations of congruent cues for sweet and sour levels, a total of six stimuli per product

category were developed: see **Figure 1**.

INSERT FIGURE 1 ABOUT HERE

Design. A 3 (product category: juice, sorbet, or gums) × 3 (number of cues: 1-3) × 2 (taste-

congruence: sweet or sour) mixed-model experimental design was used. The number of cues

was manipulated between-participants, and product category and taste-congruence were

manipulated within-participants. Each participant viewed a total of six stimuli: two for each

of the three product categories. Within a product category, each participant saw one stimulus

with only sour-congruent cues, and one stimulus with only sweet-congruent cues, both with

the same total number of cues. Between product categories, the number of cues was

randomised between-participants so that, overall, each participant saw all possible numbers

of cues (1-3) across the three product categories.

For each stimulus, five dependent variables were assessed ("Please rate this design by…"):

expected sweetness ("… how sweet you would expect this product to taste"), expected

sourness ("… how sour you would expect this product to taste"), expected tastiness ("… how

tasty you would expect this product to be"), perceived design attractiveness ("… how

attractive you find this design"), and willingness to purchase (WTP; "… how likely you

would be to buy this product, assuming it was available and at a reasonable price"). In

accordance with previous literature suggesting that the influence of packaging cues on

product expectations varies with an individual's sensitivity to design (Becker et al., 2011),

this was assessed as a covariate. Information regarding age, sex, and recent purchase of each

product category were also recorded as covariates, in order to ensure that any effect was not attributable to these variables confounding the results.

Materials and apparatus. The experiment was conducted online using Qualtrics (https://www.qualtrics.com/uk/). Participants responded to each dependent variable using 100-point Visual Analogue Scales (VAS). These are continuous rating scales with minimal (0) and maximal (100) responses anchored at each end (e.g., for expected sweetness, the minimal response was 'not sweet at all' and the maximal was 'very sweet'; referred to as 'sliders' on Qualtrics). When the participants responded, this generated a score from 0 to 100 on each dependent variable for each stimulus.

In addition, the 'Individual Differences in the Centrality of Visual Product Aesthetics' scale (CVPA; Bloch, Brunel, & Arnold, 2003) was used to assess the participants' sensitivity to design. This consisted of 11 statements relating to design aesthetics (from Bloch, Brunel, & Arnold, 2003), and, as per the originally-reported measure, participants indicated their level of agreement with each statement on a six-point Likert scale ranging from 1 (entirely disagree) to 6 (entirely agree). The average score across these statements was calculated and a median split was used to identify those with low and high sensitivities to design.

Procedure. After reading the on-screen information sheet, participants consented to continue with the experiment. Following the initial demographic and purchase behaviour questions, they began the product evaluation trials. Each trial started with the participants being instructed to examine a single stimulus for at least 5 seconds; this was done to ensure participants were responding based on a familiarity with the design. On the following page, the same stimulus was presented at the top with the five questions and their corresponding VAS below, always in the same order: sweetness, sourness, tastiness, attractiveness, and

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WTP. To indicate a response to each question, participants moved the slider on the VAS to the appropriate point on the scale. The participants could take as long as they required to make their judgment and were unable to move on to the next trial until they had made responses to all five questions. The participants rated all of the 'sweet' stimuli followed by all of the 'sour' stimuli, or vice versa, with the order of 'sweet' and 'sour' presentation randomised across participants. Within this, the order in which the three product categories were presented was also randomised. This randomisation was used to counterbalance for any possible order effects. Each participant performed a total of six trials: Individual trials measured one product category (each with a different number of cues) at either the 'sweet' or 'sour' level, on all five dependent variables. After the product evaluation trials, the participants were presented with the 11-item CVPA scale on-screen and responded to each question on the six-point Likert scale. On completion, the participants were shown a debrief page detailing the purpose of the study.

Results

All of the analyses were conducted in SPSS version 25 (IBM Corp., 2017). For each omnibus test (i.e., the between-participants ANOVA), a critical value of $p \leq .05$ was used; except for post-hoc tests (i.e., Tukey's HSD), where multiple comparisons were controlled for. Inspection of Normal Q-Q plots for each dependent variable indicated that the data approximated a normal distribution: parametric tests were adopted as a result.

Sensitivity to design (StD). Three-by-two between-participants ANOVAs were conducted to assess the effect of Number of Congruent Cues ('NoCC'; 1-3) and Sensitivity to Design ('StD'; high vs. low) on each of the five measures, separately for each product category and

taste-congruence level. No interaction between StD and number of cues was found on any measure for any of the product categories, thus showing that any effect of NoCC did not differ depending on the StD group. Therefore, except for when using stepwise multiple regression (which only includes predictor variables with sufficient effect sizes) StD was not included in further analyses.

Expected sweetness and sourness. One-way between-participants ANOVAs were conducted to assess the effect of NoCC (1-3) on expected sweetness and expected sourness with separate analyses for the three product categories. For all product categories, the main effect of number of cues was significant on expected sweetness and, except for the 'sweet' levels of the gums stimuli, for expected sourness (see **Table 4**).

INSERT TABLE 4 ABOUT HERE

Post-hoc analyses (Tukey's HSD) identified that the juice stimulus with three sweet cues (3Sw)[2] was rated as higher in expected sweetness ($M = 66.65$, $SD = 21.68$) than the stimuli with either two sweet cues (2Sw; $M = 56.41$, $SD = 21.79$) or just one (1Sw; $M = 50.91$, $SD = 22.91$). Similarly, expected sweetness was higher for the sorbet stimulus with 3Sw ($M = 72.68$, $SD = 17.87$) than the packaging stimulus with either just 2Sw ($M = 52.17$, $SD = 23.92$) or 1Sw ($M = 46.66$, $SD = 21.23$). The gums stimulus with 3Sw was also rated higher in expected sweetness ($M = 79.43$, $SD = 13.52$) than the stimulus with either 2Sw ($M = 70.73$, $SD = 16.91$) or just 1Sw ($M = 65.85$, $SD = 19.56$). However, none of the comparisons of expected sweetness between stimuli with 1Sw and 2Sw were significant in any of the product

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[2] nSw refers to the number (n) of sweet-congruent cues (Sw) on a single stimulus.

categories (see **Figure 2**). For expected sourness, the reverse was true: the juice stimulus with 3Sw (M = 39.92, SD = 27.60) was rated as lower in expected sourness than the juice stimulus with either 2Sw (M = 49.90, SD = 26.22) or 1Sw (M = 53.50, SD = 21.38; and the sorbet stimulus with 3Sw (M = 35.94, SD = 25.92) was rated as lower in expected sourness than the juice stimulus with 2Sw (M = 55.42, SD = 25.56) and 1Sw (M = 59.22, SD = 21.92).

INSERT FIGURE 2 ABOUT HERE

For the 'sour' levels, the juice stimulus with three sour cues (3So)[3] was rated as higher in expected sourness (M = 74.28, SD = 21.14) than the stimulus with either two sour cues (2So; M = 56.29, SD = 23.41) or just one (1So; M = 53.43, SD = 22.35). In the same fashion, the sorbet stimulus with 3So was rated as higher in expected sourness (M = 82.49, SD = 16.61) than the packaging stimulus with either 2So (M = 68.77, SD = 20.33) or 1So (M = 59.51, SD = 22.35). For gums, the stimulus with 3So (M = 71.21, SD = 23.66) was again rated as higher in expected sourness than the stimulus with either 2So (M = 39.35, SD = 24.75) or 1So (M = 27.31, SD = 24.14). For both sorbet and gums (but not juice) stimuli with 2So, expected sourness was significantly higher than for stimuli with just 1So (see **Figure 2**). This pattern of results was complimented by the reverse effects on expected sweetness: the juice stimulus with 3So (M = 34.72, SD = 23.57) was rated as lower in expected sweetness than the juice stimulus with either 2So (M = 52.98, SD = 22.76) or 1So (M = 52.62, SD = 21.20); the sorbet stimulus with 3So (M = 32.58, SD = 24.70) was rated as lower in expected sweetness than the juice stimulus with either 2So (M = 43.76, SD = 25.94) or 1So (M = 47.41, SD = 24.28); and

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[3] nSo refers to the number (n) of sour-congruent cues (So) on a single stimulus.

the gums stimulus with 3So (M = 42.43 SD = 27.28) was rated as lower in expected sweetness than the juice stimulus with either 2So (M = 65.90, SD = 19.37) or 1So (M = 64.88, SD = 23.17).

To quantify the independent influence of NoCC on each expected taste, stepwise multiple regression using forward selection was performed to assess NoCC and product category as independent predictors of expected sweetness for the 'sweet' levels and expected sourness for the 'sour' levels. In both cases, NoCC was the strongest predictor, alone accounting for 11.0% of the variance in expected sweetness and for 18.7% of the variance in expected sourness, increasing to 17.3% and 23.8%, respectively when controlling for product category, as shown in **Table 5**.

INSERT TABLE 5 ABOUT HERE

Expected tastiness. One-way between-participants ANOVAs were conducted to assess the effect of NoCC (1-3) on expected tastiness, separately for each product category and taste-congruence level. As shown in **Table 6**, NoCC had a significant main effect on expected tastiness for 'sweet' levels of juice and sorbet (but not gums), and for 'sour' levels of juice and gums (but not sorbet).

INSERT TABLE 6 ABOUT HERE

Post-hoc tests (Tukey's HSD) of the significant main effects for the 'sweet' levels revealed that participants rated the expected tastiness of the juice stimuli with 3Sw (M = 64.97, SD =

21.14) and 2W (M = 63.19, SD = 22.73) as being significantly higher than the juice stimuli

with only 1Sw (M = 54.59, SD = 24.05). The sorbet stimulus with 3Sw (M = 68.98, SD =

19.99) was rated as significantly higher in expected tastiness than the stimulus with 1Sw (M

= 57.41, SD = 25.11), while ratings for the sorbet with 2Sw (M = 63.93, SD = 20.65) were

directionally (though not significantly) higher than with 1Sw (see **Figure 3**).

INSERT FIGURE 3 ABOUT HERE

Post-hoc analysis of the significant main effects for the 'sour' levels revealed that the juice

stimulus with 2So was rated as significantly higher in expected tastiness (M = 62.87, SD =

21.21) than the juice stimulus with 3So (M =53.84, SD = 23.08), and directionally higher than

the stimulus with just 1So (M = 56.16, SD = 24.50). The gums stimulus with 1So (M = 65.02,

SD = 21.13) was rated as significantly higher in expected tastiness than the juice stimulus

with 3So (M = 56.09, SD = 24.59) and directionally (but not significantly) higher than the

stimulus with 2So (M = 62.99, SD = 20.87; see **Figure 3**).

Willingness to purchase (WTP). To test H3b, stepwise multiple regression (forward

selection) was conducted to assess the first four dependent variables (expected sweetness,

expected sourness, expected tastiness, and attractiveness), average StD, product category, and

NoCC as predictors of WTP, separately for 'sweet' and 'sour' levels. Ratings of expected

tastiness, design attractiveness, and average StD were all significant predictors in the model,

as was the overall model (p < .004). For each level, respectively: expected tastiness was the

strongest significant predictor of WTP, alone accounting for 53.7% and 53.9% of the

variance, rising to 61.4% and 60.0%, respectively, when design attractiveness was included, and to 61.7% and 60.4% when StD was entered into the models as well (see **Table 7**). Expected sweetness, expected sourness, NoCC, and product category did not significantly predict WTP in either case.

INSERT TABLE 7 ABOUT HERE

Power analyses. Post-hoc power analyses identified relatively low power across analyses in Experiment 1 (average power = .659). Therefore, the average effect size of all post-hoc tests between one- and two-congruent cues ($d = 0.27$) was used for an *a priori* power analysis to estimate an appropriate sample size for Experiment 2. Assuming two-tailed hypothesis-testing would be used (given the exploratory nature of Experiment 2) and controlling for multiple comparisons (i.e., $\alpha = .025$), for an acceptable power of .8, a sample size of 1,052 was required; this was rounded up to 1,100, to deal with any attrition.

Experiment 2

The results of Experiment 1 revealed that increasing the number of taste-congruent cues on product packaging can lead to increased expectations of the relevant basic taste (and decreased expectations of the opposing basic taste, assuming that sweet and sour can be treated as opposites) for the product within, as well as prospective purchase intentions. However, this only considered the combined effects of cues associated with the same basic taste (i.e., 'congruent cues'), but not what happens when the cues that are combined are

associated with different basic tastes (i.e., with 'incongruent cues'). As predicted in H2, it may be that incongruent cues counteract each other, leading to a reduced expectation of the relevant basic taste than when the cues are congruent. Furthermore, incongruent cues might be expected to reduce processing fluency and thus decrease product liking (expected tastiness/design attractiveness; H3a) and consequently WTP (H3b).

Thus, Experiment 2 was designed to assess, how the congruency of those cues with regard to expected sweetness or expected sourness influenced responses when the number of cues was held constant. Given that, in both the pre-test and Experiment 1, the explicit claim had a much stronger effect on expected taste than the other two cues, only pattern and colour cues were used in Experiment 2. This prevented any explicit product claims from 'overpowering' the other cues and thus potentially masking the congruency effect manipulations that we were interested in.

Method

Participants. A total of 1,094 individuals (398 identifying as male, 696 female) with an age range of 18-75 years ($M = 36.21$, $SD = 12.52$) took part in the experiment. The participants were recruited from Prolific Academic using the same criteria as for Experiment 1. However, participants were not eligible for this study if they had taken part in Experiment 1. All of the participants gave their informed consent and were reimbursed £0.80 for their time (average time to complete = 438 s, $SD = 183$ s, average reward/hour = £6.58/hr).

Stimuli. Faux-brands were again created with Adobe Photoshop using the same three product categories as Experiment 1. This time, all of the stimuli had two taste-congruent cues depicted on the packaging design, but the congruency of those cues (i.e., association with

sweetness or sourness in the pre-test; see Appendix A) was different: Either both were 'sweet' (SwSw), both 'sour' (SoSo), or one 'sweet' and the other 'sour' (sour colour and sweet pattern, SoSw; or sweet colour and sour pattern, SwSo), generating four stimuli per product category (see Appendix C for all stimuli); see **Figure 4**.

INSERT FIGURE 4 ABOUT HERE

Design. A 3 × 4 (product category × congruency) mixed model experimental design was used, with product category manipulated within-participants and congruency manipulated between-participants. Therefore, all participants saw one stimulus of all product categories at varying levels of congruency. The same five dependent variables were assessed for each stimulus as in Experiment 1, alongside demographic information, recent purchase behaviour, and sensitivity to design as covariates.

Materials and apparatus. Once again, Qualtrics was used to present the experiment and collect responses to each question made using VAS. The CVPA scale was again used to assess sensitivity to design (see Appendix B).

Procedure. The same procedure was followed as in Experiment 1. This time, each participant performed three product evaluation trials, each measuring a different product category at a randomly selected level of congruency, on all five dependent variables.

Results

Inspection of Normal Q-Q plots for each dependent variable indicated that the data approximated a normal distribution, so parametric tests were used for analyses, and a critical value of $p \leq .05$ was adopted.

Sensitivity to design (StD). Four-by-two between-participants ANOVAs were conducted to assess the effect of congruency (SwSw vs. SwSo vs. SoSw vs. SoSo) and StD (high vs. low) on each of the five measures, separately for each product category. No significant interaction between StD and congruency was found on any measure for any product category, except on expected tastiness for juice (F (3, 1086) = 3.01, p = .029, η_p^2 = .01). Therefore, in general, any effect of congruency did not differ depending on the StD group, so StD was only included in regression analyses, as in Experiment 1.

Expected sweetness and sourness. Six one-way between-participants ANOVAs were conducted in order to assess the effect of congruency (SwSw vs. SwSo vs. SoSw vs. SoSo) on expected sweetness and expected sourness, separately for each product category. As shown in **Table 8**, the main effects of congruency on expected sweetness and expected sourness were significant for sorbet and gums, but not for the juice stimuli.

INSERT TABLE 8 ABOUT HERE

However, post-hoc analyses (Tukey's HSD) revealed that the differences between conditions were not always as predicted by H2. For sorbet, the SoSw condition was rated as significantly lower in expected sweetness (M = 50.24, SD = 23.58) than the SwSw condition (M = 55.90,

SD = 24.31), but also the SwSo condition (*M* = 55.06, *SD* = 23.11) though not the SoSo condition (*M* = 52.68, *SD* = 24.95). For gums, the SoSo condition was rated as significantly lower in expected sweetness (*M* = 67.62, *SD* = 20.36), than the SwSo (*M* = 72.58, *SD* = 18.52), and the SwSw conditions (*M* = 71.74, *SD* = 18.43). Neither the difference in expected sweetness between SwSo and SwSw conditions, nor between SoSw (*M* = 69.23, *SD* = 21.21) and SoSo conditions reached statistical significance.

For expected sourness, sorbets in the SoSo condition (*M* = 60.46, *SD* = 24.39) and the SoSw condition (*M* = 60.18, *SD* = 22.88) were rated as significantly higher than those in the SwSw condition (*M* = 54.52, *SD* = 25.83). Contrary to our predictions, though, there was no significant difference in expected sourness ratings between SwSw and SwSo (*M* = 55.36, *SD* = 24.00), or between SoSw and SoSo sorbet conditions. For gums, none of the comparisons in expected sourness between conditions achieved significance, although the SwSw (*M* = 29.73, *SD* = 22.44) and SwSo conditions (*M* = 30.32, *SD* = 22.69) were rated directionally lower than the SoSw (*M* = 34.71, *SD* = 24.79), and SoSo conditions (*M* =34.03, *SD* = 24.99) (see **Figure 5**).

INSERT FIGURE 5 ABOUT HERE

To assess the independent influence of each cue on expected taste, the data for all of the stimuli were combined and coded for product category, pattern type (sweet/sour), and colour type (sweet/sour). These were analysed using simultaneous multiple regression as predictors of expected sweetness and expected sourness separately. Product category was the strongest significant predictor of both measures, followed by colour. However, pattern type was not a

significant independent predictor of either expected sweetness or expected sourness when controlling for product category and colour type. **Table 9** displays the statistics from these analyses.

INSERT TABLE 9 ABOUT HERE

Design attractiveness and expected tastiness. To assess H3a, a series of one-way between-participants ANOVAs was conducted in order to assess the effect of congruency on expected tastiness and design attractiveness, for the three product categories separately. Congruency did not have a significant main effect on expected tastiness for any of the product categories, or on design attractiveness for the juice or sorbet stimuli ($p > .05$). For gums, there was a main effect of congruency on design attractiveness ($F (3, 1090) = 10.82$, $p < .001$, $\eta_p^2 = .03$). However, contrary to our predictions, post-hoc tests revealed that this was due to significantly lower ratings of design attractiveness for gums in the SoSo ($M = 45.71$, $SD = 26.09$) and SoSw conditions ($M = 49.71$, $SD = 25.79$), than in either the SwSo ($M = 55.98$, $SD = 25.08$), or SwSw conditions ($M = 56.12$, $SD = 25.88$), as shown in **Figure 6.**

INSERT FIGURE 6 ABOUT HERE

Willingness to purchase (WTP). As with Experiment 1, stepwise multiple regression (forward selection) was performed in order to assess the first four dependent variables (expected sweetness, expected sourness, expected tastiness, and attractiveness), average StD

score, and congruency as independent predictors of WTP, separately for each product category. For all three product types, expected tastiness was the strongest significant predictor, alone accounting for 52.2%, 48.5%, and 47.7% of the variance in WTP for the juice, sorbet, and gums stimuli, respectively, increasing to 59.8%, 56.3%, and 58.1% when design attractiveness and average StD score were included (see **Table 10)**. Expected sweetness, expected sourness, and congruency were not, however, significant predictors of WTP for any of the three product categories.

INSERT TABLE 10 ABOUT HERE

Discussion

Taken together, the results of the two experiments reported in the present study confirm that robust crossmodal correspondences between product-extrinsic cues and expected basic tastes can be elicited using product packaging; pink colours and rounded patterns were associated with expected sweetness, and yellow colours and angular patterns with expected sourness, consistent with previous findings (e.g., Shankar et al., 2009; Velasco et al., 2014; see Piqueras-Fiszman & Spence, 2015, for a review). In addition, the results of Experiment 1 also identified that increasing the number of cues, provided that they were associated with the same basic taste (i.e., they were 'congruent'), increased the strength of these expectations, thus supporting H1. This result was further supported by the fact that an increase in expected sweetness (by increasing the number of 'sweet'-congruent cues) was accompanied by a decrease in expected sourness and vice versa, showing that effects occur in both directions. Although this was the case for expected sweetness and sourness, for expected tastiness, an

effect was only demonstrated in two out of the three product categories and, whereas greater numbers of congruent sweet cues increased expected tastiness, greater numbers of congruent sour cues decreased expected tastiness. Thus, the various uses of such cues should be considered carefully, depending on the product category in question. Extrapolating even further, note that previous studies have highlighted that sweet tastes are generally preferred over sour tastes (Velasco, Woods, Deroy, & Spence, 2015), and thus it might follow that expected tastiness would increase as expected sweetness increases, but to decrease as expected sourness increases, regardless of product category. Therefore, while increasing the number of congruent cues strengthened people's expectations for a specific basic taste, the effect on expected tastiness would appear to be dependent on the overall valence of the associated basic taste.

Experiment 2 was designed to assess how manipulating the congruency of these cues individually influenced taste expectations and evaluations. Contrary to H2, there was little evidence to suggest that incongruent cues directly counteracted the effects of congruent cues; stimuli with one sweet and one sour cue were not consistently rated as any lower in expected sweetness than those with two sweet cues or lower in expected sourness than those with two sour cues. Significant differences in expectations were found between the two incongruent combinations (i.e., SwSo and SoSw). Instead, at least with the stimuli used here, colour cues were found to dominate over pattern cues, such that when the colour of the packaging was associated with 'sweet' (i.e., pink), regardless of the pattern type, expected sweetness was higher and expected sourness was lower than when the colour of the packaging was associated with 'sour' (i.e., yellow), in which case the reverse was found.

This dominance of colour over pattern cues was confirmed by the regression analysis, which revealed that, when controlling for product type, pattern type did not significantly predict either expected sweetness or expected sourness, whereas colour did. It was not the case that no pattern-taste association existed for the individual cues, as demonstrated by the pre-test, but rather that the colour cues dominated over the pattern cues in determining participants' taste expectations when the cues were combined. In fact, in Experiment 1, significant changes in expected sweetness for the 'sweet' manipulations were not found with the addition of colour cues, but only when the third cue, explicit claims, were added to stimuli, further demonstrating that different product-extrinsic cues have differently-sized effects on taste expectations (see also Van Rompay, van Hoof, Rorinl, & Folsche, 2019). This is an important finding for product designers, who might be advised to focus primarily on ensuring that the most dominant cues on a product package set the desired taste expectation, before concerning themselves with cues with weaker effects.

Through future research, it might be possible to create a 'cue hierarchy' in order of these effect sizes, which could be useful in predicting the combined effects of multiple cues on expected tastes. At the same time, however, it is important to stress that visual inspection of the cues used here suggests that the colour cues used here were simply more salient subjectively than were the pattern cues. The possibility must therefore remain open that were the pattern cues to be made more salient they might perhaps dominate over the colour cues (cf. van Rompay, et al., 2019). At the same time, however, it is important to stress that the 'meaning' of a particular semantic or semiotic cue is always likely to be determined by the relationship between elements (see also Danesi, 2013; Gil-Pérez et al., 2019; Heatherly, Dein, Munafo, & Luckett, 2019; Plasschaert, 1995). Indeed, as stressed by colour in context theory

(see Elliott & Maier, 2012), the meaning of a colour such as pinkish-red or yellow is always determined by the context in which it occurs.

One other potentially important point to consider when it comes to interpreting the results of the present study concerns what would happen were participants actually to taste products from packaging such as the faux brands used in the present study. The possibility remains that the importance of packaging sensory cues may be overemphasized in online experimental designs such as those reported here (i.e., when they are all that the participant has to go on when asked to assess the sensory attributes of the product). It is certainly possible to imagine that the actual taste of the product might come to play a more dominant role, and hence the semantic/semiotic meaning of the packaging less, were actual product evaluation to be involved. Evaluating this possibility will remain a question for future research.

With regards to H3a, Experiment 2 provided little evidence that increasing the congruency of design cues increased ratings of design attractiveness and expected tastiness. Although seemingly in contrast with the theory of processing fluency (Reber et al., 2004; Winkielman et al., 2015), this might also be explained by the dominating effect of colour over pattern cues, meaning that the congruency of the pattern made little difference to the fluency of processing and therefore the favourability of our participants' evaluations.

Indeed, congruency did have an effect on design attractiveness for the gums category, but not in the predicted direction; rather than congruent stimuli (i.e., SoSo and SwSw) being rated as more attractive than incongruent stimuli (SoSw and SwSo), the SwSw and SwSo were rated as more attractive than the SoSo and SoSw stimuli. Given that colour cues tended to dominate our participants' taste expectations, at least with the stimuli used in the present study, this suggests that sweeter packaging variants (i.e., gums that were coloured pink) were

considered more attractive than their sourer counterparts (coloured yellow). Winkielman et al. (2015) point out that the fluency of the processing experience can involve integration across processing stages, possibly also including previous experiences (in fact, presumably likely to include the role). Thus, prior expectations for gums to be sweet may have led to more fluent processing and hence more positive evaluations when the packaging was consistent with this than when it led to more sour expectations. Participants may be less likely to have had strong prior expectations concerning the sweetness or sourness of juice and sorbet products, which might explain the lack of a similar effect for these stimuli.

The second postulate of H3, namely that higher scores for design attractiveness and expected tastiness would increase WTP, was supported by regression analyses in both experiments for all stimuli. Expected tastiness was the strongest predictor of WTP, accounting for around 50% of the variance, followed by design attractiveness, accounting for a further 5-10% of the variance. Thus, the most important consideration for consumers' purchase intentions in the present experiment was how tasty they expected the product to be, and second, how attractive they found the packaging to be.

StD also had a small, albeit significant , effect on purchase judgments, whereby individuals with greater StD made higher WTP ratings for all stimuli. Thus, consistent with Bloch et al. (2003), those who consider design more important were more willing to purchase based on the product designs presented than those with lower design sensitivity, who perhaps desired further information (e.g., ingredients, price, and nutrition) to be persuaded. Nevertheless, in contrast to Becker et al. (2011), those participants with a higher StD were no more or less influenced by congruency or the number of cues than those with a low StD. This might be because, while Becker et al. (2011) considered the effects of single cues, the effects of

interactions between the cues tested here may require less sensitivity to individual elements of the packaging design.The fact that the effects were not, however, restricted to those participants with a particular StD supports the generalisability of these findings.

Limitations

A number of considerations should be borne in mind when interpreting these results. First, although efforts were made to ensure that the stimuli were as ecologically valid as possible, using 'faux-branded' stimuli may not fully generalise to real-branded products, where known brand associations would obviously be expected to override any effects of correspondences from more subtle packaging cues. Similarly, note that while the trends are undoubtedly changing, the majority of food and beverage purchases are currently still made in-store rather than online, where consumers are exposed to many more cues, such as touch and sound (see Velasco & Spence, 2019a, for reviews). This means that the results reported here are unlikely to be entirely ecologically valid as far as describing customers' perception of packaging when in the aisles (see Woods et al., 2015, for a discussion of the value of online research). Future research using real-branded physical stimuli in more realistic purchase situations would help to show whether our results extend beyond the online setting.

However, the present study represents an advance against much of the previous literature by testing more than one product category, with the results largely consistent across these categories, hinting at a common psychological cause (i.e., crossmodal correspondences). Nevertheless, the juice, sorbet, and gum categories share a number of characteristics, such as their dependence on fruit flavours, so may not be fully representative. In addition, in some cases the effects differed between product categories, suggesting that certain interactions

between product-extrinsic cues may depend on the specific product tested. Therefore, caution should be taken before generalising these findings to packaging for other classes, or types, of product.

Finally, it is important to note that this study considered only participants' taste expectations. According to the assimilation account (Anderson, 1973), sensory expectations may change the actual experience of the product upon consumption, as has been demonstrated in a number of studies (e.g., Piqueras-Fiszman & Spence, 2011, 2015; Tijssen et al., 2017). It would certainly be interesting in future research to investigate whether changing the strength of the expectations for sweetness or sourness (e.g., by increasing numbers of crossmodally congruent cues) would also alter the actual taste experience (see Wang, Mielby, Thybo, Bertelsen, Kidmose Spence, & Byrne, 2019).

Conclusions

The research outlined here helps clarify how different product-extrinsic cues interact in determining people's taste expectations and evaluations from product packages as assessed in an online context. The results of Experiment 1 demonstrated that increasing the number of cues on a package congruent with a particular expected taste increased the strength of the association with that taste. Meanwhile, the results of Experiment 2 demonstrated that when the cues were incongruent, rather than counteracting one another, one cue tended to dominate over the other in determining the association with a particular expected product taste. While this might be taken to be suggestive of a hierarchical organisation of product-extrinsic (visual) cues, which could certainly be explored through future research, it is important to note that subjectively-speaking, the colour cues appeared more visually salient than the

pattern cues. Hence, it remains possible that future research might demonstrate a different pattern of results were the colour cues to be made more subtle, and the pattern cues more salient. Furthermore, this study confirmed that purchase judgments were primarily determined by how tasty a product was expected to be, but also by the attractiveness of the design and an individuals' sensitivity to design. These findings have clear implications for product developers, who might well be advised not to consider each element of their packaging design in isolation, but rather the relative influence of each element in combination in determining consumers' overall expectations, evaluations and consequent purchase decisions.

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MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

FIGURE LEGENDS

Figure 1. All experimental stimuli used for Experiment 1 for (A) juice, (B) sorbet, and (C) gums product categories. The left half of each figure shows packages congruent with sweet tastes, and the right column shows packages congruent with sour tastes. The number of 'sweet'-congruent or 'sour'-congruent cues on the product package (1 to 3) increases from left to right in each panel.

Figure 2. A) Mean ratings of expected sweetness for 'sweet' levels, by number of congruent sweet cues appearing in each stimulus in Experiment 1, split across product category. Error bars display 95% confidence intervals about the mean. B) Mean ratings of expected sourness for 'sour' levels, by number of congruent sour cues appearing in each stimulus in Experiment 1, split across product category. Error bars display 95% confidence intervals about the mean. Note that this does not include expected sourness for 'sweet' levels or expected sweetness for 'sour' levels (these were omitted for simplicity, but the reverse pattern was true as described above).

Figure 3. A) Mean ratings of expected tastiness for 'sweet' levels, by number of congruent sweet cues appearing in each stimulus in Experiment 1, split across product category. Error bars display 95% confidence intervals about the mean. B) Mean ratings of expected tastiness for 'sour' levels, by number of congruent sour cues appearing in each stimulus in Experiment 1, split across product category. Error bars display 95% confidence intervals about the mean.

Figure 4. All experimental stimuli used for Experiment 2 for (A) juice, (B) sorbet, and (C) gums product categories. The left half of the figure shows product packages with the

'sweet' colour cue while the right half shows product packages with the 'sour' colour cue. The left column of each half shows packages with the 'sweet' pattern cue while the right column in each half shows packages with the 'sour' pattern cue.

Figure 5. A) Mean ratings of expected sweetness with different levels of congruency between cues appearing in each stimulus in Experiment 2, split across product category. Error bars display 95% confidence intervals about the mean. *B)* Mean ratings of expected sourness with different levels of congruency between cues appearing in each stimulus in Experiment 2, split across product category. Error bars display 95% confidence intervals about the mean.

Figure 6. Mean expected attractiveness ratings of expected sourness with different levels of congruency between cues appearing in each stimulus, for the gums in Experiment 2. Error bars display 95% confidence intervals about the mean. Note that only gums are shown as this was the only stimulus set with a significant effect of expected attractiveness.

Figure 1.

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Figure 2. A)

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

B)

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Figure 3. A)

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN
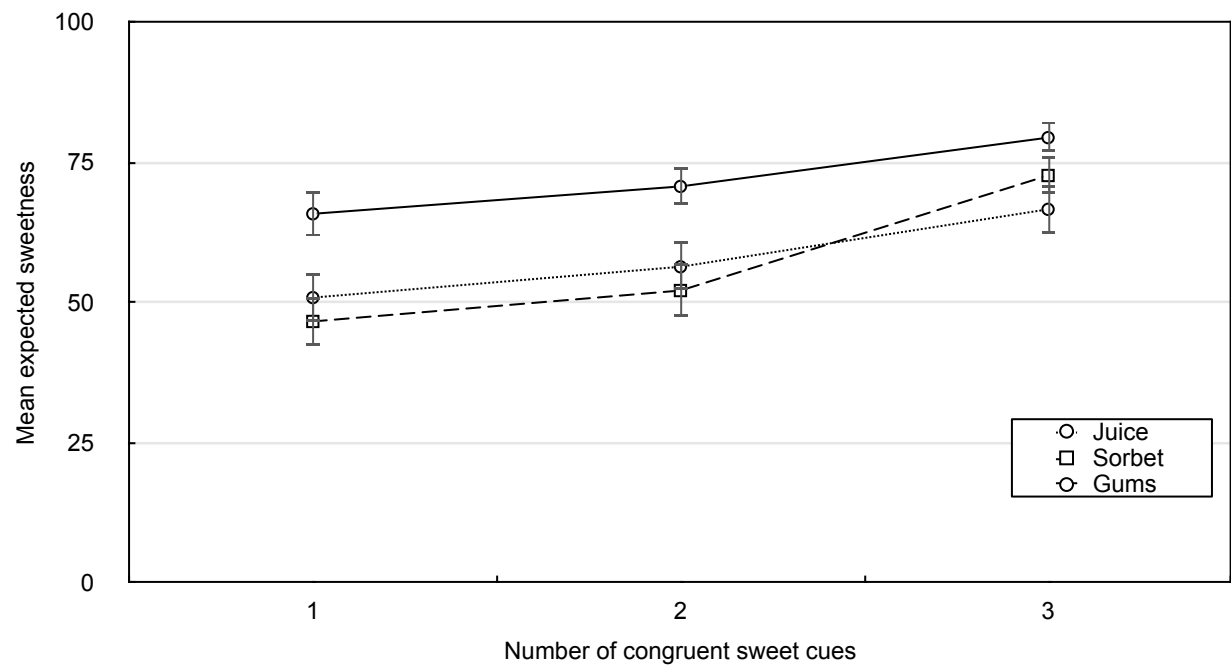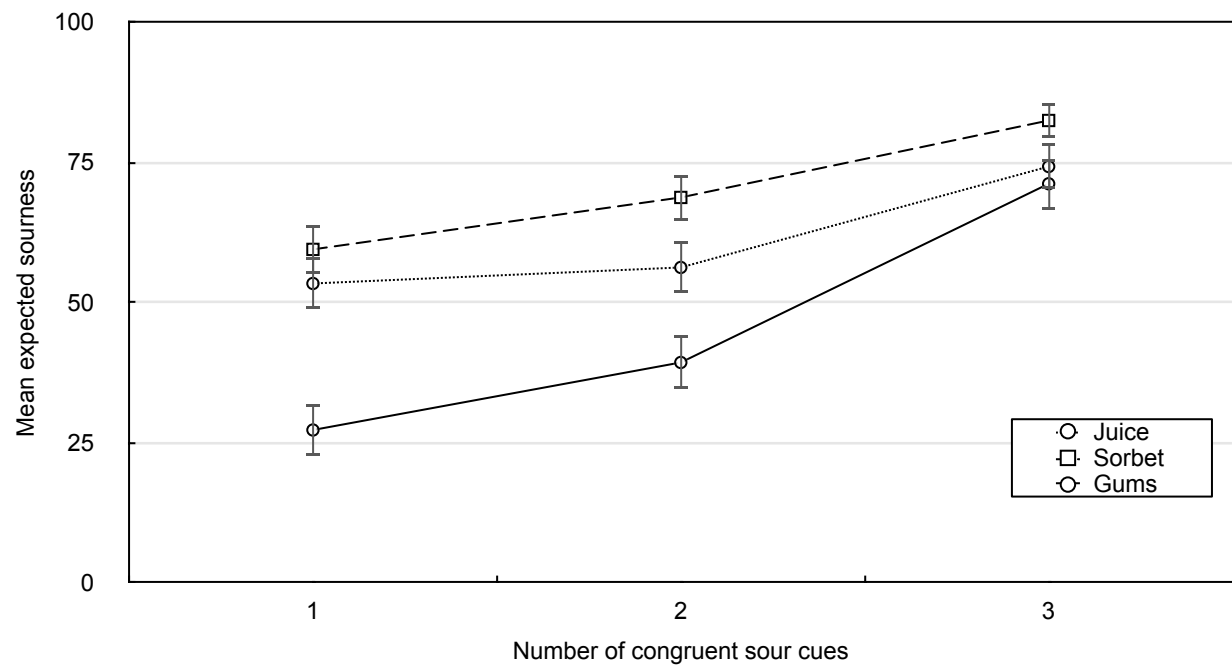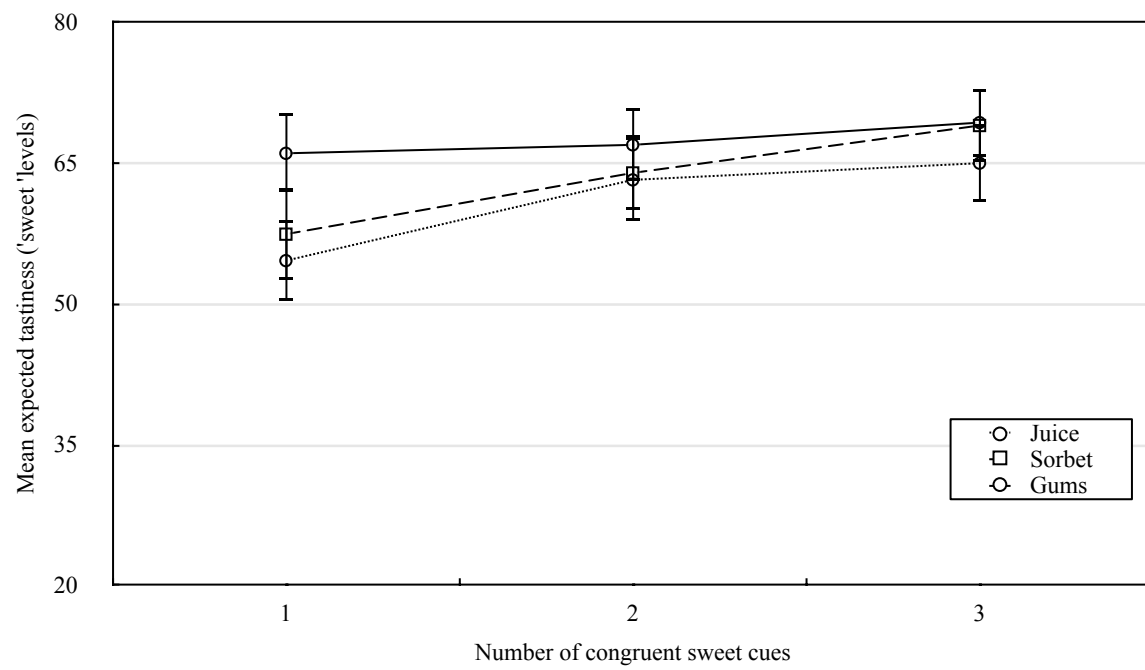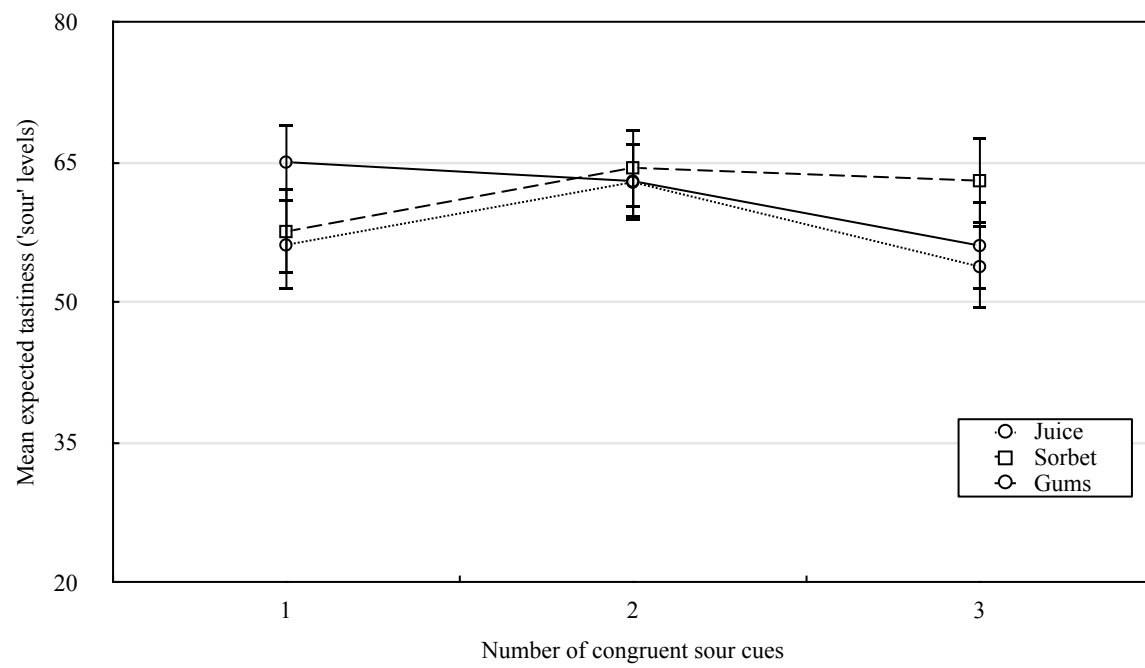
B)

Figure 4.

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Figure 5. A)

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

B)

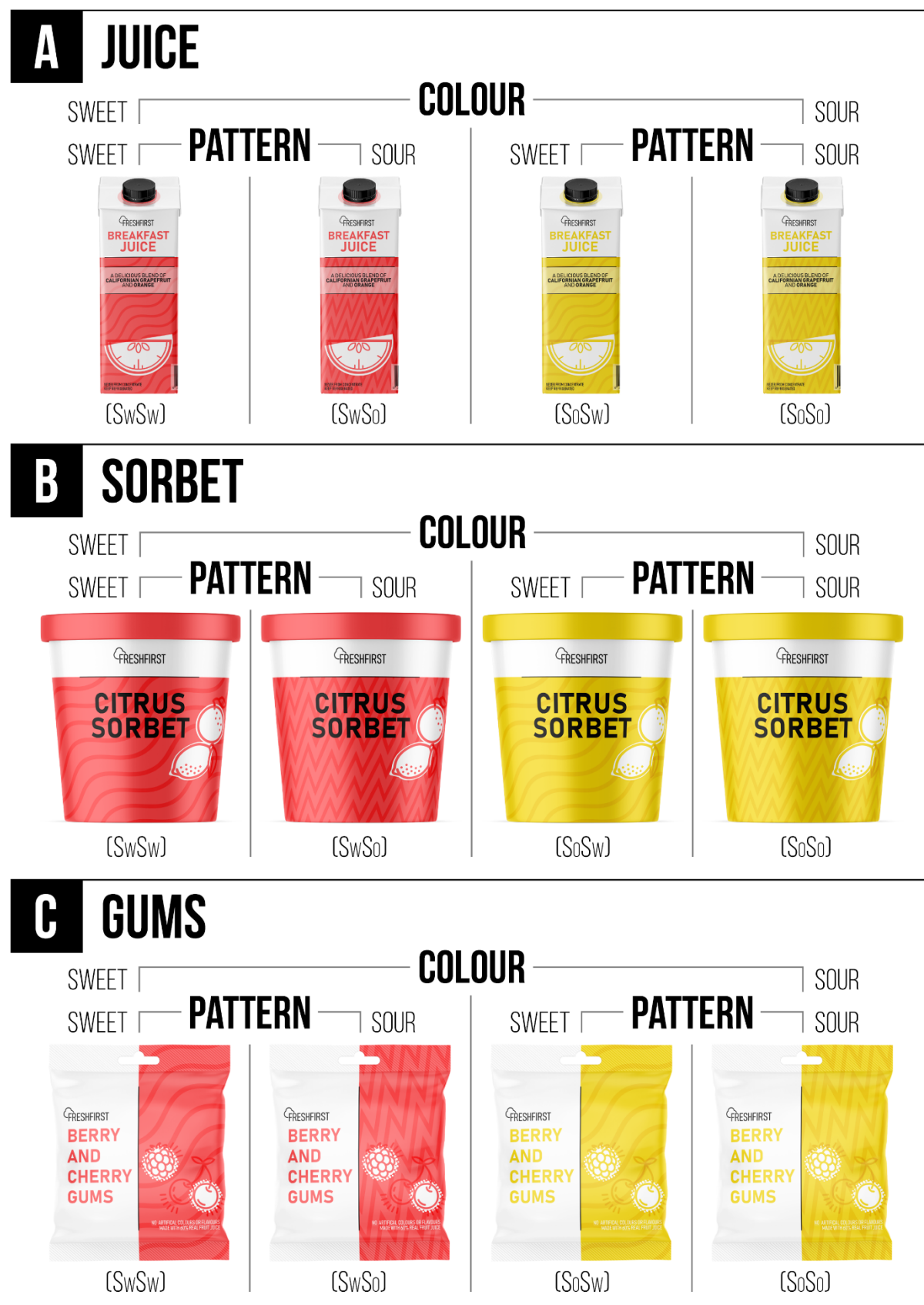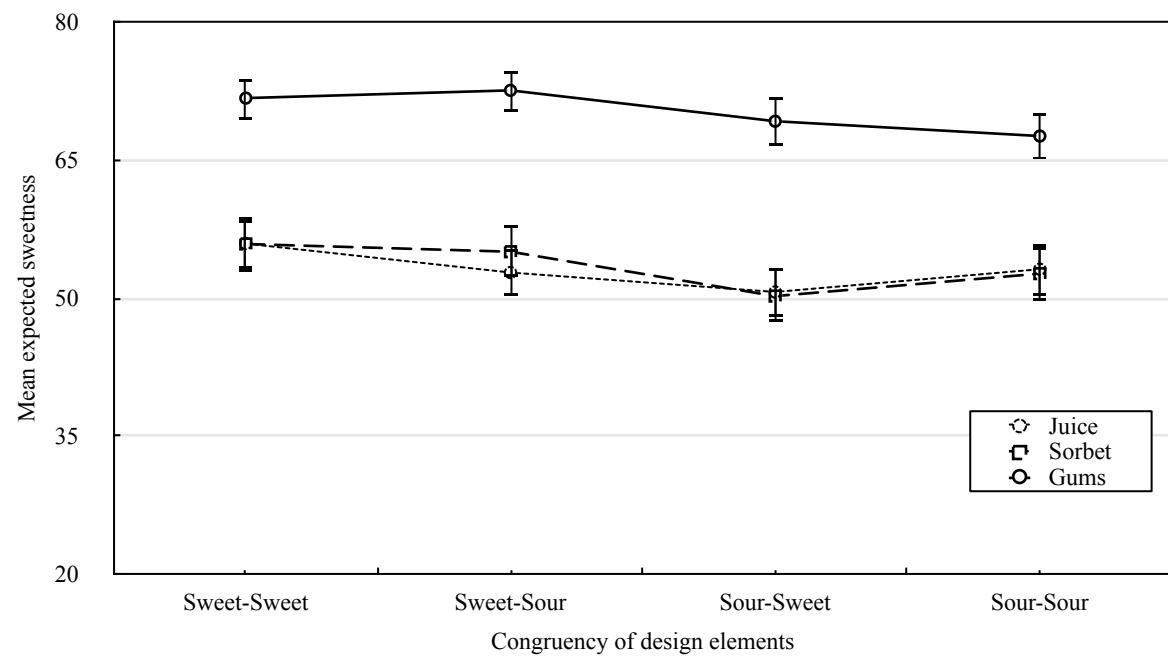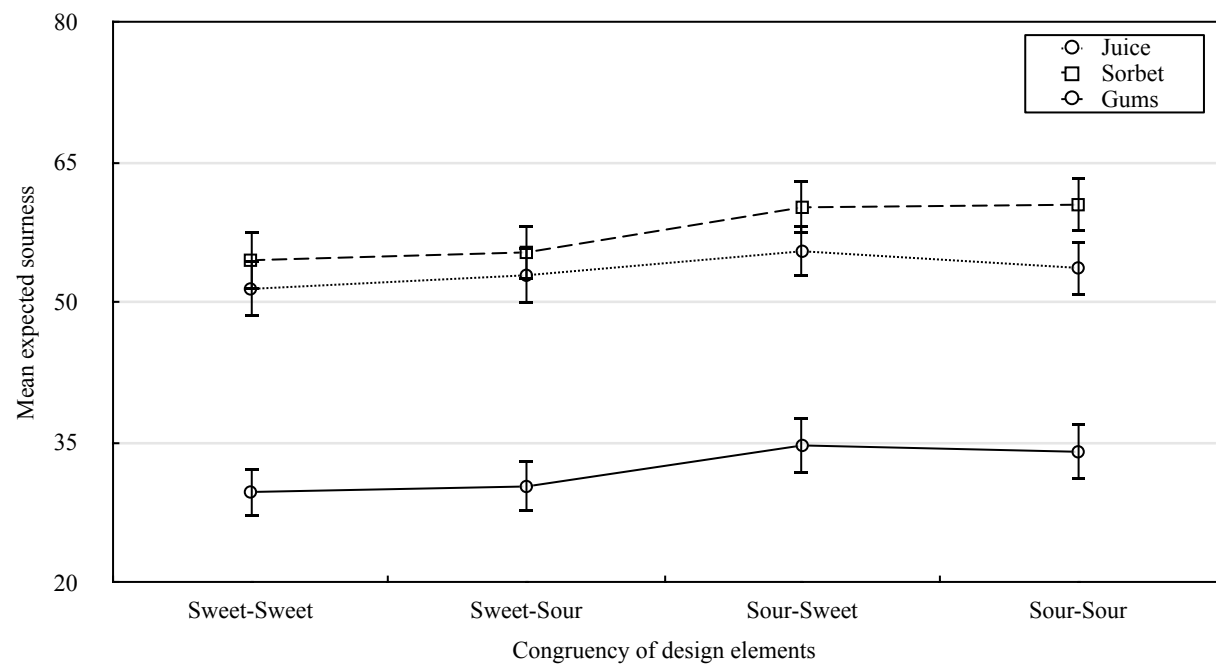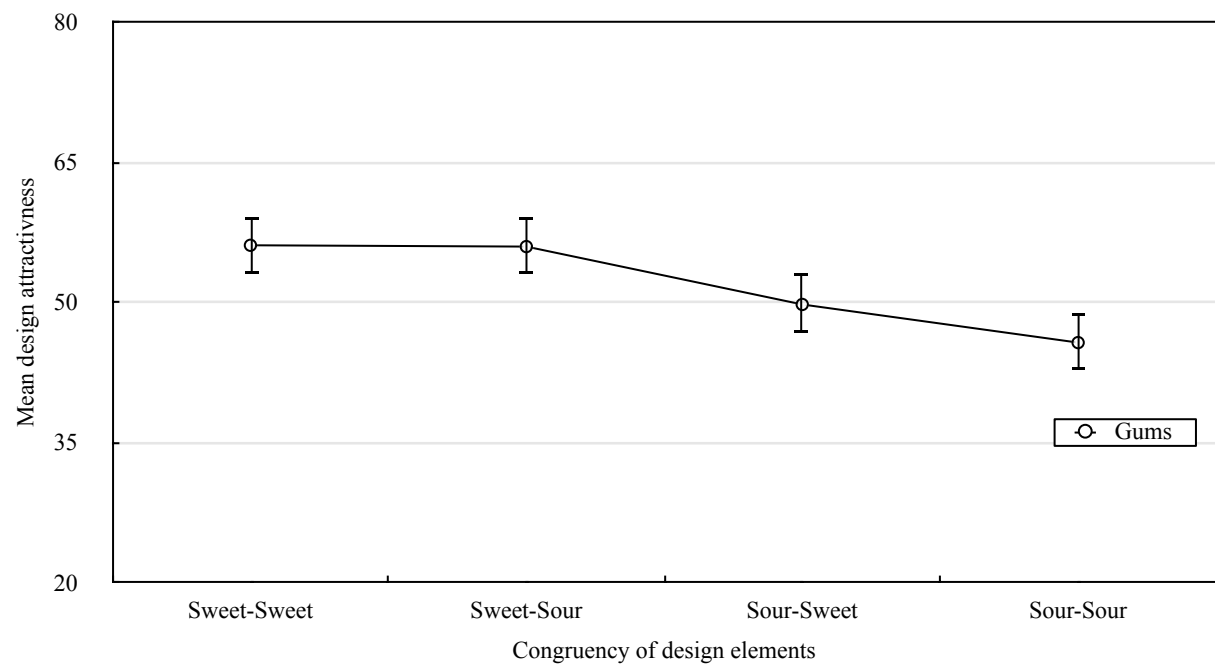MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Figure 6

Table 1. *Summary of previous studies that have documented crossmodal associations between stimulus colour and expectations for two of the basic tastes, and their evaluations.*

		Identified congruence with…		
Study	Stimuli	Expected sourness	Expected sweetness	Other product evaluations
Deliza & MacFie (2001) (discussing unpublished work by Deliza, 1996)	Coloured packaging of passion fruit juice	White (sharpness)	Orange	White packages rated higher on expected liking, as well as expected pureness, freshness, and naturalness than orange
Huang & Lu (2015)	Coloured packaging of ice-cream, iced tea, yoghurt, and breakfast cereal	-	Red	-
Jantathai, Sungsri-in, Mukprasirt & Deurrschmid (2014)	6 different coloured Thai desserts	Green (bitterness)	Pink	Differences identified by culture: Austrians preferred yellow, while Thai preferred green and pink desserts
Koch & Koch (2003)	Colour terms	Green, yellow	Orange, red	-
O'Mahony (1983)	Colour words and taste words	Yellow	Red	-
Rebollar, Lidón, Serrano, Martín & Fernández (2012)	Chewing gum packaging with in different colours ('warm' vs. 'cold') and format	-	'Warm' colours (red and orange)	'Warm' colours rated higher in willingness to buy than 'cold' colours (e.g., blue)
Tijssen, Zandstra, de Graff, & Jager (2017)	Coloured packaging of low sugar dairy drink and low-fat sausage	-	Red (for yoghurt drink) Lower brightness	Effects transferred to perceived sweetness, although effects were weaker
Wei, Ou, Luo, & Hutchings (2012)	Orange juice with different lightness, chroma, and hue	Green hues	Red and yellow hues, more saturated colours	-
Woods & Spence (2016)	Coloured squares	Green, yellow	Purple, pink	-
Wan et al. (2014)	Shapes, colour patches, or texture patches (all presented in a square shape)	Green (for cross, rectangle, and square shapes)	Pink (for cloud, heart, and star shapes)	-

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Table 2. *Summary of previous studies that have documented crossmodal associations between stimulus curvilinearity (for typefaces and shapes) and expectations for two of the basic tastes, and their evaluations.*

Study	Stimuli	Identified congruence with…		
		Expected sourness	Expected sweetness	Other product evaluations
Karnal, Machiels, Orth, & Mai (2016)	Coloured packaging of soft drinks with differently 'weighted' typeface	-	Yellow package with 'highly weighted' (thicker, more rounded) typeface	-
Salgado-Montejo et al. (2015)	Shapes	Angular, non-symmetrical shapes with multiple elements	Rounder, symmetrical shapes with fewer elements	Rounded shapes preferred to angular shapes, but only when combined with symmetry
Simmonds, Woods, & Spence (2019)	Differently shaped transparent window on product packaging	-	-	General preference for rounded window shapes, influencing numerous other evaluations and intentions
Velasco et al. (2018)	'Eat me' in different typefaces in English, Spanish, and Chinese	Angular typefaces in Spanish and English, but not in Chinese	Rounded typefaces in all 3 languages	Rounded typefaces preferred to angular typefaces written in English and Spanish, but not Chinese
Velasco, Salgado-Montejo, Marmolejo-Ramos, & Spence (2014)	Product packaging with different shapes, typefaces, and names (e.g., 'Clax' vs. 'Blum')	Angular typefaces, shapes and names ('Clax')	Rounded typefaces, shapes and names ('Blum')	-
Velasco, Woods, Hyndman, & Spence (2015)	Words 'eat me' in different typefaces, alone or on a cup	Angular typefaces	Rounded typefaces	Rounded typefaces preferred to angular typefaces
Velasco, Woods, Marks, Cheok, & Spence (2016)	Taste words and shapes	Angular shapes	Round shapes	Rounded shapes and sweet taste words preferred to angular shapes and sour taste words
Wang, Carvalho, Persoone, & Spence (2017)	Differently-shaped chocolates	-	Round chocolates	No effect of chocolate shape on expected liking
Westerman et al. (2013)	Wine bottles with different shapes on the labels	-	-	Wines with rounded shapes on their label rated more appealing, more pleasing, more practical in design, expected to taste nicer, and more likely to purchase than angular shapes

Table 3. *Summary of previous studies that have investigated the combined effect of multiple cues on associations with expected taste and/or product evaluations.*

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Researcher(s) (year)	Stimulus type	Cues combined	Measures	N	Relevant Study Findings	Notes
Ares & Deliza (2010)	Milk desert packages	Shape (round vs. square) Colour (white vs. yellow vs. black)	Expected liking Word association	105	Rounded shapes and yellow colours rated higher on expected liking than square and white or black. Yellow and round packages showed strongest word association with sweetness. Multiple factor analysis showed colour to be the most important factor influencing expected liking, followed by shape.	No direct measure of taste expectation. Didn't measure each cue in isolation so difficult to identify independent effects.
Becker, van Rompay, Schifferstein, & Galetzka (2011)	Yoghurt packages	Shape (angular vs. rounded) Colour saturation (low vs. high)	Taste intensity Product evaluations Potency perception Price expectations Sensitivity to design.	151	Angular packaging rated more intense, mediated by potency, but only for participants with high sensitivity to design. No significant interaction between shape and colour, although manipulation checks showed the effect of colour saturation was non-significant.	Unclear whether an interaction would have occurred had the main effect of both cues been significant.
Deliza, MacFie, & Hedderley (2003)	Passion fruit juice packages	Colour (orange vs. white) Picture (photograph vs. drawing) Information (none vs. medium vs. lots) Brand (no vs. major vs. minor) Language (English vs. foreign) Shape (normal vs. unusual)	Sensory expectations (sweetness, pureness, sharpness, refreshing, freshness, naturalness) Expected liking Need for cognition	125	Products with orange packages rated more sweet than white, whereas those with white packages rated more sharp than orange. Unusual (taller and narrower) packages rated less sweet than normal (e.g., Tetrapak). Individuals low in need for cognition used mostly peripheral cues to evaluate sweetness, whereas individuals high in need for cognition influenced more by information.	Although multiple attributes were manipulated at once, the interaction between attributes were not analysed. Affective ratings only analysed in terms of customer segmentation, rather than association with different attributes on the packet.
Doyle & Bottomley (2011)	Fonts for a new brand of ice-cream	Typeface (Belbottom vs. Malvern) Name ('Frish' vs. 'Frosh')	'Smooth, rich and creamyness'	21	'Frosh' rated more smooth, rich and creamy than 'frish', shown to be due to the visual characteristics of the letters o versus i, rather than sound symbolism. Belbottom font (rounded, bold) rated as more smooth, rich and creamy than Malvern font (scripted, serif), independent of the effect of the letter.	Didn't assess any affective component that might have mediated this effect. 'Smooth, rich and creamyness' are quite a subjective flavour judgement. Typefaces not displayed on product packages so not realistic.

Researcher(s) (year)	Stimulus type	Cues combined	Measures	N	Relevant Study Findings	Notes
Fenko, Lotterman, & Galetzka (2016)	Packaged cookies	Packaging shape (round vs. angular) Brand name (Asahi vs. Ramune) Cookie type (muesli vs. butter)	Perceived healthfulness Product evaluation Taste expectations (tastiness) Purchase intention	206	Congruent combination of name (Ramune) and shape (round) preferred to incongruent combinations (e.g., round and Asahi). Congruent combinations of cookie type and name (Ramune butter cookies, Asahi muesli cookies) expected to taste better and more likely to be purchased than incongruent combinations.	Demonstrates the influence of congruency on affective ratings but no measure of sensory expectations about taste. Didn't measure each cue in isolation so difficult to assess independent effects of each.
Marques da Rosa, Spence, & Tonetto (2018)	Packaging	Shape (rounded vs. angular) Colour (greyscale vs. red-to-yellow vs. blue-to-green) Product category (Experiment 2 only; buttery vs. cereal cookies)	Preference (willingness to purchase, attention-capturing, pleasantness) Taste associations Perceived product healthiness (Experiment 2 only)	50 (E1) 102 (E2)	Coloured and angular packaging preferred to grayscale and round packaging (Experiment 1). Rounded and buttery cookies packaging preferred over angular and cereal cookies packaging (Experiment 2). Angular packaging expected to be more sweet than rounded packaging. Both colour schemes associated more strongly with sweetness than greyscale, but blue-to-green also more strongly associated with sourness than yellow-to-red and grayscale packaging. No interaction effects between colour and shape identified.	Demonstrates that type of product category influences the effect of shape and colour on preference. Didn't measure each cue in isolation so difficult to identify independent effects of each cue. On inspection, 'angular' vs 'rounded' stimuli do not seem clearly distinguishable as such, and no pre-test to ensure such manipulations were successful.
Salgado-Montejo et al. (2015)	Abstract shapes	Shape (angular vs rounded) Symmetry Number of elements	Emotional valence (positive versus negative) Expected taste (sweet versus sour)	63	Symmetrical, rounded stimuli with fewer elements more likely to be rated as pleasant and sweet than asymmetrical, angular stimuli with more elements, which were more likely to be rated as sour and unpleasant. Interaction between shape and symmetry, such that roundness/angularity only had a significant effect in terms of valence when combined with the effects of symmetry/asymmetry.	Only tested all cues in combination, so difficult to isolate the independent effects of each cue. Effects of abstract shapes may not generalise to product packaging settings.

Researcher(s) (year)	Stimulus type	Cues combined	Measures	N	Relevant Study Findings	Notes
Shankar, Levitan, Prescott, & Spence (2009)	M&Ms	Colour (green vs. brown); Label (milk chocolate label vs. dark chocolate label)	Perceived chocolatey-ness Likeability	30	Brown M&Ms rated more chocolatey than green. Dark chocolate labels rated more chocolatey than milk. No effects of colour or label on likeability. No interaction between colour and label, demonstrating the cues had independent, additive effects on flavour perception.	The only study to systematically vary the number, as well as congruency of cues. No measure of affective ratings. 'Chocolatey-ness' is quite a subjective description.
Van Rompay & Pruyn (2011)	Bottled water	Shape (luxury vs. casual); Typeface (luxury vs. casualness)	Brand credibility Price expectations	142	Products that were congruent in terms of symbolic meaning (luxury vs. casual) rated as more credible and higher in price expectation than those that were incongruent.	Demonstrates positive effects of congruency, but no measure of expected taste.
Velasco, Salgado-Montejo, Marmolejo-Ramos & Spence (2014)	Basic product packages	Shape (rounded vs. angular) Typeface (rounded vs. angular) Names (Clax vs. blum) Sounds (relatively high vs. low pitch)	Expected sweetness Expected sourness Reaction times	34	Significant main effects of all 4 cues, and 2, 3, 4 way interactions. Rounded shapes, typefaces, names and low-pitched sounds rated higher in expected sweetness than angular shapes, typefaces, names and high pitched sounds, which were higher in expected sourness. Strongest associations with sweetness/sourness when all 4 cues were congruent.	Demonstrates effects of congruency on expected tastes but no measure of product liking/affective ratings. Very small sample size and non-realistic stimuli.
Wan, Velasco, Mu, Woods, Michel, & Spence (2014)	Coloured liquids in different receptacles	Receptacle type (water glass vs. wine glass vs. cocktail glass vs. plastic cup) Colour of liquid (red vs. green vs. blue vs. orange vs. brown vs. clear)	Expected flavour (from list)	100 from China, 100 from USA	Cross cultural differences between participants from USA and China in receptacle-colour-flavour associations. Although not tested statistically, data suggests that, within cultural groups, the type of receptacle made a negligible difference to the flavour associated with each colour.	Didn't analyse the interaction between receptacle and colour on expected flavour independent of culture, so difficult to draw conclusions about combining extrinsic cues from this study.

Researcher(s) (year)	Stimulus type	Cues combined	Measures	N	Relevant Study Findings	Notes
Woods & Spence (2016)	Colour patches	Colour (red vs. green vs. black vs. white) alone or side by side	Expected sweetness Expected bitterness Expected saltiness Expected sourness Reaction times	201	Combined association strength of single colour pairs predicted likelihood of associating a given colour pair to a particular taste.	Colour pairs took twice as long to be allocated to a given taste than single colours, suggesting they may have been processed individually and then assimilated, rather seen as part of a whole.
Woods, Marmolejo-Ramos, Velasco, & Spence (2016)	Coloured squares or circles with a border	Foreground-background pairs of colours (2 from red, green, black, white)	Expected sweetness Expected bitterness Expected saltiness Expected sourness Reaction times	100	Some colour pairs were shown to be more consistently linked with taste words than their constituent colours. Some pairs combined in a way that was not predicted by single colours.	Colour pairs took no longer to be allocated to a given taste than single colours suggesting that they were processed as part of a whole. Although demonstrates interesting effects of combining cues, all cues combined were of the same type.

Table 4. Results of ANOVAs showing the main effect of NoCC on expected sweetness for 'sweet' levels and expected sourness for 'sour' levels, split by product type in Experiment 1.

Product type	Expected sweetness				Expected sourness			
	F	*df*	*p*	η_p^2	*F*	*df*	*p*	η_p^2
'Sweet' levels								
Juice	25.84	2, 299	< .001	.15	7.83	2, 299	< .001	.05
Sorbet	35.90	2, 299	< .001	.19	26.08	2, 299	< .001	.15
Gums	88.53	2, 299	< .001	.37	0.66	2, 299	.517	-
'Sour' levels								
Juice	20.55	2, 299	< .001	.12	13.33	2, 299	< .001	.08
Sorbet	9.63	2, 299	< .001	.06	42.27	2, 299	< .001	.22
Gums	32.17	2, 299	< .001	.18	16.78	2, 299	< .001	.10

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Table 5. Results of stepwise multiple regression assessing NoCC and Product Category as predictors of expected sweetness for 'sweet' levels and expected sourness for 'sour' levels in Experiment 1.

Model	R^2	df	F	p	Predictor(s)	β	T	p
Expected sweetness								
Step 1	.11	1, 904	112.99	< .001	NoCC	.33	10.63	< .001
Step 2	.17	2, 903	95.65	< .001	NoCC	.33	11.03	< .001
					Product Category	.25	8.35	< .001
Expected sourness								
Step 1	.19	1, 904	208.79	< .001	NoCC	.43	14.45	< .001
Step 2	.24	2, 903	142.30	< .001	NoCC	.43	14.93	< .001
					Product Category	.23	7.86	< .001

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Table 6. Results of ANOVAs showing the main effects of NoCC on expected tastiness in Experiment 1, for each product category, separately for 'sweet' and 'sour' levels.

Product Category	'Sweet' levels				'Sour' levels			
	F	*df*	*p*	η_p^2	*F*	*df*	*p*	η_p^2
Juice	6.02	2, 299	.003	.04	4.21	2, 299	.016	.03
Sorbet	6.99	2, 299	.001	.05	2.57	2, 299	.078	-
Gums	0.74	2, 299	.479	-	4.45	2, 299	.012	.03

Note. η_p^2 values for non-significant results not included, indicated by '-'

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Table 7. Results of stepwise multiple regression assessing expected sweetness, expected sourness, expected tastiness, attractiveness, StD, product category and NoCC as independent predictors of WTP in Experiment 1, for 'sweet' and 'sour' levels.

Model	R^2	*df*	*F*	*p*	Predictor (s)	*B*	*t*	*p*
'Sweet' levels								
Step 1	.54	1, 904	1051.26	< .001	Expected tastiness	.73	32.42	< .001
Step 2	.61	2, 903	719.84	< .001	Expected tastiness	.57	23.79	< .001
					Design attractiveness	.32	13.42	< .001
Step 3	.62	3, 902	486.39	< .001	Expected tastiness	.57	23.66	< .001
					Design attractiveness	.31	12.94	< .001
					Average StD	.06	2.85	.004
'Sour' levels								
Step 1	.54	1, 904	1061.00	< .001	Expected tastiness	.74	32.57	< .001
Step 2	.60	2, 903	679.35	< .001	Expected tastiness	.59	24.56	< .001
					Design attractiveness	.28	11.73	< .001
Step 3	.60	3, 902	460.19	< .001	Expected tastiness	.59	24.36	< .001
					Design attractiveness	.27	11.27	< .001
					Average StD	.07	3.06	.002

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Table 8. Results of ANOVAs showing the main effects of congruency on expected sweetness and expected sourness, separately for each of the three product categories in Experiment 2.

Product category	Expected sweetness				Expected sourness			
	F	*df*	*p*	η_P^2	*F*	*df*	*p*	η_P^2
Juice	2.50	3, 1090	.058	-	1.26	3, 1090	.274	-
Sorbet	2.97	3, 1090	.031	.01	4.52	3, 1090	.004	.01
Gums	3.73	3, 1090	.011	.01	3.11	3, 1090	.026	.01

Note. η_P^2 values for non-significant results not included, indicated by '-'

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Table 9. Results of simultaneous multiple regression assessing product type, colour and pattern as independent predictors of expected sweetness and expected sourness in Experiment 2.

Measure	R^2	F	df	p	Predictors	β	t	P
Expected sweetness	.09	112.81	3, 3278	< .001	Product category	.30	17.86	< .001
					Colour type	.07	4.10	< .001
					Pattern type	.00	0.04	.968
Expected Sourness	.11	137.02	3, 3278	< .001	Product category	.33	19.74	< .001
					Colour type	.07	4.26	< .001
					Pattern type	.00	0.27	.787

Table 10. Results of stepwise multiple regression assessing the expected sweetness, expected sourness, expected tastiness, attractiveness, StD and congruency as independent predictors of expected WTP for each of the three product categories in Experiment 2.

Model	R^2	*df*	*F*	*p*	Predictor (s)	*β*	*T*	*P*
Juice								
Step 1	.52	1, 1092	1193.59	< .001	Expected tastiness	.72	34.55	< .001
Step 2	.60	2, 1091	805.07	< .001	Expected tastiness	.57	25.68	< .001
					Design attractiveness	.31	14.13	< .001
Step 3	.60	3, 1090	542.55	< .001	Expected tastiness	.56	25.49	< .001
					Design attractiveness	.30	13.40	< .001
					StD Average	.06	2.77	.006
Sorbet								
Step 1	.49	1, 1092	1031.45	< .001	Expected tastiness	.70	32.12	< .001
Step 2	.55	2, 1091	678.12	< .001	Expected tastiness	.54	22.74	< .001
					Design attractiveness	.32	12.94	< .001
Step 3	.56	3, 1090	469.93	< .001	Expected tastiness	.53	22.37	< .001
					Design attractiveness	.29	12.32	< .001
					StD Average	.10	4.94	< .001
Gums								
Step 1	.48	1, 1092	998.02	< .001	Expected tastiness	.69	31.59	< .001
Step 2	.58	2, 1091	749.51	< .001	Expected tastiness	.50	21.49	< .001
					Design attractiveness	.37	16.19	< .001
Step 3	.58	3, 1090	507.24	< .001	Expected tastiness	.49	21.48	< .001
					Design attractiveness	.36	15.39	< .001
					StD Average	.06	3.18	.001

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Appendix A

Pre-test: This was a manipulation check to ensure that the expected association between each level of the product-extrinsic cues and either expected sweetness or expected sourness was present. In particular, two separate experiments were conducted; the first manipulated explicit claims, colour and typeface but did not find significant effects for typeface (not reported here, for brevity). Therefore, the stimuli were updated exchanging typeface cues for background pattern cues, and a second pilot study (reported here) was conducted.

Method

Participants

A total of 97 individuals (27 males, 70 females) participated in the experiment, recruited from Prolific Academic (http://prolific.ac) and were reimbursed £1.30 for their time. All of the participants were over 18 years of age, UK residents, and reported normal or corrected-to-normal colour vision.

Design

A 3 x 3 x 2 (product category x cue x taste-congruence) within-participants design was used, such that all participants saw all 30 stimuli in a randomised order. Each participant was asked to rate each stimulus on its expected sweetness and expected sourness on a scale of 0 (not expected to be sweet/sour) to 100 (expected to be very sweet/sour). Information concerning age, sex and previous purchase behaviour was also collected.

MANAGING PRODUCT EXPECTATIONS VIA PACKAGING DESIGN

Materials and Stimuli

Stimuli were created using Adobe Photoshop CS6 software. For each of the three product categories, six stimuli were created (resulting in a total of 18 stimuli). Each stimulus contained one cue of either background pattern, colour or explicit claims and each cue had two levels; 'sweet' and 'sour', based on their association with sweetness and sourness in the literature: Background pattern was either rounded or angular (Salgado-Montejo et al., 2015; Velasco et al., 2014), colour was either pink or yellow (see Woods & Spence, 2016) and explicit claims either suggested sweetness or sourness. When neutral levels of each cue were required (i.e., when this cue was not being assessed), explicit taste claims and/or background patterns were absent, and/or a blue background was used. Stimuli used are presented in Figure A1.

INSERT FIGURE A1 ABOUT HERE

The experiment was conducted online, using the Adobe Flash-based Xperiment software (http://www.xperiment.mobi). Irrespective of the size of the monitor, the experiment was displayed in a 1024 x 768 pixel box in the centre of the screen, with white space filling any remaining pixels. Responses were made by means of two separate 1000 x 350-pixel 'box scales' with minimal responses (0) anchored at one end (not at all sweet/sour) and maximal responses (100) at the other (very sweet/sour).

Procedure

After reading the on-screen information sheet, participants clicked a button to proceed, answered the screening questions to ensure they met the inclusion criteria, and gave information about recent purchase behaviour for each product category (to control for individual differences in purchase judgments). The participants then moved on to the product evaluation trials, of which there were two parts: half of these trials measured expected sweetness and half measured expected sourness, with the order counterbalanced between participants.

On each trial, stimuli were presented at the top of the page alongside the question 'How sweet do you expect this product to be?" or "How sour do you expect this product to be?" The participants responded on a 100 x 350 pixel 'box scale', with minimal responses on the left-hand side (e.g., 'not sweet at all', representing a score of 0) and maximal on the other (e.g., 'very sweet', representing a score of 100). To indicate a response, participants dragged the relevant stimulus into an appropriate position in the box, where the horizontal position represented the scale as described above. Both stimuli for the 'sweet' and 'sour' levels of a certain cue from the same product category were presented at the same time, in a randomised order, and responses for both stimuli were made on the same box scale. The participants could take as long as they required to make their judgment but could not move on to the next trial until they had provided a response.

In total, each participant performed 18 trials: nine trials (in a random order) assessing expected sweetness for one of the three product categories (juice/sweets/sorbet) with both 'sweet' and 'sour' levels of one of the three cues (background pattern/colour/claims), and nine trials (again randomised) assessing the same stimuli, but for expected sourness. Each participant therefore rated all 18 stimuli twice; once for expected sweetness and once on

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expected sourness. On completion, the participants were shown on-screen debrief information as to the nature of the study.

Results

A series of paired samples *t*-tests assessed the difference in expected sweetness ratings between the two levels of each cue, separately for each product category. A Bonferroni correction was applied (i.e., the critical value became $p \leq .006$). As shown in Table A1, for all product categories, the 'sweet' manipulations for all cues (i.e., rounded background patterns, pink colours and sweet claims) were rated as significantly higher in expected sweetness than their respective 'sour' counterparts (i.e., angular background patterns, yellow/green colours and sour claims).

A second series of paired samples *t*-tests were then used to analyse the difference in expected sourness ratings between the same two levels of each cue, separately for each product category. A Bonferroni correction was again applied ($p \leq .006$). All comparisons were again found to be significant; for each product category and cue, all 'sour' manipulations were rated as higher in expected sourness than their 'sweet' counterparts. These effects are summarised in Table A2.

INSERT TABLES A1 & A2 ABOUT HERE

Table A1. *Expected sweetness summary statistics and pairwise comparisons. Results of t-tests between expected sweetness ratings for sour and sweet levels of each cue and product category, with means (M) and standard deviations (SD),*

Category	Cue	Sour manipulation		Sweet manipulation		t	p	d
		M	*SD*	*M*	*SD*			
Gums	Claim	26.64	19.10	**73.56**	17.47	-16.24	< .001	-1.65
	Colour	47.19	21.94	**68.59**	15.05	-7.95	< .001	-0.81
	Pattern	50.00	19.47	**60.44**	18.16	-4.79	< .001	-0.49
Juice	Claim	29.16	19.36	**71.06**	18.88	-15.11	< .001	-1.53
	Colour	42.12	20.85	**62.99**	19.94	-6.93	< .001	-0.70
	Pattern	44.69	19.99	**53.27**	19.70	-4.11	< .001	-0.42
Sorbet	Claim	25.26	15.18	**74.16**	14.54	-21.94	< .001	-2.23
	Colour	41.22	22.02	**63.24**	17.37	-8.05	< .001	-0.82
	Pattern	40.64	19.25	**52.00**	20.46	-5.11	< .001	-0.52

Note. Significantly higher mean scores are displayed in bold. Effect size statistics (Cohen's *d*) displayed are unstandardized.

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Table A2. *Expected sourness summary statistics and pairwise comparisons.* Results of t-tests between expected sourness ratings of sour and sweet levels of each cue and product category, with means (M) and standard deviations (SD)

C a t egory	Cue	Sour Manipulation		Sweet Manipulation		t	p	d
		M	*SD*	*M*	*SD*			
Gums	Claim	**71.52**	18.27	26.45	19.52	13.75	< .001	1.40
	Colour	**54.25**	23.88	35.30	17.96	7.17	< .001	0.73
	Pattern	**45.82**	23.22	36.22	19.79	4.45	< .001	0.45
Juice	Claim	**69.37**	19.54	30.68	18.63	13.73	< .001	1.39
	Colour	**62.17**	22.37	47.09	20.00	5.27	< .001	0.53
	Pattern	**55.13**	21.91	45.42	20.93	4.59	< .001	0.47
Sorbet	Claim	**76.88**	13.57	24.44	16.81	19.94	< .001	2.02
	Colour	**66.93**	21.38	42.87	20.80	7.75	< .001	0.79
	Pattern	**59.72**	19.04	47.39	18.95	5.60	< .001	0.57

Note. Significantly higher mean scores are displayed in bold. Effect size statistics (Cohen's *d*) displayed are unstandardized.