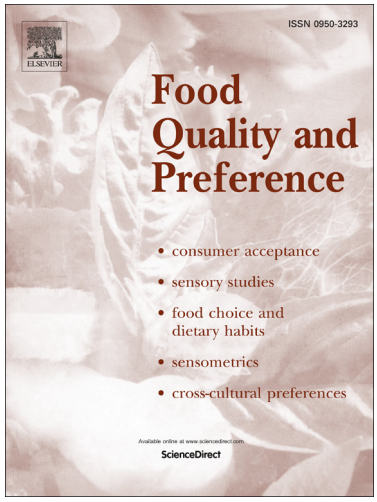

Does the shape of a cup influence coffee taste expectations? A cross-cultural, online study

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Does the shape of a cup influence coffee taste expectations? A cross-cultural, online study

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Abstract

We report a study designed to investigate whether shape-taste crossmodal correspondences would influence consumers' expectations concerning coffee. To that end, we conducted a cross-cultural online survey with respondents (N = 309) from China, Colombia, and the United Kingdom (UK). The participants had to rate eight coffee mugs on eight scales by arranging the mugs within a 1000 × 250 pixel box, placing each mug so that its horizontal position matched how strongly they thought the mug matched the scale presented. Amongst other findings, the results revealed that (1) the coffee was expected to be more aromatic from narrower diameter mugs, (2) the coffee associated with shorter mugs was expected to be both more bitter and more intense, and (3) the coffee was expected to be sweeter from wider diameter mugs. An interesting cross-cultural finding was that participants from the UK expected the mugs to be hotter than participants from either China or Colombia. These results add to a large and growing body of research highlighting the associations between visual information and a product's likely (or expected) sensory qualities. These findings may be useful to those preparing coffee as they suggest that coffee should be presented in certain mugs in order to convey a message that is congruent with the consumer's expectations.

Keywords: coffee, shape, mugs, taste expectations, cross-cultural, online

Introduction

Even before tasting, we have access to, and interpret, various pieces of sensory information concerning foods and beverages (e.g., colour, orthonasal aroma, shape, and sometimes even sound and weight; Prescott, 2015; Spence, 2015a; Spence & Wang, 2015). The role of this information in priming people and setting their sensory and hedonic expectations [1] has been well-established (Yeomans, Chambers, Blumenthal, & Blake, 2008; see also Piqueras-Fiszman & Spence, 2015, for a recent review). Shankar, Levitan, and Spence (2010), for example, demonstrated that the same colour (e.g., blue) elicits different expectations in different groups of people. Specifically, when a group of Taiwanese participants were shown a clear plastic cup containing a blue liquid, the majority of them expected the liquid to be mint-flavoured - Spence (2015b) suggests that this may be a consequence of an association with mouthwash. However, when the same stimulus was shown to a group of British participants, the majority expected raspberry-flavour instead. Similarly, Shermer and Levitan (2014) found that changing the colour (e.g., from red to blue) of pictures of salsa influenced participants' expectations regarding the salsa's spiciness. However, little is known about expectations when it comes to coffee or, and similar to Shankar et al.'s (2010) work, how expectations in relation to coffee might differ from one culture to the next.

The paucity of research exploring the influence of sensory cues on people's expectations concerning the taste/flavour of coffee is somewhat surprising, especially given Brits, for example, who are famous for their fondness for tea, consume an estimated 70 million cups of coffee in cafés, restaurants, and other outlets each and every day (Howie, 2012)[2]. Such figures hint at the ubiquity of coffee in many countries (see P. J. W., & D. H., 2013) and, given the economic incentive to keep consumers drinking coffee, café owners, restaurateurs, crockery designers and manufacturers ought, presumably, to be interested in anything that helps enhance the perception of the taste qualities, the enjoyment, or the overall coffee drinking experience for their clientele (cf. Van Doorn, Wuillemin, & Spence, 2014).

Shape-taste associations

Shape undoubtedly influences consumer behaviour (see Spence, 2012, for a review), and any shapes that are present on, or near, a food or beverage can be used by consumers to assess the likely qualities of that foodstuff. In general, people prefer rounded shapes (e.g., circles) to more angular shapes (e.g., triangles or stars; Bar & Neta, 2006; Gómez-Puerto, Munar, & Nadal, 2015; Silvia & Barona, 2009). Cheskin's (1957) oft-cited research drew attention to the impact of shapes on people's perception of different products. Cheskin placed identical products (e.g., crackers) in two different packages, one adorned with triangles, the other with circles. The participants' task was to state which product they preferred. Eighty-percent of participants reported a preference for the product from the package adorned with circles; often suggesting,

[1] Consistent with Olson and Dover (1976), an expectation is defined here as "the perceived likelihood that a product possesses a certain characteristic or attribute" (p. 169).

[2] This figure includes the cups of coffee drunk at home and in other locations (e.g., staff tea rooms); approximately 70% of which are instant coffee.

when quizzed, that this was of better quality. Westerman et al. (2012) obtained similar results in relation to people's preference for rounded shapes on, and rounded contours of, product packages.

Shape also seems to have a role in the experience when drinking a beverage (see Hanson-Vaux, Crisinel, & Spence, 2013). Demonstrating a tangible impact of shape on drinking, Wansink and van Ittersum (2003, 2005) found that both children and adults pour around 20-30% more of a drink (e.g., juice) into short/wide glasses relative to tall/thin glasses. However, participants believed the opposite to be true. These authors related this finding to Piaget's conservation task. Specifically, adults fail the task because it appears as though they believe that tall/thin containers hold more fluid than short/wide containers, and thus they pour less fluid into tall/thin containers.

Although associations between shape and taste have been explored in a range of food and beverage products, the correspondence between shape and expectations related to the taste of coffee remain unknown. Coffee is an interesting candidate for research because of its consistent, bitter character and the different bitter/sweet combinations that arise through bean selection, type of roasting of the beans, type of milk used (e.g., full fat), and whether or not sugar is added. According to Spence (2012), coffee is likely to be another product where shape-taste associations exist. The suggestion being that many coffee company logos are rounded in shape (e.g., New York Coffee Company, Costa Coffee, Starbucks Coffee), and that this might be used to suggest to customers that their coffee is not overly bitter (see also Batra, Seifert, & Brei, 2015; Zhang, Feick, & Price, 2006). However, it is important to note that this claim has yet to be substantiated, and Cheskin's (1957) early ideas (i.e., the ability of the shapes used on product packaging to affect people's product expectations) have yet to be applied to the coffee category. This research project addresses this salient gap in the literature. Specifically, and given that, in a restaurant setting, a coffee's package is often the mug or cup in which it is served, we sought to investigate shape-flavour associations in relation to coffee expectations.

Cross-cultural research

Interestingly, Bremner et al. (2013) reported that the Himba tribe of Kaokoland in rural Namibia did not show the 'usual' (i.e., Western) associations between angular and rounded shapes and the tastes and oral-somatosensory properties of beverages. It was assumed that the Himba have been unable to accumulate the 'usual' associations through experience because they have not been exposed to written language, supermarkets, or advertising. Bremner et al. found that the Himba did not match still water with an organic, amoeba-like shape, nor did they pair sparkling (i.e., carbonated) water with an angular, star-like shape. Additionally, they also matched chocolates varying in cocoa content in a manner opposite to that of their Western counterparts (i.e., Westerners match chocolate high in cocoa to angular, star-like shapes due to the increased bitterness). That said, Ngo et al. (2013) have observed consistent crossmodal correspondences across cultures. Specifically, they demonstrated that British and Colombian participants associated sweet fruit juices with round shapes and sour fruit juices with angular shapes (see also Salgado-Montejo et al., 2015; Wan et al., 2014). Bremner et al.'s (2013) findings, and the work of others (e.g., Williams & Bargh, 2008), show that at least some of the associations between shapes and the tastes, flavours, aromas, and

oral-somatosensory attributes of food and beverages are likely learned. That said, it is possible that participants matched stimuli as a function of stimulus valence, which might differ across cultures (see Velasco, Woods, Petit, Cheok, & Spence, 2016). For example, the Himba might find both chocolate high in cocoa and rounded forms appealing, and thus match them.

Aims and hypotheses

In the study reported here, we explored the impact of the shape of coffee mugs on people's expectations of the coffee. Most studies on taste/shape associations have focused on the curvilinearity of shapes. However, other shape features (in particular those that affect visual preference) may influence taste/shape associations (as shown by Salgado-Montejo et al., 2015, for symmetry; Deroy & Valentin, 2011, for thinness). Further, and similar to Piqueras-Fiszman, Alcaide, Roura, and Spence (2012), we wanted to explore the influence of the shape of the container the beverage is served in. For those reasons we explored some of the attributes that are typically varied in coffee cups, namely the 'height' of the mug (tall, short), the 'diameter' of the mug (wide, narrow), and the 'thickness' of the rim (thick, thin). It should be noted that factors other than shape can influence expectations as well. For example, the cup in which the coffee is served may affect us as a function of our perception of the general properties of the cup (i.e., cheap vs. expensive [Piqueras-Fiszman, Harrar, Alcaide, & Spence, 2011], flimsy vs. strong [Krishna & Morrin, 2008]). Here, we explore these issues too.

In the remainder of this section, the hypotheses will be discussed according to the type of expectation measured. Specifically, 'bitterness' and 'sweetness' measure expectations relating to the taste of coffee, while 'aroma', 'energy', 'temperature', and 'intensity' measure expectations concerning the properties/qualities of coffee. Finally, 'liking' and 'willingness-to-pay' measure people's expectations concerning themselves.

Taste Expectations

It was thought that if expectations are affected by a mug's attributes (e.g., height), a coffee's properties (e.g., bitterness) should be rated more favourably when associated with a particular change in that dimension. For example, it is common in several countries to serve more concentrated coffees (e.g., espresso, macchiato) in smaller cups and, as such, we expected people to rate these mugs as containing coffees that were more bitter.

Expectations regarding the coffee's properties

It is possible that different cup diameters influence expected aroma intensity. Cliff (2001) suggested that larger openings allow aromas to escape prior to evaluation, and the same logic could be applied here. That said, Spence (2011, 2016) suggested that a small-diameter glass reduces the surface area of the contents available for diffusion, and thus fewer odour molecules are released from the liquid. Given these conflicting findings, we thought it most appropriate to hypothesise that 'cup diameter' would not influence the expected aroma of coffee.

Expectations relating to the individual

It was hypothesised that increases in 'cup height' and 'cup diameter' would be associated with an increase in the amount a person was willing-to-pay for the coffee, due to the expectation that there will be more coffee in these cups. Importantly though, and consistent with Wansink and van Ittersum (2003, 2005), it may be that people pay more attention to one dimension of the cup (e.g., height) than another (e.g., width). If this is true, and Wansink and van Ittersum are correct, it was thought that people might expect that tall/thin mugs hold more coffee relative to short/wide mugs. As such, people would be willing-to-pay more for coffee from these types of mugs.

Consistent with Harrar and Spence (2013), it was thought that the thickness of the mugs would influence expected attributes of the coffee. This thought is based on the fact that thicker objects (usually) weigh more than thinner objects. Harrar and Spence found that yoghurt was perceived of as being more expensive when it was tasted from a lighter plastic spoon, relative to an artificially-weighted spoon. As such, we hypothesised that the coffee associated with thin-walled mugs, which one assumes are expected to be relatively lighter, would be deemed more expensive than the coffee associated with mugs with thicker walls. However, it could be argued that, in Harrar and Spence's work, there is a contrast between the weight of the spoon and the perceived thickness/creaminess (and thus expensiveness) of the yoghurt. In the study presented here, though, there was no real coffee, so there is no contrast. Consequently, it might be that people expect higher quality coffee to come in thicker cups.

Method

Participants

Three hundred and nine participants took part in the study. One hundred and three volunteers (46 women) aged between 17 and 29 years were from China (M_{age} = 21.50 years, SD_{age} = 8.07 years). Ninety-seven volunteers (56 females) aged between 18 and 69 years were from Colombia (M_{age} = 29.19 years, SD_{age} = 14.21 years). Finally, 105 participants (52 females) aged between 16 and 60 years were from the UK (M_{age} = 34.10 years, SD_{age} = 11.05 years).

The Chinese participants were undergraduate or graduate students from Tsinghua University, Beijing, China. For their participation, volunteers received either course credit in order to fulfil the requirements of an introductory psychology course that they were enrolled in, or were compensated ¥12.5 CNY. The experiment was approved by the ethics committee at the Psychology Department of Tsinghua University, and conformed to the ethical standards for conducting research established by the American Psychological Association. The Colombian participants were recruited from a database of participants created at the International School of Economic and Administrative Sciences at Universidad de La Sabana, Bogota, Colombia, and took part in the experiment voluntarily. The UK participants were recruited from Prolific Academic to take part in the study in return for a payment of 1.00 UK pound. By means of Prolific Academic's 'filter' feature, only those participants who reported having been born in the UK were allowed to take part in the study. The study was reviewed and approved by the Central University Research Ethics Committee at Oxford University and was carried out in accordance with the World Medical Association

(WMA, 2013) Helsinki Declaration. All participants provided informed consent prior to taking part in the study.

Stimuli

Given that the experiment was conducted online, the apparatus varied by participant. Nevertheless, the experiment utilized 'full screen' mode (i.e., utilizing the entirety of the participant's monitor), and took place within a 1024 × 768 pixel box in the centre of the screen (see Figure 1), irrespective of the size of the participant's monitor. The experiment was conducted online using the Adobe Flash-based version of Xperiment (http://www.xperiment.mobi).

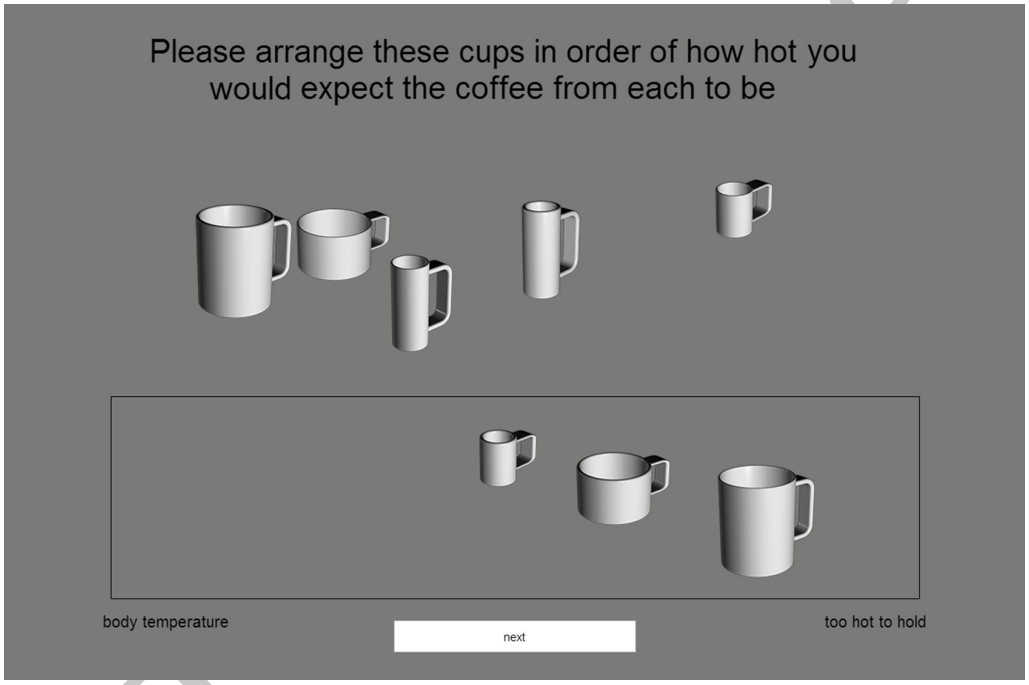

Figure 1. The pictures used in the survey.

Design

A mixed-factorial design was used that included a between-participant factor (country of origin: China, Colombia, or the UK) and the within-participants factors of the 'height of cup' (tall, short), the 'cup diameter' (wide, narrow), and the 'thickness of rim' (thick, thin). The dependent variables are defined in Table 1. Note that due to human error whilst scripting the study, participants from the UK were asked to specify how much they would pay for drinks in terms of US dollars, not UK pounds.

Table 1. The dependent variables, the question asked to assess each, and the anchors used to define the scale participants had to place the mugs along (the anchors were always placed on the far left and right of the scale; in the case of 'Willingness-to-pay' though, the additional anchors were evenly spaced between the far left and far right anchor).

Dependent variable	Question asked	Scale anchors (left to right)
Aroma	Please arrange these mugs of coffee in order of how strong smelling you would expect the coffee from each to be	Not aromatic at all; Very strongly aromatic
Bitter	Please arrange these cups of coffee in order of how bitter you would expect each to taste	Not bitter at all; Very bitter
Energy	Please arrange these mugs in order of how energising you think the coffee in each would be	Not at all energising; Very energising
Temperature	Please arrange these cups in order of how hot you would expect the coffee from each to be	Body temperature; Too hot to hold
Intensity	Please arrange these mugs of coffee in order of how intense you would expect coffee from each to taste	Not intense at all; Very intense
Liking	Please arrange these mugs of coffee in order of how much you expect to like the coffee from each	Greatest imaginable dislike; Greatest imaginable like
Sweetness	Please arrange these mugs of coffee in order of how sweet you would expect coffee from each to taste	Not sweet at all; Very sweet
Willingness-to-pay	Please arrange these mugs of coffee in order of how much money you would be willing to pay for a cup of coffee in each	English: 0 - 10 US dollars Chinese: 0 - 45 Chinese Yen Colombia: 0 - 31000 $Pesos

Procedure

A screen shot of the task is shown in Figure 1. The participants had to arrange the mugs within a 1000 × 250 pixel box, placing each mug so that its horizontal position matched how strongly they thought each mug matched the scale presented (e.g., in Figure 1, the participant is being asked to arrange the mugs according to how hot they think coffee presented in each will be). Mugs could be placed so that they overlapped (with the most recently moved placed on top of mugs moved earlier). Parenthetically, the mugs we showed to participants did not have coffee in them and we (deliberately) did not specify whether there was the same amount of coffee in each cup. As such, each participant may have had a different idea with regards to the 'amount'.

After placing all eight mugs, the participant could proceed to the next trial by pressing the space bar or clicking the 'next' button (there was a 100ms pause between trials). On each of the eight trials, a different scale was presented. The original starting positions for the mugs were arranged randomly in a 1000 × 269 pixel area above the box (if a mug's random placement overlapped with another mug, a new random placement was generated; this was repeated up to 100 times, after which the mug was placed in the position that, out of the prior 100 attempts, least overlapped existing mugs). Trial order was randomised between participants[3]. The participants took an average of 650 seconds to complete the study. After completing all the trials participants were debriefed as to the nature of the study. This kind of task has been used successfully in several recent studies (e.g., Velasco, Woods, Hyndman, & Spence, 2015).

Analyses

Eight mixed-factorial ANOVAs, subjected to Holm-Bonferroni corrections, were conducted that were identical in terms of design except for their dependent variable (Aroma, Bitterness, Energy, Temperature, Intensity, Liking, Sweetness, and Willingness-to-pay); the dependent variable was the position on the x-axis of the centre of the images of the coffee mugs, relative to the size of the box within which the mugs were placed - percentage position values were used. In relation to the Holm-Bonferroni corrections, there were 15 main effects and interactions per ANOVA, so the most stringent critical *p*-value used was 0.05 / (15 x 8) = 0.00042; critical *p*-values and statistics are detailed in Appendix 1. Contrary to popular opinion, ANOVA does *not* control for Type 1 error (see Lakens, 2016). Each ANOVA consisted of the between-participant factor of 'country of origin' (China vs. Colombia vs. UK), and the repeated-measures factors of 'height of cup' (tall vs. short), 'cup diameter' (narrow vs. wide), and 'thickness of rim' (thick vs. thin). The full report of these analyses is given in Appendix 1.

Results

Data screening

Outliers were screened, and corrected separately, for each country (values exceeding 3 x *SD* +/- mean were replaced with the next most extreme, but non-outlying, value). Eleven out of 6720 data points were corrected in this fashion for UK data, and 11/6208 for Colombian data (none of the 6592 Chinese data points were outliers).

Taste Expectations

Bitterness

Although the three-way interaction between 'thickness of rim', 'height of cup', and 'country of origin' was significant [$F(2, 302) = 9.32$, $p < .001$, $\eta^2_p = .06$], inspection of the data (see Figure 2) indicates that 'height of cup' was more impactful than 'thickness of rim' and/or 'country of origin'. This is supported by the fact that the only main effect, from these three factors, that reached statistical significance was 'height of cup' [$F(2, 302) = 69.04$, $p < .001$, $\eta^2_p = .19$]. Here, the coffee associated with short mugs ($M = 58.62$; CI

[3] Please contact Andy Woods (andytwoods@gmail.com) for the script for the Cantonese and Spanish versions of the text used in the study.

[56.76, 60.48]) was expected to be more bitter than the coffee associated with taller mugs (M = 45.34; CI [43.46, 47.21]). There was also a significant main effect of 'cup diameter' [$F(1, 302) = 137.56$, $p < .001$, $\eta^2_p = .31$], with the coffee associated with narrower diameter mugs (M = 64.07; CI [61.69, 66.46]) thought to be more bitter than the coffee associated with wider diameter mugs (M = 39.89; CI [37.74, 42.03]). Table 2 presents a summary of all the significant main effects.

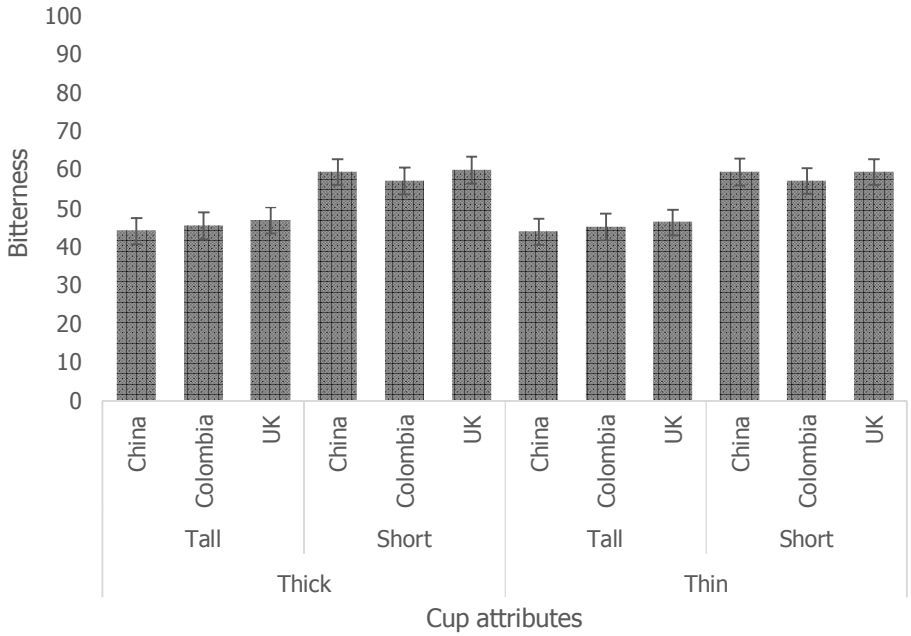

Figure 2. The interaction between 'thickness of rim', 'height of cup' and 'country of origin' for Bitterness (error bars here and henceforth represent the 95% CI around the mean).

Table 2. A summary of the significant main effects.

Expectations	DV	Main effects			
		Height of cup	Diameter of cup	Thickness of rim	Country of origin
Taste	Bitter	√	√	-	-
	Sweetness	-	√	-	-
Quality	Aroma	√	√	-	-
	Energy	-	-	-	-
	Temperature	-	-	-	√
	Intensity	√	√	-	-
Subjective ratings	Liking	-	-	-	-

Willingness-to-pay	√	√	-	-

Note: √ denotes a significant main effect

Sweetness

The main effect of 'cup diameter' achieved significance [$F(1, 302) = 33.55$, $p < .001$, $\eta^2_p = .10$), with the coffee from mugs with a wider diameter ($M = 55.38$; CI [53.05, 57.71]) expected to be sweeter than coffee from mugs with a narrower diameter ($M = 42.40$; CI [39.75, 45.05]).

Expectations regarding the coffee's properties

Aroma

The main effects of 'cup diameter' [$F(1, 302) = 13.78$, $p < .001$, $\eta^2_p = .04$] and 'height of cup' [$F(1, 302) = 45.73$, $p < .001$, $\eta^2_p = .13$] exerted a significant influence on participants' ratings of expected aroma. In terms of 'cup diameter', the coffee associated with narrower diameter mugs ($M = 59.32$; CI [56.64, 62.01]) was expected to be more aromatic than the coffee associated with wider diameter mugs ($M = 50.77$; CI [48.42, 53.12]). In relation to 'height of cup', the coffee from short mugs ($M = 60.47$; CI [58.50, 62.45]) was thought to be more aromatic than was the coffee from taller mugs ($M = 49.62$; CI [47.74, 51.50]).

Energy

There were no significant main effects or interactions (see Appendix 1).

Intensity

The main effects of 'cup diameter' [$F(1, 302) = 110.67$, $p < .001$, $\eta^2_p = .27$] and 'height of cup' [$F(1, 302) = 81.51$, $p < .001$, $\eta^2_p = .21$] were significant. The coffee associated with narrower diameter mugs ($M = 64.61$; CI [62.09, 67.12]) was expected to be more intense than that associated with wider diameter mugs ($M = 42.12$; CI [40.02, 44.22]). Likewise, coffee in short mugs ($M = 60.56$; CI [58.66, 62.46]) was expected to be more intense than coffee from tall mugs ($M = 46.17$; CI [44.39, 47.95]).

Temperature.

The only main effect that achieved statistical significance here was 'country of origin' [$F(2, 302) = 12.89$, $p < .001$, $\eta^2_p = .08$], with UK participants expecting the mugs to be hotter ($M = 55.50$; CI [53.61, 57.39]) than participants from either China ($M = 50.14$; CI [48.23, 52.04]) or Colombia ($M = 48.96$; CI [47.00, 50.93]).

Expectations relating to the individual

Liking

The interaction between 'height of cup' and 'country of origin' achieved significance [$F(2, 302) = 9.90$, $p < .001$], with a medium effect size ($\eta^2_p = .06$). Figure 3 shows that the interaction was largely driven by

Chinese participants liking coffee from short mugs (M = 58.90; CI [55.28, 62.51]) relative to taller mugs (M = 42.94; CI [39.61, 46.26]). Confidence intervals revealed that Colombians' liking of coffee from short [50.25, 57.71] and tall mugs [49.58, 56.44] and UK participants' preference for coffee from short [50.82, 57.99] and tall mugs [51.04, 57.63] overlapped – but were greater than the Chinese participants liking for coffee from tall mugs.

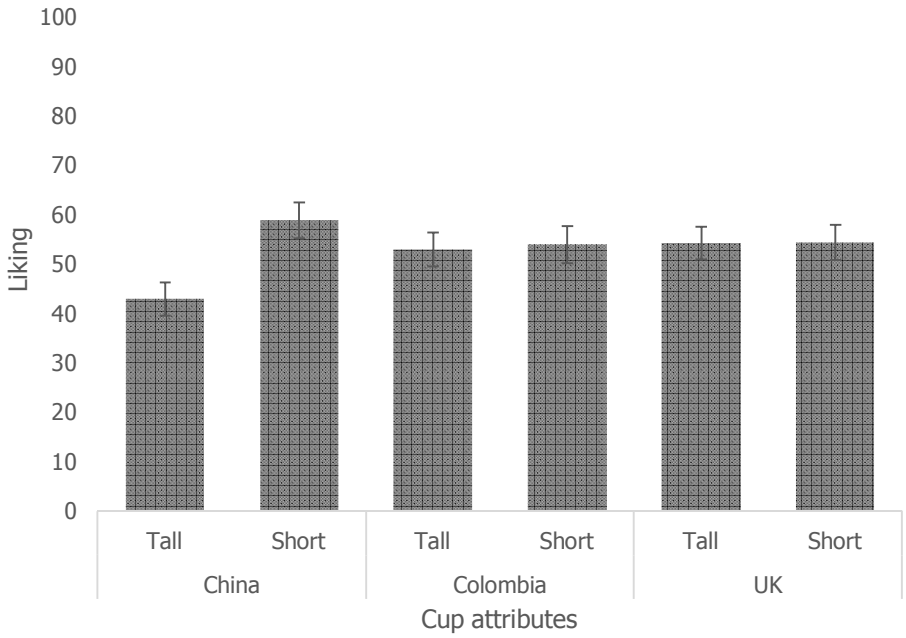

Figure 3. The interaction between 'height of cup' and 'country of origin' for Liking.

Willingness-to-pay

Chinese Yen (6.214 CNY = 1 USD) and Colombian Peso (2382 COP = 1 USD) were converted to US dollars using the currency exchange rate midway through testing (20th January, 2016, via http://www.exchangerates.org.uk/). We were interested in the relative changes as a function of our experimental conditions and although the amounts may represent something different in each country, they nevertheless provide us with the relative changes, in terms of the manipulation of interest. Given that the study was conducted over a 6 month period, and given the degree of variation of the exchange of these currencies (which, even if the relative value of the currencies remained stable, could have many possible explanations), we decided to focus more on within country variation in the Discussion as opposed to variation across countries.

There was a significant interaction (see Figure 4) between 'cup diameter' and 'country of origin' [F(2, 302) = 28.71, p < .001, η^2_p = .16]. Whilst both Colombians (M = 5.38; CI [4.81, 5.95]) and participants from the UK (M = 4.68; CI [4.38, 4.99]) rated coffee from wider diameter mugs as being more expensive than coffee from mugs with a narrower diameter (Colombians: M = 2.93; CI [2.65, 3.21]; UK: M = 3.51; CI [3.24, 3.78]), Colombians reported that they were willing-to-pay less for coffee from smaller diameter

mugs than were participants from the UK. The amount Chinese participants were willing-to-pay for coffee did not depend on the diameter of the cup (i.e., wide diameter: M = 3.55; CI [3.31, 3.80]; narrow diameter M = 3.51; CI [3.20, 3.81]).

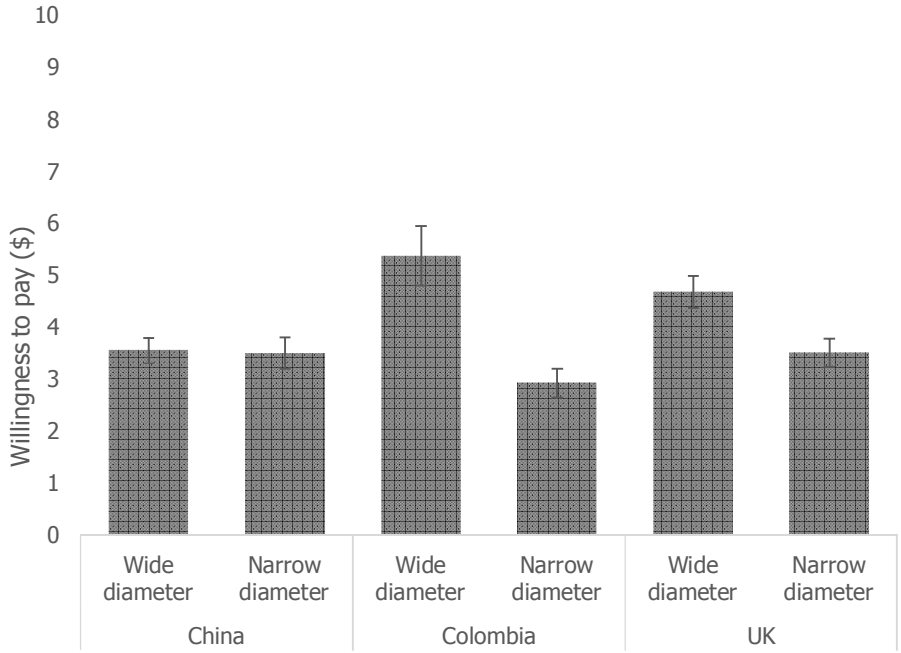

Figure 4. The interaction between 'cup diameter' and 'country of origin' for the Willingness-to-pay DV.

The interaction (see Figure 5) between 'height of cup' and 'country of origin' also achieved significance [F(2, 302) = 20.04, p < .001], with a medium effect size (η^2_p = .12). The interaction is almost identical to the previous interaction (see Figure 4). Specifically, both Colombians (M = 4.96; CI [4.48, 5.44]) and UK participants (M = 4.53; CI [4.21, 4.79]) were willing-to-pay more for coffee from tall mugs than they were for coffee from short mugs (Colombians: M = 3.35; CI [3.02, 3.67]; UK: M = 3.66; CI [3.37, 3.96]), whereas the amount Chinese participants were willing-to-pay did not depend on the height of the mug (i.e., tall: M = 3.54; CI [3.29, 3.79]; short: M = 3.52; CI [3.28, 3.76]).

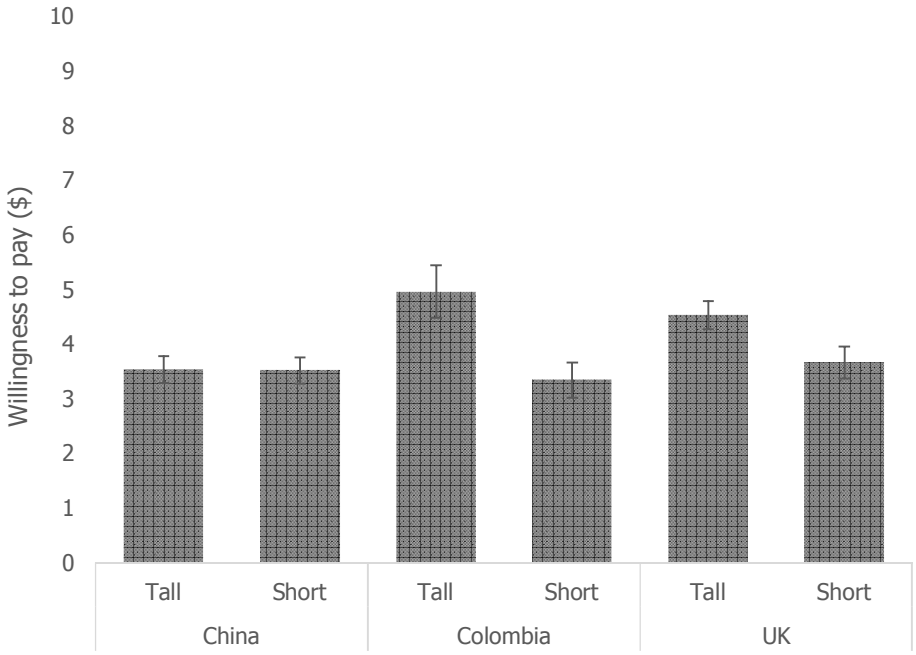

Figure 5. The interaction between 'height of cup' and 'country of origin' for the amount one was Willing-to-pay.

'Cup diameter' and 'height of cup' also interacted [$F(1, 302) = 12.83$, $p < .001$, $\eta^2_p = .04$]. People were willing-to-pay the most for tall/wide cups ($M = 5.06$; CI [4.75, 5.38]), followed by short/wide cups ($M = 3.98$; CI [3.76, 4.21]) and tall/narrow mugs ($M = 3.60$; CI [3.41, 3.79]), which did not differ from one another, and, finally, short/narrow mugs ($M = 3.05$; CI [2.83, 3.26]).

The main effects of 'cup diameter' [$F(1, 302) = 90.62$, $p < .001$, $\eta^2_p = .23$] and 'height of cup' [$F(1, 302) = 66.10$, $p < .001$, $\eta^2_p = .18$] exerted a significant influence on the amount participants' were willing-to-pay. Unsurprisingly, and in relation to 'cup diameter', people were willing-to-pay more for coffee from mugs with a wider diameter ($M = 4.57$; CI [4.37, 4.78]) than they were for coffee from narrower diameter mugs ($M = 3.53$; CI [3.35, 3.72]). As for 'height of cup', people were willing-to-pay less for coffee from short mugs ($M = 3.70$; CI [3.53, 3.87]) than they were for coffee from taller mugs ($M = 4.41$; CI [4.22, 4.60]).

Discussion

The main issue explored in this study was whether expectations about coffee are influenced by changes in the shape of the mug. The results revealed that 'cup diameter' and 'cup height' influenced the expected aroma, bitterness, intensity, and amount a participant was willing-to-pay; 'cup diameter' also influenced the expected sweetness. An interesting cross-cultural finding was that participants from the UK expected the mugs to be hotter than participants from either China or Colombia. In contrast to Harrar and Spence's (2013) finding relating to the weight of spoons, the weight (which was assumed to be associated with 'thickness') of the mugs did not influence expected attributes of the coffee – this seems odd given that tea drinkers would presumably consider 'cup thickness' an important issue (consider, for example, the thin lip

of a bone China cup). Harrar and Spence found that yoghurt was thought to be more expensive when it was tasted from a lighter plastic spoon, relative to an artificially-weighted spoon. As such, we initially thought that coffee associated with thin-walled mugs, which one assumes are expected to be relatively lighter, would be considered more expensive than the coffee associated with mugs with thicker walls. However, some literature (e.g., Piqueras-Fiszman et al., 2011; Piqueras-Fiszman & Spence, 2012) suggests that the coffee associated with thick-walled mugs, which one assumes are expected to be relatively heavier, would be deemed more expensive than the coffee associated with mugs with thinner walls. Further, in Harrar and Spence's work there was a contrast between the weight of the spoon and the perceived thickness/creaminess (and thus expensiveness) of the yoghurt. Consequently, it might be that people expect higher quality coffee to come in thicker cups. Neither of these hypotheses were supported, which may be a consequence of the fact that our task measured expectations, whereas Harrar and Spence (2013) tested perceptions. It might also be true that, because we used conservative Holm-Bonferroni corrections, effects that achieved significance in previous work did not do so here. However, the null finding might be an artefact of the stimuli we used. It is possible that participants had difficulty distinguishing the two variable levels (i.e., thick walls vs. thin walls), and thus provided similar responses regardless of the 'thickness of rim'.

Taste Expectations

Bitterness

The coffee associated with short mugs was expected to be more bitter than the coffee associated with taller mugs. A seemingly logical interpretation of this finding is that people (from several cultures) expect the ratio of coffee to milk (or water) in the shorter mugs to be greater than they expect the ratio to be in taller mugs, and thus expect the coffee in shorter mugs to be more bitter. Similarly, perhaps it is that people expect certain types of coffees to be served in smaller cups. For example, in the UK and Australia, it is common for "strong" coffees (think espresso, macchiato) to be served in very small cups. At this point, it is worth considering that features such as 'cup height' may be matched to specific taste attributes. Here, we are dealing with the specific semantic context of 'coffee', and in that sense people may filter information as a function of their 'experience' with coffee (see Bohrn, Nabecker, & Carbon, 2008; Carbon, 2010 for similar arguments in relation to shape curvature preference).

This same logic can be applied to the finding that 'cup diameter' was significant. Specifically, the coffee associated with narrow-diameter mugs was thought to be more bitter than the coffee associated with wide-diameter mugs. Again, and holding mug height constant, it may be that people expect the ratio of coffee to milk (or water) in the narrower mugs to be greater than it is in wider mugs, and thus expect the coffee in narrower mugs to be more bitter.

Sweetness

The main effect of 'cup diameter' achieved statistical significance, with the coffee from mugs having a wider diameter expected to be sweeter than coffee presented in mugs having a narrower diameter. This might be the inverse of the "bitterness" finding. Specifically, the coffee associated with mugs with a

narrower diameter was thought to be less sweet (or more bitter) than the coffee associated with mugs of a wider diameter. Again, one possibility here is that people expect the ratio of coffee to milk (or water) in the wider diameter mugs to be less than it is in narrower mugs, and thus expect the drink to be less bitter (or sweeter).

Expectations regarding the coffee's properties

Aroma

To reiterate, the main effects of 'cup diameter' and 'height of cup' exerted a significant influence on participants' ratings of the expected aroma. Although it is difficult to disentangle the important factors in the work of Cliff (2001), the results presented here seem to be (somewhat) consistent with her findings in relation to wine. Specifically, we found that the coffee associated with smaller diameter mugs was thought to be more aromatic than the coffee associated with larger diameter mugs. Cliff found that wine glasses with large bowl diameters but small openings had the highest aroma intensities, regardless of the type of wine sampled. Cliff suggested that larger openings allow aromas to escape prior to evaluation, and the same logic could be applied here. However, Spence (2011) suggested that a small-diameter glass reduces the surface area of the contents that is available for diffusion, and thus fewer odour molecules are released from the liquid. Coffee might be an interesting case where expectations and perceptions differ.

In relation to 'height of cup', the coffee from short mugs was thought to be more aromatic than that from taller mugs. Although speculative, this finding (and the finding regarding 'cup diameter') might, again, be related to bitterness and the idea that people filter information as a function of their experiences. It might also relate to the work of Jeon, Lee, and Kim (2014) who highlight the importance of expectations. Jeon and colleagues showed that people expect soup to be presented in certain type of bowls, and this expectation can influence its perceived saltiness. The same logic could be applied here in that it is common in several countries to serve more concentrated coffees in smaller cups and, as such, people might expect coffees presented in these mugs to be more aromatic.

Energy

None of the main effects or interactions achieved significance. As such, the coffee associated with certain mug types was not deemed more energizing than the coffee associated with any other mug type. Supporting the null hypothesis here is interesting because one might assume that there is a correlation between 'energy' and 'volume'. Consider, for example, energy drinks: A relatively uncontroversial assumption would be that people expect larger volumes of energy drink to be more energizing than smaller volumes. It is, therefore, somewhat surprising that people do not expect larger volumes of a similarly caffeinated beverage (i.e., coffee) to be more energizing. A tentative explanation here is that the coffee category might be somewhat unique. That is, people understand that smaller coffees (e.g., espresso) are usually quite strong, and that larger coffees (e.g., lattes) often have an equivalent amount of coffee in them, but are topped-up with milk and foam.

Temperature

There was a main effect of 'country of origin'. Here, participants from the UK expected the mugs to be hotter than did the participants from either China or Colombia. An interesting, yet speculative, idea here is that people from the UK expect coffees to be warmer because the climate (13.5^{o}C) there is, on average, colder than it is in Bogota (Colombia: 18.0^{o}C) and Beijing (China: 17.8^{o}C). This proposition, obviously, requires further testing.

Intensity

The main effects of 'cup diameter' and 'height of cup' were significant. The coffee associated with the narrower diameter cups was expected to be more intense than that associated with wider mugs. Likewise, coffee in short mugs was expected to be more intense than that from tall mugs. Interestingly, these findings mimic those for bitterness. Consistent with an argument made by Van Doorn, Wuillemin, and Spence (2014), consumers appear to blur the distinction between 'intensity' and 'bitterness'. Dijksterhuis (1998) has suggested that because of the use of the word 'strong' in coffee advertising, consumers often confuse a coffee's strength or intensity with its 'bitterness' – the finding here that intensity ratings mirror bitterness ratings would support such a view.

Expectations relating to the individual

Liking

The interaction between 'height of cup' and 'country of origin' was significant, and driven largely by Chinese participants' preference for coffee in short mugs. Colombians and participants from the UK showed no preference for coffee from either short or tall mugs. However, both groups rated the coffee in these mugs as being more likeable than was Chinese participants rating of the coffee in tall mugs (see Figure 3). A possible explanation for this findings is that participants might simply be responding as a function of the 'regularities' found in coffee drinking experiences, over-and-above any crossmodal feature matching. More work is needed to clarify this issue.

Willingness-to-pay

There was a significant interaction between 'diameter of cup' and 'country of origin'. Whilst both Colombian and UK participants were willing-to-pay more for coffee from mugs having a wider (as compared to a narrower) diameter, the Chinese participants failed to differentiate between narrow and wide diameter mugs with respect to the amount they were willing-to-pay. This seems like an odd finding but, perhaps, is a consequence of the fact that coffee is still not a common beverage in China. That is, Colombians and those from the UK hold an expectation that a greater volume of coffee (as one would get in a wider diameter mug) would cost more but, due to their lack of familiarity with coffee, Chinese participants did not necessarily expect to pay more for a slightly larger quantity. The interaction between 'height of cup' and 'country of origin' mimics the interaction between 'diameter of cup' and 'country of origin' and the same explanation seems applicable. That said, as Chinese participants were younger than those from either Colombia or the UK, willingness-to-pay might be influenced by (possible) differences in coffee consumption patterns and income, regardless of the shape of mug. Further investigation is required.

There was a significant interaction between 'cup diameter' and 'height of cup' that demonstrated that participants were willing-to-pay the most for tall/wide cups, and the least for short/narrow mugs. Unsurprisingly, this finding suggests that willingness-to-pay is better explained by the perceived volume of the coffee, as opposed to the individual factors of 'height of cup' and 'cup diameter'. This interpretation is supported by the significant main effects of 'cup diameter' and 'height of cup' – where people were willing-to-pay less for *smaller* cups of coffee relative to *larger* cups of coffee. Interestingly, the findings do not seem to support those of Wansink and van Ittersum (2003, 2005). In the present study, the willingness-to-pay CIs for the short/wide mug overlap those of from the tall/narrow mug. As such, one could draw the conclusion that adults expected these mug types to hold an equivalent amount of coffee.

Limitations

There are several issues that may have influenced our results and should be considered. The first, as raised by a reviewer, was that the participants from the different countries had different mean ages and it could be the case that coffee consumption varies as a function of age. A further two differences were that whilst participants from China and the Colombia were students recruited through their universities, those from the UK were recruited through the online recruitment panel www.prolificacademic.co.uk. Further, participants recruited in Colombia did not receive monetary compensation for taking part. It is less clear if these factors would have influenced our results, nevertheless, it is worth outlining these as potential confounds to avoid in future studies related to ours.

Conclusions

The results of the survey reported here demonstrate that the shape of the mug influenced people's expectations of the taste and qualities of coffee that would be served in such a mug. Shape, or more likely 'volume', also influenced the amount participants were willing-to-pay for a coffee. If café owners, baristas, and crockery manufacturers want to manipulate people's expectations of coffee, they should carefully consider the diameter and height of the cups they use/produce, as these features will likely affect expected aroma, bitterness, sweetness, and intensity. Further, these people should be cognizant of traditions (e.g., serving more concentrated coffees in smaller cups) as they are likely to be important. When providing customers with coffee, café owners and baristas should use a mug shape that conveys a message that is congruent with consumer expectations. This is important because aligning a product with consumer expectations could contribute to product purchasing behaviour. These results add to a growing body of research highlighting the associations between visual information and a product's likely (or expected) sensory qualities.

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Appendix

Table 3: The results of 8 separate mixed-factorial ANOVAs, one for each of the dependent variables. As these were exploratory analyses, the Holm-Bonferroni multiple-comparison correction incorporated both the number of dependent variables and the number of separate comparisons for each ANOVA (maximum critical alpha was thus 0.05 / 8 x 15 = 0.00042, see Lakens, 2016). Significant factors and interactions less than this critical alpha have been suffixed with a plus-sign.

	Factors	df	F	Sig.	Critical alpha	Partial Eta Squared	
Aroma	Country of origin	2	4.230	0.015	0.001	0.027	
	Cup diameter	1	13.778	0.000	0.000	0.044	+
	Thickness of rim	1	2.447	0.119	0.001	0.008	
	Height of cup	1	45.734	0.000	0.000	0.132	+
	Diameter * Country	2	2.110	0.123	0.001	0.014	
	Thickness * Country	2	0.245	0.783	0.005	0.002	
	Height * Country	2	0.859	0.425	0.001	0.006	
	Diameter * Thickness	1	0.420	0.518	0.002	0.001	
	Diameter * Thickness * Country	2	0.146	0.864	0.007	0.001	
	Diameter * Height	1	0.146	0.703	0.004	0.000	
	Diameter * Height * Country	2	0.777	0.461	0.001	0.005	
	Thickness * Height	1	0.041	0.840	0.006	0.000	
	Thickness * Height * Country	2	1.667	0.191	0.001	0.011	
	Diameter * Thickness * Height	1	3.804	0.052	0.001	0.012	
	Diameter * Thickness * Height * Country	2	0.206	0.814	0.005	0.001	
Bitter	Country of origin	2	2.065	0.129	0.001	0.013	
	Cup diameter	1	137.560	0.000	0.000	0.313	+
	Thickness of rim	1	0.537	0.464	0.001	0.002	
	Height of cup	1	69.037	0.000	0.000	0.186	+
	Diameter * Country	2	1.414	0.245	0.001	0.009	
	Thickness * Country	2	5.012	0.007	0.001	0.032	
	Height * Country	2	0.011	0.989	0.050	0.000	
	Diameter * Thickness	1	0.045	0.833	0.006	0.000	
	Diameter * Thickness * Country	2	0.029	0.971	0.025	0.000	

	Diameter * Height	1	3.250	0.072	0.001	0.011	
	Diameter * Height * Country	2	1.991	0.138	0.001	0.013	
	Thickness * Height	1	0.019	0.891	0.008	0.000	
	Thickness * Height * Country	2	9.317	0.000	0.000	0.058	+
	Diameter * Thickness * Height	1	1.993	0.159	0.001	0.007	
	Diameter * Thickness * Height * Country	2	1.274	0.281	0.001	0.008	
Energy	Country of origin	2	7.421	0.001	0.000	0.047	
	Cup diameter	1	5.521	0.019	0.001	0.018	
	Thickness of rim	1	0.294	0.588	0.002	0.001	
	Height of cup	1	3.831	0.051	0.001	0.013	
	Diameter * Country	2	3.264	0.040	0.001	0.021	
	Thickness * Country	2	0.355	0.701	0.003	0.002	
	Height * Country	2	0.826	0.439	0.001	0.005	
	Diameter * Thickness	1	0.006	0.937	0.017	0.000	
	Diameter * Thickness * Country	2	2.571	0.078	0.001	0.017	
	Diameter * Height	1	11.905	0.001	0.000	0.038	
	Diameter * Height * Country	2	5.240	0.006	0.001	0.034	
	Thickness * Height	1	0.507	0.477	0.001	0.002	
	Thickness * Height * Country	2	0.364	0.695	0.003	0.002	
	Diameter * Thickness * Height	1	0.173	0.678	0.003	0.001	
	Diameter * Thickness * Height * Country	2	1.102	0.334	0.001	0.007	
Temp.	Country of origin	2	12.893	0.000	0.000	0.079	+
	Cup diameter	1	5.711	0.017	0.001	0.019	
	Thickness of rim	1	0.159	0.690	0.003	0.001	
	Height of cup	1	0.897	0.344	0.001	0.003	
	Diameter * Country	2	0.261	0.771	0.004	0.002	
	Thickness * Country	2	0.361	0.697	0.003	0.002	
	Height * Country	2	2.866	0.058	0.001	0.019	
	Diameter * Thickness	1	0.015	0.903	0.010	0.000	
	Diameter * Thickness * Country	2	0.943	0.390	0.001	0.006	
	Diameter * Height	1	1.507	0.221	0.001	0.005	
	Diameter * Height * Country	2	5.301	0.005	0.001	0.034	
	Thickness * Height	1	1.470	0.226	0.001	0.005	
	Thickness * Height * Country	2	1.296	0.275	0.001	0.009	
	Diameter * Thickness * Height	1	0.441	0.507	0.002	0.001	
	Diameter * Thickness * Height * Country	2	1.420	0.243	0.001	0.009	
Intensity	Country of origin	2	6.369	0.002	0.000	0.040	
	Cup diameter	1	110.671	0.000	0.000	0.268	+
	Thickness of rim	1	6.276	0.013	0.001	0.020	

	Height of cup	1	81.507	0.000	0.000	0.213	+
	Diameter * Country	2	2.987	0.052	0.001	0.019	
	Thickness * Country	2	0.699	0.498	0.002	0.005	
	Height * Country	2	0.742	0.477	0.001	0.005	
	Diameter * Thickness	1	4.662	0.032	0.001	0.015	
	Diameter * Thickness * Country	2	0.914	0.402	0.001	0.006	
	Diameter * Height	1	2.589	0.109	0.001	0.008	
	Diameter * Height * Country	2	3.966	0.020	0.001	0.026	
	Thickness * Height	1	4.021	0.046	0.001	0.013	
	Thickness * Height * Country	2	0.996	0.370	0.001	0.007	
	Diameter * Thickness * Height	1	0.287	0.593	0.002	0.001	
	Diameter * Thickness * Height * Country	2	1.281	0.279	0.001	0.008	
Liking	Country of origin	2	2.900	0.057	0.001	0.019	
	Cup diameter	1	6.078	0.014	0.001	0.020	
	Thickness of rim	1	2.178	0.141	0.001	0.007	
	Height of cup	1	11.844	0.001	0.000	0.038	
	Diameter * Country	2	5.335	0.005	0.001	0.034	
	Thickness * Country	2	0.683	0.506	0.002	0.005	
	Height * Country	2	9.896	0.000	0.000	0.062	+
	Diameter * Thickness	1	0.207	0.649	0.002	0.001	
	Diameter * Thickness * Country	2	0.393	0.675	0.003	0.003	
	Diameter * Height	1	1.587	0.209	0.001	0.005	
	Diameter * Height * Country	2	0.516	0.598	0.002	0.003	
	Thickness * Height	1	1.495	0.222	0.001	0.005	
	Thickness * Height * Country	2	0.919	0.400	0.001	0.006	
	Diameter * Thickness * Height	1	1.863	0.173	0.001	0.006	
	Diameter * Thickness * Height * Country	2	0.662	0.517	0.002	0.004	
Money	Country of origin	2	6.963	0.001	0.000	0.044	
	Cup diameter	1	90.621	0.000	0.000	0.231	+
	Thickness of rim	1	0.274	0.601	0.002	0.001	
	Height of cup	1	66.102	0.000	0.000	0.180	+
	Diameter * Country	2	28.706	0.000	0.000	0.160	+
	Thickness * Country	2	1.326	0.267	0.001	0.009	
	Height * Country	2	20.040	0.000	0.000	0.117	+
	Diameter * Thickness	1	0.707	0.401	0.001	0.002	
	Diameter * Thickness * Country	2	0.132	0.877	0.007	0.001	
	Diameter * Height	1	12.828	0.000	0.000	0.041	+
	Diameter * Height * Country	2	2.620	0.074	0.001	0.017	
	Thickness * Height	1	2.317	0.129	0.001	0.008	
	Thickness * Height * Country	2	0.668	0.514	0.002	0.004	

	Diameter * Thickness * Height	1	5.390	0.021	0.001	0.018	
	Diameter * Thickness * Height * Country	2	1.859	0.158	0.001	0.012	
Sweet	Country of origin	2	6.348	0.002	0.001	0.040	
	Cup diameter	1	33.552	0.000	0.000	0.100	+
	Thickness of rim	1	0.470	0.493	0.002	0.002	
	Height of cup	1	2.457	0.118	0.001	0.008	
	Diameter * Country	2	6.715	0.001	0.000	0.043	
	Thickness * Country	2	0.551	0.577	0.002	0.004	
	Height * Country	2	4.568	0.011	0.001	0.029	
	Diameter * Thickness	1	2.325	0.128	0.001	0.008	
	Diameter * Thickness * Country	2	1.985	0.139	0.001	0.013	
	Diameter * Height	1	7.687	0.006	0.001	0.025	
	Diameter * Height * Country	2	4.289	0.015	0.001	0.028	
	Thickness * Height	1	3.707	0.055	0.001	0.012	
	Thickness * Height * Country	2	0.095	0.910	0.013	0.001	
	Diameter * Thickness * Height	1	2.380	0.124	0.001	0.008	
	Diameter * Thickness * Height * Country	2	0.755	0.471	0.001	0.005	

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Highlights

- Shape-taste expectations elicited by pictures of mugs were examined.
- The relevant research about crossmodal associations is highlighted and reviewed.
- The width and height of the mugs was shown to be important.
- Findings highlight the complex nature of shape-flavour interactions.