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Aesthetic plating: a preference for oblique lines ascending to the right

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Abstract

Background: We report three online experiments designed to investigate how the visual presentation of a dish influences people's rating of exactly the same ingredients. For this, participants were visually presented with two dishes, each containing the same ingredients arranged in either a linear or circular presentation. The influence of different naming strategies on people's expectations concerning the dish was also assessed, as well as people's preferred position of the tested linear vs. circular food arrangement.

Results: The results highlight the importance of both visual presentation and naming on people's response (e.g. in terms of their willingness to pay) for a commercial dish. That is, participants' ratings favoured the linear over the circular arrangement of the same ingredients. Furthermore, the participants tilted the linear dish, when asked to position it such that it appeals to them most, such that the dominant element displayed an oblique line ascending to the right.

Conclusions: The results reported here provide intriguing first evidence concerning a putative preference for an oblique line ascending to the right with respect to the appreciation of the food on a plate. The implications of this kind of research for chefs and restaurateurs are discussed. We also contrast these preliminary results with findings demonstrating people's preference for horizontal/vertical lines (over oblique lines) in other aesthetic-related fields, such as painting.

Keywords: Plating, Visual presentation, Naming, Oblique line, Orientation

Background

Over the last 5 years or so, there has been a rapid growth of interest from sensory scientists, psychologists and food industry professionals concerning the influence of the visual presentation of the food on the plate and how people rate and respond to it (see [7, 24], for reviews). The research that has been published to date converges on the conclusion that people will often give different ratings to one and the same set of ingredients as a function of how they are plated. That is, the way in which a dish is plated can exert a significant influence over people's appreciation of the food. Research in this area is now being conducted in both the science laboratory and restaurant setting, but also, increasingly, online as well (see [17, 24, 28]). Furthermore, there is hope amongst some researchers at least that the principles governing the aesthetic appreciation of the visual arts could be applied to transform the art of plating into more of a

science than is currently the case (see [7, 24], for reviews; see also [31]).

This approach/philosophy has been captured by a couple of recent studies, conducted both in the laboratory and in a hotel restaurant, showing that people are willing to pay significantly more for a salad plated in a manner inspired by one of Kandinsky's paintings than when served as a regular tossed salad (see [15, 16]). Of course, there are marked individual differences in people's appreciation of different forms of art. It would thus be interesting to determine whether, for instance, a person's liking for Kandinsky's oeuvre would influence their rating of a dish (such as a plate of salad) that had been inspired by the artist's work (see [15, 16]). In short, there are many outstanding questions in this area that are worthy of further research.

There is also a literature looking at the impact of how a dish is named on the responses of diners (see [23], for a review). So, for example, in one classic study, Wansink et al. [29] served a range of savoury main courses that had been given either a basic name, or else a more descriptive food label (e.g. 'Seafood Filet' vs. 'Succulent

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Italian Seafood Filet', 'Chicken Parmesan' vs. 'Homestyle Chicken Parmesan', or 'Chocolate Pudding' vs. 'Satin Chocolate Pudding'). The intriguing result to emerge from this study was that the use of descriptive food labels led to a doubling in the number of positive comments that the dishes attracted, as compared to when the more basic food labels were used instead.

More recently, however, the results of a study by Mielby and Bom Frøst [18, 19] have revealed that the story regarding the influence of food naming on the perception of a dish may be rather more complicated than suggested by a simple reading of Wansink et al.'s [29] research. In particular, these researchers worked with one of the sous-chefs at Noma, then one of the world's top restaurants (<http://noma.dk/>). An 11-course tasting menu was specially created and served to the diners. Each of the dishes was given one of four names. Once again, the results revealed that the diner's experience of the dishes was affected by the semantic information that was provided about the food that they tasted. As such, there may be no simple answer to the question of how changing the name of a dish will influence a diner's response to it. For example, one dish, a Brie parfait rolled in rye bread crumble and a rhubarb sherbet could either be described to the diners in a hedonically evocative manner as: *'Cheese and rhubarb. A delicious and creamy parfait is united with a refreshingly and cooling ice cream of rhubarb which assembles in the mouth in pure enjoyment'*, or, in order to emphasize the culinary process, as: *'Cheese and rhubarb: this dish was frozen at a very low temperature (-22°F [-30°C]) and the ice crystals were comminuted using a Pacojet'*, or to highlight the experience, as: *'Cheese and rhubarb. Parfait of cheese and sorbet of rhubarb in another texture.'* Intriguingly, those diners who received the hedonically evocative food description (the first food description listed above) liked the dish less. Now, while these recent results make the drawing of any simple conclusions regarding what kind of name is best for a given kind of food difficult, the main point still remains that very often people's perception of, and response to, a given dish can be dramatically altered simply by changing the name/description that it is given. In other words, it can be argued that the naming of a dish is far too important a decision to be left to whim or chance.

Thus, on the basis of the research that has been published over the last decade or so, it would seem clear that both the visual arrangement of the elements on the plate, and the way in which that dish is described to the diner, can impact on how much they enjoy the food. Somewhat surprisingly, however, these two factors, which are simultaneously at play whenever a chef creates a new dish, have never been studied at one and the same time. The research outlined here will therefore hopefully

act as a prompt to further discussion concerning how these two factors interact when it comes to influencing the likely response of the diner to a dish. In a preliminary study, conducted online on a food website (<http://www.kitchentheory.com>), people's expectations given variations in both the visual presentation and the naming of the dish were assessed. In a second study, we went on to replicate the basic finding with a much larger fully counterbalanced sample of online participants. Finally, in a third experiment, we demonstrate that people favour a tilted orientation for the food on the plate in front of them thus putatively demonstrating 'a preference for an oblique line ascending to the right' in plating. This preference (in plating) should it hold up in subsequent plating studies could then be contrasted with the preference for the horizontal/vertical that has been repeatedly demonstrated when people evaluate, or select, works of art in painting (see [11, 12]).

Experiment 1

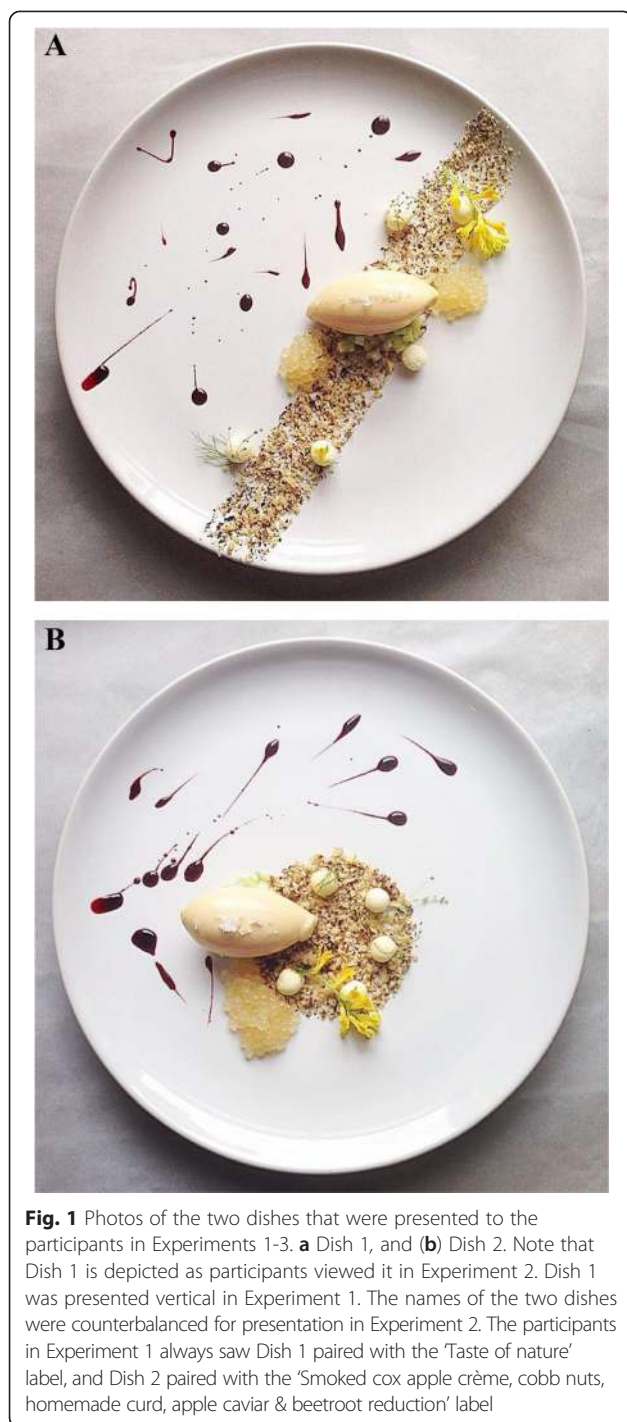
Methods

Participants

Through a food-related website (<http://www.kitchentheory.com/>), 153 participants were recruited to take part in an online study. The studies reported here were reviewed and approved by the Central University Research Ethics Committee (CUREC) of the University of Oxford. The data collection was conducted in accordance with the Declaration of Helsinki, and informed consent was obtained from all of the participants in both offline and online settings. Ten of the participants were excluded from the subsequent data analyses (one because she was an experimenter, and another nine because they failed to answer all of the questions). This left a final sample of 143 participants whose data were analysed. The majority of the participants tested in Experiment 1 were European. If they so wished, the participants provided their e-mail addresses to be entered into a draw for a complimentary table for two at Náttúra by Kitchen Theory as a reward for their participation in the study. Given the content of the website on which this survey was advertised, it is possible that many of those who took part would have had more than a passing interest in all things gastronomic.

Materials and procedure

The participants were presented with pictures of the two different dishes entitled *'Dish 1: Taste of nature'*, and *'Dish 2: Smoked cox apple crème, cobb nuts, homemade curd, apple caviar & beetroot reduction'* (see Fig. 1 and Appendix 1 for the chef's preparation sheet and the concept behind the dish). The photos were presented together on the same web page, with Dish 2 arranged below Dish 1 for 83 of the participants, and the



vertical position of the two dishes reversed for the remainder of them. The participants rated each of the dishes on 5-point scales with respect to (1) how appetizing and (2) how artistic the dish looked. The participants were then asked (3) 'What taste/flavour they would expect the dish to have?', and (4) 'How much would they be willing to pay for each of the dishes?' Responses to questions (1) and (2) were given

on 5-point rating scales ranging from 1 (Not at all) to 5 (Very). The rating scale anchors for question (3) were 1 (Sweet) and 5 (Savoury). Once they had responded to these questions, the participants were asked to provide their name and country of residence.

Results and discussion

Data analysis and results

Normality tests conducted during data exploration proved significant. Hence, for each of the four responses (i.e. (1) appetizing, (2) artistic, (3) taste and (4) price), Wilcoxon signed ranks tests were conducted in order to compare the ratings associated with each dish. Analysis of the results indicated that participants rated Dish 1 ($Mdn = 4$) as looking about as appetizing as Dish 2 ($Mdn = 4$; $z = 1.92$; $p = .054$; $r = .033$). However, the participants rated Dish 1 ($Mdn = 4$) as looking significantly more artistic than Dish 2 ($Mdn = 3$; $z = 8.15$; $p < .001$; $r = .089$). Furthermore, they also expected Dish 1 ($Mdn = 3$) to taste significantly more savoury than Dish 2 ($Mdn = 2$; $z = 3.54$; $p < .001$; $r = .107$). Finally, no significant difference was observed in terms of the amount of money that the participants would have been willing to pay for Dish 1 ($Mdn = 12$) GBP, as compared to Dish 2 ($Mdn = 12$ GBP, $z = 1.49$; $p = .135$; $r = .847$).

The results of Experiment 1 demonstrate that the arrangement of the food on the plate drives the diner's expectation with regard to its taste (Fairhurst et al., 2015). Furthermore, the visual presentation of the food on the plate interacts with the name that is given to a commercially produced dish to influence people's appreciation of the food on the plate. A large body of empirical research has already shown that such expectations can, in turn, potentially anchor a diner's (or consumer's) subsequent flavour responses/experiences (see [21], for a recent review). The results of Experiment 1 therefore add to a growing body of empirical research highlighting the importance of presentation with respect to people's ratings of a plate of food. Importantly, and in contrast to a number of the early studies in this area,¹ we used one of the dishes that had recently served as part of a pop-up dining experience in a London restaurant.

It is, though, worth highlighting a couple of potential concerns with the design of our first study. First, the names that were given to the dishes were not counterbalanced across participants. Hence, it is impossible to discern whether it was the differing visual presentation of the food that gave rise to the difference, the name and/or the written description of the dish as it appeared on the screen, or some combination or interaction, of these factors. Indeed, as we saw in the 'Background,' a separate literature has already documented the significant effect that the name of the food can have on

people’s responses to both food and drinks products (e.g. see [13, 29]; see [23], for a review).

The research that has been published to date shows that those foods that have been given a descriptive label are preferred, or at least more positive comments are made about them (see [29]). However, the research also shows that providing too much information about the preparatory process associated with creating a dish (at least a modernist dish) can result in the dish attracting lower ratings [18, 19]. Given this prior research, it is interesting to note how giving the dish the more descriptive label resulted in lower ratings in Experiment 1, seemingly contrasting with the results of Wansink et al.’s [29] previous study.

Experiment 2

Experiment 2 was designed to try and replicate the results of our first experiment while at the same time ascertaining what role, if any, the names given to the two dishes had on the participants’ expectations concerning the food, and how much they would be willing to pay for it.

Methods

Participants

Through Amazon’s Mechanical Turk, 547 participants were recruited to take part and were paid 75 cents for so doing (USD). Participants provided informed consent and the experiment was reviewed and approved by CUREC, University of Oxford. The average time taken to complete the study was 108 s (SD = 70). The data from 16 of the participants was excluded from the subsequent data analyses because of incomplete datasets. Furthermore, we applied the *z* score >3 rule [22] in order to exclude those participants who appeared to take too little or too much time to complete the study, a procedure that resulted in the exclusion of a further 10 participants. Therefore, the final analysed sample consisted of 521 participants.

Materials and procedure

The materials and procedure were very similar to those used in Experiment 1. Here, we only highlight the differences. Experiment 2 was conducted using the Xperiment platform (www.xperiment.mobi). The experiment consisted of two trials, one for each of Dishes 1 and 2, with their order of presentation counterbalanced across participants. Because of preliminary results in our lab where this orientation seems to be chosen when people are asked to orient certain dishes into their preferred orientations, Dish 1 was now tilted 33° clockwise. The participants were presented with screens containing one dish at a time. Each trial started with the introduction of the forthcoming dish, by means of one of the two names utilized in the previous experiment: either ‘*Taste of nature*,

or ‘*Smoked cox apple crème, cobb nuts, homemade curd, apple caviar & beetroot reduction*’. When the space bar was pressed, this text disappeared and was replaced by the picture of the dish. The dish and the description were counterbalanced across participants. That is, two different groups of participants now viewed the two different dishes paired differently with one of the two names.

The participants were presented with 7-point scales under each photo to rate how appetizing and how artistic they thought each of the two dishes was. Furthermore, they also used the 7-point scales provided in order to estimate how sweet they thought each dish would be. These three scales were presented in a random order on each trial (after having made each rating, a button appeared, which upon pressing hid the current scale and revealed the next scale to be shown). After having completed their ratings, the participants were asked to provide the amount (in USD) that they would have been willing to pay for each of the two dishes that they were presented with.

Data analysis and results

The data were explored and tested for assumptions of homogeneity of variance, as well as sphericity. All of these tests proved non-significant. For each of the appetizing, artistic, taste and price-dependent measures, we used mixed analyses of variance (ANOVA) with Dish type (1 vs. 2) as the within-participants factor, and Name (‘Taste of nature vs. smoked cox apple crème, cobb nuts, homemade curd, apple caviar & beetroot reduction’), as the between-participants factor (see Table 1 for a summary of the results).

Importantly, the added power resulting from the large increase in the sample size in our second experiment indicated that the participants now rated Dish 1 as looking significantly more appetizing than Dish 2, as highlighted

Table 1 Means (M) with standard errors (SE) of the mean for all the ratings of the two dishes collected in Experiment 2

	Group 1		Group 2		Group 1		Group 2	
	Dish 1		Dish 2		Dish 1		Dish 2	
	M	SE	M	SE	M	SE	M	SE
Not at all/very appetizing rating	3.19	.11	3.11	.11	3.28	.11	3.09	.11
Not at all/very artistic rating	5.95	.08	5.73	.09	5.8	.08	5.93	.09
Sweet/savoury taste rating	3.87	.10	3.87	.10	3.98	.10	3.99	.10
Price estimation	9.32	.51	9.05	.50	9.72	.50	9.30	.50

Note that the participants in Group 1 always saw Dish 1 paired with the ‘Smoked cox apple crème cobb nuts, homemade curd, apple caviar & beetroot reduction’ label, whereas the Group 2 participants always saw the same dish paired with the ‘Taste of nature’ label. The participants in Group 1 always saw Dish 2 paired with the ‘Taste of nature’ label, while those in Group 2 saw the same dish paired with the ‘Smoked cox apple crème cobb nuts, homemade curd, apple caviar & beetroot reduction’ label instead

by the main effect of Dish type ($F(1,519) = 5.48, p = .020, \eta_p^2 = .020$). Furthermore, there was also an interaction between the artistic ratings and the name that had been given to the two dishes ($F(1519) = 10.21, p = .001, \eta_p^2 = .019$). Post hoc tests revealed no significant difference in artistic ratings between the two name groups (both $ps > .113$). Nevertheless, the significant interaction stems from Dish 1 being rated as significantly more artistic by those participants who saw it paired with the name ‘Smoked cox apple crème, cobb nuts, homemade curd, apple caviar & beetroot reduction’ ($t(258) = 2.71, p = .007, r = .570$). Despite the considerable effect size, the within-participants artistic ratings comparison for ‘Taste of nature’ just failed to reach statistical significance ($t(261) = 1.77, p = .079, r = .618$; see Fig. 2).

The results of Experiment 2 revealed no main effects or interaction between the manipulated variables with respect to the taste ratings (all ps n.s.), perhaps due to the fact that the participants were rating how sweet they thought that each dish would be. Lastly, and perhaps most importantly, the participants reported being willing to pay significantly more for Dish 1 ($M = 10.90$ USD, $SE = .48$) than for Dish 2 ($M = 10.14$ USD, $SE = .44$; $F(1,519) = 5.47, p = .020, \eta_p^2 = .010$).

In one last step of data analysis, we wanted to investigate whether we would find differences between the ratings and price estimation data between the participants in Experiment 1 who had been recruited from the Kitchen Theory specialized food website and those participants recruited on Amazon’s Mechanical Turk. Note that the orientation of the plate was different between

the two experiments (straight vertical orientation in Experiment 1 vs. tilted 33° to the right in Experiment 2). To be able to make this comparison, we only used one of the groups of participants from Experiment 2 (i.e. Group 2, namely those participants who saw Dish 1 paired with the ‘Smoked cox apple crème, cobb nuts, homemade curd and apple caviar’ name and Dish 2 paired with ‘The taste of nature’), exactly as the participants in Experiment 1. The data were normalized and consequently analysed with Mann-Whitney tests. The results highlighted significant differences between the two groups (all $ps < .001$), with the participants in Experiment 1 rating the two dishes as significantly more appetizing, and as looking more artistic. They also expected the food to taste sweeter. They also reported being willing to pay significantly more for both dishes, as compared to the participants in Experiment 2, Group 2 (see Table 2 for the normalized data utilized for this Experiment 1 vs. Experiment 2 comparison).

Discussion

The results of Experiment 2 indicate that the name given to a dish interacts with its visual aesthetics to exert a significant influence over how people rate the food on the plate and how much they estimate being willing to pay for it. At this stage, it is still unclear which orientation gave rise to the preference difference for the line-arranged dish used in Experiments 1 and 2. Therefore, in Experiment 3, we directly assessed whether the difference in orientation of Dish 1 between the first two experiments (straight vertical orientation in Experiment 1 vs. 33° in Experiment 2) would have had any influence on participants ratings. Relevant here, in a recent series of online plating experiments Michel et al. [17] demonstrated that tilting the food on the plate impacts participants’ liking and appreciation of food.

Experiment 3

Methods

Participants

One hundred individuals (35 female and 65 male) recruited from Amazon’s Mechanical Turk took part in return for a payment of 50 US cents. The participants ranged in age from 18 to 68 years ($M = 33.5$). Only those living in the United States of America, Canada and the United Kingdom were eligible to take part in the study. The participants took an average of 99 s ($SD = 39$) to complete the study. All of the participants provided informed consent prior to taking part. The experiment was reviewed and approved by CUREC, University of Oxford.

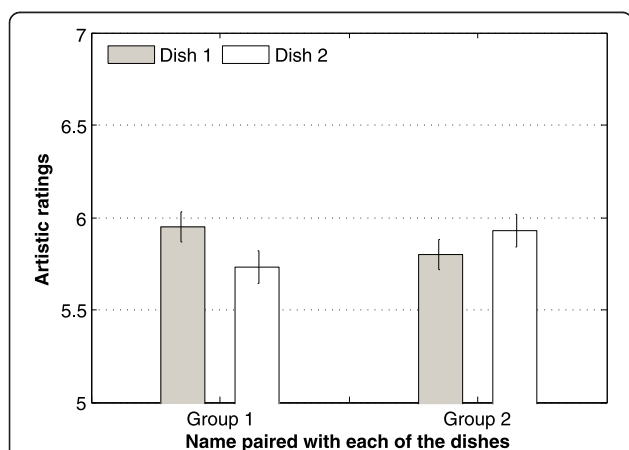


Fig. 2 Artistic ratings in Experiment 2. Note that the participants in Group 1 always saw Dish 1 paired with the ‘Smoked cox apple crème, cobb nuts, homemade curd, apple caviar & beetroot reduction’ label, whereas the participants in Group 2 always saw the same dish paired with the ‘Taste of nature’ label instead. The participants in Group 1 always saw Dish 2 paired with the ‘Taste of nature’ description, whereas those in Group 2 saw the same dish paired with the ‘Smoked cox apple crème cobb nuts, homemade curd, apple caviar & beetroot reduction’ label instead. The vertical error bars represent the standard error of the mean

Table 2 Median (Mdn), together with indicators of skewness (S) and kurtosis (K) for the normalized ratings of the two dishes collected in Experiment 1, as well as Experiment 2, Group 2 only

	Experiment 1						Experiment 2 (Group 2 only)					
	Dish 1			Dish 2			Dish 1			Dish 2		
	Mdn	S	K	Mdn	S	K	Mdn	S	K	Mdn	S	K
Not at all/very appetizing rating	.39	-.75	-.08	.49	-.24	-.82	-.21	.42	-.73	-.13	.54	-.69
Not at all/very artistic rating	-1.08	-1.24	1.71	-1.38	-1.24	-.26	.34	-1.33	1.68	.42	-1.69	2.77
Sweet/savoury taste rating	-.49	-1.01	-.94	-1.04	.31	-.94	.17	.08	-.84	.22	.07	-.89
Price estimation	.13	2.57	9.43	.22	2.62	13.12	-.31	1.65	3.79	-.32	1.66	3.98

Note that the data from this table refer to Dish 1 always paired with the 'Smoked cox apple crème cobb nuts, homemade curd, apple caviar & beetroot reduction' label, and Dish 2 always paired with the 'Taste of nature' label

Materials, design and procedure

The images of the plates of food used in Experiments 1 and 2 were once again presented in Experiment 3. The food was presented in the centre of each participant's display and could be rotated around its middle point by moving the cursor around the central position of the display. The degree of food rotation matched the degree of mouse rotation. The apparatus varied by participant. The experiment was conducted 'full screen' (i.e. utilizing the entirety of the participant's monitor), and took place within a 1024×768-pixel box in the centre of screen, irrespective of the size of the monitor. The experiment was conducted on the Internet using the Adobe Flash based Xperiment software (<http://www.xperiment.mobi>).

Procedure

At the start of each trial, a plate of food appeared in the centre of the display. It was fully rotated around 360° over a 2-s period before coming to a stop. This feature of the experimental design ensured that the participants got to see all of the orientations in which the plate could be aligned. The participants were instructed to rotate the food by moving the cursor around the centre of the image until it appeared most appealing. The initial orientation of the food was randomly selected for each participant in order to avoid any kind of anchoring effect that might have biased participants' responses had they initially been presented with the image of the food in the same initial orientation (which might have biased the results, e.g. [25]). To indicate that they were satisfied with the orientation of the dish, the participants were instructed to tap the space bar on the keyboard. All of the participants completed two trials, and afterward they were briefly debriefed as to the nature of the study.

Data analysis and results

The orientation data was analysed in *R* using the Circular package [1], a popular statistical package for the analysis of circular data (see [20], for an overview). Kuiper's Test of Uniformity was significant for both the Dish 1 plate $V = 201.20$, $p < .001$ and the Dish 2

plate $V = 165.02$, $p < .001$, thus suggesting that the data was not uniformly distributed. There was evidence that Dish 1 had a reflective symmetrical distribution ($p < .01$), while Dish 2 did not ($p = .35$; via an asymptotic theory-based test as outlined in [20], p. 87): As can be seen in Fig. 3, a cluster of data around 61° would appear to be mirrored for Dish 1, at least to a certain extent, by a smaller cluster at 241°. Descriptively, the bias-corrected mean orientation at which Dish 1 was orientated by all participants was 61.14°, with 95 % confidence intervals spanning from 44.49° to 77.79°. The concentration of the data, or bias-corrected mean resultant length, was $\rho = .40$ (CI, .26, .53; this range of values does not include zero, thus suggesting that the data was not uniformly distributed). For Dish 2, the mean orientation was 13.02, with confidence intervals of -1.99 and 28.02, while the data concentration was $\rho = .46$ (CI, .34, .58).

Discussion

The results of Experiment 3 indicate a consistent preference toward the linear dish being rotated so that the line ascended to the right. No such clear preference for a specific orientation was obtained for the round presentation.

A large body of empirical research has shown that people find it is easier to perceive horizontal and vertical lines, as compared to their oblique counterparts (e.g. [2, 6]). Interestingly, Latto et al. [11] have also shown that people prefer horizontal/vertical lines over oblique lines in a selection of Mondrian's paintings, an artist famous for his use of high contrast horizontal and vertical lines. Relevant to any consideration of the impact of the frame on preference, a number of this artist's paintings come in a lozenge, or diamond-shaped, format (that is, they have an oblique rather than a rectangular frame). Each one of these paintings was presented to the participants rotated in each one of the eight possible orientations, separated by 45°. The participants rated their liking for each of the 64 images so created using a 7-point hedonic scale. The results



Fig. 3 Circular data plot and pink rose diagrams of the 100 plate orientations for each dish selected by participants in Experiment 3 (see [20]). The *surrounding line* shows a kernel density estimate (bandwidth of 40); this is a non-parametric estimate of the underlying density of the data (each *data-point* is in effect ‘blurred’ and so contributes to a range of points that make up the line; the more *data-points* at a given orientation, the greater the bulge of the *line*). For clarity and ease of interpretation, the food has been added to the figure and oriented by the mean orientation in which the food was placed by participants

revealed a small but significant preference for those pictures in which the lines were arranged horizontally and vertically (regardless of the orientation of the frame) over those where the lines in the painting were oriented obliquely instead. Subsequent analysis of the proportion of horizontal, vertical and oblique lines in 88 paintings from 20th century paintings in the Israel Museum in Jerusalem revealed, once again, a preference amongst artists, or those who select their work, for the horizontal and vertical over the oblique [12].

With reference to the more fundamental question of why it should be that people prefer lines that are vertical and horizontal, one suggestion is that people generally prefer those shapes and arrangements of shapes that they find easier to process (see [10, 30]). Note also that we have been exposed to more horizontal and vertical lines in the built environment [26], and so a familiarity account for this vertical/horizontal preference effect is also possible.

Furthermore, in the case of a stimulus, we are all very familiar with such as the human face, the liking/usage of horizontal/vertical as opposed to oblique lines allows for a more direct parallel to our round-plated dishes, as compared to the painting frames used in the arts: For example, square-shaped faces generally look more beautiful with rather flat eyebrows, whereas round faces will always need more oblique eyebrows. This principle is well-known amongst beauticians, as well as make-up artists who make use of similar lines when applying make-up ([5, 9]; see also e.g. <http://www.femininebeauty.info/eyebrow-aesthetics>; <http://www.allure.com/makeup-looks/2014/best-brows-for-your-face-shape>; <http://www.look-fabulous.com/work/eyebrow-shapes-to-suit-your-face/>).

General discussion

The present study was conducted with the general aim of investigating how the naming of food, as well as the arrangement of food on the plate would influence people’s preference for the food seen on the plate. In order to address this question, we conducted three experiments in which the participants had to evaluate two differently arranged plates of the same ingredients (Experiments 1 and 2), as well as to rotate a line-arranged (and circularly-arranged) dish to the subjective preferred visual orientation. The results of the three online experiments reported here demonstrated that (1) the plating of a dish makes a difference to the visual appreciation of the food on the plate, not only with regard to ratings of how appetizing, artistic or tasty it looks but also, importantly, with regard to how much a diner is willing to pay for it. At the same time, our results provide robust evidence that (2) the name given to a commercial dish interacts with its visual aesthetics and impacts on people’s ratings and price estimations. Lastly, our results demonstrate that (3) diners exhibit an orientation bias, such that in the present study, they preferred the dish to be oriented at about 61° from the dish vertical line (what appears to be a preference for a line ascending to the right).

These results need to be considered with respect to the line vs. circle-arrangement that the chef (from Kitchen Theory) created for the pop-up dining experience in London. The participants in the first two experiments exhibited a clear preference for the linear arrangement of the dish. Such findings could be interpreted in terms of novelty: We are, after all, more accustomed to circular arrangements of our food.

According to Hultén, Broweus and van Dijk (2009), more than half of all plates that are sold are round and white. When this fact is combined with work on visual aesthetics suggesting that the frame (or in this case, the rim of the plate) constrains the preferred structure of the elements within that frame, e.g. Arnheim [3] described the frame of the painting as a ‘structural skeleton,’ one might reasonably consider whether the rim of the plate serves much the same function—that is, of constraining how what falls within that particular ‘frame’ will be evaluated. As Arnheim ([4], p. 72) notes: *‘The most radical promoters of centric composition are the round enclosures—circular frames, disks, spherical volumes. Such fully symmetrical structures are entirely determined by their focus in the middle.’*

Similarly, the consistent preference for the line-arranged Dish 1 across ratings and sums the participants were willing to pay for the food, as well as across different groups of people in different experiments could also be explained in terms of visual saliency—that is, the plate environment in Dish 1 favours the optimal visualization of its central element (i.e. the salted piece of curd). Visual saliency here could also be enhanced by the presentation of Dish 1 in a linearly arranged manner, such that the participants could eventually have a better view of the ingredients and consequently believe that they might be getting more food for their money. Furthermore, as suggested by one of our reviewers, the linear arrangement might have given rise to the illusion that there was more food on the plate because of the larger physical spread of ingredients over the plate’s surface. Any such illusion that there was more food on the plate could, in turn, have resulted in less anxiety that there would not be enough food to satisfy one’s hunger, and hence, in elevated ratings of preference, such as reported in the present study. Of course, one also needs to take into consideration that this significant preference of Dish 1 over the more circular Dish 2 could also result from the fact that Dish 2 with its arrangement does not provide any meaningful spatial orientation cues. In this respect, the circular arrangement in Dish 2 could be taken as rather *static*, whereas the line-arrangement could be taken as somewhat more *dynamic*. This interpretation brings us to the next point:

The line-arrangement in Dish 1 is also the one that allows us to make claims about ‘the power of the oblique line ascending toward the right’. However, it should be borne in mind that this preference was only demonstrated with a single dish, so further replications with a range of other dishes containing a linear element would be appropriate before coming to too entrenched a conclusion concerning the preference for such a line. Just to consider our participants’ favourite orientation of Dish 1 as depicted on the left-hand side of Fig. 3. The line of

nuts on the plate could parallel a right hand trajectory, one of those we will perform everyday many times without even noticing them. However, the key aspect of Dish 1 seems to be the angle of the central piece of curd, they seem to be pointing in different directions.²

Furthermore, the different backgrounds of the participants in the various studies reported here should also be considered. The participants in Experiment 1 were recruited via the Kitchen Theory website and so were presumably especially interested in food as well as, perhaps, familiar with the chef’s food. On the other hand, the many participants in Experiment 2 were recruited from Mechanical Turk, and perhaps less likely to be as interested in food than those recruited for Experiment 1—indeed there are good arguments for Mechanical Turkers being more representative of the American public at large compared to individuals recruited from other platforms (this point is discussed in a recent review, see [28]). Note also that when comparing Experiment 1 ratings to those of Group 2 in Experiment 2, we find significantly elevated appreciation across all dependent measures for the participants in Experiment 1. Such a result could also reflect the fact that Experiment 1 was conducted in autumn, whereas Experiment 2 over spring, with the seasonality of the ingredients as a potential factor influencing the results [14].

Importantly, while people’s ratings of the food differed significantly between the two dishes shown in Experiment 1 (see Fig. 1), their responses highlighted the fact that they found Dish 1 to be much more appetizing than Dish 2 in our second experiment. Importantly, in Experiment 1, Dish 1 was rated as significantly more artistic-looking than Dish 2. Experiment 2 proves, however, that Dish 1 needs to be paired with the ‘Smoked cox apple crème, cobb nuts, homemade curd, apple caviar & beetroot reduction’ description for a similar result to be obtained. This finding results from a fully counterbalanced design of two names and two dishes and is in line with previous findings suggesting that detailed descriptions result in enhanced appreciation of the food (cf. [29]). As such, the present results provide the first empirical evidence to suggest that the naming/description of a dish can interact with the visual presentation in terms of influencing people’s expected appreciation of the specific plating of the food.

Conclusions

The experiments reported here indicate that the plating of a dish impacts the visual appreciation of the food on the plate. Furthermore, it appears that the name given to a dish can also interact with its visual presentation. Importantly, our results also provide preliminary

support for an aesthetic plating preference for oblique lines ascending to the right when viewing plates of food.

Endnotes

¹Note that these early studies tended to use fairly simplistic elements in the dishes that they had their participants evaluate (see [8, 32, 34]).

²The participants in Experiment 3 exhibited a visual aesthetic preference that clock manufacturers have been aware of for a long time: Specifically, they typically advertise their watches with the hands arranged at 10:10. This is apparently because of the symmetry, the arrangement is perceived happier (see http://www.answers.com/Q/Why_are_analog_clocks_set_to_show_the_time_as_10_minutes_past_10_when_they_are_on_display_in_stores see also <http://www.ubr.com/clocks/frequently-asked-questions-faq/clocks-and-time-faq-10-10-hand-positions.aspx>).

Appendix 1 Preparation sheet for the dish

Dish ingredients

For the cream:

- Seasonal British Cox apples
- Double cream
- Gelatine (bronze leaves)
- Natural smoke liquid
- Maldon salt

For the nut mix:

- Cobb nuts
- Walnuts
- Foraged wild fennel seeds
- Natural yeast (ground powder)
- Maldon salt
- Walnut oil

For the beetroot reduction:

- Beetroot juice

For the curd:

- Whole milk
- Double cream
- White wine vinegar
- Fine sea salt

For the apple caviar:

- Cox apple juice
- Sodium alginate

- Calcium gluconate
- Water

Additional elements:

- Fennel lightly candied (simple syrup)
- Foraged wild celery pickled (water/sugar/salt/white wine vinegar)
- Foraged herbs and flowers

Concept behind the dish

As the opening course to Kitchen Theory's 'Natura' menu, this dish was designed to reflect the spirit of the menu, which included seasonality, foraging, nature, use of traditional as well as modernist techniques. Seasonality was achieved by using ingredients including: apples, beetroot, cobb nuts, walnuts, wild celery and fennel that were in season. The nature aspect was represented on the plate by use of visual elements such as the reduced beetroot juice and the spherified apple juice (caviar). Both elements represent fertility and the beginnings of all life in nature. Foraged ingredients including wild fennel seeds, cobb nuts, wild celery as well as various wild herbs and flowers were all used in the dish. Traditional and modernist techniques were used as demonstrated by the homemade curd (traditional) and apple 'caviar' (modernist).

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

JY, GJ, LY, AW and CS all contributed to the conception and the design of the study, as well as the writing of this paper. Data collection was performed by LY, AW and GJ. Statistical analysis was performed by GJ and AW. All of the authors read and approved the final version of the manuscript.

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References

1. Agostinelli C, Lund U. R package 'circular': circular statistics (version 0.4-7). 2013. URL <https://r-forge.r-project.org/projects/circular/>.
2. Appelle S. Perception and discrimination as a function of orientation: the 'oblique effect' in man and animals. *Psychol Bull.* 1972;78:266–78.
3. Arnheim R. *Art and visual perception: a psychology of the creative eye.* Berkeley, CA: University of California Press; 1974.
4. Arnheim R. *The power of the center: a study of composition in the visual arts.* Berkeley, CA: University of California Press; 1988.
5. Aucoin K. *The art of makeup.* New York: Harper Collins; 1994.
6. Davidoff JB. An observation concerning the preferred perception of the visual horizontal and vertical. *Perception.* 1974;3:47–8.

7. Deroy O, Michel C, Piqueras-Fiszman B, Spence C. The plating manifesto (I): from decoration to creation. *Flavour*. 2014;3:6.
8. Deroy O, Spence C. Can you find the golden ratio in your plate? *Flavour*. 2014;3:5.
9. Fairhurst M, Pritchard D, Ospina D, Deroy O. Bouba-Kiki in the plate: Combining crossmodal correspondences to change flavour experience. *Flavour*; 2015;4:2.
10. Hultén B, Broweus N, van Dijk M. *Sensory Marketing*. Basingstoke: Palgrave Macmillan. 2009.
11. Jewel DL. *Making up by Rex*. New York: Clarkson Potter; 1986.
12. Latto R. The brain of the beholder. In: Gregory RL, Harris J, Heard P, Rose D, editors. *The artful eye*. Oxford, UK: Oxford University Press; 1995. p. 66–94.
13. Latto R, Brian D, Kelly B. An oblique effect in aesthetics: Homage to Mondrian (1872–1944). *Perception*. 2000;29:981–7.
14. Latto R, Russell-Duff K. An oblique effect in the selection of line orientation by twentieth century painters. *Empir Stud Arts*. 2002;20:49–60.
15. Lee L, Frederick S, Ariely D. Try it, you'll like it: The influence of expectation, consumption, and revelation on preferences for beer. *Psychol Sci*. 2006;17:1054–8.
16. Lightner M, Rand S. The enhancement of natural colors to provoke seasonality. *Int J Gastron Food Sci*. 2014;2:55–9.
17. Michel C, Velasco C, Fraemohs P, Spence C. Studying the impact of plating and cutlery on ratings of the food served in naturalistic dining contexts. *Appetite*. 2015;90:45–50.
18. Michel C, Velasco C, Gatti E, Spence C. A taste of Kandinsky: assessing the influence of the visual presentation of food on the diner's expectations and experiences. *Flavour*. 2014;3:7.
19. Michel C, Woods AT, Neuhäuser M, Landgraf A, Spence C. Orienting the plate: online study assesses the importance of the orientation in the plating of food. *Food Qual Prefer*. 2015;44:194–202.
20. Mielby LH, Bom Frøst M. Expectations and surprise in a molecular gastronomic meal. *Food Qual Prefer*. 2010;21:213–24.
21. Mielby LH, Bom Frøst M. Eating is believing. In: Vega C, Ubbink J, van der Linden E, editors. *The kitchen as laboratory: Reflections on the science of food and cooking*. New York, NY: Columbia University Press; 2012. p. 233–41.
22. Pewsey A, Neuhäuser M, Ruxton GD. *Circular statistics in R*. Oxford, UK: Oxford University Press; 2013.
23. Piqueras-Fizman B, Spence C. Sensory expectations based on product-extrinsic food cues: an interdisciplinary review of the empirical evidence and theoretical accounts. *Food Qual Prefer*. 2015;40:165–79.
24. Pukelsheim F. The three sigma rule. *Am Stat*. 1994;48(2):88–91.
25. Spence C, Piqueras-Fizman B. *The perfect meal: the multisensory science of food and dining*. Oxford, UK: Wiley-Blackwell; 2014.
26. Spence C, Piqueras-Fizman B, Michel C, Deroy O. Plating manifesto (II): the art and science of plating. *Flavour*. 2014;3:4.
27. Stewart N. The cost of anchoring on credit-card minimum repayments. *Psychol Sci*. 2009;20:39–41.
28. Switkes E, Mayer MJ, Sloan JA. Spatial frequency analysis of the visual environment: anisotropy and the carpentered environment hypothesis. *Vision Res*. 1978;18:1393–9.
29. Wansink B, Painter J, van Ittersum K. Descriptive menu labels' effect on sales. *Cornell Hotel Restaur Adm Q*. 2001;42:68–72.
30. Woods AT, Velasco V, Levitan CA, Wan X, Spence C. Conducting perception research over the Internet: A tutorial review. *PeerJ*. 3:e1058
31. Yeomans M, Chambers L, Blumenthal H, Blake A. The role of expectancy in sensory and hedonic evaluation: the case of smoked salmon ice-cream. *Food Qual Prefer*. 2008;19:565–73.
32. Zeki S. Art and the brain. *J Conscious Stud*. 1999;6:76–96.
33. Zellner DA. Effect of visual cues on sensory and hedonic evaluation of food. In: Hirsch A, editor. *Nutrition and chemosensation*. Boca Raton, FL: CRC Press; 2015. p. 159–74.
34. Zellner DA, Lankford M, Ambrose L, Locher P. Art on the plate: effect of balance and color on attractiveness of, willingness to try and liking for food. *Food Qual Prefer*. 2010;21:575–8.
35. Zellner DA, Siemers E, Teran V, Conroy R, Lankford M, Agrafiotis A, et al. Neatness counts. How plating affects liking for the taste of food. *Appetite*. 2011;57:642–8.

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