

Running Head: IMPACT OF THE PLATEWARE ON THE PERCEPTION OF FOOD

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**Influence of the color and size of the plate on the subjective ratings of,
taste expectations concerning, and willingness-to-pay for, Asian noodles**

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Abstract

3 Two experiments were designed to investigate the effect of plate color and plate size
4 on taste expectations, subjective ratings of, and willingness-to-pay for, Asian noodles
5 and Italian pastas. Chinese participants viewed photographs of these foods served on
6 plates of different colors and sizes, rated their liking, familiarity, taste expectations for
7 the foods, and indicated how much they would be willing to pay for them. The foods
8 were presented against the backdrop of store-bought or computer-edited colored
9 plates. Presenting the food on white plates resulted in the highest familiarity scores.
10 Interestingly, the participants were willing to pay approximately 16% more for the
11 same quantity of Asian noodles when served on smaller (rather than larger) plates.
12 Different patterns of results were observed with two types of Italian pasta that the
13 Chinese participants were less familiar with, suggesting a moderating role of the
14 familiarity people have with the foods.

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Practical Applications

17 The present study provides novel findings concerning the influence of plateware on
18 Asian noodles, a commonly-eaten food in many Asian countries. The findings suggest
19 a fundamental difference between the role of plateware in the subjective ratings of,
20 and taste expectations concerning, regularly consumed familiar and unfamiliar foods
21 as in the present study and the snack food in previous studies. These findings are
22 therefore relevant to those researchers and practitioners interested in how receptacle,
23 as an important contextual factor, influences consumers' perception and consumption

24 of foods. These findings also have direct implications for those serving food in
25 restaurants.

26 **Keywords:** Plateware; Color; Noodles; Plate size

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1. INTRODUCTION

Many studies have revealed that our consumption of food is influenced not only by its color (Piqueras-Fiszman and Spence 2014), but also by the color of various product-extrinsic stimuli, such as the container used to serve the food, the color of any packaging, or even the color of the ambient lighting. Even though Singh (2006) suggested that the color red stimulates the appetite, red plates have actually been shown to reduce the intake of unhealthy (e.g., snack) foods such as popcorn, chocolate chip, pretzels, and white bread (Bruno *et al.* 2013; Genschow *et al.* 2012; Reutner *et al.* 2015; see Spence, 2018, for a review).

Similarly, people's subjective ratings of the flavor of food are also influenced by the physical and sensory properties of the plateware/crockery used to serve the food, such as their color. For example, the same salty/sweet popcorn served in a blue bowl was rated as slightly, but significantly sweeter/saltier than those served on a white bowl, respectively (Harrar *et al.* 2011). Meanwhile, both strawberry mousse and a slice of cheesecake served on a white plate were rated as sweeter than when presented on a black plate instead (Piqueras-Fiszman *et al.* 2012; Stewart and Goss 2013). Elsewhere, it has been shown that people expect bean curd that is served on a red plate to be spicier than that served on a white plate (Tu *et al.* 2016). Intriguingly, such expectancy effects were shown to carry over to the tasting experience.

It might be difficult to draw any straightforward conclusions regarding whether the color of the container enhances consumers' subjective ratings of specific foods, or

49 whether instead the same result would be expected no matter what food happened to
50 be presented on a plate of a given color. It is also possible that different flavors/tastes
51 of the food might be subject to the influence of the containers/plateware in different
52 ways. As summarized above, most of the foods whose ratings have been shown to be
53 influenced by the receptacles are hedonically-positive, such as cakes and snack foods
54 (i.e., chocolate chip or popcorn). By contrast, it remains unknown as to whether
55 people's perception of those foods that are eaten regularly in daily life (and which
56 constitute a major part of the diet and energy supply), might be influenced by the
57 physical or sensorial properties of the containers in which they happen to be served.

58 Asian noodles constitute one such flour-based food with a huge market in China
59 (Liu 2014). Surprisingly, to date, there has been little psychological research on them.
60 Recently, people's subjective ratings of, and taste/flavor expectations concerning
61 Asian noodles have been shown to be influenced by the materials of the receptacles
62 that are used to present them (Zhou *et al.* 2015). Specifically, the ceramic receptacles
63 led to sweeter and less savory taste expectations concerning the food than the stainless
64 steel receptacles. Nevertheless, it should be noted when the materiality of the
65 receptacles changed from ceramic to stainless steel, the color of the receptacles also
66 changed from white to silver. Therefore, it remains unclear how people's expectations
67 concerning the sensory/hedonic qualities of noodles might be influenced by the color
68 of the receptacles in which they happen to be presented.

69 Therefore, we included Asian noodles as the experimental food stimuli in the
70 present study, and plates in a variety of different colors to present them on. In addition
71 to the color of the plates, the size of the plate was also manipulated in order to
72 examine the interaction between these two physical attributes of the crockery. It
73 should be noted that plate size has a substantial effect on the amount of food that is
74 both served and consumed (for a meta-analysis of 56 studies from 20 articles, see
75 Holden *et al.* 2016).

76 Three specific research questions were addressed in two experiments: First, does
77 the color of the plate influence people's taste expectations, subjective ratings of, and
78 willingness-to-pay for, Asian noodles? It seems reasonable to expect the influence of
79 the plate color on people's subjective ratings of Asian noodles; whereas it might be
80 less likely to observe an effect on people's taste expectations, because Asian noodles
81 are commonly consumed as the background food, onto which flavorful sauces are
82 added as foreground flavors. Second, how does the size of the plate interact with its
83 color to influence people's taste expectations, subjective ratings of, and
84 willingness-to-pay for, Asian noodles? It appears plausible to expect the influence of
85 the plate size on people's willingness-to-pay for Asian noodles; whereas neither the
86 color nor the size of the plates might be powerful enough to influence people's taste
87 expectations concerning typically flavorless food such as Asian noodles. And third,
88 we were also interested in comparing the results obtained with Asian noodles to those
89 seen with Italian pasta, which differ in shapes, textures, and familiarity that Chinese

participants have with, in terms of how their ratings might be influenced by the color and/or size of the plate used to serve them.

2. MATERIALS AND METHODS

2.1 Experiment 1: Test with store-bought colored plates

2.1.1 Participants

Eighty-two Chinese participants (mean age = 21.5 years, SD = 2.2, ranging from 18 to 27 years; 41 female) were recruited from the subject pool of the Applied Cognition Laboratory of Tsinghua University. All of the participants have normal color vision and normal/corrected-to-normal vision. The experiment was approved by the ethics committee of the Psychology Department of Tsinghua University, and conformed to the ethical standards for conducting research established by the American Psychological Association. Each participant was compensated with 20 Chinese Yuan (CNY, symbolized by ¥) for taking part.

2.1.2 Materials

All of the participants came to the Applied Cognition Laboratory of Tsinghua University to complete the task via www.qualtrics.com. Photos of Asian noodles (240 pixels wide \times 180 pixels high) were presented on 17-inch monitors with a resolution of 1024 \times 768 pixels, and a refresh rate of 60 Hz. The photos were viewed one at a time at a distance of approximately 50 cm in a white-lighted room (see Figure 1 for illustrations). The noodles were purchased from one of the dining halls of Tsinghua

University, and presented on the colored plates purchased from the local IKEA store in Beijing (www.ikea.cn). We chose four plate colors which are commonly seen in the local market, including white (H: 67°, S: 4%, B: 84%), blue (H: 191°, S: 36%, B: 76%), red (H: 15°, S: 70%, B: 76%), and beige (H: 60°, S: 33%, B: 76%). These plates also varied in size, half were large (27 cm in diameter) and the remainder were small (21 cm in diameter), both of which are commonly seen dimensions in the local market, and are shown in the left and right columns of Figure 1, respectively. When preparing the photos, approximately 50 g of Asian noodles were placed on the center of each plate. Photos were taken from exactly the same viewpoint and distance, and a total of eight photos (2 plate sizes × 4 plate colors) were used. The whole experiment lasted approximately 10 minutes.

INSERT FIGURE 1 ABOUT HERE

2.1.3 Design and procedure

In Experiment 1, we used a 4 (Plate Color: white, blue, red, or beige) × 2 (Plate Size: large or small) within-participants experimental design. The 8 photos of Asian noodles served on different plates were presented to the participants in a random order, with one photo shown on each page. When viewing each photo, the participants were asked to rate how familiar and pleasant the noodles looked, as well as how

congruent the noodles were with the plate on which they were presented, all on 7-point scales. They were also asked to rate how sweet and how savory they expected the noodles to taste on 7-point scales. The participants also specified how much (in CNY) they would be willing to pay for the noodles (to indicate their willingness-to-pay), with zero CNY suggesting no willingness to pay. Before the experiment ended, all of the participants were also asked about how often they consumed Asian noodles in their daily life (i.e., never, occasionally, sometimes, or often).

2.1.4 Data analysis

First, we performed 4 (Plate Color: white, blue, red, or beige) \times 2 (Plate Size: large or small) repeated-measure Multivariate Analysis of Variance (MANOVA) on the mean subjective rating scores given by all the participants, including the familiarity, pleasantness, and food-plate congruency scores. We then performed subsequent univariate Analyses of Variance (ANOVAs) on each type of scores. Next, we performed the Plate Color \times Plate Size repeated-measures MANOVA and subsequent univariate ANOVAs on the mean scores concerning the expected sweetness/savory taste of the noodles. After that, we performed the Plate Color \times Plate Size repeated-measures ANOVA on the willingness-to-pay data. In order to interpret significant interaction terms observed in the ANOVAs mentioned above, we

also performed pairwise comparisons. Note that in all of the reported tests, p values are reported after Bonferroni-correction for multiple comparisons.

2.2 Experiment 2: Test with computer-edited colored plates

2.2.1 Participants

One hundred and eight Chinese participants (mean age = 20.8 years, SD = 2.1, ranging from 18 to 27 years; 55 female) were recruited from the same subject pool as in Experiment 1. None of the participants had taken part in Experiment 1.

2.2.2 Materials

The materials used in Experiment 2 were similar to those in Experiment 1 with the following exceptions: First, as can be seen in Figure 2, photos of three types of foods, including Asian noodles (as in Experiment 1), and two types of Italian pasta, i.e., Fusilli pasta (Melissa brand, <http://www.melissa.gr/>), and Penne pasta (Barilla brand, <http://www.barilla.it/>) were shown to the participants. Second, in order to show exactly the same noodles on each and every plate, we took the photos when the food samples were presented on grey plates (diameter in 20 or 26 cm), and then modified the colors of the plates to appear white (H: 55°, S: 19%, B: 95%), red (H: 356°, S: 99%, B: 81%), blue (H: 218°, S: 42%, B: 55%), or green (H: 124°, S: 79%, B: 63%) via Adobe Photoshop CC software (see Figure 3). It should be noted that we presented green as one of the plate colors in Experiment 2, but not the beige color as

in Experiment 1, as we did not observe any significant difference between the beige plate and any of the other plate colors in Experiment 1 (see the Results and Discussions section below for details). Therefore, a total of 24 images (4 plate colors \times 2 plate sizes \times 3 types of foods) were presented to the participants in Experiment 2.

 INSERT FIGURES 2 & 3 ABOUT HERE

2.2.3 Design and procedure

In Experiment 2, we used a 4 (Plate Color: white, red, blue, or green) \times 2 (Plate Size: large or small) \times 3 (Food Type: Asian noodle, Fusilli pasta, or Penne pasta) within-participants experimental design. The procedure of Experiment 2 was similar to that of Experiment 1 except for that Experiment 2 was completed online via www.unipark.de. The whole experiment lasted approximately 30 minutes.

2.2.4 Data analysis

First, we performed 4 (Plate Color: white, red, blue, or green) \times 2 (Plate Size: large or small) \times 3 (Food Type: Asian noodle, Fusilli pasta, or Penne pasta) repeated-measures MANOVA and subsequent univariate ANOVAs on the mean scores of subjective ratings, including the familiarity, pleasantness, and food-plate congruency scores. Next, we also performed the Plate Color \times Plate Size \times Food Type repeated-measures MANOVA and subsequent univariate ANOVAs on the mean

scores concerning the expected sweetness/savory taste of the foods. After that, we performed the Plate Color \times Plate Size \times Food Type repeated-measures ANOVA on the willingness-to-pay data. Similar to Experiment 1, we also performed pairwise comparisons with Bonferroni corrections to interpret significant interaction terms observed in the ANOVAs mentioned above.

3. RESULTS AND DISCUSSIONS

3.1 Experiment 1: Test with store-bought colored plates

3.1.1 Results

The influence of plate color and size on subjective ratings of food

Mean rating scores of familiarity, pleasantness, and food-plate congruency in Experiment 1 are shown in Figure 4. The results of 4 (Plate Color: white, blue, red, or beige) \times 2 (Plate Size: large or small) repeated-measure MANOVA on familiarity, pleasantness, and food-plate congruency revealed a significant main effect of Plate Color, $\lambda = 0.84$, $F(9, 587) = 4.77$, $p < .001$, $\eta_p^2 = 0.06$, and Plate Size, $\lambda = 0.57$, $F(3, 79) = 19.96$, $p < 0.001$, $\eta_p^2 = .43$, but no significant interaction term, $\lambda = 0.97$, $F(9, 587) = 0.87$, $p = 0.56$. Subsequent univariate ANOVAs revealed a significant main effect of Plate Color on all three scores, all $F_s > 3.30$, $ps < 0.021$. Post-hoc pairwise comparisons revealed that the participants rated the noodles served on the white plate as looking the most familiar, all $ts > 2.79$, $ps < 0.039$; whereas the blue plate (3.2) was considered less congruent with the noodles than either the red (3.8) or white (4.1) plates, both $ts > 3.10$, $ps < 0.016$. None of other pairwise comparisons reached significance on any of the scores, all $ts < 2.68$, $ps > 0.05$. The ANOVAs also revealed

a significant main effect of Plate Size on all three scores, all $F_s > 39.01$, $p_s < 0.001$, $\eta_p^2 > 0.32$. These results therefore suggest that the Asian noodles served on the small plates were rated as more familiar (4.6 vs. 4.1), more pleasant (4.0 vs. 3.3), and more congruent with the container (4.1 vs. 3.3) than those served on the large plates. There was no interaction between Plate Color and Plate Size, all $F_s < 1.17$, $p_s > 0.32$.

INSERT FIGURE 4 ABOUT HERE

The influence of plate color and size on taste expectations

Mean scores concerning the expected sweetness/savory taste of the noodles are shown in Figure 5. The results of Plate Color \times Plate Size repeated-measures MANOVA on these scores did not reveal any significant main effects or an interaction, all $\lambda_s < 0.99$, $F_s < 2.50$, $p_s > 0.09$. What is more, subsequent univariate ANOVAs failed to reveal any significant main or interaction effects either, all $F_s < 3.26$, $p_s > 0.07$.

INSERT FIGURE 5 ABOUT HERE

The influence of plate color and size on the willingness-to-pay for food

When the willingness-to-pay data were analyzed, the results of three participants were excluded from the data analyses because their willingness-to-pay scores were beyond two standard deviations from the group mean. The means of the remaining data are also displayed in Figure 5. The results of a Plate Color \times Plate Size repeated-measures ANOVA revealed a significant main effect of Plate Color, $F(3, 234) = 4.45$, $p < 0.01$, $\eta_p^2 = 0.05$. Post-hoc pairwise comparisons revealed that the participants were not willing to pay as much for the noodles when served on the blue plates (¥ 4.2) as compared to when they were served on the red (¥ 4.9) or white (¥ 5.0) plates instead, both $t_s > 3.08$, $p_s < 0.02$. None of other pairwise comparisons reached significance, all $t_s < 1.84$, $p_s > 0.42$. The results also revealed a significant main effect of Plate Size, $F(1, 78) = 23.79$, $p < 0.001$, $\eta_p^2 = 0.23$, whereas the Plate Color \times Plate Size interaction effect was, once again, not significant, $F(3, 234) < 1$. These results suggest that the participants were willing to pay significantly more for the same quantity of noodles when they were served on small plates (¥ 5.0) than when they were served on large plates (¥ 4.3).

Last, but by no means least, all of the participants reported that they had eaten Asian noodles, and they occasionally (25.6%), sometimes (43.9%), and often (30.5%) ate Asian noodles in daily life.

3.1.2 Discussion

The results of Experiment 1 revealed that the participants considered the blue plate to be less congruent with the noodles and were willing to pay less, as compared to when the same noodles were served on the red or white plates instead. The results obtained with Asian noodles are consistent with previous findings showing that consumers are willing to pay more for a glass of an alcoholic drink when the receptacle to serve it was considered to be congruent than when it was incongruent (Wan *et al.* 2015). Another result to emerge from the present study was that serving the noodles on the small plates resulted in their receiving higher familiarity, pleasantness, and congruency scores than those served on the large plates. What is more, the participants were willing to pay significantly (approximately 16%) more for the same quantity of noodles when they were served on the small plates than on the large plates instead, presumably because small plates might lead the participants to overestimate the amount of food (when compared to large plates) due to the well-known Delboeuf illusion (e.g., McClain *et al.* 2014).

On the other hand, neither the color nor the size of the plates influenced participants' expectations concerning the taste of the noodles. The absence of such an effect might result from the participants' everyday experience with Asian noodles, considering that all of the participants in the present study have (occasionally, sometimes, or often) eaten such food in their daily life. That is, Asian noodles are typically relatively tasteless and are often eaten only after being mixed with some kind of flavorful accompaniment (e.g., sauce). Note that the noodles presented in

Experiment 1 were shown by themselves without being adulterated by any sauces. Consequently, the color or size of the plate did not influence the expectations concerning the taste of the noodles. It is possible that the background plate color might accentuate the expected taste of a familiar food that already has a taste/flavor, such as the spicy bean curd in Tu et al.'s (2016) recent study, but cannot create an expectation of taste in a very bland food product.

In Experiment 2, we attempted to replicate these results, while also assessing the impact of plate size/color on another kind of food that were likely to be less familiar to our participants (specifically, we showed pictures of different types of Italian pasta) in order to determine whether familiarity with the food also mattered. Specifically, we chose two types of Italian pasta that are available in local supermarkets or restaurants to our participants, Fusilli and Penne pasta. They differ in both shape and texture from Asian noodles.

3.2 Experiment 2: Test with computer-edited colored plates

3.2.1 Results

The influence of plate color and size on subjective ratings of food

Mean familiarity, pleasantness, and food-plate congruency rating scores are shown in Figure 6. The 4 (Plate Color: white, red, blue, or green) \times 2 (Plate Size: large or small) \times 3 (Food Type: Asian noodle, Fusilli pasta, or Penne pasta) repeated-measures MANOVA revealed significant main effects of Plate Size, Plate

Color, and Food Type, all $\lambda > 0.66$, $F_s > 15.09$, $p_s < 0.001$, $\eta_p^2 > 0.12$. The results also revealed a significant two-way interaction between Plate Size and Food Type, $\lambda = 0.90$, $F(6, 424) = 3.87$, $p < 0.001$, $\eta_p^2 = 0.052$, and between Plate Color and Food Type, $\lambda = 0.94$, $F(18, 1811) = 2.23$, $p = 0.002$, $\eta_p^2 = 0.020$. Neither of the other interaction effects was significant, both $F_s < 1.44$, $p_s > 0.16$.

 INSERT FIGURE 6 ABOUT HERE

Subsequent univariate ANOVAs revealed significant main effects of Plate Color on all three ratings, all $F_s > 10.46$, $p_s < 0.001$, $\eta_p^2 > 0.09$, though the main effect on congruency ratings was qualified by a significant interaction between Plate Color and Food Type, $F(6, 642) = 2.91$, $p < 0.01$, $\eta_p^2 = 0.026$, whereas the interaction terms between Plate Color and Food Type were not significant, both $F_s < 1.89$, $p_s > 0.08$. As for familiarity and pleasantness scores, post-hoc pairwise comparisons revealed that the foods presented on the white plates were considered to be the most familiar, all $t_s > 3.92$, $p_s < 0.001$, and were rated as looking more pleasant than those served on the red or green plates, both $t_s > 3.76$, $p_s < 0.002$. As for the food-plate congruency scores (see Table 1 for statistics), Asian noodles and Penne pasta were considered most congruent with white plates as compared to any of the other three colors; and they were rated as more congruent with blue plates than with the red or green plates as well. Fusilli pasta was considered more congruent with white plates than with red

or green plates, while it was also judged more congruent with the blue plates than with the red plates. Neither of the other pairwise comparisons reached significance.

 INSERT TABLE 1 ABOUT HERE

The ANOVAs also revealed significant main effects of Plate Size on all three rating scores, all $F_s > 23.74$, $p_s < 0.001$, $\eta_p^2 > 0.18$. These results therefore suggest that the foods served on the small plates were rated as more familiar (4.2 vs. 3.9), more pleasant (3.6 vs. 3.3), and, what is more, gave rise to higher food-plate congruency scores (3.5 vs. 3.2) than those foods served on the large plates. That being said, these main effects were qualified by the Plate Size and Food Type interaction terms, all $F_s > 3.83$, $p_s < 0.05$, $\eta_p^2 > 0.03$. As summarized in Table 2, pairwise comparisons revealed that both Asian noodles and Fusilli pasta were rated as being more familiar, pleasant, and congruent with the small plates than with the large ones; whereas no such patterns were observed with Penne pasta.

 INSERT TABLE 2 ABOUT HERE

What is more, the ANOVAs also revealed a significant main effect of Food Type on familiarity scores, $F(2, 214) = 46.2$, $p < 0.001$, $\eta_p^2 = 0.30$. Unsurprisingly,

post-hoc comparisons revealed that the Chinese participants tested in the present study rated themselves as more familiar with Asian noodles than with the two types of Italian pastas, both $t_s > 7.72$, $ps < 0.001$, whereas Fusilli pasta and Penne pasta received comparable familiarity scores, $t(107) = 1.30$, $p = 0.59$. None of the other main or interaction effects were significant, all $F_s < 2.56$, $ps > 0.05$.

The influence of plate color and size on taste expectations

Mean scores concerning the expected sweet and savory taste of the food are shown in Figure 7. The Plate Size \times Plate Color \times Food Type repeated-measures MANOVA revealed a significant main effect of Plate Size, $\lambda = 0.93$, $F(2, 106) = 3.98$, $p = .022$, $\eta_p^2 = 0.070$, of Plate Color, $\lambda = 0.95$, $F(6, 640) = 2.77$, $p = 0.012$, $\eta_p^2 = 0.025$, and of Food Type, $\lambda = 0.88$, $F(4, 426) = 7.07$, $p < 0.001$, $\eta_p^2 = 0.062$. None of the interaction terms was significant, all $F_s < 1.44$, $ps > 0.22$.

 INSERT FIGURE 7 ABOUT HERE

Subsequent univariate ANOVAs revealed a significant main effect of Plate Color on savory scores, $F(3, 321) = 4.13$, $p < 0.01$, $\eta_p^2 = 0.04$. Post-hoc pairwise comparisons revealed that the foods presented on the white plates were expected to be more savory than those served on the red or green plates, both $t_s > 2.80$, $ps < 0.036$, whereas none of other pairwise comparisons reached significance, all $t_s < 1.94$, $ps >$

0.33. The results also revealed a significant main effect of Plate Size on the savory scores, $F(1, 107) = 7.40, p < 0.01, \eta_p^2 = 0.07$, thus suggesting that the food presented on the smaller plates was expected to be slightly more savory (3.4 vs. 3.3) than when served on the larger plates instead. What is more, the results also revealed significant main effects of Food Type on sweet and savory ratings, both $F_s > 11.10, p_s < 0.001, \eta_p^2 > 0.09$, whereas none of the interaction terms were significant, all $F_s < 2.68, p_s > 0.07$. Post-hoc pairwise comparisons revealed that participants expected the Penne pasta to be both sweeter and less savory, than the Fusilli pasta or the Asian noodles, all $t_s > 3.43, p_s < 0.01$, whereas none of other pairwise comparisons reached statistical significance, both $t_s < 1.22, p_s > 0.68$.

The influence of plate color and size on the willingness-to-pay for food

Preliminary analysis of the willingness-to-pay data revealed that the results from six of the participants had to be excluded from the following data analyses because they reported prices that were more than two standard deviations from the group mean. The means of the data from the remaining participants are shown in Figure 7. The results of the Plate Color \times Plate Size \times Food Type repeated-measures ANOVA revealed significant main effects of Plate Color and Plate Size, both $F_s > 8.38, p_s < 0.001, \eta_p^2 > 0.07$, but they were qualified by significant interactions between Plate Color and Plate Size, $F(3, 303) = 2.71, p < 0.05, \eta_p^2 = 0.026$, and between Plate Size and Food Type, $F(2, 202) = 7.80, p < 0.001, \eta_p^2 = 0.07$. Post-hoc pairwise

comparisons revealed that the participants were willing to pay significantly more for exactly the same food when served on the smaller plates than when served on the larger plates when they were red, blue, or green, all $t_s > 3.45$, $p_s < 0.001$, whereas the similar trend for white plates failed to reach statistical significance, $t(101) = 0.56$, $p = 0.58$. On the other hand, the participants in Experiment 2 were willing to pay significantly more for the food served on the small rather than on the large plates, $t(101) = 5.43$, $p < 0.001$, Cohen's $d = 0.54$, for Fusilli pasta, and $t(101) = 5.35$, $p < 0.001$, Cohen's $d = 0.53$, for Asian noodles, but no such pattern was seen for the Penne pasta, $t(101) = 0.24$, $p = 0.81$.

Last, but by no means least, the percentages of the participants who reported that they never, occasionally, sometimes, and often ate each type of food in daily life was as follows: Asian noodles, 0%, 13%, 39%, and 48%, respectively; Fusilli pasta, 44%, 48%, 8%, and 0%, respectively; and Penne pasta, 28%, 60%, 10%, and 2%, respectively.

3.2.2 Discussion

The results of Experiment 2 replicated the general pattern of results found in Experiment 1. That is, both the color and size of the plates influenced participants' subjective ratings of, and willingness to pay for, Asian noodles. That being said, we obtained some specific results with the computer-edited plate colors in Experiment 2 that were different from those reported with store-bought plates observed in

Experiment 1. In particular, the participants considered the computer-edited red or green plates to be less pleasant, less congruent with the food, and were willing to pay less for it compared to the white plate in Experiment 2. By contrast, the store-bought red and white plates were considered to be equally pleasant and congruent with the Asian noodles, and elicited comparable willingness-to-pay in Experiment 1. Taken together, while the influence of plate color on the subjective ratings of, and willingness-to-pay for, foods such as Asian noodles are robust, it might be moderated by the hue of the plate color.

On the other hand, it should also be noted that the type of food (and, in particular, its color; see Lyman 1989) might also moderate the influence of plate color and size on ratings of food. When the participants were not very familiar with the food such as when the Chinese participants in the present study viewed plates with Italian pasta, their subjective ratings of, willingness to pay for, and even taste expectations concerning, the food were more easily influenced by the physical properties of the containers to serve the food, such as their color and size.

4. GENERAL DISCUSSION

The results of two experiments reported here revealed the influence of the color and size of the plate used to present foods, on the subjective ratings of, and willingness to pay for these foods. That is, food served on white plates was considered to be the most familiar, which might be attributed to the fact that white

plates are much more commonly used to serve food in daily life than other colors, such as red, beige, green, or blue as used in the present study. According to estimates, half of all plates that are sold in Europe are white (Hultén *et al.* 2009). As for the plate size, Asian noodles served on small plates received higher familiarity, pleasantness, food-plate congruency, and willingness-to-pay scores in both experiments, presumably because small plates might lead the participants to overestimate the amount of food as compared to larger plates. Such results have been attributed to the Delboeuf illusion whereby the perception of a portion of food is influenced by the size of the circle (e.g., in this case, the plate) that surrounds it (e.g., McClain *et al.* 2014).

On the other hand, we obtained somewhat different results between the two experiments, involving store-bought and computer-edited red and blue plates (Experiments 1 and 2, respectively). That is, the store-bought red plate received comparable rating (except for familiarity) and willingness-to-pay scores as the white plate, whereas the computer-edited red plate received lower ratings than the white plate. By contrast, the store-bought blue plate was considered less congruent with Asian noodles than the store-bought red plate, whereas the computer-edited blue plate was considered as more congruent with Asian noodles than the computer-edited red plate. Here it should be noted that the store-bought red and blue plates were reflective, whereas the computer-edited red and blue ones were not reflective (i.e., they were matte) without any shadows, and they differed in hue. Taken together, these findings

suggested that the hues and reflectivity of the colors of the plate might moderate its influence on the subjective ratings of, and willingness-to-pay for foods such as Asian noodles.

It should be noted that the color red (when not associated with a brand, or any other meaning) has been shown to reduce the intake of those foods that are considered unhealthy (Bruno *et al.* 2013; Genschow *et al.* 2012; Reutner *et al.* 2015); and it has been suggested that serving food from blue trays may reduce consumers' food intake compared to trays of other colors (at least in Depression-era North America, Crumpacker 2006). Note, also, how blue foods are rare in nature, so people might have worries about the safety of blue food (Suzuki *et al.* 2017) and prefer them less (Lee *et al.* 2013). Therefore, one should perhaps be cautious about using red or blue as plateware colors for general populations (see Spence, submitted, for a review).

It is, of course, possible that the color of the plate might change the appearance properties of the food itself (Lampi 1973; though see Schifferstein *et al.* 2017). Alternatively, however, it is also possible that the contrast (i.e., the perceived color difference) between the foods and the receptacles, rather than the color of the receptacles themselves, is what determines people's expectations and perception of the food flavor/taste (see Lyman 1989, on this point; though see also Bruno *et al.* 2013). Using colored tableware that provides the maximal visual contrast to the food might be helpful for special populations such as Alzheimer's disease patients in terms of enhancing their intake of food and/or drinks (Dunne *et al.* 2004; Spence 2017).

What is more, the world-famous Barilla pasta brand uses dark blue as its packaging color, presumably to make their pasta stand out against the packaging (see Figure 8 for an illustration).

INSERT FIGURE 8 ABOUT HERE

It is also worth noting that food can provide a certain degree of textural complexity and visual arrangement cues (e.g., artistic plating), which might influence participants' perception and expectation of the food (Michel *et al.* 2014, 2015; Okajima and Spence 2011; Zellner *et al.* 2010, 2011). The results of the present study suggest that the type of food might also moderate the influence of plate color and size on people's expectations. Unsurprisingly, the Chinese participants who took part in the present study were not as familiar with the Italian pastas as with Asian noodles. While consumer's frequency of consumption of the pastas might influence their expectations and liking of these foods (Laureati *et al.* 2016), 44% and 28% of our Chinese participants reported never having eaten Fusilli and Penne pasta, respectively. That being the case, their subjective ratings of, willingness-to-pay for, and even taste expectations concerning, the pastas, were nevertheless still influenced by the color and size of the containers used to serve the food. Taken together, these findings suggest that plate color might accentuate the expected taste that a familiar food already originally (and even weakly) has (Harrar *et al.* 2011; Piqueras-Fiszman *et al.*

2012; Tu *et al.* 2016), as well as that of the unfamiliar food (such as the Italian pastas shown to the participants in the present study), but can hardly create a taste in a tasteless food, such as the Asian noodles which are bland by themselves and are often eaten with sauces of various flavors.

That being said, it should also be noted that the Asian noodles as well as Italian pasta (another food that is commonly consumed in Europe and North America) presented in this study were shown in their natural, and possibly “not ready-to-eat” appearance (i.e., without being combined with any flavorful sauces). Future research will therefore be needed in order to examine these foods in “ready-to-eat” looks with sauces, soup, or even side dishes.

Previous research has shown some cross-cultural differences in the sensory expectations concerning solid foods. For example, Peng and colleagues (2017) recently reported that manipulating the size of the plate (i.e., creating larger vs. smaller portion illusions) has no effect on the expected fullness or the estimated intake of Chinese and Koreans consumers, as compared to significant effects in those participants from Canada and New Zealand. Therefore, future studies will also be needed in order to examine any cross-cultural difference in the influence of receptacles on the perception of food. It will also be interesting to examine whether Asian participants are equally susceptible to the Delboeuf illusion compared to Western participants, considering that Western and Eastern participants exhibit different patterns of results in those cognitive tasks designed to examine the influence

510 of perceived object-to-object relationship, such as the rod-and-frame task (Ji *et al.*
511 2000).

512 In conclusion, the present study provides a number of novel findings concerning
513 the influence of plateware in the case of a commonly-eaten food in many Asian
514 countries, specifically, Asian noodles. It has been estimated that flour-based foods has
515 huge market (c. 600 billion CNY; approximately 89 billion USD every year) in China,
516 while noodles account for 35% of the yearly flour-based food consumption
517 nationwide (Liu 2014). Our findings suggest a fundamental difference between the
518 role of plateware in the subjective ratings of, and taste expectations concerning snack
519 food consumed for hedonic values in previous studies (Bruno *et al.* 2013; Genschow
520 *et al.* 2012; Reutner *et al.* 2015) and regularly consumed familiar and unfamiliar food
521 as in the present study, suggesting that consumers might react to the visual cues in an
522 adaptive way (see also Reutner *et al.* 2015). These findings have direct implications in
523 the business of food serving in restaurants.

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Tables

Table 1. Pairwise comparisons between food-plate congruency scores (on 7-point scales) for different types of food presented on plates in different colors ($N = 108$).

	Plate color		Blue	Green	Red
Asian noodles	White	t	3.10*	7.66**	6.44**
		<i>Cohen's d</i>	0.30	0.74	0.62
	Blue	t	-	5.48**	4.33**
		<i>Cohen's d</i>	-	0.53	0.42
	Green	t	-	-	0.98
		<i>Cohen's d</i>	-	-	-
Fusilli pasta	White	t	2.61	4.64**	5.07**
		<i>Cohen's d</i>	-	0.45	0.49
	Blue	t	-	2.49	2.94*
		<i>Cohen's d</i>	-	-	0.28
	Green	t	-	-	0.85
		<i>Cohen's d</i>	-	-	-
Penne pasta	White	t	2.88*	6.26**	6.29**
		<i>Cohen's d</i>	0.28	0.60	0.61
	Blue	t	-	3.80**	4.16**
		<i>Cohen's d</i>	-	0.37	0.40
	Green	t	-	-	0.56
		<i>Cohen's d</i>	-	-	-

Note: * denote $p < 0.05$, ** denotes $p < 0.01$, and all the p values are reported after Bonferroni-correction for multiple comparisons.

Table 2. Pairwise comparisons of familiarity, pleasantness, and food-plate congruency scores (on 7-point scales) for different types of food presented on plates in different sizes ($N = 108$).

Large vs. small plates		Asian noodles	Fusilli pasta	Penne pasta
Familiarity scores	t	4.48**	4.55**	0.00
	$Cohen's d$	0.44	0.44	-
Pleasantness scores	t	4.68**	4.22**	1.52
	$Cohen's d$	0.45	0.41	-
Congruency scores	t	5.96**	5.22**	0.89
	$Cohen's d$	0.57	0.50	-

Note: * denote $p < 0.05$, ** denotes $p < 0.01$, and all the p values are reported after Bonferroni-correction for multiple comparisons.