

## Research Article

# The Symmetry Effect: Symmetrical Shapes Increase Consumer's Health Perception of Food

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Focusing on the physical appearance of the food itself, and limiting the focus on shape to the concept of symmetry, this research investigated how food shape influences consumer perceptions of healthiness and naturalness and their subsequent food preferences. By conducting three empirical studies involving self-reported preference and trade-off choices, this research verified that it is a two-staged process of naturalness and healthiness that mediates the main effect of symmetry on foods preference. Furthermore, the incremental perceived unhealthiness of food would mitigate the positive effect of food symmetry. These findings are meaningful for food marketing managers and policymakers when making food-related decisions.

## 1. Introduction

Food choice is highly important, as it impacts overall consumer health [1]. As the World Health Organization (WHO) has reported an ongoing global obesity epidemic [2], scientists have also called for the reduced intake of food additives [3], and for consumers to learn the impact food intake has on health. Thus, food marketers and scholars alike must turn their attention to the factors that influence food choices to contribute to overall consumer welfare. Consumers' food decision-making process is complex, as multiple factors can influence food choice [1]. External cues for food, including color, physical form, and shape [4, 5], can trigger consumers' thinking processes and activate inferences regarding the expected taste and quality of the food which, in turn influence food choice [6, 7].

Derived from mathematics and geometry [8], symmetry is a feature of classical aesthetics meaning uniformity and order. Preference for symmetry has been found in a large body of research, including natural selection research in response to biological signals in the nature, and even in irrelative contexts, such as aesthetic perception and exploratory behaviors [9, 10]. In the context of food choices,

symmetry or balance shape is found to be generally preferred better than their asymmetrical or unbalanced counterpart [11, 12]. In the package design research, symmetrical design of information items around the vertical axis on food product packaging (i.e., orange juice, chocolate bars, biscuits, and pasta) positively impacts consumption experience and purchase intentions [13]. These positive effects have been found to be dependent on product value (e.g., functionality, quality, and ease of use) and visual complexity [14, 15].

The present research focused on symmetry as a shape and exclude its potential philosophical connotation. Further, to better contribute to and supplement food literature, we considered the physical appearance of the food itself, rather than the shape of the packaging. Additionally, we examined the effects of symmetry, but not other aesthetic features, since consumers can detect symmetry with little to no effort across a wide range of viewing conditions [11], and a symmetrical shape is easy to be designed by producers.

Food choices and eating behavior are increasingly discussed from health-related perspectives and, in turn, consumers have shown increased intentions to purchase healthier food [2]. Thus, pressure from the public sector and

consumer needs indicates food manufactures must provide more healthy food options for consumers. Under this trend, a significant amount of research has examined the factors influencing consumers' healthy food choices, including labeling [16] and packaging design [17, 18]. For example, fair trade food labels have been demonstrated to positively impact a product's perceived healthiness [19].

The present research explores whether symmetrical foods are perceived as healthier. Indeed, we propose that symmetry can increase food preference because consumers believe that symmetrical foods are more natural, and thus, healthier. We aimed to demonstrate these effects in three empirical studies with different types of food and in both simulated and real purchasing environments, thereby increasing the external validity. The findings of this study will contribute to research on food design by highlighting the association between symmetry and perceptions of food as being natural and healthy. Accordingly, our work will also highlight that natural foods are intuitively believed to be healthy, which can empirically contribute to the literature on the health halo effect.

## 2. Literature Review and Hypothesis Development

*2.1. The More Symmetrical, The More Natural.* Symmetry, along with order, balance, clarity, and pattern repetition, is a feature of classical aesthetics, which constitutes the aesthetic perceptions of humans [20]. As an easily controlled and easily identified element of food, the shape of symmetry has been found to bring various effects in food research. A clear preference for symmetry over asymmetry presentations of foods was examined and verified with exactly the same ingredients over all compositions [12]. Visual aesthetics of objects influence our behavior, the sight on the foods creates expectations of taste, flavor, and healthiness [18, 21–23]. Such that balanced food arrangements are rated as more attractive [12, 24] and tend to lead to higher willingness to pay for the food, than unbalanced arrangements [12, 25, 26]. Symmetrical objects that highlight a balanced rhythm themselves are found to elicit a sense of quiet because of the repeated order [27]. In marketing practices, symmetry and balance are also core design elements used to make pictures beautiful in traditional print advertising [28]. Moreover, asymmetrical foods are indicated to be defined as aesthetically imperfect in shape, providing evidence that consumers perceive symmetry relatively aesthetically pleasing [16, 29].

This study focuses on symmetry, which has been found to indicate uniformity and order constituting a traditional principle of beauty [30]. Cooperated with the revolutionary biology, we argue that this preference of symmetry is derived from the deepest evolutionary factor of natural selection. In nature, symmetry aids survival, leading to most animals and flora in nature being approximately bilaterally symmetrical [31]. Furthermore, symmetry signals higher phenotypic and genotypic make-up than asymmetry, which makes people more inclined to approach symmetrical and avoid asymmetrical objects [32]. This preference can be observed in response to biological signals in nature, such as aesthetic

perception and exploratory behaviors [10]. To specify, the perceived attractiveness of human faces was found to be influenced by the level of symmetry, in that more symmetrical faces are generally found to be more attractive [33–35]. Symmetry is also an indicative of mate value for several species in nature [36]. Moreover, symmetrical patterns are preferred even if they do not serve any biologically relevant function, in both humans and animals [37, 38].

Based on this research and the observations in our daily life, symmetry is more likely to remind humans of nature. Evidence has shown that in daily life, some objects are designed with symmetrical patterns to make them look beautiful. For instance, most buildings worldwide are approximately symmetrical to serve an aesthetic function, including the Forbidden City in China, the Taj Mahal in India, and the Palace of Versailles in France. By resembling patterns found in nature, symmetry is perceived as natural and elicits associations with nature in general [39], thus signaling an intuition: the more symmetrical, the more natural. In this study, we posit that the more symmetrical a food is, the more natural it is perceived to be, since symmetry is automatically associated with nature and thus elicits the sense of a food being natural.

*2.2. Food Symmetry Increases Consumer Preference: The "Natural is Healthy" Intuition.* Prior research indicates that intuition is generally derived from a combination of past experiences, observations, and exposure to external environmental cues [40]. Concerning personal experiences with healthiness and naturalness, consumers likely rely on easily retrievable information regarding these two attributes [41]. Messages concerning the relationship between natural and healthy could be most encountered in organic food marketing and show a positive relationship between them [42]. Marketers interpret naturalness of organic food as evidence to support the healthiness of the food, and based on exposure to this marketing environment, consumers tend to perceive organic foods as healthier since they are more natural [43]. Consumers are also frequently exposed to signals that unhealthy foods are full of additives and artificial chemicals, making specific examples of unnatural, unhealthy food highly salient [44–46].

Media coverage has been shown to play a substantial role in determining what information becomes readily retrievable [47]. The extensive articles and blog posts that can be found on the Internet devoted to natural-health ideas for healthy eating propagate the idea that it is unhealthy to consume foods that are highly processed. Further, the media coverage, which calls for a reduction in the intake of added sugars, public policy attention paid to food intake, and a search for ways to decrease the intake of highly processed food, also echoes this relationship [48]. Exposure to these articles and other messages consistent with unhealthy food being unnatural and healthy food being natural further propagates the belief in the "natural = healthy" intuition.

Thus, based on this intuition, will perceived healthiness increase consumer preference for a type of food? We believe this question can be answered affirmatively. Research has

indicated that “tasty” and “healthy” are among the most crucial considerations for consumers when making decisions regarding food [41, 49–53]. Several studies have examined the link between perceived healthiness and taste; however, while somewhat older research points to a negative association (i.e., unhealthy = tasty; [54]), more recent research provides convincing evidence for a positive relationship between perceived healthiness and taste [55–57]. For instance, the universality of the “unhealthy = tasty” intuition has been directly questioned by recent evidence from France, which found positive associations between perceptions of tastiness and perceptions of healthiness [57]. Further, this specific healthiness–tastiness relationship will remain positive among consumers who have a low food pleasure orientation compared to consumers who have a high food pleasure orientation.

The aforementioned research shows that the extent to which they incorporate motives based on either taste or health in their food choices differs among consumers [58]. This may be explained based on the different benefits on which consumers focus. Specifically, consumers may regard taste as the most important for hedonic value, but health as necessary for utilitarian value [54]. Several consumer studies have shown a tendency in some Western cultures to view the perception of food as a source of pleasure being in opposition to considering food for its health benefits [59, 60]. Under such circumstances, unhealthy foods, which provide pleasure and fulfill hedonic goals, would be preferred.

It has been observed, however, that particular food choices are not always made based on what the decision-maker likes best, and other factors could be just as or even more important than hedonic factors [61]. Studies have indicated that consumers can form preferences based on health-related attitudes motivated by expectations of a longer and higher-quality life [60, 62]. Further, from the perspective of maintaining one’s health, combined with general trends toward increased consumer awareness of healthy eating [63] and the increasing rates of obesity [64], consumers will be prompted to choose healthier foods over unhealthy ones [45].

More than ever, an understanding of the food–health relationship has resulted in healthy food becoming even more central in consumers’ lives [65, 66]. Based on the literature discussed above, we propose that symmetrical food will be perceived as healthy, and this perceived healthiness will, in turn, increase general consumer food preferences. Thus, we hypothesized that:

H<sub>1</sub>: symmetrical foods are preferred over asymmetrical ones.

H<sub>2</sub>: perceived naturalness and perceived healthiness serially mediate this symmetry effect on consumer food preference.

*2.3. Unhealthiness Mitigates the Symmetry Effect of Food Shape.* According to the discussion above, we have predicted that the more symmetrical a food is, the more natural it will be perceived to be. Since consumers intuitively

perceive naturalness to be the indicator of healthiness, and they are increasingly consuming healthy foods to promote their own well-being, they would likely prefer symmetrical foods. Symmetry would thus serve as an external cue to promote perceived healthiness when consumers make food decisions; however, other cues could also influence the formation of perceptions of healthiness for food. For example, people estimate lower calorie counts for fast-food meals that are advertised as healthy as compared to an unhealthy alternative (e. g., Subway vs. McDonald’s; [67]), indicating that advertising could influence the perception of food as being healthy.

In addition, food preferences and choices often require different objectives or goals (e. g., taste, nutritional value, and price) to be considered, and this may involve a complicated decision-making process directed toward satisfying these different goals. However, people generally eat because they need to fulfill their appetite, which is a hedonic value [67], another major goal many people hold when selecting food is to maintain good health, which is a utilitarian value [50]. Unhealthy food has been found to have a unique appeal for consumers. For example, individuals believe that unhealthy food is generally more fulfilling than healthy alternatives since unhealthy food is tastier [67]. This perception makes the desire to eat healthily compete with the desire to fulfill one’s appetite [64, 68, 69]. Thus, when a food is simultaneously found to be symmetrical and unhealthy, the symmetry-evoked preference for healthy food and the preference for fulfilling one’s appetite with unhealthy food conflict. Accordingly, people experience a self-control conflict between eating healthily and eating freely [70–72]. Perceived healthiness or unhealthiness of food therefore will have different effects on consumer decisions regarding food.

Based on cue utilization theory, consumers rely on extrinsic and intrinsic cues to infer a product’s experience or credence qualities [73]. For food, intrinsic cues include physical characteristics, such as their color or shape, while extrinsic cues represent external factors, such as brand, price, or labels [74]. In the present study, symmetry is an intrinsic cue, as it cannot be changed without altering the physical form of the food. However, labels or brands may be manipulated without modifying the physical properties of the food itself. As a result, if highly caloric, unhealthy foods traditionally labeled as “junk food” are designed to be symmetrical, they are unlikely to be perceived as healthy.

As mentioned above, the more symmetrical a food is, the more natural it will be perceived to be, and increasing the perceived healthiness of a food will enhance consumer preference. Thus, when a food is perceived to be unhealthy based on other aspects, such as an inappropriate color, an opposite effect will work together with the symmetry effect. Specifically, although the symmetry of a food increases its perceived healthiness, other factors that decrease perceived healthiness could lead to a reverse effect, making it difficult to predict actual consumer preference. Thus, we predict that the degree to which a food is perceived as healthy will mitigate the symmetry effect, that is, the symmetry effect

may be weakened or even be eliminated for foods that are perceived as being more unhealthy than other foods. We thus postulated the following:

H<sub>3</sub>: for foods that are perceived to be unhealthy, the symmetry effect on food preference will be weakened.

### 3. Method

**3.1. Research Overview.** We tested our hypotheses through three experiments of which the participants of online studies were all recruited through a crowdsourcing platform in mainland China in February, 2022. All participants volunteered in participating in our studies and our experimental design passed the review of the ethics review committee.

Three experiments were conducted to assess our theorization of how symmetrical foods are perceived as healthiness thus increasing consumer food preference. Study 1 aimed to verify the symmetry effect on food preference and the underlying mechanism of our proposed two-stage mediation process (i.e., food naturalness and healthiness). To increase the robustness of our findings, Study 2 was designed to provide replicating evidence in a more controlled manner with homogeneous samples (i.e., undergraduates) under real-world conditions. Finally, in Study 3, we offer additional mediation evidence for our “naturalness = healthiness” explanation through moderation instead of directly measuring mediators. All three studies were conducted in Mainland China, to control for the effect of country on food preference. Common filtering criteria were used across all three studies, and for each study, we reported all stimuli, manipulations, data exclusions, and measures. As for the sample size of the studies, we used Gpower to estimate a minimum required sample size of participants per experimental condition to achieve a desired power of 0.80 at an alpha level of  $p = 0.05$ , based on an effect size average from previous research that has used similar measures (see [75] for a meta-analysis). The results showed that the minimum of samples for Study 1, 2, and 3 were 90, 145, and 64.

**3.2. Study 1: Symmetry Increases Consumer Food Preferences.** Study 1 was primarily designed to investigate our H<sub>1</sub> that consumers are more likely to prefer a symmetrical item instead of an asymmetrical version of that item. Accordingly, we conducted an online experiment in which we manipulated the symmetry of food and measured consumer reactions. This study also initially explored our proposed two-stage mediation process of food naturalness and healthiness, thereby providing an overall test for our conceptual framework.

**3.2.1. Procedure.** The sample included 119 students from a Chinese university who took part in this online study for monetary compensation (USD 0.72). Experimental materials were disseminating using a popular social platform (i.e., WeChat) in China. Upon registering, participants were assigned at random to evaluate symmetric or asymmetric food indicating a between-subjects experimental design.

Data of six respondents (5.0%) were ignored because they did not pass the attention check (“If you are filling out the questionnaire carefully, please choose option three”), resulting in 113 ( $M_{age} = 23.34$ ,  $SD = 5.49$ ; 54 female, 47.8%) valid responses.

After learning the study’s background and veiled purpose (participants were told that we were ostensibly interested in their dieting behaviors), participants were asked to view a picture of either symmetrical or asymmetrical chocolates. These chocolate pictures have passed the pretest and will not lead to different visually aesthetics appealing. Then participants evaluated that picture on different dimensions. Specifically, participants indicated the perceived naturalness [39] and healthiness of the target chocolate on two seven-point scales (where 1 = not at all and 7 = very much). We also asked about their preferences regarding the chocolate symmetry (to what extent do you think the above products are axial symmetry; 1 = not at all and 7 = very much). Finally, participants provided their basic demographic information (i.e., gender and age), present hunger level, and how frequently they purchased chocolates.

#### 3.2.2. Results

**Food Preference.** We conducted a one-way ANOVA for consumer preference and observed a significant main effect of food symmetry ( $F(1, 111) = 96.15$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.46$ ). As we predicted (Figure 1), participants in the symmetrical condition reported a higher preference ( $M = 5.90$ ,  $SD = 0.93$ ) for the target item than their counterparts in the asymmetrical condition ( $M = 3.93$ ,  $SD = 1.19$ ). As including age, gender, self-reported hunger level, and purchase frequency as covariates did not affect our results across all studies, for brevity, the results of these covariates will not be reported in detail hereafter.

**Perceived Naturalness.** A similar ANOVA was performed for perceived naturalness and revealed a similarly significant main effect of food symmetry ( $F(1, 111) = 100.77$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.48$ ). Specifically, participants rated a piece of symmetrical chocolate as being more natural ( $M = 5.82$ ,  $SD = 0.90$ ) compared with an asymmetrical piece ( $M = 3.91$ ,  $SD = 1.12$ ; Figure 1).

**Perceived Healthiness.** We conducted a one-way ANOVA for perceived healthiness and found a significant main effect of food symmetry ( $F(1, 111) = 88.72$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.44$ ). Consistent with our expectations, a piece of chocolate with a symmetrical shape was perceived as being healthier than an asymmetrical piece ( $M_{\text{symmetrical}} = 5.56$ ,  $SD = 0.89$ ;  $M_{\text{asymmetrical}} = 4.00$ ,  $SD = 0.87$ ; Figure 1).

**Mediation Process.** To further explore the sequential mediation process of perceived naturalness and healthiness, we conducted a mediation analysis (SPSS PROCESS Macro Model 6 with 10,000 bootstrapped draws) with food symmetry as the independent variable (1 = symmetrical and 0 = asymmetrical), perceived naturalness as the first mediator, perceived healthiness as the second mediator, food preference as the dependent variable, and covariates. As shown in Figure 2, the indirect effect of food symmetry



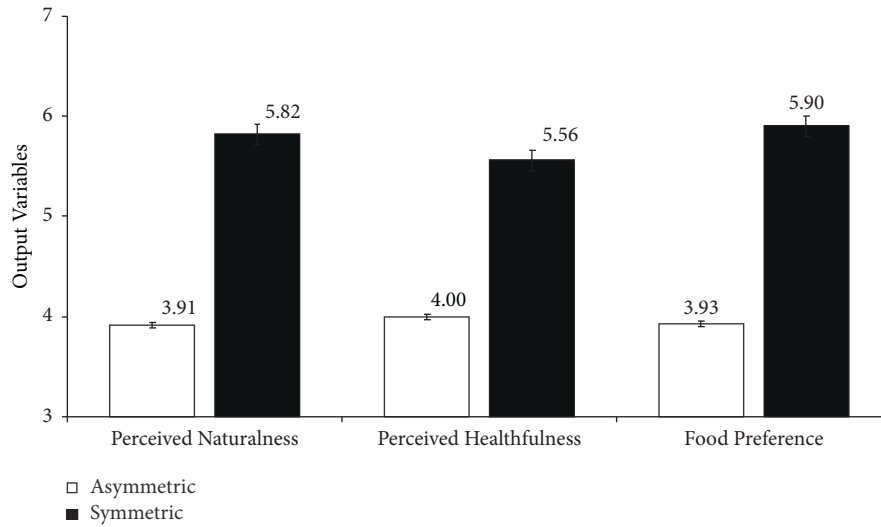


FIGURE 1: Perceived naturalness, healthiness, and food preferences as a function of food symmetry.

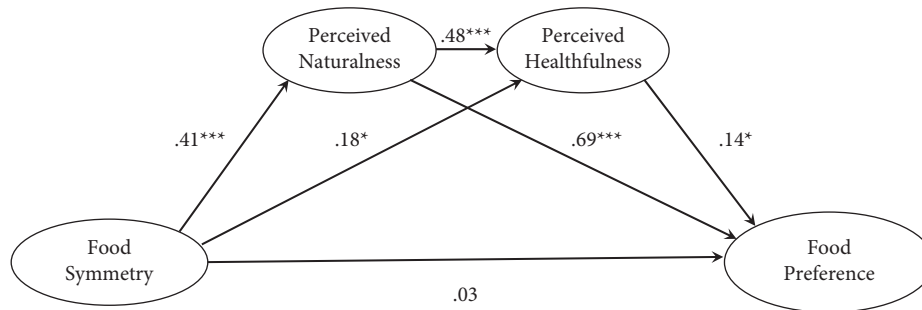


FIGURE 2: Sequential mediation pathway of perceived naturalness and healthiness in Study 1. All path coefficients are standardized beta values; \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

through perceived naturalness and healthiness was significant (effect size = 0.08, SE = 0.05, 95% CI = (0.01, 0.19)). Specifically, food symmetry led to greater perceived naturalness ( $\beta = 0.41$ , SE = 0.21,  $t = 5.38$ ,  $p < 0.001$ ), which in turn resulted in higher perceived healthiness ( $\beta = 0.48$ , SE = 0.08,  $t = 5.31$ ,  $p < 0.001$ ), and healthiness perceptions ultimately increased participants' preferences for this item ( $\beta = 0.14$ , SE = 0.08,  $t = 2.23$ ,  $p = 0.006$ ). Accounting for this indirect effect gave rise to nonsignificant direct effect of food symmetry on consumer preference (effect size = 0.10, SE = 0.16;  $t = 0.61$ ,  $p = 0.546$ , 95% CI = (-0.22, 0.41)), suggesting full sequential mediation.

**3.2.3. Discussion.** The results of Study 1 offer initial empirical evidence for our H1, showing that giving a food with symmetric shape leads to greater preferences for it. Study 1 also demonstrates the sequential mediation process of perceived naturalness and healthiness in the relationship between food symmetry and consumer preference, providing preliminary support for our proposed explanation. Conducted through an online and controlled condition, this Study 1 tested the positive effect of symmetric shape of a kind of food on consumers' preference toward it. This effect is found to be effective through consumers' perceived

naturalness and healthiness. To be specific, consumers perceive a symmetrical food to be more natural than its asymmetrical version, this perception sequentially leads consumers to view the symmetrical food healthier, which finally increases consumer preference.

**3.3. Study 2: Food Symmetry and Actual Choices.** Study 2 had two objectives. First, we aimed to replicate the findings of Study 1 in a more controlled manner. Accordingly, we conducted Study 2 offline in a behavioral lab. Second, we aimed to generalize our previous findings to a real-world setting, thereby providing more actionable insights for marketers and policymakers.

**3.3.1. Procedure.** The sample included 250 nonbusiness undergraduates ( $M_{\text{age}} = 22.36$ ,  $SD = 2.51$ ; 102 female, 40.8%), sourced from three campuses of a public Chinese university, who took part in this offline study for monetary compensation (USD 1.53). Upon checking into the lab, participants were told that we were interested in their taste preference, and they were then assigned at random to either the symmetrical or asymmetrical condition indicating a between-subjects experimental design. Immediately after participants

provided written informed consent, they were presented with a plate of salad, which was arranged either symmetrically or asymmetrically. Then, they were required to decide between the salad and monetary compensatory as the reward of their participation. After participants made their selection, they provided their demographic information, reported their current hunger level and purchase frequency, and completed food symmetry manipulation check.

**3.3.2. Results. Manipulation Check.** The ANOVA for the symmetry manipulation check revealed a significant main effect of food symmetry, confirming the success of our food symmetry manipulation.

**Food Choice.** A chi-squared test revealed a significant effect of food symmetry on consumer' food choices ( $\chi^2 = 6.56$ ,  $df = 1$ ,  $p = 0.01$ ). Consistent with our expectation, participants in the symmetrical condition (vs. asymmetrical) were more likely to choose the salad ( $P_{\text{symmetrical}} = 37.3\%$  vs.  $P_{\text{asymmetrical}} = 22.2\%$ ) as their reward rather than monetary compensation ( $P_{\text{symmetrical}} = 62.7\%$  vs.  $P_{\text{asymmetrical}} = 77.8\%$ ).

**3.3.3. Discussion.** Study 2's results demonstrate that displaying food in a symmetrical (vs. asymmetrical) manner will increase the probability of choosing it, conceptually replicating our findings in Study 1 with a more actual measure—food choice. Specifically, when foods are prepared and showed in a symmetrical manner (vs. asymmetrical manner), consumers are more likely to choose them. Importantly, this study extends our findings to a real-life setting. Compared with consumers' self-reported preferences to a specified food, their actual choices are more valuable for practitioners. Taking these results together, this study not only validates the robustness of the food symmetry effect we observed but also provides more practical implications for decision-makers who are concerned with food consumption.

Thus far, Studies 1 and 2 have illustrated the overall impact of food symmetry on consumer perceptions, preferences, and actual choice behaviors. We have also preliminarily explored the mechanism underlying the symmetry effect for food. However, it is important to note that there are several alternative explanations that could account for the observed food symmetry effect, some of which stem from the food symmetry manipulation in Study 1. In Study 3, we aimed to demonstrate an empirical investigation from experiments that were conducted to provide robust support regarding our proposed "symmetry  $\rightarrow$  naturalness  $\rightarrow$  healthiness  $\rightarrow$  preference" process.

**3.4. Study 3: Unhealthiness Mitigates the Food Symmetry Effect.** The final study had three primary objectives. The first aim was to replicate our previous findings with different items, thus demonstrating the robustness of our proposed food symmetry effect. We also sought to offer additional mediation evidence for our "naturalness = healthiness" explanation, through moderation instead of directly measuring

mediators. If our explanation was correct, the incremental unhealthiness of foods would mitigate the positive effect of food symmetry; specifically, the food symmetry effect would be weakened or disappeared. Finally, we attempted to establish the boundary condition of the food symmetry effect, thereby providing more actionable insights for decision-makers concerned with food consumption.

**3.4.1. Procedure.** The sample included 326 undergraduate students from a public university in southwest China who took part in this online experiment for monetary compensation (USD 1.52). After being informed of the instructions, they were assigned at random to one of six scenarios in a 2 (food shape: symmetrical vs. asymmetrical)  $\times$  3 (food unhealthiness: low vs. moderate vs. high) between-subjects design. The survey weblink was disseminated via WeChat. Data of 19 undergraduates (5.82%) were considered invalid, as they did not choose the correct option in our attention check ("please choose the third option if you are filling out the questionnaire seriously") that was embedded in our questionnaire, thereby leaving us with 307 ( $M_{\text{age}} = 22.52$ ,  $SD = 4.35$ ; 169 female, 55.1%) valid respondents.

The experimental procedures and measures were consistent with those we used in Study 1, but with several key differences. We manipulated food unhealthiness by asking 40 participants ( $M_{\text{age}} = 21.43$ ,  $SD = 4.89$ ; 19 female, 47.5%) to assess the unhealthiness of our target items in a pretest. Specifically, participants indicated the energy, protein, fat, and sugar content of the target food on four seven-point scales (where 1 = not at all and 7 = very much). The results confirmed that wholemeal bread, ice cream, and spicy strips were of low ( $M = 2.70$ ,  $SD = 1.03$ ), moderate ( $M = 4.18$ ,  $SD = 1.50$ ), and high ( $M = 4.69$ ,  $SD = 1.02$ ) levels of unhealthiness, respectively.

**3.4.2. Results. Manipulation Check for Food Symmetry.** First, a 2 (food symmetry)  $\times$  3 (food unhealthiness) ANOVA for food symmetry was conducted, and the results indicated that food symmetry was successfully manipulated, regardless of whether unhealthiness level of the target item was low ( $M_{\text{symmetrical}} = 4.94$ ,  $SD = 1.38$ ;  $M_{\text{asymmetrical}} = 1.64$ ,  $SD = .68$ ;  $F(1, 301) = 233.54$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.44$ ), moderate ( $M_{\text{symmetrical}} = 5.31$ ,  $SD = 1.40$ ;  $M_{\text{asymmetrical}} = 2.64$ ,  $SD = 1.51$ ;  $F(1, 301) = 133.01$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.31$ ), or high ( $M_{\text{symmetrical}} = 5.35$ ,  $SD = 0.72$ ;  $M_{\text{asymmetrical}} = 1.83$ ,  $SD = 0.85$ ;  $F(1, 301) = 247.71$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.45$ ). In the case of symmetry, the main effect is significant ( $F(1, 161) = 19.417$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.194$ ); in the case of asymmetry, the main effect is also significant ( $F(1, 145) = 71.576$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.497$ ).

**Food Preference.** We conducted another two-way ANOVA for food preference and observed significant main effects of food symmetry ( $F(1, 301) = 285.40$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.49$ ) and unhealthiness ( $F(2, 301) = 87.66$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.37$ ), with a significant interaction term between the two ( $F(2, 301) = 9.43$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.06$ ). Specifically, in Figure 3, Panel A shows participants who were exposed a

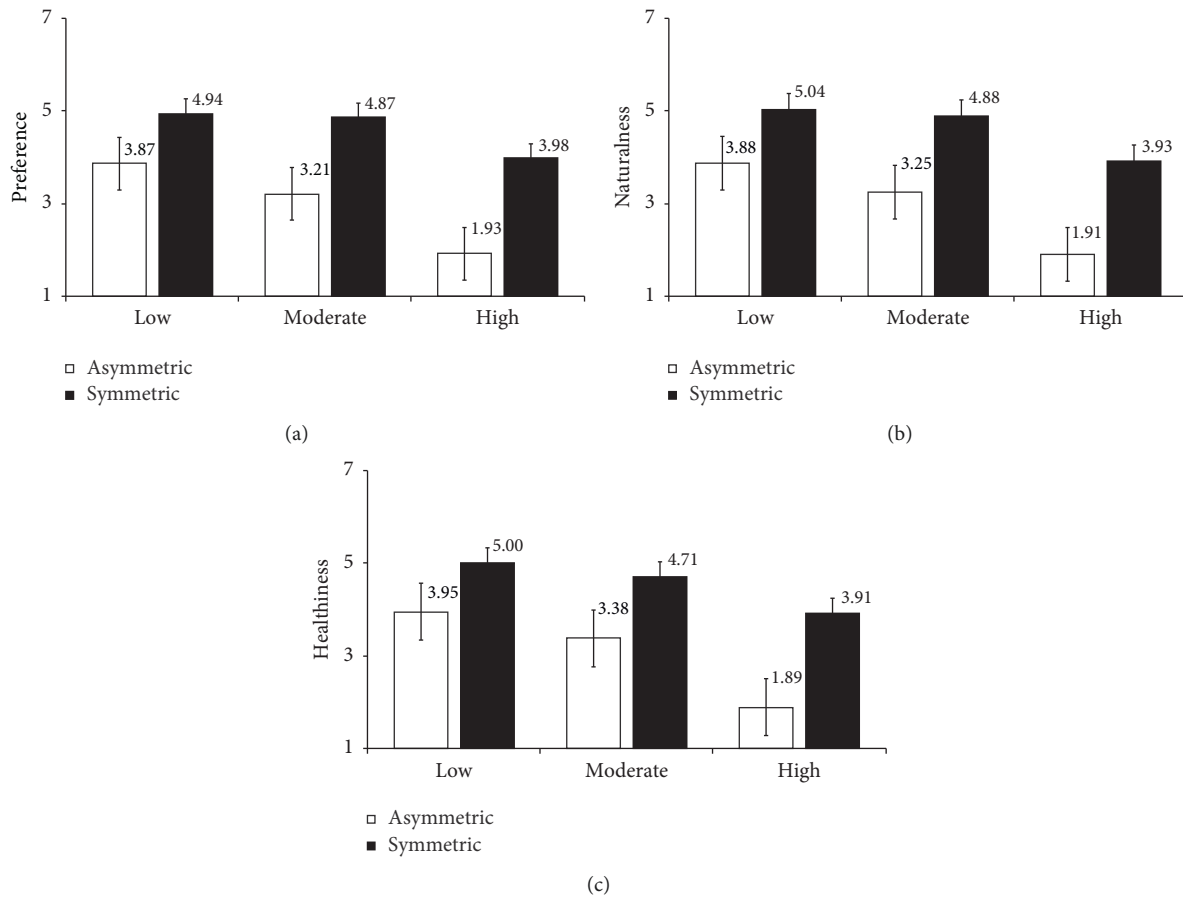


FIGURE 3: Food preference (a), perceived naturalness (b), and perceived healthiness (c) as functions of food symmetry and food unhealthiness ( $M \pm SD$ ).

symmetrical item with low unhealthiness reported a significant greater preference ( $M = 4.94$ ,  $SD = 1.01$ ) than those who were exposed to an asymmetrical item with high unhealthiness level ( $M = 3.87$ ,  $SD = 0.47$ ;  $F(1, 301) = 46.28$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.13$ ). We also observed consistent results for items with moderate ( $M_{\text{symmetrical}} = 4.87$ ,  $SD = 0.90$ ;  $M_{\text{asymmetrical}} = 3.21$ ,  $SD = 1.16$ ;  $F(1, 301) = 96.06$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.24$ ) and high unhealthiness ( $M_{\text{symmetrical}} = 3.98$ ,  $SD = 0.50$ ;  $M_{\text{asymmetrical}} = 1.93$ ,  $SD = 0.73$ ;  $F(1, 301) = 157.97$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.34$ ).

**Perceived Naturalness.** A similar two-way ANOVA for perceived naturalness revealed significant main effects of food symmetry ( $F(1, 301) = 315.87$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.51$ ) and unhealthiness ( $F(2, 301) = 107.47$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.42$ ), as well as a significant interaction term ( $F(2, 301) = 8.02$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.05$ ). In Figure 3, Panel B shows planned contrasts further demonstrated that participants in the low unhealthiness condition were more likely to rate a symmetrical item ( $M = 5.04$ ,  $SD = 1.04$ ) as more natural than its asymmetrical counterpart ( $M = 3.88$ ,  $SD = 0.51$ ;  $F(1, 301) = 58.67$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.16$ ). Similar patterns were found in the moderate ( $M_{\text{symmetrical}} = 4.88$ ,  $SD = 0.71$ ;  $M_{\text{asymmetrical}} = 3.25$ ,  $SD = 1.27$ ;  $F(1, 301) = 101.93$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.25$ ) and high ( $M_{\text{symmetrical}} = 3.93$ ,  $SD = 0.41$ ;  $M_{\text{asymmetrical}} = 1.91$ ,  $SD = 0.43$ ;  $F(1, 301) = 167.93$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.36$ ) unhealthiness conditions.

**Perceived Healthiness.** We also conducted a two-way ANOVA for perceived healthiness. There were significant main effects for both food symmetry ( $F(1, 301) = 310.71$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.51$ ) and unhealthiness ( $F(2, 301) = 130.59$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.47$ ); a significant two-way interaction term was also observed ( $F(2, 301) = 12.04$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.07$ ). In Figure 3, Panel C shows that participants rated symmetrical items ( $M = 5.00$ ,  $SD = 0.91$ ) as eliciting more perceptions of healthiness than asymmetrical food in the low unhealthiness condition ( $M = 3.95$ ,  $SD = 0.47$ ;  $F(1, 301) = 57.48$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.16$ ). We found similar results in the moderate ( $M_{\text{symmetrical}} = 4.71$ ,  $SD = 0.70$ ;  $M_{\text{asymmetrical}} = 3.38$ ,  $SD = 1.16$ ;  $F(1, 301) = 79.64$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.21$ ) and high ( $M_{\text{symmetrical}} = 3.91$ ,  $SD = 0.43$ ;  $M_{\text{asymmetrical}} = 1.89$ ,  $SD = 0.43$ ;  $F(1, 301) = 195.86$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.39$ ) unhealthiness conditions.

**Moderated Sequential Mediation Process.** We conducted a moderated sequential mediation analysis (bootstrapped with 10,000 draws; Figure 4). The results revealed that the sequential mediation pathway underlying the effect of food symmetry on consumer preference for the target food (i.e., participants' perceptions of food naturalness [first mediator] and healthiness [second mediator]) was moderated by food unhealthiness (95% CI =  $(-0.46, -0.09)$ ). The estimated regression coefficients are summarized in Table 1. To specifically illustrate the nature of moderated mediation, we

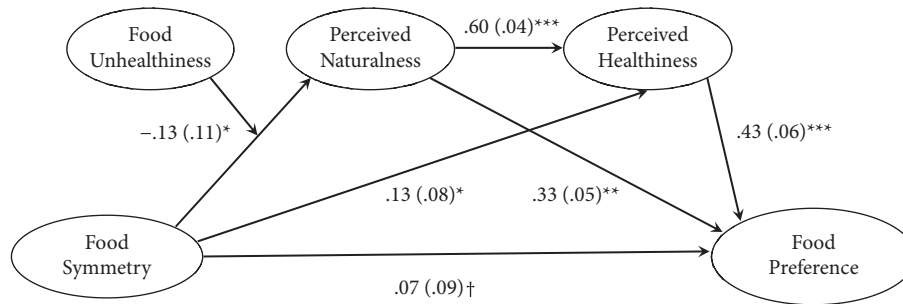


FIGURE 4: Moderated sequential mediation pathways of perceived naturalness and perceived healthiness. Standard errors are in parentheses; all path coefficients are standardized beta values; †  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

TABLE 1: Standardized OLS regression coefficients with 95% confidence intervals estimating perceived naturalness, perceived healthiness, and food preference.

	Perceived naturalness ( $M_1$ )		Perceived healthiness ( $M_2$ )		Food preference ( $Y$ )	
	$\beta$	95% CI	$\beta$	95% CI	$\beta$	95% CI
Food symmetry ( $X$ )	0.54 (0.10)***	(1.11, 1.64)	0.13 (0.08)*	(0.08, 0.59)	0.07 (0.09)†	(-0.02, 0.42)
Perceived naturalness ( $M_1$ )			0.60 (0.04)***	(0.42, 0.70)	0.33 (0.05)***	(0.18, 0.49)
Perceived healthiness ( $M_2$ )					0.43 (0.06)***	(0.26, 0.63)
Food unhealthiness ( $W$ )	0.54 (0.09)***	(0.67, 0.97)	0.21 (0.06)***	(0.16, 0.46)	0.03 (0.07)	(-0.09, 0.19)
Food symmetry $\times$ food unhealthiness	-0.13 (0.11)*	(-0.46, -0.09)	-0.05 (0.07)	(-0.23, 0.04)	0.00 (0.08)	(-0.15, 0.14)
Age	-0.01 (0.01)	(-0.02, 0.01)	0.03 (0.01)†	(0.00, 0.02)	0.02 (0.01)	(-0.01, 0.01)
Gender	-0.01 (0.09)	(-0.20, 0.15)	-0.06 (0.06)*	(-0.25, -0.03)	-0.01 (0.06)	(-0.14, 0.11)
Hunger level	0.10 (0.04)*	(-0.01, 0.19)	0.09 (0.02)*	(0.01, 0.15)	0.08 (0.03)	(-0.02, 0.15)
Purchase frequency	0.11 (0.04)*	(0.00, 0.20)	0.15 (0.02)***	(0.06, 0.18)	0.14 (0.03)**	(0.04, 0.19)
Constant		(2.01, 3.02)		(0.36, 1.20)		(-0.38, 0.39)
	$R^2 = 0.64$		$R^2 = 0.83$		$R^2 = 0.83$	
	$F(7, 299) = 74.22, p < 0.001$		$F(8, 298) = 185.24, p < 0.001$		$F(9, 297) = 165.04, p < 0.001$	

Standard errors are in parentheses. †  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

conducted a separate sequential mediation model (SPSS PROCESS Macro Model 6 with 10,000 bootstrapped draws) with food symmetry as the independent variable, perceived naturalness as the first mediator, perceived healthiness as the second mediator, food preference as the dependent variable, and covariates, for the low, moderate, and high unhealthiness conditions, respectively.

In the low unhealthiness condition, the indirect effect of food symmetry on consumer preference through naturalness and healthiness was significant (effect size = .25, SE = .10, 95% CI = (0.09, 0.49)). The symmetrical food (i.e., whole-meal bread) elicited higher naturalness perceptions ( $\beta = 0.57$ , SE = 0.15,  $t = 7.25$ ,  $p < 0.001$ ), which, in turn, resulted in higher healthiness perceptions ( $\beta = .53$ , SE = 0.07,  $t = 7.33$ ,  $p < 0.001$ ), and ultimately increased consumer preference for this food ( $\beta = .43$ , SE = 0.08,  $t = 5.58$ ,  $p < 0.001$ ). A similar sequential mediation pattern was observed in the moderate unhealthiness condition (effect size = 0.46, SE = 0.20, 95% CI = (0.16, 0.94)). Specifically, giving a moderate healthy item a symmetrical shape increased participants' naturalness perceptions ( $\beta = 0.54$ , SE = 0.24,  $t = 5.71$ ,  $p < 0.001$ ), which sequentially led to higher perceived healthiness ( $\beta = 0.77$ , SE = 0.06,  $t = 11.02$ ,  $p < 0.001$ ), and healthiness perceptions ultimately increased consumer preference for this item ( $\beta = 0.42$ , SE = 0.12,  $t = 4.00$ ,  $p < 0.001$ ). In contrast, we did not observe a significant indirect effect (effect size = 0.13, SE = 0.15, 95% CI = (-0.08, 0.50)).

**3.4.3. Discussion.** Through moderated sequential mediation analysis, Study 3 provides further evidence for our proposed  $H_3$ , in which perceived naturalness and healthiness sequentially mediate the food symmetry effect. Further, Study 3 replicates our main findings in Study 1 and 2, in that symmetrical (vs. asymmetrical) items elicit more naturalness perceptions, which, in turn, results in higher perceptions of healthiness, and ultimately increases consumer preference for that item. Moreover, Study 3 established a boundary condition of the food symmetry effect, in which food unhealthiness attenuates this effect. Specifically, the symmetry effect would only be effective for foods with a low or moderate level of unhealthiness, not those with a high unhealthiness level.

## 4. General Discussion

Aligned with an increased number of research on consumers food preferences and choices, this research found a symmetry effect of food shape on food preference. This means that consumers food perception and choice are not only influenced by the widely explored food taste and food nutrition but also food shapes.

The results of the experiments described in this research show that whether food is symmetrical or asymmetrical influences consumer perceptions of and preferences toward it. Specifically, consumers are more likely to prefer a



symmetrical item over its asymmetrical counterpart, through the two-stage mediation process of perceived food naturalness and healthiness. This current research had two specific aims. The first aim was to test whether symmetrical food is perceived as more natural, and thus healthier, than asymmetrical food. The second aim was to find a boundary condition for this perception, to specify and analyze whether this symmetry effect would hold for food perceived to be unhealthy.

The findings of Study 1 indicated that consumers prefer a symmetrical piece of chocolate to an asymmetrical one, regardless of their hunger level, gender, or age, supporting our initial hypothesis that consumers are more likely to prefer symmetrical to asymmetrical food. This finding is similar to those of previous aesthetic literature showing that symmetry is generally preferred compared with its asymmetry counterpart [9]. Study 2 was designed to replicate the findings of Study 1 in an offline environment using a different type of food. In addition, the current study also verified that the underlying mechanism of this symmetry effect is a two-stage mediation process in which symmetrical foods are perceived as natural and thus healthy, which elicits consumer food preference. The underlying mechanism is consistent with prior findings that naturalness is likely to lead to healthy perception of foods [76]. Nevertheless, a sequential mediation process of naturalness and healthiness between food shape and consumer preference is built through this research. This preference holds among general food choices, but when perceived unhealthiness increases, the symmetry effect could change. Our findings demonstrated that the symmetry–natural–healthy relationship would only be effective for foods with a low or moderate level of unhealthiness, but not those with a high unhealthiness level.

*4.1. Conceptual Contributions for Current Theoretical Frameworks.* Our work makes three contributions to the literature on food consumption. First, we contribute to food choice research [67, 77, 78] using the external cue of symmetry (vs. asymmetry) since it is difficult for consumers to know implicit information (e.g., nutritional value) when making food purchase decisions. Almost every consumer is faced with food choices every day, including deciding what food to buy and how much [1]. These types of decisions also often need to be made within a very limited time period [76, 79–81]. In addition, external cues for food, especially visual cues such as packaging and physical characteristics, are easily spotted and predominantly what consumers process when making decisions [82]. Thus, it is essential to explore all possible external factors that influence consumers' food decisions. Our findings have enhanced this research by demonstrating that customers prefer symmetrical over asymmetrical food.

Second, we also enrich the literature in the fields of psychology and consumer behavior regarding a two-stage mindset process [83–85] Chaiken (1987), by demonstrating that symmetry is an elicited perception of naturalness,

supported the existence of the natural=healthy intuition. This relationship has a similar influence on consumers' food decisions as other beliefs found in prior research, such as the price–quality heuristic and organic=healthy intuition [86–89]; for a review, see [90].

Third, this study may extend the literature on healthy eating. Consumers often intuitively perceive healthy foods to be more expensive and less tasty [54, 91]; however, we found that symmetry contributes to enhancing the perceived naturalness and healthiness of food. Further, this finding was shown to be maintained in foods with high level of perceived healthiness, indicating that perceived unhealthiness plays an important and robust role in consumers' food decisions. In addition, our work demonstrated that natural foods are intuitively believed to be healthy, which empirically contributes to the literature on the health halo effect.

*4.2. Actionable Insights for Managers, Policymakers, and Consumers.* As many reports have shown an ongoing global obesity epidemic [2], policymakers are making efforts to control this trend and maintain a healthy society. Based on the present results, designing food products to be symmetrical could increase consumers perceptions of them as natural and healthy. Thus, policymakers could encourage marketers to produce healthy foods in more symmetrical forms and control the design of relatively unhealthy foods to reduce the effects of a preference for symmetry on unhealthy foods.

Managers in the food industry should pay attention to their food design since visual cues are significant communication tools in modern industry [82, 92]. From a marketing perspective, visual cues are used to draw attention [93–95], provide sensory pleasure and stimulation, and communicate about a product or brand [3]. For individuals, visuals can be aesthetically pleasurable, provide information, and help them make sense of what they see [96]. To follow the recommendation from policies and meet consumers pursuit toward eating healthily, food manufactures need to produce more healthy food. However, healthy food should be presented to consumers without the need for complex information processing, which may require intuitive cues, such as package color and food shape, to help simplify this process. According to our findings, creating products that are symmetrical in design would increase consumer preference by eliciting their perceptions of those products being natural and healthy.

In fact, it is quite difficult for consumers to understand the nutritional composition of food simply through the label on the package. It requires significant effort to systematically process the nutritional information before making every food purchase decision, as people make a vast number of food decisions each year. Under these circumstances, other extrinsic cues are used to calculate how healthy a product is (e.g., price, shape, and aesthetics [97]). Based on our findings, consumers should doublecheck their purchase decisions since symmetrical foods are perceived healthier and more natural simply because of the experience derived from human evolution.

4.3. *Limitations and Avenues for Further Research.* The current research includes three studies conducted with university students. Although this target group is frequently employed in consumer behavior research, representative samples from other groups will be required to boost the robustness of the present findings in future food research. This is because different consumers have various goals when making food purchasing decisions that could possibly exceed the effect of symmetry.

Apart from the symmetry effect on food preference, we also observed that purchase frequency was a significant covariate with food symmetry and exerted a considerable impact on consumers. Future studies could extend the findings on the effect of symmetry on food preference by considering other covariates (e.g., familiarity, basic impression).

Our findings show a main effect of symmetry on consumer perceptions of and preference for food; however, the actual level of consumption for symmetrical food remains unclear. Future research should investigate the real consumption of symmetrical foods since food intake has the most impact on consumers' health.

## Data Availability

The data used to support the findings of this study are included within the article.

## Conflicts of Interest

There are no conflicts of interest to declare.

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## References

- [1] K. L. Haws, R. W. Reczek, and K. L. Sample, "Healthy diets make empty wallets: the healthy=expensive intuition," *Journal of Consumer Research*, vol. 43, 2017.
- [2] WHO, 2016, <https://www.who.int/activities/controlling-the-global-obesity-epidemic>.
- [3] S. Kumar, A. Dhir, S. Talwar, D. Chakraborty, and P. Kaur, "What drives brand love for natural products? The moderating role of household size," *Journal of Retailing and Consumer Services*, vol. 58, Article ID 102329, 2021.
- [4] G. Pleyers, "Shape congruence in product design: impacts on automatically activated attitudes," *Journal of Retailing and Consumer Services*, vol. 61, Article ID 101935, 2021.
- [5] S. Zhou, S. Chen, and S. Li, "The shape effect: round shapes increase consumers' preference for hedonic foods," *Psychology and Marketing*, vol. 38, no. 11, pp. 2051–2072, 2021.
- [6] L. Bello Acebrón and D. Calvo Dopico, "The importance of intrinsic and extrinsic cues to expected and experienced quality: an empirical application for beef," *Food Quality and Preference*, vol. 11, no. 3, pp. 229–238, 2000.
- [7] S.-T. Wei, L.-C. Ou, M. R. Luo, and J. B. Hutchings, "Optimisation of food expectations using product colour and appearance," *Food Quality and Preference*, vol. 23, no. 1, pp. 49–62, 2012.
- [8] A. Bigoin-Gagnan and S. Lacoste-Badie, "Symmetry influences packaging aesthetic evaluation and purchase intention," *International Journal of Retail & Distribution Management*, vol. 46, no. 11/12, pp. 1026–1040, 2018.
- [9] J. Suher, C. Szocs, and K. van Ittersum, "When imperfect is preferred: the differential effect of aesthetic imperfections on choice of processed and unprocessed foods," *Journal of the Academy of Marketing Science*, vol. 49, no. 5, pp. 903–924, 2021.
- [10] A. T. Woods and C. Spence, "Using single colors and color pairs to communicate basic tastes," *I-Perception*, vol. 7, no. 4, Article ID 204166951665881, 2016.
- [11] S. Lacoste-Badie, A. B. Gagnan, and O. Droulers, "Front of pack symmetry influences visual attention," *Journal of Retailing and Consumer Services*, vol. 54, Article ID 102000, 2020.
- [12] C. Velasco, C. Michel, A. T. Woods, and C. Spence, "On the importance of balance to aesthetic plating," *International Journal of Gastronomy and Food Science*, vol. 5-6, no. 6, pp. 10–16, 2016.
- [13] C. Velasco and N. Veflen, "Aesthetic plating and motivation in context," *International Journal of Gastronomy and Food Science*, vol. 24, Article ID 100323, 2021.
- [14] M. E. H. Creusen, R. W. Veryzer, and J. P. L. Schoormans, "Product value importance and consumer preference for visual complexity and symmetry," *European Journal of Marketing*, vol. 44, no. 9/10, pp. 1437–1452, 2010.
- [15] D. Qi, J. Penn, R. Li, and B. E. Roe, "Winning ugly: profit maximizing marketing strategies for ugly foods," *Journal of Retailing and Consumer Services*, vol. 64, Article ID 102834, 2022.
- [16] N. Loebnitz and K. G. Grunert, "The effect of food shape abnormality on purchase intentions in China," *Food Quality and Preference*, vol. 40, pp. 24–30, 2015.
- [17] V. Harrar, B. Piqueras-Fiszman, and C. Spence, "There's more to taste in a coloured bowl," *Perception*, vol. 40, no. 7, pp. 880–882, 2011.
- [18] C. Spence, K. Okajima, A. D. Cheok, O. Petit, and C. Michel, "Eating with our eyes: from visual hunger to digital satiation," *Brain and Cognition*, vol. 110, pp. 53–63, 2016.
- [19] C. Berry and M. Romero, "The fair trade food labeling health halo: effects of fair trade labeling on consumption and perceived healthfulness," *Food Quality and Preference*, vol. 94, Article ID 104321, 2021.
- [20] T. Lavie and N. Tractinsky, "Assessing dimensions of perceived visual aesthetics of web sites," *International Journal of Human-Computer Studies*, vol. 60, no. 3, pp. 269–298, 2004.
- [21] R. Hurling and R. Shepherd, "Eating with your eyes: effect of appearance on expectations of liking," *Appetite*, vol. 41, no. 2, pp. 167–174, 2003.
- [22] M. Li, Y. Jin, J. Zhang, and R. Liu, "Does shape in backgrounds matter? Effects of shape–taste congruence on product evaluations," *Journal of Retailing and Consumer Services*, vol. 67, Article ID 102990, 2022.
- [23] C. Spence and B. Piqueras-Fiszman, *The Perfect Meal: The Multisensory Science of Food and Dining*, Wiley-Blackwell, Hoboken, NJ, USA, 2014.
- [24] D. A. Zellner, E. Siemers, V. Teran et al., "Neatness counts. How plating affects liking for the taste of food," *Appetite*, vol. 57, no. 3, pp. 642–648, 2011.
- [25] C. Michel, A. T. Woods, M. Neuhäuser, A. Landgraf, and C. Spence, "Rotating plates: online study demonstrates the importance of orientation in the plating of food," *Food Quality and Preference*, vol. 44, pp. 194–202, 2015.

- [26] J. Roque, C. Guastavino, J. Lafraire, and P. Fernandez, "Plating influences diner perception of culinary creativity," *International Journal of Gastronomy and Food Science*, vol. 11, pp. 55–62, 2018.
- [27] J. Meyers-Levy and A. M. Tybout, "Schema congruity as a basis for product evaluation," *Journal of Consumer Research*, vol. 16, no. 1, p. 39, 1989.
- [28] C. Velasco, A. T. Woods, and C. Spence, "Evaluating the orientation of design elements in product packaging using an online orientation task," *Food Quality and Preference*, vol. 46, pp. 151–159, 2015.
- [29] I. E. de Hooze, M. Oostindjer, J. Aschemann-Witzel, A. Normann, S. M. Loose, and V. L. Almli, "This apple is too ugly for me," *Food Quality and Preference*, vol. 56, pp. 80–92, 2017.
- [30] N. Turoman, C. Velasco, Y.-C. Chen, P.-C. Huang, and C. Spence, "Symmetry and its role in the crossmodal correspondence between shape and taste," *Attention, Perception, & Psychophysics*, vol. 80, no. 3, pp. 738–751, 2018.
- [31] J. R. Finnerty, "Did internal transport, rather than directed locomotion, favor the evolution of bilateral symmetry in animals?" *BioEssays*, vol. 27, no. 11, pp. 1174–1180, 2005.
- [32] M. Enquist and A. Arak, "Symmetry, beauty and evolution," *Nature*, vol. 372, no. 6502, pp. 169–172, 1994.
- [33] S. W. Gangestad, R. Thornhill, and R. A. Yeo, "Facial attractiveness, developmental stability, and fluctuating asymmetry," *Ethology and Sociobiology*, vol. 15, no. 2, pp. 73–85, 1994.
- [34] G. Rhodes, F. Proffitt, J. M. Grady, and A. Sumich, "Facial symmetry and the perception of beauty," *Psychonomic Bulletin & Review*, vol. 5, no. 4, pp. 659–669, 1998.
- [35] G. Rhodes, A. Sumich, and G. Byatt, "Are average facial configurations attractive only because of their symmetry?" *Psychological Science*, vol. 10, no. 1, pp. 52–58, 1999.
- [36] R. Thornhill and S. W. Gangestad, "The evolution of human sexuality," *Trends in Ecology & Evolution*, vol. 11, no. 2, pp. 98–102, 1996.
- [37] D. Humphrey, "Preferences in symmetries and asymmetries in drawings: asymmetries between ages and sexes," *Empirical Studies of the Arts*, vol. 15, no. 1, pp. 41–60, 1997.
- [38] R. Reber, N. Schwarz, and P. Winkielman, "Processing fluency and aesthetic pleasure: is beauty in the perceiver's processing experience?" *Personality and Social Psychology Review*, vol. 8, no. 4, pp. 364–382, 2004.
- [39] L. Hagen, "Pretty healthy food: how and when aesthetics enhance perceived healthiness," *Journal of Marketing*, vol. 85, no. 2, pp. 129–145, 2021.
- [40] M. W. Morris, T. Menon, and D. R. Ames, "Culturally conferred conceptions of agency: a key to social perception of persons, groups, and other actors," *Personality and Social Psychology Review*, vol. 5, no. 2, pp. 169–182, 2001.
- [41] K. G. Grunert and J. M. Wills, "A review of European research on consumer response to nutrition information on food labels," *Journal of Public Health*, vol. 15, no. 5, pp. 385–399, 2007.
- [42] K. Nadricka, K. Millet, and P. W. J. Verlegh, "When organic products are tasty: taste inferences from an organic = healthy association," *Food Quality and Preference*, vol. 83, Article ID 103896, 2020.
- [43] M. K. Magnusson, A. Arvola, U. Koivisto Hursti, L. Aberg, and P. Sjöden, "Attitudes towards organic foods among Swedish consumers," *British Food Journal*, vol. 103, no. 3, pp. 209–227, 2001.
- [44] M.-F. Chen, "Consumer attitudes and purchase intentions in relation to organic foods in taiwan: moderating effects of food-related personality traits," *Food Quality and Preference*, vol. 18, no. 7, pp. 1008–1021, 2007.
- [45] T. de Magistris and A. Gracia, "The decision to buy organic food products in southern Italy," *British Food Journal*, vol. 110, no. 9, pp. 929–947, 2008.
- [46] B. Goetzke, S. Nitzko, and A. Spiller, "Consumption of organic and functional food. A matter of well-being and health?" *Appetite*, vol. 77, pp. 96–105, 2014.
- [47] B. Combs and P. Slovic, "Newspaper coverage of causes of death," *Journalism Quarterly*, vol. 56, no. 4, pp. 837–849, 1979.
- [48] K. Ditlevsen, P. Sandøe, and J. Lassen, "Healthy food is nutritious, but organic food is healthy because it is pure: the negotiation of healthy food choices by Danish consumers of organic food," *Food Quality and Preference*, vol. 71, pp. 46–53, 2019.
- [49] K. Brunsø, T. A. Fjord, and K. G. Grunert, "Consumers' Food Choice and Quality Perception," *RePEc search*, vol. 61, 2020.
- [50] D. N. Cox, L. Melo, D. Zabarar, and C. M. Delahunty, "Acceptance of health-promoting Brassica vegetables: the influence of taste perception, information and attitudes," *Public Health Nutrition*, vol. 15, no. 8, pp. 1474–1482, 2012.
- [51] V. Lazarevic, "Encouraging brand loyalty in fickle generation Y consumers," *Young Consumers*, vol. 13, no. 1, pp. 45–61, 2012.
- [52] S. P. Nguyen, H. Girgis, and J. Robinson, "Predictors of children's food selection: the role of children's perceptions of the health and taste of foods," *Food Quality and Preference*, vol. 40, pp. 106–109, 2015.
- [53] W. Verbeke, J. Scholderer, and L. Lähteenmäki, "Consumer appeal of nutrition and health claims in three existing product concepts," *Appetite*, vol. 52, no. 3, pp. 684–692, 2009.
- [54] R. Raghunathan, R. W. Naylor, and W. D. Hoyer, "The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products," *Journal of Marketing*, vol. 70, no. 4, pp. 170–184, 2006.
- [55] S. Haasova and A. Florack, "Practicing the (Un)Healthy = tasty intuition: toward an ecological view of the relationship between health and taste in consumer judgments," *Food Quality and Preference*, vol. 75, pp. 39–53, 2019.
- [56] J. Jo and J. L. Lusk, "If it's healthy, it's tasty and expensive: effects of nutritional labels on price and taste expectations," *Food Quality and Preference*, vol. 68, pp. 332–341, 2018.
- [57] C. O. C. Werle, O. Trendel, and G. Ardito, "Unhealthy food is not tastier for everybody: the 'Healthy = Tasty' French intuition," *Food Quality and Preference*, vol. 28, no. 1, pp. 116–121, 2013.
- [58] K. Roininen and H. Tuorila, "Health and taste attitudes in the prediction of use frequency and choice between less healthy and more healthy snacks," *Food Quality and Preference*, vol. 10, no. 4–5, pp. 357–365, 1999.
- [59] R. Kivetz and I. Simonson, "Earning the right to indulge: effort as a determinant of customer preferences toward frequency program rewards," *Journal of Marketing Research*, vol. 39, no. 2, pp. 155–170, 2002.
- [60] K. Roininen, H. Tuorila, E. H. Zandstra et al., "Differences in health and taste attitudes and reported behaviour among Finnish, Dutch and British consumers: a cross-national validation of the health and taste attitude scales (htas)," *Appetite*, vol. 37, no. 1, pp. 33–45, 2001.
- [61] C. de Graaf, F. M. Kramer, H. L. Meiselman et al., "Food acceptability in field studies with US army men and women:



- relationship with food intake and food choice after repeated exposures," *Appetite*, vol. 44, no. 1, pp. 23–31, 2005.
- [62] L. Dubé, H. Fatemi, J. Lu, and C. Hertzler, "The healthier the tastier? USA–India comparison studies on consumer perception of a nutritious agricultural product at different food processing levels," *Frontiers in Public Health*, vol. 4, p. 6, 2016.
- [63] C. Moorman and E. Matulich, "A model of consumers' preventive health behaviors: the role of health motivation and health ability," *Journal of Consumer Research*, vol. 20, no. 2, p. 208, 1993.
- [64] K. Geyskens, S. Dewitte, M. Pandelaere, and L. Warlop, "Tempt me just a little bit more: the effect of prior food temptation actionability on goal activation and consumption," *Journal of Consumer Research*, vol. 35, no. 4, pp. 600–610, 2008.
- [65] J. Aschemann-Witzel, K. G. Grunert, H. C. M. van Trijp et al., "Effects of nutrition label format and product assortment on the healthfulness of food choice," *Appetite*, vol. 71, pp. 63–74, 2013.
- [66] M. Banovic and T. Otterbring, "Athletic abs or big bellies: the impact of imagery, arousal levels, and health consciousness on consumers' attitudes towards plant-based protein products," *Food Quality and Preference*, vol. 87, Article ID 104067, 2021.
- [67] P. Chandon and B. Wansink, "The biasing health halos of fast-food restaurant health claims: lower calorie estimates and higher side-dish consumption intentions," *Journal of Consumer Research*, vol. 34, no. 3, pp. 301–314, 2007.
- [68] G. Loewenstein, "Out of control: visceral influences on behavior," *Organizational Behavior and Human Decision Processes*, vol. 65, no. 3, pp. 272–292, 1996.
- [69] M. Muraven and R. F. Baumeister, "Self-regulation and depletion of limited resources: does self-control resemble a muscle?" *Psychological Bulletin*, vol. 126, no. 2, pp. 247–259, 2000.
- [70] S. Ramanathan and P. Williams, "Immediate and delayed emotional consequences of indulgence: the moderating influence of personality type on mixed emotions," *Journal of Consumer Research*, vol. 34, no. 2, pp. 212–223, 2007.
- [71] W. Stroebe, W. Mensink, H. Aarts, H. Schut, and A. W. Kruglanski, "Why dieters fail: testing the goal conflict model of eating," *Journal of Experimental Social Psychology*, vol. 44, no. 1, pp. 26–36, 2008.
- [72] K. D. Vohs and R. J. Faber, "Spent resources: self-regulatory resource availability affects impulse buying," *Journal of Consumer Research*, vol. 33, no. 4, pp. 537–547, 2007.
- [73] K. G. Grunert, "Food quality and safety: consumer perception and demand," *European Review of Agricultural Economics*, vol. 32, no. 3, pp. 369–391, 2005.
- [74] B. Akdeniz, R. J. Calantone, and C. M. Voorhees, "Effectiveness of marketing cues on consumer perceptions of quality: the moderating roles of brand reputation and third-party information: effectiveness of marketing cues on perceptions of quality," *Psychology and Marketing*, vol. 30, no. 1, pp. 76–89, 2013.
- [75] A. L. Duckworth and M. L. Kern, "A MetaAnalysis of the convergent validity of self-control measures," *Journal of Research in Personality*, vol. 45, no. 3, pp. 259–268, 2011.
- [76] A. J. Cameron, E. Charlton, W. W. Ngan, and G. Sacks, "A systematic review of the effectiveness of supermarket-based interventions involving product, promotion, or place on the healthiness of consumer purchases," *Current Nutrition Reports*, vol. 5, no. 3, pp. 129–138, 2016.
- [77] E. A. Howlett, S. Burton, K. Bates, and K. Huggins, "Coming to a restaurant near you? Potential consumer responses to nutrition information disclosure on menus," *Journal of Consumer Research*, vol. 36, no. 3, pp. 494–503, 2009.
- [78] M. L. Scott, S. M. Nowlis, N. Mandel, and A. C. Morales, "The effects of reduced food size and package size on the consumption behavior of restrained and unrestrained eaters," *Journal of Consumer Research*, vol. 35, no. 3, pp. 391–405, 2008.
- [79] D. R. Bell, D. Corsten, and G. Knox, "From point of purchase to path to purchase: how preshopping factors drive unplanned buying," *Journal of Marketing*, vol. 75, no. 1, pp. 31–45, 2011.
- [80] W. D. Hoyer, "An examination of consumer decision making for a common repeat purchase product," *Journal of Consumer Research*, vol. 11, no. 3, p. 822, 1984.
- [81] B. A. Swinburn, G. Sacks, K. D. Hall et al., "The global obesity pandemic: shaped by global drivers and local environments," *The Lancet*, vol. 378, no. 9793, pp. 804–814, 2011.
- [82] K. L. Sample, H. Hagtvedt, and S. A. Brasel, "Components of visual perception in marketing contexts: a conceptual framework and review," *Journal of the Academy of Marketing Science*, vol. 48, no. 3, pp. 405–421, 2020.
- [83] S. Chaiken, "Heuristic versus systematic information processing and the use of source versus message cues in persuasion," *Journal of Personality and Social Psychology*, vol. 39, no. 5, pp. 752–766, 1980.
- [84] Chaiken and Shelly, "The heuristic model of persuasion," in *Proceedings of the Social Influence: The Ontario Symposium*, ed. M. P. Zanna, J. M. Olson, and C. Peter Herman, vol. 5, pp. 3–39, Hillsdale, NJ, USA, 1987.
- [85] S. Chaiken and A. H. Eagly, "Communication modality as a determinant of persuasion: the role of communicator salience," *Journal of Personality and Social Psychology*, vol. 45, no. 2, pp. 241–256, 1983.
- [86] A. Gneezy, U. Gneezy, and D. O. Lauga, "A reference-dependent model of the price–quality heuristic," *Journal of Marketing Research*, vol. 51, no. 2, pp. 153–164, 2014.
- [87] J. Huber and J. McCann, "The impact of inferential beliefs on product evaluations," *Journal of Marketing Research*, vol. 19, no. 3, p. 324, 1982.
- [88] D. R. Lichtenstein and S. Burton, "The relationship between perceived and objective price-quality," *Journal of Marketing Research*, vol. 26, no. 4, pp. 429–443, 1989.
- [89] D. R. Lichtenstein, N. M. Ridgway, and R. G. Netemeyer, "Price perceptions and consumer shopping behavior: a field study," *Journal of Marketing Research*, vol. 30, no. 2, pp. 234–245, 1993.
- [90] R. S. Hughner, P. McDonagh, A. Prothero, C. J. Shultz, and J. Stanton, "Who are organic food consumers? A compilation and review of why people purchase organic food," *Journal of Consumer Behaviour*, vol. 6, no. 2–3, pp. 94–110, 2007.
- [91] T. A. Brunner, K. van der Horst, and M. Siegrist, "Convenience food products. Drivers for consumption," *Appetite*, vol. 55, no. 3, pp. 498–506, 2010.
- [92] P. H. Bloch, F. F. Brunel, and T. J. Arnold, "Individual differences in the centrality of visual product aesthetics: concept and measurement," *Journal of Consumer Research*, vol. 29, no. 4, pp. 551–565, 2003.
- [93] A. L. McGill and P. Anand, "The effect of vivid attributes on the evaluation of alternatives: the role of differential attention and cognitive elaboration," *Journal of Consumer Research*, vol. 16, no. 2, p. 188, 1989.



- [94] R. Pieters, M. Wedel, and R. Batra, "The stopping power of advertising: measures and effects of visual complexity," *Journal of Marketing*, vol. 74, no. 5, pp. 48–60, 2010.
- [95] J. P. L. Schoormans and H. S. J. Robben, "The effect of new package design on product attention, categorization and evaluation," *Journal of Economic Psychology*, vol. 18, no. 2–3, pp. 271–287, 1997.
- [96] M. W. Long, D. K. Tobias, A. L. Craddock, H. Batchelder, and S. L. Gortmaker, "Systematic review and meta-analysis of the impact of restaurant menu calorie labeling," *American Journal of Public Health*, vol. 105, no. 5, pp. e11–e24, 2015.
- [97] A. Carlson and E. Frazao, "Are healthy foods really more expensive? It depends on how you measure the price," *SSRN Electronic Journal*, vol. 96, 2012.