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*Research Paper*

## Design Complexity: Assessing Cross-Modal Correspondence between Complex Food Images and the Desire to Eat.

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### ABSTRACT

Customers' visualization influences their choice of foods based on the appearance and presentation of food images in marketing communication. Despite the momentous role of complex food images in gaining consumers' attention, the propositions of complex food image effects are rare in sensory cues and food advertising literature. The present study investigated whether complex food images increase consumers' evaluation and predisposition to desire to eat in two experiments with a post-test only between-subject design. Participants ( $N=300$ ) in four design complexity principles 150 (75 complex and 75 simple), 150 (75 aesthetic and 75 displeasing). The findings from the two studies revealed that complex and aesthetic food images significantly increased the desire to eat when the food images in the advertisement are elaborate, attractive, bright, arousal, multiple, and satisfying—indicating a cross-modal correspondence between complex food images and the desire to eat. Palatable positively mediated the relationship between complex, aesthetic food images and the desire to eat. Theoretical and practical implications for design complexity in food marketing communication are discussed.

**Keywords:** Aesthetic food images, complex food images, cross-modal correspondence, design complexity, desire to eat, food cues, marketing communications.

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## 1. INTRODUCTION

Food image proliferation in fast food restaurant marketing communication has gotten to a level of clarification that strongly appeals to our senses, such as visual, gustatory, olfactory, and orosensory. Food cues interact and develop extreme pleasure and reward that are unavoidable to consumers at any given time. Nevertheless, most served food looks less in appearance than in the advertisement. However, so many consumers have not untangled themselves from the influence of complex food images predominantly seen in most fast-food promotions. Sensational transference has played a significant role in explaining how the somatosensory of customers' visualization influences their choice of products based on the visage of the products or how food images are presented in promotions and advertisements (Motoki et al., 2020). The rising advertising media and fast-food restaurant clutter have twisted unprecedented challenges toward the firms' attainment of their goals. Although food images fascinate the desire to eat, most served foods look less in appearance than what is seen in the advertisement, and many consumers have not disassociated from the influence of complex food images seen in marketing media because it slows down readers and achieve eye-catching (attention). Food image's appearance influences the excellent consumer's appetite for the priming, subtle, and potentially far-reaching effects in the presentation that transfer corresponding sensory evaluation and facilitate the consumer's extrinsic interaction with the physical appearance of advertised food images (Keesman et al., 2016). Specifically, the food image's physical appearance is an element of multisensory mechanisms (Chambers et al., 2016), and applying it to the interconnection of senses facilitates the influential triggering of Ghrelin, which is speedily discharged into the bloodstream enabling a spike in hunger and appetite while looking at a detailed food image (Tomono & Tomono, 2020).

Images with greater depth and variety in essential visual elements, color, brightness, and edges are complex visually (Pieters et al., 2010). In particular, food image complexity captures the unstructured variety in the visual qualities of image pixels, whereas design complexity taps the structured variation in terms of specific forms, objects, and their groupings in advertising

(Puškarević et al., 2018). One prospect is that complexity encourages adaptive investigative behavior by awakening curiosity about the relevant presentation in our environment (Sun & Firestone, 2021). Unassertive image gazing is viewed as a precursor or anticipatory stage in food intake. In natural eating circumstances, exposure to a meal's visual appearance and its fragrance is common and induces eating behavior (Blechert et al., 2019).

Past studies have examined food cues in an experimental procedure and have concluded that food cues induced a significant food choice and purchase intention. For example, (Keesman et al., 2016; Tomono & Tomono, 2020; Schienle & Wabnegger, 2021). These studies shed light on the importance of food cues in inducing eating behavior. They argue that food cues have a significant impact on consumers based on consumption behavior. However, exposing people to the sensory cues of delicious food enhances subjective evaluation, craving, and eating, even though the subjects were already full. Consumption-related behaviors could also be triggered through automatic food image appearance processes (Harris et al., 2009). In a new development, Gidlöf et al. (2021) research suggests that hunger and satiety determine how people will pay attention to food images.

The present study relied on design complexity principles to investigate whether complex food images influence the desire to eat and the possibilities of objective evaluation of consumers' response to presented food images, despite the disparity between the complex food images and the physically served food in the restaurant; the consumers have not disassociated from the served foods. Exhibitions involving visuals are fundamental because of their application in fast-food marketing communications. Also of note is its use in fast food marketing communications to promote appetite and food choice (Motoki et al., 2020). The visual proliferation in advertisements depicts the intensity of its inducement on consumers' food choices. The study considered cross-modal interactions in which individuals experienced a desire to eat after seeing presented food images, which would contribute to the participant's response.

The review also highlights the importance of expanding food image advertising research beyond the current discourse. To date, little is known about the impact of complex food images on a desire to eat and how they are used to influence consumers. However, most research has focused on food marketing and health implications, such as obesity, low-nutrient, and high-calorie products. Consequently, we know little about how complex food images affect the desire to eat. This study

fills these information gaps by examining the effect of complex food images using a new technique based on the cross-modal correspondence theory.

## **2. LITERATURE REVIEW**

Several previous studies have examined food advertisements based on cross-modal correspondence. For example, (Spence et al., 2016; Kusumasondjaja & Tjiptono, 2019; Lowe et al., 2018; Lee & Lim, 2020). These studies perceived sensory interaction across food images and senses, which suggests that human senses interact when visual information is presented, and have concluded that food advertisements induce a significant interaction that influences food choices and purchase intention. The ads create a stimulating sensation that interacts with the viewer's senses while processing the visual information (Lee & Lim, 2020).

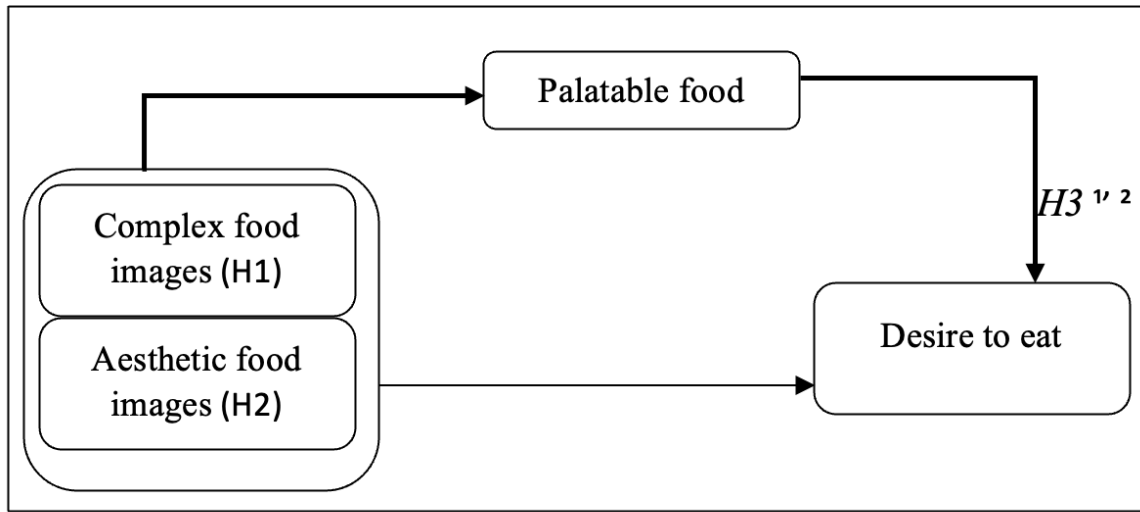
Sensory cues trigger and transfer corresponding to sensory evaluation. Moreover, facilitates the consumer's extrinsic interaction with the physical appearance of cues. Previous sensory research has indicated that cues such as food images correspond with the brain's senses and create an interaction for instance, subtle differences in food perception (Domracheva & Kulikova, 2020). There is a significant margin of cross-modal retrieval strategies for food images and cooking recipes (Wang et al., 2021). Overlooking the present methods on a cross-modal recipe search, and either figure or recipe essentials can be altered during food image generation (Sugiyama & Yanai, 2021). However, there was greater taste awareness, bulk consumption, product endorsement, preference, and sensual cross-modal impacts of progressive pictorial and taste cues on gustatory sensitivities (Biswas et al., 2021). The transformed measured values resulted from the increased drive to eat, given that the episodic memory remembered and matched the food image with smell, which indicated a high sense of food presentation (Tomono & Tomono, 2020). Specifically, these previous studies perceived the effectiveness of food (smell, taste, images) cross-modally interacting with the brain's senses when presented as a cue in food advertisements.

Past research on food image aesthetics and prettiness has demonstrated that food image aesthetics plays a fundamental role in presentation and visualization. Consumers' visual aesthetics gauge and analyze presented food images to distinguish and determine whether any food image is pleasing and rewarding fondness (Sheng et al., 2021). Moreover, it draws attention to food image advertisements because they convey feelings of friendliness, arouse loving memories, mesmerize illusions, and orchestrate the desire to eat (Sheng et al., 2021). For example, subjects liked the

chicken and the sauce more when presented in a more attractive manner (Zellner et al., 2014). The meal presentation was perceived as artistic, and the participants were willing to pay more (Michel et al., 2015). The participants liked food more and were willing to pay more when food was horizontally and centrally presented (Rowley & Spence, 2018), which ascribed that unattractive food weakened consumers' self-esteem (Grewal et al., 2019). These previous studies delineated insightful revelations on the aesthetic appreciation of food images, depicting the extent of beauty, arts, and enjoyment in food presentation.

Neuroimaging research recently discovered that palatable foods are proficient in stimulating brain circuitry in the amygdala, which activates response to food cues or desire to eat (Hardaway et al., 2019). Palatability is a psychological and physiological evaluation arising from the visual assessment of food images and decoding of the liking, pleasantness, taste, and satisfaction from its appearance. Palatable food stimulates the recompense system, thereby influencing consumption behavior. Food abundant in fat and sugar will intensify food consumption, which signifies the action and expression of indicators regulatory to appetite and will orchestrate prolonged consumption (Erlanson-Albertsson, 2005).

Based on previous studies on food images and advertising, we hypothesized the positive effect of complex food images compared to simple food images. (H1) Participants exposed to complex food images will elicit a more favorable desire to eat than consumers exposed to simple food images. (H2) Participants exposed to aesthetic food images will elicit a more favorable desire to eat than consumers exposed to displeasing food images. (H3) Palatable food positively mediated the relationship between complex, aesthetic<sup>2</sup> food images and the desire to eat. Finally, we also question whether complex food images influence the desire to eat. Food advertisements using complex visual cues generate more fun and excitement than less simple visuals. Food cues attract more attention and desire to eat and promote restaurant products, which are perceived to be multi-sensory modalities to achieve organizational goals.



**Figure 1.** Conceptual framework

### 3. STUDY 1

#### 3.1 Method and materials

A single-factor post-test-only between-subject design experiment with two manipulated conditions (complex and simple) was designed to investigate a cross-modal correspondence between complex food images and the desire to eat, and the mediating role of Palatable on the relationship between complex food image and the desire to eat. The complex or simple food images represent the between-subject design of the experiment. Complex images have high visual realism and semantic consistency; the bandwidth resolution is high (design complexity) and consists of various degrees of elements in the layout (feature complexity) intended to evoke the processing of the cues presented. Simple images with low bandwidth resolution without multiple components are designed to dissuade the processing capabilities of the cue given (Da Silva et al., 2011; Pan et al., 2020; Yu & Winkler, 2013).

The experimental stimuli in study one comprised two versions of barbecued chicken (Duo roasted Chicken wings and roasted wings) and all-time favorite pasta (Creamy Carbonara and Chicken Chop Asam Pedas pasta). Adapted from one of the prominent fast-food restaurant advertisements based on the definition of complexity, Pieters et al. (2010) highlighted that complexity involves two distinctive aspects; feature and design complexity. Feature complexity accounts for the

number of elements present in any given layout, and design complexity accounts for the detailed variation in the layout that conveys the primary visual form, such as color, shape, brightness, and edge patterns of a layout. We aim to present complex food images in design and features to reinforce and sensitize consumers' desire to eat while looking at complex food images. An actual food image that incorporated complex features and designs, for instance, shape, color, illumination, detail, elaborate, edge, and pattern, was used in the experiment. The background was not altered except for the removed price tag, and we did not tamper with the slogan, logo, or brand name. While the simple stimulus was a simple food image without elaborate, detailed variation and made up of on single food, intentionally meant to dispossess control group participants from having thoughts of complex food images while responding to the questions.



**Figure 2.** Complex image (www.pizzahut.com).



**Figure 3.** Simple image (Our own)



Barbecue chicken (Duo roasted Chicken wings and roasted wings) and all-time favorite pasta (Creamy Carbonara and Chicken Chop Asam Pedas pasta) (Figure 2) were selected as appropriate food images from Pizza Hut Restaurant for the first experiment and several reasons: 1. The appearance of the barbecue chicken and pasta is eye-catching. 2. The uniqueness of the barbecue and pasta is exceptional. 3. The healthy nature of barbecue chicken and pasta makes it an irresistible and favorite food for everyone. Finding nourishing foods – is the brain's fundamental responsibility, which relies mainly on visualization, especially in an accustomed food search (Spence et al., 2016). The simple food image in Figure 3, was a random picture we took from the street food, which does not require any detail variation because it is a control stimulus.

All-inclusive, 150 (75 complex and 75 simple) participants in two condition groups (one for treatment and one for control) participated in an online experiment. We utilized convenient sampling to recruit participants through an online survey-embedded experiment from various

social media platforms such as Weibo, Facebook, Instagram, LinkedIn, WhatsApp, and Telegram after getting their consent that they will participate in the experiment on 23rd October 2022. To enrich the data quality, we required participants to meet specific criteria. However, all the participants were required to (1) be non-vegetarian and (2) non-diabetic; they filled and returned the form on 30th October 2022, which ascertained their eligibility to participate in the experiment and those that meet the selection criteria were included to participate in the experiment. On 2nd November 2022, the participants were randomly assigned to complex or simple food image conditions using a web-based randomization system after being numbered, before receiving the digital banners according to their treatment before filling out the questionnaire, and on 9th November 2022, we completed the entire data collection.

### **3.2 Measures**

Puškarović et al. (2018) study and Blechert et al. (2019) food images and viewing analysis and subscale used complex to test the manipulation of complex food images. The complex food images were assessed with a six-item consisting of (brightness/dark, elaborate/simple, multiple image/single image, and arousal/unaroused, interest/not interested, likable/unlikeable) on a 7-point extreme adjectival bipolar scale. After visually evaluating the food images, the participants were asked to rate their likeness to eating the food, 1 unlikely and 7 very likely. For instance, how bright is the food image; does it make you feel like eating? Palatable was measured with six subscales consisting (of enjoyment/displeasure, satisfied/unsatisfied, rewarding/unrewarding, arousal, attractive/unattractive, and beautiful/ugly).

A five-item scale measured the dependent variable for the desire to eat (Van Strien et al., 2016) using a 7-point extreme adjectival bipolar (1=very unlikely and 7=very likely). For example, looking at the food images, I feel like eating. Cronbach's alpha was utilized to verify the reliability of scales and measure the internal consistency of a group of items (See Appendix 1) (e.g., the items used to measure complexity and desire to eat). Complex food image items were satisfactory with a coefficient alpha of ( $\alpha \geq .99$ ). Next, the desire to eat items showed an excellent coefficient alpha of ( $\alpha \geq .99$ ).

### **3.3 Results**

As a manipulation check, after visually appraising the food images, we asked participants whether they had seen multiple food images and whether complex food images on the food advertisement influenced their desire to eat; after asking all questions about the food image complexity, 99.3%



answered correctly. To verify whether the manipulation was successful, we conducted an independent sample t-test; the result revealed that complex food image ads ( $M=73.160$ ,  $SD=2.885$ ) compared to simple ads ( $M=13.040$ ,  $SD=1.969$ ) demonstrated a statistically significant effect  $t(148)=148.050$ ,  $P<.001$ . The complex food image ad with a significantly larger mean depicts the effect of the treatment on consumers exposed to complex food image advertisements. Thus, it supports that participants exposed to complex food images elicit a more favorable desire to eat than consumers exposed to the simple ad (H1).

### **3.4 Mediation analysis for complex food image**

The study evaluated the mediating role of palatable foods on the relationship between complex food images and the desire to eat. We conducted mediation analysis using the Process v2.15 macro in SPSS (Hayes, 2013; model 4). The outcome variable is the desire to eat, and the predictor variable for the analysis is complex food images. Whereas the mediator variable for the analysis was palatable. The results revealed a significant indirect effect of aesthetic food images on the desire to eat ( $\beta = .284$ ,  $SE = .1026$ ,  $p < .001$ ), supporting H3<sup>1</sup>. Furthermore, the direct effect of aesthetic food image on the desire to eat in the presence of the mediator was significant ( $\beta = .685$ ,  $SE = .038$ ,  $p < .001$ ). However, palatable partially mediated the relationship between complex food images and the desire to eat.

In summary, study 1 demonstrated that complex food image in advertising positively increases the desire to eat, indicating a cross-modal correspondence between complex food images and the desire to eat. One prospect is that complexity encourages adaptive investigative behavior by awakening curiosity about the relevant presentation in our environment (Sun & Firestone, 2021).

## **4. STUDY 2**

### **4.1 Method and materials**

The second experiment was a post-test-only between-subjects experiment, similar to study 1, with two manipulated conditions, aesthetic (aesthetic and displeasing), was designed to verify study 1 by investigating a cross-modal correspondence between aesthetic food images and desire to eat and the mediating role of palatable on the relationship between aesthetic food image and the desire to eat. The aesthetic or displeasing food images represent the between-subject design of the experiment. The aesthetic is a concept of beauty, the senses, the feeling of pleasantness, and artistic values intended to evoke cognitive processing; Aesthetics is something special, an unexpected

experience that breaks the dullness of everyday life, and something we pay extra attention to. While displeasing is ugly, unattractive, uninspired, and emotional detachment intended to dissuade the control group from having aesthetic feelings (Augustin et al., 2012; Paakki et al., 2019; Miele & Murdoch, 2002).

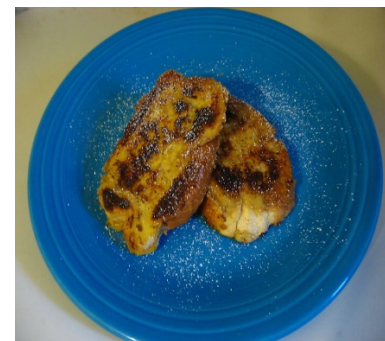
The stimuli in the second study consist of two versions of salad and soup (Caesar Salad and Hawaiian Chicken Salad) and (Mama Mia meatball), fast food restaurant advertisement banners adopted based on the definition of complexity, Pieters et al. (2010) averred that complexity comprises two unique facets; feature and design complexity. Feature complexity depicts the number of components present in any given outline, and design complexity accounts for the detailed variation in the layout that conveys the primary visual form, such as color, shape, brightness, and edge patterns of a layout (Puškarević et al., 2018). We aim to present aesthetic food images in beauty, appealing to freshness, seasonality, and typicality, to strengthen and sensitize consumers' desire to eat while looking at complex food images. Aesthetics is the concept and notion of fine arts, such as beauty, senses, enjoyment, rewards, and sensation of pleasurableness and creative values (Augustin et al., 2012; Paakki et al., 2019; Miele & Murdoch, 2002). The background was not altered, and we did not remove the slogan, logo, or brand name; instead, we removed the price tag to reduce sensitivity and allow a free emotional attachment. The displeasing stimulus was a displeasing food image, ugly, unattractive, uninspired, and emotional detachment. It was intended to deprive control group participants of having thoughts about aesthetic food images or emotional attachment while responding to the questions.



**Figure 4.** Aesthetic (www.pizzahut.com)



**Figure 5.** Displeasing (Our own)



Vegetable salad and soup (Caesar Salad and Hawaiian Chicken Salad) and meatballs (Mama Mia meatballs) (Figure 4) were selected as suitable food images from Pizza Hut Restaurant for the

second experiment for several reasons: 1. It is a healthy choice because it does not contain cholesterol. 2. Naturally low in calories and sodium. 3. The visual appearance of vegetable salad soup, and meatballs leads to foraging and the desire to eat. 4. The vegetable salad, soup, and meatballs are eye-catching. Searching for nourishing food sources is unquestionably indispensable for human health, an activity where visualization plays an essential role (Spence et al., 2016). The displeasing food image in Figure 5, was a random picture from street food without any detail variation.

In general, 150 (75 aesthetic and 75 displeasing) participants in two condition groups (one for treatment and one for control) participated in an online experiment. Participants were recruited through social media platforms, for instance, Instagram, Facebook, and WhatsApp, like in study 1, which facilitated the collection of many responses from diverse participants. The same selection criteria in Study 1 were applied to select participants in this study. The participants in this study do not have any pre-knowledge of the study 1 stimulus or this very study stimulus before the test to avoid bias that might cause invalid data. The participants were randomized into aesthetic or displeasing as in Study 1 and each participant was exposed to only one of the two stimuli in the experiment before completing the questionnaire. Of participants in Study 2, 55.3% were male, and the age distribution was following order: 19 -25 (25.3%), 41-46 (22%), 31-35 (20%), and 36-40 (17.3%), and 26-30 (15.3%). The marital status was as follows: Single (52.7%), Married (38%), Divorced (7.3%) and Widowed (2%).

#### **4.2 Measures**

Based on Miniukovich & Marchese's (2020) study and Blechert et al. (2019) food image viewing analysis and scale, we used aesthetics to test the manipulation of complex food images because of the link between complexity and aesthetics. After visually assessing the food images with experiment 1, the participants were asked to rate their likeness to eating the food, 1 unlikely and 7 very likely. The aesthetic was evaluated with a seven-item comprised of (attractive/unattractive, appealing/unappealing, likable/unlikeable, beautiful/ugly, not tasty/tasty, unsatisfied/satisfied, unaroused/aroused) on 7-point extreme adjectival bipolar scale. For example, how attractive is the food image; does it make you feel like eating?

The dependent variable was assessed with a five-item scale for the desire to eat (Van Strien et al., 2016) using a 7-point extreme adjectival bipolar (1=very unlikely and 7=very likely). For example, looking at the food images, I feel like eating. We used Cronbach's alpha to verify the scale

reliability and internal consistency of a group of items or constructs (See Table 1. Appendix) (e.g., the items used to measure were aesthetic and desire to eat). Aesthetic items were satisfactory with a coefficient alpha of ( $\alpha \geq .99$ ). Whereas the desire to eat items was excellent with a coefficient alpha of ( $\alpha \geq .99$ ).

### 4.3 Results

As a manipulation check, after visually assessing the food images, we asked participants to indicate whether they had seen elaborate and attractive food images on the advertisements presented after asking all questions about the food image aesthetic; 98.7% answered correctly. To authenticate whether the manipulation was successful, we conducted an independent sample t-test; the result revealed that aesthetic food images ads ( $M=80.653$ ,  $SD=2.586$ ) compared to displeasing ( $M=15.320$ ,  $SD=1.55$ ) demonstrated a statistically significant effect  $t(148)=138.036$ ,  $P<.001$ . Thus, it supports that participants exposed to aesthetic food images elicit a more favorable desire to eat than consumers exposed to displeasing food images H2.

### 4.4 Mediation analysis for complex food image

We assessed the mediating role of palatable foods on the relationship between aesthetic food images and the desire to eat. We conducted mediation analysis using the Process v2.15 macro in SPSS (Hayes, 2013; model 4). The outcome variable is the desire to eat, and the predictor variable for the analysis is aesthetic food images. Whereas the mediator variable for the analysis was palatable. The results revealed a significant indirect effect of aesthetic food images on the desire to eat ( $\beta = .2137$ ,  $SE = .1066$ ,  $p < .001$ ), supporting H3<sup>2</sup>. Furthermore, the direct effect of aesthetic food image on the desire to eat in the mediator's presence was significant ( $\beta = .771$ ,  $p < .001$ ). However, palatable partially mediated the relationship between aesthetic food images and the desire to eat.

In summary, study 2 confirmed the positive effect of aesthetic food images in the advertisement because visual complexity provides the participants with an aesthetic encounter up to an ideal level (Lee & Lim, 2022) that increases the desire to eat and the cross-modal correspondence between complex food images and desire to eat.

## 5. DISCUSSION

Apprehensive of the consciousness of design complexity, this study investigates the effect of complex food images on the desire to eat. We used complex and aesthetic food images in four

advertisements presented to participants in two experiments to verify the effects and cross-modal correspondence between complex food images and the desire to eat because of the psychological and physiological mechanisms involved in food images and the desire to eat. Study 1 results revealed that complex food image ads (vs. simple ads) were rated significantly more with bright, elaborate, multiple, aroused, interesting, and likable. In contrast, simple ads (vs. complex ads) were rated less with dark, simple, single, unaroused, uninteresting, and unlikeable. Whereas study 2 depicted aesthetic food images (vs. displeasing ads) were rated significantly more as attractive, appealing, likable, beautiful, tasty, satisfying, and arousing. However, displeasing ads (vs. aesthetic ads) were rated less with unattractive, unappealing, unlikeable, ugly, unsatisfied, and unaroused. The food feature aesthetics associations likely stemmed from the massive assortment of design features that could be twisted to create several layout and component conformations (Miniukovich & Marchese, 2020).

The two studies delineated a significant revelation on cross-modal correspondence between complex food images and the desire to eat. In particular, the food image's physical appearance is an element of multisensory mechanisms (Chambers et al., 2016), and applying it to the interconnection of senses facilitates the influential triggering of Ghrelin, which is speedily discharged into the bloodstream enabling a spike in hunger and appetite while looking at a detailed food image (Tomono & Tomono, 2020).

Study 1 probed the proposed cross-modal procedure by assessing the effects of complex food images on the desire to eat. The findings of study 1 revealed that people exposed to complex food image ads elicited a greater desire to eat than participants unexposed, which signifies cross-modal correspondence between complex food images and the desire to eat—indicating that complex food images generate participants' more desire to eat because of the psychological and physiological mechanisms. Study 1 supports the findings of (Spence et al. 2016; Kusumasondjaja & Tjiptono, 2019; Lowe et al., 2018; Lee & Lim, 2020). These studies perceived sensory interaction across food images and senses, which suggests that human senses interact when visual information is presented, and have concluded that food advertisements induce a significant interaction that influences food choices and purchase intention.

The findings of study 2 further elucidated the inseparable stance between complexity and aesthetics. The findings revealed that participants exposed to aesthetic food images elicited a more favorable desire to eat than participants exposed to displeasing ads, suggesting a cross-modal

correspondence between aesthetic complex food images and the desire to eat. Study 2 is consistent with the findings of (Sheng et al., 2021; Zellner et al., 2014; Michel et al., 2015; Rowley & Spence, 2018; Grewal et al., 2019). These previous studies delineated insightful revelations on the aesthetic appreciation of food images, depicting the extent of beauty, arts, and enjoyment in food presentation.

Overall, the findings of the two studies corroborated the belief in food advertising literature that food images or food cues stimulate the brain and cause a cross-modal interaction between complex food images and the desire to eat. Specifically, the food image's physical appearance is an element of multisensory mechanisms (Chambers et al., 2016), and applying it to the interconnection of senses facilitates the influential triggering of Ghrelin, which is speedily discharged into the bloodstream enabling a spike in hunger and appetite while looking at a detailed food image (Tomono & Tomono, 2020). The findings delineated the impact of design complexity, which tends to increase appetite when food images are elaborate, beautiful, bright, attractive, multiple, and satisfying. Images with greater depth and variety in essential visual elements, color, brightness, and edges are more visually complex (Pieters et al., 2010). The present study extended the scope of food image studies by investigating the effect of design complexity, which consists of the design complexity principles and components.

The findings of this study offer practical and essential implications for the present-day fast-food restaurant and food advertisement spread across different digital media and mass media platforms. Besides, it draws attention to food image advertisements because it conveys feelings of friendliness, arouses loving memories, mesmerizes illusions, and orchestrate the desire to eat (Sheng et al., 2021). The study findings suggest that fast food restaurant and marketing communication uses design complexity principles such as complexity and aesthetics to create complex food images and initiate interaction towards achieving communication across the different facets of consumers and achieve a maximum level of optimal brand patronage, loyalty, and favorable behavioral change.

The study further revealed that palatability plays a crucial role in complex food images' effect on the desire to eat. Therefore, designing complex food images requires an element of palatability to increase enjoyment, reward, satisfaction, and arousal tendencies that will trigger hunger and desire to eat because palatability mesmerizes emotions and triggers hunger and desire to eat while looking at the food images (Hardaway et al., 2019).

## **6. CONCLUSION**

Consumers' visual aesthetics gauge and analyze presented food images to distinguish and determine whether any food image is pleasing and rewarding fondness (Sheng et al., 2021). The study depicted cross-modal interactions between complex food images and the desire to eat. The participants elicited an increased desire to eat when the food images were attractive, elaborate, bright, beautiful, arousal, satisfactory, multiple, and likable.

The findings come up with valuable information that explicates the effect of complex food images. The empirical procedures and affirmation of the study disclosed that complex food images tend to positively increase the desire to eat when the food image ads are attractive, elaborate, bright, beautiful, arousal, satisfactory, multiple, and likable. Invigorating cross-modal interactions in the middle of divergent senses has been a basic grand design or stratagem in food marketing and advertising (Lee & Lim, 2022; Spence et al., 2010). The study applied cross-modal correspondence to examine the complex food images' effects on the desire to eat. Cross-modal correspondences have been termed as a propensity for sensory characteristics, or elements, in one procedure, either tangibly present or simply imaginary, to be corresponding (or related) with a sensory trait in an additional sensory modality (Spence, 2012).

### **6.1 Limitations**

The study encountered some limitations. First, limited literature on complex food images because the concept has not been widely researched. Second, a methodological approach focused only on an online experimental survey, which could have been a restaurant setting or a real-time laboratory study with valid data. Finally, the analysis focused on independent t-tests only because we did not expand our study to other sub-levels of the variable used in the study.

### **6.2 Future Research**

Future research should focus on studying the sub-levels of the variables used in the context of this study, such as complex features and design, such as brightness/dark, elaborate/simple, multiple image/single image, and arousal/unaroused, interest/not interested, likable/unlikeable. Aesthetic: attractive/unattractive, appealing/unappealing, likable/unlikeable, beautiful/ugly, not tasty/tasty, unsatisfied/satisfied, unaroused/aroused. And apply other analyses like ANOVA and the Post Hoc test. A real-time approach should be adopted to increase the validity of the data and achieve a reliable study.

### Compliance with Ethics Guideline

This work is part of the ongoing work approved by JKEUPM in February 2022 and does not involve any procedure that will be harmful to human or animal subjects.

**Consent to Participate:** Participants are given relevant project information, including legal data protection information, in a form they can retain indefinitely. Participants have the right to ask a question on any part of this study that is not clear. Participants can withdraw from any part of the study if he/she wishes to withdraw.

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**Appendix 1.** Measurement Scale and Cronbach’s alpha for experiments 1 and 2

Variables		Items	Responses scale	Cronbach’s Alpha	
				1 <sup>st</sup> Exp.	2 <sup>nd</sup> Exp.
Manipulation Checks	Complex food images	<ul style="list-style-type: none"> <li>How bright is the food images</li> <li>How elaborate is the food images</li> <li>How multiple is the food images</li> <li>How aroused is the food images</li> </ul>	7-point Semantic differential scale	.995	
	Desire to eat	<ul style="list-style-type: none"> <li>How interesting is the food images</li> <li>How likeable is the food images</li> <li>Does the food images makes you feel like eating</li> <li>Does the food images trigger your desire to eat</li> <li>Do you have desire to eat looking at the food images</li> <li>Would you like to place an order for the food</li> <li>Looking at the food images pleasantness does it make you feel like eating</li> </ul>	1=Very unlikely 2=Unlikely 3=somewhat unlikely 4=neither unlikely nor likely 5=somewhat likely 6=Likely 7= Very likely		
	Aesthetic of food images	<ul style="list-style-type: none"> <li>How attractive is the food images</li> <li>How appealing is the food images</li> <li>How likeable is the food images</li> <li>How beautiful is the food images</li> </ul>	7-point Semantic differential scale		
	Desire to eat	<ul style="list-style-type: none"> <li>How tasty is the food images</li> <li>How satisfied is food images</li> <li>How aroused is the food images</li> <li>Does the food images makes you feel like eating</li> <li>Does the food images trigger your desire to eat</li> <li>Do you have desire to eat looking at the food images</li> <li>Would you like to place an order for the food</li> <li>Looking at the food images pleasantness does it make you feel like eating</li> </ul>	1=Very unlikely 2=Unlikely 3=somewhat unlikely 4=neither unlikely nor likely 5=somewhat likely 6=Likely 7= Very likely	.996	.995

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