# SEEING IS TASTING:
# EFFECTS OF VISUAL DESIGN ON MULTISENSORY FOOD EXPERIENCE IN THE CONTEXT OF ONLINE PLATFORMS

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# ACKNOWLEDGEMENTS

ONLY JESUS

# ABSTRACT

This study investigated whether and how food imagery with repetition and different compositional lines influences crossmodal correspondences between vision and taste in the context of food consumption through Instagram (Study 1) and an online food ordering platform (Study 2). Using cheeseburgers and iced tea photos as visual stimuli, the results revealed that, in many cases, the effect of repetition on visual appeal significantly increased from 1 item to 2-item repetition, but the perceived visual appeal did not significantly increase from 2-item to 3-item repetition. This finding indicates that 2-item repetition may be an optimal level of complexity for pleasing, after which further visual complexity decreases the viewer's pleasure. Particularly, the results from beverage imagery showed that the effect of repetition was found in the right diagonal condition. For the cheeseburger photos, the results showed that differences between types of compositional lines were found in 3-item repetition. Although the significantly different pairs of compositional lines were not exactly the same in both the Instagram and online food ordering platform settings, this study found that horizontal compositions had a lesser effect on visual appeal compared to other compositions throughout the cheeseburger and iced tea experiments. In addition, right diagonal lines were relatively more effective in terms of visual appeal and the crossmodal responses, except for the cheeseburger in Study 2. A series of experiments provided evidence of crossmodal correspondences between vision and taste by demonstrating serial mediating effects of visual appeal and taste perception on behavioral intention. The results of this study also suggest guidance

for industry practitioners in planning and executing multisensory marketing strategies with their online food imagery; for example, using menu photos with repetition of food items (e.g., 2-item repetition) and a specific type of compositional line (e.g., right diagonal composition) is more effective for taste perception and behavioral intention rather than just using incidental menu photos. Taken together, the findings of this study provide insights with regard to multisensory food research by elucidating empirical evidence on the visual principles of repetition and compositional lines and a mechanism of multimodal correspondences.

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# CHAPTER ONE
# INTRODUCTION

## 1.1. Phenomenon Statement

### Multisensory Marketing with a Focus on Food

Our perceptions of environments are multisensory by nature (Spence, Puccinelli, Grewal, & Roggeveen, 2014). Consumer researchers have predicted the rise of sensory marketing (Hilton, 2015); as consumer markets become increasingly fragmented from the mass market to heterogeneous segments (Hultén, Broweus, & van Dijk, 2009). In this context, firms can use multisensory marketing to gain a competitive advantage (Spence et al., 2014). An example of the successful utilization of multisensory appeals is Dunkin' Donuts' marketing campaign in South Korea, which was designed to promote its newly released coffee. The company installed a device called *flavor radio* on buses in Seoul, which sprayed the aroma of the coffee when the Dunkin' Donuts jingle played on the bus speaker. As a result of such multisensory arousal on the bus, Dunkin' Donuts stores located near bus stops had a 16% increase in visits and a 29% increase in sales (Annear, 2012). As evidenced by this example, multisensory marketing is important in the foodservice industry (Spence & Piqueras-Fiszman, 2014), because food and restaurant experiences are formed by the intergration of all five senses. Imagine a scene in which a waiter brings the dish you have ordered dish and places it on the table in front of you. At its presentation, your eyes initiate the appreciation of the food, and your nose smells the aroma before you taste the dish. While the tastebuds in your mouth experience a bite of your steak, your ears might listen to nostalgic music playing in the restaurant. While chewing the juicy food in

your mouth, you might look around at the interior design items in some nooks of the restaurant, or you might gaze at the action of the waiter pouring red wine into your glass with a trickling sound under the ambient light of the restaurant.

Such a multisensory food experience can be elucidated by the brain's multimodality, due to which people cannot discern between different tastes without input from the other senses (Krishna, 2012). Among the five senses, vision takes a leading role in sensory perception today, as today's consumers in the digital age are visually stimulated more than ever before. Food marketers have been responding to this trend by increasingly utilizing crossmodal relations between vision and taste to stimulate a positive experience of food consumption (Spence, Levitan, Shankar, & Zampini, 2010). A great amount of the literature has supported the notion that vision significantly affects taste perception more than any of the other senses, and a visual presentation of food is found to have a significant impact on a viewer's taste perception and liking for food (Krishna, Cian, & Sokolova, 2016; Michel, Velasco, Gatti, & Spence, 2014; Zellner, Loss, Zearfoss, & Remolina, 2014).

**Food Presentation on a Digital Platform**

With the development of digital technologies, multisensory marketing provides increasing market value, because personalized online environments can intensify sensory experiences with increased marketing persuasiveness (Hultén et al., 2009). The interaction between different senses has been intensely studied in the context of online environments, as a great deal of consumption has been transferred from brick and mortar stores to online stores (Petit, Velasco, & Spence, 2019). Particularly in the digital platform, visual presentation plays an important role in converting and engaging online audiences (Chaffey & Ellis-Chadwick, 2019).

This dissertation attempts to examine how visual presentations of food engage and convert consumers through multisensory perceptions of vision and taste in the context of two major online marketing channels for restaurants: social media and online food delivery services. In the era of social media, photos and videos are important means to facilitate social exchanges online (Rainie, Brenner, & Purcell, 2012), as evidenced by the current popularity of Instagram, a photo-based social media platform. For example, it is reported that 60% of Instagram users search for new products on Instagram, and brand engagement on Instagram is 10 times higher than on other social media platforms (Smith, 2019). According to Hu, Manikonda, and Kambhampati (2014), food is one of the most popular categories of photos that people share on Instagram. Consumers post and share food photos not only to document self-creation, special occasions, restaurant reviews, and recipe tutorials (Coary & Poor, 2016) but also to receive and provide social support (Chung, Agapie, Schroeder, Mishra, Fogarty, & Munson, 2017). For this reason, Instagram has become one of the most important marketing channels for restaurants, for example, in the United States, 30% of young consumers between 18-35 reported that the presence of restaurants on Instagram influences their restaurant preference and visit intention (Donnelly, 2019).

The second study context that this study examines with regard to the effects of the visual presentation of food on multisensory perception is that of online food delivery services (hereinafter, the term *online* is used to refer to both websites and mobile apps). Online food delivery services haave become more popular over the past few years as advanced digital technology has enabled consumers to access diverse food ordering channels, such as restaurants' own websites and mobile apps, restaurants' social media platforms (e.g., Facebook's embedded "Order Food" option), and online food ordering delivery services (e.g., Grubhub, DoorDash). In the United States, 60% of consumers reported that they used online food ordering services at

least once a month as of 2018 (Everett, 2019), and restaurant revenue from the online delivery services increased by 45% in 2017 and 2020 (Statista, 2020). Therefore, it is critical for restaurants to develop effective strategies to attract, engage, and convert consumers in this emerging marketing channel. To this end, this study highlights the role of the visual presentation of food, which is found to be effective in attracting consumers' attention (Gonsalves, 2012) in the early stages of their browsing.

## 1.2. Problem Statement

The present study addresses three major issues associated with multisensory taste perception in relation to the current digital platforms. First, few studies in the literature have focused on the effects of specific visual design principles in food presentation. Although the effects of food presentation can be determined by diverse design principles as studied in visual design and photography, the extant literature in food research has for the most part examined a limited number of visual elements, such as colors (e.g., Shermer & Levitan, 2014), shapes (e.g.,Velasco, Woods, Deroy, & Spence, 2015), visual arrangement on the plate (e.g., Michel, Woods, Neuhäuser, Landgraf, & Spence, 2015), and the culinary viewpoint of food presentation (e.g., Zellner et al., 2014). Adopting the knowledge of visual design and photography, this study focuses on two visual design techniques that are frequently applied to food photography: repetition and compositional lines. Repetition attracts viewers' gaze and increases visual interest (Parks-Whitfield, 2012), while compositional lines, a technique of photographic composition, guide viewers' eyes and evoke specific feelings depending on the directional types (Petterson, 2011).

Second, although crossmodal correspondences between vision and taste in the food domain has been studied in consumer psychology (e.g., Zellner & Durlach, 2003), and increased attention has recently been paid to the empirical evidence of neuroscience (e.g., van der Laan, de Ridder, Viergever, & Smeets, 2011), not much research has investigated the crossmodal mechanism from vision to taste with regard to specific visual techniques of food photographs. Although food photographs with efficient design techniques are more likely to stimulate food imagery process compared to food photographs without a design perspective (Parks-Whitfield, 2012), few studies have examined the serial effects of visual design techniques in food photos on crossmodal mental simulation from vision to taste. Third, although many foodservice corporations are increasingly investing their budgets in digital communication channels, such as photo-based social media (e.g., Instagram) and online food ordering platforms (Herhold, 2018; Hirschberg, Rajko, Schumacher, & Wrulich, 2016), little effort has been made to explore how consumers' visual information processing takes place on these digital platforms. While food marketers recognize the importance of visual presentation of food in the emergence of new digital platforms, little is known about what design techniques can improve foods' visual aesthetics in food marketers' digital communication. Therefore, the present study attempts to fill these research gaps.

## 1.3. Purpose Statement

### Research Objectives

The current study aims to investigate the effects of visual design techniques in food presentation on consumers' behavioral intention through crossmodal correspondences in online contexts, including social media platforms and online food delivery services. The researcher's interest lies in how two particular design principles, repetition of a food item and the compositional lines in a food photo, influence a viewer's perception of taste and behavioral intention. Repetition, a design method that presents identical visual elements recurrently, is frequently utilized to enhance the design consistency and aesthetics in visual art (Williams, 2004). Repetition of food items creates visual aesthetics, increasing visual engagement (Parks-Whitfield, 2012). This effect is prominent in food photography (Parks-Whitfield, 2012). In turn, compositional lines represent another important design technique in photography that leads a viewer's eye movement to a directed point (McKinnell, 2013). Different types of compositional lines evoke different feelings (Petterson, 2011) and thoughts (Kandinsky, 1925). In this study, repetition of visual elements is operationalized as repetition of food items within a photo frame, and compositional lines are presented as implied lines created by the repetition of a food item.

This study adopts *grounded cognition* (Barsalou, 2008) as a theoretical framework which suggests that "knowledge is grounded in modality specific systems" (Barsalou, 2003, p.90). Grounded cognition theories pertain to the brain's multisensory process (Krishna, 2012) that involves modal simulations, bodily states, and situated action (Barsalou, 2008, 2009, 2016). For example, viewing a food image evokes the viewer's mental sensory simulations of the smell, taste, and texture of the presented food (Krishna & Schwarz, 2014). Berlyne's aesthetic theory

(1971) provides another theoretical lens to scrutinize the effects of repetition of visual elements and compositional lines of a food photo in the context of online food experience. This study focuses on viewers' aesthetic evaluation of the key design techniques using the theory of aesthetics (Berlyne, 1971).

The present research develops multiple studies to achieve the research goals. Study 1 is designed to test a basic research model that examines the effects of repetition and compositional lines in a food image on viewers' behavioral intention, such as purchase intention and intention to share a food/beverage photo in the context of a photo-based social media platform. Viewers' perceptions of visual appeal and taste are proposed to mediate this relationship. Study 2 is designed to test the proposed research model in a different food consumption setting, that of the online food ordering system. Specific research questions are presented as below.

**Research Questions**

- How does repetition of a food item in a food photo influence viewers' crossmodal mental simulation of vision and taste in the digital environment?
- How do compositional lines in a food photo influence viewers' crossmodal mental simulation of vision and taste in the digital environment?
- How does the visual presentation in food photos influence viewers' behavioral intentions in two different online platforms, a social media platform and an online food ordering system?

**Expected Contributions**

The present study is expected to contribute to the extant literature on both visual information processing and sensory marketing. The results of this study will extend visual

information processing while identifying the effects of visual design techniques (repetition and compositional lines) that are frequently used in food photography. The sense-based framework will contribute to an account of multisensory taste perception based on visual effects. Because sensory experiences through the human senses generate emotional attachment and awareness to a brand or company, sensory marketing plays a crucial role in clarifying a company's identity and creating brand strategies (Hultén et al., 2009). Subtle changes of sensory stimuli result in powerful influences (Hilton, 2015). Because consumers mostly do not recognize these subtle changes as marketing messages, sense-based marketing is less likely to cause normal consumer resistance to the applied ads or promotions (Hilton, 2015). In this respect, the findings of this study will provide insights to academic research across diverse disciplines and the foodservice industry by elucidating visual effects of repetition and composition of visual elements in the online marketing contexts.

To contribute to the restaurant industry, the present study will primarily discuss the significance of menu photos in restaurants' online and mobile businesses. More importantly, the results of this study are expected to indicate that using menu photos strategically is more effective than just using incidental menu photos. Moreover, with the ability to attain high quality digital photos from smartphones, it might be unnecessary for restauranteurs to hire a professional photographer to create their menu photos on their apps. If the operators recognize which methods of menu photo compositions can bring the visual effects to viewers' taste perception, they can generate stylish menu photos by themselves, using their smartphones. This would result in savings for the restaurant budget, especially in the case of small, independent restaurants. This study can offer tutorial value by educating restaurant operators on how to take and use menu photos for their websites, mobile apps, social networking services, and ordering platforms.

## 1.4. Definitions of Key Terms

The present study explores diverse disciplines within the foodservice and hospitality contexts. The domains relevant to this study are consumer psychology, neuroscience, marketing, visual design, and photography. Table 1 summarizes the definitions of and provides references for key terms used in this study.

**Table 1.** Summary of Definitions of Key Terms

| Term | Definition | Reference |
|---|---|---|
| Sensory marketing | Marketing that engages consumers' senses and affects their perception, judgment and behavior. | Krishna (2012, p.333) |
| | A service process that focuses on sensory strategies and stimuli with the goal of creating a multi-sensory brand-experience, supporting the individual's identity creation through the mind and the five senses to generate consumer value, consumer experiences, and the brand image. | Hultén (2015, p.106) |
| Multisensory marketing | Marketing that involves two or more senses in the marketing process. | Kumar (2014, p.90) |
| | Marketing that engages more than one sense and comprises consumer perception through multiple senses, including visual, auditory, olfactory, gustative, and tactile experiences. | Yoganathan et al. (2019, p.387) |
| Mental simulation | The reenactment of perceptual, motor, and introspective states acquired during experience. | Barsalou (2008, p.618) |
| Sensory modality | Any of the relatively independent sensory systems such as vision, hearing, smell, taste, and touch.<br>Also called a stimulus modality, modality, communication channel, or sense. | A Dictionary of Psychology (3rd ed, 2009) |
| Crossmodal correspondence | A tendency for a sensory feature in one modality to be linked to another modality, either actually or imaginatively. | (Parise & Spence, 2013) |

**Table 1.** Summary of Definitions of Key Terms (Cont'd)

| Term | Definition | Reference |
|---|---|---|
| Visual design elements | Visual design is reduced to design elements such as line, direction, shape, size, texture, value and color; scale of graphic expression. | Graves (1951) |
| Design principles | Laws of relationships or plans of organizations that determine the ways in which the elements combine to accomplish particular effects (e.g., repetition, harmony, contrast, and unity) | Graves (1951) |
| Repetition | Creating identical units formed by visual elements to connect space intervals. | Graves (1951) |
| | One technique of unity, which repeats visual elements by copying or mimicking them numerous times. | White (2002) |
| Composition | The application of rules that involve the formal elements of art and design principles | Präkel (2009) |
| | The artistic arrangement of the subject matter within a photographic image. | Webb (2010) |

## 1.3. Dissertation Organization

The present dissertation consists of five chapters. Chapter 1 has introduced the emergence and impacts of multisensory marketing as a new market phenomenon. The chapter has also presented research questions and objectives after discussing the gaps between industry and academia. This chapter has then addressed the expected contributions. Chapter 2 presents the theoretical framework of this dissertation based on grounded cognition (Barsalou, 2008) and the aesthetic theory (Berlyne, 1971). This chapter also provides reviews of the existing literature on primary concepts of multisensory taste perception across disciplines, such as consumer psychology, neuroscience, marketing, visual design, and hospitality management. The chapter then proposes research hypotheses based on the literature. Chapter 3 provides the methods of the pilot studies, pretests, and two main studies. Based on the results of the pilot studies, the researcher conducts pretests to develop stimuli for the main studies. The chapter contains explanations about individual studies' samples, design, procedure, and measurement as well as stimuli development. Chapter 4 describes the results of data analyses of the pilot studies, pretests, and Studies 1 and 2 in separate sections, and Chapter 5 addresses the conclusions of the present study by providing its findings, theoretical and managerial implications, and the limitations of the study and future research.

# CHAPTER TWO
# LITERATURE REVIEW

The present chapter consists of the literature review, theoretical framework and research hypotheses that are developed to explore sensory subtleties created by visual elements that affect viewers' perception of visual appeal, taste perception, and behavioral intentions. The first section discusses the extant literature on grounded cognition and mental simulation of food experience as theoretical frameworks for this study. It also highlights the limitations of the existing literature and explains how this study is intended to fill in the research gap. Drawn upon crossmodal mental simulation of grounded cognition, the second section details the core concepts of this study that are used to develop research models. The last section proposes eight research hypotheses to clarify each step of visual information processing in the two digital platforms. The proposed hypotheses are developed to test whether and how repetition (H1) or compositional lines (H2) influence on visual appeal. On a photo-based social media platform, the proposed hypotheses are tested regarding whether and how repetition (H3) or compositional lines (H4) influence purchase intention and whether and how repetition (H5) or compositional lines (H6) influence intention to share a food/beverage photo through the serial mediation of visual appeal and taste perception. On an online food ordering platform, the hypotheses are tested regarding whether and how repetition (H7) or compositional lines (H8) influence intention to order via the serial mediation of visual appeal and taste perception.

## 2.1. Literature Review

### Crossmodal Correspondence between Vision and Taste

Crossmodal correspondence is defined as the tendency for a sensory feature in one modality to be linked to another modality, either actually or imaginatively (Parise & Spence, 2013). A great volume of research has proven crossmodal correspondences between vision and taste (e.g., Alley & Alley, 1998; Christensen, 1983; Rolls, Critchley, Mason, & Wakeman, 1996). Previously, the association between vision and taste mainly interested scholars mainly from agriculture (e.g., Brice, 1954), psychology (e.g., Dunker, 1939) and food science (e.g. DuBose, Cardello, & Maller, 1980). For example, one of the early attempts to identify this mechanism is found in Moir's (1936) work, in which the author tested how the taste perception varied among different colors of various foods. To date, the study of crossmodal correspondences between vision and taste has been expanded into more diverse disciplines, such as cognitive psychology, marketing, and neurosciences. Table 2 summarizes key studies found in the literature on crossmodal correspondences between vision and taste. An extensive review of the literature on this topic reveals that this topic is applicable to the interdisciplinary field. For example, Spence and his team in experimental psychology have published their studies on this topic across diverse journals in chemistry (e.g., Spence et al., 2010), biology (e.g., Spence, 2013), food science (e.g., Michel et al., 2015), marketing (e.g., Spence et al., 2014), psychology (e.g., Spence, 2012), and neuroscience (e.g., Spence, Okajima, Cheok, Petit, & Michel, 2016). Therefore, the present research uses the term *multisensory food research* in the discipline column in the latter part of Table 2 to reflect this interdisciplinary trend.

As shown in Table 2, previous studies have tended to focus on a limited number of visual attributes, such as colors and shapes. For example, previous studies focused heavily on the effects of food colors on consumers' perception and preferences, such as flavor identification (e.g., Teerling, 1992), attractiveness of plating (Zellner & Durlach, 2003), preference for food, and perceived pleasantness (e.g., Stillman, 1993). Previous studies investigated the effects of food colors in various settings, such as restaurants (e.g., Fairhurst, Pritchard, Ospina, & Deroy, 2015) and marketplaces (e.g., Shankar, Levitan, Prescott, & Spence, 2009) and in association with adjacent objects, such as packaging, plateware, and cups (e.g., Spence, Piqueras-Fiszman, Michel, & Deroy, 2014). More recently, the effects of different shapes on taste have begun to attract researchers' interest (e.g., Velasco et al., 2015, van Rompay, Finger, Saakes, & Fenko, 2017). The comprehensive findings on the effects of shapes show that curved shapes (e.g., circle and ellipse) are matched to sweetness, whereas angular shapes are matched to other tastes (e.g., Deroy & Velentin, 2011; Liang, Roy, Chen, & Zhang, 2013). Although previous studies have demonstrated the significant effects of colors and shapes of food on taste perception, it should be acknowledged that individuals' visual perceptions of food can be generated as a function of far more visual elements. Also, different visual elements might work differently and/or more predominantly in different settings. The next section provides our study context—that is, social media and online food ordering platforms—and theoretical frameworks to understand consumers' crossmodal correspondences between vision and taste in these study contexts.

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Psychology | Pangborn (1960) | Pear nectar | Color | Sweetness | Green colored flavorless solution was perceived as the least sweet |
| | Pangborn & Hansen (1963) | Pear nectar | Color | Sweetness and sourness | Green coloring was perceived as the least sweet; no relationship between color-sweetness and color-sourness |
| | Pangborn et al. (1963) | Wine | Color | Originated from the food | No specific pattern of average response for taste discrimination in colored vs. uncolored wine; Experienced group was more influenced by the color variables |
| | Maga (1974) | Solutions | Color | Sweet, sour, bitter, and salty taste | Sweet taste was detected sensitively by green color, but bluntly by yellow color; bitter taste was decreased in the highest by red color; but no association between salty taste and color |
| | Hyman (1983) | Carbonated water and birch beer | Color (red, yellow, and brown) | Originated from the food | Food color influences taste perception and colorless birch beer |
| | Teerlings (1992) | Wine gums and yogurts | Color (red) | Originated from the foods | Different red intensities affected preference and perceived flavor |
| | Stillman (1993) | Fruit-flavored beverage | Color | Fruit flavors | Color influences flavor identification but uncommon combinations between colors and flavors decrease the identifications |
| | Philipsen et al. (1995) | Cherry-flavored beverages | Color | Sweetness | Elderly adults' flavor intensity was more influenced by intensified color compared to young adults; but color did not influence thirst quenching in both groups |

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste (Cont'd)

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Psychology | Oram et al. (1995) | Drinks | Color (red) | Sweetness | When children age increases, the drink identification is higher by their perceptual matureness |
| | Lavin & Lawless (1998) | Solutions | Color | Sweetness | Darker red did not increase the expected sweetness with children whereas opposite result was found with adolescents. |
| | Alley & Alley (1998) | Liquid and solid products | Color | Sweetness | Liquid products are perceived as sweeter than solid products |
| | Zellner & Durlach (2003) | Colored and colorless solutions | Color | Liking for flavors | Colorless solutions were rated higher for taste than colored ones; color heightened the attractiveness of the balanced plating than unbalanced one, but color/balance did not influence liking or flavor |
| | Shankar et al. (2009) | Chocolate (M&Ms) | Color (brown vs. green) and information label | Originated from the food | Flavor is perceived by visual information of color and cognitive expectancy of label |
| | Shankar et al. (2010) | | Color | Flavor | While reviewing the relationship between color and taste, the author found that the interaction between color and flavor cannot be explained only by multisensory interaction, but also by higher levels of cognitive facets such as an expectation |
| Marketing | Hoegg & Alba (2007) | Orange juice | Color (natural and darker orange color) | Sweetness (low, medium, high) | The pair with the same color having different tastes were perceived more similar than the different colored juices having same tastes. |

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste (Cont'd)

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Food Science | DuBose et al. (1980) | Beverage and cake | Color | Originated from the food | Color intensities of beverages influence overall acceptance and flavor intensities; removing beverage colors significantly reduce flavor identification; interacting between color and flavor on overall acceptability was detected in cake samples |
| | Johnson et al. (1982) | Cherry-flavored and colored beverages | Color (five levels of intensities of cherry colors) | Sweetness | Color intensity increases perceived flavor; color acceptance and pleasantness increased with color intensity level 3 before decreasing |
| | Johnson et al. (1983) | Beverages | Color (five strawberry-red colors) | Sweetness | Color intensity increases perceived flavor; color 3 was perceived as the sweetest, most pleasant, and most acceptable |
| | Roth et al. (1988) | Lemon- and lime-flavored drinks | Color (lemon and lime colors) | Perceived sweetness | Color significantly influenced perceived sweetness; the effect of color on sweetness was highest with 4.4% of sucrose level |
| | Christensen (1983) | Varied foods (e.g. cheese, bacon, orange drink) | Color (normally colored, uncolored, inappropriately colored ones) | Originated from the foods | Appropriate colored foods were perceived to have better flavor and aroma |
| | Williams et al. (1984) | Port wine | Appearance | Originated from the wine | Assessment of appearance affected that of flavor and aroma in clear glasses |

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste (Cont'd)

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Food Science | Garber et al. (2000) | Drinks (orange, grape, fruit) | Color (orange, grape, clear) | Originated from the drinks | Food color influences consumers' ability to the correct identification of flavor and to discerning flavor profiles and preferences |
| | Bayarri et al. (2001) | Fruit-flavored drinks | Color | Fruit flavors | Only orange drinks were affected by its color on flavor intensity |
| Cross-cultural Research | Zampollo et al. (2012) | | Visual preference w/ food photos | | Three colors, three to four components and the filling style of plate were preferred when experimenting with a number of food presentation photos |
| | Velasco et al. (2014) | Package photos of potato chips (Crispies) | Color (predefined web-safe colors) | Varied flavor terms on the package (e.g. BBQ, cheese and bacon) | Color associations for complex flavor mix (e.g., salt and vinegar) or unspecified flavors (e.g., natural or original) had different responses depending on the have different color associations depending on the three countries (Colombian, Chinese, and British) although natural parings were consistent across countries (e.g., red with tomato) |
| | Wan et al. (2014) | | 11 colors, 15 shapes, and 2 textures | Basic taste terms (bitter, salty, sour, and umami) | Correspondences between certain colors, shapes, and textures and taste terms |
| Physiology | de Wijk et al. (2004) | Vanilla custards | Color (w/ odor and texture) | Originated from the foods | Vision and olfaction influence the size of the first bite in oral qualities, and the color, odor, visual texture, and bite size were important when evaluating oral quality of the ingested custard |

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste (Cont'd)

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Chemistry | Levitan et al. (2008) | Smarties | Color | Originated from the food | Expected different flavors were discriminated with prior beliefs on specific associations between color and taste |
| Neuroscience | Rolls et al. (1996) | | | | Orbitofrontal cortex plays an important role for visual and taste stimuli; the modifications during visual-taste reversal is faster than the modifications during olfactory-taste reversal |
| | McClure et al. (2004) | Coke and Pepsi | Hiding brands | Originated from the food | Behavioral preferences and neural responses from ventromedial prefrontal cortex in fMRI were mostly identical between Coke and Pepsi while hiding the brands |
| | Simmons et al. (2005) | Food pictures (e.g., cheeseburger, spaghetti, etc.) vs. Location pictures | | | Viewing food photos activated both gustatory regions and visual cortex regions. |
| | Skrandies & Reuther (2008) | Pairing the first stimulus for odor/taste words with the second stimulus for color/food | | | A quantity of rapid cognitive process in the visual cortex occurred at an earlier stage on the order of 100 ms |
| | van der Laan et al. (2011) | Food photos vs. non-food photos | | | Food photos stimulated left lateral orbitofrontal cortex (region for rating pleasantness of taste and smell), bilateral posterior fusiform gyrus, and left middle insula (region for diverse food-related processes); hunger state modulated the right amygdala (region for arousal and reward processing)and left lateral; energy content modulated the hypothalamus and ventral striatum (region for regulating food intake) |

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste (Cont'd)

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Multisensory Food Research (within | Deroy & Valentin (2011) | Beer (three kinds) | Shape (2D and 3D) | Three different flavors | No biased choice toward 2D or 3D, but a significant correlation between sweetness, voluminousness, and roundness, and between bitterness, thinness and angular shapes |
| Chemistry, Food Science, Nutrition, Psychology, Marketing, & | Zellner et al. (2011) | Ingredients for salad (romaine lettuce, pita Chips, baby carrots,etc.) | Arrangements of food items on a plate | Perceived taste | Neatly arranged food presentation increases consumers' liking of taste and willingness to pay highly, compared to a messy one |
| Hospitality marketing) | Liang et al. (2013) | Sucrose solutions | Shape (and semantic familiarity) | Sweetness | Curvature shapes had higher hedonic ratings than angular shapes (e.g., rectangle, triangle); curvature increased the sweet sensitivity whereas angular shapes did not affect sweet sensitivity; semantic familiar words increased sweet sensitivity whereas unfamiliar words did not affect or even reduced sweet sensitivities |
| | Shermer & Levitan (2014) | A white bowl full of salsa images | Color (salsa portion in an image with five different colors) | piquancy (mild or spicier) | Red intensity was significantly associated with spice intensity |
| | Spence et al. (2014) | | Color, arrangement, quality of plateware | | Dining experience interacts with the visual effects of these variables |
| | Michel et al. (2014) | Formal western menu | Color and shape | Perceived taste | An art-inspired food plating (Kandinsky's paintings) increases pleasantness and flavor rating |

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste (Cont'd)

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Multisensory Food Research | Zellner et al. (2014) | Dish of a sautéed chicken breast with garnishes | Overall plating styles | Perceived taste | Attractive food presentation with its visual aspects enhanced the hedonic assessment and tastiness of the food |
| | Fairhurst et al. (2015) | Dishes in The Fat Duck | Plate shape (angular or round) and dish presentation (angular or round) | Perceived sweetness and sourness | Plate shape influenced a dish name; the congruency between plate shape and dish presentation influenced perceived tastes (e.g., rounded food on a round plate was felt sweeter than angular food on an angular plate) |
| | Spence et al. (2015) | | Color | Basic tastes (sweet, sour, bitter, salty, and umami) | Cossmodal correspondences between colors and tastes were consistent across cultures and time; the majority of people pair saltiness with white and blue, sweetness with red and pink, sourness with green and yellow, and bitterness with browny black and violet/purple |
| | Liang et al. (2016) | Sucrose solutions | Shape (and semantic familiarity) | Sweetness | Circular shapes and semantic familiar words increase sweetness sensitivities |
| | Velasco et al. (2015) | | Shapes (angular and rounded shapes) | Four taste words (bitter, salty, sour, and sweet) | Sweetness was matched to roundness whereas other tastes were matched to angularity; taste liking explains part of the roundness/angularity matchings to tastes. |

**Table 2.** Summary of Literature on Crossmodal Correspondences between Vision and Taste (Cont'd)

| Discipline | Authors (Years) | Type of Food | Type of Visual Element | Type of Taste | Key Findings |
|---|---|---|---|---|---|
| Multisensory Food Research | Lick et al. (2017) | Red wine | Label colors (red, black, orange, white) | Originated from red wine (e.g., tangy, fruity, flowery) | Label colors significantly influenced flavor expectations (e.g., red and black with tangy flavor expectations, red and orange with fruity and flowery flavors) |
| | Mirabito et al. (2017) | Impact of glassware on the beer perception | Shape (side curvature) | Originated from beer taste | Beer in a curved-sided glass was perceived as more intense and fruitier. |
| | van Rompay et al. (2017) | Drinks (coffee and chocolate drink) | Shape (rounded vs angular patterned cups from 3D print) | Taste words (strong or soft taste) | Perceived bitterness and more intense taste were derived by an angular surface patterns whereas perceived sweetness and less intense taste were derived by a rounded surface pattern (i.e., congruency between drink kinds and tactility concluded in favorable results) |
| | Turoman et al. (2018) | Images of Shapes | Shape (symmetry and contours of shapes) | Perceived taste (sweet, sour, and bitter) | Round shapes are related to sweet taste whereas angular shapes are related to sour and bitter taste; the affective factors such as pleasantness and threat are associated with the correspondence between shape and taste |
| | Machiels (2018) | A butter milk drink and a mate-based soft drink | Round form (two different forms of cups) | Sweetness | Perceived sweetness of two drinks can changed by the shape of the cup; correspondence between the angular cup and a more bitter taste for the soft drink |
| | Velasco et al. (2018) | Images of Food packages | Shape (angular and round shapes) | Sweet and sour tastes | Sweet and sour taste were matched with pairs of angular and round shapes |

**Study Contexts: Photo-based Social Media and Online Food Ordering Platform**

The literature has consistently supported the effectiveness of visual information. For example, visualized presentations are 43% more persuasive to audiences compared to non-visualized presentations (Vogel, Dickson, & Lehman, 1986). Visual content increases brand engagement, brand awareness, and message association and improves the overall design of digital platforms (Vilner, 2014). Ample evidence shows that 75% of the content brands on Facebook include photos for their marketing strategies (Ross, 2014) and that high-quality visual content in social media invokes more likes, shares, and comments than plain text (Hausman, 2017). Similarly, it has been found that online platforms using visual elements, such as photos and infographics, get 94% more views compared to platforms that do not use such visual elements (Gonsalves, 2012). Consumers' visual information processing has become a central study topic, particularly in the context of digital consumption experience, due to the fact that products are provided via visual images in the information age (Schroeder, 2002). Spence et al. (2016) contended that the visual presentation of food both consciously and unconsciously influences a viewer's perception of the taste and preference for food when he or she make decisions related to food consumption. Such curation of food images plays a critical role, as today's consumers are exposed to an abundance of food images in both the real and virtual worlds.

This study examines consumers' crossmodal correspondences when they are exposed to food images in two online contexts: social media and online food ordering platforms. In the era of social media, sharing food photos online has become an important form of contemporary visual culture (Peng & Jemmott, 2018), and the visual appearance of food has become more important than ever as evidenced by the new trend in which restaurants make their space and

foods instagrammable—that is, visually appealing when presented on Instagram (Newton, 2017). Instagram is the most popular social media platform (Hu et al., 2014), and approximately 64% of Instagram users are young (aged 18 to 29; Statista, 2018). Consumers view food as a high-priority visual stimulus on social media, and food-related contents engage and convert them in the online and mobile world (Chaffey & Ellis-Chadwick, 2019). Taking a photo of food can indicate the importance of food to a person and his or her emotional attachment to the food object (Schroeder, 2002). In addition, interpersonal communications and relationships can be expanded as individuals share food photos with each other (Connolly, 2015). Sharing food images has been particularly popular among younger generations, and it is reported that 69% of millennials take food photos or videos before they eat (Maru/Matchbox, 2017). Consumers' primary motives for sharing and viewing photos of food on social media include entertainment and information exchanges (Pember, Zhang, Baker, & Bissell, 2018); the pursuit of personal health goals is another motivation for why people track and share food data on Instagram (Chung et al., 2017). As the hospitality industry has witnessed marketing benefits from consumers' information exchanges on photo-based social media platforms such as Instagram (Matthew, 2017), scholars have investigated this phenomenon in diverse ways. For example, Peng and Jemmott (2018) found that aesthetic appeal and visual features influence viewers' food image preferences for both healthy and unhealthy food items in the online context. In the context of Instagram, Kusumasondjaja and Tjiptono (2019) found that high visual complexity of food ads increases viewers' pleasure and arousal.

Another changing landscape of the dining culture is attributed to the emergence of third-party online food ordering platforms. The rise of digital technology has made it easy and convenient for consumers to compare food options available nearby and order to have the food

delivered to their door (Hirschberg, Rajko, Schumacher, & Wrulich, 2016). The emergence of the third-party online food ordering system is affecting the entire foodservice industry. For example, online food ordering services have affected the popularity of types of foods in the United States. Additionally, the growth of ordering platforms restructures the delivery market share. While quick service eateries, such as pizza and Chinese restaurants, were previously dominant in the food delivery market, fast casual restaurants (i.e., restaurants where patrons order at the counter with no wait line and a high price point) are reported to lead the online food delivery market today (holding a 40% share), followed by quick service (32%; order at counter, no wait line, low price point) and casual dining (24%; order at table with wait staff, moderate price point) (GrubHub, 2018). Although some restauranteurs have become concerned about the emergence of these third-party ordering delivery services due to their profit construction, restaurant operators are recognizing the reality of the prevalence of the new delivery systems and thus face pressure to adopt the platforms (Muller, 2018). In many cases, restaurants' revenues are found to increase after they begin participating in online ordering delivery platforms (Statista, 2018). Third-party food delivery is beneficial for small and independent restaurants. Because small restaurant entrepreneurs often have limited financial capital and resources to develop their own websites or mobile apps and offer delivery services, online food ordering platforms offer small and independent restaurants a cost-effective way to reach and expand their customer base. Meanwhile, consumers also enjoy the convenience of having a wide array of foods delivered to their homes (Kimes, 2011). Since the rise of these third-party online platforms is fairly up-to-date, only a few studies were conducted in this context (Kimes, 2011; Muller, 2018).

This trend also evokes the importance of the visual presentation of food on online ordering platforms. Data show that restaurants that have converted from text menus to photo-

based menus on an online ordering platform have subsequently increased their conversion rates by 25% (Brierley, 2018). Accordingly, restaurants today focus on investing in quality food photographs as a part of their online content marketing in that quality photography can significantly enhance brand identity, consumers' engagement, and purchasing (Brierly, 2018). Since food marketers caution restaurants against using stock food images that do not accurately reflect the food items actually served by the restaurants, eventually resulting in damage to restaurant integrity (Craig, 2018), it is expected that restaurant operators are increasingly interested in how to create quality food photographs on their own if they cannot always hire professional photographers or food stylists. By creating their own quality food photographs, restaurants can apply their photo-based menus to online food ordering platforms whenever they need to update their menus (e.g., seasonally).

**Limitations and Research Gaps in the Extant Literature**

The literature has shown valuable findings on the correspondence between vision and taste (e.g., Spence et al., 2015). However, the researcher found several limitations and research gaps. First, prior studies focused more on the scientific verifications of the correspondence between vision and taste (e.g., Liang et al., 2013), rather than its practical point of view of food consumption on the foodservice industry, such as how the relationships can apply to markets. Second, the research stream has paid attention to basic visual elements themselves (e.g., color, shape) to validate the correspondence between vision and taste (e.g., Zellner & Durlach, 2003). Little research has been conducted on how visual design principles or compositions of food presentation affect taste perception. Third, although food images abound in the digital era, not much research has examined the visual methods of food photos as distinguished from general

photography techniques. Fourth, since online and mobile ordering delivery platforms have only recently emerged (Muller, 2018), to the best of the researcher's knowledge no study has yet provided a treatment of the crossmodality between vision and taste in this context. To fill these gaps, this study attempts to investigate how specific visual effects, repetition of visual elements, and compositional lines of food photos serially influence visual appeal, taste perception, and intention to share a food/beverage photo or willingness to order. The next section presents grounded cognition and Berlyne's (1971) aesthetic theory as theoretical frameworks to examine crossmodal correspondence between vision and taste in the context of the specific visual effects of repetition and compositional lines.

## 2.2. Theoretical Framework

### Grounded Cognition

Much research has recently been interested in sensory perception, which affects emotion and cognition (e.g., Krishna, 2012). In terms of the difference between perception and cognition, Sutcliffe (2003) explained that perception refers to "the process of receiving information from the outside world," while cognition denotes "the mental activity we describe in everyday terms as reasoning and problem solving" (Sutcliffe, 2003, p. 24). He added that the boundary of two concepts could be blurred because receiving and interpreting information occur almost simultaneously.

The traditional theory of cognition that focuses on amodal approaches has dominated the literature since the cognitive revolution in the 1950s. This theory views cognitive process as the computation of amodal symbols, which is independent from the modal systems in the brain. The

traditional cognition theory argues that knowledge exists in the system of semantic memory in the form of amodal symbols and believes that it is distinguished from the brain's modal system, in which representations are transduced into amodal symbols (Barsalou, 2008). This framework supported computational approaches to human cognition, followed by epistemological views (Fischer, 2012). However, the view has a lack of direct empirical support (Barsalou, Simmons, Barbey, & Wilson, 2003). On the other hand, a new perspective called *grounded cognition* emerged about 20 years ago. Grounded cognition implies the idea that "knowledge is grounded in modality specific systems" (Barsalou et al., 2003, p. 90). In contrast to the prior view of cognition, grounded cognition posits that the brain seldom encompasses amodal symbols; even if it contains such symbols, these amodal symbols and modal representations combine to generate cognition (Barsalou, 2008). Drawing upon this theoretical framework, psychologists have actively demonstrated its empirical findings (e.g., Elder & Krishna, 2010; Papies, 2013; Chylinski, Northey, & Ngo, 2015).

In cognitive psychology, neuroscience, and adjacent disciplines, many scholars and researchers (e.g., Krishna & Schwarz, 2014) have used *embodied cognition* (Wilson, 2002) and *grounded cognition* (Barsalou, 2008) interchangeably. Since the theoretical perspective of grounded cognition is still new, even scholars in the same stream of research have not reached consensus on consistent terminology. Barsalou (2016, 2008) argued that the term *embodied cognition* can lead to a misunderstanding that cognition is only generated by bodily states, whereas in reality cognition is grounded in simulations, situated action, and occasionally bodily states (Barsalou, 2008, 2009). Grounded cognition based on situated action refers to the conception that people's cognition functions is to serve action; that is, responding to the social or physical environment in which people are situated is the role of cognition (Schwarz, 2006).

Therefore, theories of situated action focus on the pairing of perception and action to achieve a goal, mainly in the context of robotics (Barsalou, 2008). Grounded cognition based on bodily states refers to the notion that cognition could depend on one's physical condition (Barsalou, 2008). For example, people wearing heavy backpacks judge that a hill is steeper and a distance is longer than in reality (Proffitt, Stefanucci, Banton, & Epstein, 2003). In addition to the two approaches, Barsalou (2008; 2009) argued that mental simulation plays the most significant role in grounded cognition.

**Multisensory Mental Simulation in Food Experience**

Mental simulation is defined as "the reenactment of perceptual, motor, and introspective states acquired during experience" (Barsalou, 2008, p. 618). During an experience, the brain captures the scenes across modalities and blends them with a multimodal representation in memory. Later, when a person is exposed to a similar context, his or her brain reactivates vibrant mental representations that were captured during past experiences (Barsalou, 2008). For example, while one eats a piece of chocolate cake, one's brain captures a variety of sensory perceptions related to the cake. One appraises the cake's visual presentation and experiences its unique smell, taste, and texture through the nose and mouth. Later, when one is exposed to a chocolate cake photo, one automatically simulates the earlier sensory experiences of the chocolate cake, activating the same sensory regions in the brain (e.g., Shen, Zhang, & Krishna, 2016; Chen, Papies, & Barsalou, 2016). Barsalou (2008) clarified that while mental imagery, one of the mental simulation mechanisms, is caused by conscious representations in working memory, other forms of simulation are automatically and unconsciously activated out of working memory. While past research on mental simulation focused on textual or verbal stimuli, such as

an advertisement's text copy (e.g., Escalas, 2004), the current research stream of mental simulation concentrates on visual representations (e.g., Xie, Minton, & Kahle, 2016). Xie et al. (2016) defined the former as instructed mental simulation and the latter as automatic mental simulation and further developed an account of automatic mental simulation based on grounded cognition.

Currently, researchers in cognitive psychology, neuroscience, and marketing are actively demonstrating the multisensory mental simulation of grounded cognition with a focus on food. Simmons, Martin, and Barsalou (2005) investigated how the representation of food is distributed into the brain's specific modalities. Participants viewed 32 types of food pictures (e.g., cheeseburger, spaghetti, etc.) when the examiners ran event-related functional Magnetic Resonance Imaging (fMRI). Results showed that food pictures activated both the visual association cortex and gustatory processing areas (i.e., the right insula/operculum and the left orbitofrontal cortex). Their study concluded that the findings were consistent with the assertion of grounded cognition that knowledge is grounded in modalities. Although Krishna's earlier studies on sensory marketing did not address their theoretical framework (e.g., Elder & Krishna, 2010), Krishna thereafter adopted grounded cognition to support her sensory marketing studies (e.g., Elder & Krishna, 2012). In examining taste perception with food ads, Elder and Krishna (2010) found that ads with multisensory stimuli triggered higher taste perception than did ads with taste stimulus only; that is, taste was synthesized with other senses, and consumers' thoughts about the food could be influenced by all the senses associated with the ad copy. Elder and Krishna (2012) investigated whether a visual image ad that can facilitate embodied mental simulation influences purchase intentions. In particular, they verified the effects of mental simulation through motor responses. For example, when participants' hand position matched the

orientation of the spoon handle (right or left) in a yogurt ad, it activated higher mental stimulation in the viewer, followed by higher purchase intention. Papies (2013) asked participants to write down at least five features for unhealthy/tempting food words (e.g., cookies) and healthy/neutral food words (e.g., rice) with regard to their taste, texture, temperature of the food, and the hedonic experience. The findings revealed that eating simulation features (e.g., taste, texture, or temperature of food) are more often listed for tempting food words (53%) than for neutral food words (26%), whereas visual features (e.g., color or physical features of food) are more often listed for neutral food words (45%) than for tempting food words (19%). The author suggested that engaging with written food words should result in the conscious dimension of the simulations. Furthermore, based on embodied cognition, Chylinski et al. (2015) found that each sense (i.e., vision, audition, haptics, olfaction, and taste) starts to work at each specific modality, and then the crossmodal interaction between the senses influences perception and cognition. While reviewing the fMRI neuroimaging literature, Chen et al. (2016) found that neural responses to food photos exploited the same neural process as actual eating. This revealed that food photos activated eating simulation, supporting the theoretical perspective of grounded cognition.

As such, researchers have gone on to explore a great body of research based on multisensory mental simulation in food experience. However, since grounded views are fairly innovative, more empirical research needs to be actively implemented (Barsalou, 2008). Based on this theoretical framework, the present study attempts to verify the crossmodal mental simulation from vision to taste through specific types of visual effects in the context of online platforms.

## Aesthetic Theory, Design Principles, and Food Photography

**Aesthetic Theory.** Our eyes seek out visual complexity and variety that can increase the arousal potential of a visual design (Berlyne, 1960). Birkhoff (1933) initially developed a theory of aesthetics to analyze polygonal forms. His equation of aesthetic measure (M) is estimated by the number of order elements (O) positively and by the complexity (C) negatively, that is, M = O/C. He added that *unity in variety* is explained with this formula. Birkhoff's formalism may have limitations with regard to evaluating every aesthetic experience, because it neglects the subjectivity of response (Livio, 2017). However, the formula that he developed for systematic analysis of aesthetic value has considerably influenced subsequent researchers. In other words, experimental aesthetics based on the relationship between the number of elements and complexity started to develop with Birkhoff's (1933) theory of aesthetics. Berlyne (1971) found that aesthetic preference is determined by motivational factors (e.g., novelty, complexity, surprise, and ambiguity) that change the hedonic levels of arousal. He termed the factors *collative* variables and found that aesthetic preference has an inverted-U-shaped relationship with its determinants, such as complexity.

Concerning the relationship between the level of elements and aesthetic preference, there have been discrepancies in the literature on experimental aesthetics (e.g., Jones, 1964; Smets, 1973), although the literature has the same basis in the notion that complexity with increasing the number of elements. Since increasing the levels of visual elements corresponds to growing complexity, and increased complexity is subsequently presumed to raise visual aesthetics, some argue that monotonic preference increases with increasing numbers of elements (e.g., Jones, 1964). This is often true in the art domain, because real artworks are considered more meaningful when they are more complex (Hekkert & Leder, 2008). However, a multitude of

studies postulate that complexity has an inverted-U-shaped relationship with aesthetic preference in experimental aesthetics (e.g., Berlyne, 1971; Smets, 1973; Martindale, Moore, & Borkum, 1990). As a main contention of experimental aesthetics, Berlyne's (1971) theory suggests that increasing visual elements increases visual complexity, and human eyes prefer an appropriate level of visual complexity. However, after the optimal complexity for pleasing, increasing complexity by increasing elements contributes to reducing pleasantness. Hence, the relationship between preference and the number of elements has an inverted-U-shape that reflects a general aesthetic principle of unity in variety (Berlyne, 1971). Consistent with Berlyne (1971), in a fashion advertising study by Cox and Cox (2002) complex ad image started as a negative perception, but repeated exposure to the image increased likability. That is, consumers preferred a complex design as their mind adjusted to it through repeated exposure, whereas they became bored by repeated exposure to a plain design (Cox & Cox, 2002). Ample evidence subsequently has affirmed the inverted-U-shaped relationship between visual complexity and aesthetic preference throughout diverse visual relevant domains, including the retail store environment (Gilboa & Rafaeli, 2003), abstract geometric images and web pages (Bauerly & Liu, 2008); color combinations (Tsutsui & Ohmi, 2011), and grayscale images (Güçlütürk, Jacobs, & van Lier, 2016).

In this context, this study draws upon multisensory mental simulation of grounded cognition and aesthetic theory to explore whether and how specific visual techniques affect viewers' perception of visual appeal and correspond to taste perception, followed by behavioral intentions. Among varied techniques of photography and design, this study focuses on repetition and compositional lines due to these two methods' aesthetic capacity and the frequency with which they have been acknowledged in *food* photography domain (Atherton, 2013a; 2013b). The

fundamental mechanism is that repetition and compositional lines in food images are more likely to stimulate viewers' mental simulation by integrating their effects with unity in variety (Berlyne, 1971) compared to food images without these methods.

**Repetition.** Repetition refers to a technique of recurring visual design elements, such as line, shape, form, color, texture, and space (White, 2002). Repetition is one of the design principles that academics and practitioners in the fields of visual design, arts, and architecture have consistently taught and utilized. Nonetheless, it may be challenging to identify who initially established the definitions and the criteria of these design principles and visual design elements. Many graphic designers and architects assumed the modern principles of design began with Bauhaus (German art school, 1919-1933), which introduced the modern concept of design. Painter and art professor Graves (1902-1978), in his book *The Art of Color and Design* (1951), defined the elements of design as line, direction, shape, size, texture, value, and color. These design elements are mixed, arranged, and composed by the application of design principles. Lovett (1999) identified the seven principles of design as *balance, gradation, repetition, contrast, harmony, dominance,* and *unity*. With a focus on typography and graphics, Williams (2004) selected four basic design principles from extant design theories—*contrast, repetition, alignment,* and *proximity*. On the other hand, White (2002) identified seven *design components* (*unity, gestalt, space, dominance, hierarchy, balance,* and *color*) instead of using the term design principles. To achieve *unity* of design, he further suggested four techniques—*proximity, similarity, repetition,* and *theme with variations*. As such, the classifications of design principles vary according to different visual design theorists and experts. Among these different criteria, many graphic designers and web designers often refer to Williams's (2004) C.R.A.P (contrast,

repetition, alignment, and proximity). Presumably, a system of four principles is somewhat simpler compared to others' seven to nine principles.

In the food domain, repetition plays a primary and crucial role in food presentation, styling, and photography (Parks-Whitfield, 2012). Design principles are applied to a photograph so as to visually attract viewers' gaze. In other words, the application of design principles creates compelling imagery by increasing the visual appeal of photographic images (Webb, 2010). In this regard, repetition is a design principle that is often spotlighted in visual design and photography (Webb, 2010). Particularly in food photography, repetition of foods creates strong food imagery that increases visual aesthetics (Parks-Whitfield, 2012). For example, American painter Wayne Thiebaud (1920-) has used repeated food items as primary motifs in his art (e.g., repeated cakes, lollipops, etc.). Food photographer Parks-Whitfield, in her book *Food Styling and Photography for Dummies,* pointed out the importance of repetition in food photography and explained the fundamentals of the technique. In visual-centric social media and food ordering platforms, visual images of foods serve as an important catalyst that stimulates viewers' attention. If the visual presentations of food on the platforms are more attractive to consumers, food businesses are more likely to achieve their marketing goals (Hausman, 2017). Therefore, using repetition in a food photo or pictorial menu online should help to strengthen design unity and to increase visual interest (Williams, 2004). The next section presents a concept close to repetition, that of compositional lines, as another visual variable used in this study.

**Photographic Composition and Compositional Lines.** Photographic composition refers to creating a visual outcome by arranging formal elements, such as line, shape, form, texture, light, and color (Präkel, 2009). Webb (2010) explicated that "design and composition are the two sides of the same coin in photography" (p.11). Design indicates the process of arranging

visual elements within a frame, and composition signifies the outcome of the design (Webb, 2010). To direct viewers' eyes, photographic composition combines arrangement with the choice of viewpoint (Präkel 2009; Guy, n.d.), resulting in what are called compositional lines. Using lines refers to a technique of composition that draws the viewers' attention (Wileman, 1993). Compositional lines provide a photograph's composition with a structure (Carroll, 2014) and also enhance the photo to create depth and dimensionality in the photographic frame (McKinnell, 2013). Accordingly, applying lines in composition contributes to directing the viewe'r eyes to the main subject(s) of a photo (McKinnell, 2013). Präkel (2006) explained lines (either actual or virtual) as a mental construct because the brain's visual system tends to simplify objects into the form of lines by emphasizing the edges and contours of objects (known as *lateral inhibition*). Even if actual lines are not used in a photo frame, implied lines in composition can influence audiences. Therefore, the method of using compositional lines is relevant to repetition because, along with repeated food items in food photography, lines direct the viewers' eyes to explore a visual path which is imaginarily generated by repetitions.

Different types of compositional lines can contribute to creating varied motional feelings (Lahrache, El Ouazzani, & El Qadi, 2018). Kandinsky (1925) conceptualized what types of lines correspond with specific thoughts. Lines can commonly provide feelings of directional movement or rhythm, and each type of line can evoke diverse psychological associations. For example, a horizontal line is the most stable type of line (Präkel, 2006), being associated with horizons and the ground (Pettersson, 2011). A vertical line associates the viewers with height or power (Calvert, Sheena, & Casey, 2009), while a diagonal line evokes unstable feelings (Petterson, 2011). The imbalance caused by a diagonal line can make viewers feel a sense of dynamism (Fleming & Levie, 1978). Langfeld (1920), in *The Aesthetic Attitude,* related empathy

and mood to the curved lines of characters' dresses or hair while analyzing fine art masterpieces. Sammartino and Palmer (2012) examined aesthetic preference for the vertical composition of single-object pictures and found that participants preferred the objects to be above or below the center of the frame in spatial asymmetries, whereas they preferred the objects to be closer to the center of the frame in spatial symmetries (Sammartino & Palmer, 2012).

In terms of geometric shape preference or affective response, research in experimental arts and aesthetics has demonstrated that people are more likely to be attracted to horizontal and vertical lines than to diagonal lines (e.g., Latto, Brian, & Kelly, 2000; Latto & Russell-Duff, 2002); a downward-pointing triangle is perceived as unpleasant, and curvilinear forms are perceived as pleasant (e.g., Larson, Aronoff, & Steuer, 2012), and upward-pointing triangles are perceived as more stable and attractive than downward-pointing triangles (e.g., Friedenberg, 2012). However, some variation lies in the perception of lines and shapes in photographic composition; photographers often prefer diagonal lines to horizontal or vertical lines due to their dynamism (Präkel, 2006).

## 2.3. Research Hypotheses

Drawing upon grounded cognition (Barsalou, 2008) and aesthetic theory (Berlyne, 1971), the present study proposes the effects of two visual techniques, repetition and compositional lines, in food photos on a crossmodal correspondence between vision and taste in the online context. Study 1 proposes the effects of repetition and compositional lines of a food photo on viewers' behavioral intentions (i.e., purchase intention and intention to share a food/beverage photo) through crossmodal correspondence (i.e., visual appeal and taste perception) (Figure 1). These relationships are examined with different food categories in the context of a photo-based social media platform. Study 2 replicates the key mechanism of this study, the effects of repetition and compositional lines on crossmodal mental simulation from vision to taste, in the context of an online food ordering platform (Figure 2).

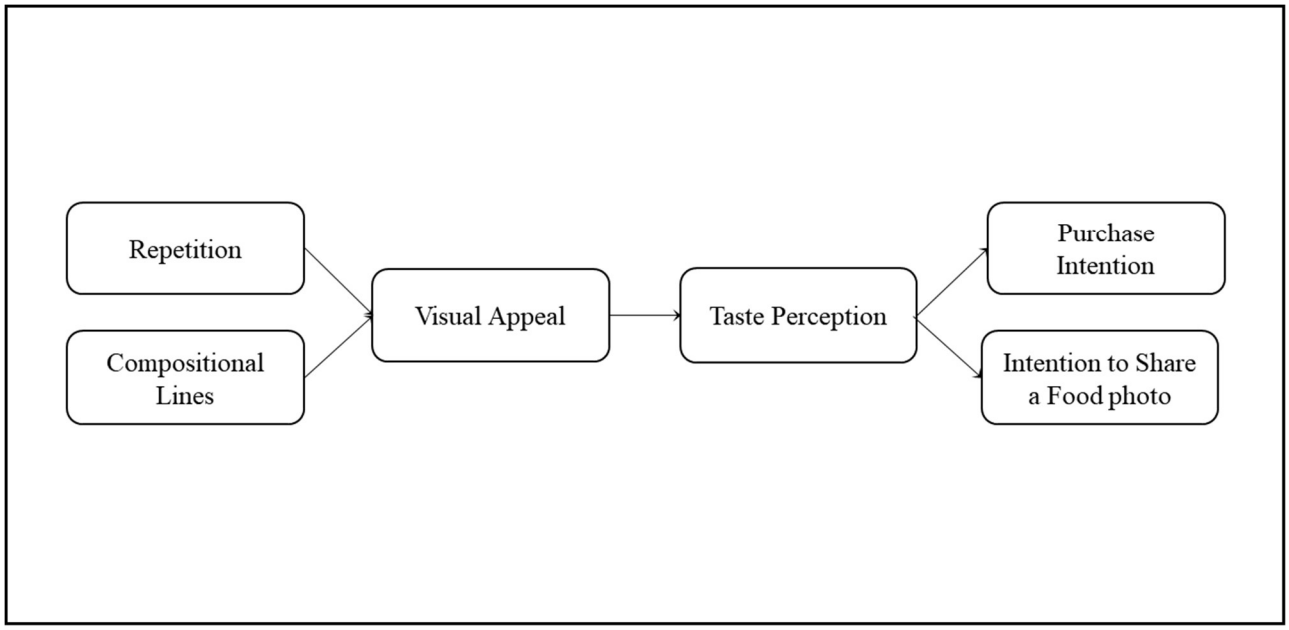



Figure 1. Conceptual Framework of Study 1 (Photo-Based Social Media Platform)

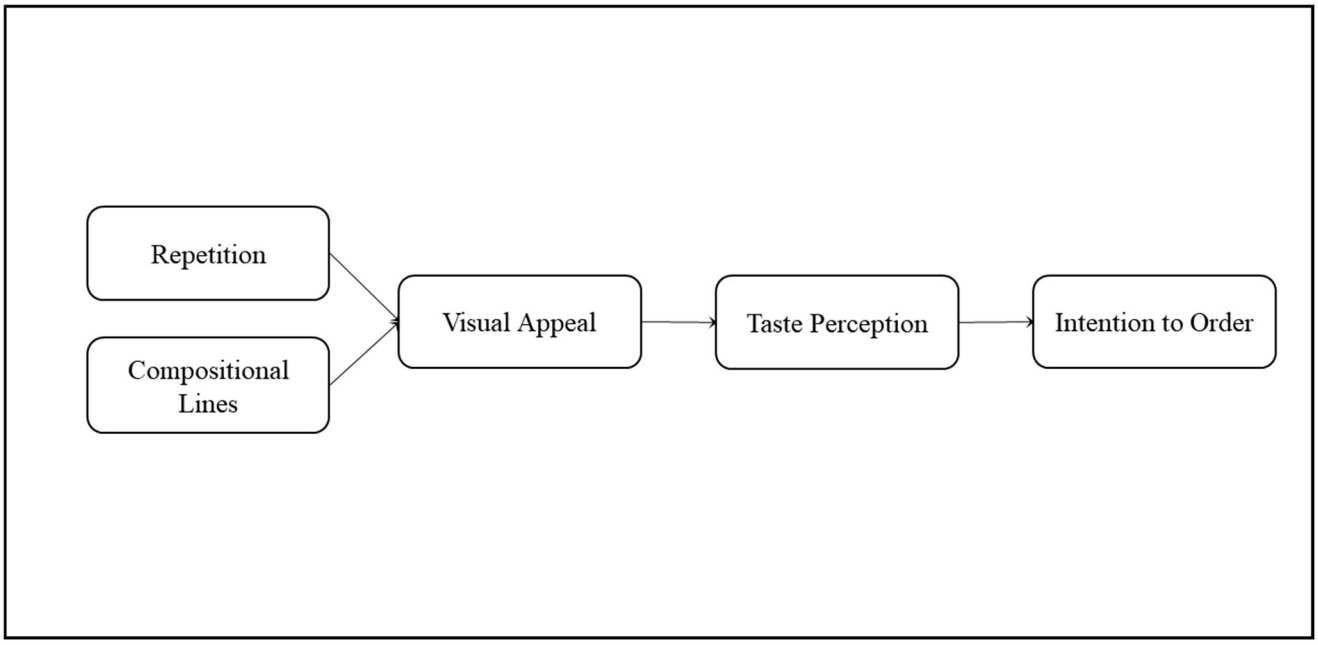



Figure 2. Conceptual Framework of Study 2 (Online Food Ordering Platform)

**Effect of Repetition of Visual Elements**

This study initially suggests that repetition of food items in a food photo has a greater effect on visual appeal compared to the identical food item without repetition. Adding a desired visual technique (i.e., repetition) to a photograph can accelerate attention and engagement (Cian, Krishna, & Elder, 2014). The principle of repetition refers to reiterating visual elements to create unity (White, 2002). Graves (1951) noted that repetition of an element in art and design provides strong impressions of integration, clarity, and empathy. The literature in the fine arts, visual design, and photography has shown that repetition as a design principle is an effective tool to enhance visual aesthetics and pleasantness (Williams, 2004). Also, this technique familiarizes a viewer's eyes with specific visual design elements like shape, color, and textures (Soegaard, 2018) and, subsequently, reinforces visual appeal (Williams, 2004). This is because visual complexity generated by repetition of visual elements increases viewers' arousal and interest (Berlyne, 1971). Particularly in food photography, the effects of repetition of foods on a visual aesthetic are highlighted, while echoing of a food works as a compelling method to generate food imagery (Parks-Whitfield, 2012). Food stylists adopt this design principle frequently to highlight a main food object in their photography and engage viewers (Atherton, 2013b; Parks-Whitfield, 2012).

In the literature, a limited number of studies have examined the effects of repetition in food imagery. Woods, Michel, and Spence (2016) examined the effects of different numbers of repeated food items (i.e., three, four, six) on viewers' liking in a dining setting and found that viewers prefer food plating with more food items. Similarly, Madzharov and Block (2010) also found that the number of items in a food package is positively related to consumers' quantity estimation and an actual eating amount. Their findings consistently support the positive effect of

repetition of food items on viewers' liking and judgment. A possible reasoning for these findings is that repetition of the same food object strengthens visual interest (Williams, 2004), because the visual complexity generated by repeated food items increases viewers' arousal (Berlyne, 1971; Cox & Cox, 2002). Also, experts in food photography emphasize that repetition is an effective design technique that enhances visual aesthetic in food imagery (Hausman, 2017; Parks-Whitfield, 2012). Based on this reasoning, this study hypothesizes as follows:

**Hypothesis 1.** The presence (vs. absence) of repetition will enhance perceived visual appeal.

**Effects of Types of Compositional Lines**

Compositional lines are utilized to enhance the visual composition of a photograph, drawing viewers' attention into the main subjects of the photograph (McKinnell, 2013; Parks-Whitfield, 2012). That is, compositional lines aid in visual aesthetics by orienting viewers' attention to specific directions, such as vertical, horizontal, or diagonal (Pettersson, 2011). Since human eyes tend to follow a line (Präkel, 2006), if a photographer actively uses compositional lines in a photo, viewers' eyes will be strongly stimulated to follow it. The literature shows inconsistent notions regarding the effects of types of compositional lines. For example, findings of experimental arts and aesthetics reveal that horizontal and vertical lines are more preferred than diagonal lines (Latto et al., 2000; Latto & Russell-Duff, 2002) and that upward-pointing triangles are more favored than downward-pointing triangles (e.g., Friedenberg, 2012). In a study examining the aesthetic effect of a diagonal line implied in food plating, Spence et al. (2019) found that people prefer the stable and balanced alignment that is creased by horizontal or

vertical lines over diagonally aligned food presentations. Their findings support a notion that horizontal and vertical lines are easier to process and that people are more familiar with these lines in the environment compared to oblique lines (Pettersson, 2011). Exploring the effects of visual arrangement of food on the plate, Michel et al. (2015) demonstrated that an upward-pointing triangle composition of food was the most preferred food plating when the plate was rotated. The results were explained by the findings of experimental arts, which show that viewers are uncomfortable with downward-pointing triangles because the sharp vertex points towards the observer (Larson, Aronoff, & Steuer, 2012). In addition, Shen, Wan, Mu, and Spence (2015) demonstrated that people liked food items and packages displayed in an upward-pointing triangular shape more than items presented in a downward-pointing triangular shape. The photography literature, differing from that of experimental arts and aesthetics, shows that diagonal lines or downward-pointing triangles are often more effective and utilizable than more stable horizontal/vertical lines and upward-pointing triangles, because the former evoke more arousal and attention (Präkel, 2006). Youssef, Juravle, Youssef, Woods, & Spence (2015) found that people prefer oblique food arrangement on a plate, especially when the line ascends to the right direction. Similarly, Schlosser, Rikhi, and Dagogo-Jack (2016) found that the upward diagonal alignment enhances people's product evaluations more favorably than horizontal alignment. These findings are supported by a notion in the design and photography literature that diagonal lines arouse a feeling of expectation and tension, and therefore could be preferable to horizontal lines that imply stability, continuity, and restfulness (Präkel, 2006; Webb, 2010).

When analyzing the contradictory findings, the present study posits that the compositional preference could vary depending on the angle. Note that Michel et al. (2015) experimented with rotating food plating photographed only with an overhead (90-degree) angle,

concluding in the preference for an upward-pointing triangle. On the other hand, beyond the scope of close-up food presentations on plates, the majority of photos of separate food items with slanted angles (around 45- to 75-degree) have been photographed with non-upright triangle compositions.

In sum, creating implied lines or patterns, different types of compositional lines produce varied motional feelings (Lahrache, El Ouazzani, & El Qadi, 2018; Lidwell, Holden, & Butler, 2010; Williams, 2004). Well-designed alignment creates compelling imagery and increases the visual appeal of a presented image (Webb, 2010), because compositional lines in a visual stimulus control a viewer's attentional direction and influence the viewer's aesthetic judgement (Pettersson 2011; Palmer, Schloss, & Sammartino, 2013). Therefore, this study hypothesizes as follows:

**Hypothesis 2.** The effects of compositional lines will affect perceived visual appeal.

## Crossmodal Mental Simulation of Vision and Taste

This study proposes that visual design techniques in a food photo, such as repetition and compositional lines, influence visual appeal and taste perception by activating automatic mental simulations at the unconscious level (Xie et al., 2016; Barsalou, 2008). Neuroscience research has shown that food visuals activate the taste cortices in the brain (e.g., Simmons et al., 2005). The neuroimaging literature highlights that food photographs trigger mental simulations of eating, which means that neural responses to a food photo are identical to the neural patterns of the actual eating (Chen et al., 2016). In addition to sound evidence from neuroscience, a great body of multidisciplinary research has corroborated the crossmodal correspondence between

vision and taste as functions of specific visual attributes, such as colors (e.g., Spence et al., 2015) and shapes (e.g., Velasco et al., 2015). The common conclusion of prior studies is that visual presentations of food can facilitate both the process and the outcome of mental simulations (Xie et al., 2016).

Research shows that human eyes favor orderly arranged and composed images (Redies, 2007). Previous studies show that repetition with foods improves visual aesthetics, strengthening visual depth and imagery (Parks-Whitfield, 2012), and that the types of implied lines lead viewers' attention in different directions (Kandinsky,1925; Pettersson, 2011; Palmer et al., 2013). Thus, this study proposes that each unique combination of different numbers of repetitions with different types of compositional lines generates a different mental correspondence and influences viewers' taste perception and behavioral intentions. In other words, different spatial composition through repetition and compositional lines can contribute to creating specific thoughts and imagery in the mind (Kandinsky, 1925).

Before visiting a restaurant and purchasing from its menu, consumers often check the restaurant's Instagram to find out what a plate of food at the restaurant looks like (Craig, 2018). This implies that the instagrammable quality of a food photo has become a determinant of whether consumers will choose to dine at that restaurant (Craig, 2018). Because almost 80% of the population in the United States uses social media (Statista, 2019), people's consumption centers on visuals that they watch, post, and share on social media (Schroeder, 2002). Photos in a visual-centric social media platform influence users' purchasing behavior; for example, statistics show that Instagram are 70% more likely to purchase a product online than non-users (Smith, 2019). Based on these findings, the researcher assumes that quality food photos using the visual design techniques in this study enhance purchase intention through the mediation of vision-to-

taste crossmodality (Chen et al., 2016). This study is interested in how the visual design in a food image enhances viewers' intention to share a food/beverage photo on a photo-based social media platform. Sharing food photos online is a rising phenomenon throughout the world (Peng & Jemmott, 2018), since it is an effective way for people to share their emotional attachment (Schroeder, 2002) and to reinforce their connections to others (Connolly, 2015). Therefore, the extent to which a food photo is shared may indicate an indirect marketing index, and restauranteurs can utilize this phenomenon to promote their food and restaurant through online viral marketing (Craig, 2018). Therefore, this research hypothesizes as follows:

**Hypothesis 3.** The effects of compositional lines on purchase intention will be serially mediated by visual appeal and taste perception on Instagram.

**Hypothesis 4.** The effects of compositional lines on purchase intention will be serially mediated by visual appeal and taste perception on Instagram.

**Hypothesis 5.** The effect of repetition on intention to share a food/beverage photo will be serially mediated by visual appeal and taste perception on Instagram.

**Hypothesis 6.** The effects of compositional lines on intention to share a food/beverage photo will be serially mediated by visual appeal and taste perception on Instagram.

**Hypothesis 7.** The effect of repetition on intention to order will be serially mediated by visual appeal and taste perception in the online food ordering system.

**Hypothesis 8.** The effects of compositional lines on intention to share a food/beverage photo will be serially mediated by visual appeal and taste perception in the online food ordering system.

## 2.4. Summary

This chapter first reviewed the literature on crossmodal correspondences between vision and taste and explored the study context of photo-based social media and online food ordering platforms. Second, this chapter secondly introduced grounded cognition (Barsalou, 2008) and Berlyne's (1971) aesthetic theory to provide this study's theoretical framework. Through the lens of these two theories, this chapter next explained this study's key concepts (i.e., repetition and compositional lines) and the crossmodal mental simulation from vision to taste (i.e., repetition and compositional lines in a food photo → visual appeal → taste perception). Finally, this chapter lastly proposed seven research hypotheses to clarify each step of the proposed research model, including the effects of repetition and compositional lines on visual appeal and on behavioral intentions through the serial mediation of visual appeal and taste perception. Table 3 summarizes the hypotheses proposed in this study.

**Table 3.** List of Hypotheses

| Proposed Relationships | | | | | #H | Hypotheses Statements |
|---|---|---|---|---|---|---|
| Aesthetic theory (Berlyne, 1971) | | | | | | |
| Repetition / Compositional lines | → | Visual appeal | | | H1 | The presence of repetition (vs. absence of repetition) will enhance perceived visual appeal. |
| | | | | | H2 | The effects of compositional lines will affect viewers' visual appeal. |
| Food multisensory mental simulation (Barsalou, 2008) | | | | | | |
| Repetition/ Compositional lines | → Visual appeal → | Taste perception | → | Purchase intention | H3 | The effect of repetition on purchase intention will be serially mediated by visual appeal and taste perception on Instagram |
| | | | | | H4 | The effects of compositional lines on purchase intention will be serially mediated by visual appeal and taste perception on Instagram. |
| | | | | Intention to share a food/beverage photo | H5 | The effect of repetition on intention to share a food/beverage photo will be serially mediated by visual appeal and taste perception on Instagram. |
| | | | | | H6 | The effects of compositional lines on intention to share a food/beverage photo will be serially mediated by visual appeal and taste perception on Instagram. |
| Repetition/ Compositional lines | → Visual appeal → | Taste perception | → | Intention to order | H7 | The effect of repetition on intention to order will be serially mediated by visual appeal and taste perception in the online food ordering system. |
| | | | | | H8 | The effects of compositional lines on intention to order will be serially mediated by visual appeal and taste perception in the online food ordering system. |

1

# CHAPTER THREE
# METHODS

This chapter presents the research methods that are adopted to fulfill the study objectives including pilot studies, stimuli development, pretests, sample and procedure, and measurement for two main studies. Pilot studies were conducted to examine the preliminary effects of repetition and compositional lines on visual pleasantness. Pilot studies 1, 2 and 3 used a one-factor between-subjects design with repetition and/or compositional lines of visual elements as the manipulated variable. Based on the results of the pilot studies, pretests were conducted to develop stimuli for the main studies. The researcher conducted pretests to determine the appropriate number of repetitions and compositional lines to be presented in the stimuli for the main study. Two studies were developed in the main study. Study 1 was designed to examine the proposed research model in the context of Instagram, a photo-oriented social media platform, and Study 2 was designed to test the research model in the context of an online food ordering platform. This study was reviewed and approved by the University of Tennessee Institutional Review Board (Approval No: UTK IRB-18-04420-XM; Appendix A).

## 3.1. Pilot Studies

### Pilot Study 1: Effects of Repetition on Visual and Taste Perception

**Participants, Design, and Procedure.** Participants (n = 231) were recruited from Amazon Mechanical Turk. Participants were required to (1) be located in the United States, (2) have

completed more than 50 approved survey tasks, and (3) have at least a 95% approval rate by MTurk users. Of the participants, 57.2% were female, and the age distribution was as follows: 18-29 (33.5%), 30-49 (49.8%), 50-64 (13.5%), and over 65 (3.3%). Participants were randomly assigned to one of two experimental conditions: 1) a repetition condition that presented two pieces of mini chocolate cake plated together with a headline reading "Mini Chocolate Cake," and 2) a non-repetition condition that showed one piece of the mini chocolate cake with the aforementioned headline.

After exposure to the experimental stimulus, participants answered six items related to visual appeal (Cox & Cox, 2002), two items related to taste perception (Elder & Krishna, 2010; Raghunathan, Naylor, & Hoyer, 2006), and one item related to purchase intention (Elder & Krishna, 2012; Petrova & Robert, 2005). All items were adapted from previous studies and measured on 9-point scales. Additionally, the questionnaire asked participants to report their hunger level at the time of the experiment as a covariate. As a manipulation check on repetition, participants were asked how many food pieces they saw in the previous screen. Finally, this study asked about demographic information.

**Pilot Study 2: Replication of Pilot Study 1**

**Participants, Design, and Procedure.** The purpose of Pilot Study 2 was to replicate the findings of Pilot Study 1 in the context of a beverage category, this time a beverage. Participants (n= 213) were recruited from an online (MTurk) panel. The participants of Pilot Study 1 were completely blocked from participation in Pilot Study 2 so as to avoid a bias that might be caused by exposure to a similarly manipulated stimulus and survey items. Of the participants in Pilot Study 2, 51% were female, and the age distribution was as follows: 30-49 (50%), 18-29 (26%), 50-64 (16.3%), and over 65 (7.7%). Participants were randomly assigned to three conditions and

viewed a stimulus that presented one, two or three glasses of strawberry juice with a headline reading “Jamie’s Strawberry Juice” (Figure 3). That is, in addition to replicating Pilot Study 1, the researcher included a third condition that increased repetition one level higher (i.e., 3-item repetition). Pilot Study 2 used the same measurement as the instrument of Pilot Study 1. Pilot Study 2 employed a one-factor (non-repetition vs. 2-item repetition vs. 3-item repetition) between-subjects experiment with serial mediation analysis.

**Pilot Study 3: Effects of Compositional Line**

**Participants, Design, and Procedure**. The researcher conducted Pilot Study 3 to investigate the effect of a compositional line and its serial mediation: compositional line → visual appeal → taste perception → purchase intention. Participants (n = 94) were recruited from Amazon MTurk. The same qualification criteria used in previous studies were applied to participants in Pilot Study 3. The participants of previous studies were completely blocked from participation in Pilot Study 3. Of the participants, 64.9% were female, and the age distribution was as follows: 30-49 (61.7%), 18-29 (30.9%) and 50-64 (7.4%). The visual stimuli with the manipulation of compositional lines were the same as in Pilot Study 2 (strawberry juice). A one factor (compositional line) between-subject design was used with three conditions (diagonal line vs. horizontal line vs. triangular line) based on 3-item repetition (i.e., three glasses of strawberry juice).

Visual Stimuli for Pilot Study 1




Non-Repetition




Repetition

Visual Stimuli for Pilot Study 2



Non-Repetition



2-item Repetition



3-item Repetition

Visual Stimuli for Pilot Study 3



Diagonal



Horizontal



Downward-pointing Triangle



Upward-pointing Triangle

**Figure 3.** Visual Stimuli for Pilot Studies 1, 2, 3 and 4

**Pilot Study 4: Effects of Upward-Pointing Triangle versus Downward-Pointing Triangle**

This pilot study was designed to explore visual preference between upward- and downward-pointing triangles. Participants (n= 178) were recruited through Prolific. Participants were required to (1) be located in the United States, (2) have completed more than 50 approved survey tasks, (3) have at least a 95% approval rate, and (4) not have participated in previous studies. Of the participants, 43.24% were female, and the age distribution was as follows: 30-49 (50.8%), 18-29 (35.14%), and 50-64 (10.81%). The participants were asked to identify whether they perceived either an upward-pointing triangle or a down-triangular composition of three glasses of strawberry juice to be more visually appealing. Figure 3 presents the visual stimuli for Pilot Studies 1, 2, 3, and 4. The results of the pilot studies are discussed in detail in Chapter 4.

## 3.2. Stimuli Development

Pretests were conducted to determine the number of repetitions of a food item in study stimuli and to select compositional lines. Because each food has different sizes and shapes, the maximum number of repetitions and compositions that can be placed within a photo frame varies. To enhance the reliability of the proposed repetition effects, Pretest 1 was performed with two different types of food items. Another purpose of the pretest was to determine the optimal number of repetitions in study stimuli. According to Berlyne (1971), a person's aesthetic preference shows an inverted-U-shaped relationship with the numbers of visual elements in that exposing to excessive numbers of elements decreases a viewer's aesthetic preference due to perceived complexity.

With regard to the stimuli used in the pilot studies, the committee members commented that people tend to have different preferences for mini chocolate cake and strawberry juice. In light of this feedback, the researcher selected cheeseburgers as an entrée and iced tea as a drink category for the main studies' stimuli. For the stimuli development, the researcher studied the current trend of consumers' online food ordering in the United States (Grubhub, 2019) and selected cheeseburgers for the entrée category because it was one of the most popular ordered food items in America in 2019 (Locke, 2019) and chose iced tea for the beverage category due to its long history of popularity in America culture (Danovich, 2015; Simonson, 2017).

This study applied Cornil and Chandon's (2016) methodological approach, which was developed to examine consumers' multisensory food experience. In pretests, participants were exposed to photos of an identical food item with different numbers of repetitions: for example, if the maximum number of repetitions that can be presented in a photo frame is five, participants would view five photos of the food item (i.e., from non-repetition to five-item repetition). After the exposure, participants were asked to rank the visual appeal of each stimulus (Cornil & Chandon 2016). Using Adobe Photoshop, the researcher developed photos of the same food item which consisted of two to four repetitions and four different types of compositional lines (i.e., horizontal, vertical, diagonal lines ascending from left to right (right diagonal) and diagonal lines ascending from right to left (left diagonal). A total of eleven to twelve conditions were applied for the cheeseburger and the iced tea. As a result, 23 photos were developed for the stimuli. All photos were displayed in an Instagram template in Study 1 and in a template of an online food ordering platform in Study 2.

## 3.3.1. Pretests

### Pretest for Study 1: Determining the Number of Repetitions

**Participants, Stimuli, and Procedure.** Pretest 1 was conducted to determine the number of repetitions tested in the main studies and to identify the ranks among types of compositional lines in terms of visual appeal. Participants were recruited through Prolific. Participants were required to (1) be located in the United States, (2) have completed more than 50 approved survey tasks, (3) have at least a 95% approval rate, and (4) have no dietary restrictions. The stimuli were cheeseburger and iced tea images. The images were JPEG files of 800 × 601 pixels modified from public domain photos (CC0 1.0 on Pixabay), photographed at a slanted (45-75-degree) angle. To generate an experiment condition of repetition, the researcher duplicated the original images of cheeseburger and a glass of iced tea using Adobe Photoshop CC 2017, then slightly blurred and reduced the duplicated pieces to simulate the human eyes' natural functions of focus and perspective. The visual stimuli are presented in Figure 4.

Participants (n= 237, female = 45.1%) were each randomly assigned to one of the conditions that showed images with different numbers of repetitions in the same compositional line (i.e., horizontal, vertical, R- diagonal, left diagonal). The effects of repetition were tested in different conditions of compositional lines for confounding checks to examine whether the effects of repetition on visual preference differ when food items are presented in different compositional lines. All conditions for compositional lines presented four images (i.e., non-repetition to 4-item repetition), except the horizontal condition. In a within-subjects design, participants in the horizontal condition for cheeseburgers viewed two images: non-repetition and 2-item repetition; participants in the same condition for iced tea viewed three images: non-

repetition, 2-item repetition, and 3-item repetition. Participants were asked to rank the presented images in order of visual appeal. The difference in the numbers of repetitions presented was necessary because of the width limitation (601 pixels) of a photo frame. For the other three compositional lines, the height (800 pixels) of the photo frame allowed for a maximum of 4-item repetition.

**Pretest 2: Selecting Compositional Lines that Shape a Polygon**

In addition to Pretest 1 to determine the number of repetitions among linear compositions, Pretest 2 was conducted to select compositional lines that shape polygons. Participants were recruited through Prolific. The same qualification criteria as in Pretest 1 were applied for the selection of participants. The participants of Pretest 2 were completely blocked from participation in Pretest 1 so as to avoid a bias that might be caused by exposure to a similarly manipulated stimulus and survey items. The images were JPEG files of 800 × 601 pixels modified from a public domain photo (CC0 1.0 on Pixabay), photographed at a slanted (45-75-degree) angle. To shape each polygonal condition, the researcher duplicated original images of a cheeseburger and a glass of iced tea using Adobe Photoshop CC 2017, then slightly blurred and reduced the duplicated pieces to simulate the human eyes' natural function of focus and perspective. Pretest 2 was conducted as a within-subjects design. Participants (n= 56, female = 44.6%) showed four polygonal conditions (i.e., upward-pointing triangle, downward-pointing triangle, rectangle, and diamond shape compositions) for both the cheeseburger and the iced tea and were asked to rank the four presented images in order of visual appeal. The visual stimuli are presented in Figure 5.

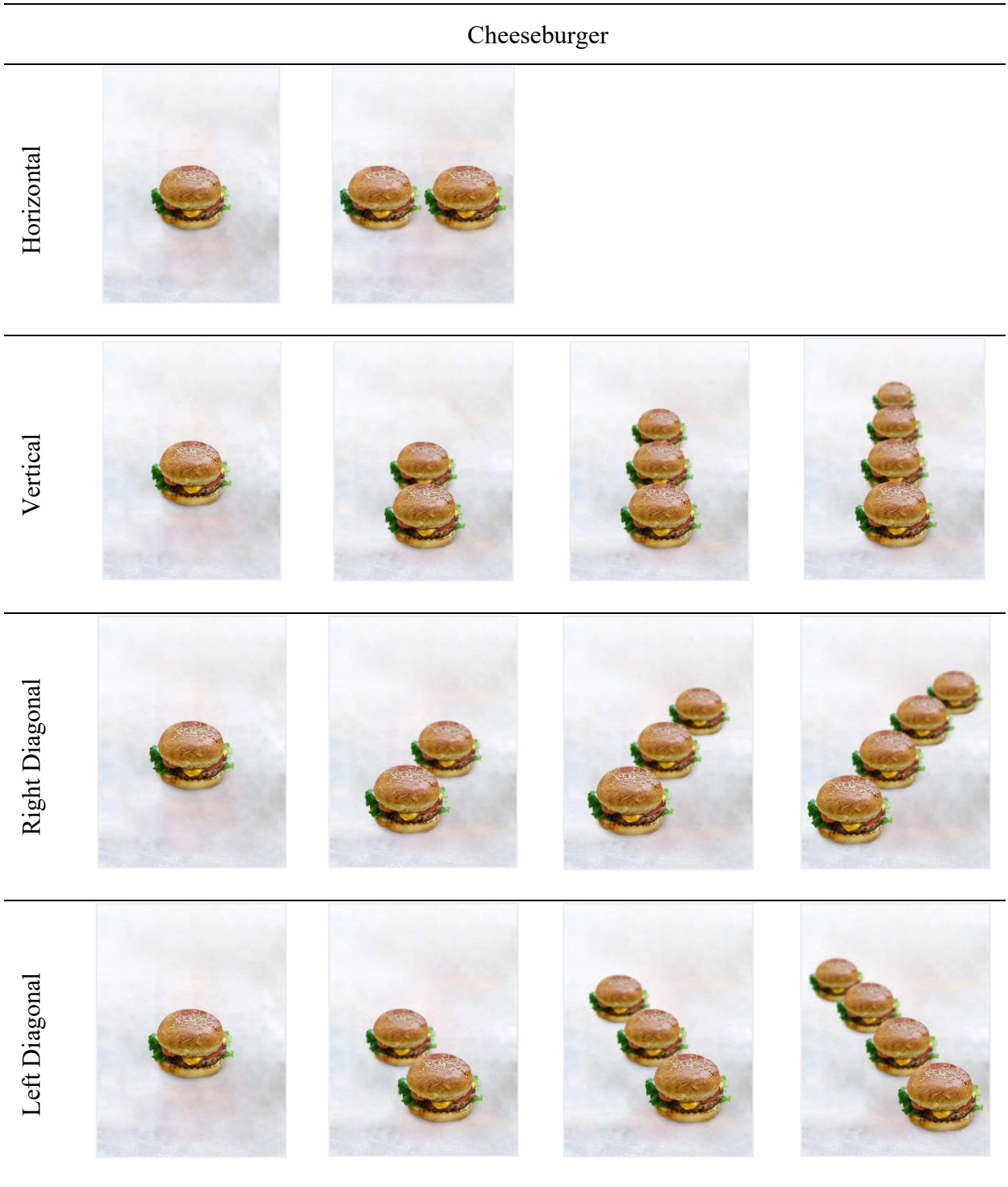



**Figure 4.** Visual Stimuli for Pretest 1

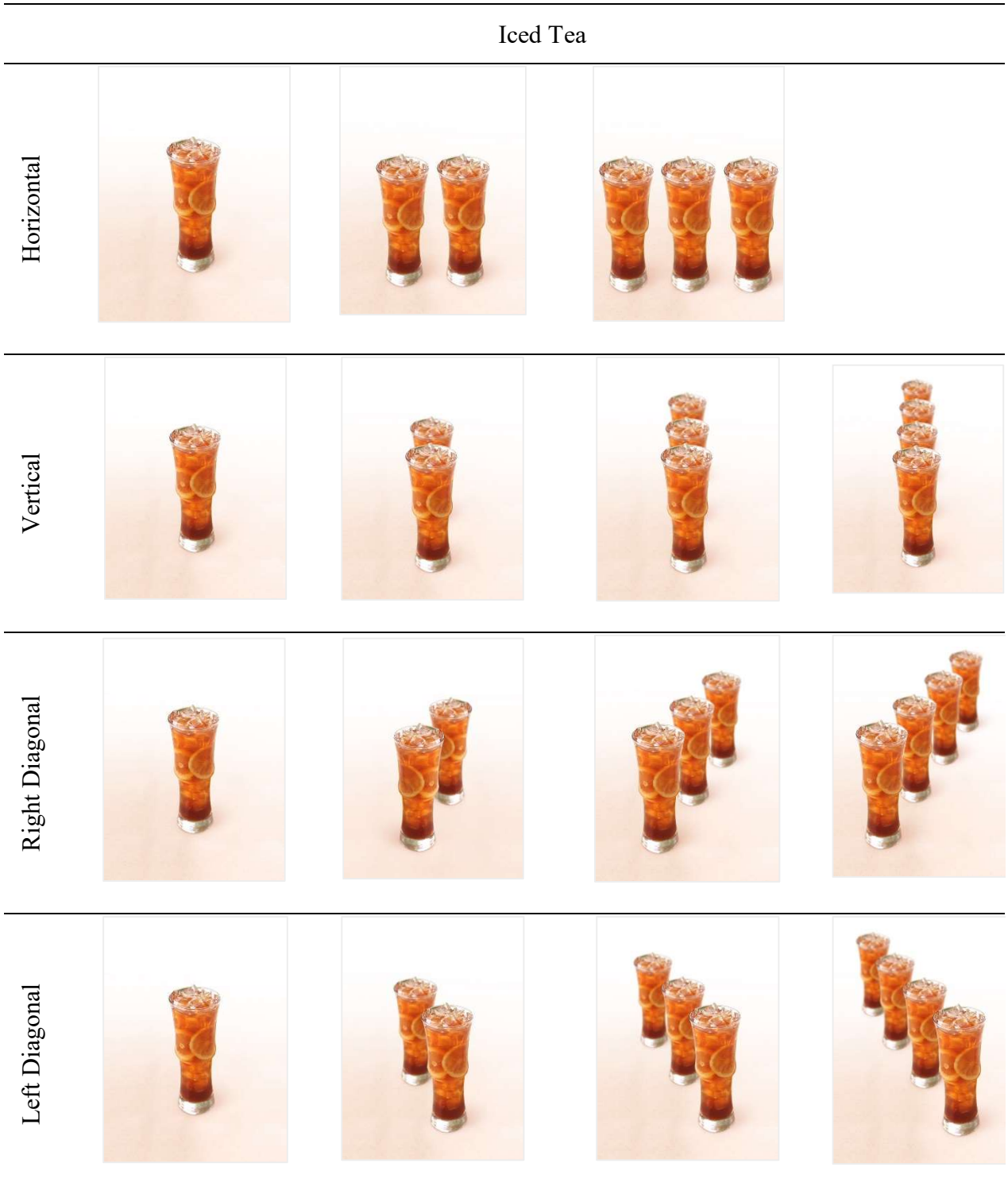



**Figure 4.** Visual Stimuli for Pretest 1 (cont'd)

| Cheeseburger | | | |
|---|---|---|---|
|  |  |  |  |
| Upward-pointing Triangle | Downward-pointing Triangle | Rectangle | Diamond |
| **Iced Tea** | | | |
|  |  |  |  |
| Upward-pointing Triangle | Downward-pointing Triangle | Rectangle | Diamond |

**Figure 5.** Visual Stimuli for Pretest 2

## 3.4. Study 1

### Study 1: The Effects of Repetition and Compositional Lines in a Food/Beverage Photo on Instagram

Study 1 examined the effects of repetition and type of compositional lines on purchase intention and intention to share a food/beverage photo on Instagram via the serial mediation of visual appeal and taste perception. Instagram was selected as a study platform because it is a dominant photo-oriented social media platform that delivers stronger brand engagement than

Facebook and Twitter (Smith, 2019). In addition, Instagram has been shown to be the most influential marketing channel for restaurants (Donnelly, 2019). Study 1 included two sub-tests, one for cheeseburger photos and one for iced tea photos.

**Participants and Stimuli.** Participants were recruited from Prolific were required to (1) be located in the United States, (2) have completed more than 50 approved survey tasks, (3) have at least a 95% approval rate, (4) have no dietary restrictions relevant to a cheeseburger and iced tea, and (5) have not participated in the pretest. Study 1 for cheeseburger photos used 1,001 questionnaires after excluding seven incomplete ones. Respondents were randomly assigned to one of eleven experimental conditions presenting food images with different numbers of repetition and compositional lines (n = 61-96 per condition). Participant count is considered appropriate because participants per cell exceeded 30 (Hair *et al*., 2010). Of the participants, 47.1% were female, and the age distribution was as follows: 18-29 (55.1%), 30-49 (36.3%), 50-64 (7.4%), and over 65 (1.2%). Participants also indicated their ethnicity (64.9% Caucasian, 16.7% Asian or Pacific Islander, 9.5% Hispanic, 5.8% African-American, 2.3% others, and 0.8% Native American); household income (41.2% less than $30k, 17.7% $30-49.9k, 14.2% $50-69.9k,10% $70-89.9k, 6.8% $90-109k, 4% over 150k, 3.4% $110-129k, and 2.6% 110-129k). Study 1 for iced tea photos used 788 questionnaires. Respondents were randomly assigned to one of eleven experimental conditions (n = 65-73 per condition). Of the participants, 46.9% were female, and the age distribution was as follows: 18-29 (46.5%), 30-49 (40.4%), 50-64 (6.1%), and over 65 (2%). Participants also indicated their ethnicity (61.5% Caucasian, 15.8% Asian or Pacific Islander, 7.4% Hispanic, 7% African-American, 2% others, and 1.2% Native American) and household income (30.3% less than $30k, 18.2% $30-49.9k, 15% $50-69.9k, 10% $90-109k, 9.8% $70-89.9k, 4.9% over 150k, 3.9% $110-129k, and 2.9% 130-149k).

2-item Repetition Condition




Horizontal




Vertical




Right Diagonal




Left Diagonal

3-item Repetition Condition




Horizontal




Vertical




Right Diagonal




Left Diagonal




Upward-pointing Triangle




Downward-pointing Triangle




Non-Repetition

**Figure 6.** Visual Stimuli of Cheeseburger in Study 1

2-item Repetition Condition



Horizontal



Vertical



Right Diagonal



Left Diagonal

3-item Repetition Condition



Horizontal



Vertical



Right Diagonal



Left Diagonal



Upward-pointing Triangle



Downward-pointing Triangle



Non-Repetition

**Figure 7.** Visual Stimuli of Iced Tea in Study 1

**Design and Procedure.** Respondents were randomly assigned to one of eleven experimental conditions. As the use of a smartphone with a touchscreen increases a user's product valuations compared to the use of a mouse-driven computer, and different screen sizes of devices might influence viewers' levels of attention and arousal (Reeves & Lang, 1999), participants were restricted to accessing the online survey through their smartphones using filters available through Prolific. In addition, the use of a smartphone for data collection is justified as the use of mobile shopping has been increasing in recent years (Flynn, 2017). In particular, the mobile-dependent search and shopping in the foodservice sector have been found to increase by 50% recently (Flynn, 2017). The food and beverage images from pretests were inserted in an Instagram template with a brief textual message and hashtags. A hypothetical and gender-neutral restaurant name was created to avoid a potential confounding factor for brand familiarity (see Figure 6 and Figure 7).

**Measurement.** All measurement items were adapted from previous studies: three items that measure perceived visual appeal (Bell, Holbrook, & Solomon, 1991), two items measuring taste perception (Elder & Krishna, 2010; Raghunathan et al., 2006), one item measuring purchase intention (Elder & Krishna, 2012; Petrova & Robert, 2005), and two items measuring intention to share a food/beverage photo (Lee, Kim, & Ham, 2016). The instrumentation is presented in Table 4. All items were measured on 7-point scales. Participants also reported their demographic information. Additionally, one item measuring perceived repetition of food and one item measuring perceived composition of food items were used as manipulation checks.

**Table 4.** Instrumentation

| Construct | Item | Sources |
|---|---|---|
| Visual Appeal | Please rate how much you agree with the following statements. (1: Strongly disagree, 7: Strongly agree)<br>1. The food/beverage looks aesthetically pleasing.<br>2. The food/beverage looks attractive.<br>3. The food/beverage is visually appealing | Cox & Cox (2002) |
| Taste Perception | How tasty do you think this food/beverage would be?<br>How much do you think you would enjoy eating this food /beverage?<br>(1: not at all, 7: very much) | Michel et al. (2014)<br>Raghunathan et al. (2006) |
| Purchase Intention | How likely would you be to purchase this food /beverage?<br>(1: not at all likely; 7: very likely) | Elder & Krishna (2012); Petrova & Cialdini (2005); Michel et al. (2014) |
| Intention to Share a food/beverage photo | I plan to share this food/beverage post.<br>I intend to share this food/beverage post on Instagram<br>(1: very unlikely; 7: very likely) | Lee, Kim, & Ham, (2016) |
| Intention to order (Study 2) | How likely would you be to order this food /beverage? (1: very unlikely; 7: very likely) | Michel et al. (2014) |

## 3.5. Study 2

### Study 2: Effects of Repetition and Compositional Lines in a Food/Beverage Photo on the Online Food Ordering Platform

Study 2 was designed to replicate Study 1 in a different study context: that of an online food ordering platform. Study 2 examined the effects of repetition and types of compositional line on intention to order on an online food ordering platform via the serial mediation of visual

appeal and taste perception. A template of a hypothetical online food ordering app (called *ChillBites*, Figure 8 and Figure 9) and a hypothetical and gender-neutral restaurant name were created to avoid a potential confounding factor for brand familiarity. Study 1 included two sub-tests, one for cheeseburger photos and one for iced tea photos.

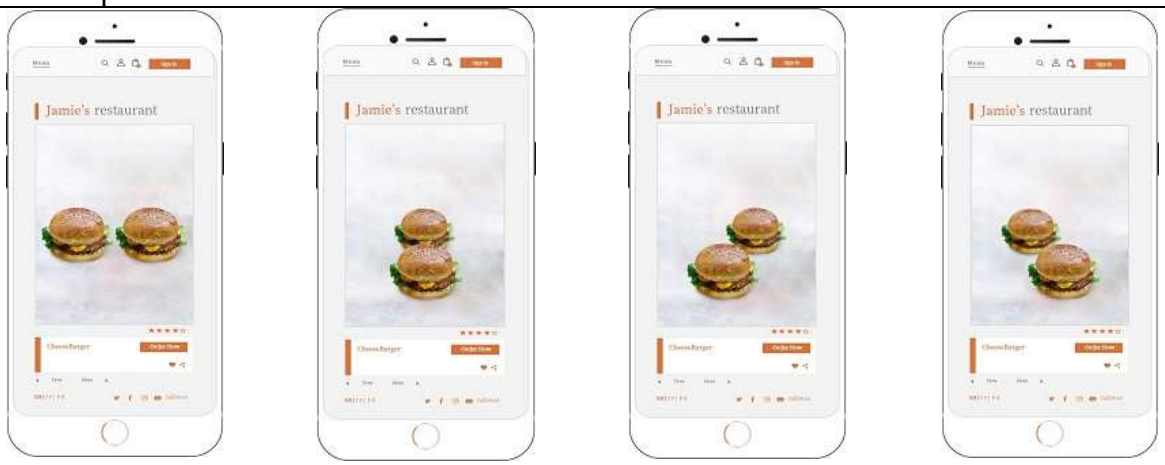
**Participants and Stimuli.** Participants were recruited from Prolific and were required to (1) be located in the United States, (2) have completed more than 50 approved survey tasks, (3) have at least a 95% approval rate, (4) have no dietary restrictions relevant to a cheeseburger and iced tea, and (5) have not participated in the pretests or Study 1. For the cheeseburger, Study 2 was measured using 695 questionnaires. Respondents were randomly assigned to one of eleven experimental conditions that presented food images with different numbers of repetitions and compositional lines (n = 61-96 per condition). Participant count is considered appropriate because participants per cell exceeded 30 (Hair *et al*., 2010). Of the participants, 46.9% were female, and the age distribution was as follows: 18-29 (46.5%), 30-49 (40.4%), 50-64 (6.1%), and over 65 (2%). Participants also indicated their ethnicity (61.5% Caucasian, 15.8% Asian or Pacific Islander, 7.4% Hispanic, 7% African-American, 2% others, and 2% Native) and household income (30.3% less than $30k, 18.2% $30-49.9k, 15% $50-69.9k, 10% $90-109k, 9.8% $70-89.9k, 4.9% over 150k, 3.9% $110-129k, and 2.9% 130-149k). For the iced tea, Study 2 used 698 questionnaires. Respondents were randomly assigned to one of eleven experimental conditions (n = 61-96 per condition). Of the participants, 42.3% were female, and the age distribution was as follows: 18-29 (42.8%), 30-49 (36.1%), 50-64 (7.7%), and over 65 (1.7%). Participants also indicated their ethnicity (60.2% Caucasian, 9.6% Asian or Pacific Islander, 8.9% African-American, 6.6% Hispanic, .2.9% others, and 0.3% Native), and household income

(26.2% less than $30k, 16.3% $30-49.9k, 13.5% $50-69.9k, 12.2% $70-89.9k, 7.32% $90-109k, 6% $110-129k, 4.3% over 150k, and 2.6% 130-149k).

**Design and Procedure.** Respondents were randomly assigned to one of eleven experimental conditions. As the use of a smartphone with a touchscreen increases a user's product valuations compared to the use of a mouse-driven computer, and as different screen sizes of devices might influence viewers' levels of attention and arousal (Reeves & Lang, 1999), participants were restricted to accessing the online survey through their smartphones using filters available through Prolific. In addition, the use of a smartphone for data collection is justified as the use of mobile shopping has been increasing in recent years (Flynn, 2017). In particular, the mobile-dependent search and shopping in the foodservice sector have been found to increase by 50% recently (Flynn, 2017). A brief description and the intro photo of an online food delivery app were presented to familiarize participants with the service. Participants were asked to imagine that they were using a mobile food delivery app to order food and beverage at home. The visual stimuli are illustrated in Figure 8 and Figure 9. All other procedure remained the same as in Study 1.

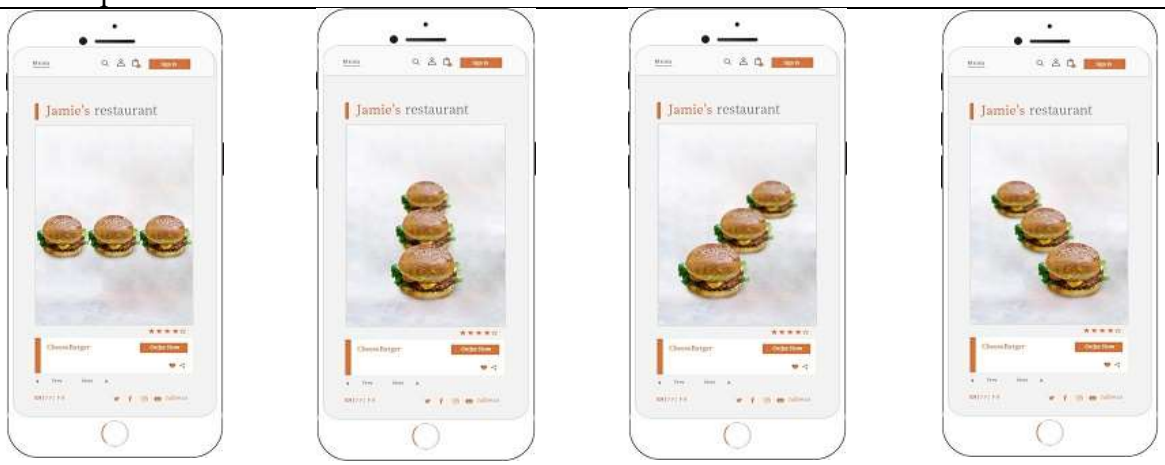
**Measurement.** The same measurement items used in Study 1 were adopted in Study 2 except behavioral intention. Given that Study 2 tests the proposed research model in the context of online food ordering service, a dependent variable was intention to order the presented food. One item that measures participants' intention to order is adapted from Michel et al. (2014).

2-item Repetition Condition

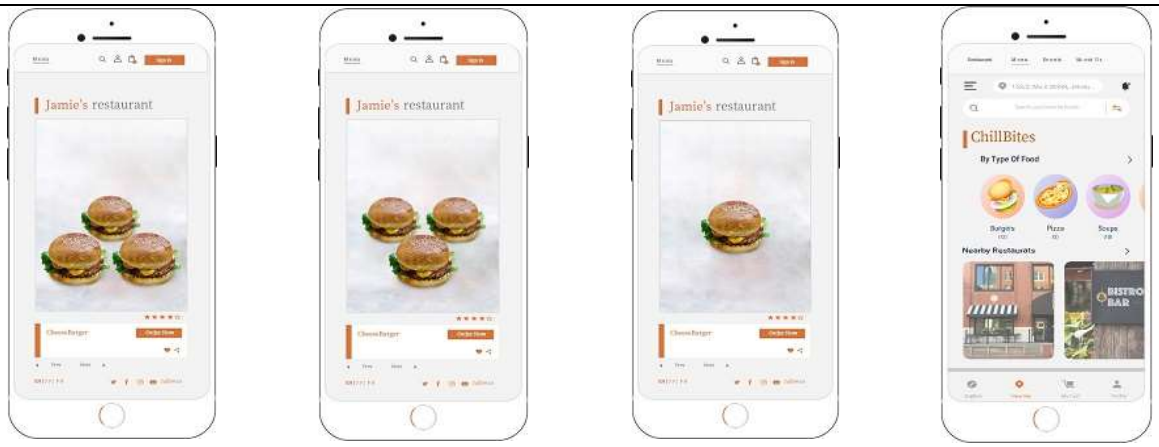



Horizontal | Vertical | Right Diagonal | Left Diagonal

3-item Repetition Condition



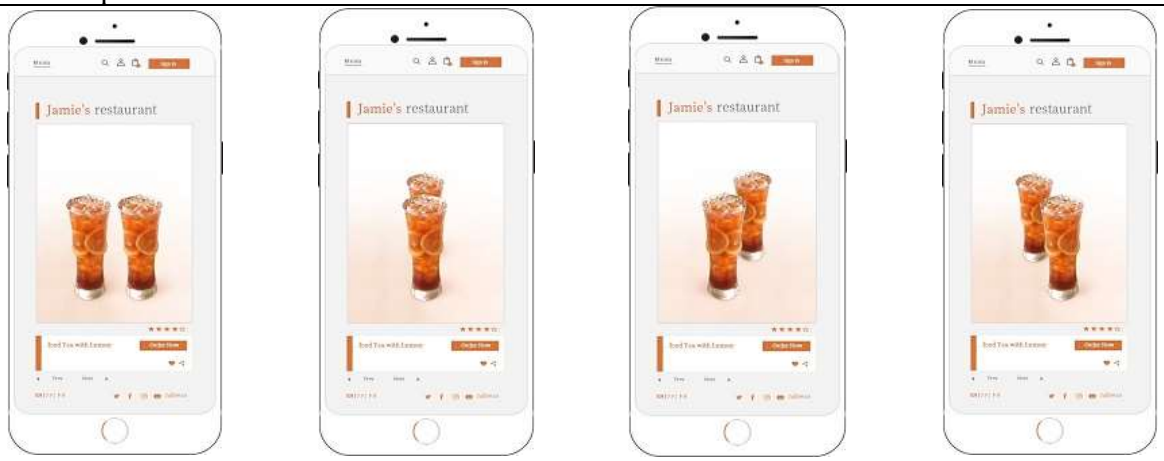

Horizontal | Vertical | Right Diagonal | Left Diagonal




Upward-pointing Triangle | Downward-pointing Triangle | Non-Repetition | Intro

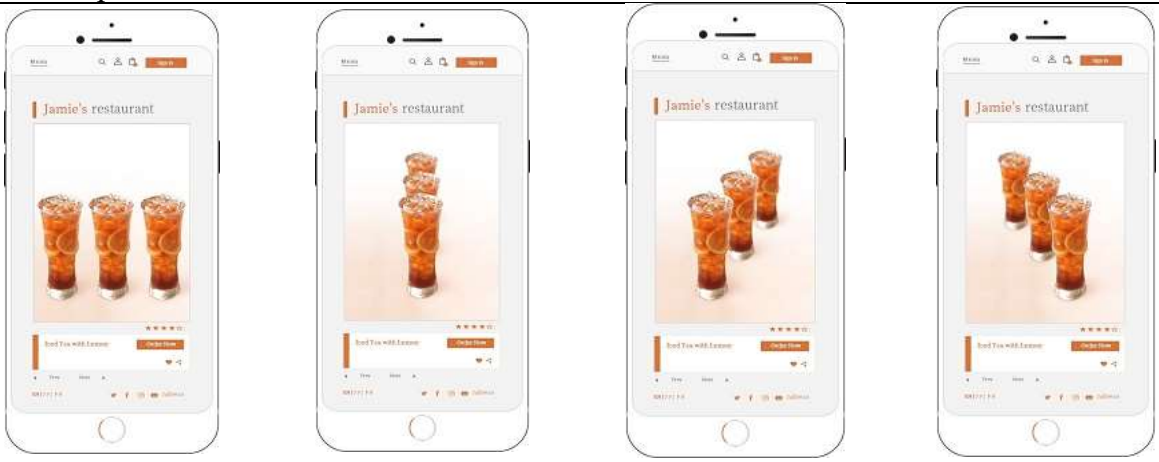
**Figure 8.** Visual Stimuli of Cheeseburger in Study 2

2-item Repetition Condition

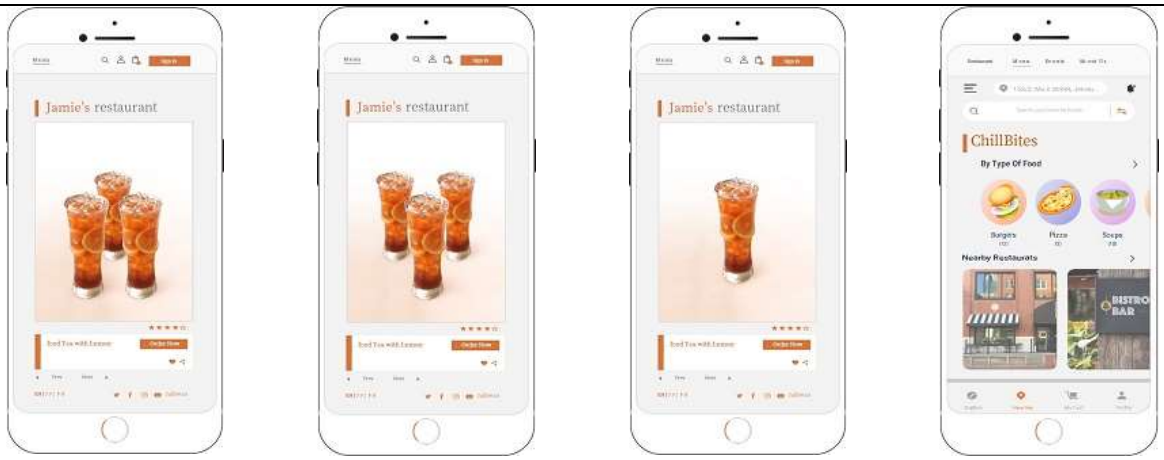



Horizontal | Vertical | Right Diagonal | Left Diagonal

3-item Repetition Condition




Horizontal | Vertical | Right Diagonal | Left Diagonal




Upward-pointing Triangle | Downward-pointing Triangle | Non-Repetition | Intro

**Figure 9.** Visual Stimuli of Iced Tea in Study 2

# CHAPTER FOUR
# RESULTS

This chapter includes the results of data analyses that assessed the hypothesized conceptual models. Data were collected through online panels multiple times for Pilot Studies, Pretests, Studies 1 and 2. The results of Pilot Studies, Pretests, Studies 1 and 2 were presented in separate sections of the chapter. For main studies, one-way Analysis of Variance (ANOVA) was conducted to test the effects of a different sets of repetition and compositional lines. Then, the researcher conducted serial mediation analyses adopting Hayes' PROCESS model to test serial mediation effects of crossmodal correspondence from vision to taste. A short summary of the findings is presented after each study.

## 4.1. Pilot Studies

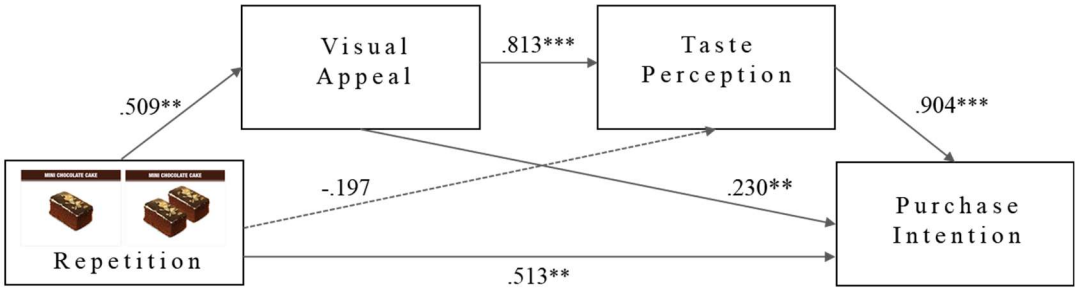
### Results of Pilot Study 1: Mini Chocolate Cake for the Effects of Repetition

As a manipulation check, the researcher asked participants how many piece(s) of chocolate cake they had seen after asking all questions about the ad perception: 99.5% of participants answered correctly ($\chi^2(1) = 211.03$, $p < .001$), indicating that the manipulation was successful. The researcher conducted an analysis of covariance (ANCOVA), which posits the effect of repetition on viewers' evaluation of visual appeal. After statistically controlling for participants' hunger level, the effect of repetition on visual appeal was significant, $F(1, 212) = 4.446$, $p < .05$, $\eta_p^2 = .021$, indicating that participants in the repetition condition perceived a significantly higher

level of visual appeal ($M_{repetition}$ = 6.948, *SD* = 1.735) than did those who were exposed to the stimulus with a single food item ($M_{non\text{-}repetition}$ = 6.439, *SD* = 1.735) (note that adjusted means and standard deviations are used hereafter).

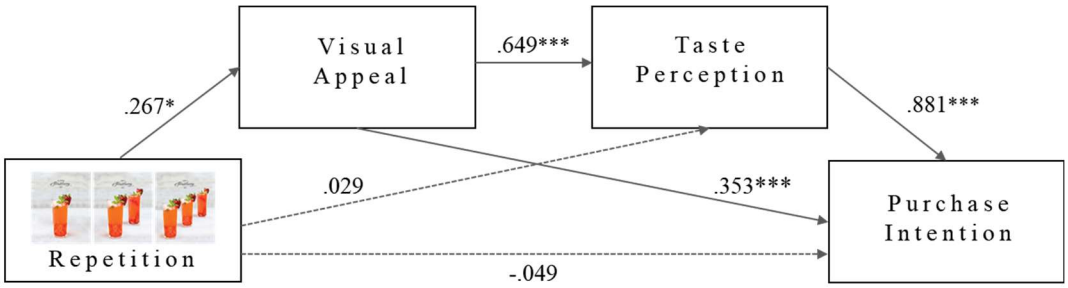
Next, the researcher conducted Hayes' PROCESS model 6 (Hayes 2013) to test proposed serial mediation effects of visual appeal and taste perception. The results showed a significant effect of repetition on visual appeal (*B* = .509, *SE* = .237, *t*(212) = 2.149, *95% bootstrap CI* = .042, .975) and purchase intention (*B* = .513, *SE* = .232, *t*(210) = 2.210, *95% bootstrap CI* = .054, .971). The direct effect of repetition on taste perception was not found to be significant (*B* = -.197, *SE* = .188, *t*(211) = -1.049, *95% bootstrap CI*= -.567, .173). Additionally, the results revealed that visual appeal increases viewers' taste perception (*B* = .813, *SE* = .054, *t*(211) = 15.094, *95% bootstrap CI* = .707, .920) and purchase intention (*B* = .230, *SE* = .096, *t*(211) = 2.398, *95% bootstrap CI* = .041, .419), and taste perception enhances viewers' purchase intentions (*B* = .904, *SE* = .085, *t* (210) = 10.630, *95% bootstrap CI* = .736, 1.071). The serial mediation effects of visual appeal and taste perception were statistically significant (*Effect* = .374, *SE* = .177, *95% Bootstrap CI* = .030, .725).

In summary, the results of Pilot Study 1 demonstrated that repetition of food items in food imagery increases viewers' likelihood of buying the presented food item, and cross-modal correspondences between vision and taste mediate this relationship. It is noteworthy that the use of repetition influences taste not directly but rather through viewers' aesthetic pleasure. This finding supports the notion that repetition effectively enhances mental simulation of eating the food through cross-modal responses that involve vision and taste, which, in turn, increases a viewer's intention to buy the presented food item.



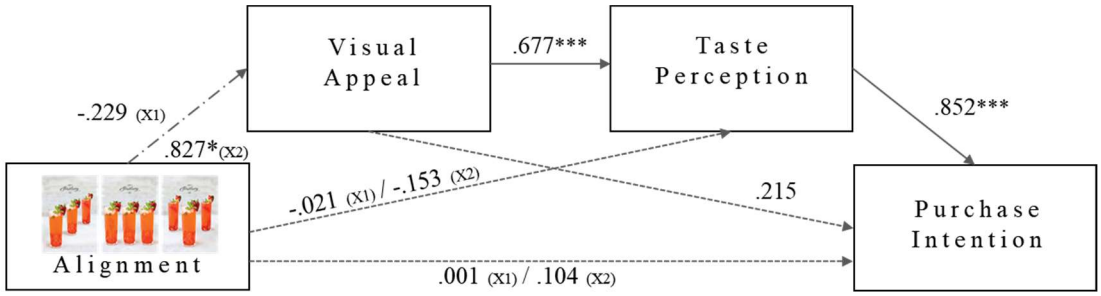

*** $p < .01$; ** $p < .05$; * $p < .10$

Estimates of 95% bootstrap confidential intervals for indirect effects:
Repetition → Visual appl. → Purchase Int. [.001, .298] *
Repetition → Taste perception → Purchase Intention [-.506, .166]
Repetition → Visual appl.→ Taste Perception → Purchase Int. [.030, .725] *
* indicates statically significant relative indirect effects




* $p < .05$, ** $p < .01$, *** $p < .001$

Estimates of 95% bootstrap confidential intervals for indirect effects:
Repetition → Visual appeal → Purchase Intentions [.009, .232] *
Repetition → Taste Perception → Purchase Intention [-.129, .186]
Repetition → Visual appeal → Taste Perception → Purchase Intentions [.027, .275] *
* indicates statically significant indirect effects




* $p < .05$, ** $p < .01$, *** $p < .001$

Estimates of 95% bootstrap confidential intervals for relative indirect effects:
Compositional lines 1 (X1) → Visual appeal → Purchase Intentions [-.479, .127]
Compositional lines 2 (X2) → Visual appeal → Purchase Intentions [-.012, .670]
Compositional lines 1 (X1) → Taste Perception → Purchase Intention [-.505, .479]
Compositional lines 2 (X2) → Taste Perception → Purchase Intention [-.492, .231]
Compositional lines 1 (X1) → Visual appeal → Taste Perception → Purchase Intentions [-.675, .351]
Compositional lines 2 (X2) → Visual appeal → Taste Perception → Purchase Intentions [.067, 973] *
* indicates statically significant relative indirect effects; Compositional lines 1 (X1) is the contrast between horizontal and diagonal compositions and Compositional lines 2 (X2) is the contrast between triangular and horizontal compositions

**Figure 10.** Serial Mediation Analysis of Pilot Studies 1, 2, and 3

**Results of Pilot Study 2: Strawberry Juice for the Effects of Repetition**

As a manipulation check, the researcher asked participants how many glasses of strawberry juice participants had seen in the visual stimulus after asking all questions about the ad perception. The manipulation was successful as 93.8% of participants answered correctly ($\chi^2(4) = 347.64$, $p < .001$). After statistically controlling for participants' hunger level, the results of ANCOVA revealed that perceived visual appeal increases as the number of repetitions increase, $F(2, 192) = 2.857$, $p = .059$, $\eta_p^2 = .029$. That is, visual appeal perceived from the food advertisement was highest in the 3 item-repetition condition ($M = 7.750$, $SD = 1.185$), followed by the two-item repetition condition ($M = 7.567$, $SD = 1.287$) and finally the non-repetition condition ($M = 7.224$, $SD = 1.285$). The researcher compared the differences using Helmert contrasts because repetition was an ordinal factor (Kabacoff, 2015; Hayes & Preacher, 2014). The results revealed that the mean scores of visual appeal were significantly different ($p < .05$) between the non-repetition condition and the two-item repetition condition but not significantly different between two-item repetition and three-item repetition ($p > .1$). That is, the statistically significant difference in visual appeal only existed between non-repetition and two-item repetition.

Next, the researcher conducted Hayes' PROCESS model 6 (Hayes 2013) to test the effects of cross-modal correspondences between vision and taste. The results supported the significant effect of repetition on visual appeal ($B = .267$, $SE = .113$, $t(193) = 2.360$, *95% bootstrap CI*= .044, .490). The direct effects of repetition on taste perception ($B = .029$, $SE = .100$, $t\ (192) = .287$, *95% bootstrap CI* = -.169, .227) and purchase intention ($B = -.049$ $SE = .128$, $t\ (191) = -.383$, *95% bootstrap CI* = -.302, .204) were not found to be significant. In addition, the results revealed that visual appeal increased viewers' taste perception ($B = .649$, $SE$

= .063, $t(192) = 10.310$, *95% bootstrap CI* = .525, .773) and purchase intention ($B = .352$, $SE = .100$, $t(191) = 3.517$, *95% bootstrap CI* = .155, .550), and the level of taste perception enhanced viewers' purchase intentions ($B = .881$, $SE = .092$, $t(191) = 9.550$, *95% bootstrap CI*= .699, 1.062). The results demonstrated that the serial mediation effects of visual appeal and taste perception were statistically significant (*Effect* = .153, *SE* = .062, *95% Bootstrap CI* = .027, .275).

In summary, the findings of Pilot Study 2 confirmed the positive effect of repetition in food imagery on purchase intention and the importance of cross-modal correspondences between vision and taste. Consistent with Pilot Study 1, the results of Pilot Study 2 demonstrated that repeated food items increase the likelihood of purchasing the presented food product compared to a single food object. This finding supports our hypothesis that repetition increases aesthetic experience, which then increases taste perception. Additionally, the findings of Pilot Study 2 showed that a further increase in the number of repetitions (i.e., two versus three) does not significantly enhance viewers' visual appeal. In brief, the findings of these studies demonstrated that repetition of a product unit in food imagery increases a likelihood of a viewer's purchase intention because it increases the viewer's sensory experience from vision to taste, but this relationship is not linear.

**Results of Pilot Study 3: Strawberry Juice for the Effects of Compositional Lines**

As a manipulation check, the researcher asked what type of arrangement the three glasses of juice participants had seen in the presented stimulus after asking all questions about the imagery perception. The results showed that 93.2% of respondents perceived the manipulated composition as intended. Therefore, the manipulation was successful ($\chi^2(4) = 168.06$, $p < .001$).

After statistically controlling for participants' hunger level, the results of ANCOVA showed that perceived visual appeal differed by types of composition ($F(2, 90) = 2.521$, $p = .086$, $\eta_p^2 = .053$). The results revealed that the triangular composition was perceived as having the highest visual appeal ($M_{triangular} = 7.924$, $SD = 1.540$), followed by diagonal composition ascending from left to right ($M_{right\ diagonal} = 7.326$, $SD = 1.526$) and finally horizontal composition ($M_{horizontal} = 7.097$, $SD = 1.516$). The statistically significant difference was found only between triangular composition and other two compositions, but no significant difference was found between diagonal and horizontal compositions ($p > .1$).

Next, the researcher conducted Hayes' PROCESS model 6 (Hayes 2013) to test the serial path from composition to visual appeal to taste perception to purchase intention. Since this study used repetition in Pilot Studies 1 and 2 based on diagonal composition, the researcher consistently used diagonal composition as the reference group with the effect coding system of multi-categorical option (Hayes and Preacher 2014). The results showed that the relative direct effect of composition 1 (horizontal composition vs. diagonal composition) on visual appeal ($B = -.352$, $SE = .222$, $t(90) = -1.584$, *95% bootstrap CI* = -.793, .089) was insignificant, whereas the direct effect of composition 2 (triangular composition vs. diagonal composition) on visual appeal ($B = .475$, $SE = .220$, $t(90) = 2.160$, *95% bootstrap CI* = .038, .912) was found to be significant. In addition, the results revealed that visual appeal increased viewers' taste perception ($B = .677$, $SE = .071$, $t\ (89) = 9.511$, *95% bootstrap CI* = .535, .818), and the level of taste perception enhanced purchase intention ($B = .852$, $SE = .123$, $t(88) = 6.924$, *95% bootstrap CI* = .607, 1.096), but the other relative direct effects were not significant ($p > .1$). Although the results showed that other relative indirect paths were insignificant (*Effect* = -.203, $SE = .148$, *95% Bootstrap CI* = -.515, .055), the indirect path from compositional lines to purchase intention

(triangular vs. diagonal compositions → visual appeal → taste perception → purchase intention) was significant (*Effect* = .274, *SE* = .11, *95% Bootstrap CI* = .071, .505). In summary, the findings of Pilot Study 3 demonstrated the effect of composition in food imagery. The results confirmed the superior effect of triangular composition on viewers' visual preference. Contrary to the researcher's expectation, no significant difference was found between diagonal and horizontal compositions in terms of its effect on visual appeal. The finding of Pilot Study 3 supported cross-modal correspondences between vision and taste as a serial mediating effect of visual appeal and taste perception was found between triangular and diagonal aligned food images. Figure 10 presents the results of the serial multiple mediation analyses for Pilot Studies 1, 2, and 3.

**Results of Pilot Study 4: Effects of Upward-Pointing Triangle versus Downward-Pointing Triangle**

The results of Pilot Study 4 revealed that 70.8% of respondents reported that they preferred the three-item strawberry juice photo in downward-pointing triangle over the photo in upward-pointing triangle composition. A binomial test indicated that the proportion of downward-pointing triangle was higher than the expected .50, $p < .001$ (two-tailed). Therefore, the findings of Pilot Study 4 demonstrated that the down-triangular composition is more effective in generating visual appeal than the upward-pointing triangular composition in food imagery. This finding is inconsistent with the findings of a previous study (Michel et al. 2015) in which upward-pointing triangular orientation is most preferred. However, it is worth paying attention to different settings: While Michel et al. (2015)'s study examined the effects of different orientations of repeated food elements on a plate (i.e. three pickled onion pieces on a plate), visual stimuli in this study presented different compositions of repeated units of a food

product (i.e. three glasses of strawberry juice). That is, it is possible that visual stimuli in Michel et al.'s study had stronger interaction effects between a triangular shape of a piece of pickled onion and Gestalt orientations of the repeated food elements on a plate, which generated the preferred upward-pointing triangular orientation of the food plating (Michel et al., 2015).

## 4.2. Pretests

### Results of Pretest 1: Determining the Numbers of Repetitions

The Friedman test was conducted to examine differences in rank-ordering of food/beverage photos in terms of visual preferences. For images of cheeseburgers in the horizontal composition, the results revealed that rank orders are marginally different between a photo with non-repetition and a photo with 2-item repetition ($\chi^2(1) = 3.556$, $p = .060$); however, in the vertical composition condition, the difference in rank-ordering was statistically significant, and ranks were revealed in the order of non-repetition, 3-item, 4-item, and 2-item repetitions ($\chi^2(3) = 18.568$, $p < .001$). Then, post-hoc Wilcoxon signed-ranks tests were performed to identify details of the difference among a pair of the compositions. The results revealed that in the vertical composition condition, 3-item repetition is perceived more visually appealing than 4-item repetition at a significant level ($Z = 2.481$, $p = .013$), but no significant difference was found between other pairs. For the diagonal composition conditions, the results of Friedman test showed that the difference in order-ranking was statistically significant in both the right diagonal ($\chi^2(3) = 31.184$, $p < .001$) and left diagonal ($\chi^2(3) = 78.363$, $p < .001$) composition conditions. The results of Wilcoxon signed-ranks tests revealed that in the right diagonal-composition

condition, 2-item repetition is more visually appealing than 3-item repetition ($Z = 2.275$, $p = .022$), followed by 4-item repetition ($Z = 3.524$, $p < .001$); but, in the left diagonal condition, an image with 3-item repetition was found to be more visually appealing than 4-item repetition ($Z = 6.491$, $p < .001$), but no other pairs were significantly different in perceived visual appeal.

For iced tea images, the results of the Friedman test revealed that in the horizontal-composition condition, rank-ordering for visual preference was marginally different among non-repetition, 3-item and 2-item repetitions ($\chi^2(2) = 5.640$, $p = .060$). In the vertical-composition condition, rank-ordering was shown from non-repetition, 3-item, 2-item, to 4-item repetitions statistically ($\chi^2(3) = 49.66$, $p < .001$). The results of Wilcoxon signed-ranks tests further revealed that non-repetition was more visually appealing than 3-item repetition at a significant level ($Z = 3.486$, $p < .001$) in the vertical-composition condition. Other pairs were not significantly different in terms of visual appeal. For the right diagonal-composition condition, the results of Friedman test showed the rank-ordering from 2-item repetition, non-repetition, 3-item, to 4-item repetition ($\chi^2(3) = 18.856$, $p < .001$). The results of Wilcoxon signed-ranks tests further revealed that an image with 3-item repetition was more visually appealing than an image with 4-item repetition ($Z = 3.470$, $p < .001$). Other ranking differences were not statistically significant. For the left diagonal-composition condition, the results of Friedman test showed the rank-ordering from 2-item repetition, 3-item repetition, non-repetition, to 4-item repetition ($\chi^2(3) = 23.66$, $p < .001$). The results of Wilcoxon signed-ranks tests further revealed that a photo with non-repetition was more visually appealing than a photo with 4-item repetition ($Z = 6.052$, $p < .001$). Other pairs were not significantly different in perceived visual appeal. Table 5 summarizes the results of Pretests 1 and 2.

**Table 5**. Results of Pretests 1 and 2

| Stimuli | Composition condition | Rank-order [a] | Significant differences [b] |
|---|---|---|---|
| Cheeseburgers | Horizontal | Non-repetition > 2-item | |
| | Vertical | Non-repetition > 3-item > 4-item > 2-item repetition | 3-item > 4-item repetition |
| | Right diagonal | Non-repetition > 2-item > 3-item > 4-item | 2-item > 3-item > 4-item repetition |
| | Left diagonal | Non-repetition > 2-item > 3-item > 4-item | 3-item > 4-item repetition |
| | Polygonal | Downward-pointing triangle > Upward-pointing triangle > Diamond > Rectangle | Downward-pointing triangle>Diamond<br>Diamond > Rectangle<br>Upward-pointing triangle > Rectangle |
| Iced tea | Horizontal | Non-repetition>3-item>2-item repetition | |
| | Vertical | Non-repetition>3-item>2-item>4-item repetition | Non-repetition > 3-item repetition |
| | Right diagonal | 2-item > Non-repetition > 3-item > 4-item | 3-item > 4-item repetition |
| | Left diagonal | 2-item > 3-item > Non-repetition > 4-item | Non-repetition > 4-item repetition |
| | Polygonal | Downward-pointing triangle > Diamond > Upward-pointing triangle > Rectangle | Downward-pointing triangle > Upward-pointing triangle<br>Diamond > Rectangle<br>Upward-pointing triangle>Rectangle |

**Note.* Rank-orders for visual preferences. Rank-orders [a] display the results of Friedman tests; significant differences [b] display the results of Wilcoxon signed-ranks tests.

**Results of Pretest 2: Selecting Compositional Lines that Shape a Polygon**

The Friedman test was conducted to examine differences in rank-ordering of polygonal compositions (i.e., upward-pointing triangle, downward-pointing triangle, rectangle, and diamond shape) of food/beverage photos in terms of visual preferences. For images of cheeseburgers, the results revealed the rank-ordering in the order of downward-pointing triangle, upward-pointing triangle, diamond, to rectangle ($\chi^2(3) = 49.492$, $p < .001$). Then, post-hoc

Wilcoxon signed-ranks tests were performed to identify details of the difference between a pair of the compositions. The results revealed that downward-pointing triangle is perceived more visually appealing than diamond ($Z = 3.932$, $p < .001$) and rectangle ($Z = 5.314$, $p < .001$), but there was no difference between downward-pointing triangle and upward-pointing triangle ($p > .1$); upward-pointing triangle is perceived more visually appealing than rectangle ($Z = 4.766$, $p <. 001$); and finally diamond shape was perceived more visually appealing than rectangle (2.310, $p < .05$).

For iced tea images, the results of the Friedman test showed the rank-ordering in the order of downward-pointing triangle, upward-pointing triangle, diamond, and rectangle ($\chi^2(3) = 52.742$, $p <.001$). Then, post-hoc Wilcoxon signed-ranks tests were performed to identify details of the difference between a pair of the compositions. The results revealed that upward-pointing triangle is perceived more visually appealing than downward-pointing triangle was perceived more visually appealing than diamond ($z = 2.574$, $p < .01$), upward-pointing triangle ($Z = 3.44$, $p < .001$), and rectangle ($Z = 5.606$, $p < .001$); diamond was perceived more visually appealing than rectangle ($Z = 4.803$, $p < .001$), there was no difference between diamond and upward-pointing triangle ($p > .1$); and finally, upward-pointing triangle was perceived more visually appealing than rectangle ($Z = 3.942$, $p < .001$).

The findings of the pretests indicated that 4-item repetition is the least visually appealing. This finding was consistent across different types of food (i.e., cheeseburgers, iced tea) and compositional lines except the horizontal-composition condition that presented only non- and 2-item repetition. Although some results of Friedman tests showed non-repetition as rank 1, the majority of the cases were not statistically significant from rank 2 throughout cheeseburger and iced tea. However, this finding suggests that the relationship between the number of repetition

and visual appeal is nonlinear. That is, the effects of increasing the number of repetitions on visual appeal increases up to a maximum of three, and then the effects decrease. The inversion of the repetition effect might be due to visual complexity. Visual complexity offers a viewer aesthetic experience up to an optimal level, but the viewer's pleasure decreases as visual complexity further increases (Berlyne 1971; Cox and Cox 2002; Pieters, Wedel, and Batra 2010). In this regard, a higher-order organization such as repetition can compress perceived visual complexity (Forsythe et al. 2011). Hence, three repetition conditions that include non-repetition, 2-item repetition, and 3-item repetition were included for the repetition of an identical food object in the linear compositions (i.e., horizontal, vertical, right diagonal, left diagonal) in the main studies. In addition, the findings of Pretest 2 demonstrated that downward pointing triangular composition is most visually appealing compared to other polygonal compositions. To this end, the researcher selected a downward-pointing triangle and upward-pointing triangle to be tested for 3-item based comparisons in the main studies, along with other 3-item linear compositions.

## 4.3. Study 1

### Results of Study 1: Cheeseburger Photos on Instagram

**Manipulation Check.** For manipulation checks, participants were asked how many cheeseburgers they had seen and what the arrangement of the cheeseburger(s) was in the Instagram post that they had viewed. The manipulations were successful as 98.7% of the participants correctly reported the number of repetition ($\chi^2(6) = 1863.313$, $p < .001$), and 84.7 %

of the participants reported a composition in the study stimuli correctly ($\chi^2(48) = 4216.754$, $p < .001$).

**Hypothesis Test for the Effects of Repetition.** Hypothesis 1 posits the effects of repetition on visual appeal. Only linear compositions were included in this analysis because H1 is interested in a comparison between photos with non-repetition and 2-item repetition. One-way analysis of variance (ANOVA) was conducted for each linear composition (i.e., horizontal, vertical, right diagonal, left diagonal). When Levene's test of homogeneity of variance was violated ($p < .05$), a one-way ANOVA with the Welch's correction (Welch, 1951) and the Games-Howell procedure (Games & Howell, 1976) for the post hoc analysis were used throughout data analyses. When photos presented cheeseburgers in the horizontal composition, the results of one-way ANOVA indicated that the level of visual appeal was significantly different between non-repetition, 2-item repetition, and 3-item repetition conditions (Welch's $F(2, 141.08) = 6.077$, $p < .01$). The levels of perceived visual appeal were rated in the order of the 2 item-repetition ($M = 5.069$, $SD = 1.315$, n = 92), the 3-item repetition ($M = 4.491$, $SD = 1.360$, n = 97), and the non-repetition ($M = 4.339$, $SD = 1.718$, n = 61) conditions. The results of Games-Howell post hoc tests showed that the differences of all pairs were significant ($p < .05$) except for a pair of 3-item repetition and non-repetition conditions. That is, levels of perceived visual appeal were not significantly different between the 3-item repetition condition and the non-repetition condition ($p > .1$). Also, the results of one-way ANOVA demonstrated a significant difference in perceived visual appeal among three repetition conditions for photos that present the vertical composition of cheeseburgers (Welch's $F(2, 142.89) = 6.324$, $p < .01$). Levels of perceived visual appeal were rated in the order of the 2 item-repetition ($M = 5.262$, $SD = 1.415$, n = 94), the 3-item repetition ($M = 5.11$, $SD = 1.431$, n = 94) and the non-repetition ($M$

= 4.339, *SD* = 1.718, n =61) conditions. The results of Games-Howell post hoc tests showed that the differences of all the pairs were significant ($p$ <.05) except for a pair of the 3-item repetition and the 2-item repetition conditions ($p$ >.1). For photos that present cheeseburgers in the right diagonal composition, the results of one-way ANOVA demonstrated a significant difference among three repetition conditions (Welch's $F(2, 139.35) = 6.018$, $p$ <.01). That is, levels of perceived visual appeal were rated in the order of the 3 item-repetition (M = 5.213, *SD* = 1.213, n = 95), the 2-item repetition (*M* = 5.123, *SD* = 1.374, n = 94), and the non-repetition (*M* = 4.339, *SD* = 1.718, n =61) conditions. The results of Games-Howell post hoc tests showed that all the differences of all pairs were significant ($p$ < .01) except for a pair of the 3-item repetition and the 2-item repetition conditions. ($p$ >.1). Lastly, for photos of cheeseburgers in the left diagonal composition, the results of one-way ANOVA demonstrated a significant difference in perceived visual appeal among three repetition conditions (Welch's $F(2, 140.5) = 6.665$, $p$ < .01). Levels of perceived visual appeal were in the order of the 2 item-repetition condition (*M* = 5.278, *SD* = 1.327, n = 95), the 3-item repetition condition (*M* = 4.933, *SD* = 1.283, n = 95), and the non-repetition (*M* = 4.339, *SD* = 1.718, n = 61) conditions. The results of Games-Howell post hoc tests showed that a differences of the non-repetition and 2-item repetition ($p$ <.01) and a difference of the non-repetition and 3-item repetition ($p$ =.058) were statistically significant, but a difference between the 3-item repetition and 2-item repetition conditions were not statistically significant ($p$ >.1). Thus, H1 was supported. Table 6 presents the descriptive statistics, and Figure 11 illustrates the significant results of mean plots for repetition for cheeseburger photos in Study 1.

**Hypothesis Test for the Effects of Compositional Lines.** Hypothesis 2 posits the different effects of compositional lines on viewers' perception of visual appeal. A series of one-

way ANOVAs were conducted to test the effects of compositional lines within each repetition condition. When photos of two identical cheeseburgers were presented, the results of one-way ANOVA revealed no significant difference in perceived visual appeal among different compositional lines (i.e., horizontal, vertical, right diagonal, left diagonal) ($F(3, 372) = .571$, $p > .1$). However, when photos of three identical cheeseburgers were presented, the results revealed significant differences in perceived visual appeal among different compositional lines ($F(5, 558) = 4.767$, $p < .001$). Levels of perceived visual appeal were rated in the order of the upward-pointing triangle composition ($M = 5.272$, $SD = 1.237$, n = 93), the right diagonal composition ($M = 5.213$, $SD = 1.374$, n = 94), the vertical composition ($M = 5.110$, $SD = 1.431$, n = 94), the left diagonal ($M = 4.933$, $SD = 1.283$, n = 95), the downward-pointing triangle composition ($M = 4.758$, $SD = 1.294$, n = 91), and the horizontal composition ($M = 4.491$, $SD = 1.360$, n = 97). In addition, the results of Tukey HSD post hoc tests revealed that the differences were statistically significant between right diagonal and horizontal compositions, and upward-pointing triangle and horizontal compositions at $p < .01$; the difference between the vertical composition and the horizontal composition was significant at $p < .05$; the difference between the upward- and downward-pointing triangle compositions was not significant ($p = .094$); the differences of all other pairs were not statistically significant ($p > .1$). Thus, H2 was partially supported. Figure 12 illustrates the significant results of mean plots for compositional lines.

**Table 6.** Descriptive Statistics of Study 1: Cheeseburger

Dependent Variable: Visual Appeal

| Repetition | Composition | Mean | Std. Deviation | N |
|---|---|---|---|---|
| 0 | N/A | 4.339 | 1.718 | 61 |
| 2 | Horizontal | 5.059 | 1.315 | 92 |
| 2 | Vertical | 5.262 | 1.415 | 94 |
| 2 | Right diagonal | 5.123 | 1.213 | 95 |
| 2 | Left diagonal | 5.277 | 1.327 | 95 |
| 3 | Horizontal | 4.492 | 1.360 | 97 |
| 3 | Vertical | 5.110 | 1.431 | 94 |
| 3 | Right diagonal | 5.213 | 1.374 | 94 |
| 3 | Left diagonal | 4.933 | 1.283 | 95 |
| 3 | Upward-pointing triangle | 5.272 | 1.237 | 93 |
| 3 | Downward-pointing triangle | 4.758 | 1.294 | 91 |
| | Total | 5.007 | 1.378 | 1001 |

*N/A: not applicable.

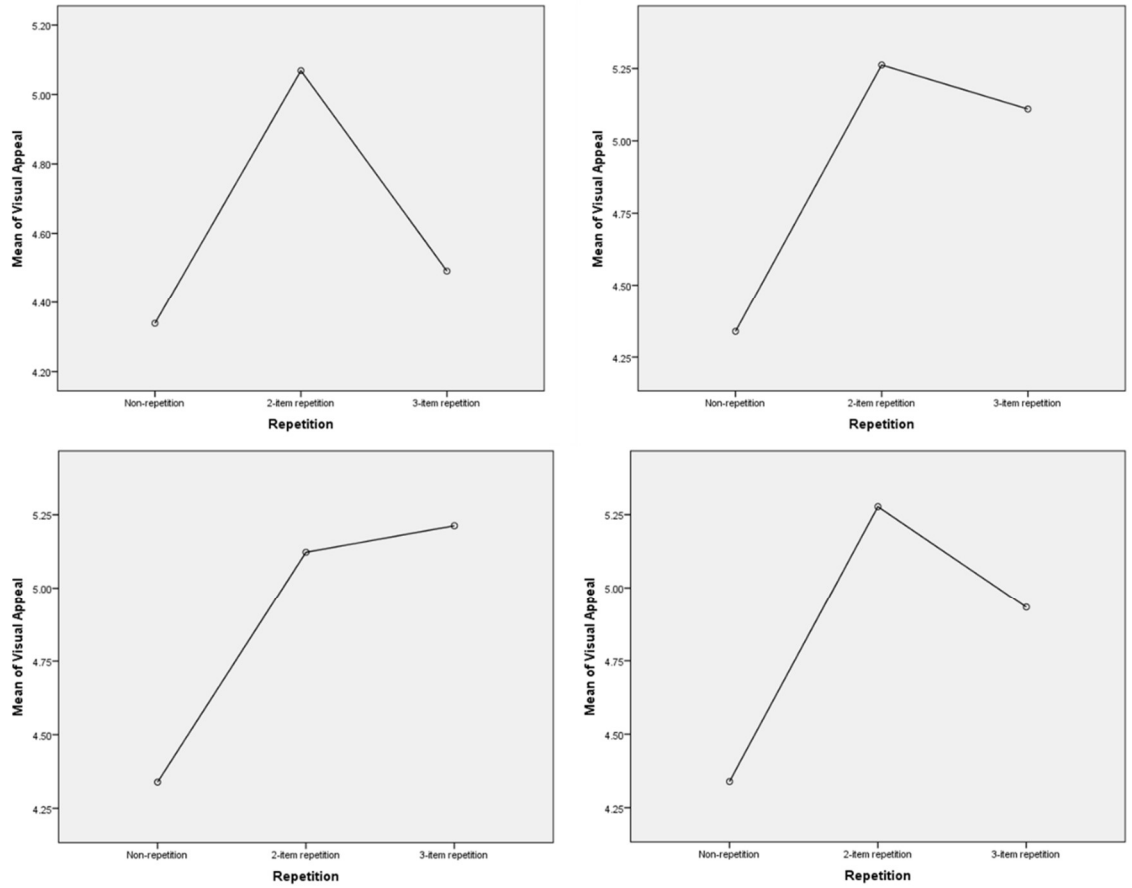



**Figure 11.** Mean Plots for Repetition in Horizontal (Upper left), Vertical (Upper right), Right Diagonal (Lower left), and Left Diagonal (Lower right) Compositions

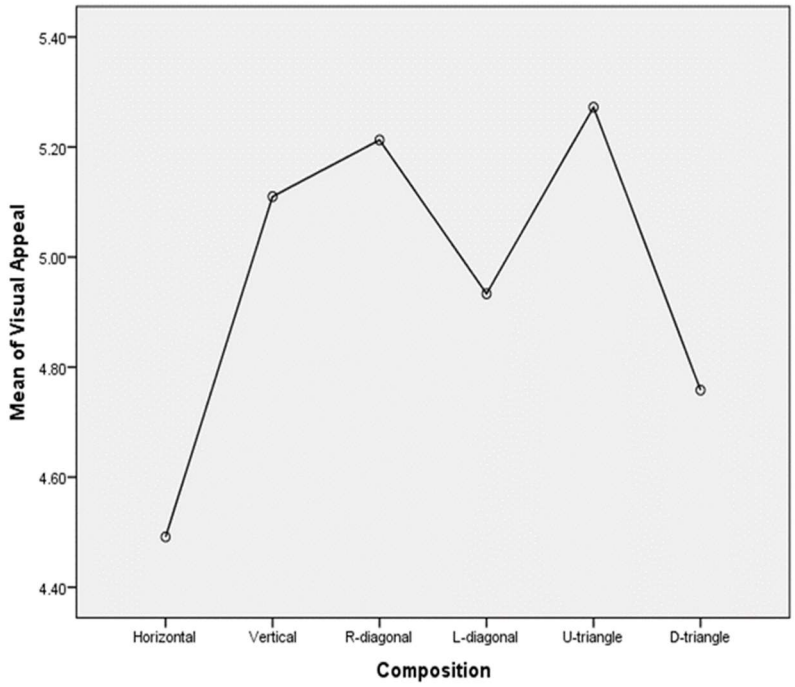



**Figure 12.** Mean Plot for Compositional Lines

**Hypothesis Test for the Effects of Crossmodal Responses on Purchase Intention.**

Hayes' PROCESS model 6 (Hayes 2013) was conducted to test the proposed serial mediation effects of visual appeal and taste perception on purchase intention (H3-4) on Instagram. Hypothesis 3 posits that the effect of repetition in a food photo on purchase intention is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each compositional line condition. Repetition was treated as a multicategorical variable, and indicator coding was used with the non-repetition condition as a reference group. In the horizontal composition condition, the results revealed that the effect of 2-item repetition on visual appeal was significantly higher than the effect of non-repetition item repetition (X1: 2-item vs non-repetition), but there was no significant difference between 3-item repetition and non-repetition (X2: 3-item vs. non-repetition) conditions ($B_{X1}$= .730, $SE_{X1}$ = .238, $t_{X1}$ (247) =

3.072, *95% bootstrap* $CI_{X1}$= .262, .1.198; $B_{X2}$ = .153, $SE_{X2}$ = .235, $t_{X2}$ (247) = .649, *95% bootstrap* $CI_{X2}$ = -.311, .616). That is, compared to participants in the non-repetition condition, those in the 2-item repetition condition reported a higher level of visual appeal perceived from the presented food photo; the difference in perceived visual appeal was not different between participants in the non-repetition condition and the 3-item condition. The results also demonstrated that the direct effect of visual appeal on taste perception was statistically significant ($B$ = .669, $SE$ = .036, $t$(246) = 18.590, *95% bootstrap CI* = .598, .740), and the direct effect of taste perception on purchase intention was significant ($B$ = .709, $SE$ = .079, $t$(245) = 8.952, *95% bootstrap CI* = .553, .865). The results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were statistically significant for the effect of 2-item repetition (X1), but not for the effect of 3-item repetition (X2) when non-repetition was used as the reference group ($Effect_{X1}$ = .346, $SE_{X1}$= .122, *95% bootstrap* $CI_{X1}$ = .108, .585; $Effect_{X2}$ = .072, $SE_{X2}$ = .120, *95% bootstrap* $CI_{X2}$ = -.180, .302). In turn, with sequential coding in PROCESS, the serial mediation effects of visual appeal and taste perception were significantly higher for the 2-item repetition condition than for the 3-item repetition condition (X2: 3-item vs. 2-item repetitions) ($Effect_{X2}$ = -.274, $SE_{X2}$ = .097, *95% bootstrap* $CI_{X2}$ = -.470, -.090).

In the vertical composition condition, the results showed that the effect of 2-item repetition and 3-item repetition on visual appeal was significantly higher than that of non-repetition ($B_{X1}$= .924, $SE_{X1}$ = .247, $t_{X1}$ (246) = 3.127, *95% bootstrap* $CI_{X1}$= .285, .1.257; $B_{X2}$ = .771, $SE_{X2}$ = .247, $t_{X2}$ (246) = 3.127, *95% bootstrap* $CI_{X2}$ = .285, .1257). That is, compared to participants in the non-repetition condition, those in the 2-item repetition and 3-item repetition conditions reported a higher level of visual appeal perceived from the presented food photo. The

results also demonstrated that the direct effect of visual appeal on taste perception was statistically significant ($B$ = .692, $SE$ = .040, $t$(245) = 17.113, *95% bootstrap CI* = .612, .772), and the direct effect of taste perception on purchase intention was significant ($B$ = .672, $SE$ = .069, $t$(244) = 9.672, *95% bootstrap CI* = .535, .808). The results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were statistically significant for the effect of 2-item repetition (X1) and 3-item repetition (X2) when non-repetition was used as the reference group ($Effect_{X1}$ = .429, $SE_{X1}$ = .133, *95% bootstrap* $CI_{X1}$ = .179, .700; $Effect_{X2}$ = .358, $SE_{X2}$ = .129, *95% bootstrap* $CI_{X2}$ = .119, .623). However, with sequential coding in PROCESS, the serial mediation effects of visual appeal and taste perception were not significantly higher for 2-item repetition than for 3-item repetition (X2: 3-item vs. 2-item repetition) in the vertical condition ($Effect_{X2}$ = -.071, $SE_{X2}$ = .096, *95% bootstrap* $CI_{X2}$ = -.269, .113).

In the right diagonal composition condition, the results revealed that the effects of 2-item repetition (X1) and 3-item repetition (X2) on visual appeal were significantly higher than that of non-repetition ($B_{X1}$ = .784, $SE_{X1}$ = .231, $t_{X1}$ (247) = 3.390, *95% bootstrap* $CI_{X1}$ = .329, .1.240; $B_{X2}$ = .874, $SE_{X2}$ = .232, $t_{X2}$ (247) = 3.771, *95% bootstrap* $CI_{X2}$ = .418, 1.330). That is, compared to participants in the non-repetition condition, those in the 2-item and 3-item repetitions conditions reported a higher level of visual appeal perceived from the presented food photo. The results also demonstrated that the direct effect of visual appeal on taste perception was statistically significant ($B$ = .640, $SE$ = .044, $t$(246) = 14.590, *95% bootstrap CI* = .554, .727), and the direct effect of taste perception on purchase intention was significant ($B$ = .717, $SE$ = .070, $t$(245) = 10.270, *95% bootstrap CI* = .580, .855). The results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were statistically significant for the

effect of 2-item repetition (X1) and 3-item repetition (X2) when non-repetition was used as the reference group (*Effect*$_{X1}$ = .360, *SE*$_{X1}$= .119, *95% bootstrap CI*$_{X1}$ = .138, .601; *Effect*$_{X2}$ = .401, *SE*$_{X2}$ = .125, *95% bootstrap CI*$_{X2}$ = .161, .648). However, with sequential coding in PROCESS, the serial mediation effects of visual appeal and taste perception were not significantly higher for 3-item repetition than for 2-item repetition (X2: 3-item vs. 2-item repetition) in the right diagonal composition (*Effect*$_{X2}$ = .041, *SE*$_{X2}$ = .087, *95% bootstrap CI*$_{X2}$ = -.138, .208).

In the left diagonal composition condition, the results showed that the effects of 2-item repetition (X1) and 3-item repetition (X2) on visual appeal were significantly higher than that of non-repetition (*B*$_{X1}$= .938, *SE*$_{X1}$ = .232, *t*$_{X1}$(248) = 4.039, *95% bootstrap CI*$_{X1}$= .481, .1.396; *B*$_{X2}$ = .595, *SE*$_{X2}$ = .232, *t*$_{X2}$(248) = 2.559, *95% bootstrap CI*$_{X2}$ = .137, 1.052). That is, compared to participants in non-repetition condition, those in the 2-item and 3-item repetitions conditions reported a higher level of visual appeal perceived from the presented food photo. The results also revealed that the direct effect of visual appeal on taste perception was statistically significant (*B* = .634, *SE* = .043, *t*(247) = 14.697, *95% bootstrap CI* = .549, .719), and the direct effect of taste perception on purchase intention was significant (*B* = .740, *SE* = .074, *t*(246) = 10.058, *95% bootstrap CI* = .595, .885). The results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were statistically significant for the effects of 2-item repetition (X1) and 3-item repetition (X2) when non-repetition was used as the reference group (*Effect*$_{X1}$ = .440, *SE*$_{X1}$= .127, *95% bootstrap CI*$_{X1}$ = .205, .704; *Effect*$_{X2}$ = .280, *SE*$_{X2}$ = .122, *95% bootstrap CI*$_{X2}$ = .048, .524). However, with sequential coding in PROCESS, the serial mediation effects of visual appeal and taste perception were not significantly higher for 2-item repetition than for 3-item repetition (X2: 3-item vs. 2-item repetition) in the left diagonal composition (*Effect*$_{X2}$ = -.161, *SE*$_{X2}$ = .091, *95% bootstrap CI*$_{X2}$ = -.345, .022). Thus, H3 was partially

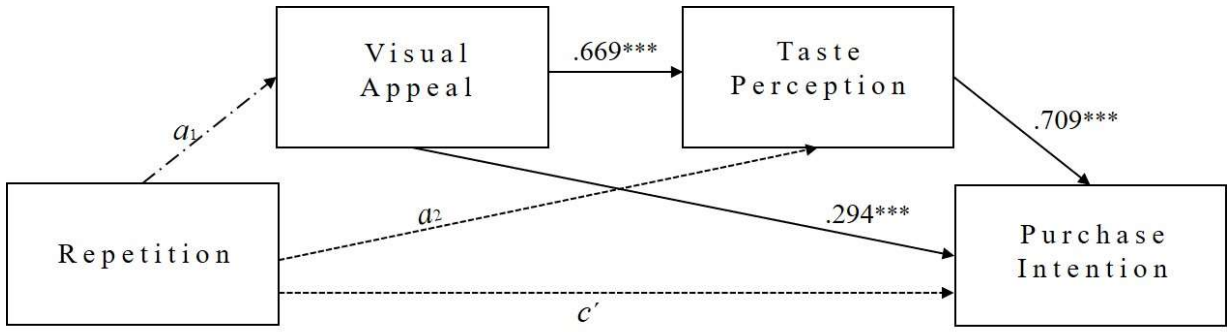
supported. Figure 13 presents the serial mediation analyses for the effects of repetition on purchase intention for cheeseburger photos on Instagram.

Next, the researcher conducted the serial mediation models based on the same number of repetitions with sequential coding. Hypothesis 4 posits that the effects of compositional lines in a food photo on purchase intention is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each number of repetition condition. In the 2-item repetition condition, the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly different among different composition conditions: that is, between the vertical and the horizontal composition conditions (X1: vertical vs. horizontal), between the right diagonal and vertical composition conditions (X2: right diagonal vs. vertical), and between left diagonal and right diagonal composition conditions (X3: left diagonal vs. right diagonal) ($Effect_{X1}$ = .021, $SE_{X1}$= .150, *95% bootstrap* $CI_{X1}$ = -.275, .316; $Effect_{X2}$ = -.147, $SE_{X2}$ = .149, *95% bootstrap* $CI_{X2}$ = -.440, .146; $Effect_{X3}$ = .102, $SE_{X3}$ = .149, *95% bootstrap* $CI_{X3}$ = -.190, .394). The direct effect of visual appeal on taste perception ($B$ = .597, $SE$ = .034, $t$(371) = 17.366, *95% bootstrap CI* = .530, 665) and the direct effect of taste perception on purchase intention were statistically significant ($B$ = .751, $SE$ = .061, $t$(370) = 12.382, *95% bootstrap CI* = .632, .870).

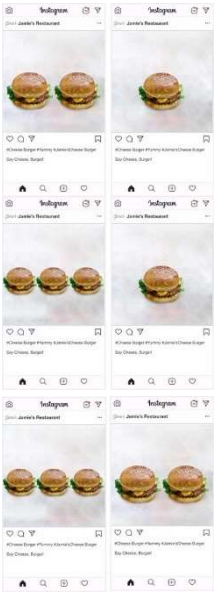
In the 3-item repetition condition, the results showed that participants perceived a significantly higher level of visual appeal in the vertical composition condition than in the horizontal composition condition (X1: vertical vs. horizontal); the effect of downward-pointing triangle was significantly higher than upward-pointing triangle (X5: downward-pointing triangle vs. upward-pointing triangle) ($B_{X1}$ = .619, $SE_{X1}$= .193, *95% bootstrap* $CI_{X1}$ = .240, .997; $B_{X5}$ = -.514, $SE_{X5}$ = .196, $t_{X5}$ (558) = -2.619, *95% bootstrap* $CI_{X5}$ = -.900, -.129). However, no

difference was found between the right diagonal and the vertical composition conditions (X2: right diagonal vs. vertical), between the left diagonal and the right diagonal conditions (X3: left diagonal vs. right diagonal), and between the upward-pointing triangle and the left diagonal composition conditions (X4: upward-pointing triangle vs. left diagonal) ($B_{X2}$ = .103, $SE_{X2}$ = .194, $t_{X2}$ (558) = .529, *95% bootstrap* $CI_{X2}$ = -.279, .484; $B_{X3}$ = -.279, $SE_{X3}$ = .194, $t_{X3}$ (558) = -1.442, *95% bootstrap* $CI_{X3}$ =-.660, .101; $B_{X4}$ = .339, $SE_{X4}$ = .194, $t_{X4}$ (558) = 1.746, *95% bootstrap* $CI_{X4}$ = -.043, .721). The results also demonstrated that the direct effect of visual appeal on taste perception ($B$ = .734, $SE$ = .028, $t$(557) = 26.432, *95% bootstrap CI* = .679, .788) and the direct effect of taste perception on purchase intention were statistically significant ($B$ = .686, $SE$ = .052, $t$(556) = 13.310, *95% bootstrap CI* = .585, .787). The results showed that the serial mediation effects of visual appeal and taste perception were significantly higher in the vertical composition condition than in the horizontal composition condition (X1); higher in the upward-pointing triangle composition condition than the downward-pointing triangle composition condition (X2) ($Effect_{X1}$ = .311, $SE_{X1}$ = .105, *95% bootstrap* $CI_{X1}$ = .111, .521; $Effect_{X5}$ = -.259, $SE_{X5}$ = .097, *95% bootstrap* $CI_{X5}$ = -.455, -.070). To additionally find the contrasts between other pairs, the researcher conducted another serial mediation model for 3-item compositional lines. The results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were significantly higher in the right diagonal condition than in the horizontal condition (X1) ($Effect_{X1}$ = .369, $SE_{X1}$ = .112, *95% bootstrap* $CI_{X1}$ = .165, .603) although that for upward-pointing triangle vs. right diagonal (X2) was not significant ($Effect_{X2}$ = .031, $SE_{X2}$ = .098, *95% bootstrap* $CI_{X2}$ = -.167, .223). Thus, H4 was partially supported. Figure 14 presents the serial mediation analyses for the effects of compositional lines on purchase intention for cheeseburger photos on Instagram.

Effects of Repetition in the Horizontal Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .730** $a_2$ = -.003 $c'$ = .516·
2-item vs. Non-rep. → Visual Appl.→ Purchase Int. [.052, .433] *
2-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.197, .227]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.108, .585] *

$a_1$ = .153 $a_2$ = .084 $c'$ = .047
3-item vs. Non-rep. → Visual Appl.→ Purchase Int. [-.106, .213]
3-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.145, .283]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.180, .302]

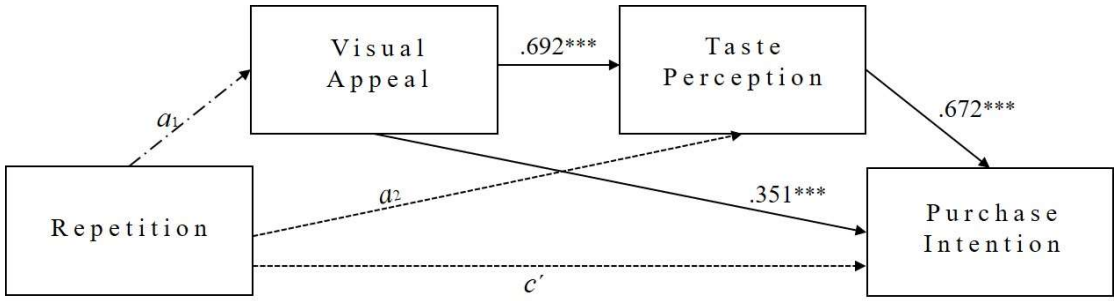
$a_1$= -.577** $a_2$ =.088 $c'$ = -.088
3-item vs. 2-item → Visual Appl.→ Purchase Int. [-.331, -.046] *
3-item vs. 2-item → Taste Prcp. → Purchase Int. [-.093, .209]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Purchase Int. [-.470, -.090] *

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

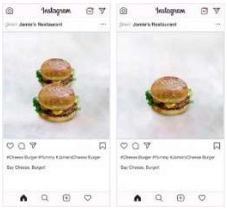
**Figure 13.** Serial Mediation Analysis for Repetition: Cheeseburger Photos in Study 1

Effects of Repetition in the Vertical Condition

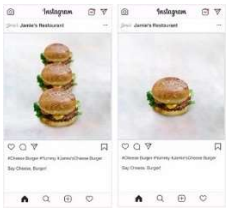



· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

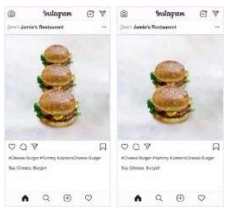
Estimates of 95% bootstrap confidential intervals for relative indirect effects:



$a_1$ = .924*** $a_2$ = .122 $c'$ = -.042
2-item vs. Non-rep. → Visual Appl.→ Purchase Int. [.125, .584] *
2-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.129, .308]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.179, .700] *



$a_1$ =.771** $a_2$ = -.092 $c'$ = -.051
3-item vs. Non-rep. → Visual Appl.→ Purchase Int. [.079, .528] *
3-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.279, .157]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.119, .623] *



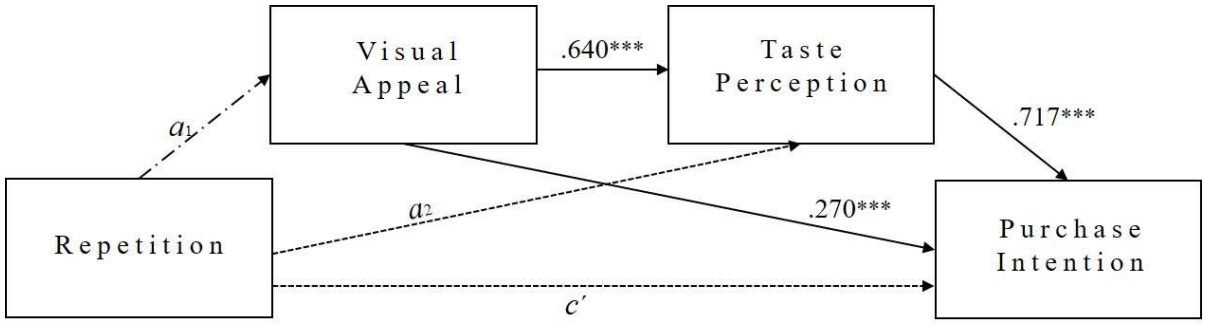
$a_1$ = -.153 $a_2$ = -.214 $c'$ = -.009
3-item vs. 2-item → Visual Appl.→ Purchase Int. [-.204, .094]
3-item vs. 2-item → Taste Prcp. → Purchase Int. [-.336, .034]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Purchase Int. [-.269, .113]

* indicates statically significant relative indirect effects

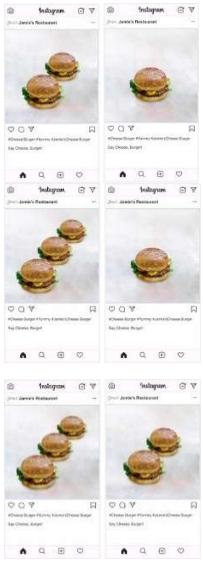
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 13.** Serial Mediation Analysis for Repetition: Cheeseburger Photos in Study 1 (Cont'd)

Effects of Repetition in the right diagonal Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .784*** $a_2$ = .084 $c'$ = -.152
2-item vs. Non-rep. → Visual Appl.→ Purchase Int. [.068, .410] *
2-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.166, .304]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.138, .601] *

$a_1$ = .874*** $a_2$ = -.113 $c'$ = -.093
3-item vs. Non-rep. → Visual Appl.→ Purchase Int. [.079, .442] *
3-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.322, .160]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.161, .648] *

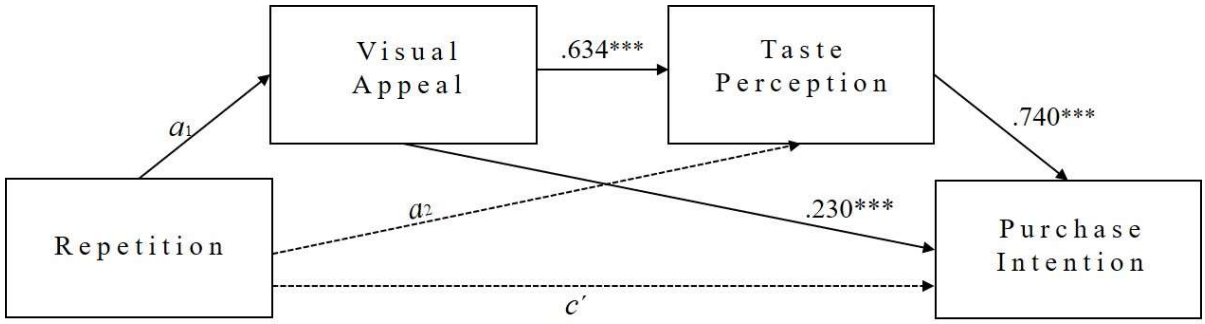
$a_1$ = .090 $a_2$ = -.197 $c'$ = .059
3-item vs. 2-item → Visual Appl.→ Purchase Int. [-.083, .129]
3-item vs. 2-item → Taste Prcp. → Purchase Int. [-.347, .052]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Purchase Int. [-.138, .208]

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

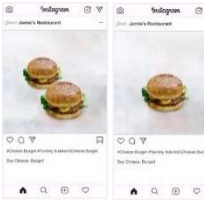
**Figure 13.** Serial Mediation Analysis for Repetition: Cheeseburger Photos in Study 1 (Cont'd)

Effects of Repetition in the Left Diagonal Condition

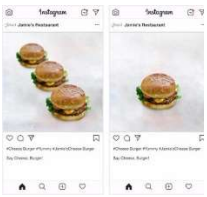



· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

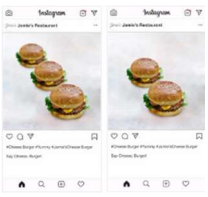
Estimates of 95% bootstrap confidential intervals for relative indirect effects:



$a_1$ = .938*** $a_2$ = .028 $c'$ = -.029
2-item vs. Non-rep. → Visual Appl.→ Purchase Int. [.061, .431] *
2-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.206, .265]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.205, .704] *



$a_1$ = .595** $a_2$ = -.064 $c'$ = .164
3-item vs. Non-rep. → Visual Appl.→ Purchase Int. [.015, .315] *
3-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.279, .194]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.048, .524] *



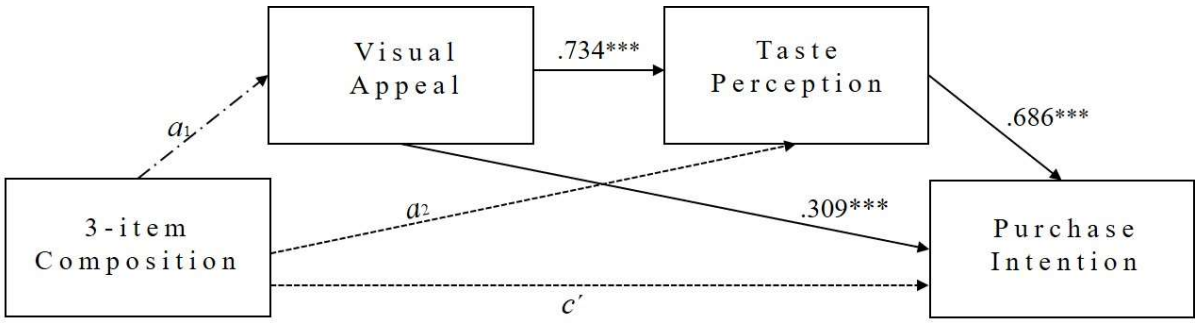
$a_1$ = -.344· $a_2$ = -.093 $c'$ = .193
3-item vs. 2-item → Visual Appl.→ Purchase Int. [-.203, .010]
3-item vs. 2-item → Taste Prcp. → Purchase Int. [-.266, .132]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Purchase Int. [-.345, .022]

* indicates statically significant relative indirect effects

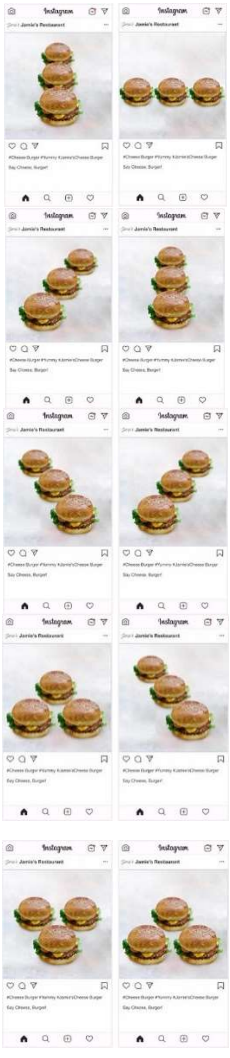
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 13.** Serial Mediation Analysis for Repetition: Cheeseburger Photos in Study 1 (Cont'd)

Effects of Compositional Lines in the 3-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .619** $a_2$ = -.199 $c'$ = .103
Vert. vs. Horz. → Visual Appl.→ Purchase Int. [.064, .349] *
Vert. vs. Horz. → Taste Prcp. → Purchase Int. [-.311, .022],
Vert. vs. Horz. → Visual Appl. → Taste Prcp. → Purchase Int. [.111, .521] *

$a_1$ = .103 $a_2$ = -.070 $c'$ = -.089
R-diag. vs. Vert. → Visual Prcp. Appl.→ Purchase Int. [-.097, .165]
R-diag. vs. Vert. → Taste → Purchase Int. [-.238, .145],
R-diag. vs. Vert. → Visual appl. → Taste Prcp. → Purchase Int. [-.156, .259]

$a_1$ = -.279 $a_2$ = .071 $c'$ = .247
L-diag. vs. R-diag. → Visual Appl.→ Purchase Int. [-.219, .033]
L-diag. vs. R-diag. → Taste Prcp. → Purchase Int. [-.131, .247]
L-diag. vs. R-diag. → Visual Appl. → Taste Prcp. → Purchase Int. [-.340, .054]

$a_1$ = .339· $a_2$ = .006 $c'$ = .032
U-triag. vs. L-diag. → Visual Appl.→ Purchase Int. [-.006, .230]
U-triag. vs. L-diag. → Taste Prcp. → Purchase Int. [-.163, .172],
U-triag. vs. L-diag. → Visual Appl. → Taste Prcp. → Purchase Int. [-.010, .353]

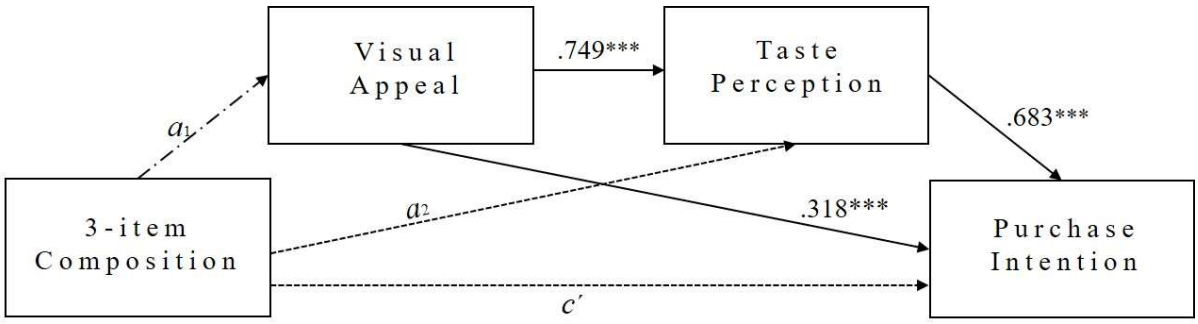
$a_1$ = -.514** $a_2$ = .017 $c'$ = -.246
D-triag. vs. U-triag. → Visual Appl.→ Purchase Int. [-.300, -.041] *
D-triag. vs. U-triag. → Taste Prcp. → Purchase Int. [-.150, .171]
D-triag. vs. U-triag. → Visual Appl. → Taste Prcp. → Purchase Int. [-.455, -.070] *

* indicates statically significant relative indirect effects

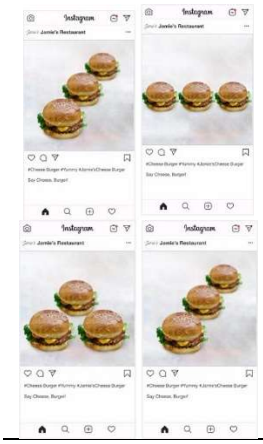
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 14.** Serial Mediation Analysis for Composition: Cheeseburger Photos in Study 1

Effects of Compositional Lines in the 3-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .721*** $a_2$ = -.280* $c'$ = .009
R-diag. vs. Horz. → Visual Appl.→ Purchase Int. [.081, .431] *
R-diag. vs. Horz. → Taste Prcp. → Purchase Int. [-.383, -.022] *
R-diag. vs. Horz. → Visual Appl. → Taste Prcp. → Purchase Int. [.165, .603] *

$a_1$ = .060 $a_2$ = .076 $c'$ = .280
U-triag. vs. R-diag. → Visual Appl.→ Purchase Int. [-.108, .143]
U-triag. vs. R-diag. → Taste Prcp. → Purchase Int. [-.115, .242]
U-triag. vs. R-diag. → Visual Appl. → Taste Prcp. → Purchase Int. [-.167, .223]

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 14.** Serial Mediation Analysis for Composition: Cheeseburger Photos in Study 1 (Cont'd)

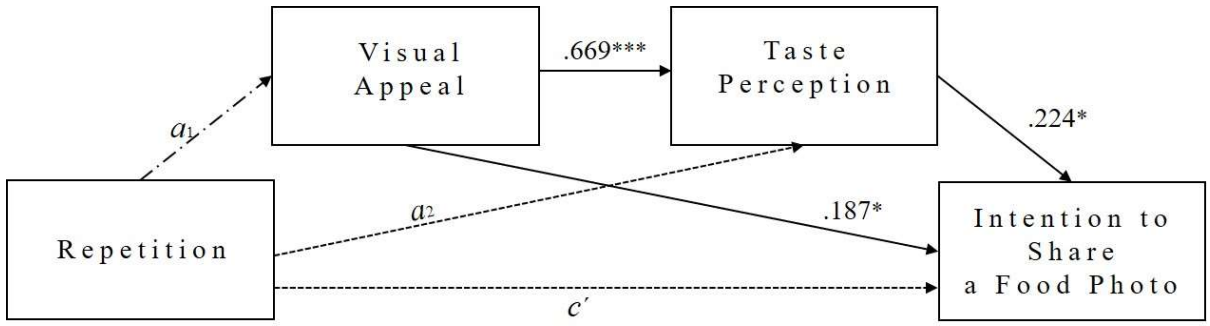
**Hypothesis Test for the Effects of Crossmodal Responses on Intention to Share a Food Photo.** Hayes' PROCESS model 6 (Hayes 2013) was conducted to test the proposed serial mediation effects of visual appeal and taste perception on intention to share a photo (H5-6) on Instagram. Hypothesis 5 posits that the effect of repetition in a food photo on intention to share a food photo is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each compositional line condition. In the horizontal composition condition, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were significantly higher for 2-item repetition than for non-repetition condition (X1: 2-item repetition vs. non-repetition) whereas the serial mediation for 3-item repetition was not significantly higher than that for non-repetition condition (X2: 3-item vs. non-repetition) ($Effect_{X1}$ = .109, $SE_{X1}$= .055, *95% bootstrap* $CI_{X1}$ = .019, .232; $Effect_{X2}$ = .023, $SE_{X2}$ = .042, *95% bootstrap* $CI_{X2}$ = -.070, .112). Additionally, with sequential coding in PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were significantly higher for 2-item than those for 3-item (X2: 3-item vs. 2-item repetition) in the horizontal condition ($Effect_{X2}$ = -.086, $SE_{X2}$ = .048, *95% bootstrap* $CI_{X2}$ = -.138, -.011). In the vertical composition condition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were significantly higher for 2-item repetition (X1) and 3-item repetition (X2) when the non-repetition condition was a reference group ($Effect_{X1}$ = .189, $SE_{X1}$= .073, *95% bootstrap* $CI_{X1}$ = .064, .347; $Effect_{X2}$ = .158, $SE_{X2}$ = .068, *95% bootstrap* $CI_{X2}$ = .039, .306). However, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were not significantly higher for the 2-item repetition condition than for 3-item repetition condition (X2:

3-item vs. 2-item repetition) with the vertical composition was not significant ($Effect_{X2}$ = -.031, $SE_{X2}$ = .044, *95% bootstrap* $CI_{X2}$ = -.125, .053). In the right diagonal composition condition, the results demonstrated that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were significantly higher for the 2-item repetition condition (X1) and 3-item repetition condition (X2) when the non-repetition condition was used as a reference group ($Effect_{X1}$ = .095, $SE_{X1}$= .048, *95% bootstrap* $CI_{X1}$ = .019, .207; $Effect_{X2}$ = .106, $SE_{X2}$ = .051, *95% bootstrap* $CI_{X2}$ = .021, .222). However, with sequential coding in PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were not significantly higher for the 3-item repetition condition than the 2-item condition (X2: 3-item vs. 2-item repetition) in the right diagonal condition ($Effect_{X2}$ = .011, $SE_{X2}$ = .025, *95% bootstrap* $CI_{X2}$ = -.038, .066). In the left diagonal composition condition, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were significantly higher for the 2-item (X1) and 3-item (X2) conditions when the non-repetition condition was a reference group ($Effect_{X1}$ = .142, $SE_{X1}$= .066, *95% bootstrap* $CI_{X1}$ = .025, .279; $Effect_{X2}$ = .090, $SE_{X2}$ = .052, *95% bootstrap* $CI_{X2}$ = .004, .205). However, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were not significantly higher for the 2-item condition than the 3-item condition (X2: 3-item vs. 2-item repetition) in the left diagonal composition condition ($Effect_{X2}$ = -.052, $SE_{X2}$ = .037, *95% bootstrap* $CI_{X2}$ = -.136, .007). Thus, H5 was partially supported. Figure 15 presents the serial mediation analyses for the effects of repetition on intention to share a food photo for cheeseburger photos on Instagram.

Next, the researcher conducted the serial mediation models based on the same number of repetitions with sequential coding. Hypothesis 6 posits that the effects of compositional lines in a food photo on intention to share the food photo is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each number of repetition condition. In the 2-item repetition condition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were not significantly different among different composition conditions: that is, between the vertical and the horizontal composition conditions (X1: vertical vs. horizontal), between the vertical and the right diagonal composition conditions (X2: right diagonal vs. vertical), between the left diagonal and the right diagonal composition conditions (X3: left diagonal vs. right diagonal), ($Effect_{X1}$ = .018, $SE_{X1}$= .023, *90% bootstrap* $CI_{X1}$ = -.013, .059; $Effect_{X2}$ = -.013, $SE_{X2}$ = .021, *90% bootstrap* $CI_{X2}$ = -.049, .018; $Effect_{X3}$ = .015, $SE_{X3}$ = .020, *90% bootstrap* $CI_{X3}$ = -.014, .053). The direct effect of visual appeal on taste perception ($B$ = .597, $SE$ = .034, $t$(371) = 17.366, *90% bootstrap CI* = .541, 654) and the direct effect of taste perception on purchase intention were statistically significant ($B$ = .158, $SE$ = .081, $t$(370) = 1.957, *90% bootstrap CI* = .025, .292). In the 3-item repetition condition, the results showed that participants perceived a significantly higher level of visual appeal in the vertical composition condition than in the horizontal composition condition (X1: vertical vs. horizontal); the effect of the upward-pointing triangular composition was statistically higher than that of downward-pointing triangle (X5: downward-pointing vs. upward-pointing triangle) ($Effect_{X1}$ = .619, $SE_{X1}$= .193, *95% bootstrap* $CI_{X1}$ = .240, .997; $B_{X5}$ = -.514, $SE_{X5}$ = .196, $t_{X5}$(558) = -2.619, *95% bootstrap* $CI_{X5}$ = -.900, -.129). However, no differences were found between the right diagonal and vertical composition conditions (X2), between the left diagonal and the right diagonal composition conditions (X3), between the upward-pointing

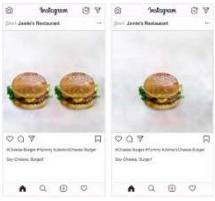
triangle and the left diagonal composition conditions (X4) ($B_{X2}$ = .103, $SE_{X2}$ = .194, $t_{X2}$(558) = .529, *95% bootstrap* $CI_{X2}$ = -.279, .484; $B_{X3}$ = -.279, $SE_{X3}$ = .194, $t_{X3}$(558) = -1.442, *95% bootstrap* $CI_{X3}$ =-.660, .101; $B_{X4}$ = .339, $SE_{X4}$ = .194, $t_{X4}$(558) = 1.746, *95% bootstrap* $CI_{X4}$ = -.043, .721). The results also showed that the direct effect of visual appeal on taste perception (*B* = .734, *SE* = .028, *t*(557) = 26.432, *95% bootstrap CI* = .679, .788) and the direct effect of taste perception on intention to share a food photo were statistically significant (*B* = .146, *SE* = .068, *t*(556) = 2.157, *95% bootstrap CI* = .013, .279). Finally, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were significantly higher in the vertical composition condition than in the horizontal composition condition (X1: vertical vs. horizontal); higher in the upward-pointing triangular composition than in the downward-pointing triangular composition condition (X5: downward-pointing triangle vs. upward-pointing triangle) ($Effect_{X1}$ = .066, $SE_{X1}$ = .035, *95% bootstrap* $CI_{X1}$ = .009, .147; $Effect_{X5}$ = -.055, $SE_{X5}$ = .032, *95% bootstrap* $CI_{X5}$ = -.125, -.005). To additionally find the contrasts between other pairs, the researcher conducted another serial mediation model for 3-item compositional lines. The results showed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were significantly higher in the right diagonal composition condition than in the horizontal composition condition (X1: right diagonal vs. horizontal) ($Effect_{X1}$ = .093, $SE_{X1}$ = .054, *95% bootstrap* $CI_{X1}$ = .007, .217) although the serial mediation path was not significantly different between the upward-pointing triangle composition condition and the right diagonal composition condition (X2) ($Effect_{X2}$ = .008, $SE_{X2}$ = .028, *95% bootstrap* $CI_{X2}$ = -.046, .069). Thus, H6 was partially supported. Figure 16 presents the serial mediation analyses for the effects of compositional lines on intention to share a food photo for cheeseburger photos on Instagram.

Effects of Repetition in the Horizontal Condition

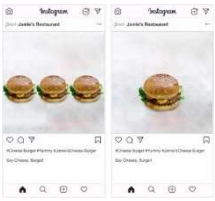



· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

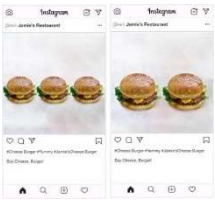
Estimates of 95% bootstrap confidential intervals for relative indirect effects:



$a_1$ = .730** $a_2$ = -.003 $c'$ =.516·
2-item vs. Non-rep. → Visual Appl.→ ISP [.021, .310] *
2-item vs. Non-rep. → Taste Prcp. → ISP [-.075, .077]
2-item vs. Non-rep. → Visual Appl. → ISP → Purchase Int. [.019, .232] *



$a_1$ = .153 $a_2$ = .084 $c'$ =.047
3-item vs. Non-rep. → Visual Appl.→ ISP [-.065, .152]
3-item vs. Non-rep. → Taste Prcp. → ISP [-.049, .104]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → ISP [-.070, .112]



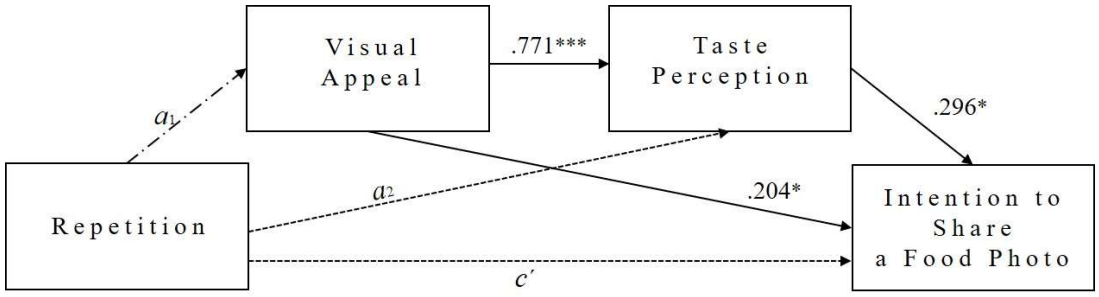
$a_1$ = -.577** $a_2$ = .088 $c'$ = -.088
3-item vs. 2-item → Visual Appl.→ ISP [-.167, -.016] *
3-item vs. 2-item → Taste Prcp. → ISP [-.020, .060]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → ISP [-.138, -.011] *

* indicates statically significant relative indirect effects

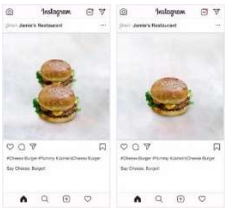
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Food Photo

**Figure 15.** Serial Mediation Analysis for Repetition (DV: ISP): Cheeseburger Photos in Study 1

Effects of Repetition in the Vertical Condition

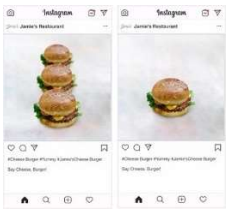



· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

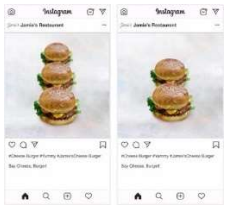


Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .924*** $a_2$ = .122 $c'$ = -.042
2-item vs. Non-rep. → Visual Appl.→ ISP [.029, .425] *
2-item vs. Non-rep. → Taste Prcp. → ISP [-.055, .148]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → ISP [.064, .347] *



$a_1$ = .771** $a_2$ = -.092 $c'$ = -.051
3-item vs. Non-rep. → Visual Appl.→ ISP [.021, .356] *
3-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.134, .074]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.039, .306] *



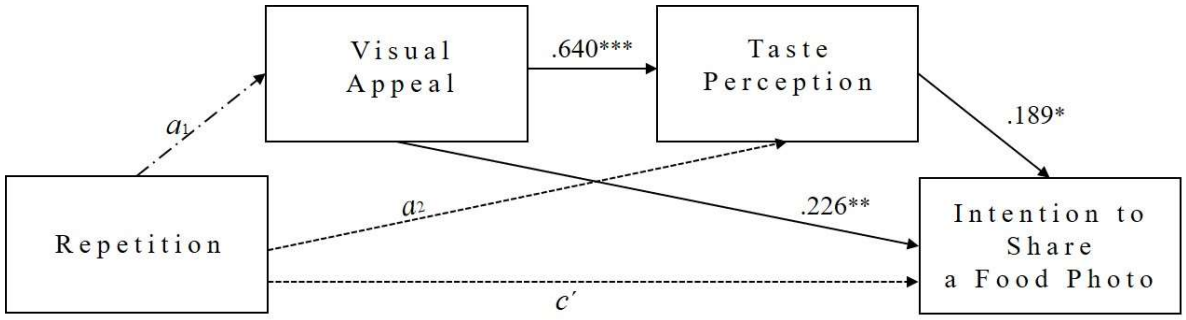
$a_1$ = -.153 $a_2$ = -.214 $c'$ = -.009
3-item vs. 2-item → Visual Appl.→ Purchase Int. [-.142, .049]
3-item vs. 2-item → Taste Prcp. → Purchase Int. [-.166, .013]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Purchase Int. [-.125, .053]

* indicates statically significant relative indirect effects

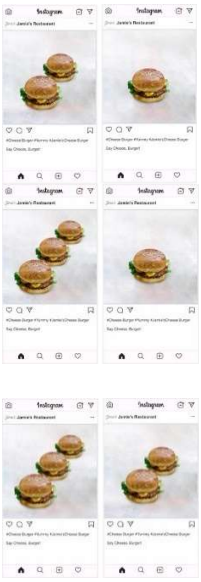
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Food Photo

**Figure 15.** Serial Mediation Analysis for Repetition (DV: ISP): Cheeseburger Photos in Study 1 (Cont'd)

Effects of Repetition in the right diagonal Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .784*** $a_2$ = .084 $c'$ = -.152
2-item vs. Non-rep. → Visual Appl.→ ISP [.043, .356] *
2-item vs. Non-rep. → Taste Prcp. → ISP [-.053, .086]
2-item vs. Non-rep. → Visual appl. → Taste Prcp. → ISP [.019, .207] *

$a_1$ = .874*** $a_2$ = -.113 $c'$ = -.093
3-item vs. Non-rep. → Visual Appl.→ ISP [.053, .392] *
3-item vs. Non-rep. → Taste Prcp. → ISP [-.103, .046]
3-item vs. Non-rep. → Visual appl. → Taste Prcp. → ISP [.021, .222] *

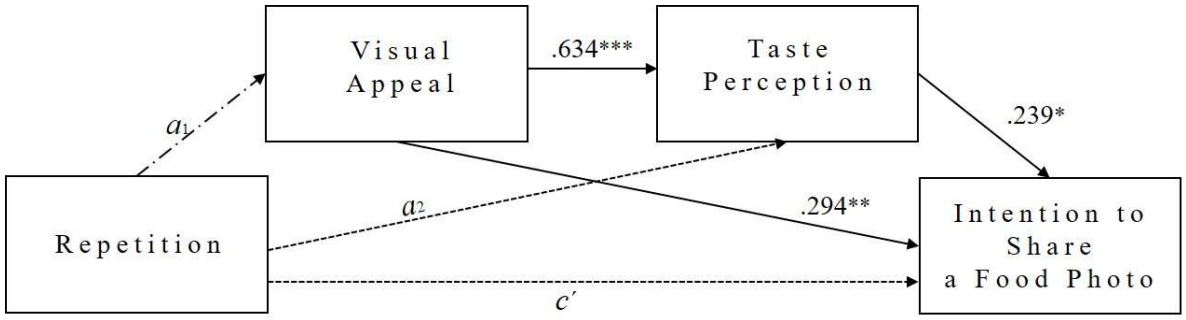
$a_1$ = .090 $a_2$ = -.197 $c'$ = .059
3-item vs. 2-item → Visual Appl.→ ISP [-.064, .113]
3-item vs. 2-item → Taste Prcp. → ISP [-.053, .087]
3-item vs. 2-item → Visual appl. → Taste Prcp. → ISP [-.038, .066]

* indicates statically significant relative indirect effects

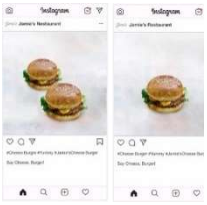
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Food Photo

**Figure 15.** Serial Mediation Analysis for Repetition (DV: ISP): Cheeseburger Photos in Study 1 (Cont'd)

Effects of Repetition in the Left Diagonal Condition

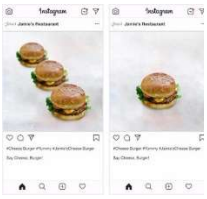



· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

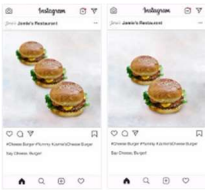


Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .938*** $a_2$ = .028 $c'$ = -.029
2-item vs. Non-rep. → Visual Appl.→ ISP [.089, .539] *
2-item vs. Non-rep. → Taste Prcp. → ISP [-.080, .093]
2-item vs. Non-rep. → Visual appl. → Taste Prcp. → ISP [.025, .279] *



$a_1$ = .595** $a_2$ = -.064 $c'$ = .164
3-item vs. Non-rep. → Visual Appl.→ ISP [.022, .386] *
3-item vs. Non-rep. → Taste Prcp. → ISP [-.110, .066]
3-item vs. Non-rep. → Visual appl. → Taste Prcp. → ISP [.004, .205] *



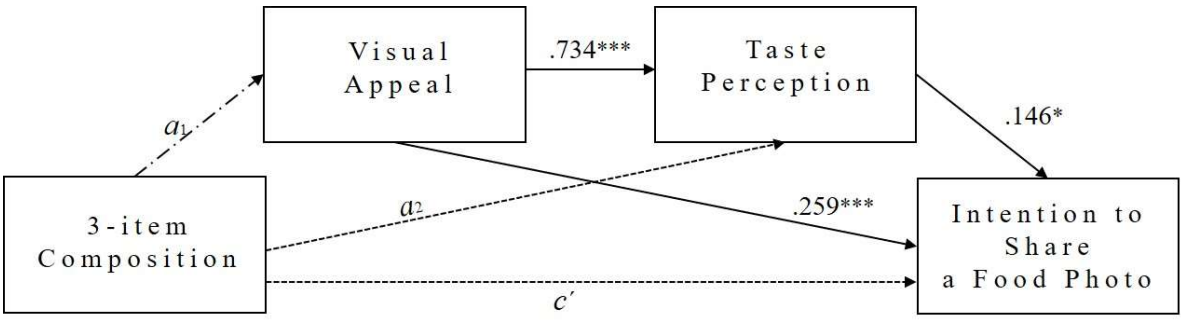
$a_1$ = -.344· $a_2$ = -.093 $c'$ = .193
3-item vs. 2-item → Visual Appl.→ ISP [-.247, .011]
3-item vs. 2-item → Taste Prcp. → ISP [-.076, .097]
3-item vs. 2-item → Visual appl. → Taste Prcp. → ISP [-.136, .007]

* indicates statically significant relative indirect effects

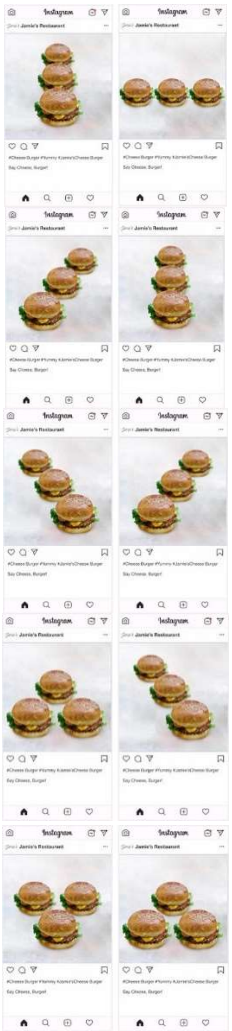
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Food Photo

**Figure 15.** Serial Mediation Analysis for Repetition (DV: ISP): Cheeseburger Photos in Study 1 (Cont'd)

Effects of Compositional Lines in the 3-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .619** $a_2$ = -.199 $c'$ = .103
Vert. vs. Horz. → Visual Appl.→ ISP [.054, .301] *
Vert. vs. Horz. → Taste Prcp. → ISP [-.083, .005]
Vert. vs. Horz. → Visual Appl. → Taste Prcp. → ISP [.009, .147] *

$a_1$ = .103 $a_2$ = -.070 $c'$ = -.089
R-diag. vs. Vert. → Visual Appl.→ ISP [-.078, .140]
R-diag. vs. Vert. → Taste Prcp. → ISP [-.061, .034]
R-diag. vs. Vert. → Visual Appl. → Taste Prcp. → ISP [-.032, .063]

$a_1$ = -.279 $a_2$ =.071 $c'$ = .247
L-diag. vs. R-diag. → Visual Appl.→ ISP [-.184, .023]
L-diag. vs. R-diag. → Taste Prcp. → ISP [-.032, .060]
L-diag. vs. R-diag. → Visual Appl. → Taste Prcp. → ISP [-.088, .010]

$a_1$ = .339· $a_2$ = .006 $c'$ = .032
U-triag. vs. L-diag. → Visual Appl.→ ISP [-.004, .199]
U-triag. vs. L-diag. → Taste Prcp. → ISP [-.038, .042]
U-triag. vs. L-diag. → Visual Appl. → Taste Prcp. → ISP [-.002, .095]

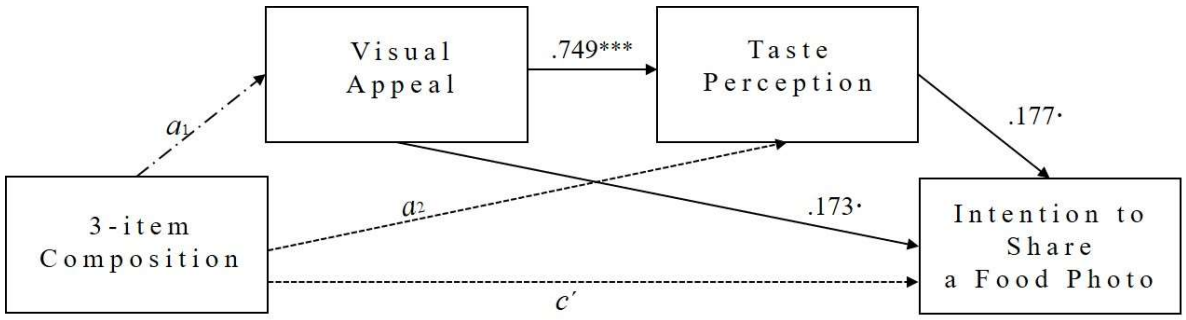
$a_1$ = -.514** $a_2$ = .017 $c'$ = -.246
D-triag. vs. U-triag. → Visual Appl.→ ISP [-.251, -.035] *
D-triag. vs. U-triag. → Taste Prcp. → ISP [-.038, 040]
D-triag. vs. U-triag. → Visual Appl. → Taste Prcp. → ISP [-.125, -.005] *

* indicates statically significant relative indirect effects

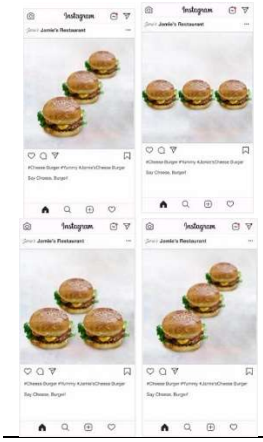
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Food Photo

**Figure 16.** Serial Mediation Analysis for Composition (DV: ISP): Cheeseburger Photos in Study 1

Effects of Compositional Lines in the 3-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .721*** $a_2$ = -.280* $c'$ =.009
R-diag. vs. Horz. → Visual Appl.→ ISP [.021, .272] *
R-diag. vs. Horz. → Taste Prcp. → ISP [-.131, .001]
R-diag. vs. Horz. → Visual Appl. → Taste Prcp. → ISP [.007, .217] *

$a_1$ = .060 $a_2$ = .076 $c'$ = .280
U-triag. vs. R-diag. → Visual Appl.→ ISP [-.063, .085]
U-triag. vs. R-diag. → Taste Prcp. → ISP [-.032, .073],
U-triag. vs. R-diag. → Visual Appl. → Taste Prcp. → ISP [-.046, .069]

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Food Photo

**Figure 16.** Serial Mediation Analysis for Composition (DV: ISP): Cheeseburger Photos in Study 1 (Cont'd)

In summary, the results of Study 1 for cheeseburger photos on Instagram demonstrated the effects of repetition and compositional lines on perceived visual appeal. In general, repetition was found to be effective in visual appeal across the horizontal, vertical, right diagonal, and left diagonal composition conditions but the difference between 3-item and 2-item repetitions was mostly not significant. Differences among compositional lines in the 3-item repetition condition influenced visual appeal; upward-pointing triangle, right diagonal, vertical were superior to

horizontal. However, compositional lines (i.e., horizontal, vertical, right diagonal, left diagonal) in the 2-item repetition condition did not differ in visual appeal. In the serial mediation analyses, the effects of the 2-item repetition and the 3-item repetition conditions (vs. non-repetition) on purchase intention/intention to share a food photo were serially mediated by visual appeal and taste perception, but there was no difference between the 3-item repetition and the 2-item repetition conditions. In terms of compositional lines in the 3-item repetition condition, the serial mediation effects of visual appeal and taste perception on purchase intention/intention to share a food photo were significantly higher in the vertical than in the horizontal compositions; higher in the upward-pointing triangle than in the downward-pointing triangle compositions; higher in the right diagonal than in the horizontal compositions. However, the serial mediation effects of visual appeal and taste perception on purchase intention/intention to share a food photo were not significantly different among 2-item compositional lines.

**Results of Study 1: Iced Tea Photos on Instagram**

**Manipulation Check.** For manipulation checks, participants were asked how many glass(es) of iced tea they had seen and what the arrangement of the glass(es) of iced tea was in the Instagram post that they had viewed. The manipulations were successful as 99.2% of the participants answered correctly reported the number of repetition ($\chi^2(6) = 1533.8$, $p < .001$), and 83.9% of the participants reported a composition in the study stimuli ($\chi^2(36) = 3688.72$, $p < .001$).

**Hypothesis Test for the Effects of Repetition.** Hypothesis 1 posits the effects of repetition on visual appeal. One-way ANOVA was conducted for each linear composition (i.e., horizontal, vertical, right diagonal, left diagonal). The results of one-way ANOVA indicated that

when photos presented iced tea in the horizontal composition, the levels of visual appeal were not significantly different between non-repetition, 2-item repetition, and 3-item conditions (Welch's $F(2, 208) = .385$, $p > .1$); the estimates of perceived visual appeal were similar between 3-item repetition ($M = 5.237$, $SD = 1.271$, n = 73) and 2-item repetition ($M = 5.233$, $SD = 1.390$, n = 73), followed by the non-repetition condition ($M = 5.046$, $SD = 1.674$, n = 65). The results of one-way ANOVA indicated that when photos presented iced tea in the vertical composition, the levels of visual appeal were not significantly different between non-repetition, 2-item repetition, and 3-item repetition conditions (Welch's $F(2, 206) = 1.05$, $p > .1$); perceived visual appeal was highest in the 3 item-repetition condition ($M = 5.390$, $SD = 1.240$, n = 71), followed by the 2-item repetition condition ($M = 5.237$, $SD = 1.228$, n = 73) and finally the non-repetition condition ($M = 5.046$, $SD = 1.674$, n =65). The results of one-way ANOVA showed that when photos presented iced tea in the right diagonal composition, the levels of visual appeal were significantly different between non-repetition, 2-item repetition, and 3-item repetition conditions (Welch's $F(2, 129.57) = 3.545$, $p < .05$). Perceived visual appeal was highest in the 3 item-repetition condition ($M = 5.667$, $SD = .985$, n = 73), followed by the 2-item repetition condition ($M = 5.612$, $SD = 1.147$ n = 73) and finally the non-repetition condition ($M = 5.046$, $SD = 1.674$, n =65). The results of Games-Howell post hoc tests showed that the difference between 3-item and non-repetition was significant ($p < .05$) and the difference between 2-item and non-repetition was significant ($p = .062$) but the difference between 3-item repetition and 2-item repetition was not significant ($p > .1$). The result of one-way ANOVA revealed that when photos presented iced tea in the left diagonal condition, the levels of visual appeal were not significantly different between non-repetition, 2-item repetition, and 3-item repetition conditions (Welch's $F(2, 133.92) = 1.143$, $p > .1$). Perceived visual appeal was highest in the 3 item-repetition condition ($M =$

5.419, *SD* = 1.349, n = 70), followed by the 2-item repetition condition (M = 5.164, *SD* = 1.476, n = 73) and finally the non-repetition condition (*M* = 5.046, *SD* = 1.674, n =65). Thus, H1 was partially supported.

**Hypothesis Test for the Effects of Compositional Lines.** Hypothesis 2 posits the different effects of compositional lines on viewers' perception of visual appeal. A series of one-way ANOVAs were conducted to test the effects of compositional lines within each repetition condition. When photos of two identical glasses of iced tea were presented, the results of one-way ANOVA revealed no significant difference in perceived visual appeal among different compositional lines (i.e., horizontal, vertical, right diagonal, left diagonal) ($F(3, 288) = 1.734$, $p > .1$). When photos of three identical glasses of iced tea were presented, the results revealed no significant differences in perceived visual appeal among four compositional lines ($F(5, 425) = 1.233$, $p > .1$), but the levels of visual appeal was significantly higher in the right diagonal composition condition than in the horizontal composition condition ($F(1, 144) = 5.203$, $p < .05$). Levels of perceived visual appeal were rated in the order of the right diagonal (*M* = 5.667, *SD* = .985, n = 73), the downward-pointing triangle (*M* = 5.472, *SD* = 1.403, n = 72), the left diagonal (*M* = 5.419, *SD* = 1.349, n = 70), the vertical (*M* = 5.340, *SD* = 1.240, n = 71), the horizontal (*M* = 5.237, *SD* = 1.271, n = 73), and the upward-pointing triangle (*M* = 5.204, *SD* = 1.460, n = 72) conditions. Thus, H2 was partially supported. Table 7 presents the descriptive statistics, and Figure 17 illustrates the significant results of mean plots for repetition and compositional lines for iced tea photos in Study 1.

**Table 7.** Descriptive Statistics of Study 1: Iced Tea

Dependent Variable: Visual Appeal

| Repetition | Composition | Mean | Std. Deviation | N |
|---|---|---|---|---|
| Non-Repetition | | 5.046 | 1.674 | 65 |
| 2 | Horizontal | 5.233 | 1.390 | 73 |
| 2 | Vertical | 5.237 | 1.228 | 73 |
| 2 | Right diagonal | 5.612 | 1.147 | 73 |
| 2 | Left diagonal | 5.164 | 1.476 | 73 |
| 3 | Horizontal | 5.237 | 1.271 | 73 |
| 3 | Vertical | 5.390 | 1.240 | 71 |
| 3 | Right diagonal | 5.667 | .984 | 73 |
| 3 | Left diagonal | 5.419 | 1.349 | 70 |
| 3 | Upward-pointing triangle | 5.204 | 1.460 | 72 |
| 3 | Downward-pointing triangle | 5.472 | 1.403 | 72 |
| | Total | 5.337 | 1.341 | 788 |

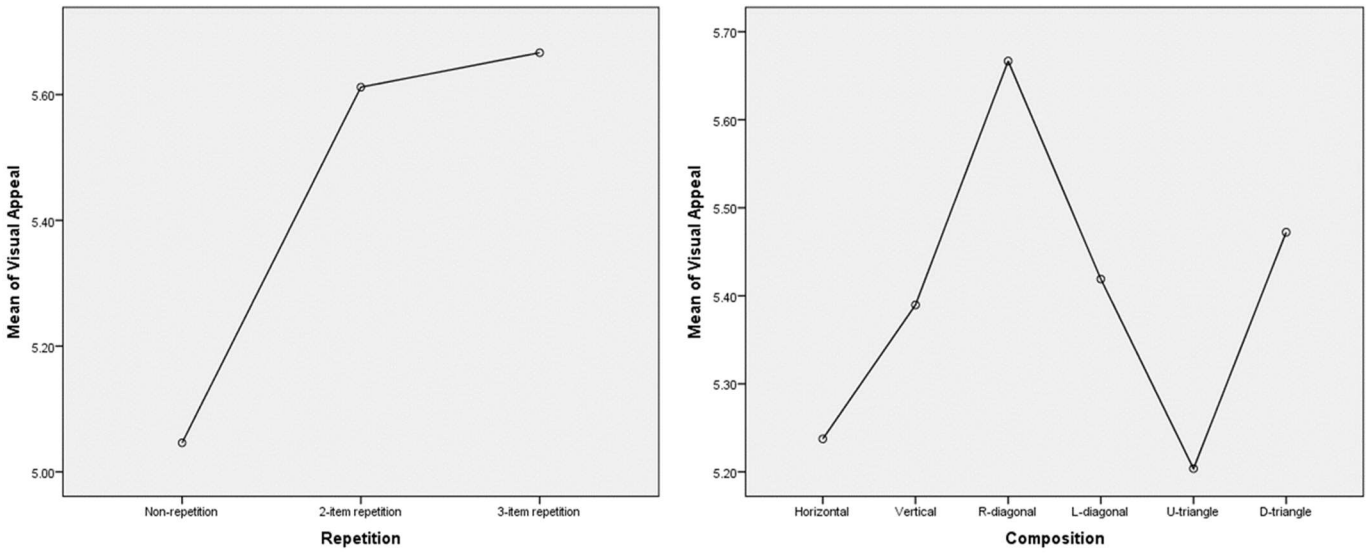



**Figure 17.** Mean Plot for Repetition in Right Diagonal (Left) and Mean Plot for Compositional Lines (Right)

**Hypothesis Test for the Effects of Crossmodal Responses on Purchase Intention.**

Hayes' PROCESS model 6 (Hayes 2013) was conducted to test the proposed serial mediation effects of visual appeal and taste perception on purchase intention (H3-4) on Instagram. Hypothesis 3 posits that the effect of repetition in a beverage photo on purchase intention is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each compositional line conditions. Repetition was treated as a mutlicategorical variable using the non-repetition condition as a reference group. In the horizontal composition condition, the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly higher in both 2-item and 3-item repetition conditions than in the non-repetition condition (X1: 2-item vs. non-repetition; X2: 3-item vs. non-repetition) ($Effect_{X1}$ = .134, $SE_{X1}$= .189, *95% bootstrap* $CI_{X1}$ = -.176, .455; $Effect_{X2}$ = .137, $SE_{X2}$ = .181, *95% bootstrap* $CI_{X2}$ = -.151, .442). The direct effect of visual appeal on taste perception ($B$ = .799, $SE$ = .054, $t(207)$ = 14.680, *95% bootstrap CI* = .710, .888) and the direct effect of taste perception on purchase intention were statistically significant ($B$ = .896, $SE$ = .068, $t(206)$ = 13.103, *95% bootstrap CI* = .783, 1.009). In turn, with sequential coding in PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly higher for 3-item than 2-item (X2: 3-item vs. 2-item repetition) in the horizontal composition ($Effect_{X2}$ = -.003, $SE_{X2}$ = .157, *95% bootstrap* $CI_{X2}$ = -.257, .262).

In the vertical composition condition, the results revealed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly higher for both 2-item repetition and 3-item repetition conditions than the non-repetition condition (X1: 2-item vs. non-repetition; X2: 3-item vs. non-repetition) ($Effect_{X1}$ = .131, $SE_{X1}$= .176, *95% bootstrap*

$CI_{X1}$ = -.156, .418; $Effect_{X2}$ = .235, $SE_{X2}$ = .177, *95% bootstrap* $CI_{X2}$ = -.050, .530) although the direct effect of visual appeal on taste perception was statistically significant ($B$ = .762, $SE$ = .061, $t$(205) = 12.512, *95% bootstrap CI* = .661, .862), and the direct effect of taste perception on purchase intention was statistically significant ($B$ = .900, $SE$ = .066, $t$(204) = 13.625, *95% bootstrap CI* = .791, 1.009). Additionally, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly higher for the 3-item repetition condition than the 2-item (X2: 3-item vs. 2-item repetition) in the vertical composition ($Effect_{X2}$ = .104, $SE_{X2}$ = .139, *95% bootstrap* $CI_{X2}$ = -.125, .327).

In the right diagonal composition, the results showed that the effects of 2-item repetition (X1) and 3-item repetition (X2) on visual appeal were significantly higher than that of non-repetition ($B_{X1}$= .566, $SE_{X1}$ = .219, $t_{X1}$(208) = 2.580, *95% bootstrap* $CI_{X1}$ = .204, .928; $B_{X2}$ = .621, $SE_{X2}$ = .219, $t_{X2}$(208) = 2.830, *95% bootstrap* $CI_{X2}$ = .258, .983). That is, compared to participants in the non-repetition condition, those in the 2-item repetition and the 3-item repetition conditions reported higher levels of visual appeal perceived from the presented iced tea. The results also demonstrated that the direct effects of visual appeal on taste perception were statistically significant ($B$ = .788, $SE$ = .058, $t$(207) = 13.503, *95% bootstrap CI* = .692, .885), and the direct effect of taste perception on purchase intention was statistically significant ($B$ = 1.012, $SE$ = .075, $t$(206) = 13.460, *95% bootstrap CI* = .888, 1.136). The results revealed that the serial mediation effects of visual appeal and taste perception on purchase intention were significantly higher for both 2-item repetition (X1) and 3-item repetition (X2) compared to the non-repetition condition ($Effect_{X1}$ = .360, $SE_{X1}$= .119, *95% bootstrap* $CI_{X1}$ = .059, .848; $Effect_{X2}$ = .401, $SE_{X2}$ = .125, *95% bootstrap* $CI_{X2}$ = .125, .869). However, in sequential coding in

PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly higher for the 3-item repetition condition than the 2-item condition (X2: 3-item vs. 2-item repetition) in the right diagonal composition ($Effect_{X2}$ = .044, $SE_{X2}$ = .144, *95% bootstrap* $CI_{X2}$ = -.240, .327).

In the left diagonal composition condition, the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions compared to the non-repetition condition ($Effect_{X1}$ = .089, $SE_{X1}$= .203, *95% bootstrap* $CI_{X1}$ = -.251, .417; $Effect_{X2}$ = .281, $SE_{X2}$ = .200, *95% bootstrap* $CI_{X2}$ = -.040, .612) although the direct effect of visual appeal on taste perception was statistically significant ($B$ = .764, $SE$ = .052, $t$(204) = 14.610, *95% bootstrap CI* = .678, .850), and the direct effect of taste perception on purchase intention was statistically significant ($B$ = .985, $SE$ = .064, $t$(203) = 15.456, *95% bootstrap CI* = .880, 1.090). Additionally, in sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception were also not significantly higher for the 3-item repetition than the 2-item repetition (X2: 3-item vs 2-item repetition) conditions in the left diagonal composition ($Effect_{X2}$ = .192, $SE_{X2}$ = .177, *95% bootstrap* $CI_{X2}$ = -.101, .478). Thus, H3 was partially supported. Figure 18 presents the serial mediation analyses for the effects of repetition on purchase intention for iced tea photos on Instagram.

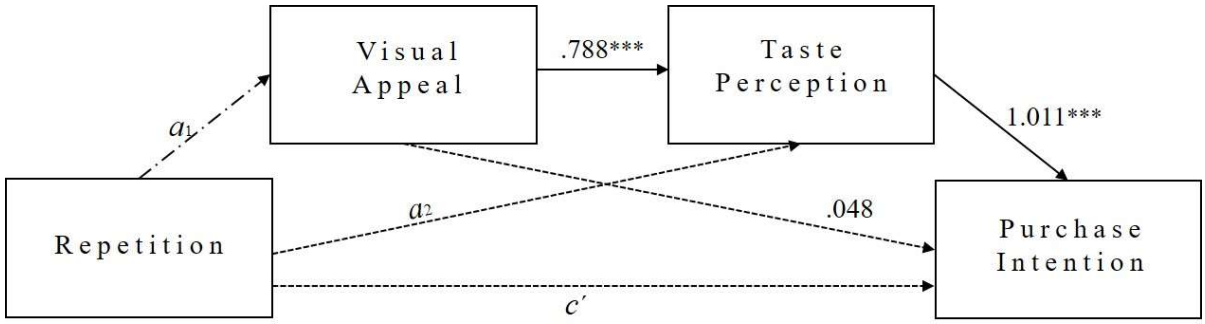
Next, the researcher conducted the serial mediation models based on the same number of repetitions with sequential coding. Hypothesis 6 posits that the effects of compositional lines in a beverage photo on intention to share a beverage photo is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each number of repetition condition. In the 2-item repetition condition, the results revealed that participants

perceived a significantly higher level of visual appeal in the right diagonal than in the vertical composition condition (X2); higher in the right diagonal than in the left diagonal composition condition (X3) ($B_{X2}$ = .374, $SE_{X2}$ = .218, $t_{X2}$(288) = 1.718, *90% bootstrap* $CI_{X2}$ = .015, .734; $B_{X3}$ = -.448, $SE_{X3}$ = .218, $t_{X2}$ (288) = -2.34, *90% bootstrap* $CI_{X3}$ = -.807, -.088). However, no difference was found between the vertical and the horizontal composition conditions (X1) ($B_{X1}$ = .005, $SE_{X1}$= .218, $t_{X2}$ (288) = .021, *90% bootstrap* $CI_{X1}$ = -.355, .364). The direct effect of visual appeal on taste perception ($B$ = .755, $SE$ = .052, $t$(287) = 14.546, *90% bootstrap CI* = .669, 840) and the direct effect of taste perception on purchase intention were statistically significant ($B$ = .935, $SE$ = .056, $t$(286) = 16.604, *90% bootstrap CI* = .842, .1.027). Finally, the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were significantly higher in the right diagonal condition than in the vertical (X2); higher in the right diagonal condition than in the left diagonal condition (X3) ($Effect_{X2}$ = .264, $SE_{X2}$ = .140, *90% bootstrap* $CI_{X2}$ = .035, .495; $Effect_{X3}$ = -.316, $SE_{X3}$ = .154, *90% bootstrap* $CI_{X3}$ = -.569, -.064). In an additional analysis to find the contrasts between other pairs of compositional lines in the 2-item repetition, the serial mediation effects of visual appeal and taste perception on purchase intention were significantly higher in the right diagonal composition condition than in the horizontal composition condition (X1); higher in the right diagonal composition condition than in the left diagonal composition condition (X2) ($Effect_{X1}$ = .284, $SE_{X1}$ = .154, *90% bootstrap* $CI_{X1}$ = .032, .538; $Effect_{X2}$ = -.335, $SE_{X2}$ = .167, *90% bootstrap* $CI_{X2}$ = -.609, -.062).

In the 3-item repetition condition the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were not significantly different among different composition condition: that is, between the vertical and the horizontal composition

conditions (X1), between the right diagonal vs the vertical composition conditions (X2), between the left diagonal and the right diagonal composition conditions (X3), between the upward-pointing triangle and the left diagonal composition conditions (X4), and between the downward-pointing triangle and the upward-pointing triangle composition conditions (X5) ($Effect_{X1}$ = .121, $SE_{X1}$= .163, *95% bootstrap* $CI_{X1}$ = -.204, .439; $Effect_{X2}$ = .220, $SE_{X2}$ = .146, *95% bootstrap* $CI_{X2}$ = -.061, .519; $Effect_{X3}$ = -.196, $SE_{X3}$ = .160, *95% bootstrap* $CI_{X3}$ = -.517, .109; $Effect_{X4}$ = -.171, $SE_{X4}$ = .188, *95% bootstrap* $CI_{X4}$ = -.534, .202; $Effect_{X5}$ = .213, $SE_{X5}$ = .188, *95% bootstrap* $CI_{X5}$ = -.152, .573). The direct effect of visual appeal on taste perception ($B$ = .812, $SE$ = .041, $t$(424) = 19.705, *95% bootstrap CI* = .731, .893) and the direct effect of taste perception on purchase intention were statistically significant ($B$ = .976, $SE$ = .051, $t$(423) = 19.013, *95% bootstrap CI* = .875, 1.077). In an additional analysis to find the contrasts between other pairs of compositional lines in the 3-item repetition condition, the results showed that the serial mediation effects of visual appeal and taste perception on purchase intention were significantly higher in the right diagonal composition condition than in the horizontal composition condition (X1); higher in the right diagonal composition condition than in the upward-pointing triangle composition condition (X2) ($Effect_{X1}$ = .311 $SE_{X1}$ = .144, *95% bootstrap* $CI_{X1}$ = .047, .616; $Effect_{X2}$ = -.336, $SE_{X2}$ = .154, *95% bootstrap* $CI_{X2}$ = -.643, -.045). Thus, H4 was partially supported. Figure 19 presents the serial mediation analyses for the effects of compositional lines on purchase intention for iced tea photos on Instagram.

Effects of Repetition in the Right Diagonal Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .566* $a_2$ = -.315 $c'$ = .115
2-item vs. Non-rep. → Visual Appl.→ Purchase Int. [-.081, .158]
2-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.695, .058]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.059, .848] *



$a_1$ = .621** $a_2$ = -.091 $c'$ = -.240
3-item vs. Non-rep. → Visual Appl.→ Purchase Int. [-.082, .167]
3-item vs. Non-rep. → Taste Prcp. → Purchase Int. [-.457, .264]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Purchase Int. [.125, .869] *



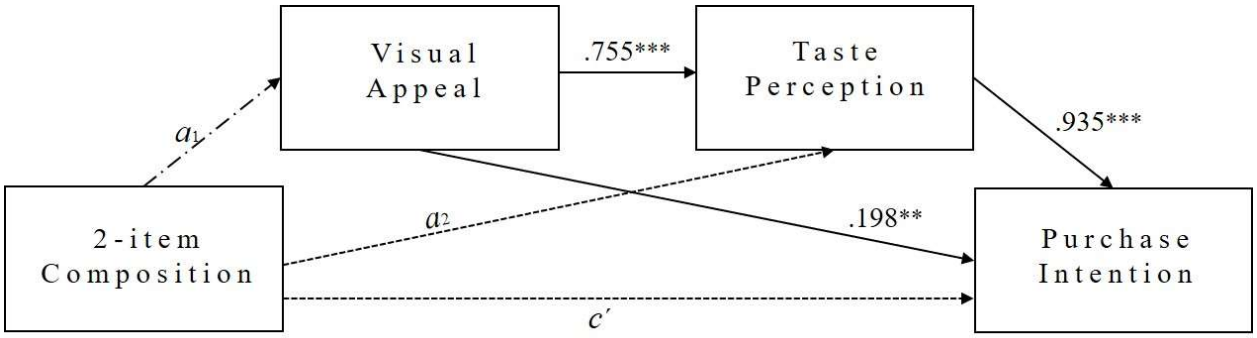
$a_1$ = .055 $a_2$ = .224 $c'$ = -.355·
3-item vs. 2-item → Visual Appl.→ Purchase Int. [-.036, .048]
3-item vs. 2-item → Taste Prcp. → Purchase Int. [-.110, .560]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Purchase Int. [-.240, .327]

* indicates statically significant relative indirect effects

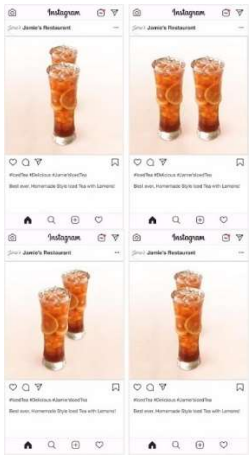
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 18.** Serial Mediation Analysis for Repetition: Iced Tea Photos in Study 1

Effects of Compositional Lines in the 2-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



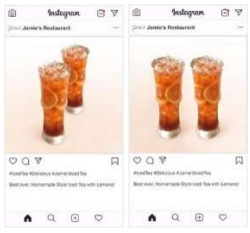
Estimates of 90% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .005 $a_2$ = -.031 $c'$ = .025
Vert. vs. Horz. → Visual Appl.→ Purchase Int. [-.068, .073]
Vert. vs. Horz. → Taste Prcp. → Purchase Int. [-.313, .268]
Vert. vs. Horz. → Visual appl. → Taste Prcp. → Purchase Int. [-.236, .246]

$a_1$ = .374· $a_2$ = -.111 $c'$ = -.097
R-diag. vs. Vert. → Visual Appl.→ Purchase Int. [.006, .165] *
R-diag. vs. Vert. → Taste Prcp. → Purchase Int. [-.385, .200]
R-diag. vs. Vert. → Visual Appl. → Taste Prcp. → Purchase Int. [.035, .495] *

$a_1$ = -.448* $a_2$ = .139 $c'$ = .123
L-diag. vs. R-diag. → Visual Appl.→ Purchase Int. [-.181, -.014] *
L-diag. vs. R-diag. → Taste Prcp. → Purchase Int. [-.168, .423]
L-diag. vs. R-diag. → Visual Appl. → Taste Prcp. → Purchase Int. [-.569, -.064] *

* indicates statically significant relative indirect effects



Estimates of 90% bootstrap confidential intervals for relative indirect effects:

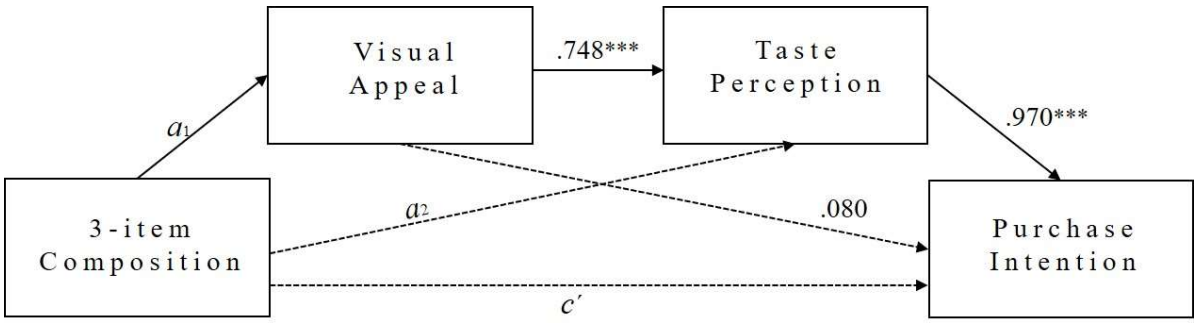
$a_1$ = .379· $a_2$ = -.153 $c'$ = -.056
R-diag. vs. Horz. → Visual Appl.→ Purchase Int. [-.001, .145]
R-diag. vs. Horz. → → Taste Prcp. → Purchase Int. [-.439, .152]
R-diag. vs. Horz. → → Visual Appl. → Taste Prcp. → Purchase Int. [.032, .538] *

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

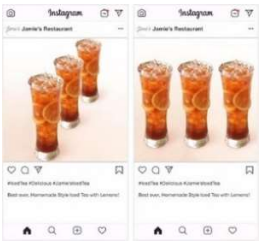
**Figure 19.** Serial Mediation Analysis for Composition: Iced Tea Photos in Study 1

Effects of Compositional Lines in the 3-item Repetition Condition

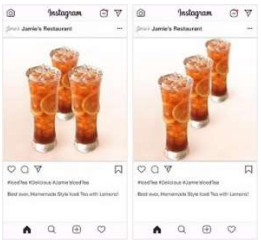



· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

Estimates of 95% bootstrap confidential intervals for relative indirect effects:



$a_1$ = .429* $a_2$ = .083 $c'$ = -.289
R-diag. vs. Horz. → Visual Appl.→ Purchase Int. [-.057, .150]
R-diag. vs. Horz. → Taste Prcp. → Purchase Int. [-.240, .392]
R-diag. vs. Horz. → Visual Appl. → Taste Prcp. → Purchase Int. [.047, .616] *



$a_1$ = -.463* $a_2$ = -.392 $c'$ = .382·
U-triag. vs. R-diag. → Visual Appl.→ Purchase Int. [-.169, .058]
U-triag. vs. R-diag. → Taste Prcp. → Purchase Int. [-.760, -.027] *
U-triag. vs. R-diag. → Visual Appl. → Taste Prcp. → Purchase Int. [-.643, -.045] *

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 19.** Serial Mediation Analysis for Composition: Iced Tea Photos in Study 1 (Cont'd)

**Hypothesis Test for the Effects of Crossmodal Responses on Intention to Share a Beverage Photo.** Hayes' PROCESS model 6 (Hayes 2013) was conducted to test the proposed serial mediation effects of visual appeal and taste perception on intention to share a beverage photo on Instagram (H5-6). Hypothesis 5 posits that the effect of repetition in a beverage photo on purchase intention is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each compositional line condition. Repetition was treated as a multicategorical variable using the non-repetition condition as a reference group. In the horizontal composition, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to share a food photo were not significantly higher for both the 2-item repetition (X1) and the 3-item repetitions (X2) conditions compared to the non-repetition condition ($Effect_{X1}$ = .053, $SE_{X1}$= .078, *95% bootstrap* $CI_{X1}$ = -.067, .184; $Effect_{X2}$ = .054, $SE_{X2}$ = .074, *95% bootstrap* $CI_{X2}$ = -.062, .183). Additionally, with sequential coding in PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were not significantly higher for the 3-item repetition condition than the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the horizontal composition condition ($Effect_{X2}$ = .001, $SE_{X2}$ = .064, *95% bootstrap* $CI_{X2}$ = -.107, .101). In the vertical composition, the results demonstrated that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions compared to the non-repetition condition ($Effect_{X1}$ = .053, $SE_{X1}$= .072, *95% bootstrap* $CI_{X1}$ = -.059, .175; $Effect_{X2}$ = .095, $SE_{X2}$ = .074, *95% bootstrap* $CI_{X2}$ = -.020, .221). With sequential coding in PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were not significantly higher for the 3-item repetition condition than

the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the vertical composition ($Effect_{X2}$ = .042, $SE_{X2}$ = .059, *95% bootstrap* $CI_{X2}$ = -.049, .141).

In the right diagonal composition condition, the results revealed that the effects of the 2-item repetition (X1) and the 3-item repetition (X2) conditions on visual appeal were significantly higher than that of the non-repetition condition ($B_{X1}$ = .566, $SE_{X1}$= .219, $t$(208) = 2.580, *95% bootstrap* $CI_{X1}$ = .134, .998; $B_{X2}$ = .621, $SE_{X2}$ = .219, $t$(208) = 2.830, *95% bootstrap* $CI_{X2}$ = .188, 1.053). The results also demonstrated that the direct effect of visual appeal on taste perception was statistically significant ($B$ = .788, $SE$ = .058, $t$(207) = 13.503, *95% bootstrap CI*= .673, .904), and the direct effect of taste perception on intention to share a beverage photo was statistically significant ($B$ = .428, $SE$ = .109, $t$(206) = 3.943, *95% bootstrap CI* = .214, .642). The results showed that the serial mediation effects of visual appeal and taste perception on intention share a beverage photo were significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions ($Effect_{X1}$ = .191, $SE_{X1}$= .091, *95% bootstrap* $CI_{X1}$ = .028, .385; $Effect_{X2}$ = .209, $SE_{X2}$ = .089, *95% bootstrap* $CI_{X2}$ = .049, .403). However, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were not significantly higher for the 3-item repetition than the 2-item repetition conditions (X2: 3-item vs. 2-item) in the right diagonal composition ($Effect_{X2}$ = .019, $SE_{X2}$ = .060, *95% bootstrap* $CI_{X2}$ = -.094, .142). In the left diagonal composition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions compared to the non-repetition condition ($Effect_{X1}$ = .034, $SE_{X1}$= .080, *95% bootstrap* $CI_{X1}$ = -.122, .191; $Effect_{X2}$ = .074, $SE_{X2}$ = .072, *95% bootstrap* $CI_{X2}$ = -.060, .225). With sequential

coding in PROCESS, the results demonstrated that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were not significantly higher for 3-item repetition than the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the left diagonal condition ($Effect_{X2}$ = .108, $SE_{X2}$ = .080, *95% bootstrap* $CI_{X2}$ = -.038, .283). Thus, H5 was partially supported. Figure 20 presents the serial mediation analyses for the effects of repetition on intention to share a beverage photo for iced tea photos on Instagram.

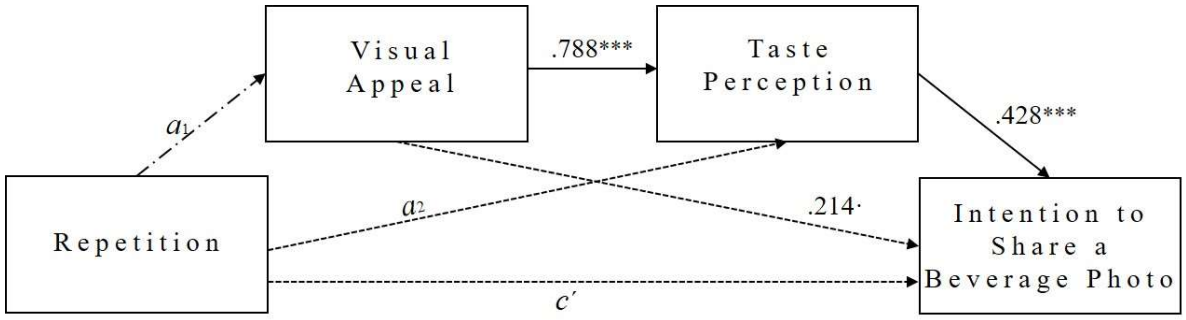
Next, the researcher conducted the serial mediation models based on the same number of repetitions with sequential coding. Hypothesis 6 posits that the effects of compositional lines in a beverage photo on intention to share the beverage photo is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each number of repetition condition. In the 2-item repetition, the serial mediation model for compositional lines showed that participants perceived a significant level of visual appeal in the right diagonal composition condition than the vertical composition condition (X2: right diagonal vs. vertical); the effect of the right diagonal composition was significantly higher than the left diagonal condition (X3: left diagonal vs. right diagonal) ($B_{X2}$ = .374, $SE_{X2}$ = .218, $t_{X2}$(288) = 1.718, *90% bootstrap* $CI_{X2}$ = .015, .734; $B_{X3}$ = -.448, $SE_{X3}$ = .218, $t_{X2}$(288) = -2.34, *90% bootstrap* $CI_{X3}$ = -.807, -.088). However, no difference was found between the vertical and the horizontal composition conditions (X1: vertical vs. horizontal) ($B_{X1}$ = .005, $SE_{X1}$ = .218, $t_{X2}$(288) = .021, *90% bootstrap* $CI_{X1}$ = -.355, .364). The direct effect of visual appeal on taste perception (*B* = .755, *SE* = .052, *t*(287) = 14.546, *90% bootstrap CI* = .669, 840) and the direct effect of taste perception on intention to share a beverage photo were statistically significant (*B* = .428, *SE* = .082, *t*(286) = 5.248, *90% bootstrap CI* = .293, .563). Finally, the results demonstrated that the serial mediation effect of visual appeal and taste perception on intention to share a beverage

photo were significantly higher in the right diagonal composition condition than the vertical composition condition (X2); higher in the right diagonal composition condition than in the left diagonal composition condition (X3) ($Effect_{X2}$ = .121, $SE_{X2}$ = .068, *90% bootstrap* $CI_{X2}$ = .014, .235; $Effect_{X3}$ = -.145, $SE_{X3}$ = .075, *90% bootstrap* $CI_{X3}$ = -.275, -.028). In an additional analysis to find the contrasts between other pairs of compositional lines in the 2-item repetition condition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were significantly higher in the right diagonal composition condition than in the horizontal composition condition (X1: right diagonal vs. horizontal); higher in the left diagonal composition condition than in the right diagonal composition condition (X2) ($Effect_{X1}$ = .133, $SE_{X1}$ = .076, *95% bootstrap* $CI_{X1}$ = .009, .259; $Effect_{X2}$ = -.157 $SE_{X2}$ = .082, *95% bootstrap* $CI_{X2}$ = -.296, -.031).

In the 3-item repetition condition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were not significantly different among different composition conditions: that is, between the vertical and the horizontal composition conditions (X1: vertical vs. horizontal), between the right diagonal and the vertical composition conditions (X2: right diagonal vs vertical), between the left diagonal and the right diagonal composition conditions (X3: left diagonal vs. right diagonal), between the upward-pointing triangle and the left diagonal composition conditions (X4: Upward triangle vs. left diagonal), and between the downward-pointing triangle and the upward-pointing triangle composition conditions (X5: Downward triangle vs. Upward triangle) ($Effect_{X1}$ = .039, $SE_{X1}$= .056, *95% bootstrap* $CI_{X1}$ = -.050, .135; $Effect_{X2}$ = .072, $SE_{X2}$ = .051, *95% bootstrap* $CI_{X2}$ = -.008, .159; $Effect_{X3}$ = -.065, $SE_{X3}$ = .053, *95% bootstrap* $CI_{X3}$ = -.154, .018; $Effect_{X4}$ = -.056, $SE_{X4}$ = .065, *95% bootstrap* $CI_{X4}$ = -.168, .045; $Effect_{X5}$ = .070, $SE_{X5}$ = .065, *95% bootstrap* $CI_{X5}$ =

-.031, .180). The direct effect of visual appeal on taste perception ($B$ = .812, $SE$ = .041, $t$(424) = 19.705, *95% bootstrap CI* = .744, .880) and the direct effect of taste perception on intention to share a beverage photo were statistically significant ($B$ = .321, $SE$ = .068, $t$(423) = 4.737, *95% bootstrap CI* = .209, .433). In an additional test to find the contrasts between other pairs of compositional lines in the 3-item repetition condition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to share a beverage photo were significantly higher in the right diagonal composition condition than in the horizontal composition condition (X1: right diagonal vs. horizontal); higher in the right diagonal composition condition than in the upward-pointing triangle composition condition (X2: Upward triangle vs. right diagonal) ($Effect_{X1}$ = .066 $SE_{X1}$ = .042, *95% bootstrap* $CI_{X1}$ = .003, .164; $Effect_{X2}$ = -.072, $SE_{X2}$ = .046, *95% bootstrap* $CI_{X2}$ = -.181, -.001). Thus, H6 was partially supported. Figure 21 presents the serial mediation analyses for the effects of compositional lines on intention to share a beverage photo for iced tea photos on Instagram.

Effects of Repetition in the Right Diagonal Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

Estimates of 95% bootstrap confidential intervals for relative indirect effects:



$a_1$ = .566* $a_2$ = -.315 $c'$ =.115
2-item vs. Non-rep. → Visual Appl.→ ISP [.005, .287] *
2-item vs. Non-rep. → Taste Prcp. → ISP [-.323, .023]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → ISP [.028, .385] *



$a_1$ = .621** $a_2$ = -.091 $c'$ = -.240
3-item vs. Non-rep. → Visual Appl.→ ISP [.0111, .304] *
3-item vs. Non-rep. → Taste Prcp. → ISP [-.196, .103]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → ISP [.049, .403] *



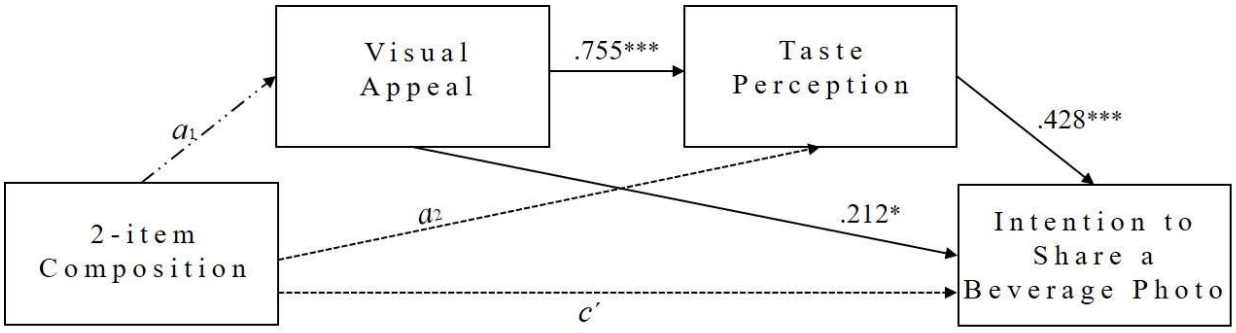
$a_1$ = .055 $a_2$ = .224 $c'$ = -.355·
3-item vs. 2-item → Visual Appl.→ ISP [-.068, .109]
3-item vs. 2-item → Taste Prcp. → ISP [-.047, .256]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → ISP [-.094, .142]

* indicates statically significant relative indirect effects

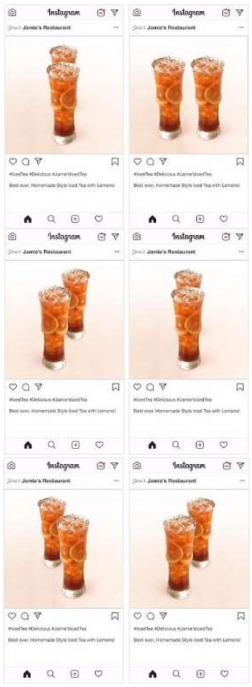
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Beverage Photo

**Figure 20.** Serial Mediation Analysis for Repetition (DV: ISP): Iced Tea Photos in Study 1

Effects of Compositional Lines in the 2-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 90% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .005 $a_2$ = -.031 $c'$ = .025
Vert. vs. Horz. → Visual Appl.→ ISP [-.080, .082]
Vert. vs. Horz. → Taste Prcp. → ISP [-.149, .125]
Vert. vs. Horz. → Visual Appl. → Taste Prcp. → ISP [-.115, .116]

$a_1$ = .374· $a_2$ = -.111 $c'$ = -.097
R-diag. vs. Vert. → Visual Appl.→ ISP [.007, .169] *
R-diag. vs. Vert. → Taste Prcp. → ISP [-.187, .085]
R-diag. vs. Vert. → Visual Appl. → Taste Prcp. → ISP [.014, .235] *

$a_1$ = -.448* $a_2$ = .139 $c'$ = .123
L-diag. vs. R-diag. → Visual Appl.→ ISP [-.204, -014] *
L-diag. vs. R-diag. → Taste Prcp. → ISP [-.073, .203]
L-diag. vs. R-diag. → Visual Appl. → Taste Prcp. → ISP [-.275, -.028] *

* indicates statically significant relative indirect effects



Estimates of 90% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .379 $a_2$ = -.163 $c'$ = .806
R-diag. vs. Horz. → Visual Appl.→ ISP [-.002, .147]
R-diag. vs. Horz. → Taste Prcp. → ISP [-.214, .068]
R-diag. vs. Horz. → Visual Appl. → Taste Prcp. → ISP [.009, .259] *

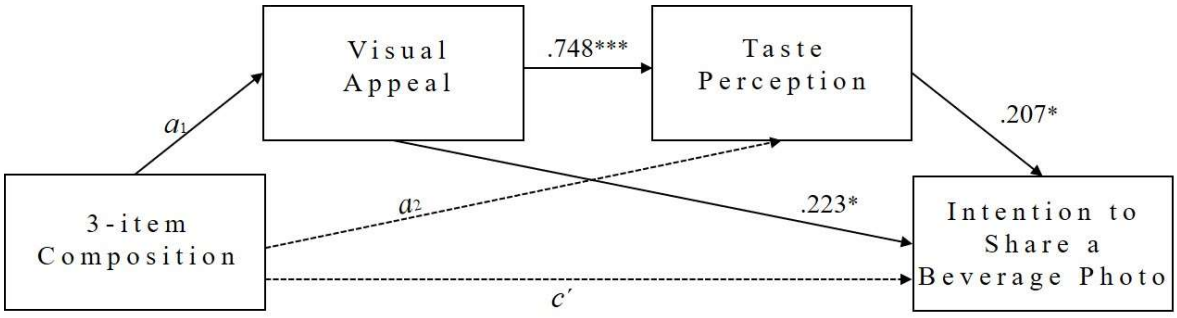
* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Beverage Photo

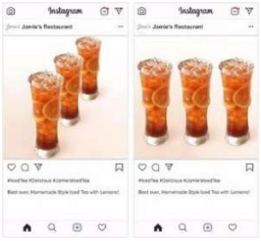
**Figure 21.** Serial Mediation Analysis for Composition (DV: ISP): Iced Tea Photos in Study 1

(Cont'd)

Effects of Compositional Lines in the 3-item Repetition Condition

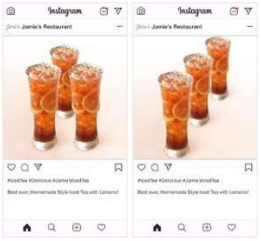



· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .429* $a_2$ = .083 $c'$ = -.289
R-diag. vs. Horz. → Visual Appl.→ ISP [.005, .239] *
R-diag. vs. Horz. → Taste Prcp. → ISP [-.057, .097]
R-diag. vs. Horz. → Visual Appl. → Taste Prcp. → ISP [.003, .164] *



$a_1$ = -.463* $a_2$ = -.392 $c'$ = .382·
U-triag. vs. R-diag. → Visual Appl.→ ISP [-.250, -.003] *
U-triag. vs. R-diag. → Taste Prcp. → ISP [-.198, .001]
U-triag. vs. R-diag. → Visual Appl. → Taste Prcp. → ISP [-.181, -.001] *

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention; ISP = Intention to Share a Beverage Photo

**Figure 21.** Serial Mediation Analysis for Repetition (DV: ISP): Iced Tea Photos in Study 1 (Cont'd)

In summary, the results of Study 1 for iced tea photos on Instagram showed that participants perceived significantly higher levels of visual appeal for both the 2-item repetition and the 3-item repetition conditions compared to the non-repetition condition when the glasses of iced tea were presented in the right diagonal composition. However, the levels of visual appeal were not significantly different between non-repetition, 2-item repetition, and 3-item repetition

in other composition conditions. When three glasses of iced tea were presented, participants perceived significantly higher level of visual appeal in the right diagonal composition than in the horizontal composition. When two glasses of iced tea were presented, four compositional lines did not differ in perceived visual appeal. In terms of repetition in the right diagonal composition condition, the effects of the 2-item repetition and the 3-item repetition conditions (vs. non-repetition) on purchase intention/intention to share a beverage photo were serially mediated by visual appeal and taste perception, but there was no difference between the 3-item repetition and the 2-item repetition conditions. In terms of compositional lines in the 2-item repetition condition, the serial mediation effects of visual appeal and taste perception on purchase intention/intention to share a beverage photo were significantly higher in the right diagonal composition condition than the vertical composition condition; higher in the right diagonal composition condition than in the left diagonal composition condition; higher in the right diagonal than in the horizontal compositions. In the 3-item repetition condition, the serial mediation effects of visual appeal and taste perception on purchase intention/intention to share a beverage photo were significantly higher in the right diagonal composition condition than in the horizontal composition condition; higher in the right diagonal composition condition than in the upward-triangle composition condition.

## 4.4. Study 2

### Results of Study 2: Cheeseburger photos on an Online Food Ordering Platform

**Manipulation Check.** For manipulation checks, participants were asked how many cheeseburgers they had seen and what the arrangement of the cheeseburgers was on the online food ordering platform that they have viewed. The manipulations were successful as 95.11% of the participants correctly reported the number of repetition ($\chi^2(4) = 1071.9$ $p < .001$), and 74 % of the participants reported a composition in the study stimuli correctly ($\chi^2(42) = 1980.36$, $p < .001$).

**Hypothesis Test for the Effect of Repetition.** Hypothesis 1 posits the effects of repetition on visual appeal. One-way ANOVA was conducted for each linear composition (i.e., horizontal, vertical, right diagonal, left diagonal). The results of one-way ANOVA indicated that when photo presented cheeseburgers in the vertical composition, the level of visual appeal was significantly different between non-repetition, 2-item repetition, and 3-item repetition condition ($F(2, 180) = 2.841$, $p = .061$). The levels of perceived visual appeal were rated in the order of the 3 item-repetition condition ($M = 5.307$, $SD = 1.330$, n = 64), the 2-item repetition condition ($M = 5.116$, $SD = 1.205$, n = 63), and the non-repetition condition ($M = 4.750$, $SD = 1.340$, n = 56). The results of Tukey HSD post hoc tests showed that the difference between 3-item repetition and non-repetition was significant ($p = .051$) whereas other pairs were not statistically different ($p > .1$). However, the results of one-way ANOVAs in the horizontal, the right diagonal, and the left diagonal conditions showed that the effect of repetition on visual appeal was not statistically significant ($p > .1$). Thus, H1 was partially supported.

**Hypothesis Test for the Effects of Compositional Lines.** Hypothesis 2 posits the different effects of compositional lines on viewers' perception of visual appeal. A series of one-way ANOVAs were conducted to test the effects of compositional lines within each repetition condition. When photos of three identical cheeseburgers were presented, the results of one-way ANOVA revealed significant differences in perceived visual appeal among different compositional lines (i.e., horizontal, vertical, right diagonal, left diagonal, upward-pointing triangle, downward-pointing triangle) ($F(5, 376) = 3.444$, $p < .01$). The levels of perceived visual appeal were rated in the order of the downward-pointing triangle composition ($M = 5.467$, $SD = 1.162$, n = 65), the vertical composition ($M = 5.307$, $SD = 1.330$, n = 64), the upward-pointing triangle composition ($M = 5.091$, $SD = 1.294$, n = 62), the left diagonal composition ($M = 5.089$, $SD = 1.308$, n = 64), the horizontal composition ($M = 4.813$, $SD = 1.285$, n = 64), and the right diagonal composition ($M = 4.598$, $SD = 1.688$, n = 63). The results of Tukey HSD post hoc tests revealed that the difference between downward-pointing triangle and right diagonal was significant at $p < .01$, and the difference between vertical and right diagonal was significant at $p < .05$, and the difference between downward-pointing triangle and horizontal was significant at $p = .07$ whereas other pairs were not statistically different ($p > .1$). However, when photos of two identical cheeseburgers were presented, the results of one-way ANOVA showed no significant difference among different compositional lines (i.e., horizontal, vertical, right diagonal, left diagonal based on 2-item repetition) ($F(3, 253) = .093$, $p > .1$). Thus, H2 was partially supported. Table 8 presents the descriptive statistics, and Figure 22 illustrates the significant results of mean plots for repetition and compositional lines for cheeseburger photos in Study 2.

**Table 8.** Descriptive Statistics of Study 2: Cheeseburger

Dependent Variable: Visual Appeal

| Repetition | Composition | Mean | Std. Deviation | N |
|---|---|---|---|---|
| Non-Repetition | | 4.750 | 1.340 | 56 |
| 2 | Horizontal | 5.149 | 1.469 | 65 |
| 2 | Vertical | 5.116 | 1.205 | 63 |
| 2 | Right diagonal | 5.041 | 1.545 | 65 |
| 2 | Left diagonal | 5.047 | 1.336 | 64 |
| 3 | Horizontal | 4.813 | 1.285 | 64 |
| 3 | Vertical | 5.307 | 1.330 | 64 |
| 3 | Right diagonal | 4.598 | 1.688 | 63 |
| 3 | Left diagonal | 5.089 | 1.308 | 64 |
| 3 | Upward-pointing triangle | 5.091 | 1.377 | 62 |
| 3 | Downward-pointing triangle | 5.467 | 1.162 | 65 |
| | Total | 5.047 | 1.385 | 695 |

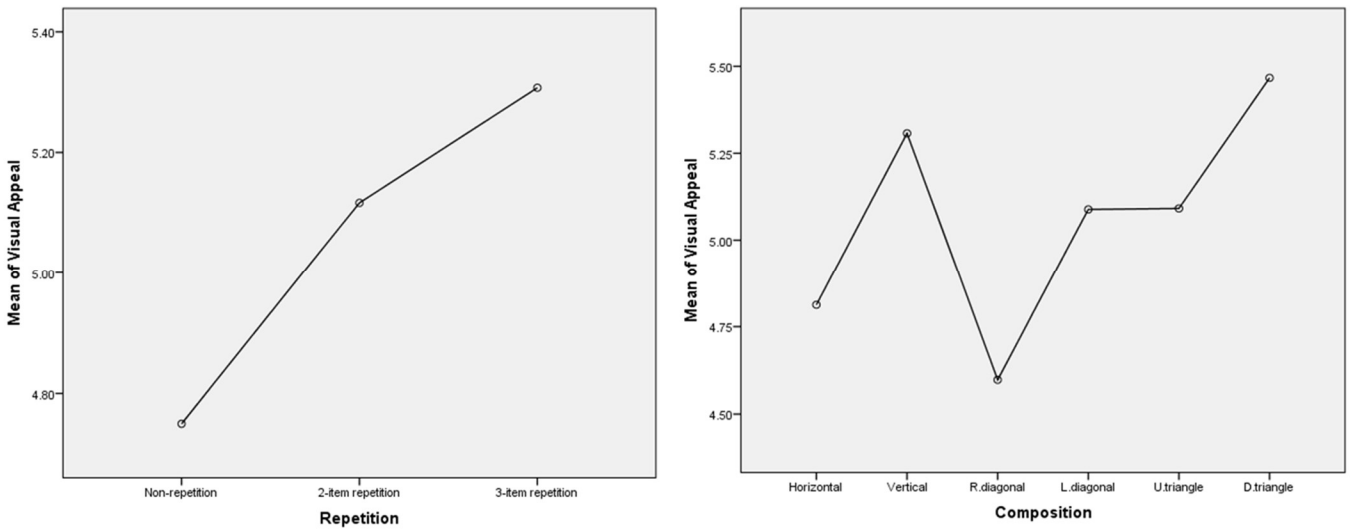



**Figure 22.** Mean Plot for Repetition in Vertical (Left) and Mean Plot for 3-item Compositional Lines (Right)

**Hypothesis Test for the Effects of Crossmodal Responses on Intention to Order.**

Hayes' PROCESS model 6 (Hayes 2013) was conducted to test the proposed serial mediation effects of visual appeal and taste perception on intention to order (H7-8) on an online food ordering platform. Hypothesis 7 posits that the effect of repetition in a food photo on intention to order is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each compositional line condition. Repetition was treated as a multicategorical variable using the non-repetition as a reference group. In the horizontal composition, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) compared to the non-repetition condition ($Effect_{X1}$ = .201, $SE_{X1}$= .125, *95% bootstrap* $CI_{X1}$ = -.050, .499; $Effect_{X2}$ = .032, $SE_{X2}$ = .125, *95% bootstrap* $CI_{X2}$ = -.202, .295) although the direct effect of visual appeal on taste perception was statistically significant ($B$ = .671, $SE$ = .045, $t$(181) = 14.846, *95% bootstrap CI* = .581, .760), and the direct effect of taste perception on intention to order was significant ($B$ = .752, $SE$ = .0103, $t$(180) = 7.277, *95% bootstrap CI* = .548, .956). Additionally, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for 3-item repetition than the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the horizontal composition ($Effect_{X2}$ = -.170, $SE_{X2}$ = .125, *95% bootstrap* $CI_{X2}$ = -.422, .068).

In the vertical composition condition, the results showed that the effect of 2-item repetition (X1) on visual appeal was not significantly higher than that of the non-repetition condition, but the effect of 3-item repetition (X2) on visual appeal was significantly higher than that of the non-repetition condition ($B_{X1}$ = .366, $SE_{X1}$ = .237, $t_{X1}$(180) = 1.545, *95% bootstrap*

$CI_{X1}$ = -.102, .834; $B_{X2}$ = .557, $SE_{X2}$ = .236, $t_{X2}(180)$ = 2.359, *95% bootstrap* $CI_{X2}$ = .091, 1.024). The results also demonstrated that the direct effect of visual appeal on taste perception was statistically significant ($B$ = .655, $SE$ = .050, $t(179)$ = 13.223, *95% bootstrap CI* = .557, .753), and the direct effect of taste perception on intention to order was statistically significant ($B$ = .722, $SE$ = .102, $t(178)$ = 7.054, *95% bootstrap CI* = .520, .924). The results showed that the serial mediation effects of visual appeal and taste perception on intention to order were significantly higher for the 3-item repetition condition compared to the non-repetition condition ($Effect_{X2}$ = .264, $SE_{X2}$ = .127, *95% bootstrap* $CI_{X2}$ = .041, .532), but the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for the 2-item repetition condition compared to the non-repetition condition ($Effect_{X1}$ = .173, $SE_{X1}$ = .120, *95% bootstrap* $CI_{X1}$ = -.041, .439). Additionally, with sequential coding in PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for the 3-item that the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the vertical composition ($Effect_{X2}$ = .090, $SE_{X2}$ = .109, *95% bootstrap* $CI_{X2}$ = -.128, .307).

In the right diagonal composition condition, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for the non-repetition condition than both the 2-item repetition (X1) and the 3-item repetition (X2) conditions ($Effect_{X1}$ = -.126, $SE_{X1}$= .137, *95% bootstrap* $CI_{X1}$ = -.397, .146; $Effect_{X2}$ = -.234, $SE_{X2}$ = .137, *95% bootstrap* $CI_{X2}$ = -.509, .022) although the direct effect of visual appeal on taste perception was statistically significant ($B$ = .630, $SE$ = .043, $t(180)$ = 14.687, *95% bootstrap CI* = .545, .714), and the direct effect of taste perception on intention to order was significant ($B$ = .813, $SE$ = .087, $t(179)$ = 9.365, *95% bootstrap CI* = .641, .984). Additionally, with sequential

coding in PROCESS, the results showed that the serial mediation effects of visual appeal and taste perception were not significantly higher for the 3-item repetition condition than the 2-item repetition condition (X2: 3-item vs. 2-item) in the right diagonal composition ($Effect_{X2}$ = -.227, $SE_{X2}$ = .149, *95% bootstrap* $CI_{X2}$ = -.534, .050).

In the left diagonal composition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions compared to the non-repetition condition ($Effect_{X1}$ = .158, $SE_{X1}$= .137, *95% bootstrap* $CI_{X1}$ = -.085, .458; $Effect_{X2}$ = .180, $SE_{X2}$ = .137, *95% bootstrap* $CI_{X2}$ = -.063, .467) although the direct effect of visual appeal on taste perception was statistically significant ($B$ = .701, $SE$ = .049, $t$(180) = 14.219, *95% bootstrap CI* = .604, .799), and the direct effect of taste perception on intention to order was significant ($B$ = .760, $SE$ = .092, $t$(179) = 8.256, *95% bootstrap CI* = .578, .942). Additionally, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception were not significantly higher for the 3-item repetition condition than the 2-item repetition condition (X2) in the left diagonal composition ($Effect_{X2}$ = .022, $SE_{X2}$ = .125, *95% bootstrap* $CI_{X2}$ = -.239, .261). Thus, H7 was partially supported. Figure 23 presents the serial mediation analyses for the effects of repetition on intention to order food for cheeseburger photos on an online food ordering platform.

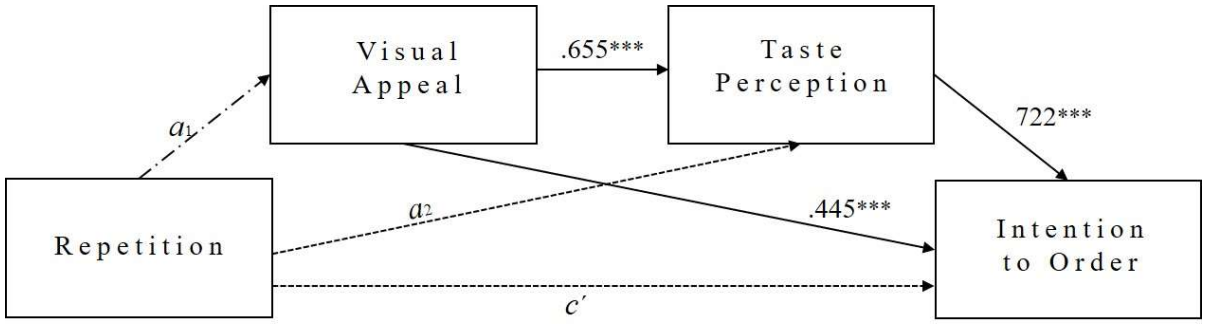
Next, the researcher conducted the serial mediation models based on the same number of repetitions with sequential coding. Hypothesis 8 posits that the effects of compositional lines in a food photo on intention to order is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each number of repetition condition. In the 2-item repetition condition, the results showed that the serial mediation effects of visual

appeal and taste perception on intention to order were not significantly different among different composition conditions: that is, between the vertical and the horizontal composition conditions (X1: vertical vs. horizontal), between the right diagonal and the vertical composition conditions (X2: right diagonal vs. vertical), between the left diagonal and the right diagonal composition conditions (X3: left diagonal vs. right diagonal) ($Effect_{X1}$ = -.020, $SE_{X1}$= .140, *95% bootstrap* $CI_{X1}$ = -.294, .259; $Effect_{X2}$ = -.046, $SE_{X2}$ = .147, *95% bootstrap* $CI_{X2}$ = -.337, .238; $Effect_{X3}$ = .004, $SE_{X3}$ = .151, *95% bootstrap* $CI_{X3}$ = -.283, .306). The direct effect of visual appeal on taste perception ($B$ = .702, $SE$ = .037, $t$(252) = 19.180, *95% bootstrap CI* = .630, .774) and the direct effect of taste perception on intention to order were statistically significant ($B$ = .860, $SE$ = .081, $t$(251) = 10.561, *95% bootstrap CI* = .699, .1.020).

In the 3-item repetition condition, the results showed that participants perceived a significantly higher level of visual appeal in the vertical composition condition than in the horizontal composition condition (X1); the effect of vertical was significantly higher than right diagonal (X2); and the effect of left diagonal was significantly higher than right diagonal (X3) ($B_{X1}$ = .495, $SE_{X1}$= .242, $t_{X5}$ (376) = 2.049, *90% bootstrap* $CI_{X1}$ = .097, .893; $B_{X2}$ = -.709, $SE_{X2}$ = .243, $t_{X2}$(376) = -2.926, *90% bootstrap* $CI_{X2}$ = -1.109, -.310; $B_{X3}$ = .491, $SE_{X3}$ = .243, $t_{X3}$(376) = 2.024, *90% bootstrap* $CI_{X3}$ = .091, .891). However, no differences were found between the upward-pointing triangle and the left diagonal composition condition (X4), between the downward-pointing triangle and the upward-pointing triangle composition conditions (X5) ($B_{X4}$ = .003, $SE_{X4}$ = .244, $t_{X4}$(376) = .012, *90% bootstrap* $CI_{X4}$ = -.399, .404; $B_{X5}$ = .375, $SE_{X5}$ = .243, $t_{X5}$(376) = 1.547, *90% bootstrap* $CI_{X5}$ = -.025, .775). The direct effect of visual appeal on taste perception ($B$ = .680, $SE$ = .033, $t$(375) = 20.581, *90% bootstrap CI* = .625, .734) and the direct effect of taste perception on intention to order were statistically significant ($B$ = .841, $SE$ = .063,

$t(374) = 13.359$, *90% bootstrap CI* = .738, .945). Finally, the results demonstrated that the serial mediation effects of visual appeal and taste perception were significantly higher in the vertical composition condition than in the horizontal composition condition (X1); higher in the vertical composition condition than in the right diagonal composition condition (X2); higher in the left diagonal composition condition than the right diagonal composition condition (X3); and higher in the downward-pointing triangle composition condition than the upward-pointing triangle composition condition (X5) ($Effect_{X1}$ = .283, $SE_{X1}$ = .131, *90% bootstrap* $CI_{X1}$ = .064, .492; $Effect_{X2}$ = -.406, $SE_{X2}$ = .154, *90% bootstrap* $CI_{X2}$ = -.664, -.149; $Effect_{X3}$ = .281, $SE_{X3}$ = .153, *90% bootstrap* $CI_{X3}$ = .028, .526; $Effect_{X5}$ = .215, $SE_{X5}$ = .133, *90% bootstrap* $CI_{X5}$ = .004, .444). In an additional test to find the contrasts between other pairs of compositional lines in the 3-item repetition condition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to order were significantly higher in the downward-pointing triangle composition condition than in the right diagonal (X2: downward triangle vs. right diagonal) ($Effect_{X2}$ = .489, $SE_{X2}$ = .155, *95% bootstrap* $CI_{X2}$ = .201, .817) while the serial mediation effects were not statistically different between the right diagonal and the horizontal composition conditions (X1: right diagonal vs. horizontal) ($Effect_{X1}$ = -.121, $SE_{X1}$ = .151, *95% bootstrap* $CI_{X1}$ = -.427, .164). Thus, H8 was partially supported. Figure 24 presents the serial mediation analyses for the effects of compositional lines on intention to order food for cheeseburger photos on an online food ordering platform.

Effects of Repetition in the Vertical Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

Estimates of 95% bootstrap confidential intervals for relative indirect effects:



$a_1$ = .366 $a_2$ = -.148 $c'$ = -.232
2-item vs. Non-rep. → Visual Appl.→ Int. Order [-.041, .385]
2-item vs. Non-rep. → Taste Prcp. → Int. Order [-.347, .110]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Int. Order [-.041, .439]



$a_1$ = .557* $a_2$ = -.286 $c'$ = -.160
3-item vs. Non-rep. → Visual Appl.→ Int. Order [.036, .512] *
3-item vs. Non-rep. → Taste Prcp. → Int. Order [-.462, .027]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Int. Order [.041, .532] *



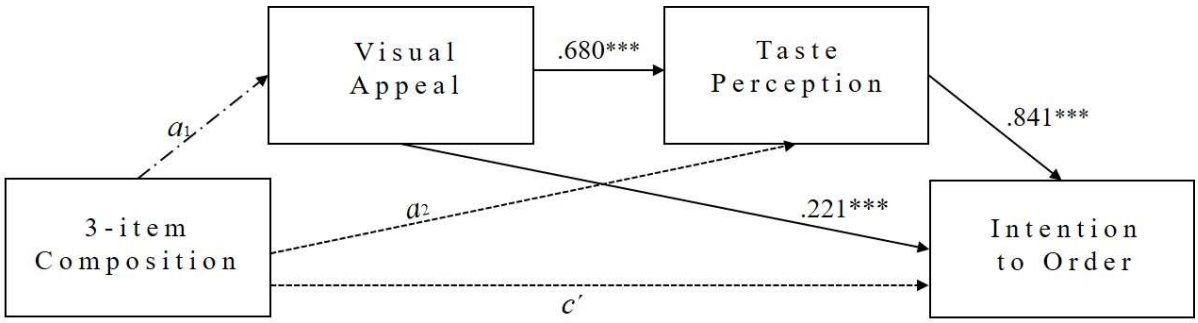
$a_1$ = .191 $a_2$ = -.138 $c'$ = .072
3-item vs. 2-item → Visual Appl.→ Int. Order [-.110, .311]
3-item vs. 2-item → Taste Prcp. → Int. Order [-.316, .113]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Int. Order [-.128, .307]

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 23.** Serial Mediation Analysis for Repetition: Cheeseburger Photos in Study 2

Effects of Compositional Lines in the 3-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 90% bootstrap confidential intervals for relative indirect effects:

$a_1$ = .495* $a_2$ = -.141 $c'$ = -.117
Vert. vs Horz. → Visual Appl.→ Int. Order [.018, .227]
Vert. vs Horz. → Taste Prcp. → Int. Order [-.335, .087]
Vert. vs Horz. → Visual Appl. → Taste Prcp. → Int. Order [.064, .492] *

$a_1$ = -.709** $a_2$ = .019 $c'$ = -.014
R-diag. vs Vert. → Visual Appl.→ Int. Order [-.311, -.039] *
R-diag. vs Vert. → Taste Prcp. → Int. Order [-.207, .234]
R-diag. vs Vert. → Visual Appl. → Taste Prcp. → Int. Order [-.664, -.149] *

$a_1$ = .491* $a_2$ = -.034 $c'$ = .075
L-diag. vs R-diag. → Visual Appl.→ Int. Order [.009, .239] *
L-diag. vs R-diag. → Taste Prcp. → Int. Order [-.247, .195]
L-diag. vs R-diag. → Visual Appl. → Taste Prcp. → Int. Order [.028, .526] *

$a_1$ = .003 $a_2$ = .011 $c'$ = -.008
U-trig. vs L-diag. → Visual Appl.→ Int. Order [-.083, .098]
U-trig. vs L-diag. → Taste Prcp. → Int. Order [-.193, .214]
U-trig. vs L-diag. → Visual Appl. → Taste Prcp. → Int. Order [-.223, .222]

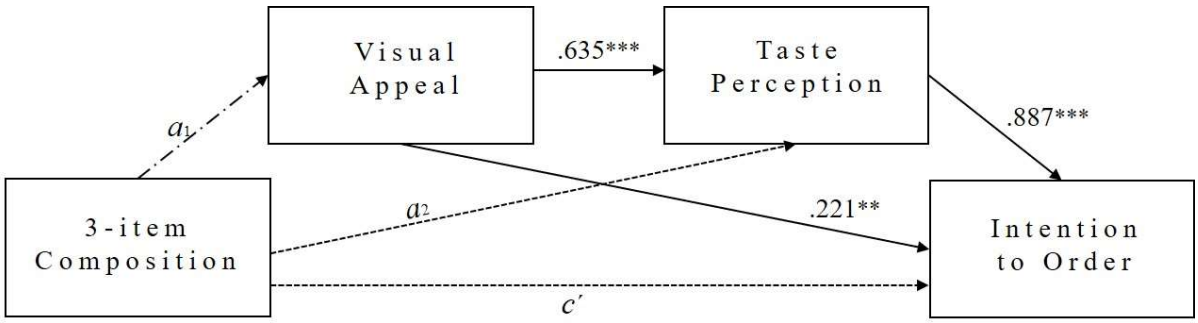
$a_1$ = .375 $a_2$ = -.024 $c'$ = .156
D-trig. vs U-trig. → Visual Appl.→ Int. Order [.002, .178] *
D-trig. vs U-trig. → Taste Prcp. → Int. Order [-.243, .194]
D-trig. vs U-trig. → Visual Appl. → Taste Prcp. → Int. Order [.004, .444] *

* indicates statically significant relative indirect effects

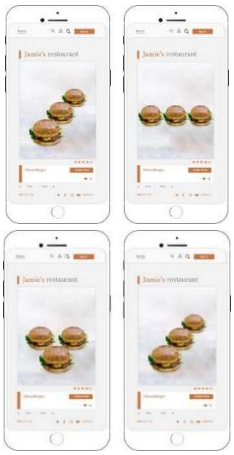
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 24.** Serial Mediation Analysis for Composition: Cheeseburger Photos in Study 2

Effects of Compositional Lines in the 3-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = -.214 $a_2$ = -.132 $c'$ = -.119
R-diag. vs. Horz. → Visual Appl.→ Int. Order [-.203, .066]
R-diag. vs. Horz. → Taste Prcp. → Int. Order [-.405, .133]
R-diag. vs. Horz. → Visual Appl. → Taste Prcp. → Int. Order [-.427, .164]

$a_1$ = .869*** $a_2$ = -.008 $c'$ = .198
D-triag. vs. R-diag. → Visual Appl.→ Int. Order [.039, .414] *
D-triag. vs. R-diag. → Taste Prcp. → Int. Order [-.313, .315]
D-triag. vs. R-diag. → Visual Appl. → Taste Prcp. → Int. Order [.201, .817] *

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 24.** Serial Mediation Analysis for Composition: Cheeseburger Photos in Study 2 (Cont'd)

In summary, the results of Study 2 for cheeseburger photos on an online food ordering platform showed that when the glasses of iced tea were presented in the vertical diagonal composition, participants perceived significantly higher levels of visual appeal for the 3-item repetition condition than the non-repetition condition, but there were no differences between the 2-item repetition and the non-repetition condition, and between the 3-item repetition and the 2-item repetition conditions. In addition, the levels of visual appeal were not significantly different

between non-repetition, 2-item repetition, and 3-item repetition in other composition conditions. When three glasses of iced tea were presented, participants perceived significantly higher levels of visual appeal in the downward-pointing triangle composition than in the right diagonal composition; higher in the vertical composition than in the right diagonal composition; and higher in the downward-pointing triangle composition than in the horizontal composition condition. When two glasses of iced tea were presented, the results showed no significant differences in perceived visual appeal among different compositional lines. In terms of repetition in the vertical composition condition, the serial mediation effects of visual appeal and taste perception on intention to order were significantly higher for the 3-item repetition condition than for the non-repetition condition; higher for the 3-item repetition condition than for the 2-item repetition condition. In terms of compositional lines in the 3-item repetition condition, the serial mediation effects of visual appeal and taste perception on intention to order were significantly higher in the vertical composition than the horizontal composition; higher in the vertical composition than in the right diagonal composition; higher in the left diagonal composition than in the right diagonal composition; higher in the downward-pointing triangle composition than in the upward-pointing triangle composition; higher in the downward-pointing triangle composition than in the right diagonal composition. However, in the 2-item repetition condition, the serial mediation effects of visual appeal and taste perception on purchase intention/intention to share a beverage photo were not significantly different among different compositional lines.

**Results of Study 2: Iced Tea Photos on an Online Food Ordering Platform**

**Manipulation Check.** For manipulation checks, participants were asked how many glasses of iced tea they had seen and what the arrangement of the glasses of iced tea was on the

online food ordering platform that they had viewed. The manipulations were successful as 99.14% of the participants correctly reported the number of repetition ($\chi^2(4) = 1335.25$, $p < .001$), and 80.64% of the participants reported a composition in the study stimuli correctly ($\chi^2(42) = 2588.47$, $p < .001$).

**Hypothesis Test for the Effects of Repetition.** Hypothesis 1 posits the effects of repetition on visual appeal. One-way ANOVA was conducted for each linear composition (i.e., horizontal, vertical, right diagonal, left diagonal). The results of one-way ANOVA indicated that the levels of visual appeal were not significantly different between non-repetition, 2-item repetition, and 3-item conditions throughout in the horizontal, vertical, right diagonal, and left diagonal composition conditions ($p > .1$). Thus, H1 was not supported.

**Hypothesis Test for the Effects of Compositional Lines.** Hypotheses 2 posits the different effects of compositional lines on viewers' perception of visual appeal. A series of one-way ANOVAs were conducted to test the effects of compositional lines within each repetition condition. When photos of two identical glasses of iced tea were presented, the result of one-way ANOVA revealed no significant differences in perceived visual appeal among different compositional lines (i.e., horizontal, vertical, right diagonal, left diagonal) ($F(3, 250) = 1.583$, $p > .1$). When photos of three identical glasses of iced tea were presented, the results of one-way ANOVA also showed no significant differences in perceived visual appeal among different compositional lines (i.e., horizontal, vertical, right diagonal, left diagonal, upward-pointing triangle, downward-pointing triangle compositions based on 3-item repetition) ($F(5, 375) = .706$, $p > .1$). Thus, H2 was not supported. Table 9 presents the descriptive statistics for iced tea photos in Study 2.

**Table 9.** Descriptive Statistics of Study 2: Iced Tea

Dependent Variable: Visual Appeal

| Repetition | Composition | Mean | Std. Deviation | N |
|---|---|---|---|---|
| Non-Repetition | | 5.032 | 1.593 | 63 |
| 2 | Horizontal | 5.458 | 1.290 | 64 |
| 2 | Vertical | 5.286 | 1.366 | 63 |
| 2 | Right diagonal | 5.533 | 1.292 | 65 |
| 2 | Left diagonal | 5.048 | 1.486 | 62 |
| 3 | Horizontal | 5.339 | 1.533 | 63 |
| 3 | Vertical | 5.472 | 1.531 | 65 |
| 3 | Right diagonal | 5.397 | 1.382 | 63 |
| 3 | Left diagonal | 5.339 | 1.216 | 63 |
| 3 | Upward-pointing triangle | 5.027 | 1.559 | 63 |
| 3 | Downward-pointing triangle | 5.271 | 1.460 | 64 |
| | Total | 5.293 | 1.433 | 698 |

**Hypothesis Test for the Effects of Crossmodal Responses on Intention to Order.**

Hayes' PROCESS model 6 (Hayes 2013) was conducted to test the proposed serial mediation effects of visual appeal and taste perception on intention to order (H7-8). Hypothesis 7 posits that the effect of repetition in a beverage photo on intention to order is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each compositional line condition. Repetition was treated as a multicategorical variable using the non-repetition condition as a reference group. In the horizontal composition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions compared to the non-repetition condition ($Effect_{X1}$ = .102, $SE_{X1}$= .079, *90% bootstrap* $CI_{X1}$ = -.005, .222; $Effect_{X2}$ = -.030, $SE_{X2}$ = .064, *90% bootstrap* $CI_{X2}$ = -.137, .073) although the direct effect of visual appeal on taste perception was statistically significant ($B$ = .532, $SE$ = .066,

$t(184) = 8.10$, *90% bootstrap CI* = .423, .640), and the direct effect of taste perception on intention to order was significant ($B = .983$, $SE = .072$, $t(183) = 13.567$, *90% bootstrap CI* = .863, 1.103). Additionally, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for the 3-item repetition condition than the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the horizontal composition ($Effect_{X2} = -.063$, $SE_{X2} = .134$, *90% bootstrap* $CI_{X2}$ = -.288, .153).

In the vertical composition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions compared to the non-repetition condition ($Effect_{X1} = .153$, $SE_{X1} = .150$, *90% bootstrap* $CI_{X1}$ = -.086, .406; $Effect_{X2} = .231$, $SE_{X2}$ = .155, *90% bootstrap* $CI_{X2}$ = -.013, .494) although the direct effect of visual appeal on taste perception was statistically significant ($B = .607$, $SE = .057$, $t(184) = 10.614$, *90% bootstrap CI* = .513, .702), and the direct effect of taste perception on intention to order was significant ($B = .902$, $SE = .088$, $t(183) = 10.29$, *90% bootstrap CI* = .757, 1.047). Additionally, with sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for the 3-item repetition condition than the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the vertical composition ($Effect_{X2} = .079$, $SE_{X2} = .137$, *90% bootstrap* $CI_{X2}$ = -.150, .299).

In the right diagonal composition, the results demonstrated that the effect of 2-item repetition (X1) on visual appeal was significantly higher than that of the non-repetition condition, but the effect of 3-item repetition (X2) on visual appeal was not significantly higher than that of the non-repetition condition ($B_{X1} = .484$, $SE_{X1} = .257$, $t_{X1}(184) = 1.887$, *95%*

*bootstrap* $CI_{X1}$ = .060, .908; $B_{X2}$ = .338, $SE_{X2}$ = .2361 $t_{X2}$(184) = 1.300, *90% bootstrap* $CI_{X2}$ = -.092, .770). The results showed that the direct effect of visual appeal on taste perception was statistically significant (*B* = .574, *SE* = .072, *t*(183) = 8.04, *90% bootstrap CI* = .456, .693), and the direct effect of taste perception on intention to order was also significant (*B* = .976, *SE* = .065, *t*(182) = 14.958, *90% bootstrap CI* = .869, 1.084). The result revealed that the serial mediation effects of visual appeal and taste perception on intention to order were significantly higher for the 2-item repetition condition compared to the non-repetition condition ($Effect_{X1}$ = .272, $SE_{X1}$ = .154, *90% bootstrap* $CI_{X1}$ = .029, .532), but the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for the 3-item repetition condition than the non-repetition condition ($Effect_{X2}$ = .190, $SE_{X2}$ = .161, *90% bootstrap* $CI_{X2}$ = -.056, .462). Additionally, with sequential coding in PROCESS, the serial mediation effects of visual appeal and taste on intention to order were not significantly higher perception for the 3-item repetition condition than the 2-item repetition condition (X2: 3-item vs. 2-item repetition) in the right diagonal composition ($Effect_{X2}$ = -.082, $SE_{X2}$ = .134, *90% bootstrap* $CI_{X2}$ = -.304, .139).

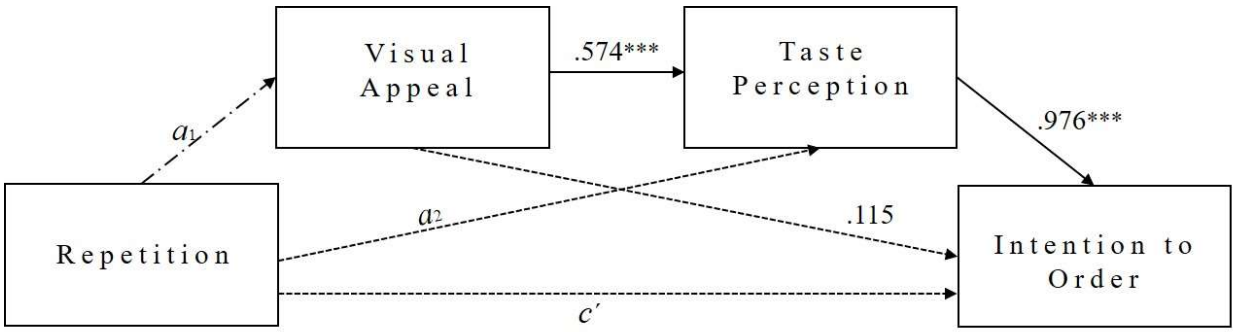
In the left diagonal composition, the results showed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for both the 2-item repetition (X1) and the 3-item repetition (X2) conditions compared to the non-repetition condition ($Effect_{X1}$ = -.001, $SE_{X1}$= .173, *90% bootstrap* $CI_{X1}$ = -.279, .292; $Effect_{X2}$ = .174, $SE_{X2}$ = .163, *90% bootstrap* $CI_{X2}$ = -.079, .444) although the direct effect of visual appeal on taste perception was statistically significant (*B* = .608, *SE* = .062, *t*(182) = 9.810, *90% bootstrap CI* = .505, .710), and the direct effect of taste perception on intention to order was also significant (*B* = .991, *SE* = .073, *t*(181) = 13.544, *90% bootstrap CI* = .870, 1.112). Additionally, with

sequential coding in PROCESS, the results revealed that the serial mediation effects of visual appeal and taste perception on intention to order were not significantly higher for the 3-item repetition condition than the 2-item repetition condition (X2: 3-item vs. 2-item repetition) with the left diagonal composition ($Effect_{X2}$ = .175, $SE_{X2}$ = .146, *90% bootstrap* $CI_{X2}$ = -.060, .422). Thus, H7 was partially supported. Figure 25 presents the serial mediation analyses for the effects of repetition on intention to order a beverage for iced tea photos on an online food ordering platform.

Next, the researcher conducted the serial mediation models based on the same number of repetitions with sequential coding. Hypothesis 8 posits that the effects of compositional lines in a beverage photo on intention to order is serially mediated by visual appeal and taste perception. Separate serial mediation analyses were conducted for each number of repetition condition. In the 2-item repetition, the serial mediation model for repetition showed that participants perceived a significantly higher level of visual appeal in the right diagonal composition condition than in the left diagonal composition condition (X3) ($B_{X3}$ = -.485, $SE_{X3}$ = .240, $t_{X3}$(249) = -2.021, *95% bootstrap* $CI_{X3}$ = -.958, -.012). However, no differences were found between the vertical and the horizontal composition conditions (X1), and between the right diagonal and the vertical composition conditions (X2) ($B_{X1}$ = -.130, $SE_{X1}$= .241, $t_{X5}$(249) = -.541, *95% bootstrap* $CI_{X1}$ = -.605, .344; $B_{X2}$ = .205, $SE_{X2}$ = .240, $t_{X2}$(249) = .856, *95% bootstrap* $CI_{X2}$ = -.267, .678). The direct effect of visual appeal on taste perception ($B$ = .517, $SE$ = .060, $t$(248) = 8.636, *95% bootstrap CI* = .399, .635) and the direct effect of taste perception on intention to order food were statistically significant ($B$ = .929, $SE$ = .061, $t$(247) = 15.148, *95% bootstrap CI* = .809, .1.050). Finally, the results showed that the serial mediation effects of visual appeal and intention to order were significantly higher in the right diagonal composition condition than in the left diagonal

composition condition (X3) (*Effect*$_{X3}$ = -.233, *SE*$_{X3}$ = .123, *95% bootstrap CI*$_{X3}$ = -.483, -.001). In the 3-item repetition, the serial mediation effects of visual appeal and taste perception on intention to order and on visual appeal were not significantly different among different composition conditions: that is, between the vertical and the horizontal composition conditions (X1), between the right diagonal and the vertical composition conditions (X2), between the left diagonal and the right diagonal composition conditions (X3), between the upward-pointing triangle and the left diagonal composition conditions (X4), and between the downward-pointing triangle and the upward-pointing triangle composition conditions (X5) (*Effect*$_{X1}$ = .070, *SE*$_{X1}$= .144, *95% bootstrap CI*$_{X1}$ = -.210, .352; *Effect*$_{X2}$ = -.044, *SE*$_{X2}$ = .139, *95% bootstrap CI*$_{X2}$ = -.322, .234; *Effect*$_{X3}$ = -.026, *SE*$_{X3}$ = .126, *95% bootstrap CI*$_{X3}$ = -.275, .217; *Effect*$_{X4}$ = -.139, *SE*$_{X4}$ = .128, *95% bootstrap CI*$_{X4}$ = -.385, .111; *B*$_{X5}$ = .103, *SE*$_{X5}$ = .139, *95% bootstrap CI*$_{X5}$ = -.182, .375). The direct effect of visual appeal on taste perception (*B* = .559, *SE* = .048, *t*(371) = 11.588, *90% bootstrap CI* = .464, .654) and the direct effect of taste perception on intention to order food were statistically significant (*B* = .945, *SE* = .042, *t*(370) = 22.562, *90% bootstrap CI* = .862, 1.027). Thus, H8 was partially supported. Figure 26 presents the serial mediation analyses for the effects of compositional lines on intention to order a beverage for iced tea photos on an online food ordering platform.

Effects of Repetition in the Right Diagonal Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001

Estimates of 90% bootstrap confidential intervals for relative indirect effects:



$a_1$ = .484· $a_2$ = .253 $c'$ = .213
2-item vs. Non-rep. → Visual Appl.→ Int. Order [-.007, .157]
2-item vs. Non-rep. → Taste Prcp. → Int. Order [-.157, .642]
2-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Int. Order [.030, .532] *



$a_1$ = .339 $a_2$ = .060 $c'$ = .074
3-item vs. Non-rep. → Visual Appl.→ Int. Order {-.018, .121]
3-item vs. Non-rep. → Taste Prcp. → Int. Order [-.334, .453]
3-item vs. Non-rep. → Visual Appl. → Taste Prcp. → Int. Order [-.056, .462]



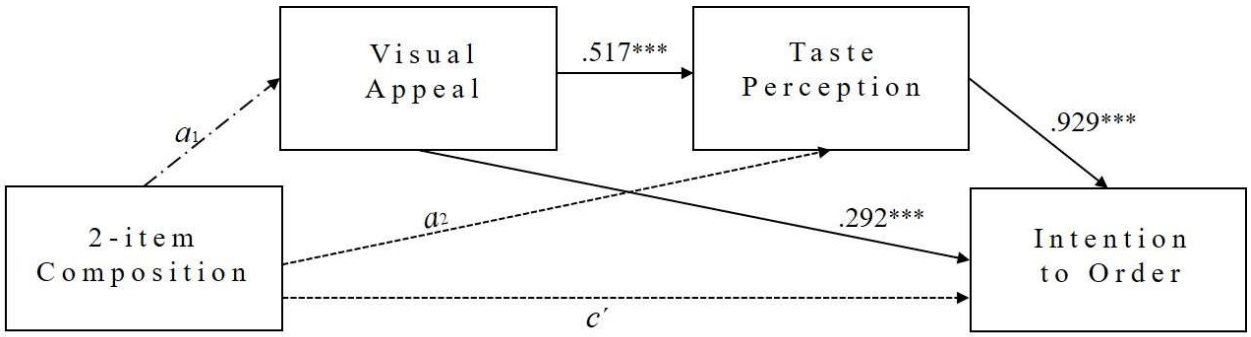
$a_1$ = -.145 $a_2$ = -.193 $c'$ = -.139
3-item vs. 2-item → Visual Appl.→ Int. Order [-.087, .026]
3-item vs. 2-item → Taste prcp. → Int. Order [-.618, .238]
3-item vs. 2-item → Visual Appl. → Taste Prcp. → Int. Order [-.304, .139]

* indicates statically significant relative indirect effects

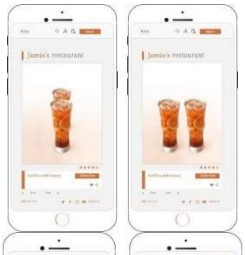
*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 25.** Serial Mediation Analysis for Repetition: Iced Tea Photos in Study 2

Effects of Compositional Lines in the 2-item Repetition Condition




· $p$ <.1, * $p$ < .05, ** $p$ < .01, *** $p$ < .001



Estimates of 95% bootstrap confidential intervals for relative indirect effects:

$a_1$ = -.130 $a_2$ = .191 $c'$ = .301
Vert. vs. Horz. → Visual Appl.→ Int. Order [-.177, .100]
Vert. vs. Horz. → Taste Prcp. → Int. Order [-.205, .576]
Vert. vs. Horz. → Visual Appl. → Taste Prcp. → Int. Order [-.289, .151]



$a_1$ = .205 $a_2$ = -.265 $c'$ = .015
R-diag. vs. Vert. → Visual Appl.→ Int. Order [-.071, .209]
R-diag. vs. Vert. → Taste Prcp. → Int. Order [-.696, .174]
R-diag. vs. Vert. → Visual Appl. → Taste Prcp. → Int. Order [-.114, .320]



$a_1$ = -.485* $a_2$ = .112 $c'$ = .151
L-diag. vs. R-diag. → Visual Appl.→ Int. Order [-.328, -.001] *
L-diag. vs. R-diag. → Taste Prcp. → Int. Order [-.327, .544]
L-diag. vs. R-diag. → Visual Appl. → Taste Prcp. → Int. Order [-.483, -.001] *

* indicates statically significant relative indirect effects

*Note.* $a_1$ denotes the coefficient of the direct path from repetition to visual appeal; $a_2$ denotes the coefficient of the direct path from repetition to taste perception; $c'$ denotes the coefficient of the direct path from repetition to purchase intention.

**Figure 26.** Serial Mediation Analysis for Composition: Iced Tea Photos in Study 2

In summary, the results of Study 2 for iced tea photos on an online food ordering platform showed no significant differences in perceived visual appeal among non-repetition, 2-repetition, and 3-repetition. Also, the levels of visual appeal were not significantly different among different compositional lines. However, in terms of repetition in the right composition condition, the serial mediation effects of visual appeal and taste perception on intention to order were significantly higher for the 2-item repetition condition than for the non-repetition condition, but not significantly different between the 3-item repetition and the non-repetition condition, and between the 3-item repetition and the 2-item repetition. In terms of compositional lines in the 2-item repetition condition, the serial mediation effects of visual appeal and taste perception on intention to order were significantly higher in the right diagonal composition than in the left diagonal composition. However, in the 3-item repetition condition, the serial mediation effects of visual appeal and taste perception on purchase intention/intention to share a beverage photo were not significantly different among different compositional lines.

# CHAPTER FIVE
# DISCUSSIONS AND IMPLICATIONS

This study aimed to investigate the effects of visual design principles in food presentation on consumers' behavioral intention through crossmodal correspondences in online contexts, such as social media platforms and online food delivery services. Based on *grounded cognition* (Barsalou, 2008) and Berlyne's (1971) aesthetic theory as theoretical frameworks, this study hypothesized that food imagery with repetition and different compositional lines influences crossmodal correspondences between vision and taste in the context of food consumption through online platforms. That is, the presented study examined how the intensity of visual complexity generated from repetition (Berlyne, 1971) and different feelings evoked from compositional lines affect the viewer's mental sensory simulations of the presented food (Barsalou, 2008; Krishna & Schwarz, 2014). To achieve the study purposes, Study 1 was designed to examine effects of repetition and compositional lines in a food image on viewers' perception of visual appeal, which, in turn, influences viewer's behavioral intention, purchase intention and intention to share a food/beverage photo through crossmodal correspondences between vision and taste in the context of Instagram. Study 2 was designed to test the proposed research model in an online food ordering system. This chapter discusses the theoretical and managerial implications based on the findings of the study and concludes with the limitations of the study.

## 5.1. Discussion of Findings

First, this study provided crucial insights as to what level of repetition is effective in visual appeal. The results for the cheeseburger and iced tea in Study 1 and cheeseburger in Study 2 revealed that repetition of food items effectively heightens a viewer's sensory pleasure in vision and taste, which then increases the likelihood of purchasing the presented food item. In the Instagram context (Study 1), repetition of the cheeseburger image increased visual appeal in the horizontal, vertical, right diagonal, and left diagonal composition conditions and repetition of the iced tea image also increased visual appeal. On an online food ordering platform setting (Study 2), repetition of the cheeseburger image increased with vertical composition. In many cases, the contrasts of visual appeal were found between 2-item repetition and non-repetition and between 3-item repetition and non-repetition, but 3-item vs. 2-item repetitions were not significantly different. In other words, the effect of repetition on visual appeal significantly increased from 1 item to 2-item repetition, but the perceived visual appeal did not significantly increase from 2-item to 3-item repetition. This finding validates Berlyne's (1971) visual aesthetic theory that 2-item repetition may be an optimal level of complexity for pleasing, after which further visual complexity decreases the viewer's pleasure. Subsequently, the serial mediation model for repetition throughout Studies 1 and 2 also showed this tendency, in that the contrast between 3-item and 2-item repetitions was not significant, whereas the contrasts between 2-item repetition and non-repetition and between 3-item repetition and non-repetition were significant. In addition, particularly in the category of beverage, the effect of repetition was found in the right diagonal condition.

Second, the study contributed to the visual information processing literature by suggesting relative visual impacts between different compositional lines. For the cheeseburger, compositional lines with 2-item repetition did not have an effect on visual appeal. However, the results also showed that differences between types of compositional lines were found in 3-item repetition. The researcher assumes that compositional differences become distinct as implied lines and shapes are enlarged with increasing numbers of food items, as well as that three (vs. two) items can be used to produce more different types of compositions, including triangular arrangements. Although the significantly different pairs of compositional lines were not the same in both the Instagram and online food ordering platform settings, this study found that horizontal composition tended to it had a lesser effect on visual appeal compared to vertical composition, diagonal, and triangular compositions throughout the cheeseburger and iced tea experiments in the Instagram and online food ordering platform contexts. The serial mediation models for compositional lines also demonstrated the inferiority of horizontal lines from the comparisons between vertical and horizontal lines (cheeseburger in Studies 1 and 2) and between right diagonal and horizontal lines (cheeseburger and 2-item and 3-item iced tea in Study 1). In addition, right diagonal lines were relatively more effective in visual appeal and the crossmodal correspondence between vision and taste, except for the cheeseburger in the online ordering platform setting. The right diagonal composition increased perceived visual appeal compared to the horizontal composition (cheeseburger and iced tea in Study 1), the left diagonal composition (iced tea in Studies 1 and 2), and the upward-pointing triangle composition (iced tea in Study 1). The right diagonal composition increased the serial mediating effects of visual appeal and taste perception compared to the 2-item left diagonal composition (iced tea in Studies 1 and 2), the 2-item horizontal composition (iced tea in Study 1), the 3-item horizontal composition

(cheeseburger in Study 1, iced tea in Study 1), and the upward-pointing triangle composition (iced tea in Study 1). This result supports prior studies indicating that people prefer oblique food arrangements particularly when the line ascends toward the right (e.g., Youssef et al., 2015). The design and photography literature also support this notion that diagonal lines are preferred over horizontal lines, as they provide feelings of dynamism, expectation and tension (Webb, 2010; Präkel, 2006).

Third, the present study provided evidence of crossmodal correspondences between vision and taste by suggesting serial mediating effects of visual appeal and taste perception on behavioral intention. This study focused on the neuroscientific evidence that food photos activate taste cortices in the brain, as the same neural patterns occur in actual eating (Simmons et al., 2005; Chen et al., 2016). This automatic mental simulation is related to the crossmodal correspondences between vision and taste based on grounded cognition (Barsalou, 2008; Spence, 2011). In general, the findings demonstrated that design principles effectively facilitate viewers' crossmodal correspondences when they are applied to the online platform settings. Therefore, the findings of this study advance the knowledge of visual information processing and sensory marketing by providing empirical evidence on the visual principles of repetition and compositional lines and a mechanism of multimodal correspondences.

## 5.2. Theoretical Implications

This study contributed to the diverse literature across visual aesthetics, multisensory food research, and hospitality marketing. The findings of this study extended knowledge of visual aesthetics by providing empirical evidence on the effects of repetition and compositional lines in

food imagery. Although an increasing body of research has explored visual elements in food contexts, there is lack of findings on visual design principles. The present study extended the limited scope of those studies to the broader concept of design principles that comprise those basic elements. For example, previous studies investigated the effects of different visual elements in food presentation, such as colors (e.g., Piqueras-Fiszman, Velasco, & Spence 2012; Velasco et al., 2014; Shermer & Levitan 2014), shapes (e.g., Velasco et al., 2016; Velasco et al., 2015), and visual arrangement on the plate (e.g., Michel et al., 2015, Woods et al., 2016). In addition, the existing literature has rarely investigated the effects of food styling that can be drawn from food-photography-related factors. In photography, the roles of repetition and composition can be explained by visual complexity and visual effectiveness in perceived visual aesthetics (Berlyne, 1971; Forsythe et al., 2011; Williams, 2004). However, there is lack of empirical studies on the effects of visual complexity and food photography in food marketing. Thus, the findings of this study added substantially to the understanding of visual effects of food in foodservice and hospitality marketing.

In addition, the findings of this study contribute to supporting a notion in the neuroscience literature that food photos activate taste cortices in the brain, as the same neural patterns occur in actual eating (Simmons et al., 2005; Chen et al., 2016). This automatic mental simulation based on grounded cognition (Barsalou, 2008) is related to the crossmodal correspondences between vision and taste (Hung, Styles, & Hsieh, 2017; Xie, Minton, & Kahle, 2016; Spence, 2011). More importantly, the findings of this study provide evidence that design principles effectively facilitate viewers' crossmodal correspondences. Although design principles have been utilized in the practical fields, little scholarly efforts have been made to examine the effects of visual design, particularly with regard to multisensory food research. Therefore, the

findings of this study provide insights to diverse disciplines with regard to multisensory food research by elucidating empirical evidence on the visual principles of repetition and compositional lines and a mechanism of multimodal correspondences.

## 5.3. Managerial Implications

The present research provides guidance for foodservice industry practitioners in planning and executing marketing strategies with their online food imagery. Today's food marketers recognize that visual content has become more important than ever, as consumers in the digital era are known to be visually stimulated (Petit, Velasco, & Spence, 2019; Spence et al., 2016; Schroeder, 2002). The findings of this study suggest that food marketers utilize multisensory strategies in visual content development and adopt visual design techniques. The results of this study verified that using menu photos with repetition of food items and a specific type of compositional line is more important than just using incidental menu photos. For example, food marketers and practitioners can strategically apply 2-item repetition when photographing menu items. More importantly, the findings of this study demonstrated the significance of menu photos for the restaurants' online and mobile businesses. Using the findings of this study as a guide, restauranteurs may take their own menu photos for their Instagram profiles and online ordering apps. By doing so, they can save money by not hiring a professional photographer or a graphic designer. Despite the advanced technology available to obtain high-quality digital photos from smartphone cameras, many small, independent restaurants neither promote their menu photos on Instagram nor apply their menu photos on food ordering platforms due to their limited budgets. This study can guide operators to recognize how easily they can generate more attractive menu

photos by using principles such as 2-item repetition or a right diagonal composition. Therefore, this study provides a tutorial for menu photos by educating restaurant operators on how to take and use menu photos for their websites, mobile apps, social networking services, and ordering platforms. Because visual enhancement in sensory experiences is likely to trigger emotional attachment to and awareness of a brand or company, subtle changes in visual stimuli result in powerful influences (Hilton, 2015).

**Limitations and Future Research**

This research clearly has limitations. First, although the researcher attempted to reduce potential confounding factors, such as color variations in an image, when developing the visual stimuli, it must be acknowledged that relevant limitations may still exist due to some confounding factors. For example, in the photo of iced tea, the shape of the glass might have interacted with the implied compositional lines. Second, this study revealed some inconsistent findings in the effects of compositional lines depending on the number of items displayed and the type of food.

Hence, the findings of this study might not be generalizable due to the limited experimental setting, and further investigation may be needed to justify the differences theoretically and empirically. Therefore, future studies are encouraged to further replicate these experiments within the same food categories in different circumstances, such as retail brochures, menu photos, and food photos on social media, to ensure external validity. Also, while this study tested the proposed research model in the context of different online settings, future studies might also consider other contextual factors. For example, one can order food when home alone or at an office; a family can order a meal to eat together; or one might order food for a special occasion or holiday. Because the ordering consumer may consider others who will be sharing the

meal, dining occasions involving ordering food can affect the choice of specific foods (Marshall, 1993). Therefore, it is recommended that future studies examine the effects of different dining occasions on consumers' perception and decision making in the proposed research model.

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# APPENDICES

# APPENDIX A

# IRB APPROVAL

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

Xmpt311 Revision Approval (w/o Provisos)

March 12, 2020

Jinha Lee,
UTK - Coll of Education, Hlth, & Human - Retail, Hospitality, and Tourism Mgmt

**Re: UTK IRB-18-04420-XM**
**Study Title:** Seeing is Tasting: Effects of Visual Design on Multisensory Food Experience in the Online Platforms

Dear Jinha Lee:
The UTK Institutional Review Board (IRB) reviewed your application for **revision** of your previously approved project, referenced above. The IRB determined that your revision application is eligible for expedited review under 45 CFR 46.110(b), and that your study remains eligible for **exempt** status. The following revisions to your project were approved as complying with proper consideration of the rights and welfare of human subjects:

> Change study title to: Seeing is Tasting: Effects of Visual Design on Multisensory Food Experience in the Online Platforms
> Application version 1.4

In the event that subjects are to be recruited using solicitation materials, such as brochures, posters, web-based advertisements, etc., these materials must receive prior approval of the IRB. Any alterations (revisions) in the research project must be submitted to and approved by the UTK Institutional Review Board prior to implementation of these revisions. In addition, you are responsible for reporting any unanticipated serious adverse events or other problems involving risks to subjects or others in the manner required by the local IRB policy.

Sincerely,

Colleen P. Gilrane

**Colleen P. Gilrane, Ph.D.**

Institutional Review Board | Office of Research & Engagement
1534 White Avenue Knoxville, TN 37996-1529
865-974-3466 865-974-7400 fax irb.utk.edu

BIG ORANGE. BIG IDEAS.

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

March 04, 2020

Jinha Lee,
UTK - Coll of Education, Hlth, & Human - Retail, Hospitality, and Tourism Mgmt

**Re: UTK IRB-18-04420-XM**
**Study Title:** Not "Less is more!" The effects of repetition of visual design elements in food ads on visual and taste perception

Dear Jinha Lee:

The UTK Institutional Review Board (IRB) reviewed your application for **revision** of your previously approved project, referenced above. The IRB determined that your revision application is eligible for expedited review under 45 CFR 46.110(b), and that your study remains eligible for **exempt** status. The following revisions to your project were approved as complying with proper consideration of the rights and welfare of human subjects:

- Change project type from Research Project to Dissertation
- Remove Sejin Ha as Key Study Personnel
- Change study contexts from simple food advertising to Instagram (study 1) and an online food ordering platform (study 2)
- Increase number of participants from 90 to 2100
- Add one manipulation variable was added for the dissertation-repetition and compositional lines
- Delete some previous measurement items
- Change participant population from students to online panels
- Add a pretest
- Increase the number of food photos a participant will see from one photo to three photos
- Updated informed consents to incorporate these changes
- Application version 1.3

- Informed Consent Statement for Study 2 - Version 1.0
- Informed Consent Statement for Study 1 - Version 1.0
- Informed Consent Statement for Pretest - Version 1.0
- Dissertation Questionnaire - Version 1.0

In the event that subjects are to be recruited using solicitation materials, such as brochures, posters, web-based advertisements, etc., these materials must receive prior approval of the IRB. Any alterations (revisions) in the research project must be submitted to and approved by the UTK Institutional Review Board prior to implementation of these revisions. In addition, you are responsible for reporting any unanticipated serious adverse events or other problems involving risks to subjects or others in the manner required by the local IRB policy.

Sincerely,

Colleen P. Gilrane

**Colleen P. Gilrane, Ph.D.**
**Chair**

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

April 04, 2018

Jinha Lee
UTK - Coll of Education, Hlth, & Human - Retail, Hospitality, and Tourism Mgmt

**Re: UTK IRB-18-04420-XM**
**Study Title:** Not " Less is more!" The effects of repetition of visual design elements in food ads on visual and taste perception

Dear Jinha Lee:

The Human Research Protections Program (HRPP) reviewed your application for the above referenced project and determined that your application is eligible for **exempt** review under 45 CFR 46.101, Category (2). Your application has been determined to comply with proper consideration for the rights and welfare of human subjects and the regulatory requirements for the protection of human subjects.

Therefore, this letter constitutes full approval of your application (version 1.1) as submitted, including:
Informed Consent_1.1 - Version 1.1
Recruitment_Script_Jinha_Lee - Version 1.0
Questionnaire_visual_Jinha - Version 1.0
The above listed documents have been dated and stamped IRB approved as of 4/4/2018.

Informed consent may be altered in accord with 45CFR46.116(d), with a consent cover statement used in lieu of a consent interview. The requirement to secure a signed consent form is waived under 45CFR46.117(c)(2).

In the event that volunteers are to be recruited using solicitation materials, such as brochures, posters, web-based advertisements, etc., these materials must receive prior approval of the IRB.

Any alterations (revisions) in the protocol [including any of the above listed documents stamped IRB approved] must be promptly submitted to and approved by the UTK Institutional Review Board prior to implementation of these revisions. You have individual responsibility for reporting to the Board in the event of unanticipated or serious adverse events and subject deaths.

Sincerely,

Colleen P. Gilrane

**Colleen P. Gilrane, Ph.D.**
**Chair**

Institutional Review Board | Office of Research & Engagement
1534 White AvenueKnoxville, TN 37996-1529
865-974-7697 865-974-7400 fax irb.utk.edu

BIG ORANGE. BIG IDEAS.

# APPENDIX B

## A Sample Questionnaire of Study 1

**INFORMED CONSENT**

Hello:

You are invited to participate in our survey on the restaurant menu images on Instagram. It will take approximately 2 minutes to complete the questionnaire. Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact the researcher, Jinha Lee at jlee194@vols.utk.edu. By starting this survey, you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this study.

---

**Instruction**

You will be viewing an Instagram post that show food offered in a restaurant. When you view the following Instagram post, please take sufficient time to feel the presented food.




Please rate how much you agree with the following statements (1: Strongly disagree, 7: Strongly agree).

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| The food looks aesthetically pleasing. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The food looks attractive. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The food is visually appealing. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |




Please answer the following question (1: Not at all, 7: Very much).

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| How tasty do you think this food would be? | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| How much do you think you would enjoy eating this food? | ○ | ○ | ○ | ○ | ○ | ○ | ○ |




Please answer the following questions (1: Not at all, 7: Very much).

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| I plan to share this food post. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| I intend to share this food post on Instagram. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |




Please answer the following questions (1: Very unlikely, 7: Very likely).

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| How likely would you be to purchase this food? | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

How many cheeseburger(s) did you see in this Instagram post?

- ○ One
- ○ Two
- ○ Three

What was the arrangement of the cheeseburger(s) in this Instagram post?

- ○ Horizontal
- ○ Vertical
- ○ Right diagonal (Diagonal line ascending to the right)
- ○ Left diagonal (Diagonal line ascending to the left)
- ○ Upward-pointing triangle (Inverse V shape)
- ○ Downward-pointing triangle (V shape)
- ○ Not applicable

**General Information**
The following questions will be used for description purposes only.

Gender

- ○ Male
- ○ Female
- ○ Prefer not to answer

Age

- ○ 18-29
- ○ 30-49
- ○ 50-64
- ○ 65 +

Ethnicity

- ○ African American
- ○ Native American
- ○ Hispanic
- ○ Caucasian/White
- ○ Asian or Pacific Islander
- ○ Other

Income

- ○ Less than $30,000
- ○ $30,000 - $49,999
- ○ $50,000 - $69,999
- ○ $70,000 - $89,999
- ○ $90,000 - $ 109,999
- ○ $110,000 - $129,999
- ○ $130,000 - $149,999
- ○ $150,000 +

# APPENDIX C

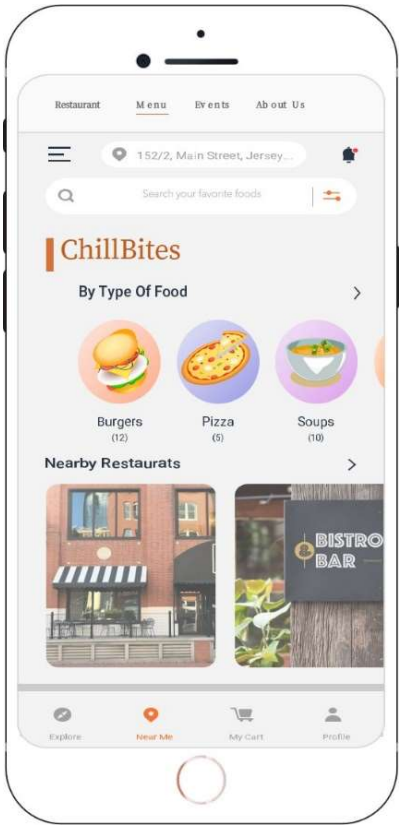
## A Sample Questionnaire of Study 2

**INFORMED CONSENT**

Hello:

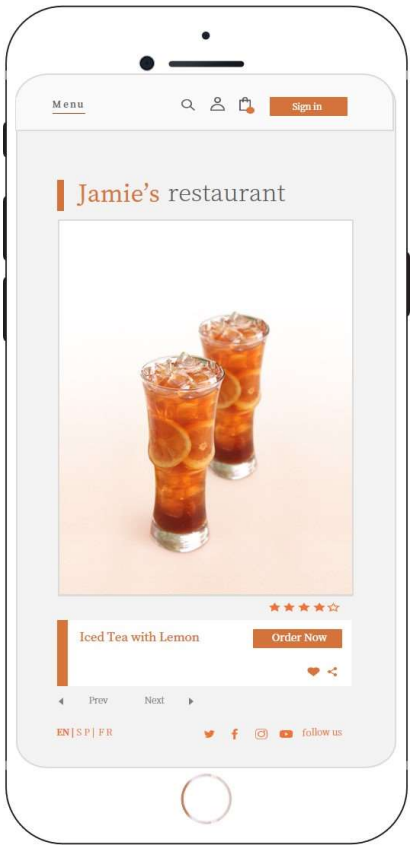
You are invited to participate in our survey on a restaurant menu image on an online food ordering platform. It will take approximately 3 minutes to complete the questionnaire. Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact the researcher, Jinha Lee at jlee194@vols.utk.edu. By starting this survey, you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this study.



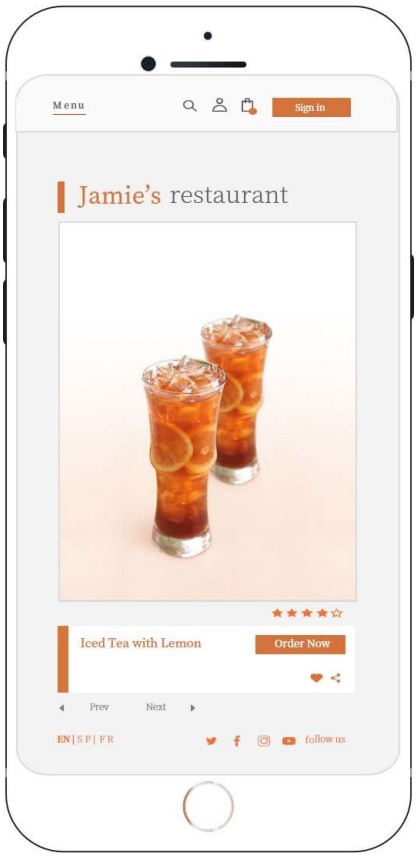

**Instruction**

Imagine that you are using a mobile food delivery app to order food and beverage at home. You're going to have them delivered to your home. The following screens will show you drinks presented in the app. Please take sufficient time to feel the food presented.



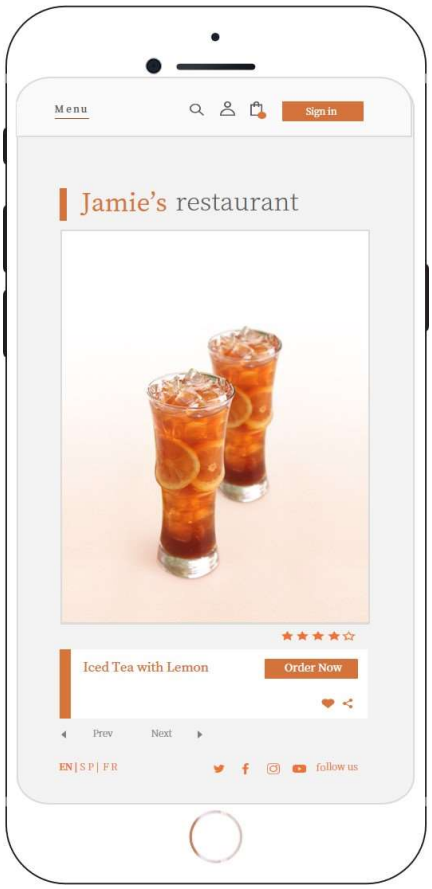

Please rate how much you agree with the following statements (1: Strongly disagree, 7: Strongly agree).

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| The beverage looks aesthetically pleasing. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The beverage looks attractive. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The beverage is visually appealing. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |




Please answer the following questions (1: Not at all, 7: Very much).

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| How tasty do you think this beverage would be? | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| How much do you think you would enjoy drinking this beverage? | ○ | ○ | ○ | ○ | ○ | ○ | ○ |




Please answer the following questions (1: Very unlikely, 7: Very likely).

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| How likely would you be to order this beverage? | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

How many glass(es) of iced tea did you see on this page?

- ○ One
- ○ Two
- ○ Three

What was the arrangement of the glass(es) of iced tea in this online food ordering app?

- ○ Horizontal
- ○ Vertical
- ○ Right diagonal (Diagonal line ascending to the right)
- ○ Left diagonal (Diagonal line ascending to the left)
- ○ Upward-pointing triangle (Inverse V shape)
- ○ Downward-pointing triangle (V shape)
- ○ Not applicable

**General Information**
The following questions will be used for description purposes only.

Gender

- ○ Male
- ○ Female
- ○ Prefer not to answer

Age

- ○ 18-29
- ○ 30-49
- ○ 50-64
- ○ 65 +

Ethnicity

- ○ African American
- ○ Native American
- ○ Hispanic
- ○ Caucasian/White
- ○ Asian or Pacific Islander
- ○ Other

Income

- ○ Less than $30,000
- ○ $30,000 - $49,999
- ○ $50,000 - $69,999
- ○ $70,000 - $89,999
- ○ $90,000 - $ 109,999
- ○ $110,000 - $129,999
- ○ $130,000 - $149,999
- ○ $150,000 +

# VITA

Jinha Lee was born in Seoul, the Republic of Korea. She earned her first PhD in Tourism Sciences at Kyonggi University in Korea in 2010 and is expected to complete her second doctorate in Retail, Hospitality, and Tourism Management at the University of Tennessee, Knoxville, with a minor in Statistics. Prior to transitioning to the US, she has taught undergraduate and graduate students in Korea for more than seven years. During her PhD program at the University of Tennessee, she has published articles in the *Journal of Hospitality Marketing & Management,* the *Journal of Quality Assurance in Hospitality & Tourism, International Hospitality Review,* and the *Journal of Hospitality & Tourism Administration*. She received the Best Paper Award at the Southeastern, Central, and South America Federation Conference in 2018. Her primary research interests relate to multisensory marketing strategies, consumer behavior in social media, and data analytics. In addition to her teaching and research career, she has participated in a variety of F&B business consultations in multi-cultural contexts and led multiple Korean government-funded educational projects, including one in Indonesia and another in Singapore. Starting in the Fall of 2020, she will be serving as an Assistant Professor of Business at Indiana Wesleyan University.