

# WHEN IS SEEING BELIEVING? MARKETPLACE DESIGNS' VISUAL INFLUENCE ON CONSUMER BEHAVIOR

by

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## ABSTRACT

Visual designs are increasingly utilized by consumers to make determinations about offerings in the marketplace, yet, the field's understanding of the role of visual design still needs further investigation. To address this, I examine the role of visual perception of marketplace designs through three essays. Essay 1 provides a conceptual framework and a systematic overview of the piecemeal visual perceptual research conducted in marketing to date. While past work has examined holistic perception and cognitive processing related to visual stimuli, my work exposes the components that comprise what consumers see in the marketplace, synthesizing findings while exposing pertinent areas under researched in marketing. Whereas consumers make determinations based off these components, consumers also process objects holistically. To capture the influence of holistic evaluations, I develop a diagnostic product design scale in Essay 2. This scale uncovers the dimensions that consumers holistically utilize in assessing goodness of marketplace designs, generating insights that allow for greater design success and better communication between marketers and designers in design development. Finally, in Essay 3, I examine how one of these piecemeal components can impact consumers' holistic perceptions. This essay demonstrates how the lighting directionality that visual

marketing stimuli (e.g. ads, packaging) feature can impact consumer perception of provision and elimination claims. Collectively, these essays provide a solid foundation for continued research into a surprisingly nascent area of marketing research.

INDEX WORDS:     holistic perception, design, packaging, piecemeal perception, product design, promotional materials, vision, marketing

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DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2019

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## DEDICATION

To my wife, Marie...per her request.

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## CHAPTER 1

### INTRODUCTION AND LITERATURE REVIEW

Design, within the context of product, advertisements, promotions, and shopping environments, is a pivotal driver of firm success (Eppinger and Ulrich 2015; Homburg, Scwemmle, and Kuehn 2015). Further, design influences both high- and low-level inferences that consumers make about brands (Rahinel and Nelson 2016). Yet, a disconnect exists between marketing and design, as there is no agreement as to what constitutes product design (Homburg et al. 2015) and aspects of design are often overlooked by marketers (Dahl 2011; Luchs and Swan 2011). For instance, numerous papers have utilized the term aesthetics interchangeably with design (Bloch, Brunel, and Arnold 2003; Orth and Malkewitz 2008), but to do so is a limited interpretation of design from how design is understood by designers, those creating products, places, and advertisements. Consequently, a greater connection between design and marketing would be beneficial to both marketing practitioners and researchers.

In addition to the importance of design, consumers are increasingly confronted with and relying upon visual information to make marketplace decisions about these designs, as evidenced by the proliferation and commercialization of Instagram, Pinterest, and other visually based platforms. Understanding visual perception is critically important for marketing managers and researchers, as the perception of products, places, promotions, and related objects is central to marketplace interactions (Krishna 2012). This need is further emphasized by the ever-growing utilization of imagery and visual assets in online marketing efforts (Kane and Pear 2016),



combined with consumers' increasing penchant for visual versus verbal information to comprehend and evaluate offerings in the marketplace (DeVecchio, Jae, and Ferguson 2018). Be it ads, products, packaging, retail environments, or other marketing-relevant visual stimuli, the baseline components that comprise these stimuli are ubiquitous and must be utilized strategically in this visually competitive marketplace. Yet, what are these visual components and their known effects on consumers? Though research abounds, no actionable meta-framework exists that provides this information, and marketing practitioners' and researchers' understanding of how these visuals impact consumer behavior is lagging.

Naturally, as consumers increasingly rely on visual images to make purchases through mobile technology (Luo et al. 2013; Verhoef et al. 2017; [www.census.gov](http://www.census.gov)), designs will be assessed through these visuals. Undoubtedly, marketers are interested in consumer reaction to design, but in understanding reactions to design, I argue that we should look to designers, their understanding of design, and the design process. Having a comprehension of how something is created can provide greater insight into understanding the subsequent reactions to this creation, rather than studying reactions to this creation in a stand-alone manner. Further, in looking at designs through the design process, marketing managers can better coordinate with designers in making needed adjustments to better meet customer needs.

Additionally, the designs of products, advertisements, promotions, and shopping environments are continually assessed through visuals. In prior years much information was gleaned from written or oral information, but as technologies have improved consumers are increasingly connected to better visual images in areas and ways by which they were not before (e.g., multiple viewing angles, videos, augmented reality, virtual reality). Thus, a better understanding of the implications of what comprises what is seen in the marketplace can greatly

inform. By increasing our understanding of visuals and applying an ample definition of design within the context of marketing research, actionable findings can be made available for marketing managers, researchers, and designers. Furthermore, greater success and sustainability of firm offerings can be achieved through a broader understanding that consumer behavior research can provide.

To begin to address this design and marketing disconnect as it relates to visual perception, I provide three essays examining different manners by which visuals influence consumers. Essay 1 culls together literature from several fields to expose what comprises the visuals of marketplace designs, allowing for more informed research and design efforts. Essay 2 develops a scale that provides insight into how consumers holistically evaluate marketplace designs, allowing for a more reliable manner to test designs. Essay 3 integrates the thinking of Essays 1 and 2 demonstrating how a visual component of marketplace designs can influence a holistic evaluation by a consumer. A more thorough overview of each of these essays is now provided.

Marketing research findings in the visual perception domain are scattered (Kahn 2017; Krishna 2012; Raghubir 2009). In particular, the field lacks a conceptual framework of the piecemeal visual components relevant to the places, products, promotions, and related objects seen in the marketplace, whereas a systematic literature review could aid researchers and practitioners in understanding and applying findings from this area. In Essay 1, I generate a conceptual framework based on research in marketing and related fields, outlining the five components of piecemeal perception: illuminance, shape, surface color, materiality, and location. Throughout this process, coherent definitions, accessible infographics, and understandings of visual perception are provided. A systematic review of piecemeal perception research within

marketing is subsequently conducted, revealing the collective takeaways and managerial relevance of each. Following, gaps are exposed that can be fruitfully explored in future research.

For Essay 2, design theorizing and marketing research are integrated to show that product designs have intrinsic (form and function) and extrinsic dimensions (solidity, usefulness, beauty, eco-consciousness, and uniqueness). The intrinsic dimensions encompass the most salient, inherent aspects of a design, those that are first noticed and evaluated by consumers, whereas the extrinsic dimensions are utilized by consumers to evaluate the potential benefits that a product could provide specifically to them after interacting with it. This research integrates design theory, expert designer input, consumer behavior perspectives, and well-established scale development procedures to develop a reliable and valid scale that measures consumer evaluations of these all-encompassing dimensions of product design. A rigorous consumer behavior perspective applied to a managerially relevant issue improves on past design scales resulting in superior diagnostic ability – revealing the dimensions of product designs that lead to positive or negative consumer response. This allows for appropriate managerial action and the ability to better communicate with designers. The substantial improvement that this scale represents is consistently demonstrated while providing considerable theoretical and practical contributions.

In Essay 3, I examine how one of the piecemeal components from Essay 1 can influence consumers' holistic evaluations. In this essay I investigate the influence of perceived lighting as featured on marketing stimuli (e.g. ads, packaging) on product preferences. Lighting directionality cues in product packaging and other promotional materials evoke spatiotemporal perceptions which interact with consumers' spatiotemporal predispositions associated to a product's provision or elimination properties. Specifically, a product that exhibits light coming

from above seems to be coming towards a consumer, while a product that exhibits light coming from below seems to be moving away. In the context of assessing products with provisional properties, consumers spatiotemporally envision an effective provider as coming towards them. Conversely, when evaluating products with eliminatory properties, consumers spatiotemporally anticipate an effective eliminating agent as moving away from them. Due to the associated spatiotemporal predisposition of consumers when encountering provision and elimination properties, consumers prefer products that feature light coming from above when these involve provision properties and coming from below when these involve elimination properties. These preferences extend to downstream consequences of purchase intentions and willingness to pay. Implications for this research are far-reaching as provision and elimination products and claims are abundant in the marketplace and consumers increasingly assess two-dimensional product images (e.g. online retailing and advertising).

Finally, in the conclusion, I summarize the primary findings from my three essays while better integrating the takeaways from each. In so doing, I also denote different avenues worth researching along this vein.

## CHAPTER 2

### ESSAY 1: A CONCEPTUAL FRAMEWORK AND REVIEW OF PIECEMEAL VISUAL PERCEPTION IN MARKETING CONTEXTS <sup>1</sup>

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<sup>1</sup> Sample, Kevin L., Henrik Hagtvedt, and S. Adam Brasel. Submitted to *Journal of the Academy of Marketing Science*, December 21, 2018.

## **Abstract**

Marketing research findings in the visual perception domain are scattered. In particular, the field lacks a conceptual framework of the piecemeal visual components relevant to the places, products, promotions, and related objects seen in the marketplace, whereas a systematic literature review could aid researchers and practitioners in understanding and applying findings from this area. In this manuscript, we generate a conceptual framework based on research in marketing and related fields, outlining the five components of piecemeal perception: illuminance, shape, surface color, materiality, and location. Throughout this process, coherent definitions, accessible infographics, and understandings of visual perception are provided. A systematic review of piecemeal perception research within marketing is subsequently conducted, revealing the collective takeaways and managerial relevance of each. Following, gaps are exposed that can be fruitfully explored in future research.

## **Introduction**

Understanding visual perception is critically important for marketing managers and researchers, as the perception of products, places, promotions, and related objects is central to marketplace interactions (Krishna 2012). This need is further emphasized by the ever-growing utilization of imagery and visual assets in online marketing efforts (Kane and Pear 2016), combined with consumers' increasing penchant for visual, over written, information to comprehend and evaluate offerings in the marketplace (DeVecchio, Jae, and Ferguson 2018). Though research abounds, no clear, actionable framework for marketers exists that provides an

understanding of the piecemeal components of visual perception. The current research seeks to develop such a conceptual framework, along with consistent definitions or relevant variables, while also providing a systematic literature review that illuminates managerially important effects and highlights numerous directions for future research.

Though several existing marketing reviews cover aspects of visual perception, they do not focus on the gaps that form the focus of the current work. For instance, prior reviews have focused on the influence of color (Labrecque, Patrick, and Milne 2013), on how online assortments are visually perceived (Kahn 2017), and on how visual perception relates to creativity (Zhu and Mehta 2017). Other reviews have considered visual stimuli as an aspect of sensory marketing, either in general (Krishna 2012) or regarding packaging in specific (Krishna, Cian, and Aydinoglu 2017). Additionally, an extant conceptual framework provides a high-level overview of the entirety of visual perception, including consumer processing of visual stimuli (Raghubir 2009), but it does not address the focus of the current work. Therefore, marketers need a unifying framework for understanding the piecemeal components of visual perception. Indeed, such a framework is especially useful for marketers and scholars, who can readily adjust these components, whether in the service of marketing strategy or research. Further, such a framework is generalizable across diverse products, brands, and related objects in the marketplace.

In this manuscript, we first generate a conceptual framework of the managerially relevant piecemeal components of visual perception, based on findings from the fields of perceptual psychology, engineering, graphic arts, architecture, and marketing. This process engenders several definitions to aid comprehension. In addition, we generate symbolic, graphic representations of these components and their facets to further aid in comprehension and application, especially for readers less familiar with the topic. (In so doing, we are also

implementing some of the findings that informed our research, including an increasing reliance on visuals; DelVecchio et al. 2018.) Next, a systematic review of marketing research provides synthesis and insight into the current state of the marketing literature on this topic, while bridging gaps and indicating managerially relevant implications and variables of interest. Finally, we discuss avenues for future research; whereas the marketing literature offers clear insights into certain piecemeal components and facets of visual perception (e.g., color's facets of hue and saturation), it is limited regarding others (e.g., illumination's facets of directionality and duration).

### **Visual Processing, Comprehension, and Piecemeal Perception**

Visual perception is a term used in both the marketing and perceptual psychology literature, but it is used inconsistently both within and across those literatures and is often applied to quite varied stages in vision, perception, cognition, and memory. To clarify the scope and boundaries of visual perception and help guide future research in this domain, we provide the following definition, which comprises most relevant research conducted to date: *Visual perception* is the processing and comprehension, via the eyes and the neural system, of holistic focal and non-focal stimuli, as comprised by their piecemeal components and as influenced by context and experience (Gibson 1950; Hoffman 1996; Kubovy and Pomerantz 2017; Peterson 2001; Rock 1983; Uttal 1981).

According to perceptual psychology research, people see focal stimuli in both a holistic manner (Ellis 2013; Koffka 2013) and by parts (Coren 2003; Sekuler and Blake 2002). Marketing research reinforces this dual perspective (Bloch 1995). As consumers process stimuli



within their perceptual field (the area of vision), they have a limited visual focus, which quickly moves between focal objects. The focal area of interest is termed the figure, and the non-focal context is termed the ground (Wagemans et al. 2012); these are constantly updated as attention shifts and mental representations are formed (Mace 1977; Rock 1983; Uttal 1981).<sup>2</sup> We provide a momentary snapshot of this process in figure 1.1.

Given our definition and understanding of perception, three distinct areas emerge that can be systematically studied by researchers: visual processing, visual comprehension, and piecemeal perception. *Visual processing* refers to the reception and automatic representation of stimuli in the brain. *Visual comprehension* refers to the categorizations and holistic evaluations that consumers make regarding perceived stimuli. Several review papers examine visual processing (e.g., as it relates to creativity: Zhu and Mehta 2017; in general: Krishna 2012; of online assortments: Kahn 2017) and visual comprehension (e.g., Gestalt perception: Wagemans et al. 2012; as related to sensory marketing and package design: Krishna et al. 2017). Furthermore, Raghurir's (2009) conceptual paper straddles both areas, providing an informative model of visual processing while explicating a taxonomy of the categorizations of visual stimuli. However, none has fully addressed *piecemeal perception*, that is, the physical components and facets of perceived stimuli. See table 1.1 for an overview of construct definitions.

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<sup>2</sup> Note that consumer context and experience can influence visual perception, although it is an almost instantaneous process. For instance, someone subjected to a surprise party recognizes friends and family members almost immediately, because perception is a proactive process seeking to provide an understanding of the world through interactions between the perceptual system and the neural influences of cognition and emotion (Gibson 1950; Kubovy and Pomerantz 2017; Sekuler and Blake 2002).

## **Motivation for the Current Research**

Researchers in marketing appear to increasingly recognize the importance of piecemeal perception, as indicated, for instance, by one review addressing the component of color (Labrecque et al. 2013). Still, researchers wanting to examine aspects of piecemeal perception would benefit from clear definitions, consistent terminology, a basic framework for understanding this domain, the identification of marketing-relevant visual components, and a systematic overview of what has been established and what remains to be investigated.

One benefit of studying piecemeal perception is that findings in this domain tend to influence consumers in ways that generalize across product categories. Further, a researcher can readily manipulate a piecemeal component's facet to study the effect on consumers, whereas a firm can easily adjust a facet in marketing efforts such as product designs or promotions (Deng and Kahn 2009; Pracejus, Olsen, and O'Guinn 2006). Thus, piecemeal perception research is especially useful for providing general, actionable insights for marketers and for discovering general, theoretical principles that are central to building theory and expanding current knowledge.

The rest of this document is structured as follows: First, we provide a conceptual framework for piecemeal perception with five marketing-relevant components and their associated facets. Next, we outline the procedure for our systematic review of the marketing literature and detail the findings from this review. Finally, we provide avenues for future research. Throughout, we generate tables and figures to make our review accessible to both marketers and researchers. Finally, we provide concluding remarks while reemphasizing the more promising future research directions.

## **Marketing-Relevant Components of Piecemeal Perception**

To lay the groundwork for our conceptual framework, we synthesized findings from perceptual psychology, engineering, graphic arts, architecture, and marketing literature. This synthesis revealed five marketing-relevant components of piecemeal perception: illuminance, shape, surface color, materiality, and location. Illuminance, shape, and either surface color or materiality are necessary for perception of an object (Gibson 1950; Rock 1983; Uttal 1981). These components allow perceivers to interpret and differentiate aspects within and between the figure and ground. Although location is not necessary for perception, this component is critically important, as our perceptual system is attuned to the location of objects in our perceptual field (Kubovy and Pomerantz 2017; Peterson 2001).

Other components and facets certainly exist, depending on research focus, but the components explored here provide a universal baseline with relevance across product category, retail, and usage scenarios. In addition, all five components and their facets can be readily manipulated by researchers and marketers. Table 1.2 provides the definitions of these components and their related facets.

The next sections expound these components and facets and illustrate marketing relevance. Where possible, we utilize marketing research to indicate this relevance, but for facets that have yet to be examined within a marketing context, we illustrate relevance with a limited selection of applied results from other literature. Thus, whereas our subsequent systematic review is all-inclusive (within our selection of marketing journals), the initial development of our conceptual framework relies on a selective mix of sources. In addition to providing definitions and discussing the relevance of each facet, the following sections provide symbolic, graphic

representations of each facet to facilitate understanding (as people are increasingly visually focused; DelVecchio et al. 2018). We now present each of the five components and their facets before conducting our literature review of the marketing research to date.

## **Illuminance**

We define *illuminance* as the amount of light perceived on an object. Without light, visual perception cannot occur (Lechner 2014; Sekuler and Blake 2002; Kubovy and Pomerantz 2017). Our review uncovered four facets that can be consistently applied to marketing contexts (e.g., retail, digital, product, environment, media): brightness, illuminance contrast, directionality, and illuminance color. Symbolic representations for each of these facets are provided in figure 1.2.

### ***Facets of Illuminance***

*Brightness.* Brightness refers to the number of lumens falling on a surface (Lechner 2014). Marketing researchers have examined brightness by manipulating ambient lighting in lab and field settings. Though ambient lighting is a holistic, environmental factor, its impact can be of a piecemeal nature. For instance, as brightness increases within a space, the light perceived on a figure of interest also increases. Collectively, the marketing research to date has demonstrated influences of brightness on consumer choice, as increased (decreased) levels of brightness lead to feelings of greater connection (disconnection) to surroundings and other consumers (Areni and Kim 1994; Biswas, Szocs, Chacko, and Wansink 2017; Huang, Dong, and Labroo 2018; Summers and Hebert 2001; Xu and Labroo 2014).

*Illuminance Contrast.* Illuminance contrast refers to differences in the perception of light over space and/or time. Spatially, different amounts of light can fall on various parts of the perceptual field, thereby creating contrasts within and between perceived objects. A common focus of perceptual psychology research has been on contrasts between figure and ground, giving rise to figure – ground separation (Regan and Beverley 1984) and influencing comprehension speed (Legge et al. 1990). Temporally, light can change over short or long intervals. Temporal fluctuation of light can be imperceptible or nonexistent in locations such as grocery stores, but quite evident in locations with erratic lighting, such as a dance venue. Perceptual psychologists have studied temporal contrasts in connection with dark/light adaptation and light constancy, as it impacts distal and proximal perceptions (Epstein 1977; Gilchrist 1988) and interactions with perception of color (Hamburger, Hansen, and Gegenfurtner 2007).

*Directionality.* We define directionality as the source of lighting in relation to the location of perception. Traditionally, most light was encountered from above (e.g., the sun), but technological innovations have allowed the generation of light from any direction within the perceptual field. This directionality of light can have a substantial impact on perception. For instance, perceptual psychologists have noted differential perceptions of shading produced by light from above versus below (Gibson 1950; Ramachandran 1988). Further, architectural research has relatedly shown that environmental “down-lighting” (vs. “up-lighting”) leads to greater consumer approach (Tural and Yener 2006).

*Illuminance Color.* The final facet of illuminance is illuminance color. Whereas surface color comprises hue, saturation, and value (Hagtvedt and Brasel 2017), illuminance color refers to the temperature and hue of perceived light in an environment or projected onto an object. Temperature refers to the coolness or warmth of perceived light and is measured in Kelvin

(Lechner 2014), whereas hue refers to the dominant wavelength, which allows for classification as red, yellow, blue, or any mixture of these (Beck 1972). These dimensions are not orthogonal; for example, one blue may be warmer or cooler than another blue, but both are cooler than red. For further clarification, illuminance color is differentiated from surface color (discussed in a later section) as illuminance color is additive while surface color is subtractive (Hagtvedt and Brasel 2017). For example, if an orange (or white) piece of clothing is under an orange light, it will appear white (or orange) because the orange light is adding that color back into the surface of the shirt. Research has revealed scattered findings regarding the influence of illuminance color of light on consumers, such as red (vs. blue) light being less likely to interfere with sleep (Gooley, Lu, Fischer, and Saper 2003). More generally, since surface color (see subsequent section) has substantial effects on behavior and attitudes, the same could be applicable for illuminance color.

## **Shape**

Our definition of *shape* is the perceived space occupied by an object in the perceptual field as comprised by the outer boundaries of that object (Ching 2014; Hoffman 1996; Peterson 2001). That is, shape allows for a distinction to be made between the figure and the ground—along with connotations derived from that shape. Our literature review revealed four pertinent facets of shape as it relates to marketing: dimensionality, unity, demarcation, and shape contrast. See figure 1.3 for symbolic representations of each of these facets.

## ***Facets of Shape***

*Dimensionality.* Dimensionality refers to an object's height, width, and/or length. To date, marketing researchers have examined dimensionality as it relates to consumer estimations between tall/thin and short/thick containers. Typically, tall/thin (vs. short/thick) presentations result in greater (vs. lesser) volume perceptions, provided haptics are not involved (Chandon and Ordabayeva 2009; Koo and Suk 2016; Krishna 2006; Raghubir and Krishna 1999; Szocs and Biswas 2016; Wansink and Van Ittersum 2003; Yang and Raghubir 2005). Additionally, consumer attitudes toward a food can influence estimates of portion sizes (Cornil et al. 2014).

*Unity.* Unity refers to an object's perceived cohesiveness as allowed by segmentation and occlusion (i.e., the blocking of view of some aspect of a perceived object; Kellman and Shipley 1991). Marketing researchers have examined unity with divergent foci, and collectively the findings suggest that perceived unity affects a variety of judgments. Judgments about preference, size and consumption, and brand personality differ based on greater (vs. lesser) unity, and sometimes these effects interact with influences from prior beliefs and categorizations (Hagtvedt 2011; Sevilla and Kahn 2014; Veryzer and Hutchinson 1998).

*Demarcation.* Demarcation refers to the outer boundary that contains the entirety of a perceived object. The demarcation of a figure can vary in smoothness, balance, and indication. Smoothness is a lack of or gradual variation in the outer boundary, balance refers to the symmetry of the outer boundary, and indication refers to a shape's implied meaning. A good example of indication is visual inertia; a shape may be presented or formed such that there is a perception of movement without actual motion taking place (e.g., a silhouette of a deer jumping; Ching 2014). Note that while indication may seem to be of a more cognitive nature, our cognitive and perceptual systems operate in parallel, with virtually no processing time required

to understand whether an illustrated deer is jumping or standing still. Marketing researchers have touched upon all these sub-facets of demarcation with explorations into indication (Cian, Krishna, and Elder 2014), balance (Bajaj and Bond 2018), smoothness (Jiang, Gorn, Galli, and Chattopadhyay 2016), and a combination of smoothness and balance (Romero and Craig 2017).

*Shape Contrast.* Shape contrast is the deviation of a perceived object from context or consumer experience. As for context, there may be varying levels of contrast between the figure and the surrounding stimuli that make up the ground. For example, one brand of conditioner in a retail store can contrast minimally with conditioners of the same brand (due to similar colors, shapes, and design used across brand lines), contrast more with conditioners by other brands, and contrast greatly with adjacent hairbrushes. Similarly, varying levels of contrast arise between a figure or ground and existing consumer expectations about how marketplace offerings should appear (c.f., prototypicality; Veryzer and Hutchinson 1998). Again, though this latter observation implicates consumer experience, we are considering the immediate recognition and reaction to the piecemeal visual components as informed by cognition. In sum, marketing research to date has approached shape contrasts from the perspective of matching consumers' mental categorizations of objects, including fonts (Folkes and Matta 2004; Huang and Kwong 2016; Landwehr, Labroo, and Herrmann 2011; Trudel and Argo 2013; Veryzer and Hutchinson 1998). Although marketing research has focused on shape contrasts from consumer expectations, perceptual psychology research has demonstrated the tendency for figures to "pop out" in visual searches (Maljkovic and Nakayama 1994; Nothdurft 1993; Wang, Cavanagh, and Green 1994), thus illustrating the importance of shape contrasts from contexts as well.



## Surface Color

In addition to illuminance and shape, any object within the perceptual field (i.e., the figure or part of the ground) must have a contrasting surface property that distinguishes it from other objects within the perceptual field for perception of that object to occur. This property can be either surface color or materiality. *Surface Color* is the hue, saturation, and lightness of the perceived exterior layer of an object within the perceptual field (Beck 1972; Labrecque, Patrick, and Milne 2013; Uttal 1981). As recommended by Hagtvedt and Brasel (2017), we use the term lightness instead of value to avoid confusion; value has other connotations in a marketing context. See figure 1.4 for a graphic guide to surface color.

### *Surface Color Facets*

*Hue.* Hue is the facet of a perceived color that allows for classification as red, yellow, blue, or any mixture of these (Beck 1972). Marketing research has examined the metaphorical identity of hues and their impact on behavior. Some of this research has focused on various hues (Bottomley and Doyle 2006; De Bock, Pandelaere, and Van Kenhove 2013), whereas some of it has focused on specific hues, such as blue (Gorn, Chattopadhyay, Sengupta, and Tripathi 2004), gold (Lee, Noble, and Biswas 2018), and red (Bagchi and Cheema 2013). Some work has also contrasted specific influences of specific hues (e.g., red vs. blue; Mehta and Zhu 2009).

*Saturation.* Saturation is the degree to which a perceived hue deviates from a gray of the same lightness (Beck 1972). Marketing researchers have examined somewhat saturated colors versus completely non-saturated colors, in other words, color versus black-and-white. The initial takeaways from earlier studies were that color is better than black-and-white for retail settings

(Bellizzi, Crowley, and Hasty 1983), products (Fernandez and Rosen 2000), and yellow pages advertisements (Sparkman Jr. and Austin 1980). However, the positive difference depends on the availability of adequate cognitive resources (Meyers-Levy and Peracchio 1995), and more recent research has demonstrated that color is not always the best option (Lee, Deng, Unnava, and Fujita 2014; Lee, Fujita, Deng, and Unnava 2017). Research on more nuanced differences than all-or-nothing has shown that saturation levels can alter perceptions of size (Hagtvedt and Brasel 2017) and healthiness (Mead and Richerson 2018).

*Lightness.* Lightness is a surface color's range from black to white. Marketing researchers have examined the consumption patterns of food based on lightness (Madzharov, Ramanathan, and Block 2016; Mai, Symmank, and Seeberg-Elverfeldt 2016). In addition, lightness research in marketing has investigated the demographic influences of gender (Semin and Palma 2014) and race (Kareklas, Brunel, and Coulter 2014).

*Combinations, Interactions, and Patterns.* Unlike the other facets in our review, marketing researchers have investigated various combinations, interactions, and patterns (as produced by changes in surface color) that arise from the facets of this component (e.g., Deng, Hui, and Hutchinson 2010; Labrecque and Milne 2012; Moore, Stammerjohan, and Coulter 2005). Although the range and complexity of such interactions complicates general interpretations, it may benefit marketers to consider potential marketplace implications.

## **Materiality**

The other contrasting surface property that can aid in perception is *materiality*: the visual texture and reactance of the exterior surface of an object as contained within the shape of that

object (Ching 2014; Gibson 1950; Hoffman 1996; Peterson 2001). Reactance refers to the amount of light absorbed, transmitted, and/or emitted by an object's surface via reflectance, opacity, and/or fluorescence (Lechner 2014; Sekuler and Blake 2002). Thus, visual texture, reflectance, opacity, and fluorescence are the four marketing-relevant facets of materiality as it relates to visual perception. See figure 1.5 for symbolic representations for these facets.

### ***Materiality Facets***

*Visual Texture.* For the purposes of this research, visual texture is defined as the apparent consistency of a perceived object's surface. Note that this definition differs from the typical tactile understanding of texture; it relates to visual instead of haptic perception, and it captures such constructs as haze, transmission, and light diffusion (Ching 2014; Lechner 2014). For instance, a tree and a photograph of a tree both have the same visual texture regardless of the actual feel of a tree being rough and the picture being smooth to the touch. Marketing researchers have examined visual texture in both a piecemeal fashion (Di Muro and Noseworthy 2012) and as it relates to processing (Zhu and Meyers-Levy 2009), noting the potential benefits or drawbacks that may arise from congruency between the visual textures of the figure and ground and consumer expectations.

*Reflectance.* For the purposes of this research, reflectance is an object's propensity to produce an image of the surrounding context on its surface, which interacts with the texture of the figure. Objects such as mirrors (high reflectance and smooth visual texture) and brass doorknobs (high reflectance and hazy visual texture) lie on one end of the reflectance continuum, while regular white copier paper (low reflectance and smooth visual texture) and sandpaper (low reflectance and jagged visual texture) lie on the other end. Marketing researchers have examined

why consumers prefer glossy surfaces to matte ones, with the underlying reason being the innate need for water (Meert, Pandelaere, and Patrick 2014). Additionally, perceptual psychologists have noted how background reflectance can shape perceptions of light on a figure (Warren and Poulton 1966), suggesting that interactions between this facet of materiality and those of illuminance are worthy of consideration.

*Opacity.* Opacity refers to the lack of transparency in an object's surface. For example, walls are typically opaque, while windows are not. Marketing researchers have demonstrated that transparent, as compared to opaque, packaging increases the salience and consumption of small foods (Deng and Srinivasan 2013). Relatedly, opaque (vs. transparent) packaging can cause products to be perceived as more pristine and consequently more valuable (Patrick, Atefi, and Hagtvedt 2017). Research outside the field of marketing has found that less (vs. more) opacity provides better health benefits for patients in healthcare facilities and offices (Fischl and Gärling 2004; Leather et al. 1998; Ulrich 1984).

*Fluorescence.* Fluorescence is the propensity of an object's surface to emit light through reflection or internal lighting. That is, whereas some materials produce their own light, others reflect a different wavelength than received such that the surface appears to glow (Lechner 2014). Fluorescence is typically constrained to this latter glowing effect, but we include objects that emit their own light through some form of electronics, as this is an important consideration for marketers. Consumers are increasingly engaged with products, such as mobile phones (Luo et al. 2013; Verhoef et al. 2017), that exhibit fluorescence, which can have psychophysical effects on variables such as sleep patterns (Chellappa et al. 2013; Hamblin and Wood 2002).

## **Location**

We define *location* as the positioning, orientation, spacing, and movement of an object in relation to other objects within an area (D'amelio 2004; Gibson 1950; Sekuler and Blake 2002; Uttal 1981). For example, a product can be located anywhere within an ad's boundaries or a retail outlet's display areas. Whereas a specific location is not necessary for perception to occur, this component can have substantial implications for perception. See figure 1.6 for symbolic representations of location's facets.

### ***Location Facets***

*Positioning.* Positioning refers to the placement of a figure within the ground or in relation to another object. Marketing researchers are increasingly investigating this area. Though the collective takeaways from this facet are scattered, positioning can have a substantial impact on consumer preferences (Chae and Hoegg 2013; Deng and Kahn 2009; Huang, Li, and Zhang 2013; Janiszewski 1990; Romero and Biswas 2016).

*Orientation.* Orientation refers to the angle of perception of an object (e.g., above, below, the side, or close-up vs. far away). Research in marketing on this topic spans from visual stimuli appearing closer or further away (Pillai, Katsikeas, and Presi 2012; Pracejus, O'Guinn, and Olsen 2013) to the orientation of visual stimuli while keeping size constant (Leonhardt, Catlin, and Pirouz 2015; Salgado-Montejo et al. 2015; van Rompay, de Vries, Bontekoe, and Tanja-Dijkstra 2012) to the consumer's angle of perception (Szocs and Lefebvre 2017). Generally, varying the orientation of a stimulus tends to influence a variety of attitudes and beliefs.

*Spacing.* Spacing is defined as the distance between an intended focal object and additional information. Research in marketing has noted the benefit of proximity in conveying effectiveness (Chae, Li, and Zhu 2013) but also the drawbacks to having focal objects too closely spaced (Coulter and Norberg 2009; Sevilla and Townsend 2016). In addition, work focused less clearly on piecemeal perception has noted the importance of environmental spacing for ceiling location (Meyers-Levy and Zhu 2007) and aisle width (Levav and Zhu 2009).

*Movement.* Movement is defined as a change in an object's location (i.e., positioning, orientation, or spacing). This change can be accomplished via directional translation (e.g., up, down, left, right), in relation to the consumer (e.g., closer or further away), by rotation, or by any combination of these. Given humans' hardwired propensity to perceive and anticipate movement (Mace 1977; Rock 1983; Uttal 1981), this facet is perhaps most obviously useful to attract attention. Marketing researchers have examined influences stemming from static versus moving figures (Park, Lennon, and Stoel 2005; Roggeveen, Grewal, Townsend, and Krishnan 2015) and from movements in specific directions (Brasel and Hagtvædt 2016; Guido, Pichierri, Natarajan, and Pino 2016; Kim and Lakshmanan 2015).

## **Systematic Review**

Our systematic review of piecemeal visual perception comprised 19 high-quality marketing and marketing-related journals (table 1.3) over, approximately, the last half century (1970 – 2018). We focused on articles that explored piecemeal visual components as they related to visual perception, and we conducted additional EBSCOhost and Google Scholar searches with

pertinent terms to ensure comprehensiveness. Relevant articles were then categorized according to our conceptual framework.

Numerous articles that initially appeared related to piecemeal perception were excluded from our review; only articles specifically focused on the act of visually perceiving piecemeal components were included. For example, we excluded articles dealing with store or brand image as an abstract concept, the back-end cognitive effects of vision, visual processing, or studies using visual imagery only as a prime or manipulation. Further, numerous papers utilize the word perception to mean beliefs or purely cognitive functioning; these do not fit the current focus. Notably, whereas the development of our conceptual framework included a smattering of marketing-relevant articles from other fields, our systematic review included only marketing literature (72 articles in total).

### ***General Findings***

Our review revealed that findings regarding the perception of piecemeal visual components fall into one of four categories, three of which pertain to assumptions and one that pertains to congruence. Assumptions refer to the conjectures that consumers make about a focal object, guided by input from its piecemeal components. In contrast, congruence refers to how well a piecemeal component matches a consumer's expectations. We briefly outline these insights in the paragraphs below. Further, in the associated tables, we provide summaries of each paper, organized first by these four findings categories and subsequently by the focal piecemeal component and facet categories, while also noting the primary dependent variable.

## ***Assumptions***

The marketing literature illuminates three kinds of assumptions that consumers make about focal objects based on the perceived piecemeal components: assumptions of interest (e.g., “I should pick that up”), physical composition (e.g., “That’s too big for me”), and traits (e.g., “That brand seems innovative”).

*Assumptions of Interest.* Fourteen marketing articles have specifically examined the effect that piecemeal visual components have on consumer evaluations of a focal object’s interestingness. While most of these articles (see table 1.4) have investigated the implications of color (Lee et al. 2014; Buechel and Townsend 2018), other work has focused on the role of illuminance (Areni and Kim 1994; Summers and Hebert 2001), shape (Raghubir and Greenleaf 2006), and materiality (Meert et al. 2014). The findings suggest that firms can attract consumer attention and interest toward focal objects by manipulating piecemeal facets, which carries implications for consumer preferences (Lee et al. 2014; Meert et al. 2014), engagement (Summers and Hebert 2001), and purchase activity (Park, Lennon, and Stoel 2005).

*Assumptions of Physical Composition.* Fifteen marketing articles (see table 1.5) have examined assumptions of physical composition. These assumptions are directly related to a focal object’s piecemeal components. Most research within this domain has focused on the perceived containing capacity of focal objects, that is, the volume an object can potentially hold (Folkes and Matta 2004; Ordabayeva and Chandon 2013), which also influences the amounts that people consume (Deng and Srinivasan 2013; Wansink and Van Ittersum 2003). Further, consumers make physical assessments of weight (Deng and Kahn 2009), size (Hagtvedt and Brasel 2017), and health (Mead and Richerson 2018) based on facets such as locational positioning or color saturation. Whereas shape appears to have the most decisive influence on assumptions of



physical composition, the relatively recent findings for location, materiality, and color suggest a potentially broad role for other components, too.

*Assumptions of Traits.* Twenty-one marketing articles have investigated the assumptions that consumers make regarding focal objects' traits, such as brand personalities or other characteristics not part of the exterior physical composition. Research has documented extended influences of such traits (Chae et al. 2013; Hagtvædt 2011; Pracejus, O'Guinn, and Olsen 2013), including spending behavior (Di Muro and Noseworthy 2012; Lee, Noble, and Biswas 2018), preferences (Sevilla and Townsend 2016; De Bock, Pandelaere, and Van Kenhove 2013), and purchase activities (Babin, Hardesty, and Suter 2003; Coulter and Norber 2009). Trait assumptions are not restricted to a single or specific piecemeal component; all but illuminance have been investigated thus far. See table 1.6 for the associated marketing articles that examine trait assumptions.

### ***Congruence***

In contrast to assumptions made about a focal object, congruence refers to how piecemeal components meet consumer expectations. Twenty-two marketing articles examine congruence (see table 1.7). The findings from these articles align with fluency literature (Bornstein 1989; Oppenheimer 2008), with greater congruence favorably influencing preferences (Brasel and Hagtvædt 2016; Romero and Biswas 2016), attitudes (Chae and Hoegg 2013), and purchase activity (Landwehr, Labroo, and Herrmann). However, researchers and marketers should be aware that congruence with consumer expectations does not always have positive outcomes. For instance, red hue carries a metaphorical identity of aggression, leading consumers exposed to this hue to be more aggressive (Bagchi and Cheema 2013). That is, their affect becomes congruent

with the available hue, leading, in this example, to negative social behavior. To date, all piecemeal components, except materiality, have been examined from a vantage of congruence.

### **Questions for Future Research**

Considering our conceptual framework and the primary insights and takeaways from our review, it becomes apparent that avenues for piecemeal perception research abound. Whereas we organized the findings from our literature review into four categories of consumer assumptions and congruence, we provide future research suggestions organized by the piecemeal components of perception as developed from our conceptual framework. At the beginning of each section, we also briefly reiterate general observations from our review for these components. This approach facilitates a clear and systematic presentation of the literature and future research avenues, as most researchers investigate phenomena by domain rather than outcome. (It should also be noted that there is much scope to investigate interactions between the piecemeal facets of perception, related to work on crossmodal interactions; Calvert, Spence, and Stein 2004).

#### ***Illuminance Future Research***

Research on illuminance, with its four facets of brightness, illuminance contrast, directionality, and illuminance color, has explored how the amount of light perceived by a customer can affect psychological outcomes such as beliefs and connections with others and the environment. Marketing researchers investigating illuminance have thus far primarily focused on brightness (but see Babin et al. (2003) for illuminance color). However, every facet of illuminance appears to be fertile ground for research, with much scope to investigate illuminance

contrast, directionality, and illuminance color. For instance, much of the architecture, engineering, and health care literature focuses on daylight in contrast to artificial lighting. Future work in marketing may find related differences; responses to retail displays may depend on lighting and time of day, and perhaps certain products or product attributes are better presented in daylight or in the artificial lighting that dominates at night. The growing field of work on crossmodal correspondences might, for example, establish a theoretically-driven link between light temperature in a retail environment and brand associations. Patterns and frequencies in luminance fluctuations might generate sympathetic rhythms that could guide attention or affect biometric responses directly. Further, illuminance color and lightness constancy have been extensively studied in psychology, yet untouched in the marketing literature. Constancy refers to the ability to accurately estimate a certain color (color constancy) or shading (lightness constancy) relative to other colors in bright or dim light (Epstein 1977; Gilchrist 1988; Sekuler and Blake 2002). These facets may also interact with each other or with other piecemeal perception components and facets. For example, illuminance's interaction with surface color or materiality enables the separation of the figure and ground, a process in which edge detection is central. Such interactions are among the many aspects of illuminance that feature prominently in the marketplace and influence perception and behavior.

### ***Shape Future Research***

Research on shape, comprising dimensionality, unity, demarcation, and shape contrast, has revealed impacts on volume estimations and categorization matching, whereas observations about these influences should also take consumer demographics into consideration. Marketing research has explored many aspects of shape, from product to branding to retail contexts and size

considerations, but the limited number of articles directly related to piecemeal perception leave numerous avenues for future research. For instance, shape contrast is an important aspect of product evaluation, but has primarily been explored from a perspective of consumer expectations. Less work has investigated shape contrasts with context or neighboring products (Patrick and Hagtvedt 2011). Whereas most prior work has focused on product-exemplar shape contrasts, future research may explore shape contrasts between figure and ground. Regarding demarcation, future work could increase the understanding of how shape perceptions influence consumer responses to product ergonomics. As more shopping and product search takes place on digital screens, the visual component of shape perceptions may become even more important than haptic evaluations of shape when considering ergonomics. Evidence points to consumers physically anticipating how they might interact with a product (Elder and Krishna 2012), yet what evaluations are made from visual depictions of more ergonomically satisfying products? Product size perceptions can differ across consumers based on the related size claim (Aydinoğlu and Krishna 2011); does a similar effect extend to shape perceptions? As an example of potential interactions between components of piecemeal perception, cool versus warm or bright versus dim light could moderate the influence of a product's shape on consumer evaluations and purchase intentions.

### ***Surface Color Future Research***

Surface color, with its three facets of hue, saturation, and lightness, is increasingly becoming a common area of visual research in marketing—for instance, much work has focused on metaphorical matching of colors and attitudes—, and a great deal of work remains to be done. Numerous books are dedicated to understanding color, but most of this understanding is based on

intuition, conjecture, and anecdotal evidence. For example, different hues appear to have specific metaphorical meanings, which may or may not vary between cultures, but many of these relationships remain to be rigorously examined. From a practical standpoint, color has unique advantages among the visual components explored here. It is the component perhaps most easily manipulated by the firm, and can apply to numerous marketing contexts, including both products and marketing activities, and both physical and digital formats. Whereas hue has traditionally received more attention than saturation and lightness in the marketing literature, the latter two facets have increasingly become a research focus, and future research may do more to explore interactive influences of all three facets as well. For example, are there other ways in which black-and-white is preferred over color, and if so, does this preference depend on specific hues? Relatedly, does the greater demonstrated preference for white (vs. black; Kareklas et al. 2014) influence perceptions and preferences of black-and-white promotions? Further, whereas prior work has focused on, for instance, the influence of saturation on size perceptions and the influence of lightness on weight perceptions, future work might uncover similar effects, perhaps including interactions with hue. Each of the surface color facets might also interact with illuminance or shape, especially as they relate to constancy and edge detection.

### ***Materiality Future Research***

Materiality, encompassing the facets of visual texture, reflectance, opacity, and fluorescence, represents ripe ground for future exploration, and its scope of influence is changing and expanding as consumers view numerous potential purchases via digital screens without physically handling the product. As with illuminance, scant research has investigated materiality, despite it being a crucially important component of piecemeal perception. For instance, with an

increasing abundance of new materials available to manufacturers and consumers, future work may uncover a variety of effects stemming from visual textures. Further, various levels of opacity and fluorescence are abundant in the marketplace, including products, promotions, and retail outlets, yet researchers have paid little attention to these variables. In addition to general phenomena, future work might explore reasons for—and the impact of—cyclical trends in opacity and reflectance. For example, the introduction of translucent iMacs created a wave of imitations in other fields, and the mid-1990s saw a rush of transparent beverages from Crystal Pepsi to Miller Clear Beer. There may be an association between transparency and purity (although packaging transparency can have the opposite effect; Patrick et al. 2017), or with opacity and permanence; these and similar questions remain to be scrutinized by researchers. Technological advances have also facilitated packaging with opaque sections and transparent windows to the product inside, yet little work has explored combinations of this kind. Reflectance may be cyclical as well; matte-finish paint jobs on cars have begun to penetrate the super-luxury market, and a move from magnesium or titanium bodies to glass-backs has shifted the general reflectance level of smartphones. How do customers come to associate varying levels of reflectance with brand or attribute associations? Are such associations driven by the actions of a category leader, or are there fundamental crossmodal correspondences that are category-independent? Further, ever-more products are emitting some type of light in one form or another. Modern laptops glow not only from their screen, but also from their keyboards, notification LEDs, and illuminated brand logos. In this age of connectivity, how do these products emanating light alter consumer behavior? Even though consumers are increasingly engaged with fluorescent products, the current lack of marketing research on fluorescence leaves much to be investigated.

### ***Location Future Research***

Research on location, with its facets of positioning, orientation, spacing, and movement, has uncovered effects ranging from weight estimates to brand attitudes. However, our review indicated that most of this research has been limited to two-dimensional promotions such as print/screen advertisements or packaging. As more opportunities for virtual reality and other consumer interactions in a three-dimensional space arise, there will be more avenues to investigate regarding positioning, orientation, and spacing. To some extent, even research in real three-dimensional space has focused on two-dimensional effects. For instance, although Sevilla and Townsend (2016) examined product spacing in field settings, the spacing was adjusted in a two-dimensional manner. Although Meyers-Levy and Zhu (2007) and Levav and Zhu (2009) investigated a three-dimensional space, their work focused more on visual processing than piecemeal perception. Future work might expand the investigations to include spacing along the other spatial axes (i.e., up vs. down, or farther back vs. closer to the front), as well as other issues. The z-plane has remained largely unexplored in consumer vision and need not be limited to product or retail environment perception. Interface design trends such as Material Design and Superflat suggest that levels of (or lack of) depth may influence consumer processing of real or implied three-dimensional scenarios, including those presented on flat screens. Relatedly, given the observation that consumers prefer a brand presented as a friend at the midline and as a leader above the midline (Huang et al. 2013), perhaps other aspects of brands or consumers (e.g., personality traits) interact with positioning. Given that products are increasingly shown with several different orientations, the question also arises whether certain orientations are better than others (as initially explored in a visual processing context by Meyers-Levy and Peracchio 1992), and whether static presentations are better than dynamic ones in which positioning shifts over

time (such as an auto-rotating product image on a website). Further, since consumers' perception is attuned to movement and marketers are increasingly engaging consumers through animations, a better understanding of the facet of movement is needed. Does a logo that fades in quickly, but remains on screen for an extended duration, tell the consumer something about the brand or product? What other interactions may arise between movement and other facets of location or the other components of piecemeal perception? Logos and other promotional materials can be manipulated in many ways, especially as digital screens have become the primary marketing medium, and scholarly investigations are lagging developments in the marketplace.

### **General Discussion**

A wealth of research on the role of visual perception of products, retail environments, packaging, and advertising is showcased in the major marketing and applied journals from the past five decades. While there has been much research on visual processing and comprehension, piecemeal perception has received sporadic but increasing attention. This latter area of research formed the focus of the current work. We began by assembling a conceptual framework of marketing-relevant components and facets of piecemeal perception, based on existing research from fields such as perceptual psychology, engineering, graphic arts, architecture, and marketing. In addition to synthesizing the research from these fields develop our conceptual framework, we also created symbolic representations to visually illustrate the various components and facets, in keeping with an increasingly visually focused society (DelVecchio et al. 2018; Kane and Pear 2016). In addition, we sorted the insights from piecemeal perception research within marketing (72 papers) into four categories, thereby systematizing extant findings in this domain. Further,



we supplemented our review with easily referenced tables that also include pertinent information not discussed in the main text. The piecemeal perception work to date may seem like a bewildering cornucopia of diverse findings, but we believe the structure presented in this article both enables a clearer overview of prior work and identifies numerous gaps and opportunities for future research.

Our conceptual framework emphasizes five marketing-relevant components: illuminance, shape, surface color, materiality, and location. These five components comprise 19 facets that can be readily investigated by researchers and manipulated by marketers for contexts such as packaging, products, promotions, and places of business. We provided support for each of these facets with research from marketing when available; when this was not available, we relied on research from other fields. Perhaps future researchers will add, subtract, or modify specific facets, or even entire components; as with most research, the current framework remains a work in progress.

Our systematic review of 19 high-quality marketing and marketing-related journals over almost 50 years included every publication focused on piecemeal visual perception. The theoretical insights generated from this review illuminated four main ways in which piecemeal perception influences consumers: assumptions of interest, assumptions of physical composition, assumptions of traits, and congruence with expectations. The three assumption categories arise when consumers make assumptions based on the piecemeal facets they see. The congruence category reflects a more internally driven process, whereby consumers map expectations onto piecemeal facets, with a good match typically leading to positive marketplace outcomes. Summaries of this prior work broken down by these four categories, the components and facet of interest, and the primary consequences are provided in accessible tables.

Thus far, research has clustered around certain facets and not around others. Part of the reason for this may be the perceived importance of certain components and facets. For example, shape and surface color represent ubiquitous, salient perceptual inputs that appear to have a strong influence on consumers across many contexts. However, it is also possible that researchers have simply overlooked some less obvious but equally potent sources of influence. For example, illuminance and materiality may subtly influence viewers in ways that researchers are less prone to consider. It is also possible that some components or facets are particularly difficult to investigate; perhaps movement falls into this category, with manipulations and measurements of movement requiring technologies that, although present in the marketplace, are not prevalent in academic research labs. The difficulty to research may also explain why researchers have yet to substantially investigate interactions between facets from varying components (e.g., hue and demarcation).

Related observations may be made about dependent variables. For example, product evaluation, brand attitudes, or brand personality characteristics are managerially important and relatively easy to measure, whereas variables such as attention and neural firing patterns may require technologies such as eye trackers or brain-scanning equipment. The field of marketing benefits from triangulation and the utilization of multiple methods at multiple levels of inquiry.

In addition to investigating the numerous gaps suggested by the current work, future work may consider phenomena at the intersection of piecemeal perception and visual comprehension, as well as the role of visual processing in such effects. For example, when consumers contemplate visual art, product design, or any stimulus within the broader realm of aesthetics, the piecemeal components and facets described in the current work come together to form a holistic impact. The same is true within the even broader realm of sensory marketing.

Future work may deconstruct such holistic impacts and identify individual and interactive influences stemming from components, or it may deepen the current understanding of the role and nature of processing at various levels of piecemeal perception versus visual comprehension. For example, consumers process an online ad holistically, but they also process the individual components and facets that comprise its overall appearance. Numerous factors may play a role in determining which form of processing takes precedence, how this processing evolves, and what the outcomes might be. As with many areas of inquiry, the more researchers increase the current knowledge of piecemeal perception, the more it becomes clear how much there is yet to learn.

## TABLES

**Table 1.1**

| <b>Definitions of Primary Visual Perception Constructs</b> |                                                                                                                                                                                                       |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Construct</b>                                           | <b>Definition</b>                                                                                                                                                                                     |
| Visual Perception                                          | The processing and comprehension, via the eyes and the neural system, of holistic focal and non-focal stimuli, as comprised by their piecemeal components and as influenced by context and experience |
| Figure                                                     | The focal area of interest                                                                                                                                                                            |
| Ground                                                     | The non-focal context in which a figure is located                                                                                                                                                    |
| Perceptual Field                                           | The area of vision                                                                                                                                                                                    |
| Visual Processing                                          | The reception of and automatic representation of stimuli in the brain                                                                                                                                 |
| Visual Comprehension                                       | The categorizations and holistic evaluations that consumers make regarding perceived stimuli                                                                                                          |
| Piecemeal Perception                                       | The physical components and facets of perceived stimuli                                                                                                                                               |

**Table 1.2**

| <b>Definitions of Piecemeal Perception's Components and Associated Facets</b> |                                                                                                                       |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <b>Construct</b>                                                              | <b>Definition</b>                                                                                                     |
| Illuminance                                                                   | The amount of light perceived on an object                                                                            |
| Brightness                                                                    | The amount of lumens falling on a surface                                                                             |
| Illuminance Contrast                                                          | The differences that occur in the perception of light over space and/or time                                          |
| Directionality                                                                | The source of lighting in relation to the location of perception                                                      |
| Illuminance Color                                                             | The temperature and hue of perceived light in an environment or projected onto an object                              |
| Shape                                                                         | The perceived space occupied by an object in the perceptual field as comprised by the outer boundaries of that object |
| Dimensionality                                                                | An object's height, width, and/or length                                                                              |
| Unity                                                                         | An object's perceived cohesiveness as allowed by segmentation and occlusion                                           |
| Demarcation                                                                   | The outer boundary that contains the entirety of a perceived object                                                   |
| Shape Contrast                                                                | The deviation of a perceived object from context or consumer experience                                               |
| Surface Color                                                                 | The hue, saturation, and lightness of the perceived exterior layer of an object within the perceptual field           |
| Hue                                                                           | The facet of a perceived color that allows for classification as red, yellow, blue, or any mixture of these           |
| Saturation                                                                    | The degree of deviation of a perceived hue from a gray of the same lightness                                          |
| Lightness                                                                     | A surface color's range from black to white                                                                           |
| Materiality                                                                   | The visual texture and reactance of the exterior surface of an object as contained within the shape of that object    |
| Visual Texture                                                                | The apparent consistency of a perceived object's surface                                                              |
| Reflectance                                                                   | An object's propensity to produce an image of the surrounding context on its surface                                  |
| Opacity                                                                       | The lack of transparency in an object's surface                                                                       |
| Fluorescence                                                                  | The propensity of an object's surface to emit light through reflection or internal lighting                           |
| Location                                                                      | The positioning, orientation, spacing, and movement of an object in relation to other objects within an area          |
| Positioning                                                                   | The placement of a figure within the ground or in relation to another object                                          |
| Orientation                                                                   | The angle of perception of an object                                                                                  |
| Spacing                                                                       | The distance between an intended focal object and additional information                                              |
| Movement                                                                      | A change in the location of an object                                                                                 |

**Table 1.3**

| <b>Sources Reviewed (1970 - early 2018)*</b>   |                                                 |
|------------------------------------------------|-------------------------------------------------|
| International Journal of Research in Marketing | Journal of Service Research                     |
| Journal of Advertising                         | Journal of the Academy of Marketing Science     |
| Journal of Advertising Research                | Journal of the Association of Consumer Research |
| Journal of Business Research                   | Management Science                              |
| Journal of Consumer Psychology                 | Marketing Letters                               |
| Journal of Consumer Research                   | Marketing Science                               |
| Journal of Marketing                           | Marketing Theory                                |
| Journal of Marketing Research                  | Psychology and Marketing                        |
| Journal of Public Policy and Marketing         | Quantitative Marketing and Economics            |
| Journal of Retailing                           |                                                 |

\* - all journals with a start date after 1970 were reviewed from their first issue

**Table 1.4**

| Assumptions of a Focal Object's Interestingness |              |                                   |      |                                                                                                                                                                                          |                                  |
|-------------------------------------------------|--------------|-----------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Component                                       | Facet        | Authors                           | Year | Key Findings                                                                                                                                                                             | Consequence                      |
| Illuminance                                     | Brightness   | Areni and Kim                     | 1994 | Brighter lighting leads to more consumer engagement with displayed products                                                                                                              | Engagement                       |
| Illuminance                                     | Brightness   | Summers and Hebert                | 2001 | Additional lighting on a display increases consumer engagement with products within that display                                                                                         | Engagement                       |
| Shape                                           | Demarcation  | Raghubir and Greenleaf            | 2006 | Ratios of rectangles can shape consumer preferences and purchase intentions                                                                                                              | Preference and Purchase Activity |
| Surface Color                                   | Saturation   | Sparkman Jr. and Austin           | 1980 | The use of a single color in a print advertisement results in higher sales than a black-and-white advertisement                                                                          | Purchase Activity                |
| Surface Color                                   | Saturation   | Bellizzi, Crowley, and Hasty      | 1983 | Color attracts shoppers more so than black-and-white                                                                                                                                     | Attraction                       |
| Surface Color                                   | Saturation   | Fernandez and Rosen               | 2000 | Color over black-and-white increases firm considerations, but product-enhancing colors lead to greater likelihood of consumer engagement with a firm                                     | Engagement                       |
| Surface Color                                   | Saturation   | Lee, Deng, Unnava, and Fujita     | 2014 | Consumers emphasize primary product features when confronted with a black-and-white image, but they emphasize secondary product features more when confronted with a color image         | Preference                       |
| Surface Color                                   | Lightness    | Kareklas, Brunel, and Coulter     | 2014 | White products and advertisements are preferred over black versions of these no matter a consumer's race                                                                                 | Preference                       |
| Surface Color                                   | Lightness    | Semin and Palma                   | 2014 | Male consumers prefer products containing lower levels of lightness, whereas females prefer higher levels of lightness                                                                   | Preference                       |
| Surface Color                                   | Combinations | Gorn, Chattopadhyay, Yi, and Dahl | 1997 | Higher levels of value, also understood as lightness, and saturation lead to greater liking for advertisements                                                                           | Liking                           |
| Surface Color                                   | Combinations | Jalali and Papatla                | 2016 | Photos containing higher levels of green and lower levels of cyan and red and higher saturation of red and blue receive higher click-rates in online visual user generated content (UGC) | Preference                       |
| Surface Color                                   | Combinations | Buechel and Townsend              | 2018 | Consumers prefer intense patterns and colors, but erroneously conclude that they will satiate quicker with these patterns and colors over more tame patterns and colors                  | Preference                       |
| Materiality                                     | Reflectance  | Meert, Pandelaere, and Patrick    | 2014 | Consumers prefer glossy over matte surfaces due to an innate desire for water                                                                                                            | Preference                       |
| Location                                        | Movement     | Park, Lennon, and Stoel           | 2005 | Consumers will have higher purchase intentions for products pictured rotating and larger than those not rotating or rotating and pictured smaller                                        | Purchase Activity                |

**Table 1.5**

| Assumptions of a Focal Object's Physical Composition |                |                                      |      |                                                                                                                                                                                                     |                                    |
|------------------------------------------------------|----------------|--------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Component                                            | Facet          | Authors                              | Year | Key Findings                                                                                                                                                                                        | Consequence                        |
| Shape                                                | Dimensionality | Raghubir and Krishna                 | 1999 | Taller containers result in greater perceptions of volume and consumption but less perceived consumption when compared to a shorter and wider container of the same size                            | Volume and Consumption Estimations |
| Shape                                                | Dimensionality | Wansink and Van Ittersum             | 2003 | Consumers pour and consume more liquid from a shorter wider glass than a taller thinner glass                                                                                                       | Consumption                        |
| Shape                                                | Dimensionality | Yang and Raghubir                    | 2005 | Taller packages lead to less quantity purchased                                                                                                                                                     | Purchase Activity                  |
| Shape                                                | Dimensionality | Chandon and Ordabayeva               | 2009 | Consumers tend to prefer increases in size when change occurs in only 1 dimension, but prefer decreases when change occurs in 3                                                                     | Preference                         |
| Shape                                                | Dimensionality | Ordabayeva and Chandon               | 2013 | Consumer's correct and erroneous size estimations can be predicted and managed using the AddChange heuristic model                                                                                  | Volume Estimation                  |
| Shape                                                | Dimensionality | Koo and Suk                          | 2016 | Consumers believe that taller packages have fewer calories but more volume than wider packages                                                                                                      | Vol./Calorie Estimation            |
| Shape                                                | Unity          | Sevilla and Kahn                     | 2014 | Shapes that appear incomplete are estimated by consumers to be smaller than those of equal weight and size, and this results in greater consumption of incomplete shaped products                   | Consumption                        |
| Shape                                                | Shape Contrast | Folkes and Matta                     | 2004 | Greater attention-grabbing shapes, due to deviations from product class in dimensionality or demarcation, are estimated to be of greater volume than shapes conforming to product class norms       | Volume Estimation                  |
| Surface Color                                        | Saturation     | Hagtvedt and Brasel                  | 2017 | Consumers perceive products with higher levels of saturation to be larger, resulting in higher purchase intentions and willingness to pay when a larger product is desired and vice versa           | Size Estimation                    |
| Surface Color                                        | Saturation     | Mead and Richerson                   | 2018 | High saturation decreases health perceptions of packaged food                                                                                                                                       | Health Estimation                  |
| Surface Color                                        | Lightness      | Madzharov, Ramanathan, and Block     | 2016 | Greater consumption of hedonic foods occurs when foods exhibit higher levels of lightness                                                                                                           | Consumption                        |
| Surface Color                                        | Lightness      | Mai, Symmank, and Seeberg-Elverfeldt | 2016 | Greater lightness leads to greater perceptions of healthiness and tastelessness                                                                                                                     | Health and Taste Estimations       |
| Materiality                                          | Opacity        | Deng and Srinivasan                  | 2013 | Less packaging opacity leads to increased small food consumption, but greater packaging opacity leads to increased vegetable and large food consumption                                             | Consumption                        |
| Location                                             | Positioning    | Deng and Kahn                        | 2009 | A product image located in the bottom, right, and bottom-right of a package leads to evaluations of greater weight, which leads to higher consumer preference when heaviness is a desired attribute | Weight Estimation                  |
| Location                                             | Orientation    | Szocs and Lefebvre                   | 2017 | Vertically distributed foods (stacked), as opposed to horizontally (laid out) are perceived as occupying less surface area due to the angle of perception, leading to greater consumption           | Volume Estimation and Consumption  |



**Table 1.6**

| Assumptions of a Focal Object's Trait(s) |                |                                                    |      |                                                                                                                                                                                                   |                          |
|------------------------------------------|----------------|----------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Component                                | Facet          | Authors                                            | Year | Key Findings                                                                                                                                                                                      | Consequence              |
| Shape                                    | Unity          | Hagtvedt                                           | 2011 | Firms with incomplete typeface logos are believed to be more innovative, but complete typeface logos convey trustworthiness                                                                       | Brand Estimation         |
| Shape                                    | Demarcation    | Henderson, Giese, and Cote                         | 2006 | Using one of six types of typeface design, a firm can convey certain value impressions to consumers                                                                                               | Brand Estimation         |
| Shape                                    | Demarcation    | Cian, Krishna, and Elder                           | 2014 | Static brand logos evoking a notion of motion lead to higher consumer engagement and positive attitudes provided an aspect of dynamism is congruent with the brand                                | Engagement and Attitude  |
| Shape                                    | Demarcation    | Jiang, Gorn, Galli, and Chattopadhyay              | 2016 | Circular logos are perceived as providing comfort and sensitivity, whereas angular logos are perceived as providing durability                                                                    | Brand Estimation         |
| Shape                                    | Demarcation    | Romero and Craig                                   | 2017 | A thin human-shaped product leads to greater spending when perceived by a consumer with high BMI                                                                                                  | WTP                      |
| Shape                                    | Demarcation    | Bajaj and Bond                                     | 2018 | Consumers associate more excitement toward a brand when encountering asymmetrical brand logos, and this leads to greater product choice when that brand is positioned as exciting                 | Brand Estimation         |
| Shape                                    | Shape Contrast | Trudel and Argo                                    | 2013 | Products are less likely to be perceived as useful and recycled when the shape is meaningfully distorted from the initial shape                                                                   | Product Estimation       |
| Surface Color                            | Hue            | Bottomley and Doyle                                | 2006 | Brands are perceived as more valuable when presented with a congruent color, such that blue, black, gray, and green are more functional and red, yellow, pink, and violet are more sensory-social | Brand Estimation         |
| Surface Color                            | Hue            | De Bock, Pandelaere, and Van Kenhove               | 2013 | Behaviors, whether good or bad, are more acceptable when presented with a congruent hue                                                                                                           | Preference               |
| Surface Color                            | Hue            | Puccinelli, Chandrashekar, Grewal, and Suri        | 2013 | Men perceive greater savings presented in red than black-and-white as long as involvement is not high                                                                                             | Savings Estimation       |
| Surface Color                            | Hue            | Lee, Noble, and Biswas                             | 2018 | Atmospherics usage of gold leads to greater consumer tipping due to the higher status associations                                                                                                | Spending Behavior        |
| Surface Color                            | Combinations   | Babin, Hardesty, and Suter                         | 2003 | Fashion stores elicit higher purchase intentions with blue interiors over orange, but soft lights can ameliorate the negative effects of orange leading to greater perceptions of price fairness  | Purchase Activity        |
| Surface Color                            | Combinations   | Ilicic, Baxter, and Kulczynski                     | 2016 | Noticeable limbal rings, the outline of the iris, increase perceptions of trustworthiness and positive attitudes                                                                                  | Spokesperson Estimation  |
| Materiality                              | Visual Texture | Di Muro and Noseworthy                             | 2012 | Money that is crumpled is perceived as contaminated and thusly spent faster than smoother money                                                                                                   | Spending Behavior        |
| Location                                 | Orientation    | Pillai, Katsikeas, and Presi                       | 2012 | Larger typeface size leads to a higher belief of understanding of advertisements                                                                                                                  | Comprehension Estimation |
| Location                                 | Orientation    | van Rompay, de Vries, Bontekoe, and Tanja-Dijkstra | 2012 | Products pictured vertically are perceived as more luxurious leading to higher purchase intentions                                                                                                | Brand Estimation         |

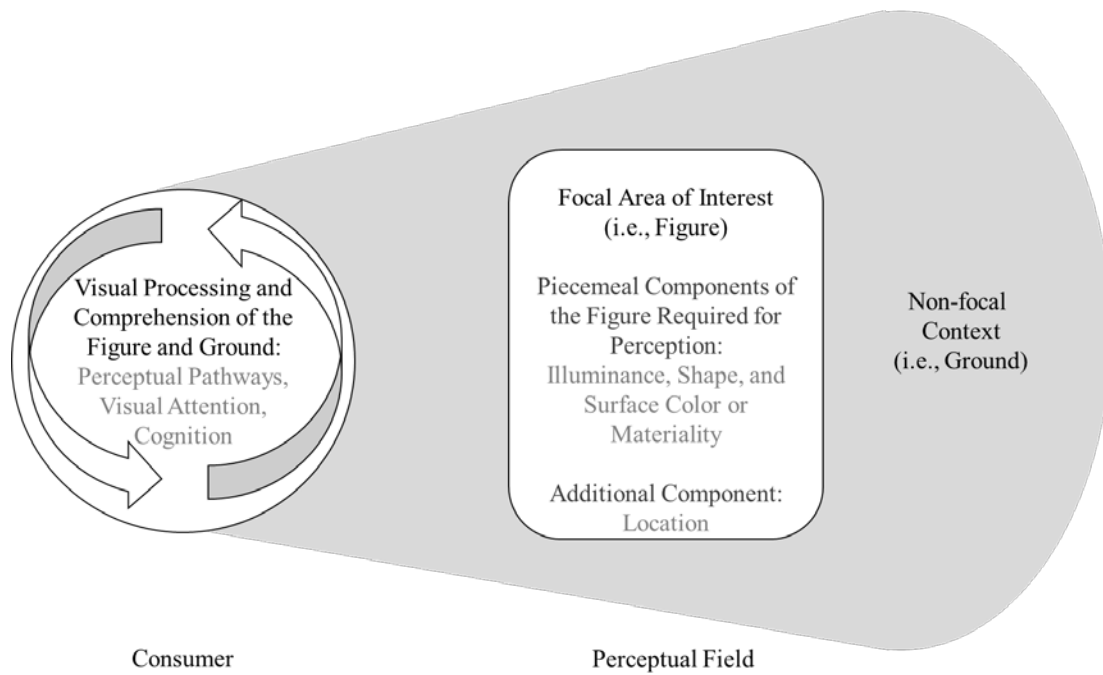
|          |             |                              |      |                                                                                                                                                                                     |                   |
|----------|-------------|------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Location | Orientation | Pracejus, O'Guinn, and Olsen | 2013 | Dependent on cultural background, a larger amount of white space (ground) and consequently a smaller figure results in higher perceptions of trustworthiness, prestige, and quality | Brand Estimation  |
| Location | Spacing     | Coulter and Norberg          | 2009 | Increased price-discount perceptions, value estimations, and purchase likelihood emerge when a printed regular price and sale price are spaced further apart                        | Purchase Activity |
| Location | Spacing     | Chae, Li, and Zhu            | 2013 | Products are evaluated as more effective when the product image is closely located to the desired outcome produced by the product                                                   | Brand Estimation  |
| Location | Spacing     | Sevilla and Townsend         | 2016 | The greater the distance between the same product, the greater the preference, aesthetic evaluations, and store evaluation                                                          | Preference        |
| Location | Movement    | Kim and Lakshmanan           | 2015 | A moving figure that changes direction is believed to be more novel than when it does not change directions                                                                         | Brand Estimation  |

**Table 1.7**

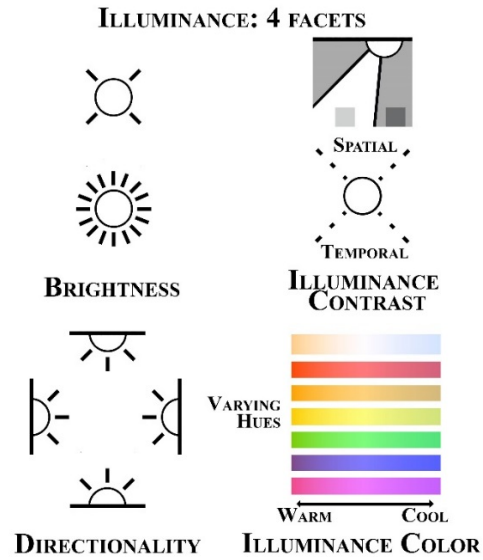
| Congruence of a Focal Object with Consumer Expectations |                          |                                             |      |                                                                                                                                     |                     |
|---------------------------------------------------------|--------------------------|---------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Component                                               | Facet                    | Authors                                     | Year | Key Findings                                                                                                                        | Consequence         |
| Illuminance                                             | Brightness               | Biswas, Szocs, Chacko, and Wansink          | 2017 | Consumers choose healthier food in bright, rather than dim, lighting                                                                | Choice              |
| Illuminance                                             | Brightness               | Huang, Dong, and Labroo                     | 2017 | Consumers make more authentic (i.e., hedonic) choices in dim rather than bright lighting                                            | Choice              |
| Shape                                                   | Unity and Shape Contrast | Veryzer and Hutchinson                      | 1998 | Unified and prototypical product designs are more preferred by consumers than segmented or atypical product designs                 | Preference          |
| Shape                                                   | Demarcation              | Henderson and Cote                          | 1998 | Dependent upon corporate image, logo shapes should be executed following certain guidelines to meet certain communication goals     | Preference          |
| Shape                                                   | Shape Contrast           | Landwehr, Labroo, and Herrmann              | 2011 | Prototypical, yet complex, automobile shapes as seen from the front of a car are more easily processed resulting in higher sales    | Purchase Activity   |
| Shape                                                   | Shape Contrast           | Huang and Kwong                             | 2016 | More difficult to read typeface results in higher variety estimations                                                               | Variety Estimations |
| Surface Color                                           | Hue                      | Gorn, Chattopadhyay, Sengupta, and Tripathi | 2004 | Colors that elicit relaxation, such as blue, increase perceptions of online loading speeds such that WOM and preferences are higher | Preference and WOM  |
| Surface Color                                           | Hue                      | Bagchi and Cheema                           | 2013 | Red backgrounds increase consumer aggression resulting in higher bid activity in auctions but lower price offers in negotiations    | Affect              |
| Surface Color                                           | Saturation               | Lee, Fujita, Deng, and Unnava               | 2017 | Greater willingness to pay is exhibited for future events presented in black-and-white or relatively soon events presented in color | WTP                 |

|               |              |                                                    |      |                                                                                                                                                                                                         |                                   |
|---------------|--------------|----------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Surface Color | Combinations | Moore, Stammerjohan, and Coulter                   | 2005 | Congruent color of the figure and ground results in higher consumer attitudes, but incongruent color of the figure and ground results in better recall and recognition                                  | Attitudes                         |
| Surface Color | Combinations | Deng, Hui, and Hutchinson                          | 2010 | Consumers emphasize hue and saturation when self-designing products, and these preferences extend to using a small set of matching colors except when emphasizing a certain feature                     | Preference                        |
| Surface Color | Combinations | Labrecque and Milne                                | 2012 | Product categories with clear market leaders establish color norms that should be followed by competitors within that category                                                                          | Preference                        |
| Location      | Positioning  | Janiszewski                                        | 1990 | Brand preferences are higher when the brand is positioned to the right (processed by the left hemisphere) of a picture and to the left (processed by the right hemisphere) of written information       | Preference                        |
| Location      | Positioning  | Chae and Hoegg                                     | 2013 | Starting reading position is associated with the past and ending reading position with the future, such that more favorable attitudes arise for products positioned with their congruent time component | Attitudes                         |
| Location      | Positioning  | Huang, Li, and Zhang                               | 2013 | Brands situated in the mid-line of an ad are evaluated higher when positioned as a friend, but when the brand is situated toward the top of an ad it is evaluated higher as a leader                    | Evaluations                       |
| Location      | Positioning  | Sundar and Noseworthy                              | 2014 | Brand logos pictured on packaging are more preferred when pictured high (low) on a package for a powerful (less powerful) brand                                                                         | Preference                        |
| Location      | Positioning  | Romero and Biswas                                  | 2016 | Preference and consumption volume are higher for healthy items when positioned to the left of unhealthy items rather than to the right of unhealthy items                                               | Preference and Consumption        |
| Location      | Orientation  | Leonhardt, Catlin, and Pirouz                      | 2015 | Consumers more highly evaluate products whose profile faces toward the center of a promotion                                                                                                            | Evaluations                       |
| Location      | Orientation  | Salgado-Montejo, Leon, Elliot, Salgado, and Spence | 2015 | Products are more highly evaluated and likely to be purchased when a concave (i.e., smiling) line is displayed on the packaging rather than a convex (i.e., frowning) line                              | Evaluations and Purchase Activity |
| Location      | Movement     | Roggeveen, Grewal, Townsend, and Krishnan          | 2015 | Consumers exhibit substantially greater preference and willingness to pay for hedonic firm offerings presented in a moving rather than static format                                                    | Preference and WTP                |
| Location      | Movement     | Brasel and Hagtvedt                                | 2016 | Consumers are more likely to prefer and choose dynamic brands when matched with an animated logo that appears to be autonomous rather than guided or static                                             | Preference                        |
| Location      | Movement     | Guido, Pichierri, Natarajan, and Pino              | 2016 | Consumers prefer upward, over downward, moving logos, regardless of power or innovativeness, but prefer innovative companies to move up and right                                                       | Preference                        |

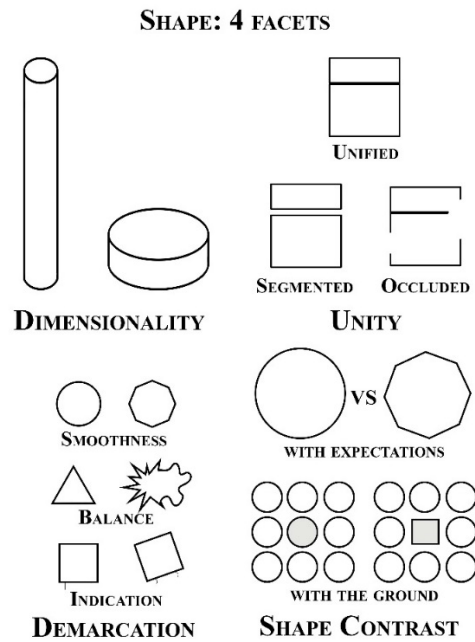
## FIGURES



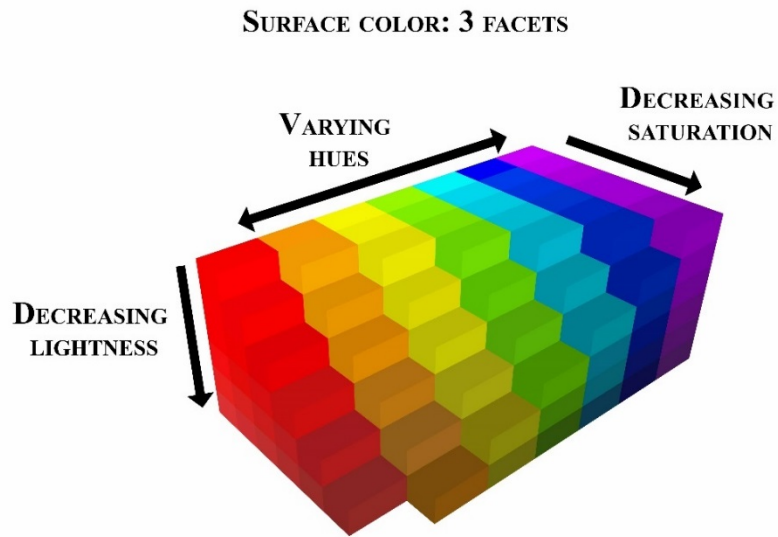
**Figure 1.1**



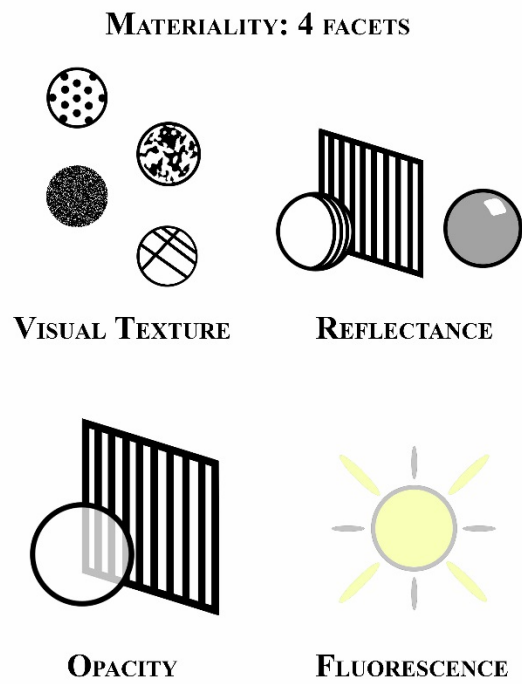
**Figure 1.2**



**Figure 1.3**

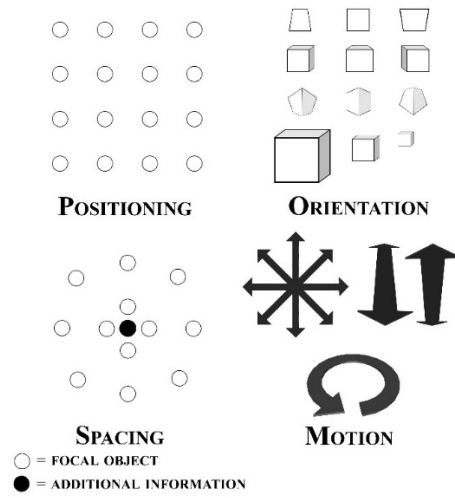


**Figure 1.4**



**Figure 1.5**

**LOCATION: 4 FACETS**



**Figure 1.6**

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## CHAPTER 3

### ESSAY 2: DIAGNOSING AND RESPONDING TO HOLISTIC CONSUMER EVALUATIONS OF NEW PRODUCT DESIGNS<sup>3</sup>

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<sup>3</sup> Sample, Kevin L., John Hulland, and Julio Sevilla. To be submitted to *Journal of Marketing Research*.

## **Abstract**

Design theorizing and marketing research are integrated to show that product designs have intrinsic (form and function) and extrinsic dimensions (solidity, usefulness, beauty, eco-consciousness, and uniqueness). The intrinsic dimensions encompass the most salient, inherent aspects of a design, those that are first noticed and evaluated by consumers, whereas the extrinsic dimensions are utilized by consumers to evaluate the potential benefits that a product could provide specifically to them after interacting with it. This research integrates design theory, expert designer input, consumer behavior perspectives, and well-established scale development procedures to develop a reliable and valid scale that measures consumer evaluations of these all-encompassing dimensions of product design. A rigorous consumer behavior perspective applied to a managerially relevant issue improves on past design scales resulting in superior diagnostic ability – revealing the dimensions of product designs that lead to positive or negative consumer response. This allows for appropriate managerial action and the ability to better communicate with designers. The substantial improvement that this scale represents is consistently demonstrated while providing considerable theoretical and practical contributions.

## **Introduction**

*“Wherefore the mere practical architect is not able to assign sufficient reasons for the forms he adopts; and the theoretic architect also fails, grasping the shadow instead of the substance. He who is theoretic as well as practical, is therefore doubly armed; able not only to*

*prove the propriety of his design, but equally so to carry it into execution.”* – Marco Vitruvius Pollio, circa first century B.C.

Unquestionably, product design is a pivotal driver of firm success (Eppinger and Ulrich 2015; Homburg, Scwemmle, and Kuehnl 2015), as consumers make both high and low-level processing inferences about brands based on designs (Rahinel and Nelson 2016). Despite its importance, agreement as to what constitutes product design is lacking (Homburg et al. 2015). In some cases, it refers only to visual aesthetics (Bloch, Brunel, and Arnold 2003; Orth and Malkewtiz 2008; Townsend and Sood 2012), whereas other definitions include non-visual dimensions (Bloch 2011; Jindal et al. 2016; Luchs and Swan 2011; Srinivasan et al. 2012). Technical and functional aspects of design are often overlooked by marketers, with little consideration given to the aims of the designers (Dahl 2011; Luchs and Swan 2011). This has resulted in the neglect of a designer-informed measure of design quality utilized by designers for over two millennia, the Vitruvian Triad (Gwilt 1826).

The position we adopt in this paper is that to have a complete understanding of how consumers respond to designs, we need to approach design as an inter-disciplinary endeavor, capturing input from both consumer behavior and strategic marketing researchers as well as designers (Eppinger and Ulrich 2015). By explicitly including designer perspectives, as encouraged by marketing researchers (Dahl 2011; Luchs and Swan 2011), a diagnostic, reliable, and valid product design scale that can appropriately diagnose where a design is excelling or lacking, allowing for corrective adjustments through appropriate communication with designers, is developed. We name this instrument the DESIGN (diagnosis of the extrinsic and intrinsic goodness of product design) scale.



The contributions of our work are as follows: First, we propose an enriched theoretical framework for better understanding the critical dimensions of product design. To do this, we combine two long-standing design theories with two divergent, yet related, dimensions emerging since the Industrial Revolution. In so doing, we provide clear definitions of the intrinsic dimensions, the more salient dimensions that are immutable to product designs unless the very nature of the design is altered (Olson 1977; Olson and Jacoby 1972; Zeithaml 1988). These intrinsic dimensions are the first dimensions of product designs consumers evaluate, being used to determine if a product design should be rejected or retained for further consideration (i.e., does this product design have any potential value or relevance for me?). We also explicate the extrinsic dimensions, those dimensions that are ascribed to product designs (Zeithaml 1988) by consumers in an assessment of how interactions with a product design will meet specific desires versus alternatives (i.e., is this product design better?). Our framework also elucidates two emergent extrinsic dimensions of product design.

Second, we ground this work in a rigorous consumer behavior perspective to understand how consumers evaluate product designs at a very fine-grained level. These findings are then aggregated to a higher, managerially relevant level to explicate consumer evaluations of product design in a more refined, pervasive, and detailed manner than allowed for by prior scales developed in product design, aesthetics, and other areas.

Third, our scale provides a bridge for marketers to engage with designers. By grounding our scale in pervasive concepts from the design realm (via literature review and designer interviews), we enable marketers to more effectively communicate with designers in a diagnostic manner using actual design language. Furthermore, as we are the first to fully explicate the relations between the form follows function principle and the Vitruvian Triad, our research can

facilitate better understanding and communication within and between the two groups of marketers and designers.

Finally, we provide enhanced diagnostic ability, allowing firms to note which dimension(s) drive failure or success. Our nuanced scale can help brand managers and product designers better gauge and respond to latent consumer desires in the creation or adjustment of product designs or product-related promotions, regardless of product category or aesthetic emphasis. Further, our scale pinpoints those dimensions of a product design or product category that lead to positive consumer response, a crucially important contribution as designs are more likely to succeed when marketers can respond to consumer insights and experiences (Griffin and Hauser 1993).

To develop the DESIGN scale, we first delineate the stand-alone, intrinsic dimensions of design through the lay theory of form follows function (Sullivan 1896). Next, we provide the extrinsic dimensions of design through discussion of the Vitruvian Triad of solid, useful, and beautiful (Gwilt 1826), augmented with two emergent, yet equally important, notions of good product design: eco-consciousness and uniqueness. While we considered other dimensions as well, none consistently emerged through designer interactions, design literature review, and systematic scale development; hence, the present work documents the relevance and validity of these two new dimensions but no others. Following this conceptual development, we proceed to generate, evaluate, and implement our scale according to established scale development practices (Netemeyer, Bearden, and Sharma 2003), resulting in a seven-dimensioned scale (form, function, solidity, usefulness, beauty, eco-consciousness, and uniqueness). Finally, in our general discussion, we explore the theoretical and practical implications of our work and potential avenues for future research.

## **Prior Design Scale Development**

Our scale builds on past work aimed at understanding consumers' assessments of product designs, while also offering several important points of departure from this earlier research. Most notably, we compare our scale instrument to the recently proposed product design scale by Homburg et al. (2015), given its superiority compared to prior scales and it being the only other true product design scale. While their scale is indeed superior to previously developed scales and provides good predictive validity, it does have some theoretical and empirical limitations that prevent it from having further predictive validity.

Theoretically, their approach in scale development inadvertently neglects important design dimensions that have been extensively used and understood within the design field for well over a century [e.g., form and function (Sullivan 1896) and usefulness (Gwilt 1826)]. Their three dimensions of aesthetics, functionality, and symbolism are the result of consumer interviews and a review of marketing literature, which has largely ignored designer input and theory (Dahl 2011; Eppinger and Ulrich 2015; Luchs and Swan 2011). In addition to not fully capturing the essence of product design as understood by the design field (i.e., using only three extrinsic dimensions), the Homburg et al (2015) scale also suffers from incompatibility with design theory. First, what they refer to as their functionality dimension is generally understood by designers as solidity or reliability (Gwilt 1826). Consequently, utilization of their scale when interacting with designers will lead designers astray as they naturally assign a different meaning to "functionality." Second, their dimension of symbolism is not a mainstream theme/concept considered by designers. Whereas symbolism is important, it addresses more than consumer evaluation of product design alone, as it focuses on how a product speaks to others about a

consumer. Thus, making this typically unconsidered dimension prominent could lead to product development confusion. Empirically, Homburg et al. (2015) provide no face nor nomological validity assessment in support of their scale development. The absence of face validity results in uncertainty as to what their dimensions are theoretically. Relatedly, the lack of nomological validity results in not knowing if their proposed measures are adequately related to the appropriate constructs. Consequently, their proposed scale has theoretical and practical limitations.

In the current research, we alleviate these deficiencies and develop a scale that achieves superior predictive validity. Theoretically, we utilize input from design experts and design theories. Additionally, we integrate consumer behavior research with marketing strategy insights to refine our understanding of product design to the benefit of the marketing practice. Empirically, beyond other assessments, we ensure that our scale has strong face validity, such that our dimensions are appropriately assessing as intended. Further, we demonstrate its nomological validity, showing how our scale dimensions relate to other important constructs.

### **Conceptual Development**

Designs are evaluated by consumers on two fundamental aspects: the intrinsic and extrinsic dimensions. Past research has noted that intrinsic dimensions are the immutable attributes of a product design that if changed result in an alteration to the very nature of the design (Olson 1977; Olson and Jacoby 1972; Zeithaml 1988). In contrast, extrinsic dimensions are those attributes of a product design that are ascribed to a design (Zeithaml 1988). Below, we first offer an understanding of the nature of these more salient intrinsic dimensions (e.g., manufacturing materials (form) and product purpose (function)) by elucidating designers' lay

theory of “form follows function,” as this provides an understanding of what constitutes product designs (Luchs and Swan 2011). Following, we describe the extrinsic dimensions that consumers assign to product designs by using Vitruvius’ set of evaluative measures, the Vitruvian Triad (Gwilt 1826), augmented with two additional core extrinsic dimensions: eco-consciousness and uniqueness. In uniting these intrinsic and extrinsic dimensions of design we capture the progression of consumer evaluation of product designs. As the intrinsic dimensions are the more salient dimensions, these are first evaluated by consumers and used to determine if a product design falls into a desired product category. The extrinsic dimensions are subsequently used to assess what specific benefits that product design can provide to a consumer versus other similar product designs once interactions with this product design begin.

### ***The Intrinsic Dimensions***

The phrase “form ever follows function” proffered by the architect Louis Sullivan in 1896 provides an established way of looking at design that has endured for well over a century. This perspective has been understood by designers to mean that any design is composed of two primary parts—form and function (Sullivan 1896; Bhatt, Hois, Kutz 2012). Marketers have suggested that form and function be studied together to understand product design (Dahl 2011), and these two dimensions have been noted to play an important role in consumer evaluations of product designs (Jindal et al. 2016; Noseworthy and Trudel 2011). Furthermore, Luchs and Swan (2011) conducted an exhaustive literature review while integrating design insights to arrive at their definition of product design: “the set of properties of an artifact, consisting of the discrete properties of the form (i.e., the aesthetics of the tangible good and/or service) and the function (i.e., its capabilities) together with the holistic properties of the integrated form and function.”

In alignment with their definition, we adopt the stance that form and function are both necessary and complete in understanding what constitutes the stand-alone dimensions of a product design. That is, the intrinsic dimensions of form and function are the inherent dimensions used by consumers to determine if a product design is worthy of being included in a consideration set within a focal product category. This is similar to how consumers negatively evaluate a product design when it deviates too far from the prototype (Liu et al. 2017; Veryzer and Hutchinson 1998). An explication of form and function is now provided.

*Form.* We define *form* as the resultant physical manifestation of a product idea. Form was initially described by Sullivan (1896) as a shape or an outward semblance, and has had numerous definitions, such as a recognizable external appearance, a particular state, or the integration of elements such as shape, size, color, and texture to make a coherent image (Ching 2014). The form has been correlated with aesthetics throughout marketing literature (e.g., Bloch et al. 2003), but we assert that aesthetics is different than form, as argued more fully below (in the “beautiful” sub-section). When consumers evaluate the form of a design, they are evaluating the stand-alone physicality of a design, as the form is compared to consumer notions of prototypes (Veryzer and Hutchinson 1998). Naturally, this is important to marketers, as extreme deviations from prototypicality can result in a design not being considered at all (Liu et al. 2017; Veryzer and Hutchinson 1998).

*Function.* We define *function* as the intended purpose and outcome provided by the form. Function was described by Sullivan (1896) as the connected inner life of the form, and this can be understood as the purpose provided by a product design. Examples of this include the weed cutting ability of an edger, the cleaning ability of a brush, or protection from the elements by a building. This is why form is said to follow function, because one must first have an intended

purpose before being able to create a form, even if the purpose is aesthetically oriented. For example, in making the initial iPhone, the form was the end-product, but it was the purpose of providing an attractive, portable phone without buttons that drove the creation of the iPhone. Consequently, a product design scale should measure how discernable the functioning of a design is to consumers, which is distinct from the functionality dimension proposed in the Homburg et al. (2015) scale (subsequently, we empirically demonstrate that their functionality dimension is equivalent to the extrinsic dimension of solidity). The importance of being discernable has been noted by design theorists, as well as marketing researchers (Noseworthy, Murray, and Di Muro 2018), claiming that designs should be readily understood by consumers (Norman 2013; Rams 2014). Relatedly, marketing research has shown that consumers make functionality assessments based on the form of product designs (Hoegg and Alba 2011; Noseworthy and Trudel 2011).

Following this line of theorizing, and due to their utilization of design insights, we adhere to the product design definition provided by Luchs and Swan (2011). However, we remove the parenthetical remarks from their definition, as these remarks point to extrinsic dimensions soon to be explained. Thus, our revised definition of product design is: "the set of properties of an artifact, consisting of the discrete properties of the form and the function together with the holistic properties of the integrated form and function."

### ***The Extrinsic Dimensions***

Consumer assessment of the form and function typically comes first, as these are the more salient dimensions to consumers, resulting in either a rejection or further evaluation of a product design. In this further evaluation, consumers attempt to determine what benefits will be

specifically provided to them by a particular product design by estimating the five extrinsic dimensions: solidity, usefulness, beauty, eco-consciousness, and uniqueness. Our thorough review of design literature indicates that these dimensions encompass all potential dimensions assigned by consumers to product designs and are important in evaluating the benefits provided by product designs (Brophy and Lewis 2011; Fiell and Fiell 2016; Norman 2013; Rams 2014). Thus, these five dimensions are comprehensive as to what constitutes the goodness of product designs to consumers.

The first three, known as the Vitruvian Triad (Gwilt 1826), capture how a product design might fit into a consumer's life, an assessment consumers make in evaluating a new product (Homburg et al. 2015). In addition, we propose eco-consciousness and uniqueness as two further fundamental extrinsic dimensions used to evaluate the goodness of a product design. Eco-consciousness assesses the impact a product design has on the environment, an ever-growing concern of consumers (Brophy and Lewis 2011; Haws, Winterich, and Naylor 2014; Griskevicius, Tybur, and Van den Bergh 2010; Luchs et al. 2010; Norman 2013; Rams 2014). Uniqueness assesses the value consumers derive from a product design in comparison to similar product designs. Research increasingly suggests this as an important dimension, as consumers value uniqueness (Irmak, Vallen, and Sen 2010; Norman 2013; Rams 2014; Simonson and Nowlis 2000; Tian, Bearden, and Hunter 2001), assess how new products will interact with currently owned products (Patrick and Hagtvedt 2011), and do not want products to be too close to the prototype in a product category (Liu et al. 2017).

*The Vitruvian Triad.* Marcus Vitruvius Pollio, a 1<sup>st</sup> century BC Roman author and architect, contended that good design was firmitas, utilitas, and venustas, or in English, solid, useful, and beautiful (Gwilt 1826). Solid, useful, and beautiful have received extensive usage



since the first century for the understanding of evaluations of good design, be it architecture or product designs. For example, questions about good design from design challenges spanning decades have sought out expert opinion on these three dimensions (Hayward 1998). Furthermore, most of Dieter Rams' (the renowned industrial designer) ten principles of good design (Rams 2014), as well as most of Don Norman's (the influential design researcher) writings on design (Norman 2013), can be readily represented within these three long-standing and encompassing categories.

*Solidity.* We define *solidity* as the maintaining of form and functionality of a design consistently over the expected life of a product. Solid, in relation to architecture, indicates an appropriate use of materials that can be relied upon repeatedly to serve the intended function over time (Gwilt 1826). That is, a design should be reliable, dependable, and be able to continue to serve its intended purpose over a reasonable period (Fiell and Fiell 2016). This constitutes using materials effectively and integrating them in a way to provide consistent, reliable results.

*Usefulness.* We define *usefulness* as meeting a consumer need through the form and/or function of a design. Useful designs have previously been noted as meeting a user's desires or needs (Gwilt 1826). Yet, the usefulness of a design should not be assigned to only utilitarian products, for even if the usefulness of a design is the generation of positive affect, such as a piece of sculpture, this is still meeting a consumer need (Fiell and Fiell 2016). Usefulness can, however, be compared to the applied science of ergonomics, which focuses on holistically enhancing consumer well-being (IEA.cc 2017). Although, meeting a consumer's desires does not always equate to enhancing consumer well-being, since consumers can act against their best interests to satisfy desires (Baumeister 2002; Hoch and Loewenstein 1991). Therefore, usefulness encompasses more than ergonomics as usefulness captures meeting a consumer need

even if it is not beneficial to a consumer's livelihood. For further clarity, usefulness is distinct from function as function evaluates how discernable the purpose of a design is, not the potential benefits consumers may receive from a product design.

*Beauty.* We define *beauty* as a positive appeal to one or more of the senses through the form and/or function of a design. Beauty is the provision of aesthetics (Gwilt 1826), and, traditionally, aesthetics is considered an appeal to all senses, not just vision (Hekkert 2006). For instance, the taste of a fine wine, the sound of a voice, the feel of cashmere, or the smell of a perfume can all be considered aesthetically pleasing or beautiful. Further, beauty can come from the way in which a product operates, such as the motion or sound of a John Deere tractor being perceived as beautiful to certain consumers. Therefore, beauty is not equal to the form of a product, nor should it be equated with hedonic objects, as utilitarian products can be considered beautiful as well. Furthermore, when looking at extant research we see how beautiful is an interactive dimension. For instance, consumers want attractive products (i.e., good designs with high beauty) due to the self-affirmation that they receive from them (Townsend and Sood 2012).

### ***Emergent Extrinsic Dimensions of Design***

Although we initially considered a wide variety of potential dimensions of product design mentioned in existing marketing literature (including technology, ergonomics, cuteness, anthropomorphism, style, ease of use, hedonic, utilitarian, simplicity, durability), the Vitruvian Triad of solidity, usefulness, and beauty has in large part successfully captured how product designs are evaluated by consumers for two millennia. Only two dimensions emerging from our design literature review and discussions with practicing designers cannot be encompassed within the Vitruvian Triad, as we discuss more fully below

Within the past half century or so, two relatively new dimensions that are a direct consequence of the Industrial Revolution and increasing consumer sophistication have emerged as core considerations for new product evaluations. These can be understood to be manifested in the interactions of product designs with the environment (dimension: eco-consciousness) and of product designs being too similar to other product designs (dimension: uniqueness).

*Eco-consciousness.* We define *eco-consciousness* as the preservation, protection, and/or promotion of environmentally friendly behavior through the form and/or function of a design or the creation of a design. Industrialization has led to natural resource exploitation and increased energy consumption (Brophy and Lewis 2011), driving greater awareness of the need to preserve natural resources. With society becoming more focused on preserving and protecting the environment, we see an increasing alignment between these environmental inclinations and consumer behavior in the marketplace, as consumers value eco-conscious products (Luchs et al. 2010) and are more likely to buy green products and pay premiums to achieve this goal (Haws et al. 2014; Griskevicius et al. 2010). Besides consumers, designers are also increasingly aware of the need to make environmentally-friendly designs (Brophy and Lewis 2011; Norman 2013; Rams 2014). The interactive nature of eco-consciousness can be seen when consumers who feel more strongly connected to a product design exhibit more environmentally friendly behavior, such as recycling, for that design (Trudel, Argo, and Meng 2016). Additionally, consumers are more apt to value and recycle product designs that keep their initial form (Trudel and Argo 2013). Thus, since consumers, designers, and the environment can benefit from eco-conscious product designs, we include it as an extrinsic dimension providing specific benefits.

*Uniqueness.* We define *uniqueness* as the manifestation of the form and/or function such that a design is perceived as distinct from other designs. Whereas the Industrial Revolution and

subsequent technological advances occurring during the last century ensured the production of reliable, higher quality products, this also resulted in the mass production of virtually identical products, a previously unachievable feat (Allen 2009). Consumers' growing preference for unique designs has been captured in marketing research. For example, consumers do not want product designs to be too much like the prototype for a product category (Liu et al. 2017), and consumer design preferences are influenced by a need for uniqueness (Irmak et al. 2010; Simonson and Nowlis 2000; Tian et al. 2001). Furthermore, in group settings consumers make choices to appear more unique (Ariely and Levav 2000), and consumers tend to prefer products with mistakes as this makes these products more novel (Reich, Kupor, and Smith 2017). Relatedly, scarcity perceptions reduce consumer satiation (Sevilla and Redden 2014) and increase consumer aggression in the acquisition of products (Kristofferson et al. 2016). Additionally, non-conformity leads to higher evaluations of consumers by others (Bellezza, Gino, Keinan 2014), so it can be beneficial to stand out in a crowd through uniqueness. These changes eventually led manufacturers to explore production flexibility and customization through, for example, 3D printing (Berman 2012), to provide consumers with more novel products. On the design side, notable designers have also noted the importance of uniqueness (Rams 2014; Norman 2013). Therefore, we acknowledge the importance of uniqueness to designs and include it in our assessment of the extrinsic dimensions.

### ***Good Product Design***

Using these two new criteria, the well-established extrinsic dimensions of the Vitruvian Triad, along with the traditional intrinsic dimensions of product design, we define *good product design* as the optimum cohesion of the form and function such that a consumer perceives a

benefit from the solidity, usefulness, beauty, eco-consciousness, and/or uniqueness. This definition, along with the product design definition and the definitions of all seven dimensions and their sources are reported in table 2.1. This table also provides two other pertinent columns for the seven dimensions of our scale. The nature column indicates whether the dimension is intrinsic or extrinsic. The final column provides a few examples of related constructs uncovered during our literature review that our seven dimensions encompass.

It must be noted that the design of a successful product does not require that all dimensions be positive, as tradeoffs are often made between different aspects of a design [e.g., it may not be possible to incorporate eco-consciousness when designing a product that emphasizes strength (Luchs et al. 2010), or to strive for uniqueness and still have a prototypical form (Liu et al. 2017)]. Further, if a consumer rates one dimension high (e.g., the beauty of an underground electric dog fence), but does not care about the dimension, this rating may not be useful in predicting the consumer's behavioral response to the design.

Having now established the theoretical framework for our scale, we next describe the steps taken to generate appropriate scale items, and then demonstrate the reliability, dimensionality, and the discriminant and predictive validity of our scale following accepted scale development practices (Netemeyer et al. 2003).

## **Scale Development**

We discuss our scale development process in three stages. In the sections that follow, we begin with an overview of each stage and the studies that generated the associated data sets. The purpose of stage 1 (data set 1) is scale generation, involving item generation followed by

assessments of convergent validity, predictive validity, and face validity. Stage 2 (data sets 2, 2a, 3, and 4) establishes the scale's temporal stability, nomological validity, further predictive validity, and experimental validity. We also use a combined data set (sets 2, 3, and 4) to assess discriminant validity in this stage. Finally, stage 3 (data set 5) establishes external validity, demonstrating the use of the scale in a marketing management context.

For every study, undergraduates received course credit or Amazon MTurk workers received a small cash sum. Our basic approach consisted of having a participant evaluate one randomly assigned design stimulus. Participants were asked to indicate their level of agreement with each item, randomly presented, on 7-point Likert scales, ranging from one (strongly disagree) to seven (strongly agree). Additionally, participants were asked to provide demographic information. (Other aspects of the studies will be further explained in subsequent sections.) A summary of data sets can be seen in table 2.2.

### **Stage 1: Item Generation**

For stage 1, over 200 items were generated using a combination of design and marketing literature review and design expert interviews. Through pretests and discussions, we whittled this preliminary set down to 140 items for further evaluation. We examined the effectiveness of these 140 items with data set 1. For taking part in the study used to collect data set 1, we provided 406 undergraduates (47.9% female; average age 20.7) with course credit. For this study, participants rated one of five randomly shown designs [an inflatable paddleboard, an anthropomorphic salt and pepper shaker, an innovative scooter, seaweed snacks, and a bath towel set (figure 2.1)] for all 140 items on 7-point Likert scales. The designs chosen for this study were diverse and comprehensive in product category and composition. Following this, participants filled out the

Homburg et al. (2015) design scale, answered several questions for predictive validity (described in more detail below), and answered general demographic questions. We used this data set for exploratory factor analysis, confirmatory factor analysis, preliminary face validity assessment, and predictive validity assessment. In this stage, we also conducted two separate surveys for face validity assessment. These generation steps are now explained in more detail.

### ***Item Generation and Exploratory Factor Analysis (Pretests and Data Set 1)***

The first step in our scale development process was to generate items supported by research and writings within marketing and the design fields. These references included Vitruvius' writings (Gwilt 1826), Dieter Rams' principles of good design (Rams 2014), Don Norman's understanding of design (Norman 2013), as well as writings on design from other sources and a review of questions from design competitions. A second source for item generation came from interviews conducted by the first author with twelve Japanese and American designers, including world-renowned architects Toyo Ito and Ryue Nishizawa. These actions generated over 200 initial items, representing the seven dimensions of our proposed scale

Using 140 items, reduced from over 200 through discussion and pretests, we assessed convergent validity of the seven dimensions through exploratory factor analysis (EFA) using data set 1. We dropped those items that did not load adequately on the expected dimension or that reduced the scale's internal consistency (this was calculated separately for each dimension). Further, we assessed cross-covariances between the separate dimensions to ensure that distinct constructs were being measured. For some of the dimensions we initially arrived at five or more appropriately loading items, but we subsequently reduced this to 3 items per dimension for the sake of parsimony in use (Netemeyer et al. 2003). This resulted in a final twenty-one item scale.

### ***Confirmatory Factor Analysis (Data Sets 1, 2, 3, 4, and Combined Data Set)***

The results from a confirmatory factor analysis (CFA) conducted using data set 1 are reported in table 2.3 (corresponding results for data sets 2, 3, 4 and the combined data set are also reported in this table). The values of  $\alpha$  reported in table 2.3 for all seven dimensions of our scale are consistently above the threshold value of 0.70 recommended by Nunnally (1978). This evidence demonstrates adequate convergent validity between the three items proposed for each of the seven dimensions, across all data sets. Furthermore, all individual item loadings are at or above the recommended .70 (Bagozzi and Yi 1988).

For data set 1, the CFA results indicate that our seven-factor correlated model meets recommended levels (Hu and Bentler 1999; Steiger 2007) in terms of goodness of fit (RMSEA = .07; CFI = .93; TLI = .91; SRMR = .05). Additionally, all the average variances extracted (AVE) meet the standards of being above .5 (Fornell and Larcker 1981), and the composite reliability for each dimension is above the recommended level of .70 (Hair et al. 1998). See table 2.4 for a summary of these results.

### ***Predictive Validity (Data Set 1)***

The final step taken to initially evaluate the worthiness of the proposed measures was to ensure that they are useful for marketers (i.e., they are predictively valid). We included the Homburg et al. (2015) scale in our data collection for set 1 so that we could compare predictive validity across scales. Thus, after completing our measures, participants also evaluated their randomly assigned designs using the Homburg et al. (2015) scale (using their recommended 5-point Likert scale).



Following these evaluations, participants responded to six predictive questions on 7-point Likert scales, with several of these being consistent with questions from the Homburg et al. (2015) paper. Two questions assessed purchase intentions: “How likely would you be to purchase this product?” and “How do you feel about buying this product in the near future?” There was also a willingness to pay question (“How much would you be willing to pay?”) and a positive attitude question where participants indicated their agreement with the following statement, “My attitude toward this product is very positive.” Finally, there were two questions used to assess Word of Mouth (WOM): “How likely would you be to tell your friends and family about this product?” and “I would tell other people about this product” with responses ranging from “strongly disagree” to “strongly agree.”

The assigned product design was used as the independent variable and the indexed purchase intention ( $\alpha = .92$ ), indexed WOM ( $\alpha = .92$ ), willingness to pay, and positive attitude measures were used as the dependent variables in a MANCOVA. The covariates were the seven dimensions from our scale. We then estimated a second MANCOVA model, replacing our proposed dimensions with the three dimensions of the Homburg et al. (2015) scale as covariates.

The MANCOVA results show that every dimension of our scale, except for eco-consciousness, is significantly predicting consumer behavior in some manner (table 2.5). The second MANCOVA model analysis reveals significant predictability for the Homburg et al. scale as well, but our scale explains more of the variance for every product and dependent variable in a comparison of  $R^2$ . Further, when comparing a model comprised of just the Homburg et al. dimensions (model 1) to a model comprised of their dimensions and our dimensions (model 2), model 2 explains significantly more variance for each dependent variable ( $p$ 's < .001; table 2.6).

### ***Face Validity***

To ensure that our scale provides diagnostic value to marketers wanting to communicate with designers, we assessed the scale's face validity by taking three steps. First, we invited 12 practicing designers from various positions (i.e., architects, artisans, graphic designers, and industrial designers) to respond to a questionnaire asking them to describe how they evaluate designs. Examination of their responses revealed multiple mentions of all seven of the dimensions included in our scale, whereas no other criteria were consistently identified.

Second, we had the designers from the first face validity step evaluate our scale dimensions and items five months later. We provided them with the scale items broken down by dimension, and asked them to indicate how appropriate these items were for measuring their intended constructs. This was assessed on a 7-point Likert scale ranging from "extremely inappropriate" (1) to "extremely appropriate" (7). The experts' evaluations provide further support for the face validity of our scale: the average responses for every dimension fall within the "moderately appropriate" to "extremely appropriate" range. The overall average dimension appropriateness score was 6.23, with the highest dimension score observed for uniqueness (6.8), and the lowest for eco-consciousness (5.8).

Finally, we looked at the means of our data set participants' evaluations of designs by dimension to see if these aligned with the design. That is, we ensured that a design such as a towel was being evaluated more for usefulness than beauty. When doing this, we see the averages across data sets 1, 2, 3, and 4 aligning with designs in anticipated patterns. For instance, the highest unique ratings were for the scooter and the paddleboard, whereas the lowest was for the towels. Further, the scooter was the lowest rated for beauty, and for the undergraduates the inflatable paddleboard was evaluated as, by far, the least solid or useful product.

This final step, taken together with the prior steps provides confidence in the content validity of our scale. First, our initial, thorough review of design sources and marketing research when establishing our scale provided appropriate constructs and related items. Second, our initial survey of designers verified the seven dimensions generated from the literature review and interviews. Third, the follow-up with the designers provided validation for the items assigned to our dimensions. Finally, our mean evaluations per product designs seen gives empirical support for the appropriateness of these constructs and items. Thus, the results from this step with the prior steps in stage 1 gives strong support for the viability of our proposed seven-dimensioned, twenty-one item scale, which we more fully evaluate in the next stage.

## **Stage 2: Scale Evaluation**

Four new data sets are used for stage two: sets 2, 2A, 3, and 4. To generate data set 2, three hundred and one U.S. MTurk workers (56.1% female; average age 37.1) evaluated one of the same five products used in stage 1, randomly presented, in addition to answering several questions for nomological validity assessment. Additionally, one hundred and eighty-four of these participants re-evaluated their assigned product three to five weeks later for a test-retest assessment (which we label data set 2A). For data set 3, three hundred and seventy-six public university undergraduates (47.2% female; average age 20.5) evaluated one of four randomly presented product designs [a breakfast center, a lawn mower, a multi-purpose kitchen tool, and a water balloon kit (figure 2.2)] to further assess predictive validity. Data set 4 is comprised of responses from one hundred and sixty-four international MTurk workers (36.0% female; average age 33.8) who evaluated one of two randomly presented coffee makers to assess experimental

validity [a control image or and a version of this control image manipulated to have a unique form (figure 2.3)]. These participants were also asked several questions further assessing nomological validity (described in more detail below). We now delineate the evaluation of our scale through discriminant validity, nomological validity, temporal stability, predictive validity, and experimental validity assessment.

### ***Discriminant Validity and CFA (Combined Data Set)***

All three primary data sets from stage 2 were combined to provide more power for our assessment of discriminant validity. A scale measuring consumer evaluations of product design, unlike typical scales, is both consumer- and product-specific providing insight into both, instead of just consumer tendencies or traits. Traditional scales measure individual consumer traits [e.g., need for uniqueness (Tian et al. 2001), CVPA (Bloch et al. 2003), GREEN scale (Haws et al. 2014)], but correlations in a design scale are determined by both the consumer and the design. Therefore, the evaluation of one product could result in two highly correlated dimensions, whereas another product may show no relation at all between these same two dimensions. For example, correlations (see tables 2.7, 2.8, and 2.9 for Pearson's  $r$  by set and stimulus) between the dimensions of solidity and usefulness are high for a stimulus from data set 4 ( $r = .83$ ), but quite low for a stimulus from data set 3 ( $r = .25$ ). Thus, to more appropriately assess discriminant validity we combine data sets 2, 3, and 4 (table 2.10), excluding the manipulated coffee machine from data set 4 since it was fabricated for that study.

We utilized the heterotrait-monotrait ratio of correlations (HTMT) for discriminant validity assessment, as it is the most appropriate method for assessing discriminant validity for variance-based SEM (Henseler, Ringle, and Sarstedt 2015). With this method, a HTMT cutoff of

0.85 offers high detection and low type one errors, resulting in better assessment of discriminant validity than traditional methods (i.e., Fornell-Larcker, overlapping confidence intervals, and constrained phi) (Voorhees et al. 2016). When using our combined data set, we see 100% discriminant validity at HTMT<sub>.85</sub> (table 2.10), as all values are below the 0.85 cutoff.

In addition to HTMT, we also conducted more traditional discriminant validity assessments. Using an un-weighted combined data set, we see 100% discriminant validity based on the Fornell-Larcker method (1981). Cross-loadings also reveal 100% discriminant validity (i.e., the intended loadings are always greater than the cross-loadings). Chi-square difference tests (Bagozzi and Phillips 1982; Jöreskog 1969) further reveal that our seven-dimensioned model performs significantly better than all alternatives at  $p < .001$ . Finally, we also assessed scale dimensionality, as in Homburg et al. (2015), with this indicating that our seven-dimensioned scale performs better than when combining constructs (table 2.10). All of these assessments demonstrate discriminant validity and support our claims that prior marketing research consistently missed important dimensions of product design.

### ***Nomological Validity (Data Sets 2 and 4)***

To be considered nomologically valid, our scale must be shown to be empirically correlated with theoretically related constructs (Netemeyer et al. 2003). For our studies, we utilized relatively good designs (overall positive reviews on Amazon) that should correlate with these theoretically related constructs of good design. We now describe these constructs.

When looking at good design holistically, other researchers have posited that good designs should generate a general, positive affect that leads to consumer response (e.g., Bloch 1995; Srinivasan, Lovejoy, and Beach 1997). Though entirely dependent upon the design, we

predict that a good design should, at the bare minimum, be highly correlated with an overall measure of positive affect, but dependent upon the design, any to all dimensions may be highly correlated as well. Thus, when assessing the nomological validity for positive affect we utilized the positive section of the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, and Tellegen 1988). Conversely, the PANAS negative dimensions should be negatively correlated with our scale, and we utilized this as well. Besides general positive feelings, good design has also been speculated to be linked to the specific feelings of achievement, joy, and inspiration (Givechi and Velasquez 2004). Since these are more specific feelings, rather than just a general, positive affect, we predict that every aspect of a good design should be positively correlated related to these.

In more detail, each of the dimensions of our scale have been suggested to be associated with other related constructs. First, regarding form and beauty, satisfaction (Han and Hong 2003) and hedonic benefits (Bloch 2011; Chitturi, Raghunathan, and Mahajan 2008; Hekkert 2006) should be positively correlated to these aspects of good design. Second, utilitarian benefits should be positively correlated with function, solidity, and usefulness (Bloch 2011; Fiell and Fiell 2016; Norman 2013). For various reasons, our measures of beauty (Townsend and Sood 2012), eco-consciousness (Griskevicius et al. 2010), and uniqueness (Simonson and Nowlis 2000) should positively correlate with symbolic benefits (Bloch 2011). Finally, our eco-consciousness measure should positively correlate with a tendency to behave in a green manner (Haws et al. 2014).

To assess these nomological relations, participants taking part in the studies that resulted in data sets 2 and 4 responded to different measures assessing these aforementioned nomological constructs. For data set 2, participants responded to the PANAS (Watson et al. 1988), questions

about achievement, joy, and inspiration (Givechi and Velasquez 2004), and single item measures about satisfaction (Han and Hong 2003), hedonic benefits (Bloch 2011), utilitarian benefits (Norman 2013), and symbolic benefits (Bloch 2011). In data set 4, participants responded to the GREEN scale (Haws et al. 2014). When looking at the correlations between our constructs and these theoretically related constructs we find significant correlations, yet not too highly correlated, in the predicted directions (table 2.11). This indicates that our scale is nomologically tied to the appropriate constructs, but discriminately valid. That is, our scale is measuring the intended constructs, which are distinct from, yet correlated with, theoretically related constructs.

#### ***Temporal Stability: Test/Retest (Data Set 2 and 2A)***

To ascertain the stability with which our scale assesses each dimension over time, one hundred and eighty-four of the participants from data set 2 (53.3% female; average age = 38.3) re-evaluated their previously assigned product three to five weeks later (yielding data set 2A). This amount of time prevents participants from remembering their previous answers while also avoiding concerns about substantial shifts in attitudes over longer periods of time. We see high correlations between the dimensions over time, indicating strong test-retest reliability (see table 2.12 for the statistics, Cronbach's alpha, and correlations).

#### ***Predictive Validity (Data Set 3)***

Despite the encouraging initial predictive validity results reported in stage 1, we felt that the Homburg et al. (2015) scale may have been at a disadvantage being measured after our scale and because it was based on their recommended 5-point Likert scale. Thus, for data set 3 we set out to alleviate these concerns by implementing their scale with 7-point Likert responses,

randomly showing participants one of four products (figure 2.2), and providing participants with scale items, randomly presented, from only our scale or only the Homburg scale. This resulted in a 4 (product design seen) X 2 (scale: ours vs. theirs) between-subjects design. Following the evaluations of products, participants responded to the same six dependent variables from stage 1: two purchase intention measures, two WOM measures, willingness to pay, and positive attitude.

As with the predictive validity assessment in stage 1, two MANCOVAs were estimated for each product design, with the indexed purchase intentions ( $\alpha = .88$ ), indexed WOM ( $\alpha = .93$ ), willingness to pay, and positive attitude measures as the dependent variables and either the seven dimensions from our scale or the three dimensions from the Homburg et al. scale as the covariates. Results from these analyses are reported in table 2.13. We see significant predictability from our measures, including the eco-consciousness measure (in contrast to the predictive validity results from stage 1). Also, when comparing  $R^2$ , our scale explains more variability than the Homburg et al. (2015) scale for fourteen out of the sixteen dependent variables. These results, combined with our initial results in stage 1, indicate that our scale is a consistently better predictor of consumer response to product designs than the Homburg et al. (2015) design scale.

#### ***Experimental Validity (Data Set 4)***

To truly be diagnostic, our scale should be able to ascertain when a design has been modified and therefore show a consistent, predictable change in the relevant design dimensions. For data set 4, we set out to manipulate one design dimension of a coffee machine (a stimulus used in the Homburg et al. (2015) scale development). To do this, we randomly presented one hundred and sixty-four international MTurk workers (36% female; average age 33.8) with an



image (figure 2.3) of the control (a regular coffee machine) or the experimental image (the same coffee machine image manipulated by a designer to have a unique shape as coffee machines are typically rather similar and it may be beneficial to stand out). Participants evaluated one of these designs using both our scale and the Homburg et al. (2015) scale. Both scales were administered using 7-point Likert scales with participants randomly seeing one question at a time from either scale resulting in a 2 (coffee machine: control vs. unique form) X 2 (scale: ours vs. theirs) mixed design.

We estimated two separate MANOVAs to examine the difference between scales and stimuli. For one MANOVA, all seven dimensions of our scale were used as the dependent variables and the product design seen was used as the independent variable. Interestingly, we see both our form and unique measures significantly detecting changes (table 2.14), yet in opposite directions. The experimental image has a significantly higher uniqueness rating ( $M_{\text{Control}} = 4.46$  vs  $M_{\text{NegForm}} = 4.94$ ;  $F(1, 162) = 5.270$ ,  $p = .02$ ), but it has a significantly lower form rating ( $M_{\text{Control}} = 5.10$  vs  $M_{\text{NegForm}} = 4.45$ ;  $F(1, 162) = 6.665$ ,  $p = .01$ ), an unintended consequence of striving for uniqueness. This potentially indicates that a traditional shape is expected by consumers in this product category, as strong deviations from prototypicality hamper evaluations (Liu et al. 2017; Veryzer and Hutchinson 1998). Consequently, despite this coffee machine being unique it may fall out of a consumer's consideration set.

For the other MANOVA, we replaced our seven dimensions with the three dimensions from the Homburg et al. (2015) scale. Strikingly, none of their dimensions pick up any differences between the designs (all  $p$ 's  $> .48$ ), a telling sign of the potentially practical limitations of the Homburg et al. scale. Additionally, since participants evaluated designs using both scales, we made a comparison between dimensions of each scale. These results (table 2.15)

reveal that, as anticipated, the Homburg et al. (2015) functionality dimension is equivalent to solidity and the aesthetics dimension is equivalent to beauty. This points to the tendency of the Homburg et al. scale to only assess some of the extrinsic dimensions and none of the intrinsic ones.

Our scale has been thoroughly vetted for face and nomological validity, has consistently performed better in prediction than the Homburg et al. scale, and it has now been shown to detect alterations to a design when the Homburg et al. (2015) scale could not. The results from this study indicate that our scale is appropriately constructed to diagnose where a design might be lacking in comparison to another design. Further, due to the face validity of our scale, these results can be conveyed to designers and appropriately utilized to make adjustments.

We have now established the validity and reliability of our theoretical and practical product design scale through the course of this stage. The final step in this stage, the experimental validity assessment, gave evidence about how our scale might be used in a managerial situation. Building on these findings, we set out in stage 3 to demonstrate how our scale could be implemented in a diagnostic manner by marketing managers to accommodate for a design's shortcomings or to emphasize a design's strengths to increase purchase intentions.

### **Stage 3: Implementation**

The method employed in the experimental validity section is typical of an action that would be taken by a firm producing several prototypes for evaluation. However, what if product redesign was not feasible, and the firm was left pondering how to market the product? In these circumstances, using our scale the firm could adjust its advertising to potentially emphasize a

dimension influencing purchase likelihood. In this section we demonstrate how this might be done using the water balloon stimulus from data set 3.

We recruited two hundred and two U.S. MTurk workers (42.6% female; average age 33.7) to take part in this study for a small cash sum. Participants evaluated one of two ads for the water balloon product from data set 3, either a control ad or an ad emphasizing environmentally friendly attributes (figure 2.4). We utilized this product and manipulation due to the low rating of eco-consciousness from data set 3. Even though the packaging for these balloons claims that they are bio-degradable, an environmentally friendly quality, most participants were apparently missing this trait resulting in the low eco-consciousness rating. Simply by changing the copy of a straightforward ad, evaluations of eco-consciousness should increase. This setup resulted in a 2 level (balloon advertisement: control vs. eco-conscious manipulated) between-subjects design.

As noted earlier, the extrinsic dimensions measure dimensions that could provide specific benefits to consumers. If a consumer does not care at all about environmental matters, even if they perceive a product design to be highly eco-conscious, eco-consciousness will not make the product design good to them. Thus, to control for individual differences about environmental matters we had participants fill out the GREEN scale (Haws et al. 2014) in a prior (allegedly unrelated) section. Following, participants evaluated the water balloons using our proposed scale and were asked to complete the two purchase intention measures used in our prior studies. Finally, gender and age were assessed.

We predicted that our simple adjustment of the copy in the experimental advertisement would lead to significantly higher eco-conscious evaluations than those seeing the control advertisement. Regression analysis reveals that, as expected and specific to our intention in this study, there is a significant main effect for the advertisement seen ( $\beta = 2.180$ ,  $SE = .818$ ,  $t(198) =$

2.666,  $p < .01$ ), such that the experimental ad was evaluated higher for eco-consciousness ( $M_{\text{ControlAd}} = 4.23$  vs.  $M_{\text{ExperimentalAd}} = 5.06$ ). Thus, our manipulation was successful in that the experimental advertisement resulted in a higher eco-consciousness evaluation for this product design. That is, we overcame the tendency for consumers to overlook the environmental claim on the packaging, as what happened in data set 3 and here with the control, by a simple advertisement adjustment. This points to the diagnostic insight of our scale, such that marketing managers can take promotional action to address deficiencies instead of completely redesigning a product design or packaging.

In the introduction we claimed that our scale should be able to help product designs succeed, and we demonstrate this here by investigating purchase likelihood. We predicted that, in general, participants would be significantly more likely to purchase the advertisement emphasizing environmentally friendly qualities. Further, participants who value environmental factors (i.e., those high in GREEN scores) should be more likely to purchase the water balloons in the experimental ad instead of the control because they will be the ones who will find goodness from these environmental claims. This coincides with our earlier statement that extrinsic dimensions will only provide goodness to consumers if they care about or have a goal involving that specific dimensions.

To assess the impact of our manipulation on purchase intentions, we conducted regression analysis on the indexed purchase intentions ( $\alpha = .93$ ) with (i) a dummy variable for advertisement seen (i.e., control (0) or experimental (1)), (ii) measured GREEN score, (iii) and the interaction between these two as independent variables. As expected, there is a significant interaction between advertisement seen and GREEN score for purchase intentions ( $\beta = .468$ ,  $SE = .172$ ,  $t(198) = 2.713$ ,  $p < .01$ ) such that those with GREEN scores above 6.127 ( $b = .574$ ,  $SE =$

.29,  $p = .05$ ) were significantly more likely to purchase the water balloons from the experimental ad. There is also a significant main effect for the advertisement seen ( $\beta = -2.291$ ,  $SE = .907$ ,  $t(198) = -2.525$ ,  $p = .01$ ), as expected, such that those seeing the experimental ad were more likely to purchase than those seeing the control ( $M_{\text{ControlAd}} = 4.59$  vs.  $M_{\text{ExperimentalAd}} = 4.68$ ).

This study demonstrates the important insights marketers can gain from utilizing our scale. In stage 2 we saw that participants were rating these water balloons with an environmental claim on the packaging low for eco-consciousness. By adjusting an advertisement for this product, we have increased consumers' eco-consciousness perceptions and purchase intentions. Thus, our reliable and valid scale has now been shown to serve well in diagnosing issues with product designs besides just predicting consumer response to a product design. Having established the solidity of our scale, we now move to our general discussion.

## **General Discussion**

Despite the relevance of product design in today's marketplace (e.g., Haws et al. 2014; Homburg et al. 2015; Irmak et al. 2010; Liu et al. 2017; Noseworthy and Trudel 2011; Townsend and Sood 2012; White et al. 2016), existing marketing research tools fail to systematically and reliably determine what product dimension(s) will spark particular consumer responses. In this paper, we have proposed a tool that aims to help address this objective. First, we generated the seven dimensions for assessing product designs by utilizing long-standing design theories and emergent themes. We explain how product designs have two intrinsic dimensions, form and function (Dahl 2011; Luchs and Swan 2011; Noseworthy and Trudel 2011; Sullivan 1896), which are more salient and first utilized by consumers in determining if a product design will fall

into a consideration set. We also delineate how the five extrinsic dimensions, solidity, usefulness, beauty, eco-consciousness, and uniqueness (Gwilt 1826; Haws et al. 2014; Irmak et al. 2010; Norman 2013; Rams 2014), can be employed by consumers to determine if specific benefits can be had from interactions with a product design compared to other product designs.

Next, we generated a scale according to recommended procedures (Netemeyer et al. 2003). For the first stage, a thorough literature review, interviews, and two pretests generated a list of 140 items for potential usage in the measurement of these dimensions. Exploratory Factor Analysis and a pursuit of parsimony resulted in a 21-item scale with three items per dimension. We then conducted confirmatory factor analysis, predictive validity assessment, and face validity assessment, demonstrating that our proposed scale was ready for further evaluation. In the second stage, we conducted several studies in the generation of data for discriminant validity, temporal stability, nomological validity, predictive validity, and experimental validity assessment. Not only did we find satisfactory results in this stage, but we also demonstrated the superior nature of our scale over the Homburg et al. (2015) product design scale. We then proceeded to stage 3 to implement our scale in a managerial setting. This stage demonstrated that our scale can properly diagnose a product design dimension worthy of highlighting to increase consumer perceptions and purchase intentions. Thus, we have generated a diagnostic, predictive, reliable, and valid scale to measure consumer response to design, a research priority that has been emphasized, in one form or another, over the last decade (MSI.org 2017). In so doing, we make several important theoretical and practical contributions as described below.

## ***Theoretical Contributions***

By providing a holistic understanding of product design for marketers and designers we contribute to theory. First, we have taken a large step towards alleviating the confusion within marketing as to what constitutes product design. As noted in the introduction, various approaches and understanding of design have peppered marketing research. Though important elements have been considered in prior research (Bloch et al. 2003; Homburg et al. 2015), there is no consistency, and surprisingly the Vitruvian Triad, which has been extensively used to assess the goodness of designs within design realms for millennia (Brophy and Lewis 2011; Gwilt 1826; Hayward 1998; Rams 2014), has been completely missed. We assuage these issues by providing a complete and comprehensive understanding as to what the dimensions of product designs are. Further, due to our interactions with design experts and our design literature review, confidence can be had in the completeness and accuracy of our seven dimensions.

Second, while prior marketing research has touched upon dimensions of designs that are both intrinsic and extrinsic (Homburg et al. 2015), the present work is the first to specifically delineate what these are and the roles that they play in consumer product evaluations. We explain how the intrinsic dimensions are the more salient dimensions that are inherent to product designs. These are first utilized by consumers to determine if a design is worth considering, and the extrinsic dimensions are then used to determine the specific benefits that can be had from interactions with a product design compared to other product designs. Thus, researchers interested in specific product categories would be wise to focus on the two intrinsic dimensions. Conversely, if a researcher is interested in how a specific consumer trait is influencing perceived goodness of a product design, this researcher will know to focus on the five extrinsic dimensions.

Third, we show how long term social responses to the Industrial Revolution have changed consumer evaluations of product designs. Before the turn of the 20<sup>th</sup> century, there was no need to consider how consumers felt about eco-consciousness and uniqueness, and we see this evidenced in the lack of emphasis on these dimensions in long-standing design literature. However, the industrial age has fundamentally changed product design, production, and use. Over time, consumers have responded to this shift by demanding that product designs incorporate both greater eco-consciousness (as they observe the negative byproducts of industrialization) and greater uniqueness (in response to the impersonalization fostered by mass production). Thus, to fully capture good product designs, we include these two emergent extrinsic dimensions that have not been historically included in the evaluation of good designs.

Finally, the integration of a consumer behavior-grounded perspective with a higher-level marketing focus helps this scale have better predictive, experimental, and diagnostic ability than any other design or aesthetic related measures available. These abilities are also what lead to our managerial implications.

### ***Managerial Implications***

From a practical standpoint, we have created a scale that points to product design strengths and/or deficiencies that hint at better paths to follow in product development. Additionally, our scale uses familiar language that can be communicated to designers. By so doing, this allows for better development of product designs and promotions by gathering insights from consumers, breaking down communication barriers between the marketing and design departments, and making adjustments as necessary. For the product development process, consumers can be asked to evaluate a product – still in development – with our scale while also



responding to questions relating to purchase likelihood, willingness to pay, and WOM. The scale results would then be used to identify those aspects of the product that are hindering (as well as fostering) purchase intentions, as evidenced in the experimental validity section. As a next step, the firm developing the product could adjust the deficient aspects of the product design and then ask consumers (either the same group or a new one) to evaluate the modified product. We believe that utilizing our scale for product redesign will lead to more positive results. Similarly, this scale may be used for the introduction of brand extensions and new product lines, as the results obtained with the scale for earlier products could be used as a base for these new introductions.

Much like for product development, the present instrument can also be useful in testing various alternative promotional strategies being considered for the marketing of products (both established as well as new). Similar to stage 3 of our scale development, consumers would evaluate a product or packaged good which would in turn indicate those dimensions of the product (or packaging) that are being missed by consumers or hindering positive outcome behaviors. Subsequently, promotional material could be created (or packaging redesigned) to address those dimensions. For example, if a product is perceived to be low in terms of its solidity, messaging or new packaging could be developed to rectify this problem. Finally, consumers would evaluate the modified packaging or new promotional material, while again indicating purchase intentions. We believe that utilizing our scale to identify product positioning deficiencies and to then assess the efficacy of new promotional approaches will result in more positive market results.

## ***Future Research and Conclusions***

The insights provided in this paper lay a fertile framework for future research. For instance, even though the intrinsic dimensions are more salient, there are most likely times when a product is too beautiful or unique for a consumer to ignore. Thus, when or why will an extrinsic dimension spark consumer behavior toward a product design more so than one of the more salient intrinsic dimensions? Furthermore, consumers have varying personality traits and emotions, and when will these influence preferences for certain design dimensions? Additionally, how does the scarcity or luxuriousness of products play a moderating role on these dimensions of product design?

We have created a scale that allows marketers to understand how consumers evaluate product designs, yet, there are numerous types of design that interest marketers and those in other fields: architectural, fashion, graphic, interior, and web. Additions, subtractions, or adjustments could be made to our product design scale, dependent upon the design-type of interest. Since our scale is grounded in pervasive, long-standing thoughts from the design field, the dimensions should overlap, but there will be needed changes as well. For instance, how can we better understand consumer response to the design of mobile applications? Further, we have only demonstrated this scale with visual stimuli, but as previously noted beauty is an appeal to any of the senses. Thus, how can this scale be applied to evaluations of product designs that appeal to other senses more so than vision, such as perfumes or wines? This is only a small sampling of potential avenues for future research.

We set out to produce a scale that could measure consumer response to product designs. We did this by integrating design theorizing and marketing insights. Through the course of this article we have used established scale development procedures (Netemeyer et al. 2003), while

integrating more recent techniques (e.g., Henseler et al. 2015; Voorhees et al. 2016). We demonstrate not only the reliability and validity of our scale, but also its higher effectiveness over the next best alternative. We provide substantial theoretical and practical contributions to the marketing discipline while addressing the crucially important issue of design (e.g., Dahl 2011; Homburg et al. 2015; Luchs and Swan 2011; MSI.org 2017). We hope that the introduction of the theoretically and technically rigorous DESIGN scale that integrates insights from design theorists, design experts, and marketing researchers (strategy and consumer) can bring a better and comprehensive understanding of design for researchers, communication across disciplines, more sustainable product designs for consumers, and insights hitherto unavailable to our field.

## TABLES

**Table 2.1**

| Definitions and Sources of Key Constructs |                                                                        |                                                                                                                                                                                       |                            |                                                                   |
|-------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------|
| Constructs/<br>Dimensions                 | Source/Theory                                                          | Definition                                                                                                                                                                            | Nature                     | Examples of<br>Related/Captured<br>Constructs                     |
| Form                                      | "Form ever follows function"<br>- 19th century (Sullivan 1896)         | The resultant physical manifestation of a product idea                                                                                                                                | Intrinsic                  | shape, color,<br>material, simplicity                             |
| Function                                  | "Form ever follows function"<br>- 19th century (Sullivan 1896)         | The intended purpose and outcome provided by the form                                                                                                                                 | Intrinsic                  | discernability,<br>understandability,<br>intuitiveness            |
| Solidity                                  | The Vitruvian Triad<br>- 1st century B.C. (Gwilt 1826)                 | The maintaining of form and functionality of a design consistently over the expected life of a product                                                                                | Extrinsic                  | reliable, dependable,<br>ease of use                              |
| Usefulness                                | The Vitruvian Triad<br>- 1st century B.C. (Gwilt 1826)                 | The meeting of a consumer need through the form and/or function of a design                                                                                                           | Extrinsic                  | ergonomics,<br>technology,<br>utilitarian                         |
| Beauty                                    | The Vitruvian Triad<br>- 1st century B.C. (Gwilt 1826)                 | The positive appeal to one or more of the senses through the form and/or function of a design                                                                                         | Extrinsic                  | aesthetics, cuteness,<br>anthropomorphism,<br>technology, hedonic |
| Eco-consciousness                         | Industrial Revolution<br>Ramifications<br>- Middle of the 20th century | The preservation, protection, and/or promotion of environmentally friendly behavior through the form and/or function of a design or the creation of a design                          | Extrinsic                  | local, green,<br>sustainable,<br>environmental                    |
| Uniqueness                                | Industrial Revolution<br>Ramifications<br>- Middle of the 20th century | The manifestation of the form and/or function such that a design is perceived as distinct from other designs                                                                          | Extrinsic                  | cutting-edge,<br>novelty, personal fit,<br>handmade               |
| Product Design                            | Modified definition from<br>Lucas and Swan (2011)                      | "the set of properties of an artifact, consisting of the discrete properties of the form and the function together with the holistic properties of the integrated form and function." | Intrinsic                  | -                                                                 |
| Good Product Design                       | Combination of our research                                            | The optimum cohesion of the form and function such that a consumer perceives a benefit(s) from the solidity, usefulness, beauty, eco-consciousness, and/or uniqueness                 | Intrinsic and<br>extrinsic | -                                                                 |

**Table 2.2**

| Summary of Stages, Data Sets, and Primary Aims |          |     |          |          |                                |                                                      |                                  |
|------------------------------------------------|----------|-----|----------|----------|--------------------------------|------------------------------------------------------|----------------------------------|
| Primary Stage                                  | Data Set | n   | % female | Avg. Age | Designs Evaluated: Appendix A* | Primary Purpose                                      | Source                           |
| 1                                              | 1        | 406 | 47.9     | 20.7     | Figure 1                       | Convergent and Face Validity                         | Public University Undergraduates |
| 2                                              | 2        | 301 | 56.1     | 37.1     | Figure 1                       | Discriminant and Nomological Validity                | U.S. Mturk Workers               |
|                                                | 2A       | 184 | 53.3     | 38.3     | Figure 1                       | Temporal Stability                                   | U.S. Mturk Workers**             |
|                                                | 3        | 376 | 47.2     | 20.5     | Figure 2                       | Discriminant and Predictive Validity                 | Public University Undergraduates |
|                                                | 4        | 164 | 36.0     | 33.8     | Figure 3                       | Discriminant, Experimental, and Nomological Validity | International Mturk Workers      |
| 3                                              | 5        | 202 | 42.6     | 33.7     | Figure 4                       | Diagnostic Ability                                   | U.S. Mturk Workers               |

\* - We utilized a wide range of product designs to show the extensive usability of our scale

\*\* - A subset of participants from Data Set 2

**Table 2.3**

| <b>Confirmatory Factor Analysis (CFA) Factor Loadings and Alphas, by Dimension and Data Set</b> |                     |      |      |      |          |
|-------------------------------------------------------------------------------------------------|---------------------|------|------|------|----------|
| Item                                                                                            | Factors by Data Set |      |      |      |          |
|                                                                                                 | 1                   | 2    | 3    | 4    | Combined |
| Form dimension ( $\alpha = .86, .90, .86, .83, .83$ )**                                         | Factor 1            |      |      |      |          |
| Is this design ugly?*                                                                           | 0.9                 | 0.91 | 0.9  | 0.71 | 0.87     |
| Do you find this design to be unappealing?*                                                     | 0.8                 | 0.85 | 0.8  | 0.77 | 0.83     |
| Is this design terrible to look at?*                                                            | 0.9                 | 0.85 | 0.8  | 0.86 | 0.83     |
| Function dimension ( $\alpha = .78, .75, .69, .76, .76$ )                                       | Factor 2            |      |      |      |          |
| Does this design give a poor indication of use?*                                                | 0.74                | 0.73 | 0.69 | 0.67 | 0.69     |
| Is it difficult to determine what this design does?*                                            | 0.76                | 0.72 | 0.59 | 0.81 | 0.71     |
| Would it take a while to find out how to use this design?*                                      | 0.71                | 0.68 | 0.66 | 0.69 | 0.70     |
| Solidity dimension ( $\alpha = .81, .85, .81, .78, .78$ )                                       | Factor 3            |      |      |      |          |
| Are you confident that this design will keep its value over time?                               | 0.79                | 0.82 | 0.78 | 0.84 | 0.84     |
| Will this design last a long time?                                                              | 0.76                | 0.78 | 0.71 | 0.86 | 0.78     |
| Do you think this design operates well?                                                         | 0.74                | 0.82 | 0.79 | 0.65 | 0.80     |
| Usefulness dimension ( $\alpha = .77, .84, .75, .79, .79$ )                                     | Factor 4            |      |      |      |          |
| Does this design have a good purpose?                                                           | 0.74                | 0.77 | 0.70 | 0.74 | 0.75     |
| Is this design beneficial?                                                                      | 0.75                | 0.84 | 0.76 | 0.75 | 0.80     |
| Would this design help you?                                                                     | 0.70                | 0.82 | 0.71 | 0.74 | 0.79     |
| Beauty dimension ( $\alpha = .87, .92, .84, .88, .88$ )                                         | Factor 5            |      |      |      |          |
| Is this design cool?                                                                            | 0.85                | 0.90 | 0.80 | 0.79 | 0.86     |
| Does this design attract you?                                                                   | 0.82                | 0.90 | 0.76 | 0.85 | 0.87     |
| Does this design have a good style?                                                             | 0.82                | 0.89 | 0.86 | 0.90 | 0.89     |
| Eco-consciousness dimension ( $\alpha = .86, .83, .90, .78, .78$ )                              | Factor 6            |      |      |      |          |
| Is this design eco-friendly?                                                                    | 0.8                 | 0.82 | 0.86 | 0.90 | 0.85     |
| Do you think this is a 'green' design?                                                          | 0.8                 | 0.73 | 0.89 | 0.72 | 0.78     |
| Does this design help the environment?                                                          | 0.9                 | 0.82 | 0.84 | 0.83 | 0.84     |
| Uniqueness dimension ( $\alpha = .85, .89, .86, .82, .82$ )                                     | Factor 7            |      |      |      |          |
| Would you say this design is unique?                                                            | 0.8                 | 0.91 | 0.89 | 0.75 | 0.88     |
| Is this design different from other designs?                                                    | 0.8                 | 0.78 | 0.80 | 0.85 | 0.80     |
| Does this design seem to be original?                                                           | 0.80                | 0.88 | 0.77 | 0.79 | 0.84     |

\* - indicates reverse coded

\*\* - Alphas are listed in data set order: 1, 2, 3, 4, and combined

**Table 2.4**

| <b>CFA (Data Set 1)</b>          |               |
|----------------------------------|---------------|
| Chi Square (df)                  | 513.000 (168) |
| CFI                              | 0.93          |
| TLI                              | 0.91          |
| RMSEA                            | 0.07          |
| SRMR                             | 0.05          |
| AVE <sub>Form</sub>              | 0.68          |
| AVE <sub>Function</sub>          | 0.55          |
| AVE <sub>Solidity</sub>          | 0.59          |
| AVE <sub>Usefulness</sub>        | 0.54          |
| AVE <sub>Beauty</sub>            | 0.69          |
| AVE <sub>Eco-consciousness</sub> | 0.68          |
| AVE <sub>Uniqueness</sub>        | 0.66          |
| CR <sub>Form</sub>               | 0.86          |
| CR <sub>Function</sub>           | 0.78          |
| CR <sub>Solidity</sub>           | 0.81          |
| CR <sub>Usefulness</sub>         | 0.78          |
| CR <sub>Beauty</sub>             | 0.87          |
| CR <sub>Eco-consciousness</sub>  | 0.87          |
| CR <sub>Uniqueness</sub>         | 0.85          |

AVE: Average Variance Extracted; CR: Composite Reliability

**Table 2.5**

| <b>MANCOVA Results Using (a) Proposed Scale and (b) Homburg et al. Scale (Data Set 1)</b> |                   |                           |                           |                           |                           |
|-------------------------------------------------------------------------------------------|-------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| n = 406                                                                                   |                   |                           |                           |                           |                           |
|                                                                                           |                   | LTP                       | WOM                       | WTP                       | POS                       |
| Dependent Variables:                                                                      |                   | Mean = 3.13;<br>SD = 1.65 | Mean = 3.16;<br>SD = 1.63 | Mean = 2.81;<br>SD = 1.50 | Mean = 3.67;<br>SD = 1.65 |
| Independent Variable:<br>Product Design Seen                                              |                   | 6.674***                  | 1.883                     | 4.515***                  | 2.427*                    |
| Covariates                                                                                | Form              | 1.324                     | 0.604                     | 1.549                     | 5.889*                    |
|                                                                                           | Function          | 9.296**                   | 1.777                     | 14.036***                 | 0.244                     |
|                                                                                           | Solidity          | 9.088**                   | 0.476                     | 15.958***                 | 5.571*                    |
|                                                                                           | Usefulness        | 9.743**                   | 4.296*                    | 6.631**                   | 6.428*                    |
|                                                                                           | Beauty            | 15.424***                 | 14.554***                 | 0.745                     | 19.688***                 |
|                                                                                           | Eco-consciousness | 0.027                     | 1.664                     | 0.020                     | 0.195                     |
|                                                                                           | Uniqueness        | 5.574*                    | 0.150                     | 1.694                     | 0.017                     |
| R <sup>2</sup>                                                                            |                   | 0.41                      | 0.29                      | 0.28                      | 0.43                      |
| -----<br>Homburg et al. Scale                                                             |                   |                           |                           |                           |                           |
| Independent Variable:<br>Product Design Seen                                              |                   | 16.727***                 | 6.167***                  | 7.618***                  | 10.649***                 |
| Covariates                                                                                | Aesthetic         | 5.866*                    | 10.263***                 | 4.649*                    | 20.300***                 |
|                                                                                           | Functional        | 2.797†                    | 8.342**                   | 3.316†                    | 1.161                     |
|                                                                                           | Symbolic          | 3.989*                    | 8.037**                   | 3.657†                    | 0.02                      |
| R <sup>2</sup>                                                                            |                   | 0.20                      | 0.16                      | 0.12                      | 0.20                      |
| ΔR <sup>2</sup>                                                                           |                   | 0.21                      | 0.13                      | 0.16                      | 0.23                      |

† sig at .1, \*sig at .05, \*\*sig at .01, and \*\*\*sig at .001

LTP = Likelihood to Purchase ( $\alpha = .92$ ); WOM = Word of Mouth ( $\alpha = .92$ );

WTP = Willingness to Pay; POS = Positive Attitude



**Table 2.6**

| Predictive Validity (Data Set 1): Product Designs 1, 2, and 3 |  |                           |                           |                           |                           |                                |                           |                           |                           |                           |                           |                           |                           |         |
|---------------------------------------------------------------|--|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------|
| Product Design                                                |  | Paddleboard (n = 83)      |                           |                           |                           | Salt and Pepper Shaker (n =80) |                           |                           |                           | Scooter (n =82)           |                           |                           |                           |         |
| Dependent Variables :                                         |  | LTP                       | WOM                       | WTP                       | POS                       | LTP                            | WOM                       | WTP                       | POS                       | LTP                       | WOM                       | WTP                       | POS                       |         |
|                                                               |  | Mean = 3.40;<br>SD = 1.72 | Mean = 3.80;<br>SD = 1.63 | Mean = 3.31;<br>SD = 1.53 | Mean = 4.22;<br>SD = 1.68 | Mean = 3.59;<br>SD = 1.49      | Mean = 3.56;<br>SD = 1.48 | Mean = 2.97;<br>SD = 1.41 | Mean = 4.13;<br>SD = 1.41 | Mean = 2.45;<br>SD = 1.46 | Mean = 2.88;<br>SD = 1.62 | Mean = 2.43;<br>SD = 1.48 | Mean = 2.90;<br>SD = 1.38 |         |
|                                                               |  | Form                      | 0.113                     | 0.738                     | 0.303                     | 1.095                          | 2.257                     | 7.093**                   | 1.887                     | 3.793†                    | 0.252                     | 0.037                     | 2.470                     | 0.483   |
|                                                               |  | Function                  | 1.242                     | 0.226                     | 2.185                     | 0.220                          | 3.923†                    | 6.634*                    | 9.927**                   | 1.072                     | 0.266                     | 0.013                     | 0.895                     | 0.297   |
|                                                               |  | Solidity                  | 6.840*                    | 0.514                     | 9.537**                   | 3.701†                         | 1.818                     | 1.479                     | 10.574**                  | 0.732                     | 3.182†                    | 0.739                     | 8.389**                   | 2.217   |
| Eco-consciousness                                             |  | Usefulness                | 1.189                     | 1.555                     | 0.356                     | 2.821†                         | 7.237**                   | 3.799†                    | 1.785                     | 5.271*                    | 0.121                     | 0.045                     | 0.077                     |         |
|                                                               |  | Beauty                    | 1.736                     | 2.379                     | 0.642                     | 1.663                          | 2.351                     | 0.855                     | 0.024                     | 3.127†                    | 1.319                     | 1.101                     | 0.287                     | 4.055*  |
|                                                               |  | Uniqueness                | 1.394                     | 0.076                     | 0.508                     | 0.028                          | 4.044*                    | 3.401†                    | 2.819†                    | 0.788                     | 4.031*                    | 0.005                     | 0.270                     | 0.264   |
|                                                               |  | R <sup>2</sup>            | 0.38                      | 0.30                      | 0.38                      | 0.46                           | 0.42                      | 0.34                      | 0.30                      | 0.42                      | 0.24                      | 0.14                      | 0.26                      | 0.25    |
|                                                               |  | Aesthetic                 | 0.230                     | 0.110                     | 0.090                     | 1.890                          | 0.254                     | 1.520                     | 5.150*                    | 0.208                     | 3.570†                    | 4.531*                    | 3.287†                    | 7.563** |
| Homburg et al. Scale                                          |  | Functional                | 0.110                     | 0.290                     | 0.560                     | 0.040                          | 0.027                     | 2.630                     | 0.784                     | 0.305                     | 0.409                     | 0.327                     | 1.462                     | 0.039   |
|                                                               |  | Symbolic                  | 7.876**                   | 7.456**                   | 8.463**                   | 1.04                           | 2.223                     | 3.908†                    | 0.687                     | 0.96                      | 0.835                     | 3.606†                    | 0.321                     | 3.325†  |
| R <sup>2</sup>                                                |  | 0.10                      | 0.10                      | 0.14                      | 0.11                      | 0.05                           | 0.09                      | 0.11                      | 0.05                      | 0.04                      | 0.08                      | 0.05                      | 0.09                      |         |
| ΔR <sup>2</sup>                                               |  | 0.28                      | 0.20                      | 0.24                      | 0.35                      | 0.37                           | 0.25                      | 0.19                      | 0.37                      | 0.20                      | 0.06                      | 0.21                      | 0.16                      |         |

† sig at .1, \*sig at .05, \*\*sig at .01, and \*\*\*sig at .001

LTP = Likelihood to Purchase ( $\alpha = .92$ ); WOM = Word of Mouth ( $\alpha = .92$ ); WTP = Willingness to Pay; POS = Positive Attitude

**Table 2.6 (cont.)**

| Predictive Validity (Data Set 1): Product Designs 4 and 5 |                   |                           |                           |                           |                           |                           |                           |                           |                           |
|-----------------------------------------------------------|-------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Product Design                                            |                   | Seaweed Snack (n = 78)    |                           |                           |                           | Towel Set (n = 83)        |                           |                           |                           |
| Dependent Variables:                                      |                   | LTP                       | WOM                       | WTP                       | POS                       | LTP                       | WOM                       | WTP                       | POS                       |
|                                                           |                   | Mean = 2.26;<br>SD = 1.51 | Mean = 2.55;<br>SD = 1.57 | Mean = 2.17;<br>SD = 1.46 | Mean = 2.95;<br>SD = 1.71 | Mean = 3.92;<br>SD = 1.43 | Mean = 2.98;<br>SD = 1.57 | Mean = 3.13;<br>SD = 1.32 | Mean = 4.11;<br>SD = 1.51 |
|                                                           | Form              | 0.085                     | 1.626                     | 0.089                     | 1.208                     | 2.627                     | 1.676                     | 0.027                     | 0.445                     |
|                                                           | Function          | 3.447†                    | 0.130                     | 2.335                     | 0.009                     | 0.055                     | 0.067                     | 0.027                     | 1.502                     |
|                                                           | Solidity          | 0.363                     | 0.339                     | 0.038                     | 2.642                     | 0.252                     | 0.031                     | 1.315                     | 0.010                     |
|                                                           | Usefulness        | 0.880                     | 1.240                     | 3.603†                    | 0.257                     | 0.562                     | 0.091                     | 5.715*                    | 1.100                     |
|                                                           | Beauty            | 5.574*                    | 13.465***                 | 0.993                     | 6.840*                    | 1.530                     | 0.562                     | 0.719                     | 1.061                     |
|                                                           | Eco-consciousness | 0.338                     | 2.591                     | 0.379                     | 0.266                     | 0.271                     | 1.973                     | 0.440                     | 0.055                     |
|                                                           | Uniqueness        | 0.849                     | 1.076                     | 1.385                     | 1.897                     | 1.987                     | 6.002*                    | 0.804                     | 2.380                     |
|                                                           | R <sup>2</sup>    | 0.30                      | 0.33                      | 0.18                      | 0.46                      | 0.33                      | 0.34                      | 0.25                      | 0.25                      |
| Homburg et al. Scale                                      | Aesthetic         | 6.607*                    | 2.262                     | 3.604†                    | 14.093***                 | 2.66                      | 1.95                      | 0.956                     | 3.000†                    |
|                                                           | Functional        | 0.064                     | 0.128                     | 0.004                     | 0.699                     | 6.857*                    | 5.898*                    | 8.969**                   | 1.769                     |
|                                                           | Symbolic          | 0.096                     | 0.348                     | 0.023                     | 0.856                     | 0.88                      | 0.36                      | 2.22                      | 0.16                      |
| R <sup>2</sup>                                            |                   | 0.18                      | 0.09                      | 0.11                      | 0.20                      | 0.08                      | 0.08                      | 0.21                      | 0.05                      |
| ΔR <sup>2</sup>                                           |                   | 0.12                      | 0.24                      | 0.07                      | 0.26                      | 0.25                      | 0.26                      | 0.04                      | 0.20                      |

† sig at .1, \*sig at .05, \*\*sig at .01, and \*\*\*sig at .001

LTP = Likelihood to Purchase ( $\alpha = .92$ ); WOM = Word of Mouth ( $\alpha = .92$ ); WTP = Willingness to Pay; POS = Positive Attitude

Table 2.7

| DESCRIPTIVE STATISTICS, INTERNAL CONSISTENCY, AND DISCRIMINANT VALIDITY BY DESIGN (Data Set 1 & 2) |      |      |      |      |      |      |       |       |       |       |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
|----------------------------------------------------------------------------------------------------|------|------|------|------|------|------|-------|-------|-------|-------|------|------|---------------------|------|----------|------|----------|------|------------|---|--------|---|---------------|---|------------|---|
| Data Set                                                                                           | Mean |      |      |      | SD   |      |       |       | α     |       |      |      | Pearson Correlation |      |          |      |          |      |            |   |        |   |               |   |            |   |
|                                                                                                    | 1    |      | 2    |      | 1    |      | 2     |       | 1     |       | 2    |      | Form                |      | Function |      | Solidity |      | Usefulness |   | Beauty |   | Eco-conscious |   | Uniqueness |   |
|                                                                                                    | 1    | 2    | 1    | 2    | 1    | 2    | 1     | 2     | 1     | 2     | 1    | 2    | 1                   | 2    | 1        | 2    | 1        | 2    | 1          | 2 | 1      | 2 | 1             | 2 | 1          | 2 |
| Design: Paddleboard (n = 83, 60)                                                                   |      |      |      |      |      |      |       |       |       |       |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Form                                                                                               | 4.79 | 5.43 | 1.39 | 1.37 | 0.86 | 0.81 | 1     | 1     |       |       |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Function                                                                                           | 4.69 | 4.95 | 1.20 | 1.37 | 0.80 | 0.73 | 0.77  | 0.68  | 1     | 1     |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Solidity                                                                                           | 4.00 | 4.35 | 1.28 | 1.28 | 0.86 | 0.83 | -0.02 | 0.08  | -0.16 | -0.17 | 1    | 1    |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Usefulness                                                                                         | 4.53 | 4.70 | 1.16 | 1.17 | 0.75 | 0.76 | 0.20  | 0.20  | 0.08  | 0.03  | 0.72 | 0.44 | 1                   | 1    |          |      |          |      |            |   |        |   |               |   |            |   |
| Beauty                                                                                             | 4.83 | 5.11 | 1.23 | 1.28 | 0.87 | 0.90 | 0.39  | 0.35  | 0.15  | -0.02 | 0.61 | 0.60 | 0.67                | 0.49 | 1        | 1    |          |      |            |   |        |   |               |   |            |   |
| Eco-consciousness                                                                                  | 4.14 | 4.23 | 1.24 | 1.40 | 0.90 | 0.88 | -0.30 | 0.03  | -0.30 | -0.18 | 0.41 | 0.58 | 0.31                | 0.65 | 0.19     | 0.51 | 1        | 1    |            |   |        |   |               |   |            |   |
| Uniqueness                                                                                         | 4.89 | 5.25 | 1.21 | 1.15 | 0.82 | 0.86 | 0.07  | -0.03 | -0.05 | -0.17 | 0.38 | 0.11 | 0.39                | 0.23 | 0.48     | 0.43 | 0.39     | 0.27 | 1          | 1 |        |   |               |   |            |   |
| Design: Salt and Pepper Shaker (n = 80, 56)                                                        |      |      |      |      |      |      |       |       |       |       |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Form                                                                                               | 4.75 | 4.98 | 1.30 | 1.71 | 0.85 | 0.92 | 1     | 1     |       |       |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Function                                                                                           | 4.86 | 5.43 | 1.29 | 1.43 | 0.79 | 0.81 | 0.78  | 0.53  | 1     | 1     |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Solidity                                                                                           | 4.39 | 4.63 | 1.06 | 1.43 | 0.72 | 0.88 | 0.10  | 0.60  | -0.03 | 0.58  | 1    | 1    |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Usefulness                                                                                         | 4.55 | 4.89 | 1.16 | 1.32 | 0.77 | 0.84 | 0.19  | 0.59  | 0.07  | 0.48  | 0.56 | 0.76 | 1                   | 1    |          |      |          |      |            |   |        |   |               |   |            |   |
| Beauty                                                                                             | 4.62 | 4.88 | 1.19 | 1.69 | 0.85 | 0.93 | 0.43  | 0.86  | 0.24  | 0.41  | 0.49 | 0.67 | 0.66                | 0.70 | 1        | 1    |          |      |            |   |        |   |               |   |            |   |
| Eco-consciousness                                                                                  | 4.03 | 4.00 | 1.14 | 0.89 | 0.83 | 0.58 | -0.30 | 0.20  | -0.34 | 0.15  | 0.41 | 0.50 | 0.36                | 0.42 | 0.33     | 0.33 | 1        | 1    |            |   |        |   |               |   |            |   |
| Uniqueness                                                                                         | 4.84 | 5.77 | 1.10 | 0.97 | 0.75 | 0.78 | 0.15  | 0.39  | -0.04 | 0.21  | 0.43 | 0.26 | 0.55                | 0.44 | 0.64     | 0.41 | 0.28     | 0.18 | 1          | 1 |        |   |               |   |            |   |
| Design: Scooter (n = 82, 60)                                                                       |      |      |      |      |      |      |       |       |       |       |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Form                                                                                               | 3.52 | 4.36 | 1.27 | 1.75 | 0.83 | 0.91 | 1     | 1     |       |       |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Function                                                                                           | 4.27 | 4.40 | 1.18 | 1.32 | 0.74 | 0.69 | 0.47  | 0.32  | 1     | 1     |      |      |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Solidity                                                                                           | 3.70 | 4.28 | 1.17 | 1.22 | 0.77 | 0.80 | -0.13 | 0.35  | -0.24 | 0.03  | 1    | 1    |                     |      |          |      |          |      |            |   |        |   |               |   |            |   |
| Usefulness                                                                                         | 3.98 | 4.72 | 1.12 | 1.23 | 0.71 | 0.83 | -0.27 | 0.39  | -0.27 | 0.06  | 0.67 | 0.74 | 1                   | 1    |          |      |          |      |            |   |        |   |               |   |            |   |
| Beauty                                                                                             | 3.49 | 4.01 | 1.23 | 1.67 | 0.80 | 0.92 | 0.05  | 0.68  | -0.20 | 0.07  | 0.67 | 0.69 | 0.57                | 0.74 | 1        | 1    |          |      |            |   |        |   |               |   |            |   |
| Eco-consciousness                                                                                  | 4.26 | 4.90 | 1.25 | 1.21 | 0.85 | 0.86 | -0.28 | 0.16  | -0.21 | -0.04 | 0.51 | 0.52 | 0.63                | 0.54 | 0.44     | 0.52 | 1        | 1    |            |   |        |   |               |   |            |   |
| Uniqueness                                                                                         | 4.60 | 5.53 | 1.18 | 1.14 | 0.82 | 0.88 | -0.49 | -0.10 | -0.44 | -0.19 | 0.52 | 0.24 | 0.58                | 0.34 | 0.34     | 0.22 | 0.52     | 0.50 | 1          | 1 |        |   |               |   |            |   |

**Table 2.7 (cont.)**

| DESCRIPTIVE STATISTICS, INTERNAL CONSISTENCY, AND DISCRIMINANT VALIDITY BY DESIGN (Data Set 1 & 2) (cont.) |      |      |      |      |          |      |                     |          |          |            |        |               |            |      |      |      |
|------------------------------------------------------------------------------------------------------------|------|------|------|------|----------|------|---------------------|----------|----------|------------|--------|---------------|------------|------|------|------|
| Data Set                                                                                                   | Mean |      | SD   |      | $\alpha$ |      | Pearson Correlation |          |          |            |        |               |            |      |      |      |
|                                                                                                            | 1    | 2    | 1    | 2    | 1        | 2    | Form                | Function | Solidity | Usefulness | Beauty | Eco-conscious | Uniqueness | 1    | 2    | 2    |
| Design: Seaweed Snack (n = 78, 64)                                                                         |      |      |      |      |          |      |                     |          |          |            |        |               |            |      |      |      |
| Form                                                                                                       | 3.98 | 4.46 | 1.39 | 1.97 | 0.83     | 0.93 | 1                   | 1        |          |            |        |               |            |      |      |      |
| Function                                                                                                   | 4.41 | 5.10 | 1.24 | 1.39 | 0.79     | 0.79 | 0.37                | 0.62     | 1        | 1          |        |               |            |      |      |      |
| Solidity                                                                                                   | 3.71 | 4.29 | 1.18 | 1.51 | 0.80     | 0.89 | 0.51                | 0.77     | 0.17     | 0.50       | 1      | 1             |            |      |      |      |
| Usefulness                                                                                                 | 3.80 | 4.15 | 1.21 | 1.45 | 0.78     | 0.87 | 0.40                | 0.72     | 0.27     | 0.41       | 0.80   | 0.81          | 1          | 1    |      |      |
| Beauty                                                                                                     | 3.62 | 4.12 | 1.44 | 1.93 | 0.90     | 0.95 | 0.60                | 0.84     | 0.10     | 0.45       | 0.74   | 0.84          | 0.64       | 0.82 | 1    | 1    |
| Eco-consciousness                                                                                          | 3.59 | 3.91 | 1.28 | 1.30 | 0.88     | 0.86 | 0.21                | 0.30     | -0.06    | -0.10      | 0.63   | 0.45          | 0.63       | 0.50 | 0.58 | 0.44 |
| Uniqueness                                                                                                 | 3.75 | 4.50 | 1.28 | 1.26 | 0.80     | 0.74 | 0.26                | 0.16     | -0.22    | 0.11       | 0.52   | 0.32          | 0.43       | 0.33 | 0.46 | 0.35 |
| Design: Towel Set (n = 83, 61)                                                                             |      |      |      |      |          |      |                     |          |          |            |        |               |            |      |      |      |
| Form                                                                                                       | 4.95 | 5.64 | 1.36 | 1.18 | 0.85     | 0.84 | 1                   | 1        |          |            |        |               |            |      |      |      |
| Function                                                                                                   | 5.00 | 5.63 | 1.28 | 1.19 | 0.76     | 0.71 | 0.59                | 0.52     | 1        | 1          |        |               |            |      |      |      |
| Solidity                                                                                                   | 4.59 | 5.29 | 1.15 | 0.77 | 0.80     | 0.59 | 0.27                | 0.36     | 0.25     | 0.19       | 1      | 1             |            |      |      |      |
| Usefulness                                                                                                 | 4.50 | 5.30 | 1.19 | 1.14 | 0.80     | 0.88 | 0.30                | 0.30     | 0.12     | 0.31       | 0.71   | 0.52          | 1          | 1    |      |      |
| Beauty                                                                                                     | 4.22 | 4.69 | 1.32 | 1.10 | 0.85     | 0.81 | 0.30                | 0.36     | -0.04    | -0.03      | 0.60   | 0.33          | 0.66       | 0.41 | 1    | 1    |
| Eco-consciousness                                                                                          | 3.86 | 3.95 | 1.24 | 0.98 | 0.84     | 0.73 | -0.12               | -0.13    | -0.31    | -0.16      | 0.35   | 0.28          | 0.37       | 0.40 | 0.35 | 0.35 |
| Uniqueness                                                                                                 | 2.96 | 3.03 | 1.28 | 1.42 | 0.79     | 0.86 | -0.39               | -0.28    | -0.61    | -0.40      | 0.09   | 0.31          | 0.28       | 0.17 | 0.46 | 0.37 |
|                                                                                                            |      |      |      |      |          |      |                     |          |          |            |        |               |            |      | 0.50 | 0.50 |
|                                                                                                            |      |      |      |      |          |      |                     |          |          |            |        |               |            |      | 1    | 1    |

**Table 2.8**

| DESCRIPTIVE STATISTICS, INTERNAL CONSISTENCY, AND DISCRIMINANT VALIDITY BY DESIGN (Data Set 3) |      |      |      |                     |          |          |            |        |                   |            |
|------------------------------------------------------------------------------------------------|------|------|------|---------------------|----------|----------|------------|--------|-------------------|------------|
|                                                                                                | Mean | SD   | α    | Pearson Correlation |          |          |            |        |                   |            |
|                                                                                                |      |      |      | Form                | Function | Solidity | Usefulness | Beauty | Eco-consciousness | Uniqueness |
| Design: Breakfast Center (n = 49)                                                              |      |      |      |                     |          |          |            |        |                   |            |
| Form                                                                                           | 3.72 | 1.46 | 0.82 | 1                   |          |          |            |        |                   |            |
| Function                                                                                       | 4.99 | 1.33 | 0.78 | 0.34                | 1        |          |            |        |                   |            |
| Solidity                                                                                       | 3.48 | 1.23 | 0.79 | 0.36                | 0.30     | 1        |            |        |                   |            |
| Usefulness                                                                                     | 4.67 | 1.28 | 0.79 | 0.42                | 0.25     | 0.80     | 1          |        |                   |            |
| Beauty                                                                                         | 3.88 | 1.37 | 0.81 | 0.86                | 0.25     | 0.51     | 0.61       | 1      |                   |            |
| Eco-consciousness                                                                              | 3.58 | 1.24 | 0.84 | 0.28                | -0.04    | 0.24     | 0.39       | 0.36   | 1                 |            |
| Uniqueness                                                                                     | 5.19 | 1.12 | 0.74 | 0.13                | -0.20    | 0.15     | 0.15       | 0.30   | 0.27              | 1          |
| Design: Lawn Mower (n = 40)                                                                    |      |      |      |                     |          |          |            |        |                   |            |
| Form                                                                                           | 4.40 | 1.48 | 0.81 | 1                   |          |          |            |        |                   |            |
| Function                                                                                       | 5.29 | 1.03 | 0.49 | 0.25                | 1        |          |            |        |                   |            |
| Solidity                                                                                       | 4.58 | 1.16 | 0.81 | 0.49                | 0.10     | 1        |            |        |                   |            |
| Usefulness                                                                                     | 5.03 | 1.13 | 0.77 | 0.42                | 0.31     | 0.64     | 1          |        |                   |            |
| Beauty                                                                                         | 3.93 | 1.41 | 0.89 | 0.82                | 0.17     | 0.54     | 0.59       | 1      |                   |            |
| Eco-consciousness                                                                              | 4.82 | 1.25 | 0.91 | 0.19                | 0.19     | -0.08    | 0.22       | 0.06   | 1                 |            |
| Uniqueness                                                                                     | 4.33 | 1.29 | 0.85 | -0.06               | -0.13    | 0.18     | 0.10       | 0.12   | -0.14             | 1          |
| Design: Multi-Purpose Tool (n = 29)                                                            |      |      |      |                     |          |          |            |        |                   |            |
| Form                                                                                           | 4.74 | 1.48 | 0.92 | 1                   |          |          |            |        |                   |            |
| Function                                                                                       | 4.23 | 1.59 | 0.78 | 0.36                | 1        |          |            |        |                   |            |
| Solidity                                                                                       | 4.22 | 1.22 | 0.82 | 0.60                | 0.60     | 1        |            |        |                   |            |
| Usefulness                                                                                     | 5.01 | 1.13 | 0.81 | 0.72                | 0.64     | 0.76     | 1          |        |                   |            |
| Beauty                                                                                         | 4.51 | 1.55 | 0.92 | 0.88                | 0.46     | 0.75     | 0.80       | 1      |                   |            |
| Eco-consciousness                                                                              | 3.87 | 0.84 | 0.74 | 0.32                | 0.17     | 0.48     | 0.43       | 0.45   | 1                 |            |
| Uniqueness                                                                                     | 5.49 | 0.97 | 0.88 | 0.33                | 0.02     | 0.26     | 0.15       | 0.41   | 0.41              | 1          |
| Design: Water Balloons (n = 56)                                                                |      |      |      |                     |          |          |            |        |                   |            |
| Form                                                                                           | 4.56 | 1.32 | 0.89 | 1                   |          |          |            |        |                   |            |
| Function                                                                                       | 5.30 | 0.92 | 0.59 | 0.31                | 1        |          |            |        |                   |            |
| Solidity                                                                                       | 4.20 | 1.06 | 0.78 | 0.45                | 0.35     | 1        |            |        |                   |            |
| Usefulness                                                                                     | 4.42 | 0.87 | 0.58 | 0.54                | 0.25     | 0.25     | 1          |        |                   |            |
| Beauty                                                                                         | 4.10 | 1.09 | 0.80 | 0.75                | 0.18     | 0.43     | 0.52       | 1      |                   |            |
| Eco-consciousness                                                                              | 2.79 | 1.28 | 0.88 | 0.31                | 0.04     | 0.42     | 0.41       | 0.35   | 1                 |            |
| Uniqueness                                                                                     | 3.23 | 1.21 | 0.73 | 0.35                | -0.06    | 0.29     | 0.30       | 0.41   | 0.37              | 1          |

**Table 2.9**

| DESCRIPTIVE STATISTICS, INTERNAL CONSISTENCY, AND DISCRIMINANT VALIDITY BY DESIGN (Data Set 4) |      |      |      |                     |          |          |            |        |                   |            |
|------------------------------------------------------------------------------------------------|------|------|------|---------------------|----------|----------|------------|--------|-------------------|------------|
|                                                                                                | Mean | SD   | α    | Pearson Correlation |          |          |            |        |                   |            |
|                                                                                                |      |      |      | Form                | Function | Solidity | Usefulness | Beauty | Eco-consciousness | Uniqueness |
| Design: Coffe Control (n = 86)                                                                 |      |      |      |                     |          |          |            |        |                   |            |
| Form                                                                                           | 5.10 | 1.51 | 0.82 | 1                   |          |          |            |        |                   |            |
| Function                                                                                       | 4.44 | 1.52 | 0.76 | 0.63                | 1        |          |            |        |                   |            |
| Solidity                                                                                       | 5.34 | 0.98 | 0.82 | -0.04               | -0.20    | 1        |            |        |                   |            |
| Usefulness                                                                                     | 5.31 | 1.01 | 0.79 | -0.05               | -0.32    | 0.83     | 1          |        |                   |            |
| Beauty                                                                                         | 5.37 | 1.08 | 0.88 | -0.03               | -0.26    | 0.73     | 0.75       | 1      |                   |            |
| Eco-consciousness                                                                              | 4.49 | 1.29 | 0.85 | -0.34               | -0.51    | 0.52     | 0.68       | 0.60   | 1                 |            |
| Uniqueness                                                                                     | 4.46 | 1.39 | 0.84 | -0.33               | -0.54    | 0.47     | 0.54       | 0.64   | 0.76              | 1          |
| Design: Coffee Form Minus (n = 78)                                                             |      |      |      |                     |          |          |            |        |                   |            |
| Form                                                                                           | 4.45 | 1.70 | 0.83 | 1                   |          |          |            |        |                   |            |
| Function                                                                                       | 4.21 | 1.51 | 0.75 | 0.68                | 1        |          |            |        |                   |            |
| Solidity                                                                                       | 5.34 | 0.97 | 0.74 | 0.21                | -0.04    | 1        |            |        |                   |            |
| Usefulness                                                                                     | 5.29 | 1.06 | 0.80 | 0.21                | -0.11    | 0.74     | 1          |        |                   |            |
| Beauty                                                                                         | 5.17 | 1.38 | 0.89 | 0.34                | -0.09    | 0.80     | 0.81       | 1      |                   |            |
| Eco-consciousness                                                                              | 4.59 | 1.14 | 0.68 | -0.09               | -0.33    | 0.65     | 0.75       | 0.68   | 1                 |            |
| Uniqueness                                                                                     | 4.94 | 1.32 | 0.78 | -0.04               | -0.36    | 0.59     | 0.51       | 0.62   | 0.60              | 1          |

Table 2.10

| Discriminant Validity (Combined Data Set: n = 561) |               |               |             |                     |             |             |                 |        |                   |            |
|----------------------------------------------------|---------------|---------------|-------------|---------------------|-------------|-------------|-----------------|--------|-------------------|------------|
| Descriptive Statistics and Internal Consistency    |               |               |             |                     |             |             |                 |        |                   |            |
| Dimensions                                         | Mean          | SD            | $\alpha$    | Pearson Correlation |             |             |                 |        |                   |            |
|                                                    |               |               |             | Form                | Function    | Solidity    | Usefulness      | Beauty | Eco-consciousness | Uniqueness |
| Form                                               | 4.79          | 1.63          | 0.88        | 1                   |             |             |                 |        |                   |            |
| Function                                           | 4.95          | 1.38          | 0.74        | 0.46                | 1           |             |                 |        |                   |            |
| Solidity                                           | 4.53          | 1.30          | 0.85        | 0.46                | 0.18        | 1           |                 |        |                   |            |
| Usefulness                                         | 4.82          | 1.23          | 0.81        | 0.43                | 0.17        | 0.68        | 1               |        |                   |            |
| Beauty                                             | 4.53          | 1.51          | 0.90        | 0.66                | 0.12        | 0.66        | 0.66            | 1      |                   |            |
| Eco-consciousness                                  | 4.07          | 1.32          | 0.86        | 0.10                | -0.17       | 0.40        | 0.47            | 0.38   | 1                 |            |
| Unique                                             | 4.62          | 1.51          | 0.88        | -0.05               | -0.25       | 0.09        | 0.20            | 0.28   | 0.40              | 1          |
| HTMT Results*                                      |               |               |             |                     |             |             |                 |        |                   |            |
| Dimensions                                         |               |               |             | Form                | Function    | Solidity    | Usefulness      | Beauty | Eco-consciousness | Uniqueness |
| Form                                               |               |               |             | X                   |             |             |                 |        |                   |            |
| Function                                           |               |               |             | 0.56                | X           |             |                 |        |                   |            |
| Solidity                                           |               |               |             | 0.53                | 0.23        | X           |                 |        |                   |            |
| Usefulness                                         |               |               |             | 0.50                | 0.22        | 0.81        | X               |        |                   |            |
| Beauty                                             |               |               |             | 0.74                | 0.15        | 0.75        | 0.76            | X      |                   |            |
| Eco-consciousness                                  |               |               |             | 0.12                | -0.20       | 0.47        | 0.56            | 0.43   | X                 |            |
| Uniqueness                                         |               |               |             | -0.05               | -0.30       | 0.11        | 0.25            | 0.32   | 0.46              | X          |
| Model Comparison: Scale Dimensionality             |               |               |             |                     |             |             |                 |        |                   |            |
| Model                                              | Chi square    | df            | CFI         | TLI                 | RMSEA       | SRMR        | $\Delta$ AIC*** |        |                   |            |
| One factor                                         | 3615.86       | 189.00        | 0.53        | 0.48                | 0.18        | 0.16        | 3064.72         |        |                   |            |
| Two factors (Intrinsic and Extrinsic)              | 2890.34       | 188.00        | 0.63        | 0.59                | 0.16        | 0.15        | 2341.20         |        |                   |            |
| Six factors (Form/Beautiful combined)              | 1099.30       | 174.00        | 0.87        | 0.85                | 0.10        | 0.09        | 578.16          |        |                   |            |
| Six factors (Useful/Beautiful Combined)            | 816.32        | 174.00        | 0.91        | 0.89                | 0.08        | 0.07        | 295.18          |        |                   |            |
| Six factors (Solid/Useful Combined)                | 631.57        | 174.00        | 0.94        | 0.93                | 0.07        | 0.06        | 110.43          |        |                   |            |
| <b>Seven factors**</b>                             | <b>509.14</b> | <b>168.00</b> | <b>0.95</b> | <b>0.94</b>         | <b>0.06</b> | <b>0.06</b> | <b>0.00</b>     |        |                   |            |

\* - Discriminant validity supported with values below 0.85 (Henseler, Ringle, and Sarstedt 2014; Voorhees et al. 2015)

\*\* - Chi-square difference tests indicate that the seven-factor model is significantly better than all other iterations

\*\*\* - The seven factor model provides the best AIC, and this number was utilized to calculate the differences

**Table 2.11**

| NOMOLOGICAL VALIDITY                         |                                                                                                                                                                                                                                                                                                                                                                                               |                                                    |                                  |                                                                                                                                                                                                                    |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construct                                    | Description                                                                                                                                                                                                                                                                                                                                                                                   | Predicted Relationship                             | Source                           | Characteristics Results                                                                                                                                                                                            |
| PANAS Positive<br>(n = 301)                  | Positive emotional experience should come from consumer interactions with good designs (Srinivasan, Lovejoy, and Beach 1997; matsubara and nagamachi 1997; nagamachi 2002; Holbrook 1980; Bloch 1995; Seva, Been-Lirn Duh, Helander 2006; Holbrook 1980; Fiehl and Fiehl 2001; Fiehl and Fiehl 2016).                                                                                         | Positive correlation with our overall design scale | Watson, Clark, and Tellegen 1988 | M = 2.39;<br>SD = 1.06;<br>$\alpha = .94$<br><br>$r_{scale} = .58 p < .01$                                                                                                                                         |
| PANAS Negative<br>(n = 301)                  | In contrast to positive emotional experiences, it follows that good designs should be negatively correlated with negative emotional experiences.                                                                                                                                                                                                                                              | Negative correlation with our overall design scale | Watson, Clark, and Tellegen 1988 | M = 1.32;<br>SD = 0.65;<br>$\alpha = .93$<br><br>$r_{scale} = -.13 p < .05$                                                                                                                                        |
| Achievement, joy, & inspiration<br>(n = 301) | Good design should specifically elicit feelings of achievement, joy, and inspiration (Givechi and Velasquez 2004). Since, these are the specific feelings asserted to be associated with good design, instead of the general PANAS response, and since our design scale measures the essence of good design, all aspects of our design should be positively correlated with these constructs. | Positive correlation with all measures             | Givechi and Velasquez 2004       | $r_{form} = .50 p < .01$ ;<br>$r_{func} = .15 p < .05$ ;<br>$r_{solid} = .60 p < .01$ ;<br>$r_{use} = .60 p < .01$ ;<br>$r_{beaut} = .82 p < .01$ ;<br>$r_{green} = .48 p < .01$ ;<br>$r_{unique} = .40 p < .01$ ; |
| Satisfaction<br>(n = 301)                    | Satisfaction comes from the shape, attractiveness, simplicity, comfort, elegance, harmoniousness, and volume satisfaction that consumers experience from designs (Han and Hong 2003). Primarily, these all relate to beauty. Furthermore, consumers are prone to be self-affirmed though highly aesthetic products more so than functionality (Townsend and Sood 2012).                       | Positive correlation with Form and Beauty          | Single item measure              | M = 3.64;<br>SD = 1.92<br><br>$r_{form} = .45 p < .01$ ;<br>$r_{beaut} = .72 p < .01$                                                                                                                              |



**Table 2.11 (cont.)**

| NOMOLOGICAL VALIDITY (cont.)      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                     |                                  |                                                                                                |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------|
| Construct                         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Predicted Relationship                                              | Source                           | Characteristics Results                                                                        |
| Hedonic Benefits<br>(n = 301)     | Good designs should provide hedonic, utilitarian, and symbolic benefits (Bloch 2011). Greater pleasure is associated with hedonic products (Chitturi, Raghunathan, and Mahajan 2008), and since hedonics are an in essence an appeal to the senses (Hekkert 2006), it follows that our measures directly related to the senses, form and beauty, should be directly related to these constructs.                                                                                                | Positive correlation with Form and Beauty                           | Single item measure              | M = 3.58;<br>SD = 1.78<br>$r_{form} = .26$ $p < .01$ ;<br>$r_{beaut} = .46$ $p < .01$          |
| Utilitarian Benefits<br>(n = 301) | Utilitarian benefits are related to the ease of understanding a product (Fiell and Fiell 2001), the ability to rely on a product (Norman 2013), and the ability of a product to fulfill a need (Bloch 2011). These same aspects can be seen in our measures of function, solidity, and usefulness.                                                                                                                                                                                              | Positive correlation with Function, Solidity, and Usefulness        | Single item measure              | $r_{func} = .11$ $p < .05$ ;<br>$r_{solid} = .30$ $p < .01$ ;<br>$r_{use} = .38$ $p < .01$     |
| Symbolic Benefits<br>(n = 301)    | Symbolic benefits communicate aspects of a consumer to others (Bloch 2011). Of the aspects of a design that interact with a consumer, some are more likely to communicate information about a consumer to others. Green products can be purchased so that one might be seen by others (Griskevicius, Tybur, and Van den Bergh 2010), visually appealing designs provide self-affirmation (Townsend and Sood 2012), and uniqueness can provide intrinsic satisfaction (Simonson and Nowlis 2000) | Positive correlation with Eco-consciousness, Beauty, and Uniqueness | Single item measure              | $r_{beaut} = .43$ $p < .01$ ;<br>$r_{green} = .44$ $p < .01$ ;<br>$r_{unique} = .32$ $p < .01$ |
| GREEN<br>(n = 164)                | Consumers that are prone to purchase environmentally friendly products should rate high on the GREEN scale (Haws, Winterich, and Naylor 2014)                                                                                                                                                                                                                                                                                                                                                   | Positive correlation with Eco-consciousness                         | Haws, Winterich, and Naylor 2014 | M = 5.39;<br>SD = 1.17;<br>$\alpha = .92$<br>$r_{green} = .39$ $p < .01$                       |

**Table 2.12**

| <b>Test/Retest (Data Set 2 and 2A)</b> |      |      |        |      |                                      |       |
|----------------------------------------|------|------|--------|------|--------------------------------------|-------|
|                                        | Test |      | Retest |      | Between-Administrations Correlations |       |
|                                        | Mean | SD   | Mean   | SD   | $\alpha^*$                           | $r^*$ |
| n = 184                                |      |      |        |      |                                      |       |
| Form                                   | 4.89 | 1.70 | 5.03   | 1.61 | 0.86                                 | 0.76  |
| Function                               | 5.12 | 1.40 | 5.05   | 1.33 | 0.80                                 | 0.67  |
| Solidity                               | 4.68 | 1.31 | 4.49   | 1.34 | 0.85                                 | 0.73  |
| Usefulness                             | 4.80 | 1.19 | 4.77   | 1.28 | 0.80                                 | 0.67  |
| Beauty                                 | 4.64 | 1.49 | 4.55   | 1.57 | 0.84                                 | 0.72  |
| Eco-consciousness                      | 4.48 | 1.24 | 4.15   | 1.24 | 0.69                                 | 0.53  |
| Uniqueness                             | 4.81 | 1.56 | 4.76   | 1.55 | 0.88                                 | 0.78  |

\* - all values significant at  $p < 0.01$

**Table 2.13**

| Predictive Validity (Data Set 3): Product Designs 1 and 2 |                           |                            |                           |                           |                           |                           |                           |                           |           |
|-----------------------------------------------------------|---------------------------|----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|-----------|
| Product Design                                            |                           | Breakfast Center (n = 119) |                           |                           |                           | Lawn Mower (n = 67)       |                           |                           |           |
| Dependent Variables:                                      | LTP                       | WOM                        | WTP                       | POS                       | LTP                       | WOM                       | WTP                       | POS                       |           |
|                                                           | Mean = 2.45;<br>SD = 1.49 | Mean = 3.41;<br>SD = 1.83  | Mean = 2.50;<br>SD = 1.41 | Mean = 3.45;<br>SD = 1.57 | Mean = 3.10;<br>SD = 1.37 | Mean = 3.23;<br>SD = 1.49 | Mean = 3.34;<br>SD = 1.38 | Mean = 4.07;<br>SD = 1.36 |           |
|                                                           | n = 49                    |                            |                           |                           | n = 40                    |                           |                           |                           |           |
| Our Scale                                                 | Form                      | 1.560                      | 0.062                     | 3.053†                    | 0.186                     | 0.080                     | 1.030                     | 1.546                     | 0.078     |
|                                                           | Function                  | 4.502 *                    | 5.078 *                   | 0.444                     | 1.007                     | 0.027                     | 2.279                     | 0.474                     | 2.381     |
|                                                           | Solidity                  | 1.446                      | 1.616                     | 0.496                     | 0.467                     | 4.738 *                   | 1.445                     | 0.068                     | 1.018     |
|                                                           | Usefulness                | 12.244 ***                 | 3.485 †                   | 2.469                     | 18.572 ***                | 0.225                     | 5.101 *                   | 4.180 *                   | 10.027 ** |
|                                                           | Beauty                    | 6.433 *                    | 0.769                     | 5.704 *                   | 1.852                     | 1.189                     | 0.406                     | 0.040                     | 0.431     |
|                                                           | Eco-consciousness         | 6.104 *                    | 0.598                     | 0.058                     | 3.044 †                   | 7.210 *                   | 0.014                     | 0.009                     | 4.092 †   |
|                                                           | Uniqueness                | 0.693                      | 0.870                     | 1.007                     | 0.046                     | 0.127                     | 0.524                     | 1.874                     | 0.778     |
| R <sup>2</sup>                                            |                           | 0.72                       | 0.51                      | 0.42                      | 0.73                      | 0.60                      | 0.55                      | 0.41                      | 0.73      |
| Homburg et al. Scale                                      | n = 70                    |                            |                           |                           | n = 27                    |                           |                           |                           |           |
|                                                           | Aesthetic                 | 36.855 ***                 | 26.927 ***                | 12.950 ***                | 20.135 ***                | 6.660 *                   | 3.143 †                   | 9.898 **                  | 3.933 †   |
|                                                           | Functional                | 3.890 †                    | 3.089 †                   | 0.002                     | 15.274 ***                | 0.587                     | 2.549                     | 0.568                     | 3.318 †   |
|                                                           | Symbolic                  | 0.042                      | 1.137                     | 12.020 ***                | 3.097 †                   | 6.494 *                   | 0.713                     | 7.703 *                   | 3.112 †   |
| R <sup>2</sup>                                            |                           | 0.56                       | 0.52                      | 0.40                      | 0.61                      | 0.43                      | 0.35                      | 0.51                      | 0.48      |
| ΔR <sup>2</sup>                                           |                           | 0.16                       | -0.01                     | 0.02                      | 0.12                      | 0.17                      | 0.20                      | -0.10                     | 0.25      |

† sig at .1, \*sig at .05, \*\*sig at .01, and \*\*\*sig at .001

LTP = Likelihood to Purchase ( $\alpha = .88$ ); WOM = Word of Mouth ( $\alpha = .93$ ); WTP = Willingness to Pay; POS = Positive Attitude

**Table 2.13 (cont.)**

| Product Design       |                   | Predictive Validity (Data Set 3): Product Designs 3 and 4 |                           |                           |                           |                           |                           |                           |                           |
|----------------------|-------------------|-----------------------------------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
|                      |                   | Multit-Purpose Tool (n = 66)                              |                           |                           |                           | Water Balloons (n = 117)  |                           |                           |                           |
|                      |                   | LTP                                                       | WOM                       | WTP                       | POS                       | LTP                       | WOM                       | WTP                       | POS                       |
| Dependent Variables: |                   | Mean = 3.10;<br>SD = 1.44                                 | Mean = 3.44;<br>SD = 1.64 | Mean = 2.74;<br>SD = 1.24 | Mean = 3.95;<br>SD = 1.43 | Mean = 3.24;<br>SD = 1.32 | Mean = 2.68;<br>SD = 1.37 | Mean = 2.21;<br>SD = 1.15 | Mean = 4.06;<br>SD = 1.18 |
| Our Scale            |                   | n = 29                                                    |                           |                           |                           | n = 56                    |                           |                           |                           |
|                      | Form              | 0.493                                                     | 0.001                     | 0.893                     | 0.010                     | 5.593*                    | 0.559                     | 1.422                     | 3.843†                    |
|                      | Function          | 1.962                                                     | 0.830                     | 1.722                     | 1.303                     | 1.890                     | 0.255                     | 1.020                     | 5.348*                    |
|                      | Solidity          | 0.102                                                     | 0.065                     | 0.639                     | 2.753                     | 1.158                     | 0.012                     | 0.969                     | 3.958†                    |
|                      | Usefulness        | 9.066**                                                   | 8.549**                   | 9.220**                   | 1.770                     | 3.947†                    | 3.724†                    | 1.338                     | 3.068†                    |
|                      | Beauty            | 1.046                                                     | 0.759                     | 0.315                     | 6.081*                    | 4.261*                    | 3.298†                    | 3.772†                    | 2.905†                    |
|                      | Eco-consciousness | 2.186                                                     | 0.013                     | 6.169*                    | 1.607                     | 6.172*                    | 6.711*                    | 4.683*                    | 0.242                     |
|                      | Uniqueness        | 0.618                                                     | 3.291†                    | 1.142                     | 0.712                     | 1.424                     | 0.371                     | 0.000                     | 1.062                     |
| R <sup>2</sup>       |                   | 0.68                                                      | 0.52                      | 0.61                      | 0.88                      | 0.41                      | 0.42                      | 0.39                      | 0.43                      |
| Homburg et al. Scale |                   | n = 37                                                    |                           |                           |                           | n = 61                    |                           |                           |                           |
|                      | Aesthetic         | 17.517***                                                 | 2.719                     | 18.710***                 | 11.563***                 | 5.563*                    | 4.136*                    | 5.624*                    | 7.530*                    |
|                      | Functional        | 10.047***                                                 | 8.246**                   | 0.458                     | 16.053***                 | 2.176                     | 0.035                     | 0.000                     | 3.883†                    |
|                      | Symbolic          | 0.060                                                     | 1.594                     | 0.272                     | 1.345                     | 2.808†                    | 3.609†                    | 5.712*                    | 1.68                      |
|                      | R <sup>2</sup>    | 0.65                                                      | 0.46                      | 0.50                      | 0.67                      | 0.31                      | 0.19                      | 0.26                      | 0.37                      |
| ΔR <sup>2</sup>      |                   | 0.03                                                      | 0.06                      | 0.11                      | 0.21                      | 0.10                      | 0.24                      | 0.13                      | 0.07                      |

† sig at .1, \*sig at .05, \*\*sig at .01, and \*\*\*sig at .001

LTP = Likelihood to Purchase ( $\alpha = .88$ ); WOM = Word of Mouth ( $\alpha = .93$ ); WTP = Willingness to Pay; POS = Positive Attitude

**Table 2.14**

| Experimental Validity (Data Set 4)*                      |              |      |      |                              |
|----------------------------------------------------------|--------------|------|------|------------------------------|
| Control (n = 86) vs Experimental (Unique Shape) (n = 78) |              |      |      |                              |
| Our Scale                                                |              | Mean | SE   | Test Statistic               |
| Form                                                     | Control      | 5.10 | 0.17 | $F(1, 162) = 6.665, p = .01$ |
|                                                          | Experimental | 4.45 | 0.18 |                              |
| Function                                                 | Control      | 4.44 | 0.16 | $F(1, 162) = .926, p = .34$  |
|                                                          | Experimental | 4.21 | 0.17 |                              |
| Solidity                                                 | Control      | 5.34 | 0.11 | $F(1, 162) = .000, p = .99$  |
|                                                          | Experimental | 5.34 | 0.11 |                              |
| Usefulness                                               | Control      | 5.31 | 0.11 | $F(1, 162) = .009, p = .93$  |
|                                                          | Experimental | 5.30 | 0.12 |                              |
| Beauty                                                   | Control      | 5.37 | 0.13 | $F(1, 162) = 1.051, p = .31$ |
|                                                          | Experimental | 5.17 | 0.14 |                              |
| Eco-consciousness                                        | Control      | 4.49 | 0.13 | $F(1, 162) = .260, p = .61$  |
|                                                          | Experimental | 4.59 | 0.14 |                              |
| Uniqueness                                               | Control      | 4.46 | 0.15 | $F(1, 162) = 5.270, p = .02$ |
|                                                          | Experimental | 4.94 | 0.15 |                              |
| Homburg et al. Scale                                     |              |      |      |                              |
| Aesthetic                                                | Control      | 5.33 | 0.13 | $F(1, 162) = .476, p = .49$  |
|                                                          | Experimental | 5.20 | 0.14 |                              |
| Functional                                               | Control      | 5.69 | 0.10 | $F(1, 162) = .039, p = .84$  |
|                                                          | Experimental | 5.67 | 0.10 |                              |
| Symbolic                                                 | Control      | 4.45 | 0.16 | $F(1, 162) = .054, p = .82$  |
|                                                          | Experimental | 4.50 | 0.17 |                              |

\* - Two separate MANOVA's were estimated for these results. One with only our scale dimensions and the other with only the Homburg et al. dimensions.

**Table 2.15**

| Confirmatory Factor Analysis: Scale Comparison (Data Set 4)* |                                           |                                           |                                           |                                           |                                           |                                           |                                           |
|--------------------------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| Construct by Scale                                           | Our Scale:                                | Form                                      | Function                                  | Solidity                                  | Usefulness                                | Beauty                                    | Eco-consciousness                         |
| Homburg et al. Scale:                                        | Characteristics                           | M = 4.97;<br>SD = 1.69;<br>$\alpha = .90$ | M = 5.04;<br>SD = 1.39;<br>$\alpha = .75$ | M = 4.57;<br>SD = 1.32;<br>$\alpha = .85$ | M = 4.74;<br>SD = 1.32;<br>$\alpha = .84$ | M = 4.57;<br>SD = 1.61;<br>$\alpha = .92$ | M = 4.20;<br>SD = 1.22;<br>$\alpha = .83$ |
| Aesthetics                                                   | M = 4.62;<br>SD = 1.55;<br>$\alpha = .86$ | 0.79                                      | 0.30                                      | 0.71                                      | 0.70                                      | 0.95                                      | 0.33                                      |
| Functional                                                   | M = 5.22;<br>SD = 1.23;<br>$\alpha = .86$ | 0.56                                      | 0.43                                      | 0.85                                      | 0.69                                      | 0.60                                      | 0.32                                      |
| Symbolic                                                     | M = 3.84;<br>SD = 1.46;<br>$\alpha = .81$ | 0.19                                      | -0.20                                     | 0.37                                      | 0.42                                      | 0.50                                      | 0.47                                      |
|                                                              |                                           |                                           |                                           |                                           |                                           |                                           | 0.48                                      |

\* - As expected, our Beauty dimension is equivalent to the Homburg et al. (2015) Aesthetics dimension, and Solidity is equivalent to the Homburg et al. (2015) Functional dimension

## FIGURES



Figure 2.1



**Figure 2.2**





Figure 2.3



Figure 2.4

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## CHAPTER 4

### ESSAY 3: THE EFFECT OF PERCEIVED LIGHTING ON PERCEPTIONS OF PROVISION AND ELIMINATION<sup>4</sup>

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<sup>4</sup> Sample, Kevin L. and Julio Sevilla. To be submitted to *Journal of Marketing*.

## **Abstract**

Research has shown that consumers often rely on visual information over verbal information. The current work examines the influence of perceived lighting on product preferences. Lighting directionality cues in product packaging and other promotional materials evoke spatiotemporal perceptions which interact with consumers' spatiotemporal predispositions associated to a product's provision or elimination properties. Specifically, a product that includes light coming from above seems to be coming towards a consumer, while a product that includes light coming from below seems to be moving away. In the context of assessing products with provisional properties, consumers spatiotemporally envision an effective provider as coming towards them. Conversely, when evaluating products with eliminatory properties, consumers spatiotemporally anticipate an effective eliminating agent as moving away from them. Due to the associated spatiotemporal predisposition of consumers when encountering provision and elimination properties, consumers prefer products that feature light coming from above when these involve provision properties and coming from below when these involve elimination properties. These preferences extend to downstream consequences of purchase intentions and willingness to pay. Implications for this research are far-reaching as provision and elimination products and claims are abundant in the marketplace and consumers increasingly assess two-dimensional product images (e.g. online retailing and advertising).

## Introduction

Consumers often make marketplace decisions based on the available visual cues more so than the associated verbal information presented with these cues (Dickson and Sawyer 1990). Further, consumers exhibit a preference for visual information over verbal information (Townsend and Kahn 2013), and trends indicate that consumers are increasingly ignoring verbal information in preference for visual (DeVecchio, Jae, and Ferguson 2018). This is important for marketers, as the visual images used in conveying information about products can subtly communicate much more than literal depictions (Peracchio and Meyers-Levy 2005).

One notable feature of the visual environment that has been found to influence consumer preference is lighting. Ambient lighting has been shown to play a critical role in consumer behavior as brighter lights lead to greater hands-on engagement with displayed products (Areni and Kim 1994; Summers and Hebert 2001) and healthier, more virtuous consumption choices (Biswas et al. 2017; Huang, Dong, and Labroo 2017). In this article, we examine a different facet of lighting, the effect of perceived lighting in two-dimensional contexts. Specifically, we investigate the influence of lighting appearing to originate from above or below and its associated illusory properties, and show that this has implications for product packaging, advertising and promotion, and online retail environments. We demonstrate that the perception of light coming from above or below influences perceptions and preferences associated with the provisional or eliminatory properties of products.

We posit and find that consumers make spatiotemporal inferences about product images exhibiting light coming from above or below. When a product image or package label exhibits light from above, consumers perceive this product as coming towards them, but, when this same

product exhibits light from below, consumers envision this product as moving away. We further propose that these spatiotemporal perceptions influence consumer preference depending on the purported benefit of the product. Specifically, we show that consumers assessing a product with provisional properties (e.g., provides nutrients) expect this provider to come towards them, while consumers evaluating a product with eliminatory properties (e.g., removes pain) envision this eliminating agent as moving away. These claims interact with lighting effects such that consumers prefer product stimuli claiming to provide to be lit from above but prefer product stimuli claiming to eliminate to be lit from below. These preferences are reflected in the downstream consequences of purchase likelihood and willingness to pay.

Our research provides several theoretical and practical insights for marketers. First, we provide evidence for how perceived lighting coming from above or below influences spatiotemporal perceptions in marketing contexts such that product images lit from above appear to be coming and those lit from below appear to be moving away. While suggestive evidence for this phenomenon has been demonstrated with basic figures in abstract environments (Gibson 1950; Ramachandran 1988), we demonstrate that this phenomenon occurs even for the perception of complex marketing images. Thus, the robustness of this phenomenon is demonstrated, consequently providing an understanding of the role of perceived lighting for packages, products, and promotions. By so doing, we also contribute to the growing research examining environmental aspects of lighting effects (e.g., Biswas et al. 2017; Huang et al. 2017; Xu and Labroo 2014), but in this case rather than manipulating environmental lighting we manipulate perceived lighting in two-dimensional contexts. Second, to the best of our knowledge, ours is the first work examining spatiotemporal perceptions associated to the provisional and eliminatory properties of products and how these may interact with visual cues.

By elucidating the spatiotemporal predispositions of consumers encountering provision and elimination claims our research provides a theoretical basis for an unexplored phenomenon that is wholly pertinent to marketing. Consequently, we also add to the emerging research stream documenting the effect that visual psychophysical manipulations have on consumer perceptions and behavior (e.g. Bagchi and Cheema 2013; Buechel and Townsend 2018; Chae, Li, and Zhu 2013; Cian, Krishna, and Elder 2014; Deng and Kahn 2009; Elder and Krishna 2011; Lee et al. 2014; Hagtvedt and Brasel 2017; Romero and Craig 2017). Specifically, we do this within the domain of spatial and temporal relations. Finally, our work provides important and easily actionable implications for marketing managers.

This research is organized as follows. We first delineate, from a well-known optical illusion, how lighting appearing to come from above or below will influence spatiotemporal impressions on consumers. Next, we provide the conceptual background for spatiotemporal influences on perceptions of provision and elimination. Following, we discuss how lighting effects may interact with properties of provision or elimination. After the presentation of five studies, which build from the process to downstream marketing consequences for packaging, promotions, and products, we address the implications of this effect and potential avenues for future research.

## **Theoretical Background**

Perceptual psychologists have posited that we see the world in a proactive manner with our perceptual and cognitive systems working together to help us envision how visual stimuli may be moving toward and away from us (Gibson 1950; Rock 1983; Uttal 1981). This is

evidenced in our propensity to infer movement from still images even when no actual movement is present (e.g., Cian et al. 2014), as we are prone to perceive visual information spatiotemporally instead of statically (Sekuler and Blake 2002). In other words, consumers are spatiotemporally attuned, dynamically perceiving visual information in a way that anticipates what may come next in their perception of space.

In the current research we address spatiotemporal visual perception through two related marketing-pertinent factors. First, we look at perceived lighting directionality, and how this shapes spatiotemporal perceptions of an object being further away and coming closer (i.e., coming) and of an object being closer and going further away (i.e., going). Next, we examine how knowledge about provisional and eliminatory properties of products may also influence spatiotemporal predispositions, which in turn interact with lighting directionality to influence consumer preferences.

### ***Lighting Effects***

The study of lighting effects has received increasing attention from consumer behavior researchers. For instance, healthier food choices are made, when choices between food items are made in bright, as opposed to dim, light (Biswas et al. 2017). Relatedly, consumers have been shown to make more hedonic choices in dim lighting (Huang et al. 2017), to more readily engage in sensation seeking in the presence of bright light (Xu and Labroo 2014), and to be more likely to engage with displayed products in the presence of bright light (Areni and Kim 1994; Summers and Hebert 2001). This prior research points to the subtle influence lighting can have on consumer behavior, yet all of this research involves the magnitude (bright versus dim) of real

ambient lighting. Building on this prior work, we examine another consequential aspect of lighting – the influence of perceived lighting direction in two-dimensional contexts.

The perceived lighting direction of a two-dimensional image is, in essence, a change in coloring such that the focal image appears lighter in one area than another (i.e., a gradient). As a focal object exhibits this gradient, shading appears providing consumers with an illusion of three dimensions from only two. When an object such as a circle (see figure 3.1) exhibits shading with a lack of illumination information (i.e., the source of the lighting) and without an apparent top or bottom differential perceptions can occur dependent on the direction of the lighting. A circle lit from above (i.e., containing a gradient from white on the top to black on the bottom – the circles on the left of figure 3.1) appears to be coming at the perceiver, that is, it appears convex like a ball (Gibson 1950; Ramachandran 1988). However, this same circle rotated one hundred and eighty degrees such that it appears to be lit from below (i.e., containing a gradient from black on the top to white on the bottom – the circles on the right of figure 3.1), looks concave like it is moving away (Gibson 1950; Ramachandran 1988). The most widely accepted reason for why a spatial difference occurs between these two circles is that humans are adapted to see the world lit from above (Hess 1950; Sekuler and Blake 2002). That is, from the time that we are born, we see the world around us lit from above (e.g., the sun, overhead lighting), and when things are lit from below this is due to unnatural lighting or a reflection of light off another surface (such as how a cave is lit). Thus, our perceptual system attempts to make the most sense out of these images, resulting in an illusion from shading.



### ***Spatiotemporal Perceptions and Metaphorical Associations***

Spatiotemporal perception refers to the visual anticipation of the movement of objects in the visual field through space and time (Gibson 1950; Rock 1983; Sekuler and Blake 2002; Uttal 1981). As noted earlier, consumers are hardwired to proactively anticipate motion, and this results in three-dimensional spatiotemporal perceptions of two-dimensional images, as evidenced above in the perception of lighting directionality coming from above or below. While prior marketing research has not touched upon the influence of perceived lighting direction, past work has noted the differential, yet important, ways that consumer behavior is influenced by psychophysical and spatiotemporal perceptions as a result of metaphorical associations.

For spatial relations, consumers are more likely to choose and consume healthy foods when they are located to the left (vs. the right) of an unhealthy food choice (Romero and Biswas 2016). This health choice coincides with consumers' tendency to mentally organize magnitudes from the left to the right, with the organization here being healthfulness (left) to unhealthfulness (right) of foods. In regard to spatial locations' effect on psychophysical perceptions, products are perceived to be heavier when pictured more toward the bottom and right, as consumers anticipate heavy objects to be closer to the ground (Deng and Kahn 2009). Consequently, due to the associated metaphorical relation of heaviness and location, products displaying an image toward the bottom are preferred when heaviness is a desired quality. In another example, when a product image is located more proximal to the desired benefit of a product, consumers believe it to be of greater effectiveness, as the greater proximity makes the intended action occurring more believable to consumers (Chae, Li, and Zhu 2013).

Recent research has also shown how psychophysics and metaphorical relations may also influence spatiotemporal perceptions. Cian et al. (2014) demonstrated that brands positioned as

dynamic are preferred when an associated image indicates imminent motion (i.e., spatiotemporal connotation). Additionally, consumers not committed to a healthy lifestyle make inferences from the presence of an image with spatiotemporal connotations such that they feel like they have engaged in some form of physical activity that helps them progress toward health-related goals (Fajardo, Zhang, and Tsiros 2016). Furthermore, movement northward (vs. southward) is believed to be slower and costlier due to the spatiotemporal associations made with verticality movement in that it is easier to move down than up (Nelson and Simmons 2009). Consumers also evaluate products more positively when these are spatially congruent with anticipated temporal locations (Chae and Hoegg 2013). That is, dependent on reading style (i.e., left to right or right to left) consumers associate the starting reading position to be more relatable to the past and the ending position to be more relatable to the future.

We contribute to this emerging line of inquiry of how visual interventions in the marketing domain influence psychophysical and spatiotemporal perceptions by elucidating the unexplored area of perceived lighting direction. To our knowledge, the visual perceptual phenomenon of lighting direction has only been shown to occur with rather simple (e.g., circles) and ambiguous (i.e., no apparent top or bottom) shapes and in abstract settings where the clutter of information and cues present in marketing contexts are not a factor. However, since consumers are spatiotemporally attuned in their visual perception (Gibson 1950; Rock 1983) and often perceptual influences are cognitively impenetrable and cannot be overcome by consumers even when they are made aware of what is occurring (Pylyshyn 1999; Sekuler and Blake 2002), we believe that this is a robust effect that will occur for any two-dimensional image regardless of environmental complexity, including packaging, products, and promotions. Thus, we posit that complex marketing images exhibiting light from above or below will be perceived in a way that

is consistent with the aforementioned optical illusion, even though these products have an apparent top and bottom and will not look concave or convex.

H1: Product stimuli presented in complex marketing environments exhibiting light coming from above (below) will appear to be moving closer to (away from) consumers.

### ***Spatiotemporal Predispositions for Provision and Elimination Product Properties***

Products with providing and eliminating features are ubiquitous in the marketplace. While some products are pronouncedly provisional (e.g., energy drink) or eliminatory (e.g., odor removing spray), others can be positioned as one or another based on different brand extensions or properties (e.g., a toothpaste that provides whiter teeth or eliminates cavities). In alignment with the aforementioned prior research noting that consumers make metaphorical associations between product properties and visual predispositions (Chae and Hoegg 2013; Chae et al. 2013; Cian et al. 2014; Deng and Kahn 2009), we argue that the perceived properties of provision or elimination will influence consumer mindsets such that differential predispositions occur. These predispositions may influence consumer perceptions when they are examining packaging and advertising for products they are considering for purchase. We propose that certain elements that are present in marketing stimuli, such as lighting type or direction, may play a differential role on product perceptions depending on the properties of the product being positioned as provisional or eliminatory. But before embarking on the exploration of this interaction, we first discuss the nature of provision and elimination.

For an act of provision to take place, a provider (a firm, person, or product) must give a purported benefit to a consumer (e.g., desired particles, more energy, whiter teeth), while for an

act of elimination to take place, an eliminating agent must remove an unwanted condition or substance from a consumer (e.g., undesired particles, fatigue, teeth stains). Both acts are of a spatiotemporal nature. Specifically, for provision to occur there must be a progression toward a consumer such that a desired benefit can be received. Conversely, for elimination to occur there must be a recession such that the unwanted condition or substance can be removed.

Consumers spatiotemporally focus on the act of the providers, or providing agents (e.g., vitamins), moving closer, with the culmination of this act occurring once the product/service is delivered. Consequently, a consumer directs scant attention toward the providing agent leaving, as the act is typically finished, as far as the consumer is concerned, once the benefit is received. In contrast, while consumers may anticipate an eliminating agent first coming towards them, we posit that the general spatiotemporal focus of a consumer encountering an elimination claim is on the eliminating agent departing or removing something. Thus, even though the same progression of events (a provider or an eliminating agent must first move towards a consumer) takes place regardless of the act, we posit that consumers have markedly different spatiotemporal focal points dependent upon the act being one of either provision or elimination.

H2: Consumers thinking about provision (elimination) properties spatiotemporally envision the provider (eliminating agent) moving closer (away).

### ***The Interplay between Lighting Direction and Provision (vs. Elimination) Product Properties***

Relating provision claims to lighting effects, we propose that a product image lit from above will better match the associated anticipation of a provider's arrival. That is, a product lit from above will appear closer to consumers and should thusly align with the spatiotemporal

predisposition of providers coming closer. Conversely, a product image lit from below better matches the associated anticipation of an eliminating agent's departure. In other words, a product lit from below will appear further away to consumers and should align with the spatiotemporal predisposition of eliminating agents moving away. Additionally, we anticipate that the spatiotemporal congruency between lighting direction and product properties will positively impact consumer preferences, including the downstream consequences of purchase likelihood and willingness to pay. Further, prior research has consistently noted that many responses to visual stimuli are typically hardwired (Gibson 1950; Rock 1983; Raghurir 2009), that is, visual perceptual illusions occur outside of consumer control (Ramachandran 1980; Sekuler and Blake 2002). Moreover, perception is a dynamic process between the perceptual and neural systems occurring almost instantaneously with one influencing the other (Gibson 1950; Sekuler and Blake 2002; Uttal 1981), and external claims or properties can tap into prior experience or knowledge which can influence such perceptions (e.g., Aydinoğlu and Krishna 2010). Thus, in alignment with this theorizing, we argue that the mechanism behind these preferences is an automatic response generated by the perceptual system and these spatiotemporal predispositions.

H3: Consumer preference will be higher when a provisional (eliminary) product exhibits light coming from above (below).

H4: Consumers' spatiotemporal predisposition when assessing a product with provisional (eliminary) properties drives higher consumer preferences for images lit from above (below).

## **Overview of Studies**

Five studies provide support for the predicted phenomenon and its underlying mechanism. The first two studies provide support for each of the two separate components of the effect. Study 1 demonstrates that in complex marketing settings a two-dimensional product image appearing to be lit from above will be perceived to be coming towards a consumer, whereas when appearing to be lit from below it will be perceived to be moving away from a consumer. Study 2 establishes that provisional properties give rise to a spatiotemporal predisposition of arrival, in contrast to eliminatory properties, which give rise to a spatiotemporal predisposition of departure. The last three studies integrate the two components of the effect and show support for the hypothesized interaction. In study 3, we show that consumer preference is higher for a package with a logo exhibiting apparent light from above for a providing product, but this reverses such that consumers prefer a package with a logo with apparent light from below for an eliminating product. Study 4 validates that consumers' spatiotemporal predisposition drives the interaction effect between perceived lighting direction and provision/elimination properties. Finally, study 5 further establishes the downstream consequences of the effect by showing that it extends to purchase intentions and willingness to pay for promotional images of products.

### **Study 1: Spatiotemporal Perceptions**

The purpose of Study 1 is to provide evidence for the first component of the proposed effect, that when products appear to be lit from above they exhibit spatiotemporal connotations

such that they appear to be coming toward consumers more so than when they appear to be lit from below. Conversely, this study also set out to show that products appearing to be lit from below exhibit spatiotemporal connotations such that they appear to be moving away from consumers more so than when they appear to be lit from above. This constitutes a relevant extension of a phenomenon examined in perceptual psychology that has only been demonstrated in abstract contexts using simple, ambiguous images.

### ***Method***

Eighty-nine public university undergraduates (40.9% female;  $M_{\text{age}} = 20.7$ ) received course credit for taking part in this study. Participants were presented with the following scenario: “Pictured below is a new energy drink. Please take a moment to look at the energy drink.” The image associated with this scenario was one of a bottle with exhibited light from either above or below (figure 3.2), resulting in a 2 level (perceived lighting: above vs. below) between-subjects design. Below this stimulus we asked a question assessing perceived proximity, “Does it appear like the product is coming towards you or moving away from you?” This was asked on a 7-point Likert scale ranging from “Definitely coming towards me” (-3) to “Neither coming towards me or moving away from me” (0) to “Definitely moving away from me” (3). Following, we assessed age and gender.

### ***Results***

We estimated a one-way ANOVA with the spatiotemporal connotations (i.e., coming or going) as the dependent variable and lighting direction as the independent variable. As expected, we found a significant difference due to lighting such that the bottle lit from above appeared to

be coming towards participants while the one lit from below appeared to be more moving away from participants ( $M_{LitFromAbove} = -.55$ ,  $SD = 1.27$  vs.  $M_{LitFromBelow} = .15$ ,  $SD = 1.29$ ;  $F(1, 87) = 6.576$ ,  $p = .012$ ,  $\eta^2 = .07$ )

## ***Discussion***

In line with hypothesis 1, perceived lighting directionality had a significant effect on perceptions of the spatiotemporal connotations. When an image of a product appears to be lit from above, consumers perceive this product as coming towards them relative to going away from them. In contrast, when the same image of a product appears to be lit from below, consumers perceive the opposite, a product going away from them relative to coming towards. This is a notable effect as just the apparent lighting of a product will influence spatiotemporal perceptions. Though this effect has been repeatedly demonstrated with ambiguous shapes and images, to our knowledge, this is the first time it has been demonstrated in a marketing context involving product images that have a distinct top and bottom. The fact that the effect held in a marketing environment and across products that evoke their own consumer perceptions, demonstrates the robustness of this spatiotemporal phenomenon.

## **Study 2: Spatiotemporal Predispositions**

Before we proceed with an examination of how perceived lighting from above or below shapes consumer preferences in the presence of provision and elimination, we first establish the implications of provision and elimination on consumers' spatiotemporal predisposition. We predicted that, due to metaphorical associations, consumers encountering a provision claim



would anticipate the provider to be coming closer, whereas consumers encountering an elimination claim would anticipate the eliminating agent to be moving away.

## ***Method***

*Pretest.* We initially conducted a pretest for these claims. We recruited three hundred and two Amazon Mechanical Turk workers (44.4% female;  $M_{\text{age}} = 36.0$ ) to take part in this study in exchange for payment. Participants were randomly presented with two questions. “When someone or something gives something to you, they should?” and “When someone or something gets rid of something for you, they should?” These questions were asked on 7-point Likert scales, ranging from “Definitely come towards me” (-3) to “Neither come towards me nor move away from me” (0) to “Definitely move away from me” (3). In analysis, two one sample t-tests were estimated with a test value of 0 for our assessment of provision and elimination spatiotemporal anticipatory focus. The t-test for the first question shows a significant difference such that participants believed that an act of provision should coincide with the provider coming towards them ( $M_{\text{Movement}} = -.58$ ,  $SD = 1.79$ ;  $t(292) = -5.543$ ,  $p < .001$ ). The t-test for the second question reveals another significant difference such that a focus on elimination resulted in an expectancy of the eliminating agent to move away from the consumer ( $M_{\text{Movement}} = 1.28$ ,  $SD = 1.41$ ;  $t(292) = 15.566$ ,  $p < .001$ ).

*Main Study.* We next recruited one-hundred and thirty-one Mturk workers (52.7% female;  $M_{\text{age}} = 35.7$ ) for our main study for payment. Participants were provided with one of the following scenarios: “Imagine you are standing at your house waiting for a truck to deliver (remove) your new (old) washer and dryer. Using only 3 of the 6 images pictured below, please order what it would look like for a truck to deliver (remove) your new (old) washer and dryer

(The top image would be the first image in the sequence - one image per box please).” This resulted in a 2 level (provision vs. elimination) between-subjects design. Below this scenario were two columns. One column consisted of six randomly displayed images of a truck coming and going (figure 3.3). The other column contained three boxes numbered 1, 2, and 3 for participants to place their three chosen images in order. Restrictions were placed on this question so that participants had to place only one image in each box, resulting in participants only using three images. Following, we assessed gender and age.

We were primarily interested in how many more participants encountering the delivery (provision) condition instead of the removal (elimination) condition picked image 1, as this is the image that more closely aligns with arriving. Conversely, we were also interested in how many more participants encountering the removal condition instead of the delivery condition picked image 6, as this is the image that more closely aligns with departure. We predicted that significantly more participants would choose image 1 for the provision claim and image 6 for the elimination claim.

## **Results**

A contingency table analysis of utilization of image 1 and claim condition reveals a significant difference between provision and elimination such that those encountering the provision claim were more likely to choose image 1 ( $M_{Delivers} = 65.7\%$ ,  $SD = .48$  vs.  $M_{Removes} = 38.8\%$ ,  $SD = .48$ ;  $\chi^2(1) = 11.582$ ,  $p = .001$ ,  $\phi = -.297$ ). As expected, these results reverse when looking at choice of image 6 such that those encountering the elimination claim were significantly more likely to choose image 6 ( $M_{Delivers} = 38.8\%$ ,  $SD = .49$  vs.  $M_{Removes} = 56.3\%$ ,  $SD = .50$ ;  $\chi^2(1) = 3.996$ ,  $p = .046$ ,  $\phi = .175$ ). Even more telling is the ordering of images. There

were 120 possible ordering combinations, equating to only a 0.83% chance of one particular order of three being chosen by a participant. For each condition, the order of chosen images that best matched that condition (i.e., provision sequence of 1, 2, and then 3 and elimination sequence of 4, 5, and then 6) was chosen significantly more often than chance or any other combinations. Of the 67 participants receiving the provision claim, 31 (46.3%,  $SD = .506$ ;  $z = 60.17$ ,  $p < .001$ ) chose the sequence of images 1, 2, and 3. Of the 64 participants receiving the elimination claim, 15 (23.4%,  $SD = .516$ ;  $z = 28.04$ ,  $p < .001$ ) chose the sequence of images 4, 5, and 6.

## ***Discussion***

This study demonstrates that consumers are predisposed to focus on the aspect of arrival when encountering a provisional claim and departure when encountering an elimination claim. This is in alignment with hypothesis 2. Thus, despite the same sequence of events being required to take place for a moment of provision or elimination to occur in this scenario, consumers spatiotemporally focus on differing movements dependent upon the act. We next examine how the previously demonstrated spatiotemporal perceptions of coming and going from lighting interact with these spatiotemporal predispositions of coming and going from provision and elimination properties.

## **Study 3: Spatiotemporal Congruency**

Having established the impact that lighting can have on consumers' proximal perceptions of products and the spatiotemporal predisposition from provision and elimination, we next set out to investigate if provision and elimination have the expected impact on preferences.

Specifically, for this study, we investigate the differential effect that apparent directional lighting on a logo from above or below has on perceptions of a product that has provisional and eliminatory properties. That is, instead of lighting the entire product, we simply use a circular logo with the same gradient as evidenced in the illusion of coming and going from figure 3.1. Further, we investigate the robustness of this effect by utilizing a product that can be positioned as provisional or eliminatory, thus, only a specific claim is made about one of these properties. In alignment with hypothesis 3, we predicted that an interaction would occur such that consumer preferences would be higher for products exhibiting some form of lighting from above with a provision claim, but that these preferences would reverse such that preferences would be higher for products lit from below with an elimination claim.

## ***Method***

Four-hundred and forty-four Mturk workers (48.9% female;  $M_{\text{age}} = 33.3$ ) took part in this study for payment. Participants were presented with one of four images with either a claim of provision or elimination and lighting from above or below (figure 3.4). This resulted in a 2 (claim: provision vs. elimination) X 2 (perceived lighting: above vs. below) between-subjects design. Participants were first told the following, “An advertisement for a new mouthwash is pictured below. Please take a moment to study this ad.” On the next page the advertisement was pictured again with the following, “Now imagine that you are in the market for some mouthwash.” Below this statement we asked how much participants agree with the following, “I really like this mouthwash” and “I prefer this mouthwash” on a 7-point Likert scale ranging from “Strongly agree” (1) to “Strongly disagree” (7). Additionally, we assessed gender and age.

## **Results**

We estimated a 2 (claim: provision vs. elimination) X 2 (perceived lighting: above vs. below) between-subjects ANOVA with lighting and claim conditions as the independent variables and an indexed measure of liking and preference ( $\alpha = .92$ ) as the dependent variable. We reverse coded participant responses for the dependent variable such that the more positive answer was the higher number (figure 3.5). This analysis reveals a significant interaction such that products exhibiting light from above claiming to provide and products exhibiting light from below claiming to eliminate were more preferred ( $F(1, 440) = 10.649, p = .001, \eta^2 = .01$ ). As expected, planned contrasts reveal a significant simple effect such that participants were more likely to prefer a product lit from above when accompanied with a provisional claim ( $M_{\text{LitFromAbove}} = 4.53, SD = 1.34$  vs.  $M_{\text{LitFromBelow}} = 4.11, SD = 1.43; F(1, 440) = 5.104, p = .024, \eta^2 = .01$ ). There was also a significant simple effect for claims of elimination ( $M_{\text{LitFromAbove}} = 4.13, SD = 1.56$  vs.  $M_{\text{LitFromBelow}} = 4.57, SD = 1.24; F(1, 440) = 5.554, p = .019, \eta^2 = .01$ ). There was no main effect of lighting ( $F(1, 440) = .002, p = .93$ ) or claim type ( $F(1, 440) = .040, p = .84$ ).

## **Discussion**

As anticipated, this study demonstrated a significant interaction between claims of provision and elimination and perceived lighting from above and below such that consumers prefer products to be lit from above when accompanied with a provision claim but lit from below when an elimination claim is present. Since this was a relevant manipulation of product positioning through the brand logo, these results point to the robustness of the effect. It is demonstrated here that even though the same product can generate the same results, just a slight

change to the perceived directional lighting and the type of claim has important implications. Further, by displaying this behavior with only a logo being manipulated it demonstrates that even slight alterations to the packaging or promotional materials, instead of fully lighting a product or changing the perceived lighting of a product through the entirety of product packaging, can have substantial ramifications.

#### **Study 4: Process**

In study 3 we validated that claims and lighting can influence consumer preferences, but we have yet to demonstrate how consumers' spatiotemporal predisposition shapes these preferences (hypothesis 4). The validation of this type of perceptual mechanism is a complex task, as the perceptual system typically operates almost immediately without consumer knowledge (Raghubir 2009; Uttal 1981). To address this, we utilize adaptation, a technique commonly employed in perceptual psychology to demonstrate different operations of the perceptual system. Adaptation typically occurs for visual perception by having participants visually focus on a target for a brief amount of time (e.g., 15 seconds) to acclimatize their perception to that image (Sekuler and Blake 2002). This can be done in a myriad of ways, but the most familiar type of adaptation occurs when someone stares at a bright light for a moment of time and then looks elsewhere seeing a discolored ghost image of that light no matter where one looks.

We accomplish adaptation in this study by presenting a large (close) or small (far away) image of a camera to participants because it has a distinguishable scale (i.e., it looks further away when presented as a small image rather than just being a tiny camera). This is in alignment with

perspective manipulations utilized in art (D'Amelio 2004). If the associated spatiotemporal predisposition of provision and elimination claims indeed explain the effects demonstrated in study 3, then participants seeing the small camera image in this study should be adapted such that the image lit from above would be the next most likely temporal image to see for an elimination claim. That is, by having participants focus on a spatiotemporally distant stimulus, spatiotemporal predisposition should be reset such that an image appearing closer would be more congruent with the process of eliminating perceptions (i.e., being far away and then coming closer before then departing) rather than having the next image be far away (i.e., being far away and then departing). Thus, participants seeing a small adaptation image and then encountering an elimination claim should exhibit flipped preferences such that the image appearing to be lit from above would be preferred instead of the one appearing to be lit from below. Conversely, we propose that the large adaptation image would serve as a form of control, with consumer preferences coinciding with hypothesis 3 and the results from study 3, as this larger image would appear close and those encountering an elimination claim would then prefer the eliminating agent to be moving away after being close. We did not anticipate any change for those encountering a provision claim, as the image appearing to be lit from above would be appropriate regardless of participants seeing a small or large adaptation image.

## ***Method***

Three hundred and forty-five Mturk workers (38.3% female;  $M_{\text{age}} = 31.3$ ) took part in this study for payment. First, we told participants the following: “We are about to show you a new camera. You will only be allowed to look at this camera for a short time period (30 seconds). Please pay careful attention as you will be asked several questions about this camera on an

upcoming page.” After clicking to the next page, an image was randomly displayed of either a small (width of 150 pixels) or large (width of 650 pixels) camera (figure 3.6).

After twenty seconds had passed participants could proceed, with automatic advancement occurring after thirty seconds. We then asked a few inconsequential questions about the camera, which included an attention check since this study is truly dependent on participants paying attention to the visual stimuli. This question was worded as follows: “What color, besides silver and black, was on this camera? Please pick the closest one.” Seven answers were available with the only correct choice being brown. (The other potential answers were yellow, white, green, purple, blue, and pink). Next, participants were told the following, “Here are two potential advertisements for a face wash.” Below this were two advertisements randomly presented for a face wash with both advertisements having either provisional or elimination claims (figure 3.7). One advertisement showed a bottle that appeared to be lit from above while the other showed this same bottle with apparent lighting from below. This resulted in a 2 (adaptation image: small vs. large) X 2 (claim: provision vs. elimination) X 2 (perceived lighting: above vs. below) mixed design. Assignment and presentation on the screen was completely randomized. We assessed preference by asking, “Please indicate which one you prefer by clicking below the preferred advertisement.” Finally, participants provided gender and age.

## ***Results***

Of those taking part in this study two-hundred and thirty-one participants (41.6% female;  $M_{\text{age}} = 32.3$ ) passed the attention check. Logistic regression with camera size and claim as the independent variables and preference as the dependent variable was estimated. This analysis reveals a significant interaction based on the camera size and claim seen ( $\beta = .335$ , Wald  $\chi^2(1) =$



5.927,  $p = .015$ ,  $OR = 39.7\%$ ). In comparing responses (figure 3.8), there is a significant difference between percentage of participants choosing the image with the apparent light from below based on adaptation image in the presence of an elimination claim ( $M_{LargeAdaptationImage} = 51.8\%$ ,  $SD = .50$  vs.  $M_{SmallAdaptationImage} = 27.0\%$ ,  $SD = .45$ ;  $\beta = -.533$ , Wald  $\chi^2(1) = 7.484$ ,  $p = .006$ ,  $OR = 70.4\%$ ), but as anticipated there is no difference between adaptation images in the presence of a claim of provision ( $M_{LargeAdaptationImage} = 35.8\%$ ,  $SD = .48$  vs.  $M_{SmallAdaptationImage} = 42.4\%$ ,  $SD = .50$ ;  $\beta = .137$ , Wald  $\chi^2(1) = .497$ ,  $p = .48$ ,  $OR = 14.5\%$ ). Including all participants does not change significance for the results.

## ***Discussion***

Since the same spatiotemporal process occurs regardless of provision or elimination (i.e., at first coming towards), we anticipated that participants adapted to a small image appearing to be further away would focus on the onset of the process when a provider or eliminating agent is further away coming closer. Thus, the next logical spatiotemporal sequence of events would be for either the provider or the eliminating agent to be closer to consumers (i.e., lit from above). This would be a reversal of the findings for an elimination claim (study 3), and this was indeed the case here in study 4.

Participants encountering an elimination claim were significantly more likely to choose the image lit from above rather than the image lit from below after being adapted to a small image that appeared further away. However, when seeing a large adaptation image, most participants chose the image lit from below, in alignment with study 3. For provision, as anticipated, we find no difference between adaptation conditions, but the image perceived to be lit from above was consistently preferred as it should appear to be more coming toward

participants. These findings provide support for hypothesis 4 in that consumers' spatiotemporal predisposition associated with provision and elimination claims is behind the consumer preferences exhibited in study 3.

### **Study 5: Downstream Consequences**

Having demonstrated the mechanism behind the interaction of claims and lighting, our next study provides further evidence for consumer preference, as well as downstream consequences, while addressing issues from prior studies. In study 5, we examine if consumer preferences would remain when consumers could choose a product without apparent directional lighting. That is, in all our studies thus far, participants have only been shown products or packaging exhibiting some form of perceived directional lighting. Thus, in this study, we give participants the option of a product without any perceived lighting effects to demonstrate that the favorable match between spatiotemporal predisposition and lighting direction generates significantly higher preference than the condition without lighting. Further, besides consumer preference, we wanted to investigate consumer purchase intentions and willingness to pay to see if these coincided with preferences. We predicted that, in accordance with hypothesis 3, that a significant interaction would occur between lighting and claim such that a product lit from above with a provision claim and a product lit from below with an elimination claim would be preferred and that this would be reflected in purchase intentions and willingness to pay.

## ***Method***

Two hundred and twenty-five MTurk workers (46.7% female;  $M_{\text{age}} = 33.1$ ) took part in this study for payment. As in the later part of study 4, participants were randomly shown one pair of images with a claim of either provision or elimination on both advertisements. In contrast to study 4, though, the product images were different in that there was one experimental image, with apparent lighting from either above or below, and one control image with no apparent directional lighting (figure 3.9). Thus, every participant saw one image with lighting directionality and one image without. Presentation and assignment of images was completely randomized. This set-up resulted in a 2 (claim: provision vs. provision) X 2 (perceived lighting: above vs. below) between-subjects design. On three separate pages, with presentation of the images on each page being randomized, three separate questions were asked. The first was as follows, “Here are two potential advertisements for a face wash. Please indicate which one you prefer by clicking below the preferred advertisement.” The next question was stated as follows, “Now, imagine that you are in the market for some face wash. Based on the advertisement, please indicate which one you would be more likely to purchase.” The third question assessed willingness to pay with the following question, “Now, imagine that you are in the market for some face wash and the advertised face wash is in your budget. Based on the advertisement, please indicate which one you would be more willing to pay for.” Gender and age were also assessed.

## ***Results***

*Consumer Preference.* Logistic regression with claim and perceived lighting as the independent variables and preference as the dependent variable reveals a significant interaction

( $\beta = .581$ , Wald  $\chi^2(1) = 17.287$ ,  $p < .001$ ,  $OR = 78.9\%$ ). See figure 3.10 for these results. For those exposed to the provision condition, there is a significant difference such that participants chose the experimental image more than the control when lit from above but not when lit from below ( $M_{\text{LitFromAbove}} = 60\%$ ,  $SD = .49$  vs.  $M_{\text{LitFromBelow}} = 33\%$ ,  $SD = .47$ ;  $\beta = .562$ , Wald  $\chi^2(1) = 8.211$ ,  $p = .004$ ,  $OR = 75.4\%$ ). Conversely, for those exposed to the elimination condition, there is a significant difference such that participants chose the experimental image more than the control when lit from below but not when lit from above ( $M_{\text{LitFromAbove}} = 31\%$ ,  $SD = .47$  vs.  $M_{\text{LitFromBelow}} = 60\%$ ,  $SD = .49$ ;  $\beta = -.599$ , Wald  $\chi^2(1) = 9.083$ ,  $p = .003$ ,  $OR = 82.0\%$ ). There was no effect from lighting ( $\beta = -.018$ , Wald  $\chi^2(1) = .017$ ,  $p = .90$ ) or claim ( $\beta = .011$ , Wald  $\chi^2(1) = .006$ ,  $p = .94$ ).

*Purchase Intentions.* In a logistic regression examining purchase intentions, there is another significant interaction ( $\beta = .510$ , Wald  $\chi^2(1) = 13.507$ ,  $p < .001$ ,  $OR = 66.5\%$ ). These results (figure 3.11) mirror the results for preference as more participants chose the experimental image lit from above over the control image when it was positioned as providing but not when it was lit from below ( $M_{\text{LitFromAbove}} = 60\%$ ,  $SD = .49$  vs.  $M_{\text{LitFromBelow}} = 41\%$ ,  $SD = .50$ ;  $\beta = .377$ , Wald  $\chi^2(1) = 3.869$ ,  $p = .049$ ,  $OR = 45.8\%$ ). Additionally, the experimental image lit from below was chosen significantly more over the control image (in contrast to the image lit from above) when accompanied with an elimination claim ( $M_{\text{LitFromAbove}} = 30\%$ ,  $SD = .46$  vs.  $M_{\text{LitFromBelow}} = 60\%$ ,  $SD = .49$ ;  $\beta = -.642$ , Wald  $\chi^2(1) = 10.262$ ,  $p = .001$ ,  $OR = 90.0\%$ ). There was no effect from lighting ( $\beta = -.133$ , Wald  $\chi^2(1) = .917$ ,  $p = .34$ ) or claim ( $\beta = .126$ , Wald  $\chi^2(1) = .820$ ,  $p = .37$ ).

*Willingness to Pay.* Finally, we have another significant interaction (figure 3.12) for willingness to pay ( $\beta = .399$ , Wald  $\chi^2(1) = 8.452$ ,  $p = .004$ ,  $OR = 49.0\%$ ). The experimental

image with a provisional claim was chosen significantly more often than the control only when it was lit from above ( $M_{\text{LitFromAbove}} = 58\%$ ,  $SD = .50$  vs.  $M_{\text{LitFromBelow}} = 40\%$ ,  $SD = .49$ ;  $\beta = .375$ , Wald  $\chi^2(1) = 3.833$ ,  $p = .050$ ,  $OR = 45.5\%$ ). Also, the experimental image accompanied with an elimination claim was chosen significantly more often than the control only when it was lit from below ( $M_{\text{LitFromAbove}} = 31\%$ ,  $SD = .47$  vs.  $M_{\text{LitFromBelow}} = 52\%$ ,  $SD = .50$ ;  $\beta = -.423$ , Wald  $\chi^2(1) = 4.628$ ,  $p = .031$ ,  $OR = 52.7\%$ ). There was no main effect of lighting ( $\beta = -.024$ , Wald  $\chi^2(1) = .031$ ,  $p = .86$ ) or claim ( $\beta = .155$ , Wald  $\chi^2(1) = 1.271$ ,  $p = .26$ ).

## ***Discussion***

As anticipated, a significant interaction occurs for claim type and lighting in support of hypothesis 3. Consumers have higher preferences, are more likely to purchase, and are more willing to pay for products lit from above when these are positioned as provisional and products lit from below when these are positioned as eliminatory. Though we demonstrated that preferences correlate with these claims and lighting in study 3, this was done with the packaging through the manipulation of the logo. Here we demonstrate the robustness of this effect, as in study 4, that apparent lighting of a product, regardless of packaging, within a promotion interacts with these claims to produce the hypothesized effect. Furthermore, we have also demonstrated that in the presence of a provision claim, that the majority of consumers prefer apparent lighting from above over no apparent lighting, but in the presence of an elimination claim the majority of consumers prefer apparent lighting from below over no apparent lighting. Yet, if the congruent lighting is not available for the claim being made, consumers will prefer an absence of lighting.

## General Discussion

Prior research has examined the influence of ambient light on consumer behavior (Biswas et al. 2017; Huang et al. 2017; Xu and Labroo 2014). In the present work, we study the effects of lighting from a different perspective. Specifically, we look at the effect that perceived lighting direction in two-dimensional environments may exert on consumer behavior. Additionally, despite the abundance of products positioned as having provisional or eliminatory properties in the marketplace, no prior research has examined the effects that such distinction may generate in consumer behavior. This work investigates how claims associated to provisional or eliminatory properties may influence spatiotemporal perceptions. Through a collection of five conservatively designed studies employing subtle manipulations of lighting, we investigate both novel areas and document the important implications that arise from the interaction between perceived lighting direction and provisional versus eliminatory properties.

Specifically, we show that perceived lighting from above leads to perceptions of a product as moving closer while perceived lighting from below leads to perceptions of a product as moving farther. Further, a provision or elimination property creates a spatiotemporal predisposition for consumers such that they expect the arrival of a provider or the departure of an eliminating agent. We demonstrate that consumers prefer apparent lighting from above for products that provide, as this better matches the associated spatiotemporal predisposition. Conversely, eliminatory properties are generally preferred by consumers in the presence of perceived lighting from below. Lastly, these preferences for spatiotemporal congruency between lighting direction and product properties extend to the downstream consequences of purchase intentions and willingness to pay.

### ***Theoretical Contributions***

Our research, to the best of our knowledge, is the first to extend the understanding of perceived lighting directionality from above or below to more complex objects such as products. Prior research has shown how the perceived lighting of simple, ambiguous shapes can manipulate proximity perceptions of focal objects (Gibson 1950; Ramachandran 1988), but we contribute theoretically by demonstrating that even more complex focal objects such as products will be seen differentially based on perceived lighting from above or below. Further, by explicating the role of lighting directionality, this work takes a step beyond past marketing investigations looking at bright versus dim light (Biswas et al. 2017; Huang et al. 2017; Xu and Labroo 2014). The present work is also the first in marketing to manipulate perceived light in a constrained, two-dimensional manner rather than environmentally. Additionally, this work contributes to the growing exploration of the spatiotemporal implications of visual stimuli within the marketplace (e.g., Brasel and Hagtvedt 2016; Buechel and Townsend 2018; Hagtvedt and Brasel 2017). Our work also provides insight to packaging and color properties as it relates to perceived lighting in that a subtle manipulation of surface color can generate the proposed lighting effect.

To the best of our knowledge, the present work is also the first to examine the role of provision and elimination properties and claims. Specifically, we explicate the spatiotemporal predisposition that emerges for consumers when encountering providing or eliminating properties and claims. Though prior research has extensively investigated the effect of positive or negative claims through regulatory focus research (e.g., Jain et al. 2006; Keller 2006; Zhu and Meyers-Levy 2007), our research is focused on a similar, yet distinct, psychological

phenomenon - the psychophysical spatiotemporal predisposition that consumers have when encountering providing or eliminating properties.

### ***Managerial Implications and Future Directions***

Our work provides actionable results that are particularly important in today's marketplace. Consumers are progressively making more online purchase decisions now totaling over \$120 billion per quarter in the U.S. alone (U.S. Department of Commerce 2018), and these purchases are increasingly influenced by the two-dimensional images of products (Kane and Pear 2016). Combined with the fact that consumers are spending more time online due to the connectivity provided by mobile phones (Luo et al. 2013; Verhoef et al. 2017), consumers are encountering more advertisements and product offerings through an online environment. Yet, the present findings are relevant even beyond online or advertising environments, as even the imaging featured on the packaging or labeling of products found in brick-and-mortar environments could lead to this type of effect. Further, the present findings further establish and warn about the sensitive nature of visual cues, as subtle imagery manipulations may impact the perceived effectiveness of products (Zhu, Billeter, and Inman 2012). Given this, it is critical to understand the various aspects of visual perception that may influence consumer behavior in marketplace interactions.

Since the usage of two-dimensional images within marketing continues to increase (Kane and Pear 2016), as does consumers' preferences for images over other forms of information (DelVecchio et al. 2018), it is imperative that marketers better understand the nuances of visual perception. Our work gives insight as to the appropriate perceived lighting to employ dependent on the positioning or properties of a product. As noted earlier, while some products are more of a



providing (e.g., vitamins) or eliminating (e.g., wart removal cream) nature, other products can be positioned as either providing or eliminating based on their essential features (e.g. toothpaste). Dependent upon the product and the actions of the competition, the positioning of a product must be strategically chosen, along with the appropriate promotional or packaging materials, including lighting information, as these seemingly trivial decisions can influence purchase intentions and willingness to pay.

Furthermore, these considerations must be made no matter the retail environment. Even though this has been shown to be a two-dimensional phenomenon, this does not limit this effect to only online retail environments. Since consumers are relying more on visual information, advertising materials within brick-and-mortar stores can be appropriately designed such that these effects can occur in traditional retail environments. Also, as demonstrated in our studies, even an element of the packaging (e.g., a logo) can lead to the exhibited phenomenon.

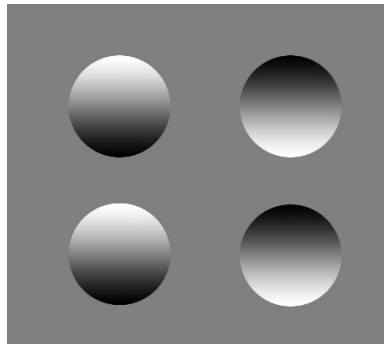
Moving beyond the areas that we studied, there are other ways by which this phenomenon could be investigated. For instance, since our studies subtly manipulated lighting, there are common methods of light manipulations in marketing contexts that could be considered. Background lighting in ads or on websites, promotional stands within retail stores or product launch shows, could all provide ample opportunity to examine this effect. Additionally, it could be possible that shelving lighting from above or below in a brick-and-mortar retail store or promotional stand could generate the same effect. Furthermore, in what other ways are consumers spatiotemporally predisposed such that lighting can have an effect on perceptions? As Aydinoglu and Krishna (2010) demonstrated, a claim of small or large could alter size perceptions of consumers, and this points to the potential for other properties or claims that can adjust consumer perceptions. What products are seen as more providing or eliminating?

## ***Limitations and Conclusions***

Our studies collectively address potential issues arising in studying a novel subject, yet, there are limitations to our work. Though our subtle manipulations were presented to consumers through computer screens or mobile phones, as would be done in real life scenarios with this phenomenon, it would be beneficial to know if this packaging effect would emerge on shelving in an actual brick and mortar retail store. Also, perceived lighting in two-dimensional images is truly a result of shading, and there could be potential boundary effects that emerge between various hues of the product, the background, and the shading. Additionally, we demonstrated this with products, but it would be especially beneficial to understand how this phenomenon effects perceptions and preferences of services and even app icons.

The present work investigated the role of lighting directionality in an increasingly visually presented and assessed marketplace. We explicated and demonstrated how products and packaging exhibiting apparent lighting from above are perceived by consumers to be more proximal, whereas products and packaging exhibiting apparent lighting from below are perceived by consumers to be more distal. This has a significant effect on consumer preferences, purchase intentions, and willingness to pay. Products perceived to be lit from above better match consumers' spatiotemporal predisposition for products that provide, but products perceived to be lit from below better match consumers' spatiotemporal predisposition for products that eliminate. The implications for our work are important for researchers and practitioners alike. For researchers, we have laid new ground for further exploration within perceived lighting and color properties as well as the previously unexplored area of provision and elimination. For practitioners, careful assessment must be made regarding product positioning and apparent lighting in an increasingly visual marketplace.

## FIGURES



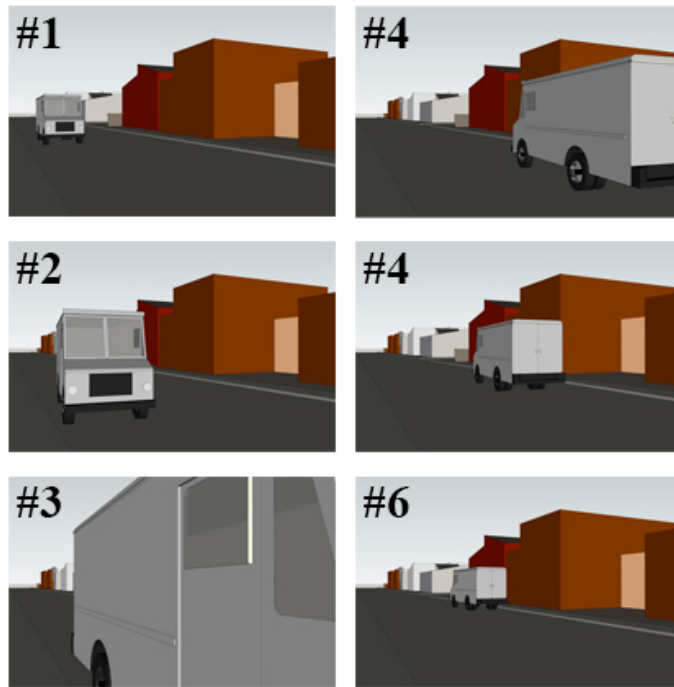
**Figure 3.1: Optical Illusion from Lighting Direction**

LIT FROM ABOVE

LIT FROM BELOW



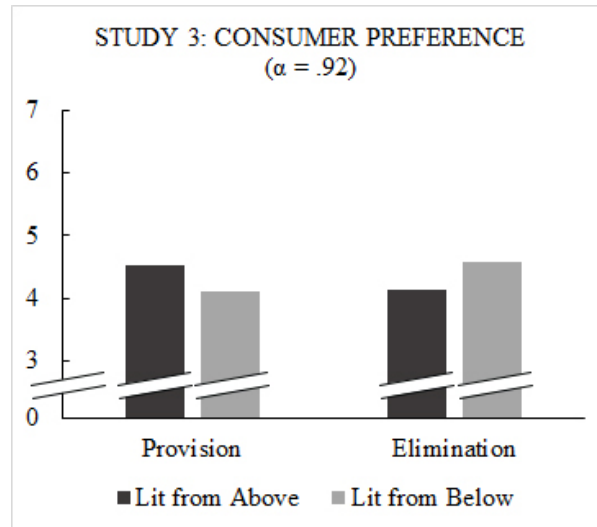
**Figure 3.2: Study 1 Stimuli**



**Figure 3.3: Study 2 Stimuli**



**Figure 3.4: Study 3 Stimuli**



**Figure 3.5**

LARGE (CLOSE) IMAGE

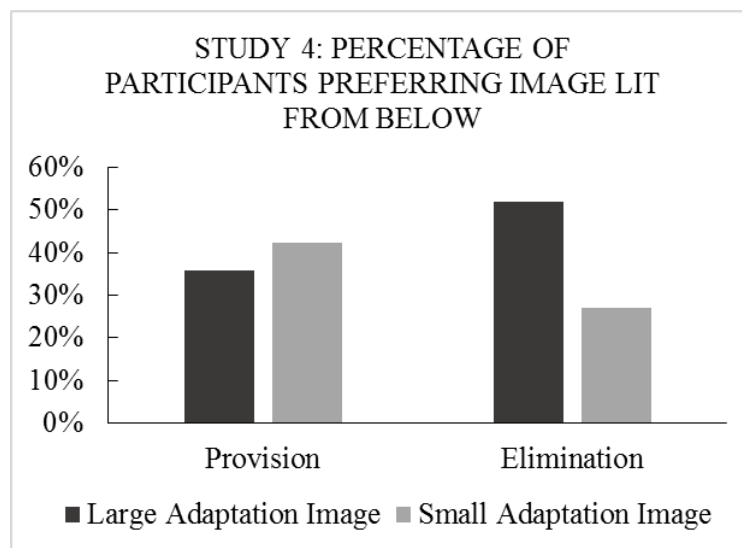
SMALL (FAR AWAY) IMAGE



**Figure 3.6: Study 4 Adaptation Stimuli**



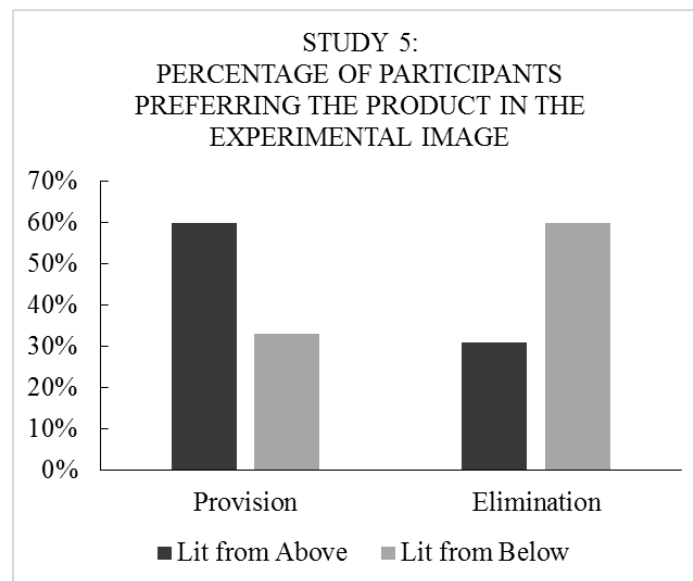
**Figure 3.7: Study 4 Stimuli**



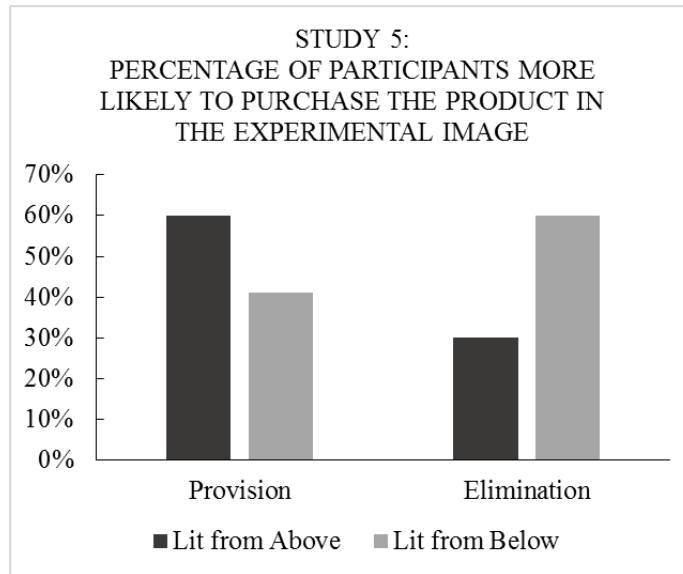
**Figure 3.8**



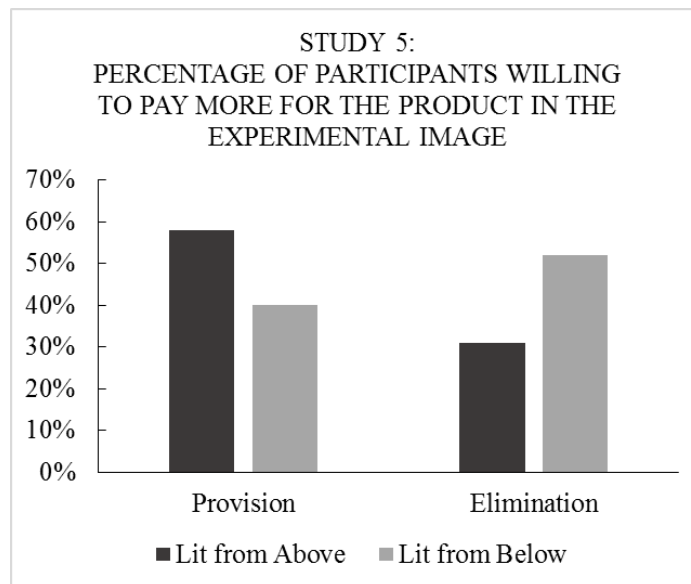
**Figure 3.9: Study 5 Stimuli**



**Figure 3.10**



**Figure 3.11**



**Figure 3.12**



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## CHAPTER 5

### CONCLUSION

Even though it seems that a field so dependent upon visuals would have a commanding knowledge of how marketplace designs are perceived, the three essays presented in this dissertation present novel insights and avenues worthy of further exploration. As mentioned in the introduction, traditionally there has been a disconnect between design and marketing coupled with an underdeveloped understanding of visual perception. With the increasing usage and focus on visuals, it is imperative that marketers gain a better understanding of how consumers visually assess marketplace designs. My dissertation takes a step in addressing this gap.

Essay 1 introduces a conceptual framework for understanding the 21 facets that comprise what is seen in the marketplace. Despite the influence of the different components and facets presented there, consumers also make holistic assessments of marketplace designs. Thus, in Essay 2, I introduce a more reliable way, than what is currently available to the marketing field, to assess how consumers visually evaluate designs and to allow for greater communication between marketers and designers. As exhibited there, much can be gained from a better integration of design theorizing and knowledge with marketing. Further explorations can be conducted into how lay theories from design can be adopted into marketing practices and research.

In addition, the facets introduced in Essay 1 are woefully unexamined, yet as Essay 3 indicates, these facets can have important implications for marketers and researchers. In that

essay, I examine how one of the facets introduced in Essay 1 can influence holistic assessments of marketplace designs and consequently consumer behavior. Whereas this last essay is a specific example of how just one facet of perception can shape preferences, interactions between any two of these facets have been all but ignored/overlooked and the example research from Essay 3 points to a myriad of future research possibilities.

Building off the essays presented here, related research questions emerge. Consumers obviously value aesthetic appeal, but as consumers become more visually focused can the introduction of this holistic view of design presented here help us to better understand how and when consumers will have more positive evaluations, purchase intentions, and WTP or is this more contingent on piecemeal perception? Furthermore, consumer internal states should play a substantial moderating role in these perceptions and evaluations. For instance, how do personality differences among consumers interact with the form of designs such that the design is seen differently, i.e. will a consumer with an embarrassing purchase see a more out-of-the way checkout area as more attractive than a more accessible checkout? Furthermore, what aspects of the usefulness, dependability, and beauty of a design allow it to remain esteemed as a good design over groups of consumers, long periods of time, or even across cultures?

Additionally, what is the role of style in all of this? How does being inside a design with a certain meaningful style, e.g. buildings, as opposed to being outside a design with the same style, e.g. products and advertisements, interact with the traits and design styles of consumers? Do different object styles with perceived meanings, e.g. the harshness of brutalism or the simplicity of minimalism, have the intended impressions when these do not align with individual differences?

Prior research has extensively focused on consumer goals, needs, and other internal factors that drive consumer behavior. Reversing this focus, my dissertation and proposed future research is on the less-investigated external factors of the visual marketplace designs of products and promotions. By gaining a better understanding of how these visual marketplace designs can better shape and meet consumer needs and desires more sustainable solutions can be provided to both consumers and firms. Collectively, the essays presented here provide new insights to the field and lay a framework for a lifetime of research.