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PRODUCT DESIGN MATTERS, BUT IS IT ENOUGH? CONSUMERS' RESPONSES TO PRODUCT DESIGN AND ENVIRONMENT CONGRUENCE

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Product Design Matters, But Is It Enough?

Consumers' Responses to Product Design and Environment Congruence

1. Introduction

Product design has been employed as a strategic tool for companies to distinguish their products in the crowded market and to communicate their messages with their consumes (Berkowitz, 1987; Kotler and Rath, 1984). Product design could transfer utilitarian, hedonic and symbolic information and benefits to consumers (Bloch, 2011; Brunner *et al.*, 2016). In addition, research shows that product design plays a major role in drawing consumers' attention to the product at the beginning of consumer-product interactions (Blijlevens *et al*., 2009; Crilly *et al.*, 2004; Kreuzbauer and Malter, 2005). Moreover, product design is shown to influence a consumer's perception of product performance and product categorization (e.g., Lee *et al*., 2011).

In today' globally competitive market, a good design, while still necessary and important, may not be sufficient to guarantee the success of the product. In fact, a growing body of academic research in retailing supports the importance of store environment as a marketing tool to influence consumers' shopping behavior and willingness to purchase (e.g., Fiore *et al*., 2000; Seock, 2009; Turley and Milliman, 2000). As a result, retailers spend a great deal of money every year to design and/or refurbish their stores in order to keep stores up-to-date (Roy and Tai, 2003). Despite these efforts, research shows that a well-designed product may still elicit negative emotions due to a poor fit with its environment (Michie and Forty, 1987). This notion is referred to as environment congruence, which is defined as high levels of cognitive fit between perceptions of the environment (here, store environment) and those of the product in a consumer's mind (Fiore *et al.*, 2000). The match between the product and its environment results

in positive synergy (Bloch *et al.*; 2018), which could influence consumers' response and generate a desire for the presented product (Fiore *et al.*, 2000). Overall, research supports the idea that environment congruence facilitates consumers' positive evaluations of products in a shopping environment (e.g., Berger and Fitzsimons, 2008; Meyers-Levy and Tybout, 1989).

While the effect of product design and environment congruence on consumers' attitude and response has been separately investigated in previous research, no empirical investigation has tested the combined effect of these two variables. The present investigation aims to fill this gap and challenges the generally accepted idea that the design elements in store environment must be aligned with those embedded in the product (Berger and Fitzsimons, 2008; Wu *et al.*, 2013). In this investigation, environment congruence refers to the degree of match between visual design elements in a product and those in its environment (here, product display). In addition, consumers' evaluative reaction toward the product is measured across all the three components of attitude (cognitive, affective, and conative/behavioral) in order to examine whether or not they are influenced similarly by the focal variables of the study. The cognitive dimension is measured using perceived aesthetics, affective response is measured for the affective component, and purchase intention for the conative (behavioral) dimension.

From a theoretical standpoint, this study contributes to two distinct but related research streams: product design and environment congruence. From a practical standpoint, the findings have important implications for product designers, retailers, and merchandising professionals. For instance, this investigation reveals how various visual design elements in a product could be used to elicit positive responses from consumers, and under what conditions the visual congruence between a product and its environment could help retailers to provide a more positive experience for consumers and increase sales. In the following sections, a discussion of

the relevant literature is provided first. Then, hypotheses are developed and tested across two experiments. The paper concludes with discussion of the findings, implications, limitations and future research directions.

2. Background of the Study

2.1. Product Design

Product design is defined as a set of properties of a product, consisting of the discrete properties of the form (i.e., aesthetics) and the function (i.e., its capabilities) together with the holistic properties of the integrated form and function (Luchs and Swan, 2011; also see Homburg *et al*., 2015). In line with this definition, product design cues refer to certain tangible and intangible characteristics of the product that shape the appearance and meanings (Lee *et al*., 2011) including form, shape, size, weight, proportion, symmetry, orientation, craftsmanship, materials, texture, reflectiveness, color, ornamentation, and typography (e.g., Artacho-Ramirez *et al*., 2008; Chang, 2008; Hoegg and Alba, 2011; Hsiao *et al*., 2008; Townsend *et al*., 2011). Product design provides utilitarian, hedonic, and symbolic information (Bloch, 2011) and consumers heavily rely on product design cues to develop product knowledge and perceptions (Rao and Monroe, 1988). Previous research overall supports the positive effect of product design and appearance on consumers' product-related perceptions (Blijlevens *et al*., 2009; Bloch, 1995; Hollins and Pugh, 1990; Lawson, 2006; Noble and Kumar, 2010).

2.2. Environment Congruence

In addition to design cues embedded in a product, extrinsic cues such as brand, packaging, store image, and store environment can help consumers develop a more comprehensive understanding of the product (Dodds *et al*., 1991; Naderi and Paswan, 2016; Orth and Malkewitz, 2008; Seock, 2009; Teas and Agarwal, 2000). In marketing literature, the

influence of store environment on shoppers' response has been studied under the term *atmospherics*, which refers to "the effort to design buying environments to produce specific emotional effects in the buyer that enhance his purchase probability" (Kotler, 1973-1974, p. 50). Previous research supports the importance of store environment as an effective marketing tool; a well-designed retail environment positively influences shoppers' product evaluation process (Brengman and Willems, 2009; Kirby and Kent, 2010) whereas a poorly-designed retail environment has a negative effect on shopping experience and affective response (Spies *et al.*, 1997). As a result, retailers have tried to create influential atmospheres in order to attract their target customers and increase sales and profitability (Sirgy *et al*., 2000; Seock, 2009; Turley and Milliman; 2000).

While retail store environment plays a crucial role in shoppers' evaluations of products, research shows that products are evaluated more favorably and chosen more frequently when the surrounding environment contains similar cues (Berger and Fitzsimons, 2008). These findings could be attributed to the notion of environment congruence (Fiore *et al*., 2000), which refers to a high level of cognitive fit between the perception of environment and the mental information stored about the product in a consumer's mind. Congruence among different elements of product presentation helps consumers better integrate meanings into an overall impression of the products, which in turn leads to a deeper level of product perception. Research shows that congruence between perceptions of promotional environment (e.g., product display) and the mental image of the product increases product and brand familiarity, acceptability, and approach response (Fiore *et al.*, 2000).

Despite these efforts, the effect of congruence between design cues embedded in a product and the design cues in its environment (e.g., product display) on consumers' response

has not been studied before, partly due to the fact that the environment is a complex configuration of several design elements that are hard to isolate even in controlled experiments. Therefore, the focus of this investigation is on environment congruence, which refers to the degree of match between visual design cues in a product and those in its environment. Product display is a common form of the environment studied in both marketing and merchandising, which is also the focus of this inquiry. Fiore *et al*. (2000) argue that product display operates as part of a store environment and has similar components that are designed to elicit a positive response. Marketing and visual merchandising literature has identified design elements and characteristics of product display such as background structure, layout, fixtures, props, color, style, texture, signage, lighting, and complexity (Fiore *et al.*, 2000; Kerfoot *et al.*, 2003; Spies *et al.*, 1997; Wu *et al.*, 2013) that can help retailers create a comprehensive experience for potential consumers.

2.3. Perceived Aesthetic

Aesthetic is defined as sensitivity to beautiful things (Veryzer, 1993). Throughout the long history of humanity, aesthetical objects have always elicited positive responses from people. The "aesthetics" origin in Greek refers to a sensory understanding of delightful objects or phenomena (Hekkert, 2006). In the context of product design, Desmet (2003) defines aesthetic as an important quality of the product that facilitates pleasure through one or more sensory modalities. Further, Veryzer (1993) defines aesthetic response as consumers' reaction to products based on perceptions of product design cues. In other words, aesthetic features of a product determine how consumers perceive its appearance and beauty (Bloch, 2011). Aesthetics has been considered one of the main components of cognitive perception (Crilly *et al.*, 2004) and a key determinant of user satisfaction (Hassenzahl, 2001). Overall, a substantial body of research

shows that aesthetic perceptions play a major role in consumers' understanding and overall evaluations of products (Blijlevens *et al*., 2009; Bloch *et al*., 2003; Crilly *et al*., 2004; Lee *et al.*, 2011; Yamamoto and Lambert, 1994). Across various studies, participants indicated higher acceptance of products with high quality aesthetic elements (Veryzer, 1993; Bloch, 1995), selected products based on their aesthetic quality (Creusen and Schoormans, 2005), and reported more positive perceptions of the products with aesthetic features even when aesthetic design was irrelevant (Madzharov and Block, 2010).

2.4. Affective Response

Affective response is defined as the general psychological state of an individual (e.g., emotions and mood) within a given situation and describes subjective experiences involving both positive and negative dimensions (Haile *et al*., 2015). The notion of affection has been widely studied in a variety of disciplines including marketing (Abbott *et al.*, 2009; Creusen and Schoormans, 2005; Da Silva and Syed Alwi, 2006; Franzak *et al*., 2014), design (Jordan, 1999; Norman, 2004), and human factors/ergonomics (Seva and Helander, 2009). Increasingly, marketers and brand managers are interested in understanding the processes through which consumers' affective responses to products and services are shaped (e.g., Franzak *et al.*, 2014). Davis (1989) suggests that affective responses of consumers and their attitudes are usually a consequence of their perceptions. Supporting this perspective, Hassenzahl (2001) argues that during the consumer-product interaction, different perceptions elicit different affective responses.

The mechanism of affective response formation can be explained using appraisal model (Scherer *et al.*, 2001). According to this model, evaluation of an object, environment, or phenomenon generates some beneficial or harmful concerns in consumers' mind, which in turn

lead to appropriate emotional reactions (Hekkert, 2006; Scherer *et al.*, 2001). When consumers perceive beneficial qualities in owning or using a product (either hedonic or utilitarian), they unconsciously develop positive affective responses. However, it is hard to define a universal relationship between visual aspects of product design and consumers' affections because it is a highly personal experience for each individual (Desmet *et al.*, 2001). Nonetheless, few empirical studies (e.g., Demirbilek and Sener, 2003; Desmet, 2003; Desmet *et al.*, 2000; Desmet *et al.*, 2001; Jordan, 1998; Seva and Helander, 2009) have attempted to tackle this issue. For instance, Kumar *et al*. (2015) verified the effect of intangible values of product design on consumers' affective response to a brand; Westbrook (1987) studied consumers' affective response in a post-purchase context; and Bahn *et al*. (2009) investigated the influence of luxuriousness in product design on consumers' affection. Despite these efforts, empirical evidence for the direct effect of product design on consumers' affective responses is lacking in both product design and marketing literature (Desmet *et al.*, 2000).

3. Theoretical Framework and Hypotheses

3.1 Product Design and Consumer Response

The mechanism of product design perception can be examined using the basic model of object recognition (Riddoch and Humphreys, 2001). According to this model, consumers first process the information about the basic components of an object such as shape and color. Then, the object components are grouped together and form an overall visual stimulus. Next, the visual stimulus is evaluated based on stored information in the memory. Finally, symbolic and semantic attributes are applied to visual stimulus in the fourth stage. Blijlevens *et al.* (2009) argue that appearance attributes together provide a consumer with an overall impression and understanding of the product. Similarly, Gestalt theory of visual perception of form (Wertheimer and Ellis,

1938) describes how people perceptually unify the elements of visual form and organize them to understand the whole shape or object. This work follows the Gestalt principles of design (a.k.a. the Gestalt Rules), which refer to a number of aesthetic principles developed to aid the production of pleasing designs (Crilly *et al*., 2004), and are recognized as the common practice guidelines for creating "good" design in the field of product design (Chou, 2011; Lugo *et al*., 2015). Subsequently, a product with good design refers to a product that is designed following any or a combination of the Gestalt principles (proximity, continuity, closure, symmetry, parallelism, similarity, and common region). However, to objectively conceptualize product design in this work, visual design cues that follow the Gestalt principles refer to high-level design cues whereas visual design cues that do not follow the Gestalt principles refer to low-level design cues. Therefore, a product with high-level design cues is expected to stimulate more positive responses in consumers. Specifically since the attitude formation sequence for a functional product is expected to be cognitive → affective → conative (Eagly and Chaiken, 1993), it is hypothesized that:

> **H1:** Products with high-level design cues (a) elicit more positive aesthetic responses, which in turn (b) lead to more positive affective responses, and subsequently (c) higher purchase intentions.

3.2. Environment Congruence and Consumer Response

Research in psychology shows that people tend to develop a preference for things merely because they are familiar with them (Zajonc, 1968, 2001), and that exposure to a stimulus increases perceptual fluency, or the ease with which a stimulus can be processed (Bornstein *et al*., 1994). Perceptual fluency, in turn, positively influences affective judgement (Reber *et al*., 1988). In the context of this investigation, when a shopper enters a retail store, he or she is first

exposed to design cues in the environment surrounding the product, which are encoded and stored in the working memory (mainly a subconscious process). Once the individual is eventually exposed to the product, if design cues embedded in the product (new information) are similar to those of the environment (information retrieved from working memory), the individual is expected to experience greater perceptual fluency, which could lead to greater product favorability. In other words, the fluency experienced as a result of consistency among different elements of product presentation (here, design cues embedded in a product and its environment) is likely to enhance consumers' perceptions of the product. In contrast, lack of congruence is likely to increase information ambiguity (disfluency), which leads to negative perceptions of the product. Berger and Fitzsimons' (2008) findings provide preliminary evidence for this line of reasoning by showing that related cues in the environment lead to more favorable evaluations of products. Therefore, and in line with the attitude formation model, it is hypothesized that:

> **H2:** Products presented in a congruent, rather than a non-congruent environment, (a) elicit more positive aesthetic responses, which in turn (b) lead to more positive affective responses, and subsequently (c) higher purchase intentions.

3.3. Combined Effect of Product Design and Environment Congruence

Previous research has separately examined the effects of product design (H1) and environment congruence (H2). When environment congruence is the only focal variable being investigated, the same product can be presented in two environments: one environment encompasses similar design cues (congruent environment) and the other does not (non-congruent). This investigation, however, aims to extend the findings of previous research by examining the effects of these two variables both separately (main effects) and together (interaction effect). A congruent environment for a product with high-level design cues means

the environment is also well-designed and encompasses high-level design cues. Under this condition (when the shopper is exposed to high-level design cues both in the product and its environment), environment congruence is expected to increase the positive influence of high-level product design cues. Similarly, when a shopper is exposed to low-level design cues both in the product and its environment, environment congruence is again expected to intensify the negative effect of low-level product design cues. In contrast, no such reinforcing effect is expected in non-congruent environments. Therefore, environment congruence is expected to play a moderating role in the relationship between product design cues and consumer response. More precisely, the positive effect of product design cues is expected to be stronger in a congruent environment than in a non-congruent environment. Therefore, and based on the attitude formation model, it is hypothesized that:

> **H3:** For a product presented in a congruent, rather than a non-congruent environment, (a) product design has a stronger effect on aesthetic responses, which in turn (b) lead to more positive affective responses, and subsequently (c) higher purchase intentions.

These hypotheses are empirically tested in two lab experiments. In the first experiment, both product design and environment congruence are manipulated and their effects on three dependent variables, namely perceived aesthetic, affective response, and purchase intentions) are examined in a 2.5D environment (a 3D interactive content presented on a 2D display). The second experiment follows a similar procedure and uses the same measurements. However, the 3D stimulus and the simulation environment are presented using a virtual reality (VR) headset in an attempt to make the experience fully immersive and closer to reality. This new tool could be instrumental in minimizing the confounding effects of some extraneous variables such as distraction and lack of realism.

4. Experiment 1

4.1. Research Design and Participants

A controlled lab experiment was conducted to investigate the hypotheses of this study. The experiment had a 2 (product design cues: high-level vs. low-level) × 2 (environment: congruent vs. non-congruent) between-subjects design. In order to examine the effects of product design cues and environment congruence separately (main effects) and together (interaction effect), these two variables were manipulated separately. To do so, a white, generic product display was used in the non-congruent conditions (Figures 1a and 1b). This product display was closely modeled after the product displays retailers often use in stores for various products (no customization), thus simulating a real store setting. In the congruent conditions, two product displays were designed, one similar to the product with high-level design cues and the other similar to the product with low-level design cues (Figures 2a and 2b). Using this experimental design makes it possible to directly test H2 (main effect of environment congruence, above and beyond the effect of product design). In addition, the interaction directly captures whether environment congruence moderates the effect of product design on consumer response, making the interpretation of the results more straightforward. Finally, and from a practical perspective, the generic product displays here are closely modeled after product displays often used by retailers. Therefore, the findings will have direct, clear implications for retailers. In sum, the four conditions are:

- Figure 1a – low-level product design cues + white, generic display (non-congruent)
- Figure 1b – high-level product design cues + white, generic display (non-congruent)
- Figure 2a – low-level product design cues + similarly designed display (congruent)
- Figure 2b – high-level product design cues + similarly designed display (congruent)

Insert Figures 1a, 1b, 2a, and 2b Here

Before running the experiment, a pre-test was conducted with eight graduate and undergraduate students from the same sampling frame to identify any potential issues with manipulations, measurements, questionnaire flow, and research protocol. Based on the feedback, some adjustments were made in the product design stimuli by making the differences more vivid and noticeable. In addition, dynamic lighting, which creates more realistic shadows, was added in order to enhance the realism of the VR environment. Further, the virtual navigation system was recalibrated in terms of speed (slower), controls (re-assigning joystick keys), and agent height (lowering the virtual perspective from 5' 11" to 5' 6" to better accommodate female participants). Finally, a few items on the questionnaire including manipulation check questions were re-worded for the purpose of clarity and/or conciseness.

Ninety-one college students (56 males, 35 females) from a large public university in the United States participated in this study in exchange for extra course credit. They ranged from 19 to 52 years old (M = 24.35, SD = 6.84). Analysis indicated that gender did not affect the dependent variables nor did it interact with the independent variables. Therefore, the gender groups were combined and analyzed together. Participants were randomly assigned to one of the four aforementioned experimental conditions and then their responses to various dependent variables were measured.

4.2. Procedure and Stimulus

A high-fidelity simulation environment was developed and presented to participants using an LG 70" Full HD 1080 TV powered by a Dell Precision 3600 Desktop PC with Nvidia Quadro 4000 GPU. An Xbox controller was also used for movements and navigations (see Appendix A). This experiment setting is called 2.5D environment in which a 3D interactive

content is presented on a 2D display. Upon arrival at the laboratory, participants were greeted and briefed about the study. The study included five parts: (1) providing demographic information, (2) training on using the joystick for navigation, (3) providing task instructions, (4) performing the task, and (5) filling out the post-test questionnaire. The virtual training environment was a simple store with minimum decoration, and the training session lasted approximately two minutes until each participant could confidently navigate the virtual environment using the joystick. The experiment's main task was completed next. Each participant was asked to use the joystick to inspect the experimental object (i.e., a point-and-shoot digital camera) as well as its surroundings in a virtual setting as presented in the 70" display. There was a five-minute time limit to perform the experimental task to ensure consistency. The task started out at the entrance of the product presentation environment which was located at a consumer electronics retail store.

A digital camera was selected as the stimulus of this study. The complexity of asymmetrical geometry and functionalities makes a digital camera a perfect choice for 3D displays as a 3D virtual environment enables participants to visually inspect the product from various angles (Leder *et al.*, 2007). In addition, a digital camera is a relevant product category for the student population (e.g., Gammoh *et al.*, 2006). The 3D simulations of two point-and-shoot digital cameras were developed using SolidWorks, 3D Studio Max, and Unity 3D, with dimensions similar to those of an existing Canon PowerShot S100 product platform (see Figures 3a and 3b). However, a fictitious brand (IMAGETECH), which participants were led to believe was a potential new product entry, was used.

Based on the literature (e.g., Desmet and Hekkert, 2007; Noble and Kumar, 2010), four product design cues (form, texture/material, color, and typography) were used to manipulate

design cues on the two virtual camera prototypes while other variables were held constant across the two versions. As discussed, the Gestalt principles of design are commonly used as guidelines for creating "good" design (Chou, 2011; Lugo *et al.*, 2015). Therefore, the form of the camera in high-level design cues condition was designed to meet five principles of Gestalt: (1) similarity: using similar visual elements; (2) proximity: arranging visual elements close to each other as a group; (3) common region: grouping the visual elements within a boundary; (4) continuity: creating a rhythmic pattern with aligning visual elements; and (5) closure: grouped visual elements that create perceptions of a complete shape or line (see Figure 3a and Appendix B). In contrast, those Gestalt principles were not followed in the design of the camera with low-level design cues. In addition, research shows that shiny and reflective materials are associated with modernity (Karana *et al.*, 2008) and metallic color highlights technological superiority in a product (Ashby and Johnson, 2003). Therefore, a combination of metallic orange and metallic black was used in the camera with high-level design cues. In the camera with low-level design cues, in contrast, an achromatic silver paint on plastic was simulated to create a dull impression. Finally, the typography in the high-level design condition employed an angular geometric shape to convey a better aesthetic of modern design through the "unity of text and form" (Kostelnick, 1990, p. 10), whereas in the low-level design condition, a commonplace font was used to minimize the design impact of typography.

Insert Figure 3a and Figure 3b Here

A product display was used in order to manipulate environment congruence. The product display was virtually developed with dimensions of 8' 2 ½" width, 8' 2 ½" length, and 8' 2 ½" height. A product stand was also virtually built with an 18" × 18" platform and 37" height. In order to increase the ecological validity of research by increasing the level of realism, a 360º

photo of an electronic retail store was used in the background of the presentation environments. For the non-congruent conditions, a generic product display was designed with cubic/rectangular form in white color combined with white fluorescent lighting (see Figures 1a and 1b). For the congruent conditions, two product displays were used: one similar to the camera with high-level design cues and the other similar to the camera with low-level design cues (high-level design cues or low-level design cues in both product and product display; see Figures 2a and 2b).

4.3. Measurements

Upon completion of the main task, self-report measures were used to capture the dependent variables. Perceived aesthetic was measured using eight statements borrowed from Lavie and Tractinsky's (2004) visual aesthetics scale and Mathwick *et al.*'s (2001) visual appeal scale. Participants rated these items on 9-point scales (1: *strongly disagree*; 9: *strongly agree*). While several scales have been used to measure affective state (e.g., Positive and Negative Affect Schedule [PANAS] by Watson *et al*., 1988; Pleasure, Arousal, Dominance [PAD] by Mehrabian and Russell, 1974), such scales are mainly aimed at measuring participants' overall emotional states in response to some emotional episodes (relatively brief emotionally charged events as in experimental manipulations). However, here participants were only asked to interact with the product in a virtual environment and express their feelings toward the product. Therefore, affective response in this study was measured using the three affection items (love, admiration, and dreaminess) borrowed from the product emotion scale (Desmet, 2012), which was specifically aimed at measuring positive emotions in human-product interactions. The items were rated on 9-point scales (1: *strongly disagree*; 9: *strongly agree*). Purchase intention was measured using one item (likelihood of purchasing the camera), rated on a 9-point scale (1: *very low*; 9: *very high*). Finally, two items were included in order to check the manipulations in this

experiment. One item was used for product design cues manipulation check: "How do you rate the design of the digital camera?" (1: *very poorly designed*; 9: *very well designed*). Environment congruence was also measured using one item ("I found visual similarities between the design of digital camera and the design of product display environment"), rated on a 9-point scale (1: *strongly disagree*; 9: *strongly agree*). At the end of the experiment, participants were debriefed, thanked, and dismissed.

4.4. Analysis and Results

The items'scores within each construct were averaged to form the composite scores. The multi-item scales used in this experiment showed high internal consistency (perceived aesthetic: α = .91; affective response: α = .88). A t-test comparing the two product design conditions revealed that camera design was rated significantly higher when high-level design cues were present (M = 7.18, SD = 1.40) compared to the condition with low-level design cues (M = 5.83, SD = 1.54; $t(89) = 4.38$, $p < .001$). A separate t-test was run to compare perceived environment congruence across the two conditions (congruent vs. non-congruent environment). The results confirmed that the level of perceived congruence between the product and its environment was higher in the congruent condition (M = 7.63, SD = 1.45) compared to the non-congruent condition (M = 6.20, SD = 1.65; $t(89) = 4.40$, $p < .001$). Therefore, both experimental conditions were manipulated successfully.

The dependent variables in this study were highly correlated ($.53 \leq r\text{s} \leq .59$, all $p\text{s} < .001$) and therefore multivariate analysis of variance (MANOVA) was conducted to test the hypotheses (Tabachnick and Fidell, 2001). This multivariate analysis revealed a significant effect for product design (Wilks' λ = .87, $F(3, 85) = 4.39$, p = .006, η_p^2 = .13), a marginally significant effect for environment congruence (Wilks' λ = .92, $F(3, 85) = 2.54$, p = .062, η_p^2 = .08), as well as a

significant interaction effect (Wilks' λ = .91, $F(3, 85) = 2.83$, p = .043, η_p^2 = .09). Between-subject effects were examined next in order to investigate how product design, environment congruence, and their interaction influence consumers' responses.

The main effect of product design was significant on perceived aesthetic ($F(1, 87) = 13.06$, p = .001, η_p^2 = .13) and affective response ($F(1, 87) = 4.55$, p = .036, η_p^2 = .05) but was not significant on purchase intentions ($F(1, 87) = 2.50$, p = .118, η_p^2 = .03). That is, high-level design cues led to more positive aesthetic (high-level design cues: M = 6.34, SD = 1.42; low-level design cues: M = 5.28, SD = 1.43) and affective response (high-level design cues: M = 4.77, SD = 1.77; low-level design cues: M = 3.99, SD = 1.75) but did not significantly increase purchase intentions (high-level design cues: M = 4.93, SD = 2.08; low-level design cues: M = 4.26, SD = 1.96). Therefore, H1a and H1b are supported but H1c is only directionally supported.

Similar results were found for environment congruence as it significantly influenced perceived aesthetic ($F(1, 87) = 4.14$, p = .045, η_p^2 = .05) and affective response ($F(1, 87) = 4.92$, p = .029, η_p^2 = .05) but had no effect on purchase intentions ($F(1, 87) = .16$, p = .694, η_p^2 = .001). As predicted, environment congruence elicited more positive aesthetic (congruent: M = 6.10, SD = 1.74; non-congruent: M = 5.51, SD = 1.19) and affective response in participants (congruent: M = 4.78, SD = 1.80; non-congruent: M = 3.96, SD = 1.71), supporting H2a and H2b respectively. However, environment congruence did not lead to higher purchase intentions (congruent: M = 4.67, SD = 2.22; non-congruent: M = 4.51, SD = 1.85). Thus, H2c is not supported.

Finally, the interaction effect was investigated. While the interaction term had significant effects on perceived aesthetic ($F(1, 87) = 5.46$, p = .022, η_p^2 = .06) and purchase intentions ($F(1, 87) = 4.23$, p = .043, η_p^2 = .05), it did not significantly influence affective response ($F(1, 87)$ =

.09, p = .764, η_p^2 = .001). Pairwise comparisons were conducted to explicate these interactions. Under the congruent environment condition, product design significantly influenced perceived aesthetic (high-level design cues: M = 6.95, SD = 1.27; low-level design cues: M = 5.24, SD = 1.75; t(44) = 3.79, p < .001), marginally influenced affective response (high-level design cues: M = 5.22, SD = 1.47; low-level design cues: M = 4.33, SD = 2.01; t(44) = 1.70, p = .096), and significantly increased purchase intentions (high-level design cues: M = 5.43, SD = 2.08; low-level design cues: M = 3.91, SD = 2.13; t(44) = 2.45, p = .018). The analysis in the non-congruent condition revealed no significant effects of product design on perceived aesthetic (high-level design cues: M = 5.69, SD = 1.31; low-level design cues: M = 5.33, SD = 1.05; t(43) = 1.04, p = .306), on affective response (high-level design cues: M = 4.30, SD = 1.97; low-level design cues: M = 3.64, SD = 1.40; t(43) = 1.31, p = .196), nor on purchase intentions (high-level design cues: M = 4.41, SD = 1.99; low-level design cues: M = 4.61, SD = 1.75; t(43) = .36, p = .723).

From a different perspective, environment congruence worked more effectively for the camera with high-level design cues across all the dependent variables; perceived aesthetic (congruent: M = 6.95; non-congruent: M = 5.69; t(43) = 3.27, p = .002); affective response (congruent: M = 5.22; non-congruent: M = 4.30; t(43) = 1.77, p = .084); and purchase intentions (congruent: M = 5.43; non-congruent: M = 4.41; t(43) = 1.69, p = .099). In contrast, environment congruence did not significantly influence the dependent variables for the camera with low-level design cues; perceived aesthetic (congruent: M = 5.24; non-congruent: M = 5.33; t(44) = .20, p = .840); affective response (congruent: M = 4.33; non-congruent: M = 3.64; t(44) = 1.36, p = .180); purchase intentions (congruent: M = 3.91; non-congruent: M = 4.61; t(44) = 1.21, p = .233).

Therefore, H3a and H3c are supported whereas H3b is only directionally supported (Figures 4a, 4b, and 4c).

Insert Figures 4a, 4b, and 4c Here

Finally, exploratory analyses were conducted to examine potential mediating roles of perceived aesthetic and affective response, as predicted by attitude formation model, which is expected to be cognitive → affective → conative for a functional product (Eagly and Chaiken, 1993). Since the effect of product design on purchase intentions was not significant, moderated mediation analysis was only conducted for affective response following the bootstrapping procedure (Hayes and Preacher, 2014). In this model, product design was the independent variable, environment congruence was the moderator, perceived aesthetic was the mediator, and affective response was the dependent variable. In other words, this model examined whether the effect of product design (IV) on affective response (DV) was mediated by perceived aesthetic (mediator) and differed depending on levels of environment congruence (moderator). Predicting affective response, bias-corrected bootstrapping with 5000 bootstrap samples supported a moderated mediation effect. More precisely, analysis of conditional indirect effects revealed that under the congruent environment condition, the indirect effect of product design on affective response was significant (b = 1.190; 95% CI = .506 to 2.011) whereas this effect was not significant under the non-congruent environment condition (b = .255; 95% CI = -.213 to .809), resulting in a significant difference between conditional indirect effects in the two conditions (index of moderated mediation = .935; 95% CI = .172 to 1.816).

4.5. Discussion

The results overall support the prediction that product design elicits more positive aesthetic and affective responses in consumers, as also highlighted in previous research. The

findings also support the idea that environment congruence plays an important role in how potential consumers perceive the aesthetics of a product and develop affective responses toward the product. However, and contrary to the predictions, participants' purchase intentions were influenced neither by product design nor by the congruency between product design and the design elements embedded in product display (environment). This finding suggests that merely adding high-level design cues to a product or presenting a product in a congruent environment does not guarantee its potential for success. In fact, the experiment shows that environment congruence leads to favorable evaluations only for products with high-level design cues. Under such circumstances, the positive effect of product design is reinforced by similar design elements embedded in the environment. In contrast, for a product with low-level design cues, congruent environment does not play an important role as there is no difference between congruent and non-congruent environments. Therefore, additional efforts (e.g., extra time and cost) to design, build, and set up a congruent presentational environment are not justified for products that are low in design quality.

These findings apparently challenge the generalizations made in the literature regarding the role of environment congruence. Hence, a follow-up experiment was designed and conducted to check the robustness and replicability of the findings in a more real setting using a VR headset (a closed, enveloping helmet that incorporates a wide-angle display). Using a VR headset, compared to an Xbox controller, is easier and more intuitive because the device tracks head movement; when users turn or tilt their head, they can see what is behind, above, or below them in the virtual world. In addition, a VR headset provides the best quality visualizations and reduces distraction, thus making the overall experience more immersive, interactive, and

realistic. Finally, participants wearing a VR headset can only see the display and are less likely to be influenced by the presence of the experimenter (the Hawthorne effect or the observer effect).

5. Experiment 2

5.1. Research Design and Participants

Similar to Experiment 1, this experiment had a 2 (product design cues: high-level vs. low-level) × 2 (environment: congruent vs. non-congruent) between-subjects design and was conducted at the same lab. Ninety students participated in this experiment in exchange for extra course credit. They ranged from 18 and 47 years old (M = 23.44, SD = 5.59) and slightly more males participated (52.2%).

5.2. Procedure, Stimulus, and Measurements

The procedure, stimulus, and measurements in this experiment were similar to those in Experiment 1. However, in an attempt to make the experience fully immersive and closer to reality, the same 3D simulation environment was presented using a stereoscopic virtual reality (VR) headset (Oculus Rift CV1) powered by a high performance Alienware laptop (see Appendix C). Participants were asked to wear the Oculus Rift head-mounted display to navigate the environment created for the experiment. Using a VR headset has some advantages and could eliminate (or at least minimize) the potential effects of some extraneous variables (e.g., familiarity, distraction, lack of realism). For instance, using Xbox controllers requires a certain level of familiarity and experience whereas using VR headsets is more intuitive. In addition, as previously mentioned, VR headsets create a more realistic world by tracking head movement, which enhances the experiment realism. Moreover, the confined field of view in VR headsets reduces distraction. Again, the training session for each participant lasted approximately two minutes until the participant could confidently use the VR headset to virtually navigate the

training environment, which was a simple product presentation environment with minimal complexity and decoration.

5.3. Analysis and Results

Items' scores within each construct were averaged to form composite scores. Both multi-item scales demonstrated high internal consistencies (perceived aesthetic: α = .95; affective response: α = .90). The appropriateness of experimental manipulations was investigated next using t-tests. As expected, participants rated the product with high-level design cues significantly higher (M = 7.31, SD = 1.64) than the one with low-level design cues (M = 5.87, SD = 1.93; $t(88) = 3.84$, $p < .001$). Another t-test indicated that participants perceived higher levels of environment congruence in the congruent (M = 7.84, SD = 1.09) rather than the non-congruent condition (M = 6.11, SD = 1.64; $t(88) = 5.91$, $p < .001$). Hence, both experimental manipulations were successful.

Similar to Experiment 1, the three dependent variables in this experiment were highly correlated ($.59 \leq r\text{s} \leq .73$, all $p\text{s} < .001$). Therefore, MANOVA was run in order to test the hypotheses while controlling for the correlations among the dependent variables. The MANOVA revealed a significant effect for product design (Wilks' λ = .80, $F(3, 84) = 7.07$, $p < .001$, η_p^2 = .202) as well as a partially significant effect for environment congruence (Wilks' λ = .92, $F(3, 84) = 2.62$, $p = .056$, $\eta_p^2 = .09$). The interaction effect, however, was not significant (Wilks' λ = .95, $F(3, 84) = 1.52$, $p = .217$, $\eta_p^2 = .05$). This analysis was then followed by tests of between-subject effects in order to separately examine the effects of product design, environment congruence, and their interaction on various forms of consumer response.

The effect of product design was significant on perceived aesthetic ($F(1, 86) = 18.02$, $p < .001$, $\eta_p^2 = .17$) and affective response ($F(1, 86) = 11.25$, $p = .001$, $\eta_p^2 = .12$) and was marginally

significant on purchase intentions ($F(1, 86) = 2.96$, $p = .089$, $\eta_p^2 = .03$). As predicted, high-level design cues elicited more positive aesthetic (high-level design cues: $M = 7.23$, $SD = 1.63$; low-level design cues: $M = 5.81$, $SD = 1.57$) and affective responses (high-level design cues: $M = 6.06$, $SD = 1.73$; low-level design cues: $M = 4.85$, $SD = 1.73$), and led to marginally higher levels of purchase intentions (high-level design cues: $M = 5.44$, $SD = 2.18$; low-level design cues: $M = 4.67$, $SD = 2.17$). Therefore, H1a and H1b are supported while H1c is marginally supported.

The main effect of environment congruence on perceived aesthetic was not significant ($F(1, 86) = 2.56$, $p = .113$, $\eta_p^2 = .03$). More precisely, environment congruence only slightly increased perceived aesthetic (congruent: $M = 6.80$, $SD = 1.50$; non-congruent: $M = 6.24$, $SD = 1.93$); therefore, H2a is only directionally supported. The same main effect was marginally significant on affective response ($F(1, 86) = 3.16$, $p = .079$, $\eta_p^2 = .04$); that is, environment congruence led to higher levels of affective response (congruent: $M = 5.79$, $SD = 1.74$; non-congruent: $M = 5.13$, $SD = 1.87$), marginally supporting H2b. Finally, environment congruence did not significantly influence purchase intentions ($F(1, 86) = .08$, $p = .778$, $\eta_p^2 = .001$); no significant difference was found between purchase intentions in the congruent ($M = 5.00$, $SD = 2.27$) and non-congruent conditions ($M = 5.11$, $SD = 2.16$). Thus, H2c is not supported.

Finally, the interaction effects were scrutinized. The interaction between product design and environment congruence had marginally significant effects on perceived aesthetic ($F(1, 86) = 2.98$, $p = .088$, $\eta_p^2 = .03$) and affective response ($F(1, 86) = 3.23$, $p = .076$, $\eta_p^2 = .04$) as well as a significant effect on purchase intentions ($F(1, 86) = 4.01$, $p = .048$, $\eta_p^2 = .05$). Pairwise comparisons indicated that under the congruent environment condition, product design had significant effects on perceived aesthetic (high-level design cues: $M = 7.77$, $SD = .77$; low-level design cues: $M = 5.79$, $SD = 1.41$; $t(43) = 5.86$, $p < .001$), affective response (high-level design

cues: M = 6.68, SD = 1.25; low-level design cues: M = 4.85, SD = 1.70; $t(43) = 4.14$, $p < .001$), and purchase intentions (high-level design cues: M = 5.83, SD = 1.92; low-level design cues: M = 4.14, SD = 2.32; $t(43) = 2.67$, $p = .011$). In contrast, the effects of product design cues disappeared in the non-congruent condition for perceived aesthetic (high-level design cues: M = 6.66, SD = 2.07; low-level design cues: M = 5.83, SD = 1.74; $t(43) = 1.46$, $p = .151$), affective response (high-level design cues: M = 5.41, SD = 1.94; low-level design cues: M = 4.86, SD = 1.80; $t(43) = .99$, $p = .326$), and purchase intentions (high-level design cues: M = 5.05, SD = 2.40; low-level design cues: M = 5.17, SD = 1.95; $t(43) = .20$, $p = .844$).

From another perspective, for the camera with high-level design cues, the congruent environment improved perceived aesthetic (congruent: M = 7.77; non-congruent: M = 6.66; $t(43) = 2.35$, $p = .027$) and affective response (congruent: M = 6.68; non-congruent: M = 5.41; $t(43) = 2.63$, $p = .012$) but not purchase intentions (congruent: M = 5.83; non-congruent: M = 5.05; $t(43) = 1.21$, $p = .234$). On the other hand, environment congruence had no effect on any of the dependent variables for the camera with low-level design cues; perceived aesthetic (congruent: M = 5.79; non-congruent: M = 5.83; $t(43) = .09$, $p = .930$); affective response (congruent: M = 4.85; non-congruent: M = 4.86; $t(43) = .01$, $p = .990$); purchase intentions (congruent: M = 4.14; non-congruent: M = 5.17; $t(43) = 1.63$, $p = .110$). Therefore, H3a and H3b are marginally supported and H3c is supported (Figures 5a, 5b, and 5c).

Insert Figures 5a, 5b, and 5c Here

Similar to Experiment 1, potential mediating roles of perceive aesthetic and affective response were explored according to the attitude formation model (Eagly and Chaiken, 1993). Again, the effect of product design on purchase intentions was not significant. Therefore, moderated mediation analysis was only conducted for affective response following the same

bootstrapping procedure. This model tested whether environment congruence moderated the effect of product design on affective response via perceived aesthetic (mediator). Predicting affective response, bias-corrected bootstrapping with 5000 bootstrap samples revealed that the conditional indirect effect of product design on affective response was significant under the congruent environment condition (b = 1.424; 95% CI = .846 to 2.129) but was not significant under the non-congruent environment condition (b = .601; 95% CI = -.203 to 1.550). However, the difference between conditional indirect effects in these two conditions was not significant (index of moderated mediation = .824; 95% CI = -.081 to 1.754).

5.4. Discussion

The results overall support the predictions and confirm the robustness of the findings in Experiment 1 with some minor differences. For instance, the effect of product design on purchase intention as well as the interaction effect on affective response that were only directionally supported in Experiment 1 became marginally significant in Experiment 2. In contrast, the main effect of environment congruence on perceived aesthetic which was supported in Experiment 1 turned insignificant in Experiment 2. As discussed earlier, the virtual reality experience in Experiment 2 was much closer to reality, thus enabling participants to form a better and more complete understanding of the product and its surrounding environment. Such immersive experiences further highlight the limitations associated with environment congruence found in Experiment 1. These findings suggest that environment congruence does not work in isolation and may not be an effective approach in promoting certain products that do not encompass high-level design cues.

6. General Discussion

6.1. Discussion of Findings

Across two lab experiments, the findings overall support the propositions of this study. Table 1 summarizes the results of the two experiments. It is worth noting that while most of the findings were similar across the two experiments, there were a few discrepancies as well. Such discrepancies could be due to limited statistical power which resulted from small sample sizes, particularly considering the strong directional support found in both experiments. These differences could also, at least partly, be attributed to the use of different navigation methods across the two experiments. More specifically, the virtual reality experience in Experiment 2 is much closer to reality because the VR headset provides a more immersive experience and enables participants to form a better and more complete understanding of the product and its surroundings.

While tangible attributes of product design enable consumers to develop a better understanding of the product (Bearden and Shimp, 1982), research in marketing and consumer behavior domains has often focused on non-visual attributes of product design such as performance, functionality, and durability (Kotler and Rath, 1984). The present work, however, is focused on visual design cues of products including form, texture/material, color, and typography style. The results overall support the notion that high-level product design cues elicit more positive aesthetic and affective responses, which is in line with the idea of stimulation of emotions under the influence of aesthetic judgment (Hassenzahl 2001). For purchase intentions, however, product design cues did not significantly increase purchase intentions in Experiment 1 and did so only marginally in Experiment 2. These results, while consistent with the predictions, should be interpreted with caution because the interaction effects are also significant. Further

analysis in fact revealed that product design plays a critical role in a congruent environment but not in a non-congruent environment. This finding is further discussed below.

Insert Table 1 Here

With regard to the role of environment congruence, previous research generally supports the notion that products are perceived more positively and purchased more frequently if they are presented in a congruent environment (Berger and Fitzsimons, 2008). The results of this study, however, challenge the generalizability of this idea. While environment congruence positively influenced aesthetic and affective responses in Experiment 1, these effects were insignificant and only marginally significant, respectively, in Experiment 2. In addition, environment congruence did not lead to higher purchase intentions across the two experiments. This finding can be explained using the interaction effect.

As discussed earlier, when shoppers are pre-exposed to similar design cues in a retail environment, they are expected to process the product's visual information easier and faster, which in turn should facilitate their intuitive recognition of aesthetic quality, leading to a more positive affective judgement (Reber *et al*., 1988). The findings, however, pose a challenge to these generalizations, which are made based on a subtle, but important assumption: high-level visual elements are embedded in product design. In such cases, strong design elements in terms of form, texture, color, and typography embedded in the environment can further amplify the product's visual design elements, leading to more positive emotional and behavioral responses. In contrast, for a product without high-level design cues (a product with basic form, ordinary texture, and neutral color), a congruent environment (also with a basic form, ordinary texture, and neutral color) is not expected to enhance the product's attractiveness. The findings across the two experiments generally supported this idea, showing that a congruent environment is only

effective for products with high-level design cues. In contrast, there is no difference between a congruent environment and a generic one in the absence of high-level product design cues. The implications of these findings are discussed next.

6.2. Research Implications

This research contributes to various research domains including product design, retail design, and environment congruence by challenging the generalizations made in the literature in regard to the role of environment congruence in consumer response. This work shows that the congruence between product design and the design elements embedded in the environment leads to more favorable perceptions only for products with high-level design cues. Under such condition, the environment functions as a mirror in which the design elements of the product are reflected (and hence reinforced).

From a practical standpoint, the findings have important implications for product designers, retailers, and merchandising professionals. Product design is a widely investigated topic and the findings here further reiterate the importance of product design elements such as form, texture, color, and graphical typography in shaping aesthetic perceptions and affective responses of consumers. Therefore, product designers should pay close attention to these design elements, particularly for hedonic products that target aesthetic perceptions and feelings of consumers. This subset allows consumers to feel pleasure, fun, and enjoyment from using the product. As a result, aesthetic perceptions and feelings toward a product with significant hedonic values are more likely to lead to purchase intentions. In contrast, for a product with dominant functional/utilitarian values, such positive perceptions and feelings may not lead to any actions. For this group of products, functional elements (e.g., picture quality and ease of use for a digital camera) play a more dominant role in consumer decision making. Therefore, enhancing visual

appearance at the expense of a product's core functionality would be a mistake for utilitarian products.

The findings with regard to the interactive effects of environment congruence and product design can also help marketing managers and retail merchandising professionals to improve consumer experience while they are shopping at a physical or virtual store (i.e., online shopping). While previous research shows that improving the aesthetic elements in the environment overall improves consumer experience, the findings of this investigation indicate that creating a congruent environment may not necessarily translate into more positive responses from consumers. A congruent environment works effectively for products with high-level design cues. For such products, presenting them in a product display with visually similar design elements enhances perceived aesthetic appeals, which in turn elicits positive emotions and eventually lead to purchase decisions. In contrast, for products with low-level design cues, the environment congruence is not instrumental and may not elicit more favorable responses. Hence, such products can simply be presented in a neutral generic display (like most displays at retail stores) especially considering the significant costs associated with designing, building, and setting up a congruent display.

6.3. Limitations and Future Research Directions

Although all aspects of the experiments were carefully designed to test the hypotheses in a controlled setting empirically, a few limitations that may affect the overall validity and reliability of the results should be considered when interpreting the research findings. One limitation is the use of relatively small student samples in both experiments. While sample sizes in both experiments meet the recommendations (i.e., 20 participants per experimental group; Simmons *et al.*, 2011), future studies could examine the generalizability of the findings using

larger and more representative samples. In addition, the findings may not be generalizable to all products and situations and future work could examine other product categories (e.g., hedonic) and contexts (e.g., website, trade shows). Moreover, several other scales measuring participants' affective response exist, and future research could replicate this work using other measures of emotional response. Similarly, psychophysiological rather than self-report measures could be used in future to check the robustness of the findings.

Future studies could also extend this work by controlling factors such as product knowledge, product involvement, and personal factors (e.g., Centrality of Visual Product Aesthetic). Similarly, future work could investigate other potential mediators such as perceptual fluency to better understand the underlying process for the proposed effects. Finally, design is a multifaceted activity, and the dimensions of design quality are not easily reducible to conduct a controlled experiment. Future studies could extend this work by adding other visual cues (e.g., size, geometry, and ornamentation) or intangible aspects of design (e.g., novelty, prototypicality, and value).

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Table 1: Summary of Findings

	Relationship Tested	Experiment 1	Experiment 2
H1a	Product Design → Perceived Aesthetic	*Supported*	*Supported*
H1b	Product Design → Affective Response	*Supported*	*Supported*
H1c	Product Design → Purchase Intention	*Not Supported*	*Marginally Supported*
H2a	Environment Congruence → Perceived Aesthetic	*Supported*	*Not Supported*
H2b	Environment Congruence → Affective Response	*Supported*	*Marginally Supported*
H2c	Environment Congruence → Purchase Intention	*Not Supported*	*Not Supported*
H3a	Interaction Term → Perceived Aesthetic	*Supported*	*Marginally Supported*
H3b	Interaction Term → Affective Response	*Not Supported*	*Marginally Supported*
H3c	Interaction Term → Purchase Intention	*Supported*	*Supported*

Figure 1a: Low-level Product Design Cues + Non-congruent Environment

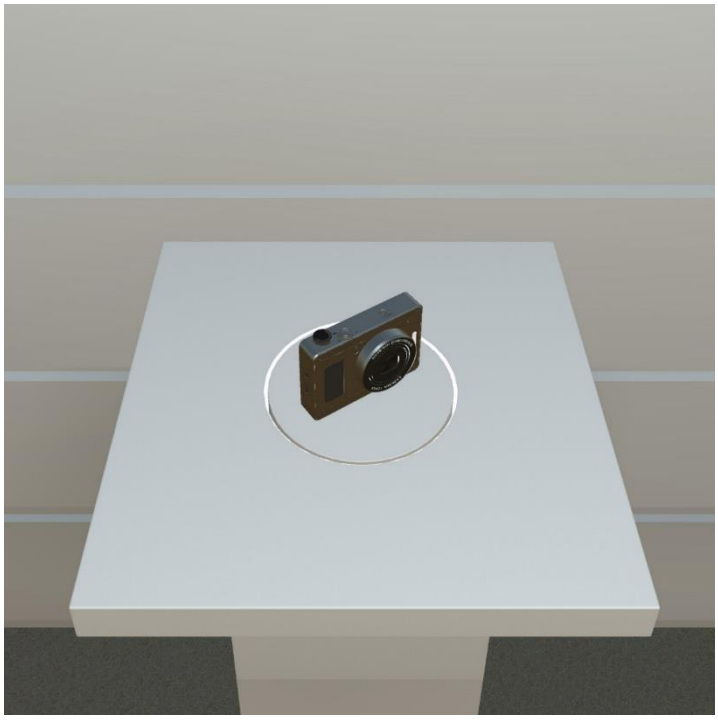


Figure 1b: High-level Product Design Cues + Non-congruent Environment

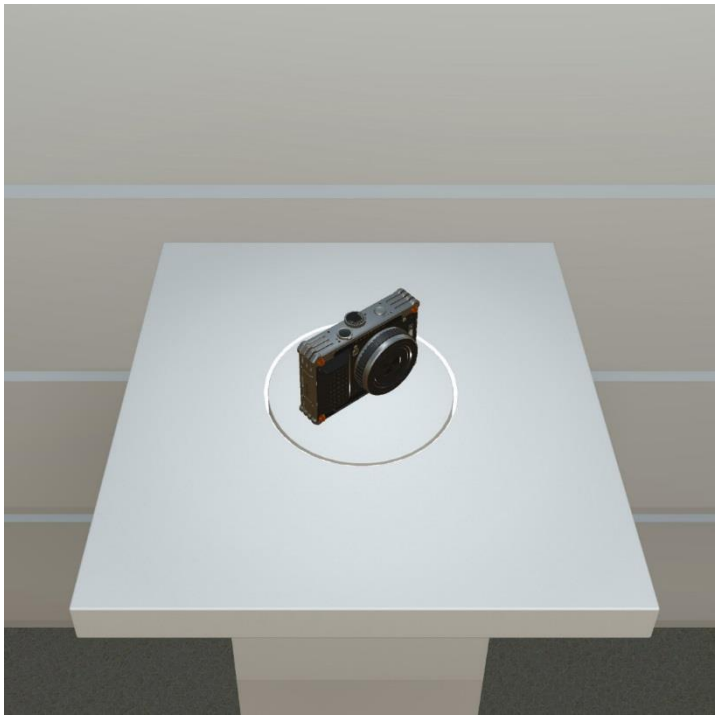


Figure 2a: Low-level Product Design Cues + Congruent Environment

Figure 2b: High-level Product Design Cues + Congruent Environment

Figure 3a: Digital Camera with High-level Design Cues (perspective view)

Figure 3b: Digital Camera with Low-level Design Cues (perspective view)

Figure 4a: The Effects of Product Design and Environment Congruence on Perceived Aesthetics (Experiment 1)

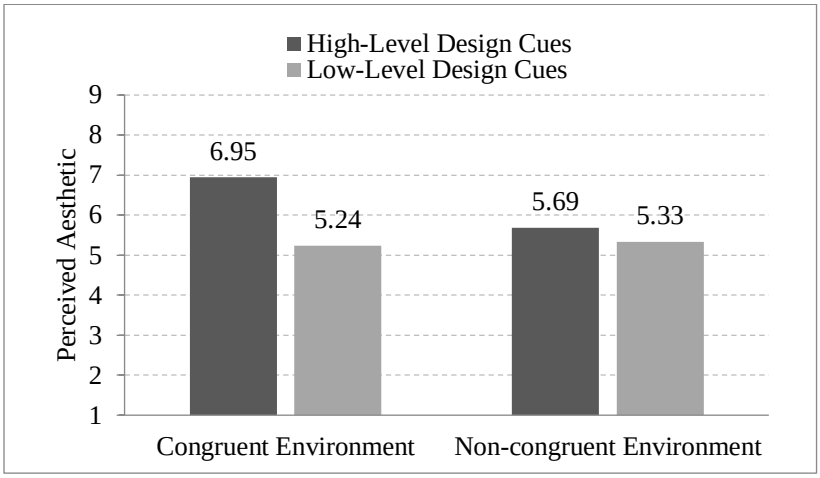


Figure 4b: The Effects of Product Design and Environment Congruence on Affective Response (Experiment 1)

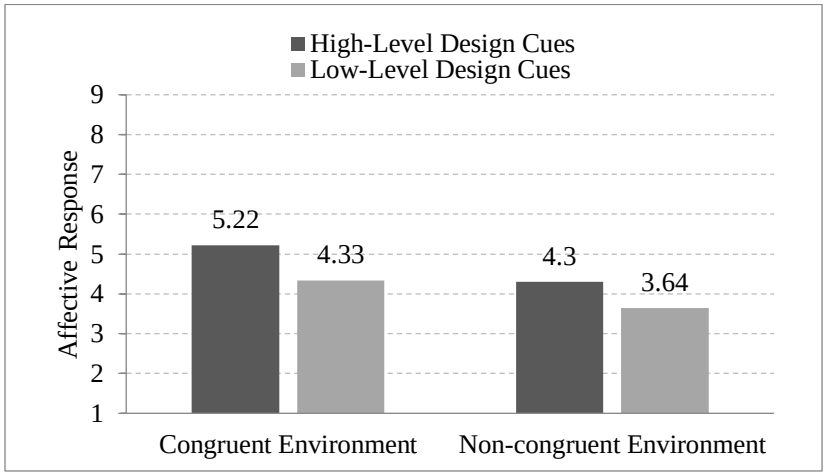


Figure 4c: The Effects of Product Design and Environment Congruence on Purchase Intentions (Experiment 1)

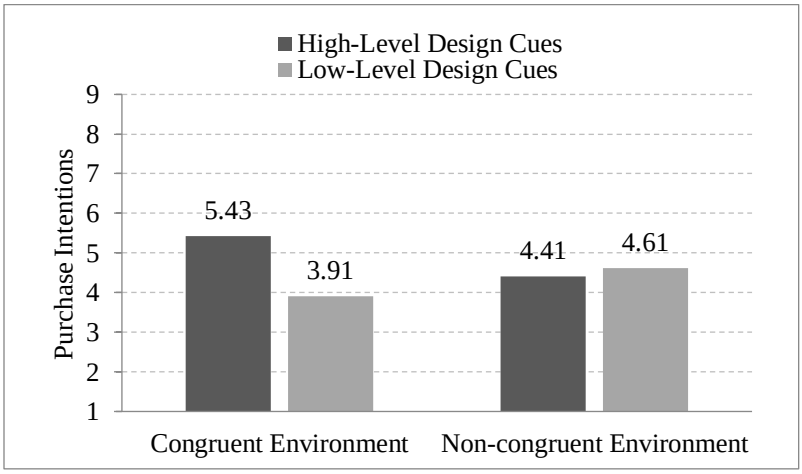


Figure 5a: The Effects of Product Design and Environment Congruence on Perceived Aesthetics (Experiment 2)

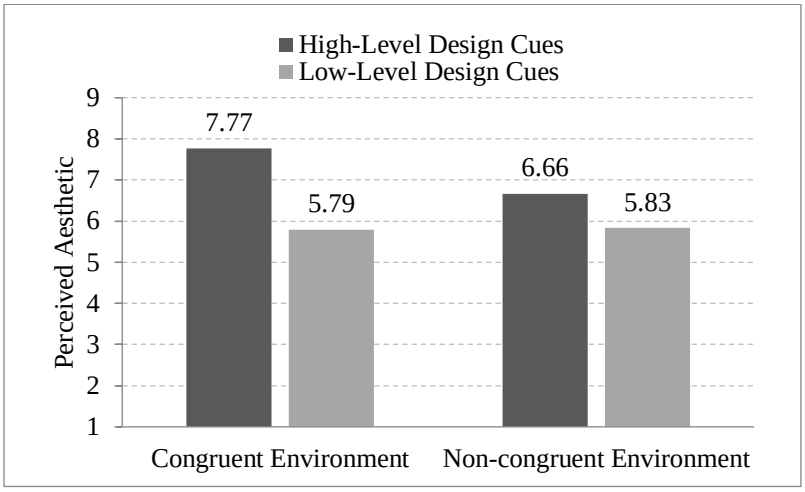


Figure 5b: The Effects of Product Design and Environment Congruence on Affective Response (Experiment 2)

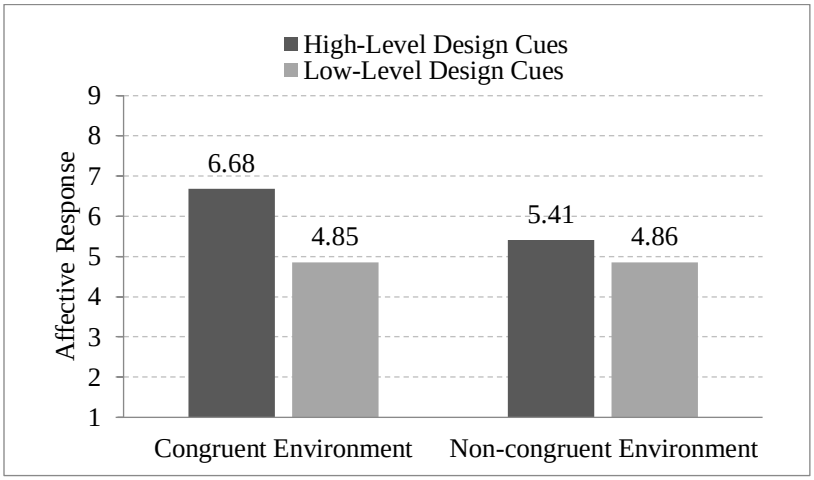
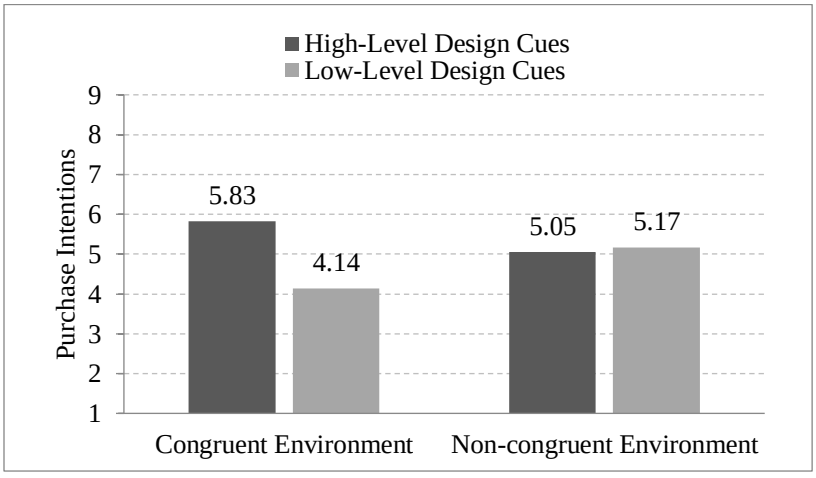
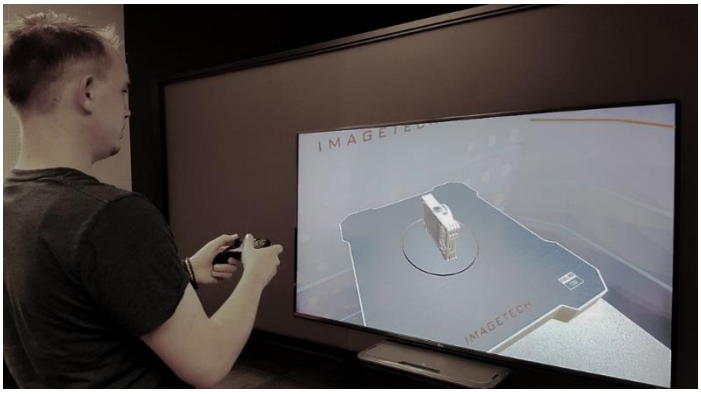


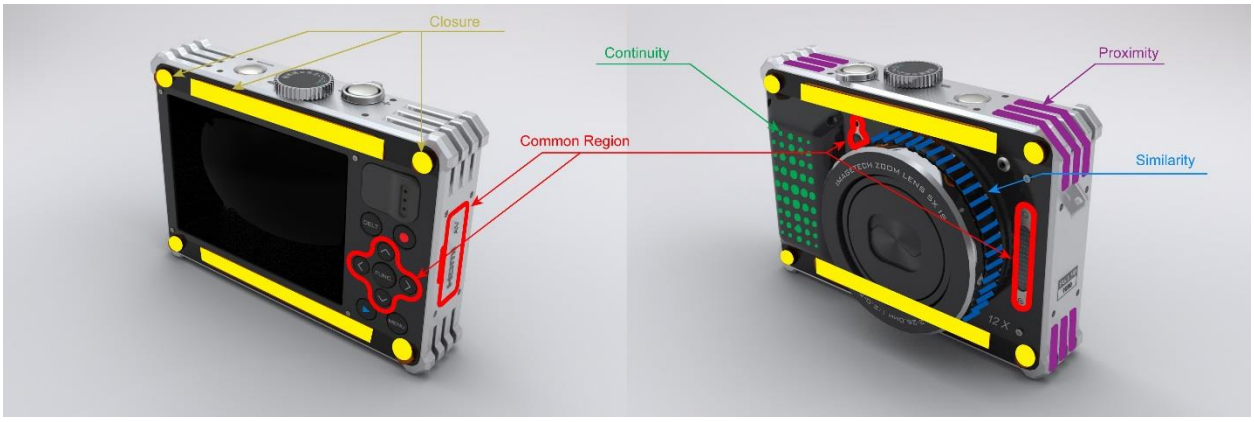
Figure 5c: The Effects of Product Design and Environment Congruence on Purchase Intentions (Experiment 2)



Appendix A: A 70” Ultra-HD TV (Experiment 1)



Appendix B: Five Gestalt Principles in the Camera with High-Level Design Cues



Appendix C: Oculus Rift CV1VR Head-Mounted Display (Experiment 2)