AN EXPERIMENT INVESTIGATING THE EFFECTS OF RETAIL GREENERY AND CORRELATED COLOR TEMPERATURE IN VIRTUAL REALITY FASHION APPAREL STORES

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ABSTRACT

Purpose: The main objective of this study is to understand the impacts of retail greenery in biophilic design and correlated color temperature on consumers' perceptions (pleasure, arousal, perceived merchandise quality) and responses (satisfaction and purchase intentions) in virtual reality fashion apparel stores.

Design: This study is a 2x2 experimental design. In this study, retail greenery/non-retail greenery are a within-subjects design, while correlated color temperature (warm/cool) and shopping orientations (utilitarian/hedonic) are a between-subjects design. 295 undergraduate US female students participated in this study.

Findings: The results showed that consumers prefer a retail greenery application over a non-retail greenery application. Cool lighting creates higher arousal than warm lighting. There are significant interaction effects between a retail greenery application and correlated color temperature. I have also found moderating effects of shopping orientations (utilitarian/hedonic).

Originality: This study first measures the combined effects of retail greenery and correlated color temperature on consumers' responses which has not been done in previous studies. This study also provides insights into how retailers strategically plan their use of biophilic design and lighting to improve the 3D Virtual Reality (VR) shopping experience.

Keywords: 3D Virtual Reality, Retail Greenery, Correlated color temperature, Shopping Orientation, Biophilic Design.

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CHAPTER ONE

INTRODUCTION

1.1. Virtual Reality (VR)

Augmented Reality and Virtual Reality are defined as new drivers for Fashion Retail (Boardman, Henninger, & Zhu, 2020). Radin (2020) states that virtual reality was one of the most popular fashion trends in 2020. According to a recent report by Goldman Sachs, VR in retail business will be worth $1.6 billion and the number of users of VR in retail business will reach to 32 million by 2025 (Rick, 2017). Cutting edge designers of virtual items include The Fabricant, Happy99, and Carlings and these designers produce virtual items and display those items in real or hyperreal bodies. Currently, practical applications of VR are heavily used in retail industries. For example, eBay first introduced the virtual reality department store in which consumers can explore collections including apparel items, accessories, and home goods (Chang, 2016). Similarly, Amazon India has also started VR projects in ten shopping malls where shoppers can explore different store sections including fashion, kitchen and dining, bath and beauty, and technology focused living rooms (Horwitz, 2018). The luxury brand Dior has introduced a virtual boutique, Dior Maison, which provides consumers with imaginative shopping experiences (Duval, 2020). Tommy Hilfiger and Coach have also setup their VR headsets in their stores where a consumer can enjoy fashion/runway shows (Smith, 2020).

Greenbaum (1992) defines virtual reality (VR) as “an alternate world filled with computer generated images that respond to human movements. These simulated environments are usually visited with the aid of an expensive data suit which features

stereophonic video googles and fiber-optic data gloves" (p.58). Virtual Reality assists consumers to interact with 3D objects and improves their sense of presence in the environment (Park et al., 2018). Interactivity and vividness are two key determinant factors of telepresence (Steuer, 1992). Nah et al. (2011) state that "users who perceive a sense of telepresence are focused on virtual or mediated environment to the extent that their stimulus field is limited to just that environment, while the physical environment is disregarded" (p.738). 3D environments have rich, dynamic, and multisensory elements which elevate consumers' sense of presence. Interactivity allows users to easily manipulate content in the environment. This interactivity is positively associated with shopping enjoyment, which affects consumers' desire to stay in an environment (Kim et al., 2007). Steuer (1992) notes that vividness refers to the richness of objects or scenes in the virtually mediated environment. 3D virtual reality environments also have a higher vividness or representational richness than 2D traditional environments (Kerrebroeck et al., 2017). As noted by Kerrbroeck et al. (2017), like interactivity, vividness also significantly influences consumers' sense of presence and positive attitudes towards advertisements. In addition, 3D interfaces create higher flow and satisfaction than 2D interfaces (Sina & Wu, 2019).

Prior research suggests that the importance of atmospherics factors have been widely discussed in the field of VR retailing (Hassouneh & Brengman, 2015). Atmospherics factors are defined as all physical and non-physical elements of a store (Eroglu & Machleit, 1993). Atmospherics factors influence our emotional and cognitive states, which improves consumers' attitudes, satisfaction, and approach behavior (Eroglu et a., 2003). The Hassouneh and Brengman (2015) study has created a typology of virtual

store atmospherics. These VR atmospheric elements are virtual shopping assistant (augmented reality shopping assistant, spoke sales avatar), virtual product presentation and control (product interactivity, visual and functional control of virtual products, product rotation), store layout, color vividness, graphics vividness, and 3D authenticity. A recent study by Roggeveen et al. (2020) categorizes atmospherics elements into four factors including (i) design elements that exist at the forefront (functional elements, layout, comfort, signage, search speed, organization of website, interface used to make selections, aesthetic elements, merchandise presentation, color, style, graphics, pictures), (ii) ambient elements that exist as background conditions (lighting, music, smells, temperature, brightness, sounds, enhanced zoom features, entertainment aspect), (iii) social people present or felt in the environment (number of others, appearance of others, behavior of other, physical/virtual presence), and (iv) trialability ability (sampling, augmented reality, and virtual reality). Additionally, Wu et al. (2021) identified three atmospheric categories including pathfinding assistance, environment, and the manner of product presentation for personalizing 3D virtual fashion stores. The researchers determined 17 modules and 207 modular options based on the above-mentioned categories. Prior research suggests that atmospherics factors in the 3D virtual reality environment have consistently positive effects on consumers' perceptions and responses. (Table one is attached:)

Table one

Summary of research in the 3D virtual reality environment

3D VR features	Mediator/Response variables	Key findings
Static images vs. VR vs. 360 tours, Bogicevic et al., 2019	Mental imagery, sense of presence, brand experience	VR increases higher elaboration than static images and 360 tour
Layout types (grid, centralization, radiation, and line), types of spatial information display: "area allocation map" and "actual scene view"), Liu et al. (2019)	Presence, spatial identification	Radiation type including areal allocation map provide better evaluation of presence and spatial identification than others
Levels of ambient conditions (2D objects and 3D objects), types of display (auto stereoscopic display, stereoscopic display, and monocular display), Liu (2017)	Desired to stay in the 3D virtual store	Auto stereoscopic display and high level of ambient conditions of the 3D virtual stores increases good sense and realism
Control, color vividness, graphics vividness (Papagiannidis et al., 2013)	Hedonic value, utilitarian value, engagement, enjoyment, satisfaction, and purchase intention	Factors of control, color vividness, graphics vividness, and 3D authenticity positively predict simulated experience, engagement, satisfaction, and then purchase intention.
Level of depth cues (low vs high), mode of display (HMD vs general display) vs 3D monitor, (Liu & Uang, 2011)	Cybersickness	3D monitor and high level of depth cues enhance perceived presence. However, cybersickness is also high in that condition.
Level of social presence (virtual sales associates vs no sales associates) (Shim et al., 2012)	Social support from a retail website, attitude toward the Website,	Perceived social presence is higher when participants see an apparel retail

	and patronage intentions	website with a virtual sales associate than no sales associate
Offline travel information and web-mediated virtual information Hyun and O'Keefe (2012)	Telepresence, cognitive, affective, and conative image	There is a causal relationship between 3D web mediated virtual information and telepresence. Telepresence significantly influences cognitive and conation image. Virtual cognitive and affective image have significant effects on virtual conation
Music in 3D VR stores Dad et al., 2018	Pleasure, Arousal, Approach and Avoidance behavior	Music significantly influences consumers'approach behavior
Social interaction in the VR environment Hudson et al. (2019)	Immersive experiences	Social interaction in the VR environment increases consumers' immersive experiences
VR shopping mall vs traditional shopping mall Lee and Chung (2008)	Enjoyment and consumer satisfaction	VR shopping mall creates higher enjoyment and customer satisfaction that the traditional shopping mall

Although atmospherics factors have been widely discussed in the retail environment, retailers still strive to differentiate their retail environments from competitors' environments (Foster and Mclelland, 2015). Retailers need to think about innovative, interactive, and holistic design ideas to create brand differentiation. In so doing, Foster and Mclelland (2015) develops a theme centric display that creates higher brand differentiation, shopping enjoyment, and brand loyalty than that created by a traditional environment. Similarly, a lifestyle display generates a higher brand experience

and shopping enjoyment than that generated by a product centric display (Sina and Kim, 2019). As noted by Sina and Kim (2019), "The term, 'lifestyle display' indicates a theme-centric display, which creates an emotional, attractive, and symbolic atmosphere (Oh & Petrie, 2012). On the other hand, a product-centric display does not necessarily present a coherent theme. Instead, this type of product display frequently used in a traditional retail format focuses on merchandise presentations appealing to target customers (Foster & McLelland, 2015)" (p.132). Innovative design ideas like brand dictated theme and lifestyle retailing provide consumers with multisensorial experiences, which causes brand differentiation. Kozinets et al. (2002) categorize retail themes into two dimensions including nature and culture (man-made). There are four types of retail themes: mindscape (spiritual), landscape (natural), cyberscape, and marketscape (physical).

1.2. Biophilic design and Retail Greenery

Among these four themes, this study discusses the impacts of biophilic design (natural theme) in virtual reality fashion apparel stores. Nature inspired design enlivens multisensory brand experiences, causing emotional connections with consumers (Malbasic and Choi, 2019). Interestingly, biomorphic (natural) visual identity facilitates holistic experiences, resulting in a both higher purchase intention and brand likeability than non-biomorphic visual identity (Vinitha et al., 2021). Also, nature inspired design i.e., biophilic design connects people closely with nature within the built environment (Kellert, 2008). This design is defined as a restorative environmental design because it promotes a positive sustainable environment by linking people with natural settings and processes. Biophilic design is an approach to reinstall the beneficial experiences of nature in the built environment. Traditional building paradigms are fundamental design flaws

because these approaches cause unsustainable resource consumption and more significantly, exclude people from nature. Biophilic design consists of six design elements such as environmental features, natural shapes and forms, natural patterns and processes, light and space, place-based relationships, and evolved human-nature relationships. In addition, this sustainable design approach provides consumers with three types of experiences: direct, indirect, and experience of space and place (Kellert and Calabrese, 2015) (Table Two is attached). It is notable that researchers often try to explain natural aspects from different perspectives that most possibly evoke our satisfaction (Ryan et al., 2014). Ryan et al. (2014) notes that biophilic design has fourteen types of patterns. These patterns are visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, thermal and airflow variability, presence of water, dynamic and diffuse light, connection with natural systems, biomorphic forms and patterns, material connection with nature, complexity, order, prospect, refuge, mystery, and risk.

Table Two

Some examples of the experiences of nature

Direct experiences of nature- light, air, water, plants, animals, weather, natural landscapes and ecosystems, and fire	Indirect experiences of nature- images of nature, natural materials, natural colors, stimulating natural light and air, naturalistic shapes and forms, evoking nature	Experience of space and place- prospect and refuge, organized complexity, integration of parts to wholes, transitional spaces, mobility and wayfinding

Biophilic design provides designers excellent opportunities to transform the traditional interior environment (ansglobal, 2019). As noted by Kellert and Calabrese (2015), biophilic design creates an emotional attachment with specific places. This design approach also facilitates prolonged and sustainable engagement with nature. In addition,

biophilic design is more attractive than non-biophilic design (Guo, 2016). This nature-inspired design enhances human health and productivity (Kellert, 2015). Schwab (2019) notes that biophilic design significantly helps to reduce mental health problems and heightens focus and attention. Google and Etsy implement these elements/aspects of biophilic design to affect employees' focus, happiness, and creativity. This design approach reinforces visual comfort, visual interest, and aesthetics (Wijesooriya and Brambilla, 2020). It also contributes to the formation of place attachment. The presence of vegetation and natural settings in the retail environment increase consumers' willingness to pay by 8-12%. Not only in retail settings, biophilic design provides benefits to office design, hospitality design, education spaces, healthcare spaces, and homes.

Previous studies have discussed the impact of biophilic design in the lodging industry (Lee, 2019), lifestyle centers (Rosenbaum et al., 2018), and hotel lobby (Nanu et al., 2020). Biophilic design has also been studied in the virtual reality environment. For example, Yin et al. (2020) compared between biophilic and non-biophilic design approaches to understand their effects on stress and anxiety in the VR environment. Findings from this study showed that the VR biophilic environment reduced stress and anxiety more than the VR non-biophilic environment. Similarly, the Emamjomeh et al. (2020) study also found the positive impact of the VR biophilic environment on consumers' feelings and mood. However, there were no significant influences on consumers' cognitive performances.

Although biophilic design has been widely explored in retail environment research, limited studies have been done to understand the effects of this design in virtual

reality fashion apparel stores. Although there have been limited studies about virtual reality fashion apparel stores, the Park et al. (2018) study is a notable exception. This study discusses the feasibility and user experience in virtual reality fashion apparel stores. However, the Park et al. (2018) study did not discuss the effects of biophilic design in virtual reality fashion apparel stores. In this study, I would like to introduce two atmospheric factors, retail greenery and correlated color temperature, to understand their impacts on consumers' perceptions and responses in VR fashion apparel stores. Retail greenery is an attribute of biophilic design, which provides consumers with direct experiences of nature (Kellert, 2008). This study fills in the gap of previous studies by comparing the retail greenery and non-retail greenery applications in VR fashion apparel stores. In sum, I have investigated whether retail greenery in biophilic design could be really a powerful and interesting design idea for the 3D VR environment.

1.3. Lighting/Correlated color Temperature

Furthermore, this study also discusses the effects of lighting on consumers' perceptions and responses in virtual reality (VR) fashion apparel stores. Lighting/Correlated color temperature is one of the most important design elements that significantly influences our mood (archdaily.com). Like the retail greenery application, lighting (natural light, filtered and diffused light, light and shadow, reflected light, light pools, warm lighting) is also an important attribute of biophilic design (Kellert, 2008). Lighting affects our shopping behavior (Summers & Hebert, 2001). For this study, I have used the color characteristics of light, that is correlated color temperature, which is defined as the color of light of a lamp as measured in kelvin degrees (Knez, 1995). The color of the light of the lamp ranges from warm lighting to cool lighting. Warm lighting

has red-yellow appearances, while cool lighting has blue-white appearances (Gordon, 2015). Interestingly, lighting research has been compared in different mediums including physical environments, Virtual Reality (VR), video reproduction, and photo reproductions (Chen et al., 2019).

Lighting/correlated color temperature not only affects our emotions and perceptions, but it also determines the image of a store environment (Quartier et al., 2014). In addition, lighting design influences our perceptions about quality and price of products (Yilmaz, 2018). Yilmaz (2018) noted that approximately 80% of consumers highly prefer visual comfort conditions in the retail environment. An integrated lighting design strategy could create visually satisfying conditions in the retail environment. Shamsul et al. (2013) found that consumers have better visual comforts under the cool-white lighting conditions compared to warm-white lighting conditions. In addition, consumers have higher satisfaction under 5200K temperature rather than 4000K temperature in the VR environment (Chen et al., 2019), so this indicates preference for cooler lighting conditions.

However, findings from previous lighting research studies are inconclusive. In fact, many studies have presented contradictory findings. As noted by Briand and Pras (2013), both bright, cool light and slightly warm temperature affect consumers' intentions to buy, and time spent in the store. On the other hand, some studies demonstrate consumers' preferences for warm lighting rather than cool lighting. For example, one study found that both American and Korean consumers enjoy pleasurable shopping experiences under warmer temperatures than cooler temperatures (Park and Farr, 2007). These findings are consistent with other studies that have found that consumers have

more positive perceptions about warm white light than cool white light (Tantanatewin & Inkarojrit, 2016; Hygge & Knez, 2001). Although lighting research has been largely conducted in retail environments, limited studies have been done to understand the impacts of correlated color temperature in the context of virtual reality fashion apparel stores. Additionally, due to contradictory findings of correlated color temperature, this study compares warm and cool VR lighting conditions to understand consumers' perceptions and responses in the context of fashion apparel stores.

1.4. Interaction Effect

My study has also investigated the interaction effects between retail greenery (vs non-retail greenery) and lighting/correlated color temperature (cool/warm lighting). There are so many important reasons to understand the interaction effects between retail greenery and correlated color temperature (cool/warm). Firstly, the measurement of interaction effects helps to understand how lighting/correlated color temperature and retail greenery conceptually fit together in the retail environment. As noted by Garaus et al. (2015), the appropriate use of store elements improves consumers' cognitive/conceptual fit. Our information processing depends on four properties: variety, novelty, complexity, and conflict. Many lighting sources and complex lighting concepts may increase high levels of variety, complexity, and conflict, resulting in a cognitive misfit. In addition, biophilic design approaches create sensory variability (Kellert, 2008). With respect to variety, complexity, and sensory variability, it is important to understand

how cool or warm lighting conceptually fits with retail greenery or non-retail greenery applications.

Secondly, the measurement of interaction effects provides us an idea about the congruence between lighting/correlated color temperature (cool/warm lighting) and retail greenery applications. Based on processing fluency theory, the Rompay et al. (2020) study found that the congruence between picture and text has positive effects on consumers' product attitude. Multisensory atmospheric congruence between music and flooring in a retail environment enlivens consumers' higher purchase-related self-confidence than multisensory atmospheric incongruence between music and flooring (Imschloss & Kuehnl, 2017). With respect to atmospheric congruence and processing fluency, it is important to investigate the interaction effects between retail greenery application and lighting (cool/warm) temperature on consumers' cognitive, emotional, and behavioral states. Finally, prior studies did not discuss much about interactions between correlated color temperature and retail greenery (vs. non-retail greenery). This study fills in the gap of prior studies by exploring the relationship between them.

1.5. Moderating effects of shopping orientations (utilitarian/hedonic)

Furthermore, this study also analyzes the moderating effects of utilitarian and hedonic shopping orientations. Utilitarian shopping orientation is a goal-oriented or task-related mode, while hedonic shopping orientation is more closely related to fun, entertainment, and emotional worth (Babin et al., 1994). The Babin et al. (1994) study developed scales to evaluate consumers' perceptions of utilitarian and hedonic shopping values. Utilitarian and hedonic shopping orientations play an important role in the virtual

reality environment. As noted by Pizzi et al. (2019), both utilitarian and hedonic shopping orientations have significantly positive impacts on satisfaction in VR stores. Efficiency influences utilitarianism, while escapism enhances hedonism. Hedonic shopping orientation brings the best amount of profit and brand royalty to retailers as compared to utilitarian shopping orientation (Scarpi et al., 2014). As noted by Scarpi et al. (2014), retailers must implement innovative design ideas in both virtual and augmented reality environments in order to provide consumers with engaging, hedonic oriented, and entertaining shopping experiences.

More significantly, various atmospherics attributes significantly affect consumers' utilitarian and hedonic shopping responses (Eroglu et al., 2003). For example, atmospheric attributes including product quality, site credibility, and shipping efficiency have notably positive effects on utilitarian shopping experiences (Ha and Im, 2016). However, multi-media features negatively influence consumers' utilitarian shopping experiences. On the other hand, website design and multimedia features enliven consumers' hedonic shopping experiences. Similarly, hedonic shopping orientation is defined as an antecedent of *consumer need* for mobile app atmospherics (Lee and Kim, 2019). In addition, several store attributes including product assortment, product value, personal interaction, accessibility, and physical aspects are potential antecedents of consumers' utilitarian and hedonic shopping experiences (Olsen and Skalernud, 2011). Based on previous studies, it could be assumed that there might be a relationship between the retail greenery application and various shopping orientations, because the retail greenery application contributes to the formation of experiential retailing. Also, the Liao (2016) study displayed the significant association between lighting and shopping

orientation. The results indicated that task-oriented shoppers have higher preferences for the uniform lighting (a small amount of focused lighting and many diffused light) as opposed to recreation-oriented shoppers, while the findings are opposite for the non-uniform lighting (a large amount of focused light and a small number of diffused light). Though shopping orientation has been widely discussed in previous research, limited studies have been done to explore how shopping orientation is associated with correlated color temperature (warm/cool). This study fills in the gap of previous studies by examining the moderating effects of shopping orientation among correlated color temperature (warm vs cool) and retail greenery (vs non-retail greenery) applications and consumers' outcomes (pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intentions).

1.6. Research purpose

The main objectives of this study are to investigate the effects of (a.) retail greenery vs non-greenery, (b.) correlated color temperature (warm vs cool), and the four intersecting stimuli, 2 (retail greenery vs non-greenery) x 2 correlated color temperature (warm vs cool) on consumers' emotional states (pleasure, arousal), cognitive states (perceived merchandise quality), satisfaction, and purchase intentions. This study will also analyze the moderating role of shopping values (utilitarian vs hedonic) contextualized by consumers' perceptions and responses.

1.7. Significance of the study

In this study, I have investigated the importance of retail greenery under two different lighting (warm and cool) conditions. Findings from this study determine the

feasibility of implementing retail greenery applications over non-retail greenery applications in the VR environment. I have also measured the interaction effect between retail greenery and correlated color temperature (cool/warm), which provides us with important findings about which correlated color temperature fits most accurately with the retail greenery application, as well as how lighting influences our perceptions about quality and attractiveness of apparel items.

Moreover, this study has tested whether its own findings do or do not support Stimulus-Organism-Response framework (S-O-R.). Using the S-O-R framework, I have compared among four stimuli (2x2, retail greenery vs non-retail greenery and cool vs warm lighting) from which I have identified the most preferable and least preferable display methods in the VR environment. Based on this study, retailers could easily implement the best display method for VR fashion stores.

Interestingly, virtual reality stores are easy to develop and cost effective (Park and Im, 2018). One can easily manipulate lighting, color, or other store environment variables to improve the design of VR fashion stores. Users can easily move merchandise items, create store layouts, change fixtures, and choose apparel items using 3D software such as Sketch Up. In addition, virtual reality (VR) can be used as a primary step to design a physical store, in addition to an online virtual store. For example, researchers could first understand consumer behavior in the VR environment, thus developing the physical or online virtual store based on such findings.

Lastly, I have investigated the *moderating role* of utilitarian and hedonic shopping orientation. Understanding utilitarian and hedonic shopping orientation are very

important because utilitarianism and hedonism have significantly positive impacts on satisfaction towards VR stores (Pizzi et al., 2019). Findings from this study explain whether retail greenery and correlated color temperature contribute to experiential retailing, as well as to potentially create an emotional connection with VR stores.

CHAPTER TWO

LITERATURE REVIEW

2.1. Stimulus-Organism-Response (S-O-R) framework

The S-O-R framework was first introduced by the Mehrabrian and Russell (1974) study. They linked three emotional states, pleasure, arousal, and dominance (PAD), with environmental stimuli and behavioral responses. Donovan and Rossiter (1982) have first introduced the S-O-R theory in retail environment research. Their study confirmed the applicability of the S-O-R theory in the retail environment. Findings from this study suggest that emotional states, including pleasure and arousal, mediate the relationship between environmental stimuli and consumers' behavioral responses. However, dominance does not show any statistically significant effects.

Stimulus

In the first part of this theory, stimuli are defined as those factors that influence consumers' perceptions (Eroglu, Malceit, and Davis, 2001). Donovan and Rossiter (1982) have further defined stimuli as the combination of marketing mix variables and environmental inputs in the retail environment. Lee et al. (2011) have stated that

"Stimuli embrace object stimuli and social psychological stimuli. Stimuli consist of a user's perceptions of different product characteristics such as design, performance,

and communication surrounding his/her experiences with the purchase and consumption." (p.1196).

Donovan and Rossiter (1982) have considered color, lighting, signage, and layout as environmental stimuli. Similarly, Yang (2015) has explored correlated color temperature and perceived complexity as environmental stimuli. Using previous studies, this study defines correlated color temperature and retail greenery as stimuli.

Organism

Organism refers to perceptual, psychological, feeling, and thinking activities (Bagiozzi, 1986), and the organism, as a mediator, identifies plays the role of a mediator between stimulus and responses or desired outcomes (Donovan & Rossiter, 1982). Organism includes both affective and cognitive states of consumers (Eroglu et al., 2001). In other words, for the purposes of this dissertation, the organism includes both the affective (emotional) and cognitive (thinking) states of the consumer. As noted by Eroglu et al. (2001), affective states influence consumers' feelings and emotions. Istbrook and Oliver (1991) have defined emotional states as

"The set of emotional responses elicited specifically during product usage or consumption experiences, as described either by the distinctive categories of emotional experience and expression (e.g., joy, anger, and fear) or by the structural dimensions underlying emotional categories, such as pleasantness/unpleasantness, relaxation/action, or calmness/excitement "(p. 85).

This study uses pleasure and arousal as affective states. Donovan and Rossiter (1982) have defined pleasure (P) as "the degree to which the person feels good, joyful, happy or satisfied with the situation" (p.38). Arousal refers to "the degree to which a

person feels excited, stimulated, alert, or active in the situation" (Donovan & Rossiter, 1982, p.38). A synopsis of previous research suggests that pleasure and arousal are significant predictors of consumers' outcomes (Donovan et al., 1994; Sherman et al., 1997; Ha & Lennon, 2010).

Another important dimension of an organism is its cognitive states. Eroglu et al. (2001) define cognitive state as "consumers' internal mental processes and states, and include attitudes, beliefs, attention, comprehension, memory, and knowledge" (p.181). This study considers perceived merchandise quality as the cognitive state. Baker et al. (2002) have found that social, design, and ambient cues significantly influence perceived merchandise quality, which, in turn affects store patronage intentions and merchandise value perceptions. In addition, store environment variables have significant effects on perceived quality of products. For example, the high brightness of the retail environment negatively affects perceived quality of a product (Hsieh et al., 2018).

Response

In considering the final aspect of the S-O-R framework, response refers to both approach and avoidance behavior of consumers (Hoffman & Turley, 2002). Approach behavior means the desirability of a consumer to stay in the environment, whereas avoidance behavior is opposite to approach behavior. Examples of responses are satisfaction, patronage intention, brand equity, behavioral intention, impulsive buying behaviors, and others.

Application of S-O-R framework

Prior research suggests that the S-O-R theory bears a vital contribution in retail environment research. For example, Baker et al. (2002) have confirmed the S-O-R link

by investigating the effects of social, design, and ambient factors on consumers' perceptions and responses. They have found that design cues exert more powerful effects on store patronage intentions than social and ambient factors. Also, pleasure, arousal, and enjoyment mediate the relationship between environmental stimuli and patronage intentions. In addition, Nah et al. (2011) have analyzed whether the 3D virtual world influences consumers' sense of presence, which is referred to as telepresence. The S-O-R theory confirms that consumers experience enhanced telepresence, local presence, emotions, pleasure, mystery, and arousal in the 3D virtual world. Moreover, prior studies consistently show that environmental stimuli significantly influence outcomes and consumers' emotional-cognitive states. (Table Three is attached)

Table three

Key findings related to Stimulus-Organism-Response framework

References	Independent variables	Dependent variables	Key findings related to S-O-R framework
Lee et al., 2011	Usefulness, ease of use, innovativeness, visual appeal, prototypicality, self-expression	Attitude, pleasure, and arousal, approach-avoidance behavior	All independent variables significantly influence approach and avoidance behavior through the mediating role of pleasure and arousal
Jang and Namkung, 2008	Product quality, atmospherics, service quality of restaurants	Positive and negative emotion, behavioral intentions	The results found that atmospherics and service quality of restaurants influence positive emotions, while product attributes contribute to negative emotions

Mosteller et al, 2014	Perceptual fluency (text font, text/background, information intensity (symmetry)	Positive affect, cognitive effort, choice satisfaction	Perceptual fluency has significant effects on positive affect and cognitive effort. Both positive affect and cognitive effort influence choice satisfaction
Kamboj et al., 2018	SNSs participation motivations	Consumer participation in brand communities on SNSs, brand trust, brand loyalty, and branding cocreation	SNSs participation motivations has significant effects on consumer participation in brand communities on SNSs, which in turn influences brand trust, brand loyalty, and branding cocreation
Kim et al., 2020	Authentic experience in virtual reality	Cognitive response, affective response (enjoyment, emotional involvement, flow state, attachment to VR, and visit intention	Authentic experience in virtual reality significantly affects cognitive and affective responses. Both cognitive and affect responses play the role as mediators between authentic experience in virtual reality and attachment to VR as well as visit intention. Attachment to VR has significant effects on intention to visit.
Lee et al., 2011	Performance (usefulness, ease of use, innovativeness of technology), appearance (visual appeal, prototypicality), communication (self-expression	Attitude, pleasure, arousal, approach and avoidance behavior	Among six factors of product attributes, innovativeness of technology, visual appeal, prototypicality, and communications have significant impacts on attitude, pleasure, and approach/avoidance behavior.
Kim and Lennon, 2013	Reputation, Website design, customer	Emotion, perceived risk, and purchase intention	Findings from the results confirmed the S-O-R framework. The

	service, reliability, security/privacy		results showed that security, reliability, Website design, and reputation has positive impacts on emotion. High reputation, great Website design reduce perceived risk. Similarly, low perceived risk heightens emotion as well as increases purchase intention

2.2. The main effects of retail greenery in the retail environment

Traditional shopping contexts include too much product information that may create mental fatigue and stress (Joye et al., 2010). The Joye et al. (2010) study has explained the importance of urban greenery based on Stress Recovery Theory. As noted by Joye et al. (2010), complex shopping contexts cause information overload. However, biophilic attributes help people to enhance relaxation. In the Berman et al. (2008) study, the researchers utilize green streets to create high biophilic stores, while no trees are used to design low biophilic stores. High biophilic stores create higher visual quality, price perceptions, and patronage behavior than low biophilic stores. Kaplan (1995) has provided a background for Attention Restoration Theory (ART) to explain how retail greenery promotes effortless brain function. Our brain's capacity to perform a specific task is limited, which causes directed attention fatigue. However, spending time in greenery spaces heightens restoration potential, which results in increased concentration. According to ART, the restoration potential of nature depends on four key properties including being away, soft fascination, extent, and compatibility. The extent of natural settings provides consumers with immersive experiences, which serve as an escape from

their daily activities. Soft fascination facilitates effortless function of our brain. Lastly, compatibility refers to an appreciation of the natural environment.

Many scholars have demonstrated the application of ART in their studies. For example, Rosenbaum et al. (2018) have applied ART in the context of lifestyle shopping centers; they compared lifestyle vs. non-lifestyle shopping centers' restoration potential, finding a higher potential for lifestyle shopping centers because they include biophilic elements such as trees, plants, and vegetation. Later, Rosenbaum et al. (2019) have used Social Impact Theory to investigate the effects of the presence of other people in a lifestyle shopping center. Researchers have used Emotive EPOC+ headsets to measure consumers' cognitive responses. Findings from the Rosenbaum et al. (2019) study have demonstrated that the presence of other people in a lifestyle shopping center elevates increased interest, excitement, and relaxation. Interestingly, Rosenbaum et al. (2020) have defined natural settings as 'therapeutic servicescapes' in the field of retailing. The reason is natural settings promote human well-being and help to create place attachment with the environment. Human wellbeing and place attachment are two important factors that can determine consumers' future purchasing behaviors. In addition, Puran and Kumar (2018) have confirmed the restorative potential of biophilic stimuli in the servicescape, demonstrating consumers' increased affective responses and preferences for biophilic stimuli instead of non-biophilic stimuli. Moreover, consumers are willing to spend more money in an indoor retail environment that includes greenery settings (Kristjansson, 2017).

Furthermore, in addition to impacting shopping behavior, connecting with nature improves sustainable behavior (Zelenski et al., 2015). Nature evokes enhanced social

value orientations. On the other hand, subsequent exposure to urban environments elicits self-focused value orientations (Iinstein et al., 2009). In a word, nature makes us more caring about others. Barton et al. (2009) have noted that walking in greenery spaces might significantly increase self-esteem and reduce feelings of anger, depression, tension, and confusion. Not only self-esteem, but greenery also improves our creative performance (Lichtenfeld et al., 2012). Lastly, greenery spaces influence loyalty (Sukatmadiredja and Atmajawati, 2018), which is one of the most important marketing outcomes. Perceived values, including utilitarian and hedonic shopping values, mediate between greenery and loyalty. In sum, nature inspired atmospherics provide sensory congruity, relevance and authenticity, comfort and peace, differentiation, and sensory patterns (Malbasic and Choi, 2019). Because of these attributes, natural settings consistently provide us with positive experiences with any settings (Table Four is attached)

Table Four

Key findings related to greenery applications and biophilic attributes

References	Independent variables	Response variables	Findings
Brengman et al., 2012	In-store greenery and perceived complexity	Pleasure, stress, and approach/avoidance responses	In-store greenery creates higher pleasure and approach behavior than without greenery applications. In addition, in-store greenery reduces stress.
Tyrvaienen et al., 2014	Place (park, city, forest), and time spent in the place	Perceived restorativeness, mood,	Places including forest and park are

		creativity, salivary cortisol concentration	more restorative than city
Chung et al., 2020	View characteristics (percentage of greenery, road, and sea from the window)	Noise annoyance	Noise annoyance is increased when participants view the greenery applications very close from the window
Berman et al. (2012)	Time (pre-walk vs post walk) and location (nature vs urban)	Working memory capacity, positive affect	Nature affects higher positive affect than urban
Yin et al., 2020	Biophilic vs non-biophilic indoor environments	Stress and anxiety	Biophilic indoor environments reduce stress and anxiety
Demir et al., 2019	Greenery	Nature connectedness, emotional, cognition, and behavioral regulation	Greenery has significant effects on nature connectedness, emotional and behavioral regulation
Vinitha et al., 2021	Biomorphic vs non-biomorphic visual identity of a brand	Perceived sustainability and brand credibility	Biomorphic visual identity of a brand affects higher perceived sustainability and brand credibility than non-biomorphic visual identity
Benfield et al., 2015	Natural and urban field settings	Stress reduction	Natural field settings significantly reduce blood pressure, which in turn, reduces stress
Benfield et al (2014)	Natural sound vs anthropogenic sound	Mood recovery	Natural sound significantly improves higher mood recovery than anthropogenic sound.
Windhager et al. (2011)	Natural stimuli such as water aquarium vs non-natural stimuli	Attention, and exploration	Natural stimuli such as water aquarium increases higher attention and exploration than non-natural stimuli.
Pretty et al., 2005	Green exercise	Mental and physical health outcomes	Green exercise has significant effects on

			mental and physical health outcomes.

Based on previous studies, the hypotheses are that

H1: Retail greenery will produce higher (a) pleasure, (b) arousal, (c) perceived merchandise quality, (d) satisfaction, and (e) purchase intention than non-retail greenery.

2.3. The interaction effects of retail greenery with other independent variables

A synopsis of prior research suggests that biophilic attributes show significant interaction effects with other independent variables. For example, the Brengman et al. (2012) study has investigated the interaction effects between perceived complexity and retail greenery to understand their effects on consumers' pleasure, stress, and approach/avoidance responses. Perceived complexity of the environment depends on the information rate. Findings from this study show that retail greenery increases consumers' pleasure and reduces stress in a high complexity store. However, retail greenery does not interact with low complexity. The authors have explained that people feel stressed in a spatially dense store and retail greenery can help people to reduce their stress.

Interestingly, greenery places also interact with time spent in those places (Tyrvaienen et al., 2014). As noted by Tyrvaienen et al. (2014), consumers' perceived restorativeness is high when they spend more time in greenery places such as parks and forests rather than short term visits to those places. Greenery places promote coherence so that people feel less stressed and highly energetic. Similarly, the Berman et al. (2012) study has found that location (urban vs nature) and time (pre-walk vs post-walk) interact with each other. Walking in nature enhances higher positive affect and working memory capacity when compared to walking in urban spaces after post walk. Findings from the

Berman et al. (2008) have demonstrated the interaction effects between picture type (nature vs urban) and the time of the test (before picture viewing vs after picture viewing). After picture viewing, natural views facilitate higher attention performance than urban views (Berman et al., 2008). In addition, compared to the red or white colored environment, a green colored environment lowers heart rate after the completion of a task (Briki and Majed, 2019).

Scholars have also explored noise annoyance and their effect on restoration potential and self-concept. Moreover, the findings of Chung et al (2020) have demonstrated interaction effects between different visual environments and noise annoyance. This study shows that in addition to the presence of greenery, it is important to consider the distance of greenery applications in environmental settings to provide a visually attractive environment. For example, greenery has interaction effects with road views on noise annoyance, that is, if a scenery contains 30% greenery views at a very close distance in a road (the scenery includes 60% of road views), it might increase noise annoyance. On the other hand, the noise annoyance reduces if I put the same amount (30%) of greenery applications in the road at a separate distance. Greenery applications in a close distance might create blockage, which undermines the restorative potential as well as the overall beauty of the environment. Biophilic attributes and greenery applications not only interact with other atmospheric factors, but they also show interaction effects with consumers' self-concepts, including idiocentric and allocentric (Ryu and Bringhurst, 2015). Idiocentric people focus on one's own interests rather than others. On the other hand, allocentric people are concerned with other's interests and objectives rather than their own interests. Idiocentric consumers perceive clothing products as more eco-

friendly when they see products in a plain store rather than a green store. However, the results are opposite for allocentric consumers.

Although biophilic attributes and greenery application show interaction effects with other independent variables, findings from some of these studies are exceptional and show the limitations of interaction effects. As noted by Demir et al. (2019), perceptual sensitivity does not interact with greenery to influence natural connectedness, cognitive function, and emotional regulation. Also, product types such as utilitarian and hedonic products do not moderate the relationships between biomorphic/non-biomorphic visual identity of a brand, perceived sustainability, and brand credibility. Lastly, lifestyle displays symbolize natural settings, which create higher pleasure and arousal than non-lifestyle displays. However, there are no interaction effects of convenience orientation and hedonic shopping values on lifestyle display and outcomes include pleasure, arousal, and approach/avoidance behaviors.

2.4. Lighting/correlated color Temperature

Correlated color temperature or Correlated Color Temperature includes three types of whites: warm white, natural white, and cool-white ("Warm light or Cool light"). Warm white LED bulbs produce 3000K or less than 3000K correlated color temperature, while cool-white LED bulbs illuminate 4000K or greater than 4000K correlated color temperature (Boray et al., 1989). For >=4000 K, lighting is bluish white, and for <=3000K lighting is yellowish white. However, Martin (2018) defines four types of lighting based on color temperature ranges from 2700K to 6000K. They are soft white (2700K-3000K), warm white (3000K-4000K), bright white (4000K-5000K), and daylight bulbs (5000K-6500K). Cool white light is more luminous and brighter than warm white

light (“Warm white or Cool White”). The use of warm or cool lighting depends both on the function of space and emotions (“Warm versus Cold light”). For example, I use warm lighting in our home because it creates a warm, relaxed, romantic, and soothing atmosphere. On the other hand, cool lighting is used in offices and art gallery sections as this lighting elevates overall functionality and generates an open and energetic atmosphere. Cool lighting provides consumers with more modern and contemporary feelings in the environment (Energy efficiency Pros, 2017).

2.5. The main effects of lighting/correlated color temperature

Lighting is an important element of the DAST framework and influences our shopping behavior. Roggeveen et al. (2020) have developed a DAST framework for retail atmospherics that includes (a) Design elements, including functional elements, signage, merchandise presentation, colors, aesthetic elements, merchandise presentation, style, graphics, pictures, (b) Ambient elements, including lighting, music, smell, temperature, brightness, sounds, enhanced zoom features, entertainment aspect, (c) Social people present in the environment or number of others, and (d) Trialability ability to try the product (augmented reality, virtual reality). A synopsis of prior research suggests that correlated color temperature has a significant impact on consumers’ perceptions and responses. For example, Janosik and Marczak (2016) have investigated the main effects of correlated color temperature (warm and cool) on the visual performance of elderly workers. Findings from this study support the main effects of correlated color temperature, that is, warm lighting creates higher visual performance than cool lighting. Also, both lighting and colors significantly affect consumers’ purchasing behavior,

repurchase intentions, Word-of-Mouth behaviors, attention, interest, liking, and satisfaction (Ozkul et al., 2019).

Furthermore, time spent in the store is positively related to soft lighting conditions (Barli et al., 2011). Lighting/correlated color temperature has a direct effect on stimulative evaluation of the retail environment (Briand and Pras, 2010). More significantly, correlated color temperature affects pleasure, arousal, approach behaviors, overall retail impressions, retail identity, perceived value, willingness to pay in auctions, stimulation, relaxation, upmarket positioning, cognitive performance, feeling of safety, and emotional perceptions (Table Five is attached).

Table Five

Key findings related to lighting/correlated color temperature

References	Independent variables	Response variables	Findings
Tantanatewin and Inkarojrit, 2016	Correlated color temperature and color	Overall retail impression and identity	Correlated color temperature has significant impacts on overall retail impression. Warm white lighting is more expressive than cool white lighting. However, cool white lighting is more attractive and technical than warm white lighting.
Yang, 2015	Correlated color temperature and perceived complexity	Perceived service scape, perceived value, and behavioral intentions	Warm lighting creates higher perceived servicescape than cool lighting

Park and Farr, 2007	Color temperature and color rendering index	Pleasure, Arousal, and Approach-Avoidance intention	3000K warm lighting creates higher pleasure and arousal than 5000 K. However, visual clarity is higher for 5000K than 3000K
Sinha and Bagchi (2019)	High vs Moderate vs Low ambient temperature	Higher willingness to pay in auctions, higher willingness to pay in negotiation	High ambient temperature influences lower willingness to pay in negotiations than moderate ambient temperature. However, the finding is opposite for willingness to pay in auctions
Mouhoubi, 2014	Lighting intensity (Bright and Dim), Shelf Height (Low vs High), and Color Temperature (Warm vs Cool)	Pleasure, arousal, feeling of safety	Cool lighting enhances higher pleasure, arousal, and approachable than Warm lighting
Lin and Yoon, 2015	Correlated color temperature and contrast	Pleasure, arousal, and attention	Cool lighting influences higher arousal than warm lighting
Knez and Hygge (2002)	Irrelevant speech and Indoor correlated color temperature	Cognitive performance and self-reported affect	Warm-white lighting has better positive effects on long-term memory recall of a novel text than cool-white lighting

Thus, I hypothesized:

H2: There will be a significant difference between cool and warm lighting on (a) pleasure, (b) arousal, (c) perceived merchandise quality, (d) satisfaction, and (e) purchase intention.

2.6. The interaction effects of correlated color temperature (warm/cool) or correlated color temperature and other independent variables

Prior research suggests that lighting or correlated color temperature has significant interaction effects with other independent variables. For example, Kang et al. (2019) have investigated the interaction effects of lighting or correlated color temperature

(warm and cool) and brightness of light (bright or dark). The Kang et al. (2019) study has demonstrated how lighting and brightness both enhance consumers' cognitive states through the mediating role of fluency (ease processing of information). The theory is if lighting/correlated color temperature and brightness conceptually fit with each other, it will enhance fluent processing of information, which heightens consumers' cognitive perceptions. Findings from this study demonstrate the conceptual fit between warm-bright lighting and cool-dim lighting. That is, both warm-bright lighting and cool-dim lighting intensify the ease processing of information. On the other hand, the interactions of warm-dim lighting and cool-bright lighting decrease ease processing of information, which has negative effects on cognitive activation. Interestingly, lighting or correlated color temperature also interacts with shelf height (low and high) (Mouhoubi, 2014). Consumers perceive cool lighting conditions as more pleasurable than warm lighting conditions under low-shelf height. In addition, there are three-way interaction effects among bright-cool lighting and shelf height. Participants consider the combination of bright-cool lighting with low shelf height as more approachable than the combination of dim-cool lighting with low shelf height. Similarly, lighting/correlated color temperature interacts with the Color Rendering Index (CRI) (Park and Farr, 2007). CRI influences objects' appearances in the environment. At 75 CRI, participants define 3000K as warm lighting and 5000K as cool lighting. However, there are no interaction effects between cool and warm lighting under 95 CRI. Also, the Park and Farr (2007) study has suggested that cultural differences interact with correlated color temperature. For example, 5000K cool lighting is more approachable for Korean subjects than 3000K warm lighting. It is

apparent that the interaction effects between lighting and other environmental variables are important to provide a good retail environment.

Lighting/correlated color temperature has interaction effects on environmental variables. Moreover, correlated color temperature interacts with lighting types (ambient and accent lighting) (Lin and Yoon, 2015). Ambient lighting is a general type of lighting, while accent lighting is used to focus on merchandise products. The use of both ambient and accent lighting creates contrasting effects. As noted by Lin and Yoon (2015), contrast effects are high when retailers use a higher number of accent lights than ambient lights. On the other hand, the use of a higher number of ambient lights than accent lights create low contrast effects. Warm lighting and high contrast effects increase arousal and attention more than cool lighting and low contrast effects. Beyond environmental variables, correlated color temperature also interacts with social factors, such as perceived crowding (high vs low) and shopping motivations (fun shopper vs task-oriented shopper) (Manen, 2018). Under warm lighting conditions, consumers perceive a retail environment with low human crowding as more attractive than a retail environment with high human crowding. In addition, a hedonically oriented shopper contemplates a retail environment as more attractive than a goal-directed shopper under warm lighting conditions. Interestingly, correlated color temperature shows interaction effects with demographic factors such as age. For example, younger adults have negative moods under warm lighting conditions, while warm lighting has no effect on older adults. At the same time, older adults demonstrate positive moods under cool lighting conditions, whereas cool lighting conditions have no effect on older adults (Knez and Kers, 2000).

Furthermore, lighting interacts with environmental variables including colors, price, illuminance, daytime, brightness, and retail outlet. (Table Six is attached)

Table Six

Key findings related to interaction effects of lighting and other independent variables

References	Independent variables	Response variables	Findings
Wardono et al., 2012	Colors (Monochromatic and complementary colors), Lighting (Dim vs Bright), Décor (elaborate and plain)	Perceived sociability and behavior related to social dining	Monochromatic color, dim lighting, and plain décor have the most positive effects on perceived sociability compared to other groups.
Zhu et al., 2019	Correlated color temperature, illuminance, and daytime (morning vs afternoon)	Cognitive performance and subjective mood	There are significant interaction effects among correlated color temperature, illuminance, and daytime
Briand and Pras, 2010	Brightness, correlated color temperature (warm vs cool) and retail outlet	Stimulation, upmarket positioning, and relaxation	A bright and cool lighting store without any product physical involvement influence stimulation of the store environment
Babin et al., 2003	Color (orange and blue), light (soft and bright), and items price ($59.95 vs $149.95)	Positive evaluation, Positive Evaluation, Patronage Intentions, Purchase Intentions, Price fairness perceptions	Consumers have favorable attitudes towards the blue store interior under the bright light condition compared to the soft light condition. The result is opposite for the orange store interior.

Although correlated color temperature shows interaction effects with other independent variables, some studies are exceptional regarding their findings. For example, Yang (2015) found that there are no significant interaction effects between correlated color temperature and perceived complexity conditions. Similarly,

Tantanatewin and Inkarojrit (2016) did not find any interaction effects between correlated color temperature and color on overall retail impression and identification. Also, lighting does not interact with irrelevant sound effects to influence cognitive performance and self-reported affect (Knez and Hygge, 2002).

Lighting is an inherent consideration of biophilic design. Kellert (2008) stated that light and space include approximately twelve attributes including natural light, filtered and diffused light, light and shadow, reflected light, light pools, warm light, light as shape and form, spaciousness, spatial variability, space as shape and form, spatial harmony, and inside-outside spaces. Thus, this study only investigates the effects of correlated color temperature and retail greenery in biophilic design as biophilic design has so many attributes and both correlated color temperature and retail greenery are attributes of biophilic design.

Thus, I hypothesized:

H3: There are significant interaction effects between retail greenery and correlated color temperature on (a) pleasure, (b) arousal, (c) perceived merchandise quality, (d) satisfaction, and (e) purchase intention

2.7. The moderating effects of utilitarian/hedonic shopping orientations

Consumers' utilitarian shopping value is task-oriented, goal-directed and closely related to efficiency, while hedonic shopping value is more related to fun, exploration, escapism, and enjoyment (Babin et al., 1994). I consider utilitarian/hedonic shopping values as a potential moderator for this study. Baron and Kenny (1986) have noted that

the strength and direction of the relation between a predictor and a dependent variable is influenced by another qualitative and quantitative variable, which is called the moderator. A moderator interacts with predictors and affects the predictors' relations with outcomes. Prior research suggests that utilitarian and hedonic shopping values moderate the relationship between environmental stimuli and outcomes. For example, utilitarian and hedonic shopping values moderate the relationship between biophilic stimuli and outcomes including pleasure and excitement (Purani and Kumar, 2018). Under hedonic shopping value, biophilic stimuli create higher pleasure and excitement than utilitarian shopping value. In addition, biophilic stimuli are more restorative for hedonic shopping value compared to utilitarian shopping value. Purani and Kumar (2018) have explained that biophilic attributes are highly effective to reduce stress of hedonic shoppers, which facilitates increased exploration for them. On the other hand, utilitarian shopping orientation is goal-directed so that utilitarian shoppers are less likely to be affected by stress. In addition, atmospheric factors provide hedonic oriented shoppers with better experiences than utilitarian-oriented shoppers (Stein and Ramaseshan, 2019).

Also, utilitarian and hedonic shopping motivations have interaction effects with sacrifice, value, and satisfaction (Luk et al., 2013). Results from this study demonstrate that the relationships among sacrifice, value, and satisfaction with behavioral intentions are stronger for utilitarian shopping motivation than hedonic shopping motivation. Similarly, the effect of satisfaction on loyalty is stronger for consumers with high-perceived value than consumers with low-perceived value (Chang and Wang, 2011). Furthermore, bunches of previous studies have found the moderating effects of utilitarian and hedonic shopping values (Table Seven is attached)

Table Seven

Key findings related to the moderating effects of utilitarian and hedonic shopping values

References	Independent variables	Response variables	Findings
Jones et al., (2006)	The interaction between satisfaction and utilitarian/hedonic values	Positive word-of-mouth, loyalty, and re-patronage intentions	There is significant interaction effects between satisfaction and shopping values. The negative effects of satisfaction on word of mouth are stronger for hedonic value compared to utilitarian value. In addition, the negative effects of satisfaction on re-patronage intentions are stronger for utilitarian value compared to hedonic value
Lunardo and Mbengue, (2009)	Perceived control	Pleasure, stress, and return intent	The level of utilitarian motivational orientation moderates the relationship between perceived control and pleasure/stress
Tsaur et al., (2014)	Selling orientation	Service outcomes	Shopping orientation of tour members interacts with selling orientation and influences shopping orientation's relations with service outcomes

Richard and Habibi, (2016)	Website atmospherics	Consumers' online behavior	Hedonism interacts with culture to enhance the effects of Website atmospherics on consumers' online behavior
Inzel and Benkenstein, (2018)	Shopping companions	Shopping experience	Shopping motivations partly interact with shopping companions. Therefore, the moderating effects of shopping motivations are partial
Chakrabarty, (2019)	Interaction effects of shopping motivations and product browsing behavior	Shopping intentions	Utilitarian shopping motivations do not interact with product browsing behavior, while hedonic shopping motivations interact with product browsing behavior

Not only biophilic attributes and other atmospheric factors, but also shopping motivations (utilitarian vs hedonic) interact with correlated color temperature (warm vs cool) (Manen, 2018). Findings from this study show that fun shoppers (i.e., hedonic shoppers) consider the retail environment as more attractive under the condition of cool lighting rather than warm lighting. However, the results are opposite for run shoppers (i.e., utilitarian shoppers). As noted by Manen (2018), cool lighting is highly arousing for utilitarian shoppers, which might reduce shoppers' attractiveness towards the retail environment. The Guido et al. (2017) study has also found similar results for hedonic products. Interestingly, consumers' purchase intentions towards hedonic products are higher than utilitarian products under blue light conditions compared to white light

conditions. However, findings from the Liao (2011) study demonstrate contrasting results when cool and warm lighting combine with uniform and non-uniform lighting. In the case of uniform lighting, retailers use a higher number of general lighting than focused lighting. On the other hand, an increased number of focused lightings is used for non-uniform lighting. The most preferable display for run shoppers is cool-uniform lighting and warm-non-uniform lighting is the least preferable display for them. More significantly, recreation-oriented shoppers show higher preference for warm/non-uniform and coon/uniform lighting than task-oriented shoppers. Based on previous studies, it is apparent that shopping motivation shows significant moderating effects between atmospheric factors and retail outcomes.

Thus, I hypothesized:

H4: Utilitarian and hedonic shopping orientations will moderate the relationship between correlated color temperature and retail greenery in biophilic design on consumers' (a) pleasure, (b) arousal, (c) perceived merchandise quality, (d) satisfaction, and (e) purchase intention.

CHAPTER THREE

METHODOLOGY

The methodology section includes experimental design, experimental stimuli, data-collection procedures, sample characteristics, instrumentation, manipulation check, and statistical analysis.

3.1. Experimental Design

This study conducted a 2 x 2 experimental design - the first two being retail greenery in biophilic design vs non-greenery and the second two correlated color temperatures: warm vs cool. In this study, retail greenery is a within-subject design, while correlated color temperature is a between-subject design. For the within-subjects design, respondents need to evaluate two conditions each (i.e., one with, and one without greenery), while for the between-subjects design, respondents must evaluate only one condition from two conditions (Budiu, 2018). I developed four stimuli to conduct this study, and they are: retail greenery/warm lighting, non-greenery/warm lighting, retail greenery/cool lighting, and non-retail greenery/cool lighting.

I choose retail greenery as a within-subjects design because participants could understand different levels of retail greenery/non-retail greenery applications. This design methodology reduces the random noise (Budiu, 2018). On the other hand, I choose correlated color temperatures as between-subjects design because visual differences are obvious between warm and cool lighting. In addition, Budio (2018) noted that between-subjects designs are easier to implement when I have multiple independent variables. In

addition, this between-subjects design approach keeps experimentation away from carryover effects (Jhangiani et al., 2019).

3.2. Randomization

I used Qualtrics randomizer to properly randomize the order of these four stimuli (presented above). I randomly assigned participants to different orders of condition, which reduces the possibility of order effects (Jhangiani et al., 2019). The following procedures are implemented to set up within-subjects and between-subjects design approaches.

a. First, I have put informed consent in the Qualtrics questionnaire
b. After that, I used Randomizer and created two groups. One group included two elements: retail greenery/cool lighting and non-retail greenery/cool lighting. The other group also included two elements: retail greenery/warm lighting and retail greenery/cool lighting. These stimuli are also evenly randomized within each group.
c. Similar questions related to manipulation check, pleasure, arousal, satisfaction, perceived merchandise quality, and purchase intention are included in each group.
d. Firstly, participants observed a 360-panorama view of one of four stimuli. The link of the 360-panorama view has been attached to the questionnaire. After that, they answered all the questions.
e. For each stimulus, the same questionnaire was used. That is, participants were required to fill out the same questionnaire for each stimulus within each group.
f. Lastly, participants answered the questions related to shopping orientation.

The order of these four stimuli (presented above) will be randomized properly as it reduces the possibility of order effects (Moffit, 2003). In addition, it produces the comparable groups, controls the confounding variable, establishes true causal and effects relationships, and participant assignment will not affect the outcomes.

3.3. Instruments

Experimental stimuli

Sketch Up software was used to develop VR apparel stores (all figures are given in the index). The Park and Im (2018) study used Sketch Up software to create VR fashion apparel stores. It is a 3D modelling software through which one can easily develop a VR environment. It has an enscape extension, which is a 3D virtual reality and real-time rendering plugin. With just one click, it creates a 360-degree VR environment in PCs. It also allows users to walk through their fully rendered project. However, it provides consumers with non-immersive VR experiences. I used Oculus Rift headset to stimulate the real VR environment. However, because of the Covid 19 pandemic season, I was unable to use VR headsets and instead opted for the 360-degree panorama view.

The following guidelines are implemented to develop non-immersive VR stores.

a. Sketch Up Pro 2019 included several important tools such as arcs, push/pull, scale, tape measurement, paint bucket, orbit, shapes, and move tools that are used to develop the virtual fashion apparel stores.

b. Biophilic design was developed by using greenery applications in the retail environment. The Rosenbaum et al. (2019) study used a greenery application to

develop biophilic design within a lifestyle center, while they removed this greenery application to generate non-biophilic design. Based on this study, I also used greenery or non-greenery applications to manipulate biophilic design conditions.

c. Based on the Tantanatewin and Inkarojrit (2016) study, the correlated color temperature was adjusted to 3000K to create warm lighting and 4200 K to develop the cool lighting condition.

d. All display methods are the same in size. Also, the brightness levels, fixtures, background color and other variables are kept constants for all stores.

e. I placed approximately 30 apparel items, 20 accessories, and plants in each VR store.

f. Enscape was used to display 360-degree VR stores.

g. I was planning to collect data using an Oculus Rift headset. However, due to Covid 19, I collected data using 360-degree panorama views. Using the Enscape software, I have created all 360-degree VR panorama views. These views are outlined:

https://api2.enscape3d.com/v3/view/0f583812-e2be-49ea-9879-d88492775fa6

https://api2.enscape3d.com/v3/view/56554b67-277b-46bd-8349-3402ff6ef700

https://api2.enscape3d.com/v3/view/30aedc02-9dfe-4fae-adab-391dc2692bd0

https://api2.enscape3d.com/v3/view/30aedc02-9dfe-4fae-adab-391dc2692bd0

3.4. Data collection procedure and sample

This study focuses only on undergraduate female consumers because I have created VR fashion stores selling only female clothes. Participants are from US universities as this study tries to control extraneous variables such as age, educational background, previous experiences, and others. The minimum required number of participants for each scenario in this study is 30. As noted by Field (2005), when the sample size is equal or greater than 30, the distribution of the sample means is normal. This is called Central Limit Theorem. The assumption of CLT is that the average of the sample means, and standard deviations is equal to the population mean and standard deviation. Only undergraduate female consumers (ages between 18-23) are chosen for this study so that age and gender are not included as covariates.

The participation in this research is completely online. I have planned to do it physically, However, due to Covid 19, I have conducted the study online. The whole procedures are summarized as:

(a) The online questionnaire first included consent form

(b) If the participant agreed with the consent form, they started answering questions

(c) I used Qualtrics Randomizer to evenly present one of the two groups. One group contains two stimuli including cool and non-greenery and cool and retail greenery applications. Another group contains warm and non-greenery and warm and retail greenery applications. These stimuli are also evenly randomized within each group to avoid any order effects

(d) Similar questions related to manipulation check, pleasure, arousal,

satisfaction, perceived merchandise quality, and purchase intention were included in each group.

(e) Firstly, participants observed a 360-panorama view of one of four stimuli. The link of the 360-panorama view has been attached to the questionnaire. After that, they answered all the questions.

(f) For each stimulus, the same questionnaires are added. That is, participants are required to fill out the same questionnaire for each stimulus within each group.

(g) Lastly, participants answered the questions related to shopping orientation

(h) I used 7-point Likert scales for all items of seven instruments.

3.5. Instrumentation

Pleasure

I used the Pleasure instrument from the Donovan and Rossiter (1982) study. This instrument consists of seven items and these items are contended-depressed, happy-unhappy, satisfied-unsatisfied, pleased-annoyed, relaxed-bored, free-restricted and hopeful-despairing.

Arousal

I also used the Arousal instrument from the Donovan and Rossiter (1982) study. Like the pleasure instrument, this instrument contained seven items and some examples are stimulated-relaxed, excited- calm, jittery-dull, and wide awake-sleepy.

Satisfaction

I adopted the Satisfaction instrument from the Magi (2003) study. This instrument has two items: “How satisfied are you with your primary grocery store (very dissatisfied-

very satisfied)?" and "How well does your primary grocery store match your expectations (not at all-completely)?" I modified these two items by replacing 'grocery store' with 'virtual stores', for example, "How satisfied are you with the virtual store (very dissatisfied–very satisfied)?" and "How well does the virtual store match your expectations (not at all-completely)?"

Purchase intentions

The patronage intention instrument was adopted from the Baker et al. (2002) study. It included three items with a Cronbach's alpha of 0.84 to 0.88. They were "The likelihood that I would shop in this store is high," and "I would be willing to buy gifts at this store."

Perceived merchandise quality

I took the perceived merchandise quality instrument from the Baker et al. (2002) study. This instrument incorporated two items: "This store offers high-quality gifts," and "The products in this store have high workmanship."

Shopping Orientations

The shopping orientations scale has been adopted from the Babin et al. (1994) study. This scale included 14 items and they are : (a) I usually buy our clothes at the most convenient place, (b) The items in the visual store have high workmanship, (c) I shop for clothes where it saves me time, (d) I put a high value on convenience when shopping for clothes, e) Shopping is truly a joy, (f) I shop, not because I have to, but because I want to, (g) Shopping truly feels like an escape, (h) Compared to other things I can do, time spent shopping is truly enjoyable, (i) I enjoy being immersed in exciting new products, (j) I enjoy shopping for its own sake, not just for items I purchase, (k) I have a good time

shopping because I am able to act on the “spur-of-the-moment.”, (l) When I shop, I feel the excitement of the hunt, (m) While shopping, I am able to forget our problems, (n) While shopping, I get a sense of adventure, (o) Shopping is not a very nice time out

3.6. Manipulation check

Based on the Brengman et al. (2012) study, I developed these items for the manipulation check of retail greenery applications. As noted by Brengman et al. (2012), participants reported higher amounts of vegetation in the in-store vegetation than without in-store vegetation. These three items are:

a. The virtual reality (VR) store includes greenery applications
b. The virtual reality (VR) stores did not include any greenery applications
c. I am not sure whether there are greenery applications or not

Park and Farr (2007) study evaluated color appearances of correlated color temperature aswarm/cool. Based on this, I have created three items to check manipulations of correlated color temperature. They are:

a. The VR environment included warm lighting
b. The VR environment included cool lighting
c. I am not sure whether there are cool/warm lighting

Participants responded to these (above present) items after they viewed the store. In the non-retail greenery VR store, I have put some flowers and a mountain landscape to represent real stores. In addition, based on the Brengman et al. (2012) study, consumers might perceive a higher amount of greenery applications in retail greenery stores vs non-retail greenery stores. That is, I can put some greenery in non-greenery

stores, on the other hand, the amount of greenery elements should not be obvious. In addition, I faced some limitations with retail applications. For example, Kellert et al. (2008) noted that greenery attributes provide consumers with direct experiences of nature. However, in our stimuli, consumers have limited interactions with greenery elements in 360 VR stores.

CHAPTER FOUR

RESULTS

4.1. Exploratory Data Analysis

Sample Characteristics and Preliminary Data Analysis

295 Undergraduate female students participated in this study. From them, 143 students are from the department of Design, Housing, and Apparel of the University of Minnesota. The age of the students is between 18-23. The remaining 152 students are from different US universities including Ohio University, Columbia University, Sanford University, University of Texas at Austin, California Institute of Technology, Washington University, and New York university. 146 students have been exposed to cool lighting and greenery/non-retail greenery conditions. On the other hand, there were 149 students for warm lighting and greenery/non-retail greenery conditions. Their family income ranges from $10000 to more than $60000.

Table Nine

Participant Characteristics

Characteristics		Participants (n=295)
Age		18-23
Gender	Female	295 (100%)
Income	$10000 to $30000	59 (20%)
	$30000 to $60000	110 (37.3%)
	$60000 to above	126 (42.7%)
Major	Design	143 (48.47%)
	Others (Accounting, Business)	152 (51.53%)
University	of Minnesota	143 (48.47%)
	Others (Ohio state, Colorado state)	152 (51.53%)

4.2. Measurement

Reliability analysis

Cronbach's alpha was used to measure the reliability of all instruments. The instrument indicates poor reliability if the Cronbach's alpha value is less than 0.7. Our analysis showed that the Cronbach's alpha value is greater than 0.7 for all instruments.

Table Ten

Reliability analysis

Instruments	*Cronbach's alpha value*
Pleasure in non-greenery condition	0.95
Pleasure in greenery condition	0.94
Arousal in non-greenery condition	0.81
Arousal is greenery condition	0.82
Richness in non-greenery condition	0.702
Richness in greenery condition	0.707
Retail greenery manipulation instruments	0.842
Warm/cool lighting instruments	0.80
Shopping values	0.89
Perceived merchandise quality in non-greenery condition	0.918
Purchase intention under retail greenery condition	0.947
Satisfaction under retail greenery condition	0.907

Sample difference

There are no significant differences in correlation matrix for both class and M-Turk participants except perceived merchandise quality. Mostly, Correlation matrix value is greater than 0.5, supporting criterion validity (Salkind, 2021).

Table 11

The correlation matrix of M-Turk Participants

Pleasure	1	0.7	0.78	0.61	0.72
Arousal	0.7	1	0.59	0.28	0.56
Satisfaction	0.78	0.59	1	0.54	0.77
Quality	0.61	0.28	0.54	1	0.58
Purchase Intention	0.73	0.56	0.77	0.58	1

Table 12

The correlation matrix of college participants

Pleasure	1	0.62	0.78	0.33	0.71
Arousal	0.62	1	0.59	0.14	0.55
Satisfaction	0.78	0.59	1	0.31	0.83
Quality	0.32	0.14	0.31	1	0.33
Purchase Intention	0.71	0.55	0.83	0.33	1

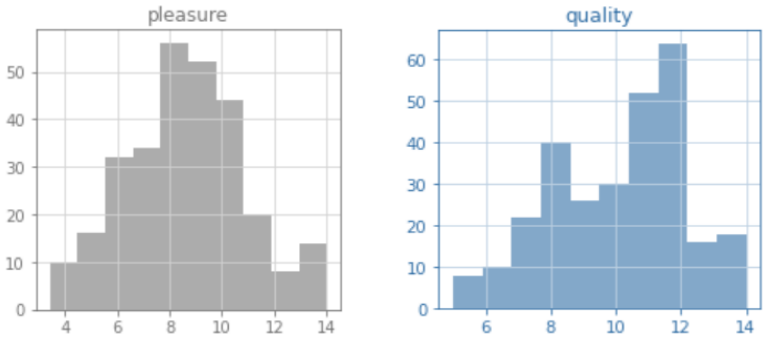
Manipulation check

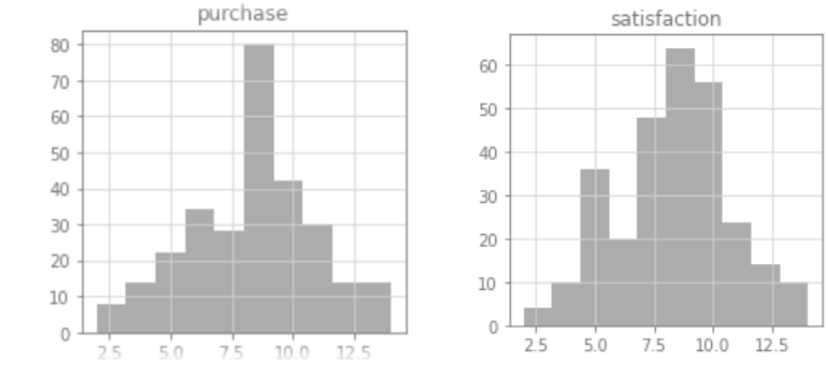
The manipulation check was successful. In the case of manipulation check for retail greenery, I have conducted mixed model ANOVA testing using SPSS where retail greenery/non-retail greenery is within-subjects design. The results showed that

manipulation check for retail greenery was statistically significant (F=284.03, p<0.000). The mean value for non-retail greenery condition is 2.799, while the mean value for retail greenery is 5.982. The manipulation check (F=148.09, p<0.000) was also successful for the lighting (warm/cool) condition. The mean value for warm and cool lighting are 5.902 and 3.128 respectively.

Normal Distribution Curve

The normal distribution curve seems fine for pleasure, arousal, satisfaction and purchase intentions except quality.





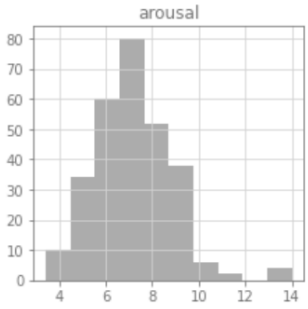


Figure One: The normal distribution curve for all variables

4.3. Homogeneity assumption test

I conducted Leven's test for all dependent variables with respect to four display methods and the test met ($p > 0.05$) the assumption.

4.4. Hypothesis Testing

Hypothesis 1. Main Effects of Retail Greenery/Non-retail greenery

The mixed model ANOVA has been conducted to understand the effects of retail greenery vs non-retail greenery on pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intention. In the mixed model ANOVA, the greenery/without conditions are within-subjects' groups. IBM SPSS 26 has been used to report all findings. Findings from my study demonstrated that hypothesis one were fully supported. For example, findings from the mixed-model ANOVA showed that retail greenery creates higher pleasure ($M_{\text{retail greenery}}$ =4.79, $M_{\text{non-retail greenery}}$ = 3.85, F=78.011, p<0.000), arousal ($M_{\text{retail greenery}}$ =3.93, $M_{\text{non-retail greenery}}$ = 3.31, F=42.845, p<0.000), perceived merchandise quality ($M_{\text{retail greenery}}$ =5.33, $M_{\text{non-retail greenery}}$ = 4.85, F=22.319, p<0.000), satisfaction ($M_{\text{retail greenery}}$ =4.74, $M_{\text{non-retail greenery}}$ = 3.63, F=79.520, p<0.000), and purchase intention ($M_{\text{retail greenery}}$ =4.60, $M_{\text{non-retail greenery}}$ = 3.75, F=44.771, p<0.000) than non-retail greenery applications. All findings are given.

Table Thirteen

Mean Scores and Standard Deviation for the Pleasure, Arousal, Perceived Merchandise Quality, Satisfaction, and Purchase Intention by Retail Greenery/Non-retail greenery conditions

Independent variables	DV	Mean	SD
Retail Greenery	Pleasure	4.79	0.106
	Arousal	3.93	0.088
	Perceived Merchandise Quality	5.33	0.121
	Satisfaction	4.74	0.122
	Purchase Intention	4.60	0.124
Non- Greenery	Pleasure	3.85	0.120
	Arousal	3.31	0.083
	Perceived Merchandise Quality	4.85	0.091
	Satisfaction	3.63	0.129
	Purchase Intention	3.75	0.126

Table Fourteen

Mixed ANOVA testing for Pleasure, Arousal, Perceived Merchandise Quality, Satisfaction, and Purchase Intention by Retail Greenery/Non-Retail Greenery conditions

Independent variables	DV	*F-Statistic*	*p-value*
Retail/ Non-Retail Greenery	Pleasure	78.011	$p<0.000^{***}$
	Arousal	42.845	$p<0.000^{***}$
	Perceived Merchandise Quality	22.319	$p<0.000^{***}$
	Satisfaction	79.520	$p<0.000^{***}$
	Purchase Intention	44.771	$p<0.000^{***}$

Hypothesis 2. Main Effects of Warm/Cool Lighting

In the mixed model ANOVA analysis, warm/cool lighting conditions are between-subjects groups. Hypothesis 2 were partially supported. Findings from the results showed that cool lighting creates higher arousal ($M_{cool\ lighting}$ =3.86, $M_{warm\ lighting}$= 3.48, F=4.031, p<0.05) than warm lighting. However, other hypotheses were not supported. There were no significant differences between warm and cool lighting on pleasure ($M_{cool\ lighting}$ =4.46, $M_{warm\ lighting}$= 4.18, F=2.012, p>0.05), satisfaction ($M_{cool\ lighting}$ =3.69, $M_{warm\ lighting}$= 3.54, F=0.891, p>0.05), perceived merchandise quality ($M_{cool\ lighting}$ =5.16, $M_{warm\ lighting}$= 5.01, F=0.619, p>0.05), and purchase intention ($M_{cool\ lighting}$ =4.22, $M_{warm\ lighting}$= 4.13, F=0.15, p>0.05

Table Fifteen

Mean Scores and Standard Deviation for the Pleasure, Arousal, Perceived Merchandise Quality, Satisfaction, and Purchase Intention by Warm/Cool lighting conditions

Independent variables	DV	Mean	SD
Cool lighting	Pleasure	3.86	0.106
	Arousal	3.93	0.088
	Perceived Merchandise Quality	5.16	0.121
	Satisfaction	3.69	0.122
	Purchase Intention	4.22	0.124
Warm lighting	Pleasure	3.48	0.120
	Arousal	3.31	0.083
	Perceived Merchandise Quality	5.01	0.091
	Satisfaction	3.54	0.129
	Purchase Intention	4.13	0.126

Table Sixteen

*Mixed ANOVA testing for Pleasure, Arousal, Perceived Merchandise Quality, Satisfaction, and Purchase Intention by Warm/*Cool *Lighting conditions*

Independent variables	DV	*F-Statistic*	*p-value*
Cool/ Warm Lighting	Pleasure	2.012	$p>0.05$
	Arousal	4.031	$p<0.05^{***}$
	Perceived Merchandise Quality	0.619	$p>0.05$
	Satisfaction	0.891	$p>0.05$
	Purchase Intention	0.15	$p>0.05$

Hypothesis 3. The Interaction Effects between Retail Greenery and Correlated color temperature

I have also measured the interaction effects between correlated color temperature and greenery applications using Mixed-design ANOVA. Hypothesis 3 were also partially supported. The results showed that there are significant interaction effects between retail-greenery and lighting conditions for pleasure ($\beta = 0.468$, SE= 0.202, t=2.324, $p<0.05$). Under the retail greenery condition, cool lighting creates higher pleasure ($M_{cool} = 5.062$ vs. $M_{warm} = 4.601$, $p<0.05$) than warm lighting. However, I did not find significant difference between cool and warm lighting on pleasure under non-retail greenery condition ($\beta = 0.071$, SE= 0.234, t=0.305, $p>0.05$). Both warm ($M_{greenery} = 4.62$ vs. $M_{non-greenery} = 3.25$, $p<0.05$) and cool lighting ($M_{greenery} = 5.06$ vs. $M_{non-greenery} = 3.42$, $p<0.05$) create higher pleasure under retail greenery condition than non-retail greenery condition.

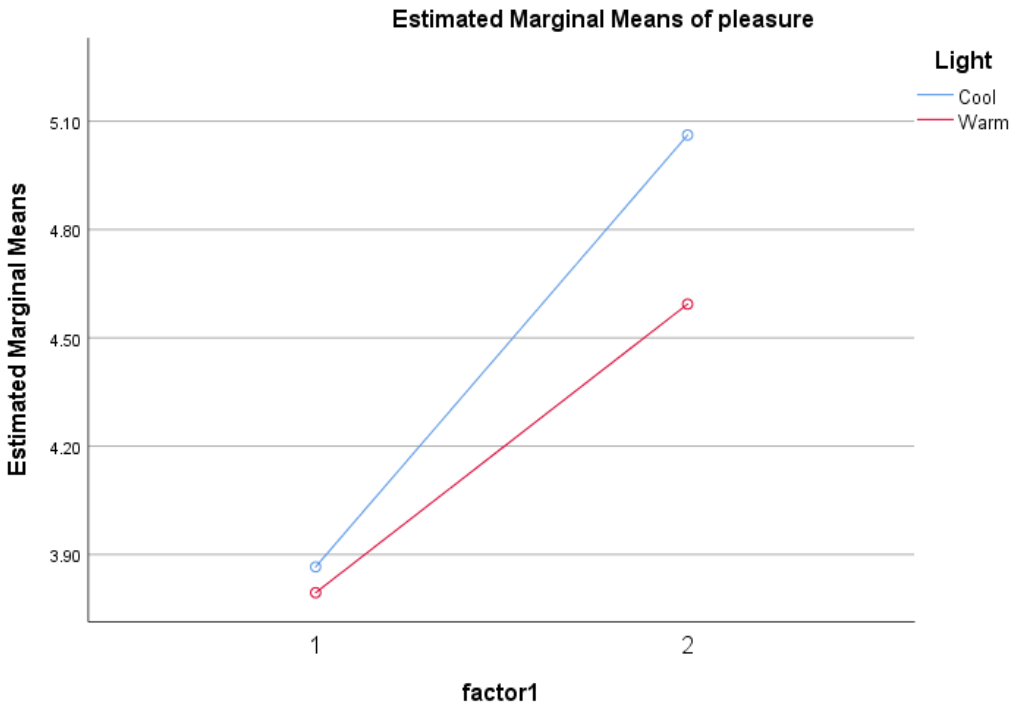


Figure Two: The interaction effects between retail greenery and correlated color temperature on pleasure, here, blue line indicates warm lighting and red line indicates cool lighting

Results from the mixed ANOVA analysis showed that there is significant interaction effects between non-retail greenery and lighting conditions for arousal (β = 0.360, SE= 0.172, t=2.097, $p<0.05$). Under the non-greenery condition, cool lighting creates higher arousal (M_{cool} =3.473 vs. M_{warm} = 3.113, $p<0.05$) than warm lighting. However, there are no significant differences between cool and warm lighting on arousal under the retail greenery condition (β = 0.094, SE= 0.173, t=0.541, $p>0.05$)

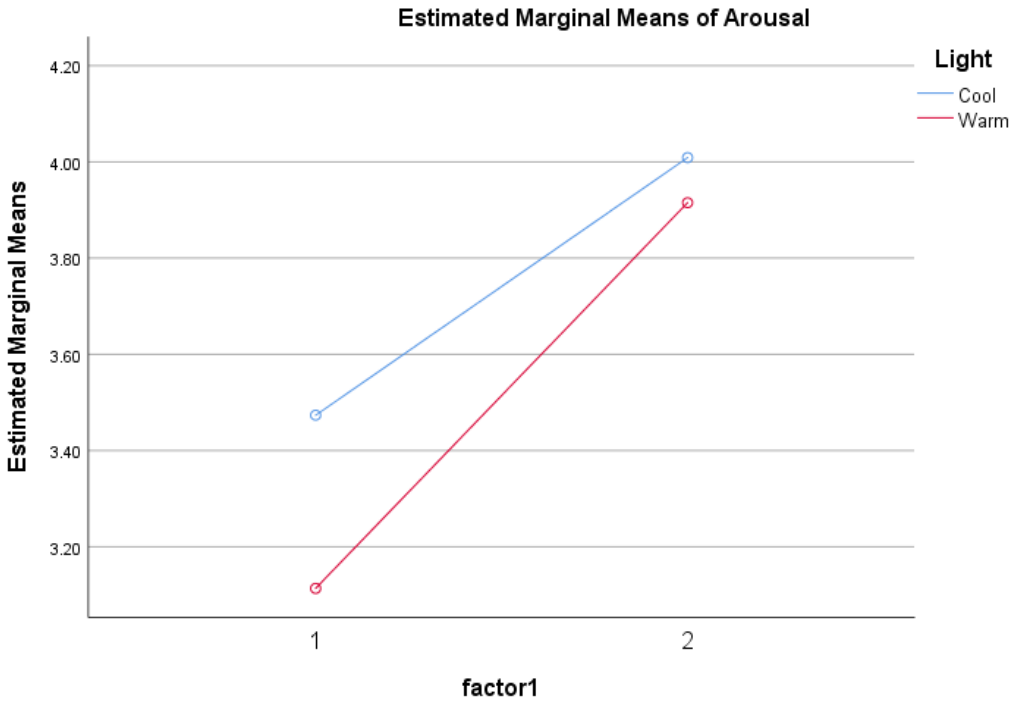


Figure Three: The interaction effects between retail greenery/non-greenery and correlated color temperature on arousal. Here, blue line indicates warm lighting and red line indicates cool lighting

Findings from the mixed-ANOVA testing demonstrated that there is significant interaction effects between retail-greenery and lighting conditions for perceived merchandise quality ($\beta = 0.459$, SE= 0.182, t=2.523, $p<0.05$). Under the retail greenery condition, cool lighting creates higher perceived merchandise quality (M_{cool} =5.55 vs. M_{warm} = 5.10, $p<0.05$) than warm lighting. However, I did not find significant difference between cool and warm lighting on perceived merchandise quality under non-retail greenery condition ($\beta = 0.088$, SE= 0.235, t=0.374, $p>0.05$).

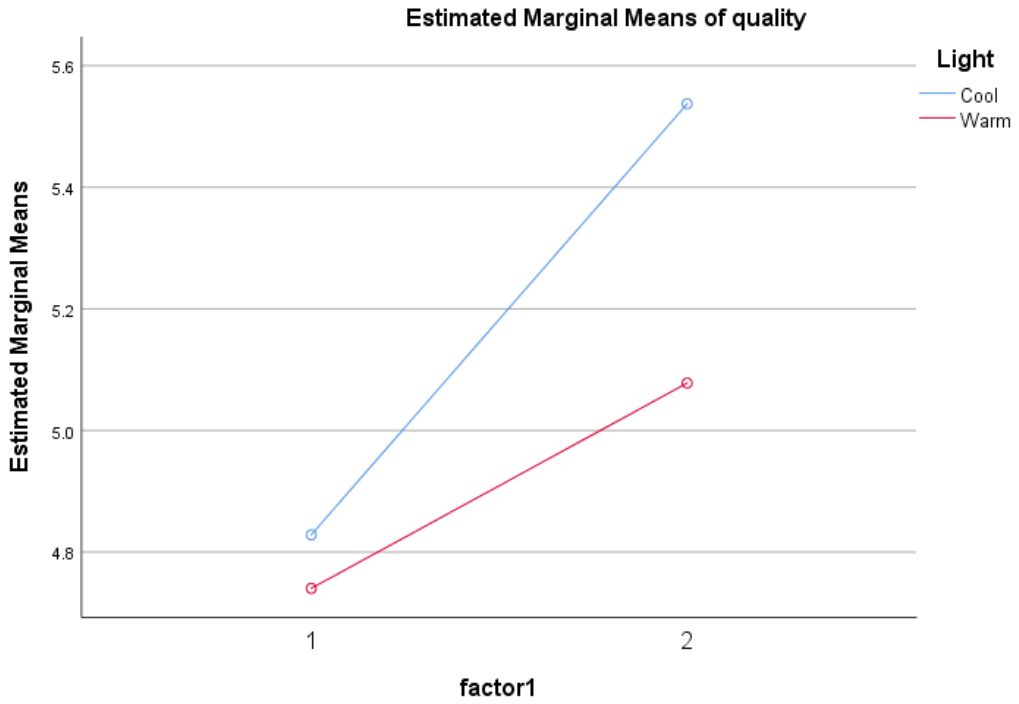


Figure Four: The interaction effects between retail greenery/non-greenery and correlated color temperature (warm/cool) on perceived merchandise quality. Here, blue line indicates warm lighting and red line indicates cool lighting

I did not find significant interaction effects between retail greenery and correlated color temperature (cool/warm) for satisfaction (β = 0.411, SE= 0.236, t=1.739, p>0.05). In addition, there are no significant differences (β = 0.220, SE= 0.250, t=0.879, p>0.05) between warm and cool lighting on satisfaction under the non-retail greenery condition.

I also did not find significant interaction effects between retail greenery and correlated color temperature (cool/warm) for purchase intention (β = 0.352, SE= 0.246, t=1.432, p>0.05). In addition, there are no significant differences (β =-0.019, SE= 0.247, t=-0.077, p>0.05) between warm and cool lighting on purchase intention under the non-retail greenery condition.

Table Seventeen

The interaction effects between Retail Greenery and Correlated color temperature (warm/cool)

Interaction terms	DV	β	SE	t	*p*
Retail Greenery X Cool/ Warm Lighting	Pleasure	0.468	0.202	2.324	$p<0.05^{***}$
	Arousal	0.094	0.173,	0.541	$p>0.05$
	Perceived Quality	0.459	0.182	2.523	$p<0.05^{***}$
	Satisfaction	0.411	0.236	1.739	$p>0.05$
	Purchase Intention	0.352	0.246	1.432	$p>0.05$

Table Eighteen

The interaction effects between Non-Retail Greenery and Correlated color temperature (warm/cool)

Interaction terms	DV	β	SE	t	*p*
Non-Retail Greenery X Cool/ Warm Lighting	Pleasure	0.071	0.234	0.305	$p>0.05$
	Arousal	0.360	0.172	2.097	$p<0.05^{***}$
	Perceived Quality	0.088	0.235,	0.374	$p>0.05$
	Satisfaction	0.220	0.250	0.879	$p>0.05$
	Purchase Intention	-0.019	0.247	-0.077	$p>0.05$

The measurement of utilitarian and hedonic shopping orientation

I have first taken the mean value for the shopping orientation scale. Shopping orientation scale includes both utilitarian and hedonic shopping orientation items. For example, one item is “Shopping is truly a joy”, which is related to hedonic shopping orientation. However, another item, “I shop for clothes where it saves me time”, is associated with utilitarian shopping orientation. Therefore, if a participant rates it as 1, I have converted it to 7 to measure hedonic shopping orientation. Similarly, if a participant

rates the question 2, I have converted it to 6. Following this procedure, the mean value for the shopping orientation scale is 5.2. Then, I have split the mean value, that below 5.2 is considered as utilitarian shopping orientation and 5.2 or more than 5.2 is considered as hedonic shopping orientation.

Hypothesis 4: The Moderating Effects of Utilitarian and Hedonic Shopping orientation

I have conducted mixed ANOVA analysis to identify the moderating effects of utilitarian and hedonic shopping values. Here, retail greenery/non-retail greenery and shopping values (utilitarian/hedonic) are defined as explanatory variables and pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intentions are response variables. As noted by Baron and Kenny (1986), moderation effects could be expected if there are significant interaction effects between these two explanatory variables (retail greenery/non-retail greenery and shopping values). Retail greenery/non-retail greenery are within-subjects design, while shopping values are between-subjects design.

Hypothesis 4 were partially supported. After conducting the mixed ANOVA analysis, I have found the significant interaction effects between the non-retail greenery condition and shopping values (utilitarian/hedonic) ($\beta = 0.766$, SE= 0.325, t=2.355, $p<0.05$) for pleasure. Under the non-retail greenery condition, utilitarian shopping value creates higher pleasure ($M_{utilitarian} = 4.10$ vs. $M_{hedonic} = 3.57$, $p<0.05$) than hedonic shopping value. Shopping values (utilitarian/hedonic) moderate the relationship between the non-retail greenery condition and pleasure. There are no significant differences between utilitarian and hedonic shopping values ($\beta = -0.004$, SE= 0.416, t=-1.479, $p>0.05$) on pleasure under the retail greenery condition. Both utilitarian ($M_{retail\ greenery}$=

4.80 vs. $M_{non\text{-}retail\ greenery}$ = 4.10, p<0.05) and hedonic shopping values ($M_{retail\ greenery}$= 4.80 vs. $M_{non\text{-}retail\ greenery}$ = 3.75, p<0.05) create higher pleasure under the retail greenery condition than the non-retail greenery condition.

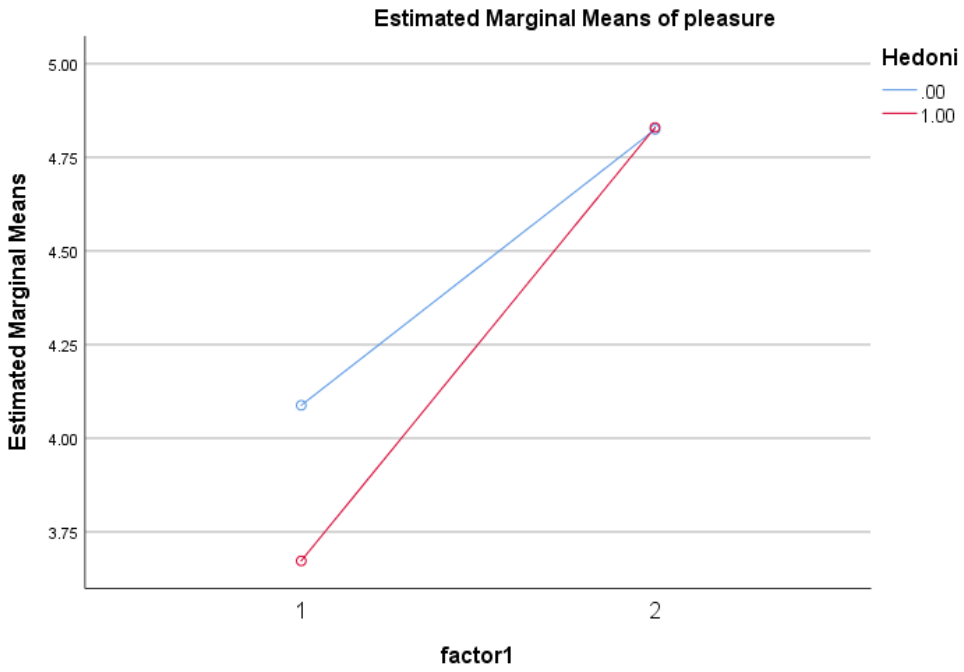


Figure Five: The interaction effects between retail greenery/non-greenery and shopping orientations (utilitarian/hedonic) for pleasure. Here, blue line indicates utilitarian shopping values and red line indicates hedonic shopping value

From the Mixed ANOVA testing, I have also found the significant interaction effects between the non-retail greenery condition and shopping values (utilitarian/hedonic) (β = 0.806, SE= 0.234, t=3.452, p<0.05) for arousal. Under the non-retail greenery condition, utilitarian shopping value creates higher arousal ($M_{utilitarian}$ = 3.55 vs. $M_{hedonic}$ = 3.10, p<0.05) than hedonic shopping value. Shopping values (utilitarian/hedonic) moderate the relationship between the non-retail greenery condition

and arousal. There are no significant differences between utilitarian and hedonic shopping values (β = 0.153, SE= 0.245, t=0.624, p>0.05) on arousal under the retail greenery condition. However, I did not find significant differences between utilitarian and hedonic shopping values on arousal under both retail greenery and non-retail greenery conditions (F=1.849, p>0.05)

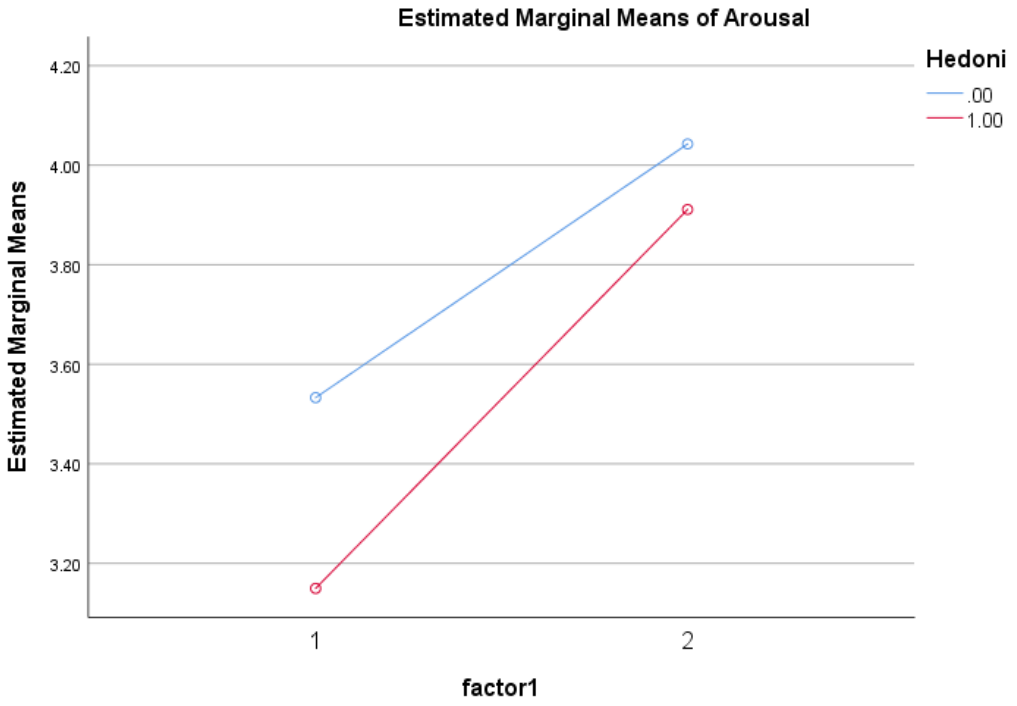


Figure Six: The interaction effects between retail greenery/non-greenery and shopping orientations (utilitarian/hedonic) for arousal. Here, blue line indicates utilitarian shopping values and red line indicates hedonic shopping value

However, I did not find significant interaction effects between non-retail greenery and shopping values for perceived merchandise quality (β = -0.311, SE= 0.485, t=-0.651, p>0.05). Also, there are no significant interaction effects between retail greenery and shopping values for perceived merchandise quality (β = -0.263, SE= 0.257, t=-1.025, p>0.05). In addition, I did not find significant differences between utilitarian and hedonic

shopping values on perceived merchandise quality under both retail greenery and non-retail greenery conditions (F=1.790, p>0.05).

Based on the Mixed ANOVA testing, I have also found the significant interaction effects between the non-retail greenery condition and shopping values (utilitarian/hedonic) (β = 0.711, SE= 0.348, t=2.045, p<0.05) for satisfaction. Under the non-retail greenery condition, utilitarian shopping value creates higher satisfaction ($M_{utilitarian}$ = 3.80 vs. $M_{hedonic}$ = 3.25, p<0.05) than hedonic shopping value. Shopping values (utilitarian/hedonic) moderate the relationship between the non-retail greenery condition and satisfaction. There are no significant differences between utilitarian and hedonic shopping values (β = 0.732, SE= 0.483, t=1.515, p>0.05) on satisfaction under the retail greenery condition. However, I did not find significant differences between utilitarian and hedonic shopping values on satisfaction under both retail greenery and non-retail greenery conditions (F=3.128, p>0.05)

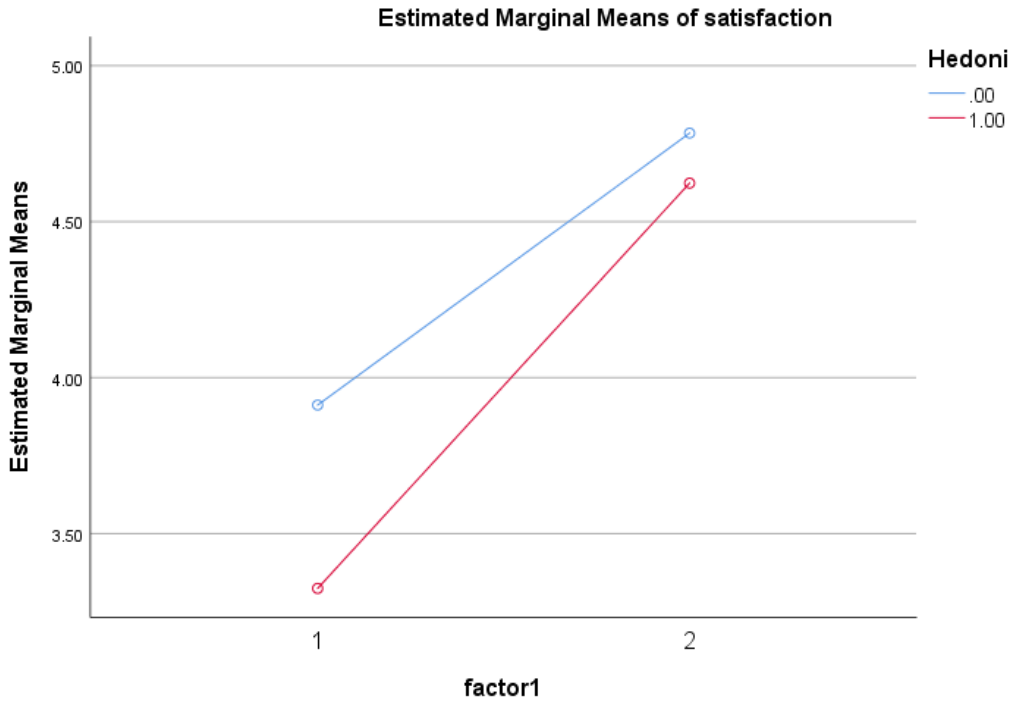


Figure Seven: The interaction effects between retail greenery/non-greenery and shopping orientations (utilitarian/hedonic) for satisfaction. Here, blue line indicates utilitarian shopping values and red line indicates hedonic shopping value

Based on the Mixed ANOVA testing, I have analyzed the significant interaction effects between the non-retail greenery condition and shopping values (utilitarian/hedonic) ($\beta = 0.764$, SE= 0.346, t=2.135, $p<0.05$) for purchase intention. Under the non-retail greenery condition, utilitarian shopping value creates higher purchase intention ($M_{utilitarian} = 3.80$ vs. $M_{hedonic} = 3.25$, $p<0.05$) than hedonic shopping value. Shopping values (utilitarian/hedonic) moderate the relationship between the non-retail greenery condition and purchase intention. There are no significant differences between utilitarian and hedonic shopping values ($\beta =0.732$, SE= 0.483, t=1.515, $p>0.05$) on purchase intention under the retail greenery condition. However, I did not find significant differences between utilitarian and hedonic shopping values on purchase intention under both retail greenery and non-retail greenery conditions ($F=3.128$, $p>0.05$).

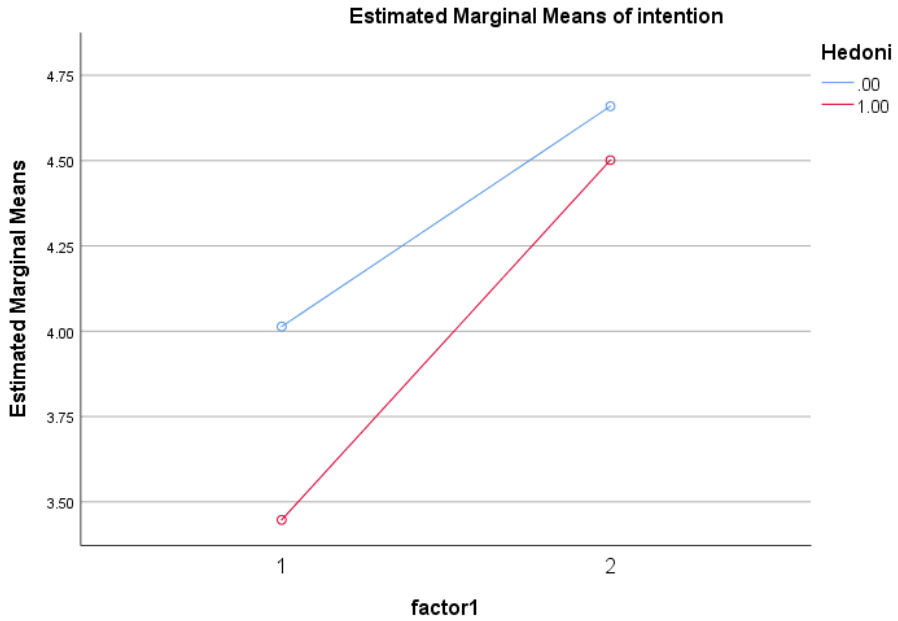


Figure Eight: The interaction effects between retail greenery/non-greenery and shopping orientations (utilitarian/hedonic) for Purchase Intention. Here, blue line indicates utilitarian shopping values and red line indicates hedonic shopping value

Table Nineteen

The interaction effects between Retail Greenery and Shopping values (utilitarian/hedonic)

Interaction terms	DV	β	SE	t	*p*
Retail Greenery X Shopping values	Pleasure	-0.004	0.416	-1.479	$p>0.05$
	Arousal	0.153	0.245	0.624	$p>0.05$
	Perceived Merchandise Quality	-0.263	0.257	-1.025	$p>0.05$
	Satisfaction	0.732	0.483	1.515	$p>0.05$
	Purchase Intention	-0.035	0.347	-0.099	p>0.05

Table Twenty

The interaction effects between Non-Retail Greenery and Shopping values (utilitarian/hedonic)

Interaction terms	DV	β	SE	t	*p*
Non-Retail Greenery X Shopping values	Pleasure	0.766	0.325	0.355	$p<0.05^{***}$
	Arousal	0.806	0.234	3.452	$p<0.05^{***}$
	Perceived Merchandise Quality	-0.311	0.485	-0.651	$p>0.05$
	Satisfaction	0.711	0.348	2.045	$p<0.05^{***}$
	Purchase Intention	0.723	0.344	2.105	$p<0.05^{***}$

In addition, I did not find significant interaction effects between shopping values and correlated color temperature for pleasure (F=0.794, p>0.05), arousal (F=2.263, p>0.05), satisfaction (F=0.316, p>0.05), purchase intentions (F=0.007, p>0.05), and perceived merchandise quality (F=0.761, p>0.05). Thus, shopping values (utilitarian/hedonic) do not moderate the relationships between correlated color

temperature and dependent variables including pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intentions.

Table Twenty-One

The interaction effects between correlated color temperature (warm/cool) and Shopping values (utilitarian/hedonic)

Interaction terms	DV	*F*	*p*
Lighting temperature X Shopping values	Pleasure	0.794	*p*>0.05
	Arousal	2.263	*p*>0.05
	Perceived Merchandise Quality	0.761	*p*>0.05
	Satisfaction	0.316	*p*>0.05
	Purchase Intention	0.007	*p*>0.05

The three-way interaction effects among retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic)

I have also analyzed the three-way interaction effects among retail greenery, correlated color temperature (warm/cool) and shopping values (utilitarian/hedonic) for pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intentions. For pleasure, I did not find significant interaction effects among non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β = -0.700, SE= 0.474, t=-1.479, *p*>0.05); I also did not find significant interaction effects among retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β =-0.004, SE= 0.416, t=-0.010, *p*>0.05). There are no significant three-way interaction effects among retail greenery/non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) on pleasure (*F*=2.856, *p*>0.05).

For arousal, I have found significant interaction effects among non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β = -0.846, SE= 0.340, t=-2.487, p<0.05). The results showed that for hedonic shopping values, cool lighting creates higher arousal (M_{cool} = 3.5 vs M_{warm} =2.8, p<0.05) than warm lighting under the non-retail greenery condition. I did not find significant interaction effects among retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β =-0.042, SE= 0.357, t=-0.118, p>0.05). There are significantly three-way interaction effects among retail greenery/non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) on arousal (F=4.721, p<0.05). For utilitarian shopping value, both cool ($M_{nongreenery}$ =3.6 vs. $M_{greenery}$ =4.00, p<0.05) and warm lighting ($M_{nongreenery}$ =3.25 vs. $M_{greenery}$ =4.06, p<0.05) create higher arousal under the retail greenery condition than the non-retail greenery condition. Similar results have found for hedonic shopping value. For hedonic shopping values, both cool $M_{nongreenery}$ =3.5 vs. $M_{greenery}$ =4.00, p<0.05 and warm lighting ($M_{nongreenery}$ =2.8 vs. $M_{greenery}$ =3.8, p<0.05) also create higher arousal under the retail greenery condition than the non-retail greenery condition

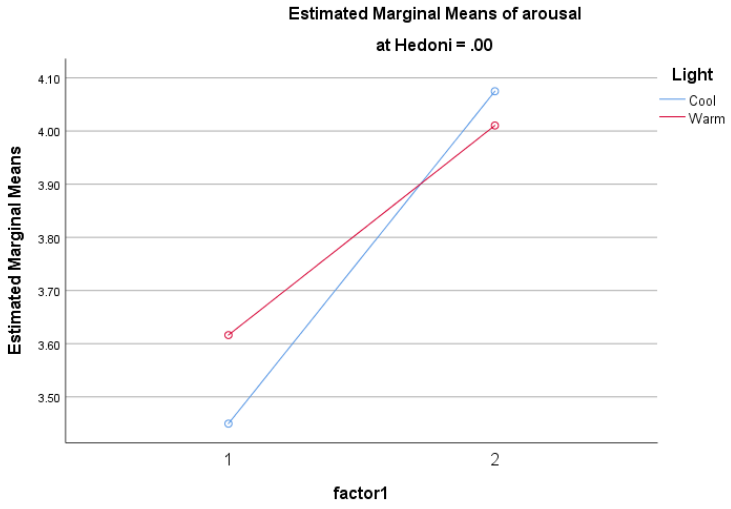


Figure Nine: The interaction effects among retail greenery, correlated color temperature, and shopping values. Here, blue line indicates cool lighting and red line indicates warm lighting

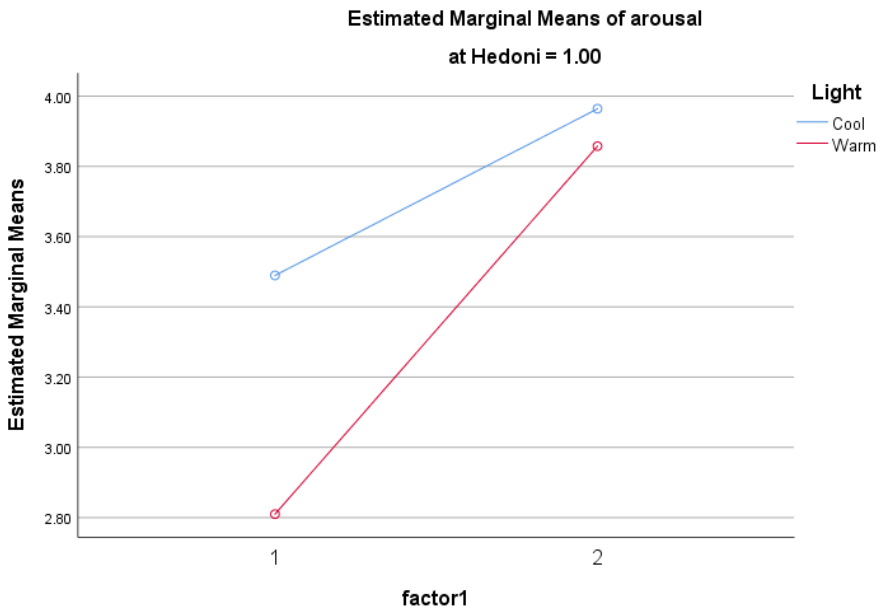


Figure Ten: The interaction effects among retail greenery, correlated color temperature, and shopping values. Here, blue line indicates cool lighting and red line indicates warm lighting

For perceived merchandise quality, I did not find significant interaction effects among non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β = -0.311, SE= 0.485, t=-0.641, p>0.05). I also did not find significant interaction effects among retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β =0.077, SE= 0.374, t=-0.205, p>0.05). There are no significant three-way interaction effects among retail greenery/non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) on pleasure (F=0.960, p>0.05).

For satisfaction, I have not found significant interaction effects among non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β = -0.247, SE= 0.506, t=-0.488, $p>0.05$). Also, I did not find significant interaction effects among retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β =0.732, SE= 0.483, t=1.515, $p>0.05$). There are significantly three-way interaction effects among retail greenery/non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) on satisfaction ($F=4.105$, $p<0.05$). For utilitarian shopping value, both cool ($M_{nongreenery}$ =3.9 vs. $M_{greenery}$ =4.40, $p<0.05$) and warm lighting ($M_{nongreenery}$ =3.8 vs. $M_{greenery}$ =5.20, $p<0.05$) create higher satisfaction under the retail greenery condition than the non-retail greenery condition. Similar results have found for hedonic shopping value. For hedonic shopping values, both cool $M_{nongreenery}$ =3.25 vs. $M_{greenery}$ =4.50, $p<0.05$ and warm lighting ($M_{nongreenery}$ =3.5 vs. $M_{greenery}$ =4.5, $p<0.05$) also create higher satisfaction under the retail greenery condition than the non-retail greenery condition.

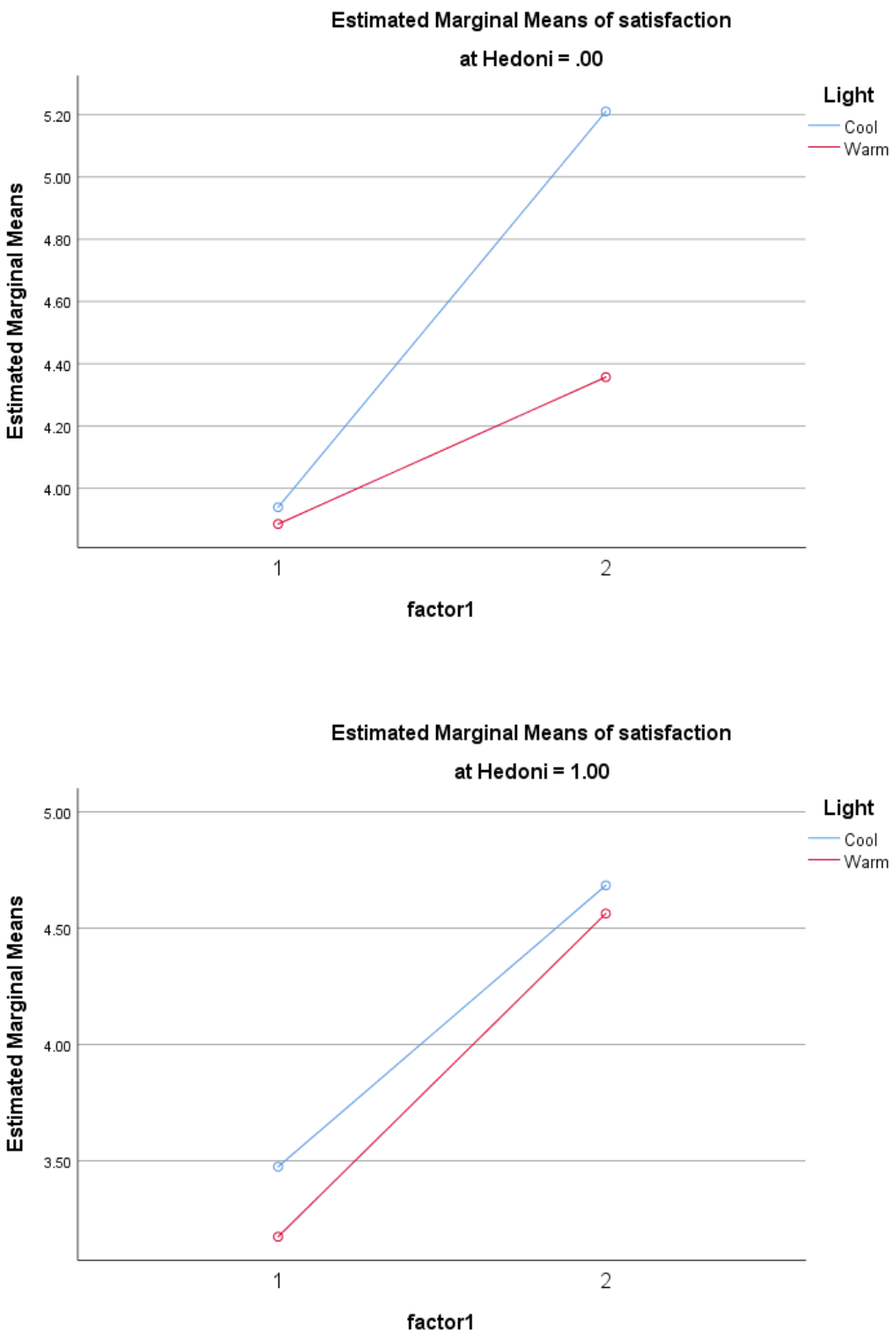


Figure Eleven: The three-way interaction effects for satisfaction

For purchase intention, I did not find significant interaction effects among non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β = -0.314, SE= 0.501, t=-0.627, p>0.05). I also did not find significant interaction effects among retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) (β =0.385, SE= 0.506, t=0.761, p>0.05). There are no significant three-way interaction effects among retail greenery/non-retail greenery, correlated color temperature (warm/cool), and shopping values (utilitarian/hedonic) on purchase intention (F=1.976, p>0.05).

Table Twenty-Three

The three-way interaction effects between Non-Retail Greenery, Correlated color temperature, and Shopping values (utilitarian/hedonic)

Interaction terms	DV	β	SE	t	*p*
	Pleasure	-0.004	0.416	-1.479	p>0.05
Retail	Arousal	0.153	0.245	0.624	p>0.05
Greenery X	Perceived Merchandise	-0.263	0.257	-1.025	p>0.05
Shopping values	Quality				
X Lighting	Satisfaction	-0.247	0.483	1.515	p>0.05
	Purchase Intention	0.385	0.506	0.761	p>0.05

Table Twenty-Four

The interaction effects among Non-Retail Greenery, Correlated color temperature (warm/cool), and Shopping values (utilitarian/hedonic)

Interaction terms	DV	β	SE	t	*p*
	Pleasure	0.766	0.325	0.355	p>0.05
Non-Retail	Arousal	0.806	0.234	3.452	p<0.05***
Greenery X	Perceived Merchandise	-0.311	0.485	-0.651	p>0.05
Shopping values	Quality				
X Lighting	Satisfaction	0.711	0.348	2.045	p>0.05

Purchase Intention	-0.314	0.501	-0.627	$p>0.05$

Summaries of findings are provided here:

a. Mixed-model ANOVA testing showed that retail greenery creates higher pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intention than non-retail greenery application
b. Cool lighting creates higher arousal than warm lighting. However, there are no significant differences between warm and cool lighting on pleasure, perceived merchandise quality, satisfaction, and purchase intentions.
c. Under the retail greenery condition, cool lighting creates higher pleasure and perceived merchandise quality than warm lighting. However, I did not find significant differences for arousal, satisfaction, and purchase intentions.
d. Under the non-retail greenery condition, cool lighting creates higher arousal than warm lighting. I did not find significant differences for pleasure, perceived merchandise quality, satisfaction, and purchase intentions.
e. Both cool and warm lighting create higher pleasure under the retail greenery condition than the non-retail greenery condition
f. Shopping values (utilitarian/hedonic) do not moderate the relationships between retail greenery and pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intentions.
g. Under the non-retail greenery condition, utilitarian shopping value creates higher pleasure, arousal, satisfaction, and purchase intentions than hedonic shopping value

h. There are no interaction effects between correlated color temperature and shopping values

i. For both utilitarian and hedonic shopping values, both cool and warm lighting create higher satisfaction and arousal under the retail greenery condition than the non-greenery condition

j. For hedonic shopping values, cool lighting creates higher arousal than warm lighting under the non-retail greenery condition

k. The three-way interaction effects among non-retail greenery condition, correlated color temperature, and shopping values (utilitarian/hedonic) are not significant for pleasure, arousal, perceived merchandise quality, satisfaction and purchase intention.

l. The three-way interaction effects among retail greenery condition, correlated color temperature, and shopping values (utilitarian/hedonic) are not significant for pleasure, perceived merchandise quality, satisfaction and purchase intention.

CHAPTER FIVE

DISCUSSIONS AND CONCLUSIONS

My study contributes to 3D virtual reality shopping by comparing two important atmospheric factors including retail greenery (vs. non-retail greenery) and correlated color temperature (warm/cool lighting). My study process can be summarized as: 1) I used S-O-R framework to guide all research hypotheses related to retail greenery, correlated color temperature, and shopping orientation; 2) I created stimuli by comparing retail greenery and non-retail greenery applications and cool lighting and warm lighting; 3) I conducted mixed ANOVA design to compare the main and interaction effects of retail greenery and correlated color temperature; 4) lastly, I measured the moderating effects of utilitarian and hedonic shopping orientations.

5.1. Findings related to S-O-R framework

Results from my study partially supported the Stimulus-Organism-Response (Mehrabrian and Russell, 1974) framework. For example, there were significant differences between retail greenery and non-retail greenery applications on pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intentions. My findings aligned with previous studies including Rosenbaum et al. (2016, 2018, 2019), Joye et al. (2010), Berman et al. (2012), Brengman et al. (2012), Pretty et al. (2005), Lichtenfield et al. (2012), and Benfield et al. (2014). In addition, I found significant impacts of correlated color temperature (warm vs cool) on consumers' arousal states, which supports the findings of Park and Farr (2007), Mouhoubi (2014), and Lin and Yoon (2015).

However, I did not find significant effects of correlated color temperature (warm vs cool) on pleasure, perceived merchandise quality, satisfaction and purchase intentions. These findings supported some previous studies and contradicted others. For example, Lin and Yoon (2015) did not find significant differences between cool and warm lighting on pleasure. On the other hand, Park and Found (2007) found that 3000K warm lighting creates higher pleasure than 5000K warm lighting. One explanation for the discrepancy of lighting research is that correlated color temperature might rely on different types of important factors including interfaces, demographics, cultural and other environmental contexts, and the interaction with other independent variables.

Another major finding of this study was the significant interaction effects between correlated color temperature (warm and cool) and retail greenery (vs non-retail greenery) applications. These findings added to the prior studies that found interaction effects of correlated color temperature (warm/cool) with other variables including brightness of light (Kang et al., 2019), lighting types (Lin and Yoon, 2015), colors and décor (Wardono et al., 2012), illuminance and daytime (Zhu et al., 2019), brightness and retail outlet (Briand and Pras, 2010), and color and items price (Babin et al., 2003).

Lastly, findings from my study further confirmed the moderating effects of utilitarian/hedonic shopping orientations. A synopsis of previous research suggested that utilitarian and hedonic shopping orientations moderate the relation between satisfaction and Word of Mouth (Jones et al., 2006), perceived control and pleasure/stress (Lunardo and Mbengue, 2009), biophilic stimuli and outcomes such as pleasure and arousal (Purani and Kumar, 2018), and satisfaction, and behavioral intentions (Luk et al., 2013).

These results supported that retail greenery in biophilic design and correlated color temperature as well as their interactions influence consumers' cognitive and affective states and their behavioral outcomes. Based on the S-O-R framework, retail greenery in biophilic design and correlated color temperature (warm/cool) could be used in virtual shopping environments. In addition, retail greenery as an environmental stimulus attribute might play a vital role in virtual environments. The results supporting the moderating effects of utilitarian and hedonic shoppers indicated that retailers could focus on both utilitarian and hedonic shoppers by manipulating retail greenery applications and correlated color temperatures in the virtual shopping environment.

5.2. The main effects of retail greenery in the VR environment

Retail greenery has many potential design applications. For example, the Rosenbaum et al. (2019) study used biophilic attributes to create a lifestyle shopping center. In a lifestyle shopping center, manicured gardens, plants, green spaces, fountains, and walkways are combined with trendy retail (Buchta, 2019). However, my study used simple stimuli to understand consumers' perceptions and responses in the VR environment. In our stimuli, I used only retail greenery, correlated color temperature, a small amount of apparel products, and some accessories. It will be interesting to investigate the impacts of biophilic design in large superstores such as Target, Walmart, and Fresh Thyme. Lastly, retailers can combine various attributes of biophilic design to understand their overall effects on consumers' responses.

The results of the current study found that under retail greenery applications consumers have higher pleasure, arousal, perceived merchandise quality, satisfaction, and

purchase intention than in non-retail greenery applications. These findings support the Attention Restoration Theory (Kaplan, 1995) and the Stress Recovery Theory (Ulrich et al., 1991). Virtual fashion apparel stores include so many intriguing stimuli, which can create information overload and stress. The inclusion of retail greenery applications has the potential to reduce consumers' overall stress and create enhanced relaxation. In addition, retail greenery applications connect consumers with nature in the virtual reality environment. The inclusion of retail greenery also provides consumers with a healthy shopping environment. The Berman et al. (2012) study demonstrated that walking in natural areas has a higher positive affect on consumers than walking in urban areas. One of the possible explanations is consumers feel energetic if they can connect with nature during their shopping in both physical and VR stores. In sum, the implementation of retail greenery in the biophilic design may provide consumers with lifestyle shopping experiences based on the Rosenbaum et al. (2019) study, and the combination of different attributes of biophilic design could further provide interesting and positive findings for retailers.

Shopping is often considered a tiring activity (Brengman et al., 2012); However, integrating vegetation and biophilic attributes could facilitate consumers engaging in smooth, and seamless shopping experiences and thereby improving their overall satisfaction and behavioral intentions. For example, Brengman et al. (2012) noted that biophilic design in the retail environment provides higher relaxation in the complex environment than in the lean environment. In addition, Joye et al. (2010) stated that consumers want to stay more in the greenery environment because of its restoration potential. However, the amount of greenery application is highly important because high

amounts of greenery application might create blockage. Only presenting biophilic elements are not enough to affect consumers' responses. As noted by Ojuri et al. (2021), retail stores with low biophilic design create higher purchase intention than retail stores with high biophilic design. Consumers' positive responses and behavioral outcomes depend on three attributes of biophilic design: biophilic forms and patterns, order and complexity, and material connection with nature. Future studies could compare high/low biophilic design and correlated color temperature (cool/warm lighting).

5.3. The main effects of correlated color temperature

Results from my study suggest that cool lighting creates higher arousal than warm lighting. The Lin and Yoon (2015) study compared the main impacts of correlated color temperature in a 3D virtual environment and found similar results. Our findings provided validation that retailers might use cool lighting along with retail greenery applications to provide an exciting VR shopping environment. Cool lighting increases visual clarity and is brighter than warm lighting (Park and Farr, 2007). My findings regarding arousal consistently support the results of previous studies.

Beyond arousal, however, this study did not find any difference in the effects of correlated color temperature (warm/cool) on pleasure, perceived merchandise quality, satisfaction, and purchase intention, which is contrary to findings from previous studies (Yang, 2015; Mouhoubi, 2014; Park and Farr, 2007). One of the important reasons for contradictory findings may be the interface. For example, consumers can walk in physical stores so that they can better interact with the environment and lighting. In our study, However, consumers interact with a VR environment and only can see panoramic views

of VR fashion apparel stores instead of being fully immersed in it. Because of the limits of panoramic views, consumers might not perceive significant differences between cool and warm lighting on pleasure, perceived merchandise quality, satisfaction, and purchase intentions. Future studies can build on this study by replicating the real VR environment, using a high immersive headset, which allows for more interaction with the environment and provides a real representation of the physical environment as opposed to simply a panoramic view.

Based on findings for correlated color temperature, it is apparent that cool lighting may cognitively fit with retail greenery application as cool lighting creates higher arousal than warm lighting. Incorporating cool lighting along with retail greenery applications might be an excellent way to reduce stress as cool lighting heightens attention, visual clarity, and excitement. However, Tantantenwin and Inkarorit (2016) noted that consumers have positive perceptions for warm white tones compared to cool white tones. In our study, I did not find significant differences between cool and warm lighting on pleasure, perceived merchandise quality, satisfaction and purchase intentions except arousal. Interestingly, studies show that culture creates significant associations around lighting (Park and Farr, 2007). For example, American participants prefer 3000K warm lighting and find it more approachable than 5000 K cool lighting, while the results are the opposite for Korean participants. Future research can investigate the moderating effects of culture on correlated color temperature (warm/cool lighting).

5.4. The interaction effects between retail greenery in biophilic design and correlated color temperature (warm and cool lighting)

Findings from my study also demonstrated the interaction effects between correlated color temperature (warm/cool) and retail greenery (vs non-retail greenery). The results showed that, under the retail greenery condition, cool lighting creates higher pleasure and perceived merchandise quality than warm lighting. Although correlated color temperature (warm/cool) did not show different effects on pleasure and perceived merchandise quality, it did interact with retail greenery to influence pleasure and merchandise quality. These findings supported the notion of fluent processing explained by Kang et al. (2019). As noted by Kang et al. (2019), if correlated color temperature conceptually fits with another environmental variable, it facilitates fluent processing. In my study, cool lighting may complement the application of retail greenery by elevating pleasure and quality, in line with the cognitive fit and fluent processing theories.

I found that there are no significant differences between warm and cool lighting under the non-retail greenery condition. Perhaps correlated color temperature does not conceptually fit with the non-retail greenery condition. However, these findings were supported by other studies such as Yang (2015), Tantanatewin and Inkarojrit (2016), and Knez and Hygge (2002). The Yang (2015) study did not find interaction effects between correlated color temperature and perceived complexity of the environment. Similarly, there were no interaction effects between correlated color temperature and colored lighting (Tantanatewin and Inkarojrit, 2016). Both warm and cool lighting created higher pleasure under retail greenery conditions than non-retail greenery conditions. Retailers

could implement both cool and warm lighting under retail greenery applications to provide consumers with pleasurable shopping experiences.

Another interesting finding of this study is that cool lighting created higher arousal than warm lighting under the non-retail greenery condition. This finding conformed to Lin and Yoon (2015), Wardono et al. (2002), Kang et al. (2019), Zhu et al. (2019), Briand and Pras (2010), Babin et al. (2003) studies. These studies also demonstrated the interaction effects between correlated color temperature with other environmental variables. My findings also showed that under the retail greenery condition, there are no significant differences between cool and warm lighting on arousal. The possible reason is that when correlated color temperature (warm/cool lighting) is combined with multisensory biophilic elements, it might show no significant effects on arousal. Finally, my study did not find any interaction effects between retail greenery and correlated color temperature for satisfaction and purchase intentions.

5.5. The moderating effects of utilitarian/hedonic shopping orientations

Furthermore, my study also demonstrated the significant moderating effects of utilitarian and hedonic shopping orientations. The results indicated that under the non-retail greenery condition, utilitarian shopping value generates higher pleasure, arousal, satisfaction, and purchase intentions than hedonic shopping orientations. My study also found that both utilitarian and hedonic shopping orientations produce higher pleasure under the retail greenery condition than the non-retail greenery condition. I did not find any significant differences between utilitarian and hedonic shopping values on pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intention under retail

greenery conditions. My findings are interesting if I compare them with the Puran and Kumar (2018) study. Puran and Kumar (2018) found that biophilic stimuli create higher pleasure than non-biophilic stimuli for only hedonic shopping values. However, my study provides evidence that both utilitarian and hedonic shopping orientations demonstrate increased pleasure for the retail greenery application. The possible reason is that both utilitarian and hedonic oriented consumers might prefer the retail greenery application as it may enhance their cognitive processing, which reduces their stress and mental efforts.

My findings related to the moderating effects of shopping orientations (utilitarian/hedonic) support previous studies: Stein and Ramaseshan (2019), Luk et al. (2013), Chang and Wang (2011), Jones et al. (2006), and Chakraborty (2019). My study found that there are no significant differences between utilitarian and hedonic shopping values on arousal, however, the results are opposite for the non-retail greenery condition. Under the non-retail greenery condition, utilitarian shopping orientation creates higher pleasure, arousal, satisfaction, and purchase intention than hedonic shopping orientation. These findings are very interesting as I know that utilitarian shopping value is goal-oriented, while hedonic shopping value is fun. My findings suggested that task-oriented shoppers may prefer the utilitarian or goal-oriented environment more than the multisensory biophilic environment. More significantly, I did not find moderating effects of shopping orientations (utilitarian/hedonic) between correlated color temperature and outcomes, including pleasure, arousal, perceived merchandise quality, satisfaction, and purchase intentions. My findings did not support the findings of the Manen (2018) study. Manen (2018) showed that the retail environment is more attractive for fun shoppers under the cool lighting condition than the warm lighting condition. In addition, the results

are opposite for goal-oriented shoppers; goal-oriented shoppers prefer warm over cool lighting.

Furthermore, I also measured the three-way interaction effects among retail greenery, correlated color temperature, and utilitarian/hedonic shopping values. I found that there are significant three-way interaction effects among retail greenery, correlated color temperature, and shopping values (utilitarian/hedonic) for satisfaction. For both utilitarian and hedonic shopping values, both cool and warm lighting create higher satisfaction under the retail greenery application than the non-retail greenery application. This suggests that the use of both warm lighting and retail greenery or cool lighting and retail greenery may enhance consumers' overall satisfaction. I found similar results for arousal. In addition, our findings revealed that for hedonic shopping values, cool lighting creates higher arousal than warm lighting under the non-retail greenery condition. Generally, cool lighting is brighter and more arousing than warm lighting and hedonic shoppers explore more than utilitarian shoppers. For that reason, perhaps hedonic shoppers feel more excitement under cool lighting conditions.

5.6. Limitations and directions for future research

This study has its limitations. For example, participants did not have the opportunity to explore in an immersive 3D virtual environment due to the pandemic (Covid-19) situation. They observed the 3D VR environment through panorama views on their own PCs. During the data collection process, I created immersive 3D virtual environments using Oculus Rift headset. However, because of the sudden rise of Covid 19, I had to collect data online. Therefore, I created 360 panorama views of virtual reality fashion apparel stores, which provided consumers with limited interaction with the VR

environment. My findings might have been different if I had conducted the experimental study in immersive 3D virtual environments.

Another limitation of this study is that I recruited participants from two sources: classroom and M-Turk providing them different incentives. For example, participants recruited from classroom received three extra credits for their courses. On the other hand, participants recruited through M-Turk got 1 USD for their participation. In addition, I did not control perceived complexity of the environment for both retail greenery and non-retail greenery VR environments. For example, the results showed that the retail greenery application creates higher perceived complexity ($M_{\text{retail greenery}} = 3.367$ vs. $M_{\text{non-greenery}} = 3.101$, $p<0.05$) than the non-retail greenery application. It indicates that perceived complexity of the environment also interacts with correlated color temperature and shopping values (utilitarian and hedonic). It is a real challenge for designers to make both retail greenery and non-retail greenery applications comparable with respect to perceived complexity.

Another important limitation of my study is that I used only two attributes including retail greenery and correlated color temperature to develop the biophilic VR environment. However, biophilic design is a comprehensive idea, which includes approximately seventy identified attributes. It is important to conduct experimental studies using other attributes of biophilic design. In addition, future research could conduct qualitative studies to design a biophilic VR environment. UX design is another good approach to create biophilic VR fashion apparel stores. For example, I could conduct user interviews, develop wireframes, and create prototypes based on usability testing. This UX design process might help to create the biophilic environment

based on users' responses. Also, it is important to note that consumers did not get direct experiences with retail greenery applications because they cannot have a physical contact with retail greenery applications. As noted by Kellert et al. (2008), retail greenery provides consumers with direct experiences of nature. Future research can conduct the study in real fashion apparel stores so that I might potentially realize the significance and benefits of biophilic design in physical spaces.

Moreover, I only investigated the moderating role of utilitarian and hedonic shopping values. Future studies could investigate the moderating role of some other important variables such as gender, age, fashion involvement (high or low), and need for cognition (high or low). Also, future research could analyze the effects of retail greenery and correlated color temperature on other interesting variables including multidimensional flow, emotional brand experience, consumer engagement, enjoyment, and loyalty intention. More significantly, future studies could investigate the interactive effects between retail greenery/non-retail greenery and colors (neutral/warm/cool) of apparel items. Since I found the interaction effects between retail greenery and correlated color temperature, learning more about interactive effects of other atmospherics factors could play a vital role in developing virtual reality fashion stores. Future studies could further explore the interactive effects between retail greenery and other environmental variables including brightness (high vs low) of light, lighting intensity, colored light, perceived complexity of the environment, and décor.

Similarly, researcher can conduct an experimental design study to understand the interaction effects between product type and environmental congruence. For example, biophilic design symbolizes a sustainable and compatible environment. It is important to

understand whether product type (organic vs non-organic) and environmental congruence (biophilic vs non-biophilic) interact with each other and affect consumers' attitudes and behaviors. Environmental congruence refers to the similarity between design cues of the environment and design cues of the product (Naderi et al., 2020). If I use organic items in the biophilic environment, it could create environmental congruence, while the combination of the biophilic environment and inorganic might create environmental incongruence. Mazar and Zhong (2010) created green stores by using more green organic items than non-organic items. On the contrary, they used more non-organic items than organic items to develop conventional stores. It would be interesting to see whether the biophilic environment could enhance consumers' green purchasing behaviors compared with non-biophilic environment.

5.7. Implications

The implementation of retail greenery in biophilic design improves consumers' satisfaction and behavioral intentions as well as their cognitive and affective states. The biophilic design VR environment provides consumers with sustainable engagement with nature, enhanced sense of relationship, and integrated architectural patterns (Kellert, 2008). In addition, this sustainable design practice makes the VR environment more distinctive through positive interactions between people and nature. As noted by Kellert and Calabrese (2015), the practice of biophilic design is associated with fitness, well-being, concentration, attention, wayfinding, successful navigation, and sensory variability.

The key difference between retail greenery and non-retail greenery applications is sensory variability, which provides consumers with more engaging shopping

experiences. This sensory variability created through biophilic attributes might contribute to the formation of telepresence. Nah et al. (2011) noted that telepresence is higher for 3D environments than 2D environments because 3D environments have enhanced multi-sensory elements compared to 2D environments. It is apparent that natural multisensory elements not only connect people closely with nature, these biophilic attributes or elements could affect consumers' perceived realism or sense of being present in the virtually mediated environment.

I confirmed that retail greenery VR environments create better consumer responses than non-retail greenery VR environments. Our study suggests future research opportunities to investigate the impacts of biophilic attributes on telepresence, flow, and brand equity. Researchers could explore whether retail greenery or biophilic attributes influence WOM so that the practice of biophilic attributes could be extended to social media sites. Multimedia sensory features are positively associated with Word of Mouth (WOM), which are an important concept of marketing (Ha & Im, 2016). Satisfaction also influences WOM.

Furthermore, retailers need to think about developing biophilic design to promote relaxation because shopping is often considered as a tiring activity (Brengman et al., 2012). Consumers may feel discouraged when they need to shop for a long time. However, the inclusion of biophilic design can reduce that problem through increased restoration. Kaplan's (1995) Attention Restoration Theory (ART) affirms that biophilic attributes help to restore energy and alleviate stress in a complex environment. Shopping environments are always crowded, and these environments include complex and intriguing multisensory elements. It would be extraordinary for retailers if retail greenery

elements and other biophilic attributes provide consumers with smooth and seamless shopping experiences. There is no denying the fact that retailer might create an excellent store environment if they will replace traditional shopping environments with biophilic environments to promote sustainable design.

More significantly, retail designers need to be cautious while implementing the biophilic design. Results from my study found that retail greenery applications create higher perceived complexity than non-retail greenery applications. Although retail greenery influences relaxation, it might also create a sense of cognitive overload if biophilic applications are not balanced within the VR environment. As noted by Nah et al. (2011), a significantly high number of multisensory elements have negative effects on brand equity through increased cognitive overload. Therefore, designers need to consider these important factors while installing biophilic attributes within virtually mediated environments. In addition, usability is highly important for any digital environment. Biophilic design should be implemented in such a way that will be highly usable for every consumer.

Furthermore, lighting is one of the most important factors within a shopping environment. However, prior studies consistently suggested that lighting research often demonstrated inconclusive findings. For example, Park and Farr (2007) advocated the positive impacts of warm lighting on clothing and luxury physical stores. However, our study showed that cool lighting creates a higher sense of arousal than warm lighting. Also, under the retail greenery condition, cool lighting creates a higher perceived merchandise quality than warm lighting. There is a possibility that performance of different types of lighting depends entirely on interfaces. In the case of lighting, physical

and virtual shopping environments make for two very different worlds. One of the possible explanations is that consumers look for visual clarity and a sense of ease in processing information within the virtual environment, while also preferring to engage in exploration within the physical environment. In addition, cool lighting may conceptually fit well with the retail greenery application, which enhances smooth and fluent processing of information.

VR settings are an excellent example of conducting experimental design research and popular A/B testing, as well as qualitative research. For example, in our study, I have compared differences among correlated color temperatures, retail greenery, and utilitarian/hedonic shopping orientations. Future research studies could conduct experimental research by using other biophilic attributes and visual merchandising cues.

My study also investigated the influence of social contexts/factors including utilitarian and hedonic shopping orientations in the virtually mediated environment. Under the retail greenery condition, our study did not find significant differences between utilitarian and hedonic shopping orientations. However, under the non-retail greenery condition, the utilitarian shopping orientation creates higher pleasure, arousal, satisfaction, and purchase intentions than the hedonic shopping orientation. Non-retail greenery conditions are utilitarian- / goal-directed, which, therefore, influences utilitarian shopping orientations rather than hedonic shopping orientations. On the other hand, it is amazing that both utilitarian- and hedonically oriented consumers have high preferences for retail greenery VR environments. Retailers could target both utilitarian- and hedonically oriented shoppers in regard to the retail greenery and biophilic VR environments.

Lastly, my study partially confirmed the Stimulus (S)-Organism (O)- Response (R) framework for virtual reality settings. The main and interaction effects of both retail greenery and correlated color temperature as well as the moderating effects of utilitarian/hedonic shopping orientation are evident in our study. However, it is apparent that applying other relevant theories is key to success for implementing biophilic design in the VR environment. For example, future research studies could apply theories of telepresence, flow theory, processing fluency theory, and brand equity theory to further explore the importance and feasibility of biophilic design in the VR environment. In addition, Attention Restoration Theory and Stress Recovery Theory both need to be tested to understand whether biophilic attributes contribute to the formation of relaxation and stress recovery in the virtually mediated environment. It will be interesting to investigate whether natural multisensory biophilic elements may have some negative effects on brand value or equity. Additionally, our study discusses pleasure and arousal as affective states, while contrasting perceived merchandise quality as a cognitive state. Future research studies can consider important theoretical constructs including stress and anxiety recovery, perceived health, well-being, and performance metrics in the workplace environment, and telepresence.

My study provides further research insights in the field of VR research and biophilic design. Biophilic design in the VR environment provides consumers with both engaging and immersive shopping experiences. Future studies could think about designing VR environments based on user-centered biophilic design to create an exciting and usable biophilic virtual shopping environment.

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APPENDIX

Part I

Please be remind that you will examine two different stores. In the next page you will view a virtual store and fill out the questionnaire. After filling out the questionnaire, you will view again a different virtual store and fill out the same questionnaire. This means you will compare two different stores using the same questionnaire.

Please copy the link of given following website and open the website. This website includes a 360-degree panorama view of a virtual reality store. Please explore the virtual reality store using up, down, and side buttons from your laptop or desktop. please fully explore the virtual store, take a virtual walk for at least 3 minutes

https://api2.enscape3d.com/v3/view/91dabc9d-47dc-4590-abf1-79f6afdecbcc

Keep in mind **only the apparel products are for sale.**

Imagine you are shopping for an apparel item for yourself or a female friend. Imagine this apparel product display is the first display you see upon encountering a retailer. Please note the attractiveness of the display and how this display would help you complete you're shopping.

Please read the descriptions to answer the following questions.

Retail greenery is defined as a natural attribute which is currently used in different fields. If the environment includes **plants, trees, or other greenery applications then it is considered as retail greenery.** In addition, if the color of the white light changes to **yellowish, it is called warm lighting**, while **bluish white is defined as cool lighting.**

Please indicate how much you agree or disagree with the following statement:

Item	Strongly disagree						Strongly agree
This visual product display does not include any retail greenery application	1	2	3	4	5	6	7
This visual product display includes retail greenery application	1	2	3	4	5	6	7
This visual product display uses cool lighting	1	2	3	4	5	6	7
This visual product display uses warm lighting	1	2	3	4	5	6	7

Part II

The second part of this questionnaire will ask you questions about the product display you have just viewed. Please refer to the picture of the product display if needed.

Please read the adjectives on each side of the boxes. Based on these adjectives, circle the number that indicates how you felt while viewing the product display.

For example:

Happy 1 2 3 4 5 6 7 Sad

If the product display made you feel very happy, you would circle 1. If the product display made you feel equally happy and sad, you would circle 4. If the product display made you very sad, you would circle 7.

Contended	1	2	3	4	5	6	7	Depressed
Happy	1	2	3	4	5	6	7	Unhappy
Satisfied	1	2	3	4	5	6	7	Unsatisfied
Pleased	1	2	3	4	5	6	7	Annoyed
Relaxed	1	2	3	4	5	6	7	Bored
Important	1	2	3	4	5	6	7	Insignificant
Free	1	2	3	4	5	6	7	Restricted
Hopeful	1	2	3	4	5	6	7	Despairing

Stimulated	1	2	3	4	5	6	7	Relaxed
Excited	1	2	3	4	5	6	7	Calm
Jittery	1	2	3	4	5	6	7	Dull
Aroused	1	2	3	4	5	6	7	Unaroused
Frenzied	1	2	3	4	5	6	7	Sluggish
Overcrowded	1	2	3	4	5	6	7	Uncrowded
Wide awake	1	2	3	4	5	6	7	Sleepy
Restricted	1	2	3	4	5	6	7	Free
Simple	1	2	3	4	5	6	7	Complex
Sparse	1	2	3	4	5	6	7	Dense
Patterned	1	2	3	4	5	6	7	Random

Part III

The third part of this questionnaire will ask you questions about your shopping behavior

Please indicate how much you agree or disagree with the following statements:

How satisfied are you with the visual store?	1(very dissatisfied)	2	3	4	5	6	7 (very satisfied)	
How well does the visual store match your expectations?	1 (not at all)	2	3	4	5	6	7 (completely)	
Imagine a perfect visual store. How close to this ideal is what you just vieId?	1 (not at all)	2	3	4	5	6	7	(very close)

Please indicate how much you agree or disagree with the following statements:

	Strongly disagree						**Strongly agree**
The likelihood that I would shop	1	2	3.	4.	5	6	7

in this store is high	
I would be willing to buy gifts at this store	1. 2. 3. 4. 5 6 7
I would be willing to recommend this store to our friends	1. 2. 3. 4. 5 6 7

Please indicate how much you agree or disagree with the following statements:

	Strongly disagree					**Strongly agree**
This visual store offers high quality items	1	2	3.	4.	5	6 7
The items in the visual store have high workmanship	1.	2.	3.	4.	5	6 7

Please copy the link of given following website and open the website. This website includes a 360-degree panorama view of a virtual reality store. Please explore the virtual reality store using up, down, and side buttons from your laptop or desktop. please fully explore the virtual store, take a virtual walk for at least 3 minutes
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This visual product display uses warm lighting	1	2	3	4	5	6	7

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Frenzied	1	2	3	4	5	6	7	Sluggish
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Patterned	1 2 3 4 5 6 7	Random

Part III

The third part of this questionnaire will ask you questions about your shopping behavior

Please indicate how much you agree or disagree with the following statements:

How satisfied are you with the visual store?	1(very dissatisfied) 2 3 4 5 6 7 (very satisfied)	
How well does the visual store match your expectations?	1 (not at all) 2 3 4 5 6 7 (completely)	
Imagine a perfect visual store. How close to this ideal is what you just viewed?	1 (not at all) 2 3 4 5 6 7 (very close)	

Please indicate how much you agree or disagree with the following statements:

	Strongly disagree						**Strongly agree**
The likelihood that I would shop in this store is high	1	2	3.	4.	5	6	7
I would be willing to buy gifts at this store	1.	2.	3.	4.	5	6	7
I would be willing to recommend this store to our friends	1.	2.	3.	4.	5	6	7

Please indicate how much you agree or disagree with the following statements:

	Strongly disagree						Strongly agree
This visual store offers high quality items	1	2	3.	4.	5	6	7
The items in the visual store have high workmanship	1.	2.	3.	4.	5	6	7

Part IV

This questionnaire will ask about your shopping values

	Strongly disagree						Strongly agree
I usually buy our clothes at the most convenient place	1	2	3.	4.	5	6	7
The items in the visual store have high workmanship	1.	2.	3.	4.	5	6	7
I shop for clothes where it saves me time.	1	2	3.	4.	5	6	7
I put a high value on convenience when shopping for clothes	1	2	3.	4.	5	6	7
Shopping is truly a joy	1	2	3.	4.	5	6	7
I shop, not because I	1	2	3.	4.	5	6	7

have to, but because I want to.	
Shopping truly feels like an escape	1 2 3. 4. 5 6 7
Compared to other things I can do; time spent shopping is truly enjoyable	1 2 3. 4. 5 6 7
I enjoy being immersed in exciting new products	1 2 3. 4. 5 6 7
I enjoy shopping for its own sake, not just for items I purchase	1 2 3. 4. 5 6 7
I have a good time shopping because I am able to act on the “spur-of-the-moment.”	1 2 3. 4. 5 6 7
When I shop, I feel the excitement of the hunt	1 2 3. 4. 5 6 7
While shopping, I am able to forget our problems	1 2 3. 4. 5 6 7

While shopping, I get a sense of adventure	1	2	3.	4.	5	6	7
Shopping is not a very nice time out.	1	2	3.	4.	5	6	7

Part V

This part of this questionnaire will ask for demographic information.

1. Please indicate your age: _____ years

2. Please indicate your sex: □Female □Male

3. Please indicate your family income: □ Under $20,000

□ $20,000-$39,999 □ $40,000-$59,999 □ $60,000-$79,999 □ $80,000-$99,999 □ $100,000 or more

4. Academic major: _____

5. Have you participated in this research before? □ No □ Yes

6. Are you an undergraduate student of the Department of Design, Housing and Apparel

□ No □ Yes

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List of figures

Figure Twelve

Product display based on non-retail greenery and cool lighting

Figure Thirteen

Product display based on retail greenery and cool lighting

Figure Fourteen
Product display based on non- retail greenery and warm lighting

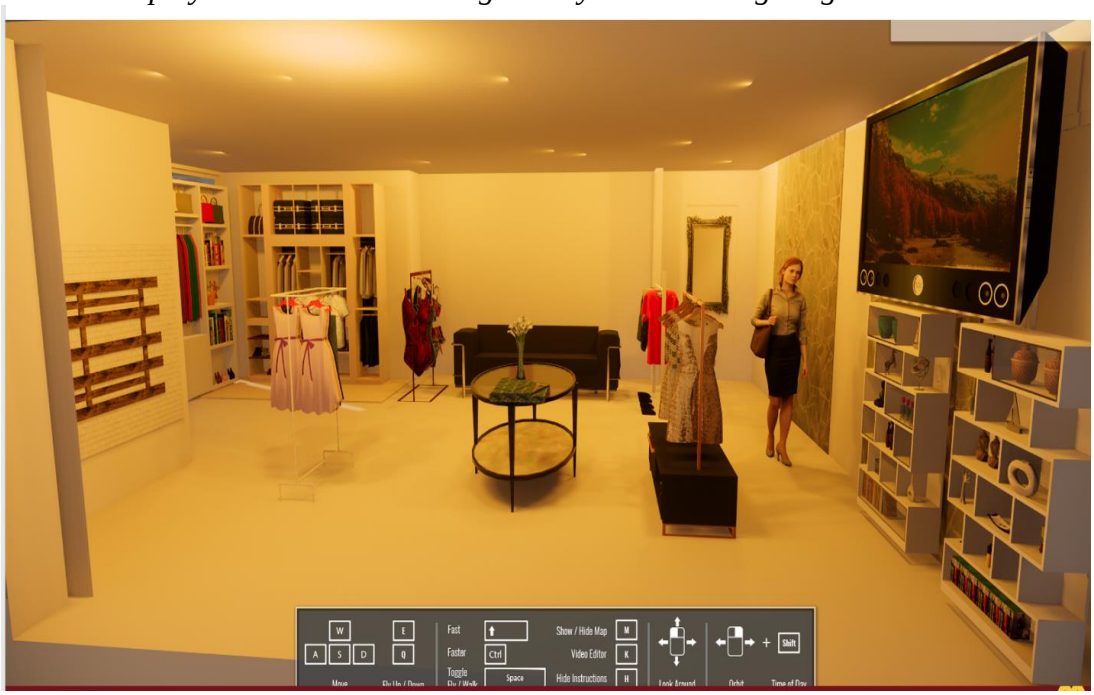

Figure Fifteen
Product display based on retail greenery and warm lighting