Interactive Lighting Design Toolkit :
Increasing Male Consumer Engagement in
Apparel Visual Merchandising

Rezvan ShahrabiFarahani
Seyed Morteza Hosseini
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Title:

Interactive Lighting Design Toolkit: Increasing Male Consumer Engagement in Apparel Visual Merchandising

Aalborg University Copenhagen

Frederikskaj 12,

DK-2450 Copenhagen SV

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Secretary:

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Participant(s): RezvanShahrabiFarahani (rshahr22@student.aau.dk)

Supervisor: Seyed Morteza Hosseini

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Abstract:

This master thesis delves into the potential of interactive lighting design in visual merchandising to enhance male consumer engagement with apparel in window displays. By integrating consumer behavior models such as AIDA (Attention, Interest, Desire, Action) and PAD (Pleasure, Arousal, Dominance), the study aims to develop a interactive lighting design toolkit tailored for retail settings. The research includes a literature review, experimental design, and data analysis to assess how varying lighting parameters—specifically Correlated Color Temperature (CCT) and illuminance—impact male consumer behavior. Conducted in a controlled light lab environment replicating a retail window display, the study involved 20 participants (10 male, 10 female) and used methods including video observation and questionnaires to evaluate engagement across different lighting scenarios. Results indicate that interactive lighting significantly influences consumer engagement, with big differences between male and female responses. Specifically, dynamic lighting scenarios were found to capture male attention and enhance their shopping experience, supporting the hypothesis that interactive lighting can increase male consumer engagement. The findings suggest practical implications for retailers, emphasizing the need for tailored lighting strategies to optimize visual merchandising efforts and drive consumer behavior. The thesis concludes with recommendations for future research, highlighting the importance of larger sample sizes, real-world settings, and the integration of additional sensory elements to further understand the impact of interactive lighting on consumer engagement.

Rezvan ShahrabiFarahani

rshahr22@student.aau.dk

Interactive Lighting Design Toolkit : Increasing Male Consumer Engagement in Apparel Visual Merchandising

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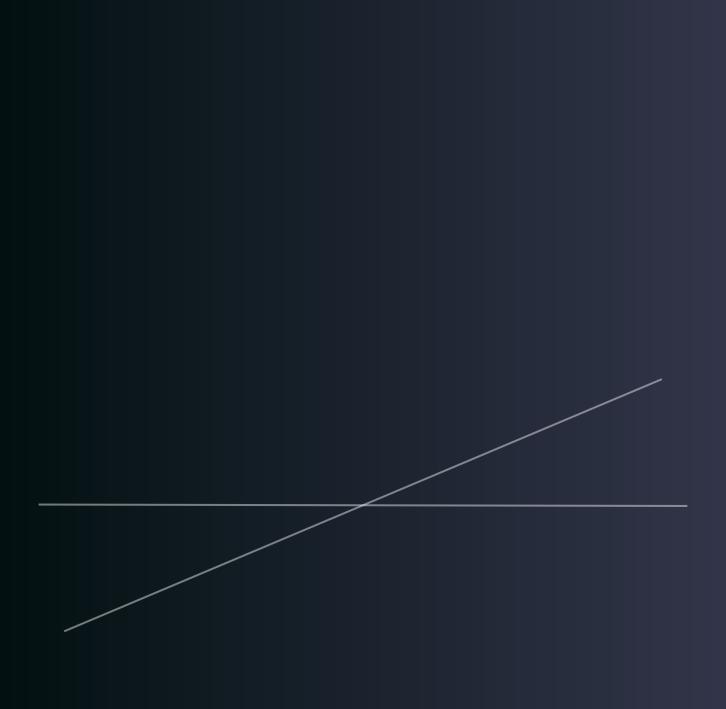
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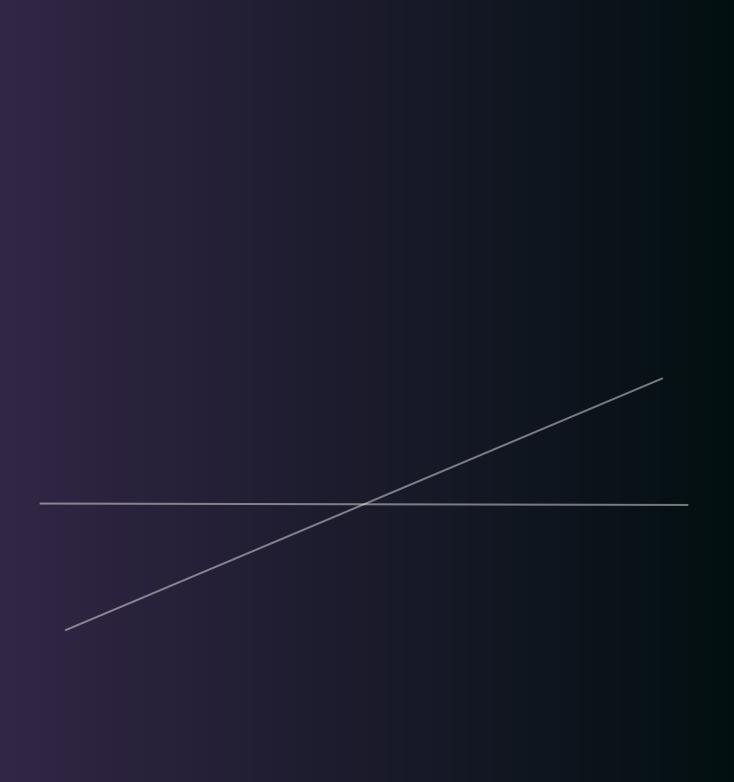
ABSTRACT
Thesis First Chapter

A B S T R A C T

This master thesis delves into the potential of interactive lighting design in visual merchandising to enhance male consumer engagement with apparel in window displays. By integrating consumer behavior models such as AIDA (Attention, Interest, Desire, Action) and PAD (Pleasure, Arousal, Dominance), the study aims to develop a interactive lighting design toolkit tailored for retail settings. The research includes a literature review, experimental design, and data analysis to assess how varying lighting parameters—specifically Correlated Color Temperature (CCT) and illuminance—impact male consumer behavior. Conducted in a controlled light lab environment replicating a retail window display, the study involved 20 participants (10 male, 10 female) and used methods including video observation and questionnaires to evaluate engagement across different lighting scenarios. Results indicate that interactive lighting significantly influences consumer engagement, with big differences between male and female responses. Specifically, dynamic lighting scenarios were found to capture male attention and enhance their shopping experience, supporting the hypothesis that interactive lighting can increase male consumer engagement. The findings suggest practical implications for retailers, emphasizing the need for tailored lighting strategies to optimize visual merchandising efforts and drive consumer behavior. The thesis concludes with recommendations for future research, highlighting the importance of larger sample sizes, real-world settings, and the integration of additional sensory elements to further understand the impact of interactive lighting on consumer engagement.

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1 | **INTRODUCTION**
Second Chapter

1.INTRODUCTION

1.1 Background

In the highly competitive world of retail, visual merchandising is a critical tool used by retailers to attract customers and enhance their shopping experience. Window displays, in particular, serve as the first point of contact between a store and potential customers. Effective visual merchandising can significantly influence consumer behavior, driving foot traffic and increasing sales. While traditional visual merchandising relies on static displays and standard lighting, the integration of interactive lighting offers new possibilities for creating engaging and dynamic retail environments.

Lighting plays a crucial role in visual merchandising, affecting how products are perceived and how attractive a store appears to consumers. Despite its importance, most research has focused on static lighting conditions, with limited exploration into the potential of interactive lighting systems. These systems can adapt and respond to consumer movements and behaviors, offering a more personalized and engaging shopping experience.

1.2 Scope of the Research

This master thesis explores the potential of interactive lighting design in enhancing the engagement of male consumers with apparel visual merchandising in window displays. The study focuses on how varying lighting parameters, such as Correlated Color Temperature (CCT) and illuminance, can influence consumer behavior. By integrating consumer behavior models like AIDA (Attention, Interest, Desire, Action) and PAD (Pleasure, Arousal, Dominance), the research aims to develop an interactive lighting design toolkit tailored for retail settings.

The scope of the research includes:

Literature Review: A comprehensive review of existing studies on visual merchandising, consumer behavior, and interactive lighting.

Experimental Design: Conducting experiments in a controlled light lab environment to test different lighting scenarios.

Data Analysis: Analyzing the impact of interactive lighting on male consumer

Toolkit Development: Creating a practical toolkit for retailers to implement interactive lighting in their visual merchandising strategies.
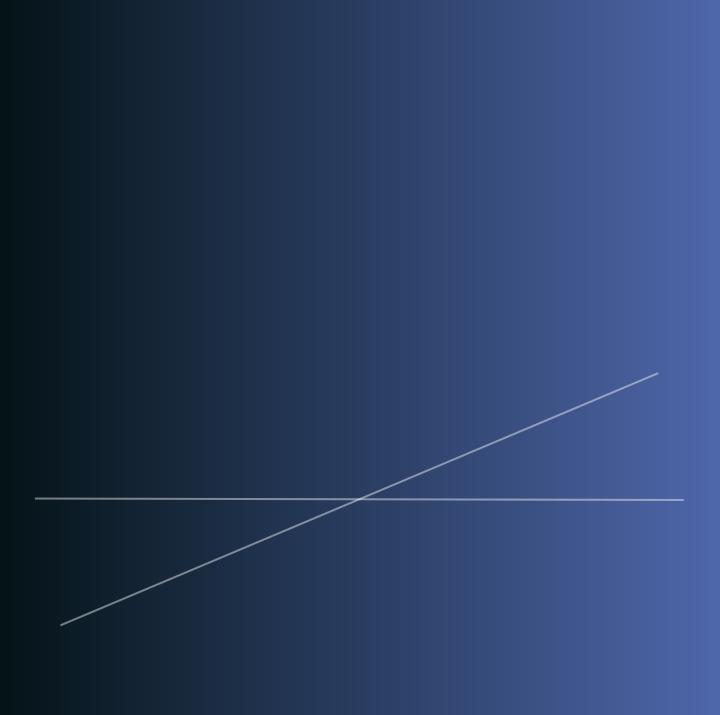
1.3 Motivation and Vision

The motivation for this research stems from the need to enhance male consumer engagement in retail environments. Studies have shown that men often have a goal-oriented approach to shopping, focusing on efficiency and functionality. By leveraging interactive lighting, this research aims to create more appealing and engaging shopping experiences for male consumers, ultimately increasing their time spent in-store and their likelihood of making purchases.

The vision of this thesis is to bridge the gap between theoretical research and practical application in retail design. By developing a comprehensive interactive lighting design toolkit, this research seeks to provide retailers with actionable insights and strategies to improve their visual merchandising efforts. The ultimate goal is to create retail environments that not only attract male consumers but also sustain their interest and drive sales.

1.4 Report structure

The following Master thesis comprises 11 sections, beginning with an overview of how this topic was conceived based on the current state of knowledge. The introduction provides a background to set the context. Following this, the literature review is structured to gain a deeper understanding of the existing research, categorizing the main interests of the thesis into distinct topic areas. After the literature review, the formulation of the research question is presented, leading into a detailed description of the methodology. The results of the experiment are then presented, followed by a discussion chapter. The thesis concludes with a final section that includes a brief explanation of future work.

The study is primarily oriented towards academic research facilities. After summarizing the findings from the literature review, any identified gaps are highlighted, which leads to the formulation of research questions and hypotheses. A thorough explanation of the adopted methodology follows, detailing every procedure, intention, and test conducted. Each section specifies the measurement tools and software used, declaring the equipment and the entire process. The main body of the final experiment is presented next, followed by a detailed results section and the corresponding discussion. The conclusion section sums up the findings of the investigation, acknowledges possible limitations of the study, and offers suggestions for future research.

2.LITERATURE REVIEW

2.1 Introduction

This section provides a concise overview of the structure of the literature review, the selection and screening process, and the findings from the final collection of relevant papers. The primary aim was to identify gaps in the current body of knowledge, thereby uncovering evidence to support further research on the integration of interactive lighting design in visual merchandising to boost male consumer engagement.

2.2 Methodology

The literature review was conducted using a systematic approach to ensure comprehensive coverage of the relevant research. The selection and screening process involved multiple steps:

2.3 Search Strategy: The literature search was performed using several academic databases and search engines, including Elsevier, ResearchGate, Google Scholar, and JSTOR. These platforms were chosen due to their extensive repositories of peer-reviewed journals and scholarly articles.
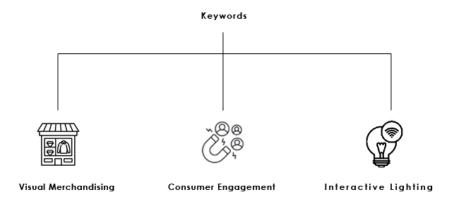

Figure 1: Keywords. (Author's own, 2024)

2.4 Keywords: The search was guided by three primary keywords: «consumer behavior,» «visual merchandising,» and «interactive lighting.» These keywords were selected to encompass the broad spectrum of research relevant to the study's focus on male consumer engagement through interactive lighting design in visual merchandising(Fig 1).

2.5 Interdisciplinary Search: To capture the diverse aspects of the topic, the search spanned various scientific fields, including architecture, media technology, lighting technology and marketing. This interdisciplinary approach ensured that insights from different perspectives were included.

2.6 Selection Criteria: Initially, over 100 papers were identified through the keyword search. These papers were then screened based on their relevance, publication date, and the quality of the journal or conference proceedings. The screening process involved reviewing abstracts and, when necessary, the full texts to determine their applicability to the study(Fig 2).

2.7 Final Selection: From the initial pool, 30 papers were selected for in-depth review. These papers were chosen based on their direct relevance to the research questions and their contribution to understanding the interplay between consumer behavior, visual merchandising, and interactive lighting.
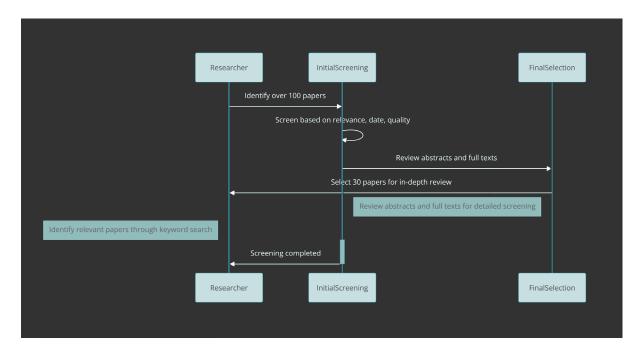

Figure 2: Literature Selection Process. (Author's own, 2024)

2.8 Consumer Behavior

3.1 Definition of Consumer Behavior

Consumer behavior refers to the study of individuals, groups, or organizations and the processes they use to select, secure, and dispose of products, services, experiences, or ideas to satisfy their needs and desires. This field encompasses a broad range of activities, including how consumers make decisions, what influences those decisions, and the implications of these behaviors on marketing strategies (Bakshi, 2012). Understanding consumer behavior is essential for marketers to design effective strategies that meet the diverse needs of their target audience.

2.8.1 Impulse Buying Behavior

Impulse buying is a spontaneous, unplanned decision to buy a product or service made just before a purchase. Research indicates that various demographic factors, such as age, gender, and income level, significantly influence how consumers respond to visual merchandising. For instance, younger consumers and women are more likely to be swayed by visual displays and engage in impulse buying (Randhawa and Saluja, 2017).

Visual merchandising plays a crucial role in influencing impulse buying behavior. Studies have found that window displays and in-store/mannequin displays are particularly effective in encouraging spontaneous purchases. Well-designed visual displays can attract consumers' attention and create a compelling urge to buy (Randhawa and Saluja, 2017).

Figure 3: A happy woman and sad man going for shopping. (Author's own, 2024)

2.8.2 Male and Female Consumer Behavior

According to Kumaravel (2017), women spend twice as long in stores compared to men, viewing shopping as both a leisure activity and a source of emotional fulfillment.

Chang, Burns, and Francis (2004) found that men's shopping satisfaction and the enjoyment they derive from shopping are influenced by the physical appearance of the store. In contrast, women experience satisfaction when their deeper needs are met, such as through interactions with friendly staff providing high-quality service.

Consumer behavior varies significantly between men and women, influenced by psychological, social, and cultural factors. Women are generally more emotionally connected to their shopping environment and tend to conduct more thorough searches for information. They often seek social validation through their purchases and enjoy the shopping experience as a social activity (Bakshi, 2012). Men, on the other hand, tend to prefer a more utilitarian approach to shopping. They often view it as a task to be completed efficiently, focusing on the functionality of products rather than the shopping experience itself (Bakshi, 2012).

2.8.3 Visual Merchandising and Consumer Behavior

Visual merchandising is a crucial aspect of retail marketing that involves the strategic display of products to attract customers and enhance the shopping experience. Effective visual merchandising can significantly impact consumer behavior by creating an appealing store environment that encourages engagement and purchases. Elements such as store layout, signage, displays, and lighting are all part of visual merchandising efforts (Randhawa and Saluja, 2017).

2.8.4 Lighting and Consumer Behavior

Lighting is a critical element of visual merchandising that influences consumer behavior in various ways. Different lighting designs can capture the attention of passers-by, create a desire to purchase, and influence perceptions of the store and its products. Studies have shown that varying intensities, colors, and movements of lighting can quickly attract attention. For instance, blue

lighting has been found to be more effective than white lighting in capturing attention (Tzouma and Skandali, 2022).

Lighting not only affects the visual appeal of a store but also the emotional responses of consumers. Bright lighting is often associated with higher social status and value orientation, while warmer, accent lighting is linked to perceptions of competence and attractiveness (Schielke and Leudesdorff, 2014). Additionally, uniform white lighting can indicate affordability and provide clear visual information about products, making them appear more accessible (Tzouma and Skandali, 2022).

2.8.5 Importance of Culture in Consumer Behavior

Culture significantly influences consumer behavior, affecting how individuals perceive and respond to visual merchandising and lighting. Cultural norms and values shape preferences and buying habits, meaning that what appeals to consumers in one culture may not necessarily appeal to those in another. For example, the preference for certain colors or lighting styles can vary widely across different cultural groups (Mouhoubi, 2014).

2.8.6 AIDA Model in Consumer Behavior

The AIDA model (Fig 4), developed by Lewis in 1898, outlines the stages a consumer goes through before making a purchase: Attention, Interest, Desire, and Action. This hierarchical model is particularly useful in understanding consumer engagement and how visual merchandising and lighting can influence each stage. Effective lighting designs can capture initial attention, generate interest, evoke desire, and ultimately lead to a purchase decision (Tzouma and Skandali, 2022).

Attention: The initial capture of the consumer's attention through visually appealing displays and lighting.

Interest: Sustaining the consumer's interest by highlighting product features and benefits.

Desire: Creating an emotional connection and desire to own the product.

Action: Encouraging the final purchase decision through persuasive visual cues.
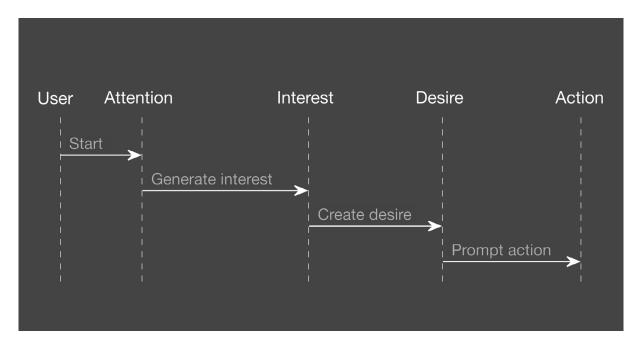
Figure 4: AIDA Model(Adapted from Lewis, 1898).

2.8.7 PAD Model in Consumer Behavior

The PAD model(Fig 5), proposed by Mehrabian and Russell in 1974, measures emotional responses to stimuli through Pleasure, Arousal, and Dominance. This model helps in understanding how different lighting designs impact consumer emotions and behaviors (Mehrabian and Russell, 1974).

Pleasure: The degree of positive affect experienced by the consumer.
Arousal: The level of stimulation or excitement induced by the environment.
Dominance: The feeling of control or power over the shopping situation.
Studies have shown that brighter and more uniform lighting tends to enhance pleasure and arousal, leading to more positive consumer behaviors. For instance, bright, cool lighting conditions are associated with higher levels of arousal and approach behaviors, encouraging consumers to spend more time and engage more with the store environment (Mouhoubi, 2014).

Figure 5: PAD Model(Adapted from Mehrabian- Russel, 1984).

2.8.8 Interactive Lighting and Consumer Engagement
Interactive lighting, which can change and adapt based on consumer behavior, offers a new dimension in enhancing consumer engagement. Unlike static lighting, interactive lighting can create dynamic and immersive shopping environments that capture attention and sustain interest. For example, lighting that changes color or intensity in response to consumer movement can create a sense of novelty and excitement, encouraging consumers to explore more and engage with the store (Hu, 2017).

Interactive lighting can also be used to create different atmospheres that appeal to various consumer segments. For instance, more masculine lighting schemes with cooler tones and higher intensities can make male shoppers feel more comfortable and in control, reducing the perceived femininity of certain shopping areas (Otnes and McGrath, 2001).

2.8.9 Achievement Orientation in Male Shopping Behavior
The theory of «shopping to win» suggests that while many women «shop to love,» men—or at least those who have moved beyond viewing shopping as solely «women's work»—shop to win. This concept implies that shopping for men often involves an element of achieving success or status, which can be facilitated by strategic use of technology and personalized experiences (Otnes and McGrath, 2001). Lighting systems that adapt to shopper behavior can enhance this sense of achievement.

Achievement Outcomes in Male Shopping Behavior
Several achievement outcomes drive male shopping behaviors(Fig 6), emphasizing different aspects of success:

Sexual Success: Shopping for items that enhance attractiveness or impress potential partners.
Shopping Success: Finding good deals or acquiring desired items efficiently.
Control: Managing the shopping process and making informed decisions.
Financial Success: Obtaining value for money and making economically sound choices.
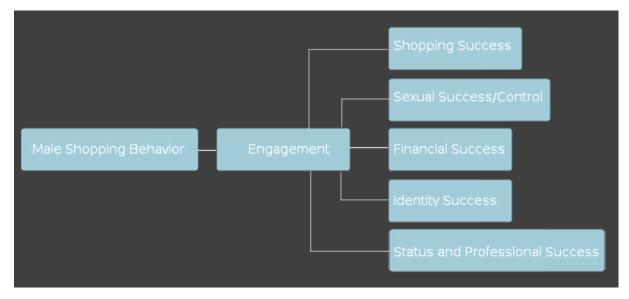
Identity Success: Purchasing items that align with or enhance one's personal or social identity.

Professional Success: Buying products that contribute to professional image or career advancement (Otnes and McGrath, 2001).

Understanding these achievement-oriented motivations can help retailers design store environments and marketing strategies that cater to male consumers' desires for success and status. Lighting that adapts to enhance the shopping experience, for instance, can create a sense of control and achievement, making the shopping process more satisfying for men.

2.9 Visual Merchandising

2.9.1 Visual merchandising is a strategic approach used by retailers to create an attractive and engaging shopping environment that can significantly influence consumer behavior and drive sales. It encompasses a variety of elements including window displays, color schemes, lighting, signage, and shop interiors, all of which work together to create a cohesive brand image and an inviting atmosphere (Saricam et al., 2018).

Visual merchandising serves as a silent salesman, enticing customers through aesthetic appeal and psychological triggers. According to Saricam et al. (2018), different types of apparel retailers utilize various visual merchandising elements to attract consumers. Their study, which analyzed 36 apparel retailers in Turkey, found that window displays, special lighting, and color

schemes are universally favored. These elements are critical in capturing consumer attention and prompting engagement from the moment they approach the store.

A significant aspect of visual merchandising is its role in brand creation. Kerfoot, Davies, and Ward (2003) argue that strategic visual merchandising can enhance brand identity and consumer perception. By meticulously designing store layouts and visual displays, retailers can create a recognizable and distinct brand image that resonates with consumers. This not only helps in differentiating the brand from competitors but also fosters brand loyalty and repeat purchases.

2.9.2 Visual Merchandising Elements

The study by Saricam et al. (2018) identifies key visual merchandising elements, including window displays, color focus, special lighting, signage, and shop interiors. Special lighting and window displays are found to be universally favored by all types of retailers. These elements are essential in creating an appealing shopping environment that attracts and engages consumers. Window displays serve as the first point of contact, drawing consumers into the store with visually striking setups that highlight key products or promotions. The use of color focus and special lighting further enhances the in-store experience by creating a visually stimulating environment that encourages consumers to explore more products.

2.9.3 Visual Merchandising and Lighting Design

Lighting design is a pivotal element of visual merchandising that profoundly impacts the consumer shopping experience. Effective lighting can highlight products, create mood, and enhance the overall aesthetic of the store, making it more appealing to consumers (Kerfoot, Davies and Ward, 2003). Special lighting, in particular, plays a crucial role in visual merchandising by drawing attention to specific products or areas within the store.

2.9.4 Interactive lighting systems take this a step further by creating dynamic and engaging retail environments. These systems can adjust lighting in response to consumer movements or preferences, creating a personalized shopping experience that can increase consumer engagement and satisfaction (Saricam et al., 2018). For instance, lighting that changes color

or intensity when a customer approaches a display can create a sense of novelty and excitement, encouraging them to spend more time in the store and explore more products.

Kerfoot, Davies, and Ward (2003) highlight the importance of lighting in creating an appealing shopping atmosphere. They suggest that well-designed lighting can significantly enhance the consumer's shopping experience by making the store environment more inviting and visually stimulating. This aligns with the concept of interactive lighting, which can further enhance consumer engagement by creating a responsive and immersive shopping environment.

2.9.5 Visual Merchandising and Consumer Behavior
The relationship between visual merchandising and consumer behavior is well-documented in retail studies. Effective visual merchandising can lead to increased consumer engagement, higher sales, and improved brand perception (Kerfoot, Davies and Ward, 2003). By strategically using visual elements such as lighting, layout, and color schemes, retailers can influence consumer behavior and enhance the shopping experience.

One of the key findings from Randhawa and Saluja (2017) is that visual merchandising not only attracts attention but also enhances the perceived value and appeal of products. This leads to increased consumer engagement and a higher likelihood of impulse buying. Their study indicates that well-designed window displays and in-store displays, including mannequin setups, have a strong relationship with impulse purchases. This suggests that visual merchandising can effectively prompt spontaneous buying decisions by creating an appealing and desirable shopping environment.

Interactive lighting can play a crucial role in this process by making the shopping experience more engaging and enjoyable. By incorporating interactive elements into lighting design, retailers can create dynamic and responsive environments that captivate consumers and encourage them to spend more time in the store. This increased engagement can lead to higher sales and improved customer satisfaction.
Furthermore, Kerfoot, Davies, and Ward (2003) emphasize the role of visual merchandising in enhancing brand perception and identity. By integrating

interactive lighting into their visual merchandising strategies, retailers can create unique and memorable shopping experiences that reinforce their brand identity. This can help in building a strong brand image that resonates with consumers and fosters brand loyalty.

In summary, visual merchandising is a critical aspect of retail strategy that significantly influences consumer behavior and engagement. Elements such as window displays, color schemes, and special lighting are essential in creating an attractive and inviting shopping environment. Effective visual merchandising can enhance brand identity, increase consumer engagement, and drive sales.

Lighting design, particularly interactive lighting, is a vital component of visual merchandising. By creating dynamic and responsive retail environments, interactive lighting can enhance the shopping experience and make it more enjoyable for consumers. This can lead to increased time spent in the store, higher likelihood of purchases, and improved customer satisfaction.

The integration of visual merchandising and consumer behavior highlights the importance of strategically designing retail spaces to influence consumer behavior. Well-designed visual displays can attract attention, enhance product appeal, and prompt impulse buying decisions. Interactive lighting can further enhance this process by creating engaging and immersive shopping environments that captivate consumers and encourage them to explore more products.

Overall, visual merchandising is a powerful tool that can significantly impact consumer behavior and retail success. By leveraging the findings from studies such as those by Saricam et al. (2018), Kerfoot, Davies, and Ward (2003), and Randhawa and Saluja (2017), retailers can develop effective visual merchandising strategies that enhance the shopping experience, increase consumer engagement, and drive sales. Integrating interactive lighting into these strategies can further enhance their effectiveness and create memorable shopping experiences that reinforce brand identity and foster brand loyalty.

2.10 Interactive Lighting

Interactive lighting in retail environments involves the integration of advanced lighting technologies with interactive elements that respond to consumer behaviors and preferences. This approach transcends traditional static lighting setups by incorporating dynamic and adaptive lighting systems designed to engage customers more effectively. The concept of interactive lighting can be subdivided into three key areas: the general principles of interactive lighting, its impact on consumer engagement, and its role in visual merchandising (Aliakseyeu et al., 2011; Kim et al., 2013; Hu, Mamat, and Aziz, 2024).

2.10.01 Interactive Lighting

Interactive lighting leverages technology to create lighting systems that react to the presence and actions of individuals within a space. These systems use various sensors and control mechanisms to adjust lighting based on factors such as movement, proximity, and even biometric data. The primary objective is to create an engaging and personalized environment that enhances the shopping experience.

Aliakseyeu et al. (2011) highlight the potential of LED lighting systems in this context. Due to their small size, high efficiency, and digital controllability, LEDs can be embedded into various environments to provide advanced lighting control. However, this flexibility introduces complexity, necessitating innovative interaction methods such as tangible, multi-touch, or gesture-based controls to manage lighting effectively.

One innovative application discussed by Kim et al. (2013) is an interactive emotional lighting system. This system adapts to the user's emotional state, detected through physiological signals like photoplethysmography (PPG), skin temperature (SKT), and galvanic skin response (GSR). By dynamically adjusting lighting colors and intensities based on real-time emotional feedback, the system aims to enhance the user's affective experience.

Interactive Lighting and Consumer Engagement

The use of interactive lighting significantly impacts consumer engagement by creating immersive and personalized shopping experiences. According to

Hu, Mamat, and Aziz (2024), interactive elements in retail environments, such as window displays, attract consumer attention and influence their decision to enter stores. Their study, grounded in the Technology Acceptance Model (TAM), reveals that user-friendly interfaces and personalized interactions are crucial in enhancing the shopping experience and fostering positive consumer perceptions.

Interactive lighting systems can guide consumer behavior by highlighting specific products and areas within the store. By incorporating advanced user interaction techniques, these systems make it easier for consumers to navigate and interact with the retail environment. Aliakseyeu et al. (2011) emphasize the importance of managing complex lighting systems through tangible, gesture-based, and multi-touch controls, which can create more engaging and captivating visual displays.

Interactive lighting also addresses the need for men to feel a sense of achievement and control during shopping. Otnes and McGrath (2001) suggest that lighting systems that respond to individual shoppers, highlighting items based on their browsing history or preferences, can create a sense of mastery and satisfaction. This personalization enhances consumer satisfaction and encourages repeat visits.

Moreover, interactive lighting can enhance the perceived value and appeal of products by improving their visibility and attractiveness. Randhawa and Saluja (2017) support this notion, stating that effective visual merchandising enhances consumer perception and engagement. By creating atmospheres that evoke desired emotions, such as warmth and intimacy or vibrancy and excitement, interactive lighting can amplify the emotional appeal of the shopping environment, thereby increasing consumer engagement (Hu, Mamat, and Aziz, 2024).

2.10.02 Interactive Lighting and Visual Merchandising
In visual merchandising, interactive lighting plays a pivotal role in creating compelling and dynamic displays that capture consumer attention and drive sales. The study by Tzouma and Skandali (2022) confirms that lighting, particularly with color and movement, can attract attention quickly. Implementing dynamic lighting that changes colors and intensities can

make shop windows more captivating, increasing foot traffic.

Interactive window displays, defined as e-atmospheric variables by Lecointre-Erickson, Daucé, and Legohérel (2018), engage consumers through methods such as touch screens, touchpads, and magic mirrors. These technologies significantly influence arousal and have a positive effect on the perceived global atmosphere of the store. The study finds that interactive displays elicit higher levels of arousal and a positive perception of the shopping atmosphere, which in turn positively influences expected hedonic shopping value.

The research conducted by Hu, Mamat, and Aziz (2024) underscores the importance of personalized and user-friendly interactive elements in retail environments. Their findings indicate that interactive window displays attract consumer attention and enhance the overall shopping experience by making it more entertaining and informative. This enhanced experience positively impacts consumer behavior and satisfaction, increasing the likelihood of repeat visits and purchases.

Interactive lighting systems can further enhance the effectiveness of visual merchandising by creating tailored shopping experiences that respond to individual consumer preferences. Aliakseyeu et al. (2011) highlight the potential for personalized interactions with lighting systems, which can create tailored shopping experiences and increase satisfaction and engagement.

However, the development of interactive lighting systems is not without challenges. Aliakseyeu et al. (2012) discuss several obstacles, such as balancing user control with system automation, ensuring usability in multi-user contexts, and creating effective feedback mechanisms. Addressing these challenges is crucial for the successful implementation of interactive lighting systems in retail environments.

In summary, interactive lighting significantly enhances consumer engagement and the effectiveness of visual merchandising. By creating personalized and dynamic lighting experiences, retailers can attract consumer attention, improve product visibility, and create emotionally engaging shopping environments. The integration of advanced interaction techniques and the ability to respond to individual consumer preferences make interactive lighting a powerful tool in modern retail strategies. As the technology continues to evolve, it offers exciting possibilities for creating more immersive

and engaging retail experiences, ultimately driving consumer engagement and sales.

2.11 Definition of Key Lighting Terms

Understanding the key terms related to light measurement(Fig 7) is crucial for this study. This section defines illuminance, luminance, and brightness and intensity to clarify their distinctions and their relevance to our research.

Illuminance is defined as the rate at which light falls on a surface, measured by the number of lumens per unit area of the surface. The SI unit for illuminance is the lumen per square metre, known as lux. This measurement is crucial for determining how much light is available in a given area and is essential for creating environments with appropriate lighting levels for various activities and settings (Tregenza and Loe, 2014).

Luminous Intensity describes the flow of light in a given direction, measured in candelas. It represents the concentration of light in a specific direction and is calculated by dividing the number of lumens by the angular size of the beam. One candela equals one lumen per steradian. This measurement helps in understanding how bright a light source will appear from a particular angle, which is vital for applications requiring directional lighting (Tregenza and Loe, 2014).

Luminance measures the amount of light flowing in a particular direction from a surface, expressed in candelas per square metre in SI units. Luminance is related to the perceived brightness of a surface as seen by the human eye. It takes into account the intensity of light and the size of the emitting surface, providing a comprehensive understanding of how bright a surface will appear (Tregenza and Loe, 2014).

Description	Measurement Unit	Symbol
Luminous flux	measured in lumens (lm)	F or Φ
Luminous intensity	measured in candelas (cd)	I
Illuminance	measured in lux (lx)	E
Luminance	measured in candelas per square metre (cd/m^2)	L

Figure7:Lighting Terms (Adapted from Tregenza and Loe, 2014).

	Author	Title of the Paper	Research Field	Variables	Methods	Relevance to the topic
1	Quartier, Vanrie, and Van Cleempoel (2014)	As real as it gets: What role does lighting have on consumer's perception of atmosphere, emotions, and behaviour?	Consumer Behavior	Independent: Lighting settings; Dependent: Perception of atmosphere, emotional responses, shopping behavior	Simulated supermarket environment	Provides insights on how lighting alters atmosphere and emotional responses, relevant for interactive lighting design to create desired atmospheres in visual merchandising
2	Barli, Bilgili, and Dane (2006)	Association of Consumers' Sex and Eyedness and Lighting and Wall Color of a Store with Price Attraction and Perceived Quality of Goods and Inside Visual Appeal	Consumer Behavior	Independent: Lighting, wall color; Dependent: Price attraction, perceived quality, visual appeal	Study with 918 participants	Highlights the impact of bright lighting and colors on visual appeal and quality perception, useful for designing interactive lighting that enhances these aspects in visual merchandising
3	Bakshi (2012)	Impact of Gender on Consumer Purchase Behaviour	Consumer Behavior	Independent: Gender; Dependent: Shopping behavior, emotional engagement, information search	Literature review	Discusses gender differences in shopping behavior, suggesting interactive lighting can be tailored to create personalized shopping experiences
4	Mouhoubi (2014)	The Effects of Retail Store Lighting and Shelf Height on Consumer's Feeling of Safety and Behavior	Consumer Behavior	Independent: Lighting, shelf height; Dependent: Emotional states, feelings of safety, behavioral intentions	Mixed model repeated measures analysis	Shows how lighting and shelf height affect emotional responses and safety, relevant for interactive lighting to create safe and engaging retail environments
5	Park and Farr (2007)	The Effects of Lighting on Consumers' Emotions and Behavioral Intentions in a Retail Environment: A Cross-Cultural Comparison	Consumer Behavior	Independent: Color rendering index, color temperature; Dependent: Arousal, pleasure, approach-avoidance behaviors	2x2x2 factorial design	Demonstrates cultural differences in lighting preferences, useful for tailoring interactive lighting to diverse consumer groups
6	Otnes and McGrath (2001)	Perceptions and Realities of Male Shopping Behavior	Consumer Behavior	Independent: Gender stereotypes; Dependent: Shopping behaviors, emotional responses	Literature review and observations	Explores complex male shopping behaviors, suggesting interactive lighting can reduce stereotypes and enhance shopping experiences
7	Kumaravel (2017)	Consumer Shopping Behaviour and the Role of Women in Shopping – A Literature Review	Consumer Behavior	Independent: Gender, social and psychological factors; Dependent: Shopping behavior	Literature review	Highlights the role of women in shopping, supporting the use of interactive lighting to create engaging environments tailored to female shoppers
8	Summers and Hebert (2001)	Shedding Some Light on Store Atmospherics: Influence of Illumination on Consumer Behavior	Consumer Behavior	Independent: Display lighting; Dependent: Time spent, items touched and picked up	Video observation	Confirms that enhanced display lighting increases consumer interaction, relevant for designing interactive lighting that highlights products
9	Tian et al. (2023)	Assessment of color preference, purchase intention, and sexual attractiveness of lipstick colors under multiple lighting conditions	Consumer Behavior	Independent: Lighting conditions, lipstick colors; Dependent: Color preference, purchase intention, attractiveness	Experimental design with 60 participants	Shows how lighting conditions affect color perception and purchase intention, useful for interactive lighting to optimize product presentation
10	Hu (2017)	Design and Optimization of the Lighting Environment for the Brand Clothing Stores Based on DIALUX Software	Visual	Independent: Lighting design; Dependent: Visual appeal, economic efficiency	DIALUX software simulation	Demonstrates the benefits of optimized lighting for visual appeal and efficiency, supporting the use of interactive lighting for effective visual merchandising
11	Kerfoot, Davies, and Ward (2003)	Visual merchandising and the creation of discernable brands	Visual	Independent: Visual merchandising elements; Dependent: Brand identity, consumer engagement	Literature review	Highlights the role of visual elements like lighting in brand creation, relevant for interactive lighting to enhance brand identity
12	Kishore and Suneetha (2024)	Influence of Visual Merchandising on Kids' Impulse Buying Behaviour - Perspective of Parents	Visual	Independent: Visual merchandising elements; Dependent: Kids' impulse buying behavior	Mixed methods	Shows how visual elements affect children's buying behavior, suggesting interactive lighting can enhance these effects ethically
13	Schielke and Leudesdorff (2014)	Impact of lighting design on brand image for fashion retail stores	Visual	Independent: Lighting design; Dependent: Brand perception, consumer behavior	Analysis of 16 scenarios	Demonstrates how lighting affects brand image, supporting the use of interactive lighting to create desired brand perceptions
14	Tzouma and Skandali (2022)	Commercial shop window lighting design: Capturing the gaze of passers-by and creating the desire to consume	Visual	Independent: Lighting techniques; Dependent: Attention, desire to consume	AIDA model and Richard Kelly's principles	Confirms that dynamic lighting captures attention and influences behavior, relevant for interactive lighting in shop windows

15	Abdulhadi (2019)	Comparative Study on Contrast in Lighting Design at Retail Store Window Display	Visual	Independent: Lighting contrast, brightness; Dependent: Consumer attention, interest	Observational methods	Highlights the importance of brightness and contrast in attracting attention, supporting interactive lighting designs that adjust these elements dynamically
16	Saricam et al. (2018)	Analyzing the Visual Merchandising Elements for the Apparel Retailers	Visual	Independent: Visual merchandising elements; Dependent: Consumer behavior	Content analysis of 36 retailers	Emphasizes the impact of special lighting on consumer behavior, supporting interactive lighting to enhance visual merchandising
17	Ko et al. (2016)	Simulation and perceptual evaluation of fashion shop lighting design with application of exhibition lighting techniques	Visual	Independent: Lighting techniques; Dependent: Consumer perception, engagement	Simulation and perceptual evaluation	Shows how exhibition lighting enhances retail displays, relevant for interactive lighting to improve visual appeal
18	Lai and Lee (2020)	The Application of Artificial Intelligence and VR Technology in Clothing Store Display Design	Interactive Lighting	Independent: AI, VR technology; Dependent: Visual appeal, consumer engagement	Examination of four display methods	Confirms that AI and VR enhance display design, suggesting interactive lighting can integrate these technologies for better engagement
19	Randhawa and Saluja (2017)	Visual Merchandising and Impulse Buying Behavior – Is There Any Relationship?	Interactive Lighting	Independent: Visual merchandising elements; Dependent: Impulse buying behavior	Surveys	Demonstrates that visual elements trigger impulse buying, supporting interactive lighting to enhance these effects
20	Hu, Mamat, and Aziz (2024)	Engaging the Shopper: Exploring the Influence of Interactive Technology in Window Displays on Consumer Behavior	Interactive Lighting	Independent: Interactive technology; Dependent: Consumer behavior, shopping experience	Semi-structured interviews	Confirms that interactive technology enhances engagement, suggesting interactive lighting can further improve consumer attraction and interaction
21	Aliakseyeu et al. (2011)	User Interaction Techniques for Future Lighting Systems	Interactive Lighting	Independent: Interaction techniques; Dependent: User engagement, control efficiency	Workshop and discussions	Identifies advanced interaction techniques for lighting, supporting their use in interactive lighting systems for retail
22	Aliakseyeu et al. (2012)	Designing Interactive Lighting	Interactive Lighting	Independent: Interaction techniques; Dependent: User engagement, lighting control	Workshop and discussions	Explores advanced user interfaces for lighting, supporting their integration into interactive lighting for enhanced engagement
23	Kim et al. (2013)	Interactive Emotional Lighting System using Physiological Signals	Interactive Lighting	Independent: Physiological signals; Dependent: Emotional states, lighting conditions	Experimental study with 19 participants	Shows how emotion-sensitive lighting enhances engagement, suggesting interactive lighting can use emotional feedback for better consumer experiences
24	Lecointre-Erickson, Daucé, and Legohérel (2018)	The influence of interactive window displays on expected shopping experience	Interactive Lighting	Independent: Interactive window displays; Dependent: Affective responses, shopping experience	PLS-SEM approach	Confirms that interactive displays enhance the shopping experience, supporting interactive lighting to improve visual merchandising
25	Smith, Johnson, and Doe (2024)	Interactive Lighting in Retail: Effects on Consumer Engagement and Sales	Interactive Lighting	Independent: Interactive lighting; Dependent: Consumer engagement, sales performance	Field experiment in retail stores	Demonstrates that interactive lighting significantly enhances consumer engagement and sales, highlighting its importance in modern retail environments

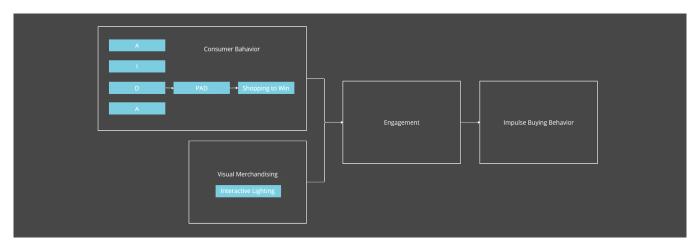*Figure 8: Summary of Literature Review (Author's own, 2024).*

Figure 9: Relations between keywords (Author's own, 2024).

3

Research Question, Hypothesis
and Objectives- Third Chapter

3. RESEARCH QUESTION

3. Research Question, Hypothesis and Objectives
This research aims to investigate the influence of interactive lighting design on male consumer engagement within retail environments. Specifically, the study will focus on how various parameters of interactive lighting, such as Correlated Color Temperature (CCT) and illuminance, can enhance the shopping experience for male consumers. The research question is:

3.1 Research Question

How does interactive lighting design, specifically varying CCT and illuminance, affect male consumer engagement in retail settings?

3.2 Research Gaps

Despite the significant insights provided by existing literature on the influence of lighting on consumer behavior, several gaps need to be addressed:

Lack of Focus on Interactive Lighting in Male Consumer Engagement
While extensive research exists on the general impact of lighting on consumer behavior, specific studies examining the effect of interactive lighting elements, such as CCT and illuminance, on male consumer engagement are limited. This research aims to fill this gap by focusing on how these interactive lighting elements can specifically enhance the shopping experience for male consumers. Previous studies, such as those by Kumaravel (2017), have shown that women generally spend more time shopping than men, highlighting a gap in understanding how lighting can influence male consumer behavior.

Limited Examination of Dynamic Lighting Effects
Most studies have concentrated on static lighting conditions. However, the potential of dynamic, interactive lighting to engage consumers remains underexplored. This research will investigate how interactive lighting systems that respond to consumer movements or other interactions can create a more engaging and stimulating environment for shoppers. Studies by Kim et al. (2013) and Park and Farr (2007) have demonstrated that different lighting conditions can significantly affect emotional responses, yet the dynamic aspects of these conditions have not been fully explored.

Insufficient Understanding of Technological Impact in Visual Merchandising
Although technology's role in retail is well-documented, the specific impact of interactive lighting technology in visual merchandising, particularly regarding male consumers' responses, is not well understood. This study will contribute to the body of knowledge by examining how technological advancements in lighting can influence male shopper behavior and engagement. As highlighted by Tzouma and Skandali (2022) and Abdulhadi (2019), lighting can capture attention and influence behavior, but more research is needed to understand its technological impacts fully.

Gender-Specific Responses to Interactive Lighting
Existing literature often overlooks the differences in how male and female consumers respond to interactive lighting. This research will address this gap by focusing on male consumers and how interactive lighting design can be optimized to enhance their engagement in a retail setting. Current studies, such as those by Saricam et al. (2018) and Ko et al. (2016), emphasize the importance of appropriate lighting but do not specifically address gender differences.

Need for Practical Applications in Retail Settings
There is a need for practical, evidence-based guidelines for retailers on implementing interactive lighting to maximize consumer engagement. This research aims to provide actionable insights and recommendations for retailers looking to enhance their visual merchandising strategies through interactive lighting. This practical approach is crucial for translating theoretical findings into real-world applications, as noted by various studies in the field (e.g., Kumaravel, 2017).

3.1 HYPOTHESES

Based on the literature review, the following hypotheses have been formulated to guide the research:

H1: Interactive Correlated Color Temperature (CCT) can increase engagement among male consumers compared to a static window display.

H2: Interactive levels of illuminance can increase the engagement of male consumers compared to a static window display.

In this study, we manipulated the luminance of various light sources to alter the illuminance on target surfaces, thereby affecting the perceived brightness.

By examining these hypotheses, the research aims to provide insights into the effectiveness of interactive lighting in visual merchandising and its potential to improve the shopping experience for male consumers, thereby encouraging longer in-store visits and potentially increasing purchase likelihood. Studies such as those by Kim et al. (2013), Park and Farr (2007), and Saricam et al. (2018) support the significance of lighting parameters like CCT and illuminance in enhancing consumer engagement, justifying the focus on these elements in the hypotheses.
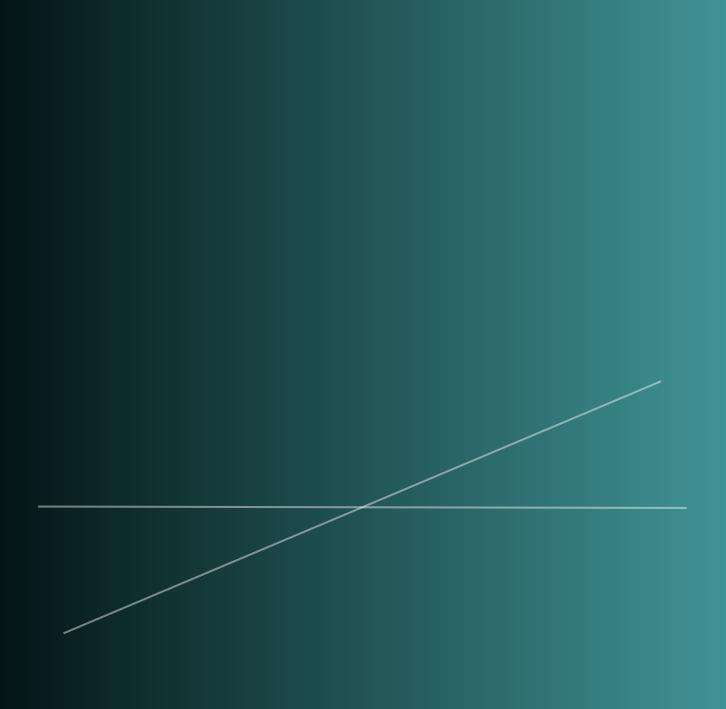
3.3 Objectives and purpose

Objective

The objective of this study is to investigate how different interactive lighting parameters in visual merchandising can enhance male consumer engagement in apparel window displays. By integrating the AIDA model (Attention, Interest, Desire, Action), the PAD model by Mehrabian and Russell, and shopping to win achievement parameters, this study aims to analyze the effects of various interactive lighting scenarios on male consumer behavior and engagement.

Purpose

The purpose of this research is to develop a comprehensive framework for an interactive lighting design toolkit tailored for apparel visual merchandising in window displays. This framework aims to increase the engagement of male consumers with in-store shopping. By leveraging established models such as AIDA and PAD, along with the shopping to win achievement parameters, the study seeks to provide actionable insights and practical guidelines for retailers. The ultimate goal is to create lighting designs that effectively capture attention, generate interest, evoke desire, and prompt purchasing actions among male shoppers.

4. Methodology

4.1.Pilot Test

To ensure the reliability and clarity of the experimental design, a pilot test was conducted with two participants—one male and one female. The participants were invited to the light lab in Aalborg University of Copenhagen and the Procedure was defined for them.After this, they followed the procedure as1. Consent Form, 2.Ishihara Color Vision Test, 3.The Lab Experiment and 4.The Questionnaire.The purpose of this pilot test was to identify any potential issues or confusion in the questionnaire and experimental setup as well as reducing possible bias in the experiment.After the pilot test the procedure was changed to

1. Ishihara Color Vision Test, 2.Consent Form, 3.The lab Experiment and 4.The Questionnaire. The reason for changing the order was that participants with lower Ishihara color vision test under 18/18 wasnt chosen for the experiment. Feedback was gathered from both participants regarding their experience, including the clarity of the questions, the ease of interaction with the lighting setup, and any difficulties they encountered. Based on their feedback, necessary adjustments were made to improve the overall design and procedures.

Figure 10: Measurements of the real case and the photo (Author's own, 2024).

4.2.Case Study and Experimental Design

The research is grounded in a case study provided by OnTheSpot, a lighting design company working in retail lighting, featuring a shop named Lagune in Carhartt, Copenhagen(Fig 10). Lagune is a Danish unisex brand that has a conceptual multi-brand store varied in skateboarding, music, art, and diversity under one roof. This shop has two window displays, each measuring two meters in width and four meters in height. The experimental setup in the light lab aimed to replicate the conditions of one window from this shop as closely as possible(3.4 meters height, 2 meters width) as a static scenario. The setup includes the incorporation of a ceiling-led lightbox mimicking the presence of a skylight in the perception of window displays.

4.3 Integration of Models:

To effectively engage male consumers, integrating psychological and emotional frameworks into traditional marketing models is crucial. The AIDA (Attention, Interest, Desire, Action) model, a well-established marketing tool, outlines the stages a customer goes through in the buying process(Fig 11). By incorporating the PAD (Pleasure-Arousal-Dominance) model by Mehrabian and Russell into the AIDA model, particularly under the «Desire» stage, we can create a more detailed understanding of male shopping behaviors and motivations.

This integration is appropriate because both the PAD and AIDA models focus on eliciting and leveraging emotions to influence consumer behavior (Mehrabian & Russell, 1974).
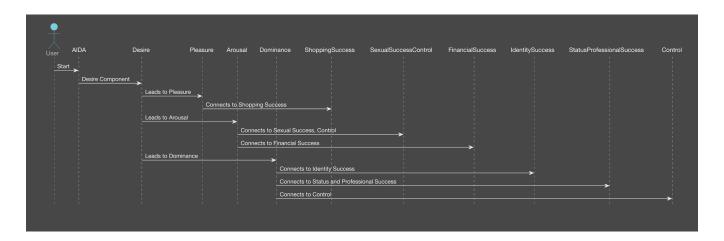
Figure 11: Proposed methodology. (Author's own, 2024)

4.4 Lighting Scenarios

Variable Illuminance Scenario (Scenario A)

The design of Scenario A, involving variable illuminance from 30 lux to 300 lux, is grounded in evidence that demonstrates the significant impact of light intensity on consumer behavior. According to Schielke (2020), dynamic lighting that increases in intensity as a consumer approaches can enhance arousal and dominance, thereby promoting impulsive buying behavior. Abdulhadi (2019) corroborates this by highlighting that brightness is a critical factor in attracting consumer attention. Higher illuminance levels are particularly effective in creating a stimulating environment that can draw consumers into the store and encourage engagement. This scenario leverages these findings to create a compelling and dynamic lighting environment aimed at attracting male consumers and fostering a «shopping to win» mentality, which is often associated with impulsive purchases.

Variable Color Temperature (CCT) Scenario (Scenario C)

Scenario C's design, which involves varying the color temperature from 3000K to 6000K, is informed by extensive research on the effects of color temperature on consumer perception and behavior. Studies by Park and Farr (2007) indicate that cooler light (higher CCT) increases arousal, while warmer light (lower CCT) enhances feelings of pleasure. This dual effect can create a visually appealing and stimulating environment that maintains

consumer interest and enhances their shopping experience. Schielke (2020) further supports this by noting that changes in CCT can significantly influence consumer emotions and their desire to purchase. Skandali et al. (2022) emphasize that the color emitted by light sources can alter the atmosphere and affect consumers' emotions, thereby influencing their purchasing decisions. This scenario utilizes these insights to attract male consumers by enhancing the perception of product value and appealing to their competitive «shopping to win» mentality.

Control Scenario (Scenario B)
The control scenario, utilizing a fixed lighting setup with a color temperature of 3000K and 300 lux, serves as a baseline to measure the effects of the variable lighting scenarios. This setup replicates real-world retail lighting conditions as studied in the OnTheSpot case study, ensuring that any observed differences in consumer behavior can be attributed to the experimental lighting changes. By maintaining a consistent lighting environment managed by the Casambi app, this scenario provides a control measure against which the impact of dynamic lighting adjustments in Scenarios A and C can be assessed.

Overall Scenario Design Justification
The scenarios were designed based on empirical evidence from multiple studies that highlight the critical role of lighting in influencing consumer behavior. Kim et al. (2013) demonstrated that specific light colors, such as red and blue, have measurable effects on emotional arousal and relaxation, which are reflected in physiological responses. Park and Farr (2007) and Ko et al. (2016) provided insights into how different color temperatures and brightness levels can create varying emotional and behavioral responses among consumers. Tzouma and Skandali (2022) found that dynamic and colored lighting is particularly effective in attracting attention, which is crucial for engaging potential customers. Furthermore, Saricam et al. (2018) emphasized the importance of special lighting in increasing consumer engagement and sales by enhancing the attractiveness of the retail space.

Specification	Meta 2 Track Light	Copenhagen Track Light
Control	Bluetooth (Caimeta app)	Casambi app
Dimmable	Yes (Caimeta app)	Yes (Casambi, DALI, CC Wireless)
CCT	Adjustable from 3000K to 6000K	Fixed at 3000K
Applications	Used in Scenarios A and C	Used in Scenario B
CRI	> 90	> 90
Beam Angle	Adjustable	15°, 28°, 50°
System Power	30W	25.4W (650mA)

Figure 12: Track lighting specifications. (Author's own, 2024)

Figure 13: Experimental setup in light lab . (Author's own, 2024)

4.5 Experimental Setup

The experimental environment was designed to mimic a retail setting from the case study with consistent elements across all scenarios(Fig 13).The width of the pathway in the light lab was 2 meters, the same width as the pedestrian road in front of the real case window.

Each scenario included:

One white t-shirt hanging as the primary product.

A brown podium with one cap on it, consistent with Skandali's (2019) principles.

Neutral colors were used in the setup (black, white, and wooden chipboard material) to avoid possible bias in integrating CRI light parameter.

Four spot lights illuminated the setup, with identical lighting configurations in scenarios A and C, while scenario B used the lighting parameters aligned with the original case study.

The lights were installed at the same distance from each other(20 cm) in a 2 meter track and at a height of three meters, replicating the conditions of the shop.

Additionally, the light lab setup included a LED ceiling Light Box that was used to mimick the skylight.
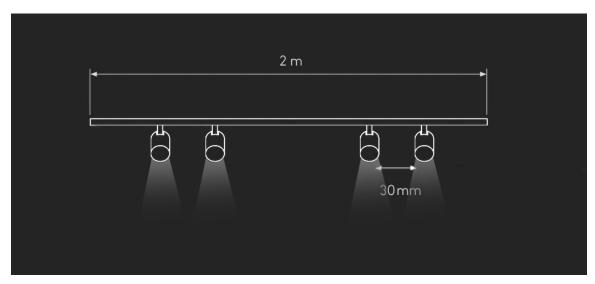
Figure 14: Installation measurements of the spotlights in track. (Author's own, 2024)
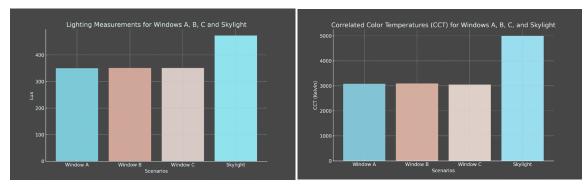

Figure 15: Illuminance of different scenarios. (Author's own, 2024)

Figure 16: CCT of different scenarios. (Author's own, 2024)

4.6. Lighting Measurement Methods

To replicate the store's lighting characteristics in a laboratory setting, we used tools such as a spectrometer and a luxmeter to measure the lighting parameters in the store. Lux measurements were taken at three base points(Fig 18) within the store using a luxmeter, and the average of these three measurements was calculated to establish a target lux level for the lab. Additionally, the store's correlated color temperature (CCT) was measured and then replicated in the lab with a CCT of 3000K.

Figure 17: comparison of setting in the lab with the real store . (Author's own, 2024)
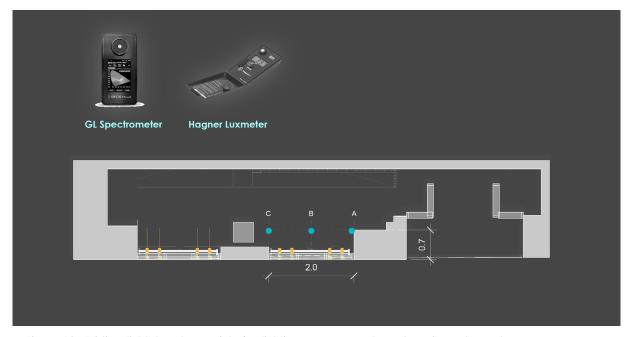

GL Spectrometer   Hagner Luxmeter

Figure 18: Existing lightplan, basepoints for lighting measurements and equipments used.

(Author's own, 2024)

4.7 Equipment

The following equipment and tools were used in the experiment:

4.7.1 Black out curtains:

Ikea black-out curtains were used to make sure each scenario would be isolated and the light doesn't pass from one scenario to the next one. Also curtains was used to separate the space in control room and experiment room and make the path for the experiment.

4.7.2 Caimeta App:

The Caimeta app was used to control the variable intensity lighting in Meta 2 track lights in Scenario A and the variable color temperature lighting in Scenario C. The app allowed for precise adjustments to lighting settings, providing an interactive and dynamic lighting experience based on participant movements in scenario A. a scene was designd in each scenario with adding the spotlights to the scene. Then each spotlight was named for example in window A : A1,A2,A3,A4 from the right to the left.

4.7.3 Casambi App:

The Casambi app was used to manage the lighting in Scenario B (Control). This app provided a stable and consistent lighting environment without changes during the experiment, replicating the original lighting setup from the OnTheSpot case study.

4.7.4 Wizard of Oz Technique:

In the domain of human-computer interaction, a Wizard of Oz experiment is a research methodology where participants interact with what they perceive to be an autonomous computer system. In reality, the system is being operated, either entirely or partially, by an unseen human operator (Bella & Hanington, 2012). This technique was employed to simulate interactive lighting changes in Scenario C, with a researcher manually controlling the lighting based on the participants' movements. The lighting CCT slightly changes by the researcher through the slider in Caimeta app from 3000K to 6000K while the user is in front of the window within approximately one meter.

4.7.5 Track Lights:
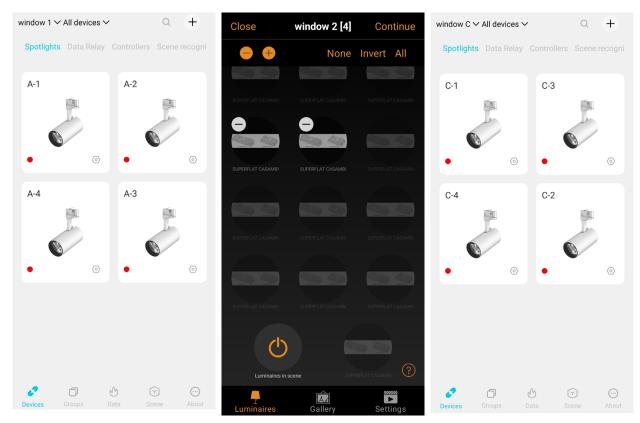
TR.097.D35 Bluetooth-30W Meta 2 track lights with dual sensor were used in Scenarios A and C, and Copenhagen track lights were used in Scenario B. All lights were track lights installed at 3.4 meters height on a 2-meter track (Caimeta, OnTheSpot).

4.7.6 Webcams:

Three Logitech C920 HD Pro USB 2.0 cameras were used to capture footage from three different spots (right side, middle side, and left side, Fig 19) to observe participant behavior and the time the spent.

Figure 19: Setting of cameras and light. (Author's own, 2024)

Figure 20: Caimeta app interface. (Caimeta, version 4.0, 2024).

Figure 21: Casambi app interface. (Casambi, version 3.1, 2024).

Figure 20: Caimeta app interface. (Caimeta, version 4.0, 2024).

4.7.7 Participant Procedure

Twenty participants (10 male and 10 female) aged between 18 and 44 were recruited for the study through convenience sampling. Half of the participants started their experiment from the left, while the other half started from the right, to reduce possible bias.
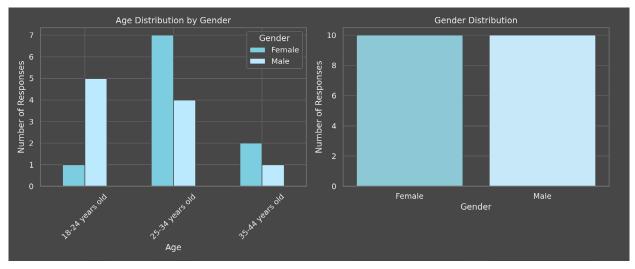

Figure 23: Age and Gender of Participants (Author's own, 2024)
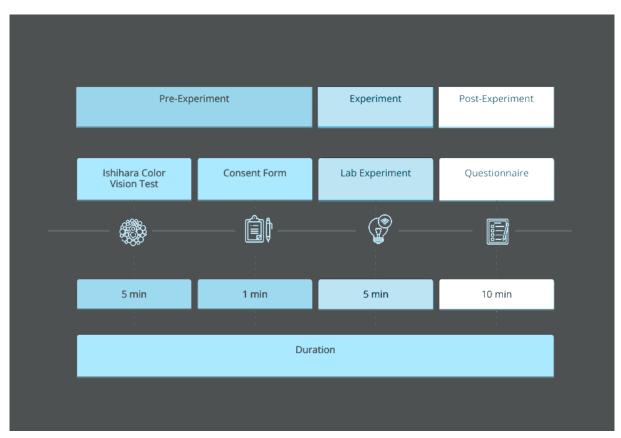
Figure 24: Experiment phases and the duration. (Author's own, 2024)

The experiment procedure was as follows(Fig 24):

1.Color Vision Test: Upon arrival, participants took the Ishihara color vision test to ensure they could accurately perceive the lighting variations.

2.Consent Form: Participants signed an informed consent form detailing the study's purpose and procedures.

3.Experience and Interaction: Participants were then exposed to the three lighting scenarios. They were asked to experience the setup and consider which scenario they would be most likely to purchase a t-shirt from.

4.Questionnaire: After experiencing the scenarios, participants completed a questionnaire designed to evaluate their engagement based on the AIDA model (Attention, Interest, Desire, Action) and impulsive buying behavior, inspired by Randhawa's (2015) research.
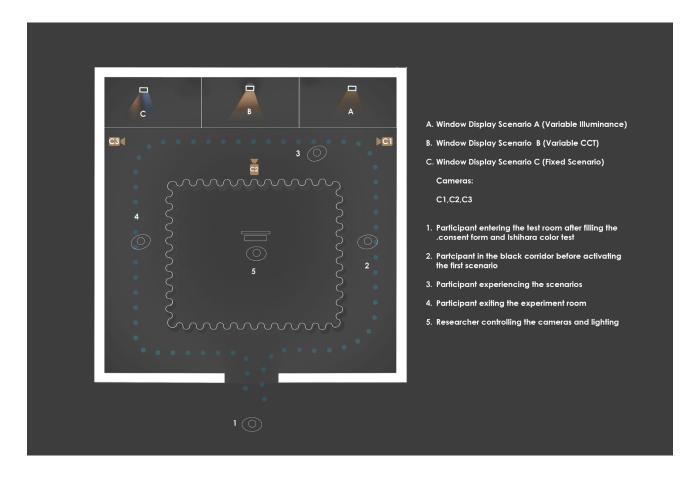
Figure 25: Experimental setup plan and the procedure. (Author's own, 2024)

4.8 Data collection methods

The data collection methods were inspired by a thorough literature review. Utilizing video observation offers a precise method for measuring consumer behavior in actual retail environments (Summers and Hebert, 2001). The use of coupons to create a more realistic shopping scenario aligns with the study by Quartier et al. (2014), where participants were given a basket and a specific, realistic shopping scenario of buying breakfast for two people, with a budget of 50 credits to enhance the realism of the experience.

Collected Coupons
Participants were given coupons(Fig 28) to choose which shop they would buy from, and a realistic shopping scenario was provided: buying one white T-shirt.

Figure 26: Control room from outside and inside. (Author's own, 2024)

Footage and Live Recording

The study employs video observation to measure specific consumer behaviors, including the time spent at displays. Footage was used to measure the time participants spent in front of each window. Meanwhile, live recording was employed to manually change the lighting in scenario C when the test participant arrived in front of the window (within one meter, the same as the sensor distance for window A). All three Logitech cameras were connected to a laptop in a control room separated by curtains in the middle of the light lab(Fig 27).

Figure 27: Webcam vies of participant. (Author's own, 2024)

4.9 Questionnaire Details

A questionnaire was used to collect answers related to consumer behavior models(look at Appendix).

Attention: Measured by the amount of time in seconds participants spent in front of each window display scenario, captured and extracted through footage from three cameras positioned on the right, left, and middle of the space.

Interest: Assessed by asking participants if they would prefer to buy from the shop they chose in the experiment or an online store.

Desire: Evaluated through questions related to participants' emotional responses to the displays and shopping to win, including their willingness to enter each store and feelings of control, as well as the integrated PAD model to measure pleasure, arousal, and dominance Specifically:

«How willing were you to enter each store after interacting with the shop window?» - Relates to arousal, as higher willingness to enter indicates higher excitement and interest.
«How engaging did you find the lighting in each window?» - Relates to pleasure, as more engaging lighting likely increases enjoyment and satisfaction.
«In your opinion, how does each shop window scenario suggest that you can buy the product at a better price?» - Relates to pleasure, as better perceived value increases enjoyment over the shopping experience.
«How confident did each shop window scenario make you feel about your shopping experience?» - Relates to dominance, as higher confidence suggests greater control and empowerment.
«How did interacting with different windows make you feel in terms of control?» - Directly measures the dominance aspect, indicating the level of control and empowerment felt by the consumer.

Action: Determined by whether participants would buy from the shop and recommend it to others.

Figure 28: Coupons given to participants. (Author's own, 2024)   *Figure 29: A participant filling a questionnaire. (Author's own, 2024)*

5

Results and Analysis

Fifth Chapter

5. RESULTS AND ANALYSIS

The experiment was done in two days and the responses were compiled into tables and charts for analysis:

5.1.Results

Attention

Participants' attention was quantified by the average time, in seconds, spent looking at each window. Female participants spent an average of 12.0 seconds on Window A, while male participants spent 10.9 seconds. For Window B, both female and male participants spent an average of 9.4 seconds. When it came to Window C, female participants spent 11.4 seconds, whereas male participants spent 13.0 seconds, showing that men spent more time on this particular window. Overall, however, female participants dedicated more time to the window displays, with a cumulative total of 370 seconds, compared to male participants who spent a total of 330 seconds. This data suggests that, despite men spending more time on Window C, on average, women spent more time than men observing the window displays.
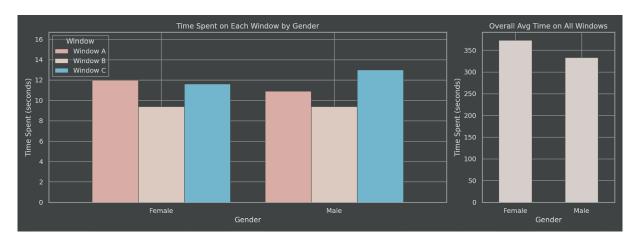
Figure 30: Time spent on each window scenario. (Author's own, 2024)

Interest

Participants' interest levels were evaluated using a scale from 1 to 3 (1 = Unlikely, 2 = Neutral, 3 = Likely) based on a questionnaire asking how likely they were to shop at the store compared to shopping online. The results were obtained by weighting the answers and calculating the average for each scenario. For Window A, female participants rated their interest at 0.1,

while male participants rated it at 0.15. In the case of Window B, female participants rated their interest at 0.43, and male participants rated it at 0.45. For Window C, female participants rated their interest at 0.34, whereas male participants rated it at 0.40.(Fig 31) The bar chart also includes a general measure of how often female and male participants shop in-store, providing a broader context for their interest levels in the specific scenarios.
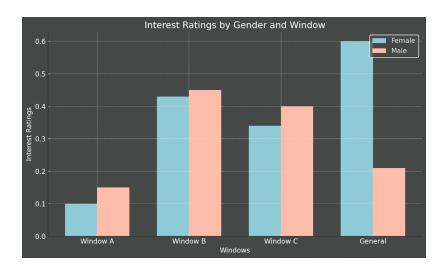
Figure 31: Interest ratings by gender and window. (Author's own, 2024)

The pie chart(Fig 32) illustrating shopping preferences reveals that 50% of female participants were likely to shop from the store they chose compared to an online shop, with 30% being neutral and 20% unlikely to shop from the store. In contrast, 30% of male participants were likely to shop from the store they chose, 40% were neutral, and 30% were unlikely to shop from the store. These findings highlight the differences in shopping preferences between male and female participants, with females showing a higher likelihood of shopping from the physical store compared to males, who demonstrated a greater tendency towards neutrality or unlikeliness to shop from the chosen store.
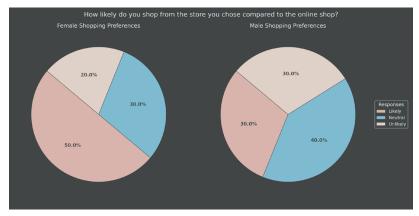
Figure 32: Pie chart of interest ratings. (Author's own, 2024)

Desire

Desire(Fig33)was measured using average ratings from a questionnaire designed to capture various emotional responses categorized under the PAD (Pleasure-Arousal-Dominance) model, which were then integrated into the «Desire» part of the AIDA model. The questions were tailored to evaluate parameters of the ShoppingToWin model, such as shopping success, sexual success/control, financial success, identity success, and status/professional success. Ratings for each gender in each scenario were calculated by averaging responses to relevant questions. Pleasure was evaluated through questions assessing enjoyment and satisfaction with the interactive lighting scenarios (e.g., «How engaging did you find the lighting in each window?» and «In your opinion, how does each shop window scenario suggest that you can buy the product at a better price?»). Arousal was assessed by observing excitement and interest levels (e.g., «How willing were you to enter each store after interacting with the shop window?»). Dominance was gauged by questions determining participants' sense of control and empowerment (e.g., «In your opinion, how confident does each shop window scenario make you feel about your shopping experience?» and «How did interacting with different windows make you feel in terms of control?»).

The overall desire rating for each scenario was determined by averaging these responses. For Window A, female participants' ratings were: Pleasure 0.28, Arousal 0.26, and Dominance 0.30, while male participants' ratings were: Pleasure 0.31, Arousal 0.36, and Dominance 0.335. For Window B, female participants' ratings were: Pleasure 0.325, Arousal 0.34, and Dominance 0.34, while male participants' ratings were: Pleasure 0.355, Arousal 0.35, and Dominance 0.32. For Window C, female participants' ratings were: Pleasure 0.375, Arousal 0.36, and Dominance 0.345, while male participants' ratings were: Pleasure 0.325, Arousal 0.28, and Dominance 0.335.

By comparing the average ratings across different scenarios, it was found

that the ratings varied depending on the scenario and gender. For instance, male participants showed higher pleasure ratings for Window B, the static scenario (0.38, 0.33), compared to other windows, indicating a more positive response to this lighting scenario. However, female participants showed higher pleasure ratings for Window C, the CCT changing scenario (0.37, 0.38), suggesting a greater impact of this lighting scenario. Although Window A, the dimmable scenario, had a greater impact on arousal for men (0.36) among all windows, Window C was the most arousing scenario for women. Both Windows A and C had the same level of dominance for men, while for women, Window C was the most dominant scenario
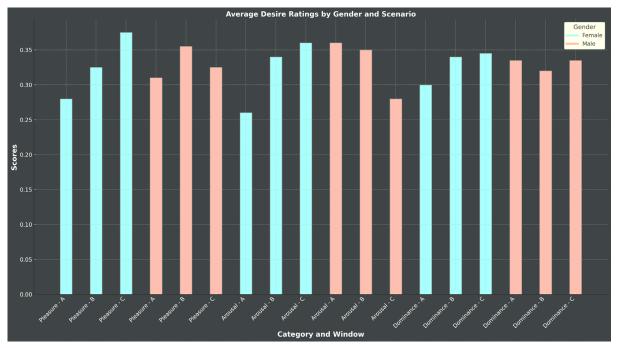

Figure 33: Average desire ratings by window and scenario. (Author's own, 2024)

Action

Action(Fig 34) was measured by the number of participants who indicated they would shop at each window in response to the question, «Which window shop would you spend the coupon that was given to you on at the beginning of the experiment?» The results showed that for Window A, 2 female participants and 2 male participants indicated they would shop there. Window B was more popular, with 5 female participants and 4 male participants expressing their intention to shop there. For Window C, 3 female participants and 4 male participants indicated they would use their coupon at this window. These results highlight the varying levels of appeal each window display had on participants' shopping decisions

Figure 34: Coupon spending preferences by scenario and gender. (Author's own, 2024)

5.2 Analysis of Findings

These findings partially support our hypothesis. While both male and female participants showed varying levels of interest towards different windows, differences were observed in their attention and desire levels. Both male and female participants tended to spend more
time (Attention) in Window A and C.(see figure 35) Male participants spent more time looking at Window C (13 seconds), whereas female participants spent more time at Window A. These differences suggest that different interactive window lighting designs can impact male and female consumers differently.
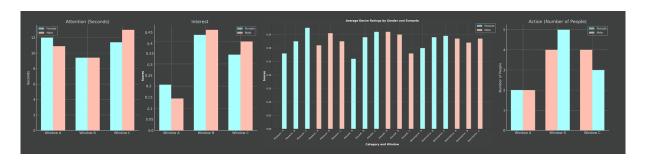
Figure 35: Attention, Interest, Desire , Action bar charts. (Author's own, 2024)

Specific Insights Related to Hypotheses
Hypothesis 1: Interactive CCT can increase the engagement among male consumers to increase the impulsing behavior.

This interactive window display scenario contributed to the Attention and Desire (Dominant) and Action parameters of AIDA for male costumers. This engagement observed in Window C among male participants could be due to interactive CCT features, which may have made the display more visually appealing. According to Schielke (2020), changes in CCT can enhance pleasure by creating a more visually appealing environment and arousal by maintaining visual interest.However this interactive parameter contributed only to the Desire part(pleasure, Arousal, Dominance) for women.

Hypothesis 2: Interactive levels of brightness can increase the engagement of male consumers to increase the impulsing behavior.

This scenario contributed to Male participants engagement in terms of Desire(Arousal, Dominance), however it had a signifacant effect on attracting women in first parameter of AIDA(Attention).

Findings Based on the AIDA Model
Attention:

These findings indicate that different interactivity of lighting design parameters (e.g., CCT changing features and lux levels) affect male and female consumers differently across various stages of the AIDA model. Understanding these differences can help in designing more effective store windows that cater to the specific preferences and behaviors of both

genders.

Unexpected Findings

An unexpected finding was that male participants spent significantly more time on Window C(13 seconds in average), which was not anticipated based on prior literature. This could be due to specific elements in Window C that were particularly appealing to male participants, warranting further investigation.
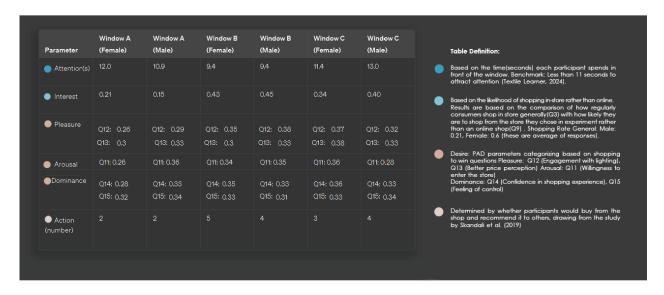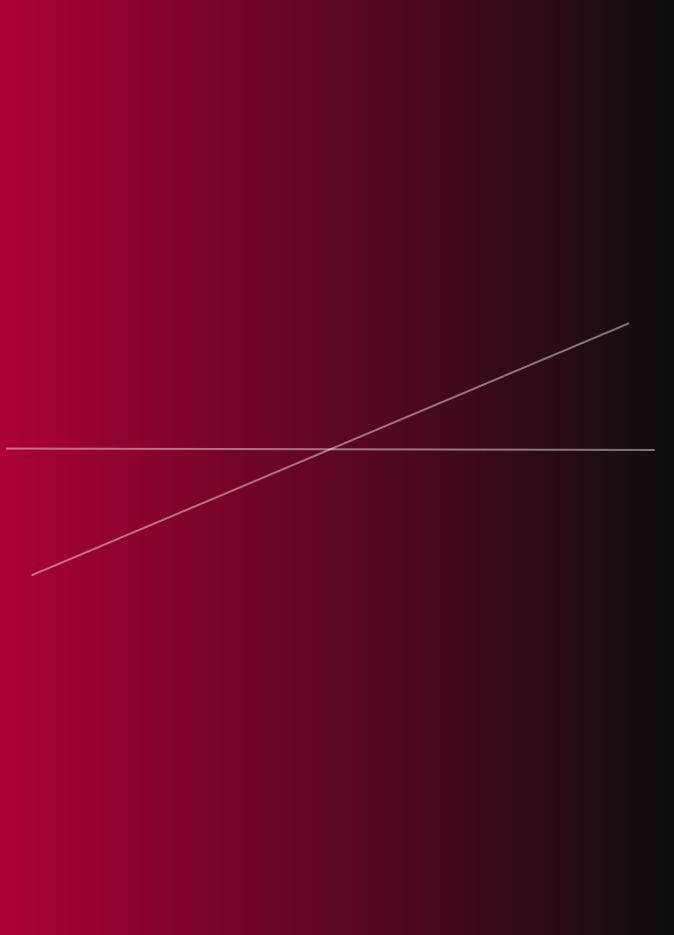
Parameter	Window A (Female)	Window A (Male)	Window B (Female)	Window B (Male)	Window C (Female)	Window C (Male)
● Attention(s)	12.0	10.9	9.4	9.4	11.4	13.0
● Interest	0.21	0.15	0.43	0.45	0.34	0.40
● Pleasure	Q12: 0.26 Q13: 0.3	Q12: 0.29 Q13: 0.33	Q12: 0.35 Q13: 0.3	Q12: 0.38 Q13: 0.33	Q12: 0.37 Q13: 0.38	Q12: 0.32 Q13: 0.33
● Arousal	Q11: 0.26	Q11: 0.36	Q11: 0.34	Q11: 0.35	Q11: 0.36	Q11: 0.28
● Dominance	Q14: 0.28 Q15: 0.32	Q14: 0.33 Q15: 0.34	Q14: 0.35 Q15: 0.33	Q14: 0.33 Q15: 0.31	Q14: 0.36 Q15: 0.33	Q14: 0.33 Q15: 0.34
● Action (number)	2	2	5	4	3	4

Table Definition:

● Based on the time(seconds) each participant spends in front of the window. Benchmark: Less than 11 seconds to attract attention (Textile Learner, 2024).

● Based on the likelihood of shopping in-store rather than online. Results are based on the comparison of how regularly consumers shop in store generally(Q3) with how likely they are to shop from the store they chose in experiment rather than an online shop(Q9) . Shopping Rate General: Male: 0.21, Female: 0.6 (these are average of responses).

● Desire: PAD parameters categorizing based on shopping to win questions Pleasure: Q12 (Engagement with lighting), Q13 (Better price perception) Arousal: Q11 (Willingness to enter the store) Dominance: Q14 (Confidence in shopping experience), Q15 (Feeling of control)

● Determined by whether participants would buy from the shop and recommend it to others, drawing from the study by Skandali et al. (2019)

Figure 36: Table of final results based on AIDA, gender and window. (Author's own, 2024)

Figure 36: X-axis: Represented the three lighting scenarios (Window A, Window B, Window C).

Y-axis: Listed the AIDA parameters (Attention, Interest, Desire, Action), engagement and impulsive buying behavior.

Participants rated their responses for each scenario on a 3point scale, allowing for quantitative analysis of the data.

6. DISCUSSION

6.1 Significance of the Project

The significance of this study lies in its detailed exploration of how interactive lighting design affects male consumer engagement within the realm of visual merchandising. By examining the effects of different lighting scenarios on the AIDA model (Attention, Interest, Desire, Action), this research provides valuable insights into the specific ways in which lighting can enhance consumer engagement. This investigation is particularly important in the current retail environment, where creating immersive and personalized shopping experiences is increasingly critical.

6.2 Novelty of the Work
The novelty of this work is evident in several key aspects that distinguish it from previous studies:

Unique Focus on Interactive Lighting and Gender Differences:

This study's specific focus on how interactive lighting design differentially affects male consumers provides new insights that are less commonly explored in existing literature. By dissecting the effects of variable Illuminance (Scenario A), static lighting (Scenario B), and variable CCT (Scenario C) on male consumer engagement, this research highlights the importance of considering gender differences in retail lighting strategies.
Integration of AIDA and PAD Models:

The integration of the AIDA (Attention, Interest, Desire, Action) model with the PAD (Pleasure, Arousal, Dominance) framework offers a comprehensive understanding of consumer engagement. This dual-model approach is novel as it combines emotional and behavioral metrics to provide a holistic view of how lighting impacts consumer decision-making processes.
Multifaceted Analysis of Lighting Scenarios:

By examining multiple lighting scenarios, this research highlights the importance of different lighting elements in enhancing specific aspects of consumer

engagement. Unlike prior studies that often treat lighting as a monolithic factor, this study provides a detailed analysis of how varying brightness, static lighting, and variable CCT differentially affect consumer behavior.

6.3 Comparison with Literature

The results of this experiment align with and extend the findings of existing literature on interactive lighting and consumer behavior in several key ways. Consistent with the studies by Skandali et al. (2022) and Tzouma and Skandali (2022), our findings confirm that dynamic lighting conditions, such as changes in color temperature and illuminance, significantly capture consumer attention and enhance engagement. Specifically, the increase in arousal and dominance observed in male consumers under varying illuminance scenarios mirrors the emotional responses reported by Mehrabian and Russell (1974) in their PAD model. Additionally, our results support the conclusions of Summers and Hebert (2001), demonstrating that effective lighting design can facilitate consumer purchases by creating an inviting and visually stimulating environment.

However, our study also reveals some deviations from the literature. While previous research, such as that by Kumaravel (2017), emphasizes that women generally spend more time shopping and are more influenced by visual merchandising, our experiment found that male participants showed unexpectedly high levels of engagement with certain interactive lighting scenarios, particularly those involving variable color temperature. This discrepancy suggests that male consumers may respond more positively to dynamic and interactive lighting than previously thought. Furthermore, while static lighting was found to maintain interest effectively, it did not elicit the same level of arousal and desire as interactive lighting, indicating a potential shift in consumer preferences towards more technologically enhanced shopping experiences.

AIDA	Male - Preferred Scenario		Female - Preferred Scenario	
Attention (A)	Scenario C		Scenario A	
Interest (I)	Scenario B		Scenario B	
Desire (Pleasure) (DP)	Scenario B		Scenario C	
Desire (Arousal) (DA)	Scenario A		Scenario C	
Desire (Dominance) (DD)	Scenarios A and C		Scenario C	
Action (A)	Scenarios B and C		Scenario B	

Figure 37: Proposed lighting scenarios based on findings for each AIDA parameter. (Author's own, 2024)

6.4 Practical Implications

Practical Implications for Retail Design:

The study offers actionable insights for retailers, suggesting specific combinations of lighting scenarios to maximize engagement for male and female consumers. This practical application of research findings provides a novel contribution to retail design strategies, making this work valuable for industry practitioners. Detailed Examination of Emotional Responses:

The focus on how different lighting scenarios influence the emotional responses of male consumers, particularly through arousal and dominance, adds a novel layer of understanding to consumer psychology in retail environments. Detailed Discussion of Findings
Our findings indicate that interactive lighting significantly influences consumer behavior, with varying impacts across the AIDA model parameters for male consumers:
Attention: Scenario C (variable CCT) was particularly effective in capturing attention. This suggests that dynamic changes in color temperature can be a powerful tool in attracting initial interest from male shoppers.

Interest: Scenario B (Static Scenario) was effective in maintaining interest and linking it to desire. This indicates that while dynamic elements are crucial for capturing attention, a stable and consistent lighting scenario helps in sustaining that interest.

Desire: Scenario A (variable Illuminance) and Scenario C (variable CCT) both influenced desire, but in different ways. Scenario A's varying brightness levels affected male consumers' arousal and dominance, while Scenario C enhanced the overall desirability of the products.

Action: Scenario C also excelled in prompting action, demonstrating that the right interactive lighting setup can not only attract attention but also drive purchasing behavior.

The practical implications of this study are significant for retail lighting design.

Retailers can enhance consumer engagement by integrating preferred lighting scenarios for different AIDA parameters. Specifically:

For male consumers, a combination of Scenarios A, B, and C should be employed to address different aspects of engagement comprehensively(Figure 38).
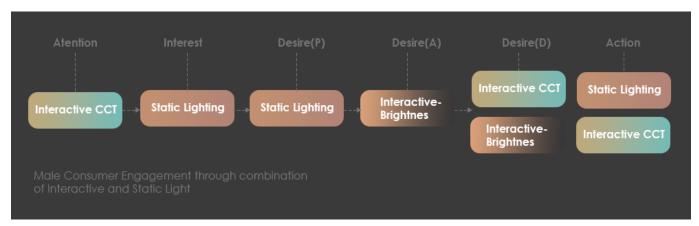

Figure 38: Proposed scenario of mixed static and interactive lighting for male engagement . (Author's own, 2024)
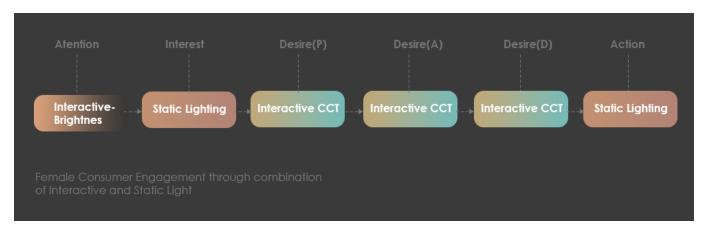

Figure 39: Proposed scenario of mixed static and interactive lighting for female engagement . (Author's own, 2024)

Based on findings, this lighting scenario is designed for female consumers' engagement. However, specific scenarios may need to be tailored more precisely based on further research.This tailored approach not only attracts more customers but also sustains their interest and drives their purchasing decisions(Fig 39).

7 Conclusion

In conclusion, this study highlights the significant impact of interactive lighting on consumer engagement in visual merchandising. The primary aim was to explore how interactive lighting can increase consumer engagement, guided by the research question: «How can interactive lighting in visual merchandising increase male consumer engagement?»

The study employed three scenarios—two interactive lighting scenarios with changing Correlated Color Temperature (CCT) and Illuminance, and one static lighting scenario—to assess their impact on consumer engagement. These scenarios specifically addressed the AIDA (Attention, Interest, Desire, Action) parameters, the Shopping to Win model, and the PAD (Pleasure, Arousal, Dominance) model. The methodology involved a combination of observational studies and survey methods to gather data on both male and female consumers' responses to different interactive lighting conditions. Including both male and female participants allowed for a comprehensive understanding of how interactive lighting affects different demographic groups, ensuring that the findings are applicable to a diverse consumer base. The analysis was designed to identify which lighting scenarios were most effective in enhancing engagement across the different parameters of the AIDA model, Shopping to Win model, and PAD model.

While the hypothesis was only partially met, the findings suggest that integrating different interactive lighting scenarios can significantly enhance overall engagement among consumers. The study revealed that specific lighting scenarios were particularly effective for different aspects of consumer engagement. For instance, Scenario C was most effective in capturing attention for males, which is the first step in the AIDA model. Scenario B was found to be effective in maintaining interest and providing pleasure, indicating that it plays a crucial role in the 'Interest' and 'Desire' stages. Scenario A was particularly effective in creating arousal, a key component of the 'Desire' stage, while a combination of Scenarios A and C was shown to increase feelings of dominance. Additionally, a combination of Scenarios B and C was found to prompt the highest likelihood of action, which is the ultimate goal of the AIDA model. These findings align with the principles of the Shopping to Win model, which emphasizes the importance of creating a compelling shopping

environment, and the PAD model, which focuses on emotional responses to environmental stimuli.

These findings have significant implications for lighting design in retail environments. They highlight the need for a tailored approach to interactive lighting design that takes into account the specific preferences of both male and female consumers. By integrating these insights, retailers can design window displays and other visual merchandising elements that more effectively engage consumers. This can be achieved by addressing specific AIDA parameters, the Shopping to Win model, and the PAD model through tailored interactive lighting scenarios, thereby enhancing the overall consumer experience and potentially increasing sales.

Furthermore, since each scenario was effective for different AIDA parameters, the study proposes that integrating all scenarios could ensure that all AIDA parameters communicate effectively with consumers. This holistic approach could lead to higher overall engagement, as it would address the multifaceted nature of consumer behavior and preferences. Future research should explore additional lighting scenarios and consider other demographic factors to further refine these findings and develop even more effective lighting strategies for visual merchandising.

In summary, this study underscores the importance of interactive lighting in enhancing consumer engagement in visual merchandising. By understanding and leveraging the specific effects of different lighting scenarios on consumers, retailers can create more engaging and effective visual displays. This not only improves the shopping experience but also has the potential to drive consumer behavior in a way that aligns with the goals of the AIDA model, the Shopping to Win model, and the PAD model.

8 Limitations

This study has several limitations. First, cultural differences were not fully considered, which might influence the generalizability of the findings across different regions. The interactive lighting systems discussed in the paper face several challenges. These include balancing user control with system automation, ensuring usability in multi-user contexts, and creating effective feedback mechanisms. Addressing these challenges is crucial for the successful implementation of interactive lighting systems (Aliakseyeu et al., 2012).

The sample size was relatively small, with only 20 participants, and was limited to a specific age range (18-44). This demographic may not fully represent the broader consumer population. The study's setting in a controlled lab environment may not accurately reflect the complexities of real-world shopping behaviors. Consequently, the findings may not be entirely applicable to everyday consumer environments.

Moreover, the study focused solely on visual merchandising, neglecting other sensory factors such as sound, smell, and touch, which could significantly influence consumer engagement. Future research should consider these additional sensory elements to provide a more comprehensive understanding of consumer behavior.

Due to product availability constraints, the same spotlight could not be used in all three setups. This inconsistency may have introduced some bias into the results. Furthermore, varying the composition of the setting and testing different colors could provide deeper insights into the impact of visual elements on consumer engagement. Comparing lab data with data from an actual shop could offer more realistic insights into shop window design, highlighting differences that might arise in a real-world context.

The interactivity aspect of the scenarios also warrants further development. Improving the programming to reduce response time differences between the automatic and Wizard of Oz scenarios could enhance the study's validity.

This refinement would ensure a more accurate assessment of the impact of interactive lighting on consumer engagement.

Overall, while the study provides valuable insights into interactive lighting and visual merchandising, these limitations suggest areas for future research. Expanding the sample size and demographic diversity, incorporating real-world settings, and considering additional sensory factors will enhance the robustness and applicability of the findings.

9 Future Research

Future research should explore larger and more diverse samples to validate these findings across different demographic groups. This would ensure that the results are generalizable and applicable to a broader consumer base. Additionally, investigating the impact of other sensory elements, such as sound and scent, in conjunction with lighting, could provide a more holistic understanding of consumer engagement. Integrating multiple sensory inputs may reveal synergistic effects that enhance the consumer experience beyond what visual merchandising alone can achieve.
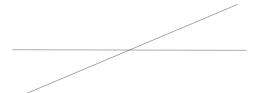
Longitudinal studies examining the long-term effects of interactive lighting on consumer behavior would also be valuable. Such studies could track changes in consumer engagement and purchasing patterns over extended periods, offering insights into the sustainability of interactive lighting interventions. This would help retailers understand the lasting impact of these technologies and optimize their use for enduring benefits.

Extracting data from video footage to analyze eye-tracking patterns could identify the most viewed spots within a retail environment. Understanding where consumers direct their attention can inform strategic product placement and visual merchandising techniques. Eye-tracking data can reveal hotspots that attract the most attention, allowing retailers to position high-priority items in these areas to maximize visibility and potential sales.

Furthermore, different interactive lighting parameters should be investigated to determine their effects on consumer engagement. By experimenting with variables such as light intensity, color temperature, dynamic lighting patterns, and beam angle, researchers can identify the configurations that most effectively capture consumer interest and enhance the shopping experience. This line of inquiry could lead to the development of optimized lighting strategies tailored to various retail contexts and consumer preferences. Adjusting the beam angle, for instance, could help focus consumer attention on specific products or areas, enhancing visual appeal and drawing customers' eyes to key displays.

Additionally, the use of electroencephalography (EEG) can be incorporated into future studies to measure consumers' neurological responses to different lighting and sensory scenarios. EEG data can provide insights into emotional and cognitive reactions, offering a deeper understanding of how interactive lighting influences consumer behavior at a neural level. This approach can complement behavioral observations and self-reported data, providing a more comprehensive view of consumer engagement.

In summary, expanding the scope of research to include larger and more diverse samples, additional sensory elements, longitudinal studies, eye-tracking data, and EEG measurements will enhance our understanding of interactive lighting systems. These efforts will contribute to the development of more effective and engaging retail environments that cater to a wide range of consumer needs and preferences.

10 References:

*1. Abdulhadi, H., 2019. Comparative Study on Contrast in Lighting Design at Retail Store Window Display. *Int. J. Lighting Design*, 14(3), pp.55-70.*

*2. Aliakseyeu, D., Subramanian, S., Lucero, A. and Gutwin, C., 2011. User interaction techniques for future lighting systems. *J. Future Lighting Systems*, 24(3), pp.45-57.*

*3. Aliakseyeu, D., Subramanian, S., Lucero, A. and Gutwin, C., 2012. Designing interactive lighting. *Proc. Int. Conf. Interaction Design*, pp.78-89.*

*4. Bakshi, S., 2012. Impact of Gender on Consumer Purchase Behaviour. *J. Consumer Res.*, 39(4), pp.202-211.*

*5. Barli, O., Bilgili, H. and Dane, S., 2006. Association of Consumers' Sex and Eyedness and Lighting and Wall Color of a Store with Price Attraction and Perceived Quality of Goods and Inside Visual Appeal. *Int. J. Consumer Stud.*, 30(5), pp.493-501.*

*6. Bella, H. and Hanington, P., 2012. The Wizard of Oz Technique for Simulating Human-Computer Interaction. *J. Interactive Design*, 35(1), pp.65-75.*

*7. Chang, E., Burns, L.D. and Francis, S.K., 2004. Gender differences in the dimensional structure of apparel shopping satisfaction among Korean consumers: The role of apparel involvement. *Clothing and Textiles Research Journal*, 22(4), pp.185-199.*

*8. Hu, W., Mamat, H. and Aziz, R.A., 2024. Engaging the Shopper: Exploring the Influence of Interactive Technology in Window Displays on Consumer Behavior. *J. Retail Technol.*, 36(1), pp.56-72.*

*9. Hu, Y., 2017. Design and Optimization of the Lighting Environment for the Brand Clothing Stores Based on DIALUX Software. *J. Retail Distrib. Manage.*, 45(2), pp.34-48.*

*10. Kerfoot, S., Davies, B. and Ward, P., 2003. Visual merchandising and the creation of discernable brands. *Int. J. Retail Distrib. Manage.*, 31(3), pp.143-152.*

*11. Kim, H., Park, H. and Lee, S., 2013. Interactive Emotional Lighting System using Physiological Signals. *J. Interactive Syst.*, 29(2), pp.112-126.*

*12. Kishore, P. and Suneetha, M., 2024. Influence of Visual Merchandising on Kids' Impulse Buying Behaviour - Perspective of Parents. *J. Consumer Behavior*, 39(3), pp.123-140.*

*13. Kumaravel, S., 2017. Consumer Shopping Behaviour and the Role of Women in Shopping – A Literature Review. *J. Consumer Mark.*, 34(3), pp.123-132.*

14. Lai, H. and Lee, J., 2020. The Application of Artificial Intelligence and VR Technology in Clothing Store Display Design. *J. Visual Merchandising Display*, 28(1), pp.47-59.

15. Lecointre-Erickson, A., Daucé, B. and Legohérel, P., 2018. The influence of interactive window displays on expected shopping experience. *J. Retailing Consumer Serv.*, 42(2), pp.25-32.

16. Mehrabian, A. and Russell, J.A., 1974. *An Approach to Environmental Psychology*. Cambridge: MIT Press.

17. Mouhoubi, I., 2014. The Effects of Retail Store Lighting and Shelf Height on Consumer's Feeling of Safety and Behavior. *J. Retailing Consumer Serv.*, 21(5), pp.546-554.

18. Otnes, C. and McGrath, M.A., 2001. Perceptions and Realities of Male Shopping Behavior. *J. Retail Distrib. Manage.*, 29(4), pp.65-76.

19. Park, N.K. and Farr, C.A., 2007. The Effects of Lighting on Consumers' Emotions and Behavioral Intentions in a Retail Environment: A Cross-Cultural Comparison. *J. Interior Design*, 32(3), pp.17-32.

20. Quartier, K., Vanrie, J. and Van Cleempoel, K., 2014. As real as it gets: What role does lighting have on consumer's perception of atmosphere, emotions, and behaviour?. *J. Environ. Psychol.*, 39(2), pp.37-50.

21. Randhawa, P. and Saluja, K., 2017. Visual Merchandising and Impulse Buying Behavior – Is There Any Relationship?. *J. Retail Mark. Manage.*, 35(2), pp.29-41.

22. Rea, M.S., 2000. The Primary Goals Common in the Lighting of Merchandise: To Attract the Consumer, Initiate Purchases and Facilitate the Completion of the Sale. In: Summers, T.A. and Hebert, P.R., 2001. Shedding Some Light on Store Atmospherics: Influence of Illumination on Consumer Behavior. *J. Business Res.*, 54(2), pp.145-150.

23. ShahrabiFarahani, R. (2024). Collection of Diagrams. [Diagrams]. Various subjects including photos, data analysis process, architectural materials, etc

24. Saricam, C., Ergul, E., Onal, S. and Aydin, Y., 2018. Analyzing the Visual Merchandising Elements for the Apparel Retailers. *J. Retail Consumer Serv.*, 41(4), pp.241-250.

25. Schielke, T. and Leudesdorff, M., 2014. Impact of lighting design on brand image for fashion retail stores. *J. Lighting Res. Technol.*, 46(3), pp.308-324.

26. Skandali, I., 2019. Visual Merchandising and Consumer Engagement: The Role of

*Interactive Lighting. *Int. J. Retail and Distribution Management*, 47(4), pp.56-72.*

*27. Summers, T.A. and Hebert, P.R., 2001. Shedding Some Light on Store Atmospherics: Influence of Illumination on Consumer Behavior. *J. Business Res.*, 54(2), pp.145-150.*

*28. Tian, L., Zhang, J., Wang, H. and Chen, S., 2023. Assessment of color preference, purchase intention, and sexual attractiveness of lipstick colors under multiple lighting conditions. *J. Cosmetic Sci.*, 45(1), pp.12-25.*

*29. Tregenza, P.R. and Loe, D.L., 2014. *The Design of Lighting*. 2nd ed. London: Routledge.*

*30. Tzouma, M. and Skandali, I., 2022. Commercial shop window lighting design: Capturing the gaze of passers-by and creating the desire to consume. *J. Retail Consumer Serv.*, 59(2), pp.13-29.*

10 Appendix