COSTUMERS' EMOTIONAL AND BEHAVIORAL RESPONSES UNDER DIFFERENT ACCENT LIGHTING CONDITIONS IN A REAL RETAIL STORE

A Master's Thesis

by

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The Graduate School of Economics and Social Sciences
of
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İHSAN DOĞRAMACI BİLKENT UNIVERSITY

November 2018

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Interior Architecture and Environmental Design.

Assist. Prof. Dr. Semiha Yılmazer
Supervisor

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Interior Architecture and Environmental Design.

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Fine Arts in Interior Architecture and Environmental Design.

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ABSTRACT

COSTUMERS' EMOTIONAL AND BEHAVIORAL RESPONSES UNDER DIFFERENT ACCENT LIGHTING CONDITIONS IN A REAL RETAIL STORE

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MFA, Department of Interior Architecture and Environmental Design

Advisor: Assist. Prof. Dr. Semiha Yılmazer

November, 2018

The aim of the study is to understand the influence of lighting color temperature on costumers' emotional and behavioral responses in a real retail store. In the experiment three different color temperatures were used on LED track spot lights that illuminates a living room furniture set. This study was conducted with 90 participants who were customers and accepted participant acceptance protocol. Thirty customers participated for each lighting condition (2700K as Warm White (WW), 5000K as Artificial Daylight (DL), 6500K as Cool White (CW)). Observation method was used to conduct behavioral analysis. Behavior mapping was used to analyze understanding of the custumers' behavioral responses. Mehrabian and Rusell's M-R model was used to analyze emotional responses. PAD (Pleasure, Arousal, Dominance) model was preferred to conduct a questionnaire in order to measure customers' emotional responses. Results showed that color temperature influenced on costumers' emotional and behavioral responses. Under warm white (WW) color temperature, people feel

more pleasure than cool white color temperature. Under WW color temperature people spent more time in front of the illuminated furniture set. Contrast color temperatures (WW and CW) increased the levels of pleasure and arousal scales of emotional responses.

Keywords: Accent Lighting, Color Temperature, Consumers' Behavior, Emotional Responses Retail Store,

ÖZET

GERÇEK BİR MAĞAZADAKİ FARKLI IŞIK KOŞULLARI ALTINDA MÜŞTERİLERİN DUYGU DURUMLARI VE DAVRANIŞLARININ ANALİZİ

Gümüşay, Büşra

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Kasım, 2018

Bu çalışmanın amacı, gerçek bir mobilya mağazasında, ışığın farklı renk sıcaklıklarının kullanıcıların duygu durumları ve davranış biçimleri üzerindeki etkilerini araştırmaktır. Deneyde üç farklı renk sıcaklığındaki LED spot aydınlatma elemanları ile belirlenen bir oturma grubunu aydınlatılmıştır. Çalışma, katılım protokolünü kabul eden 90 katılımcı ile gerçekleştirilmiştir. Her aydınlatma koşulu (2700K Sıcak Beyaz, 5000K Yapay Günışığı, 6500K Soğuk Beyaz renk sıcaklığı) altında 30'ar farklı katılımcı ile değerlendirilmiştir. Gözlem yöntemi, davranış haritalarını oluşturmak için kullanılmıştır. Mehrabian ve Russel tarafından tanımlanan M-R modeli ile katılımcıların duygu durumları ölçülmüştür. M-R modeli içerisinde uygulanan, Memnuniyet, Harekete Geçme ve Baskınlık başlıkları altında duygu durumları için sıfat çiftlerinden oluşan anket soruları uygulanmıştır. Sonuç olarak, ışığın renk sıcaklığının duygu durumları ve davranış biçimleri üzerinde ciddi etkileri olduğu ortaya konmuştur. Kullanıcılar Sıcak Beyaz renk sıcaklığı altında daha fazla memnuniyet hissetmişlerdir. Kontrast renk sıcaklığı olarak algılanan sıcak beyaz

ve soğuk beyaz renk sıcaklıklarının memnuniyet ve harekete geçme duyguları üzerinde pozitif etkiye sahip olduğu saptanmıştır.

Anahtar Kelimeler: Duygu Durumları, Mağaza Aydınlatması, Müşteri Davranış Biçimleri, Renk Sıcaklığı,

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I would like to express my appreciation to staff of the Ladin brand furniture store where I conducted my experiment, without their help, it was really difficult to make an experiment in a real store setting.

I would like to express my indebtedness to my precious family; to my father İdris Gümüşay who has always helped and supported me, also worked with me throughout my experiment for this thesis; to my mother Gülay Gümüşay for her patience, help and endless support in my whole life and to my brother Yusuf Mert Gümüşay for his support and kindness. Lastly, I would like to thank my husband Dorukan Özbek for his endless support and love. I dedicate this thesis to my precious family.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Shopping is one of the daily activities of human kind. It might have taken many different styles of shopping through the history of civilization but substantially the notion stays the same. Before the buying, people tried to exchange products between them as a shopping activity. Developments in industrial field changed shopping attitude and people started to shop its current understanding.

Starting from the 1950s, there are increasing numbers of the researchers about the analysis of customer decisions and retail store design settings (Findlay & Sparks, 2002; Baker, Levy, & Grewal, 1992; Bechtel et al., 1987; Havlena & Holbrook, 1986).

Customer decisions generally cover only buying behavior at the beginning, especially among the marketers (Kotler, 1973). Researches include the effects of store setting on the customer buying behavior.

Atmospherics concept defined by Kotler (1973) and this concepts included interior and exterior environmental settings that have possibilities to change customer

behavior (Kotler, 1973). Atmospherics included interior elements like layout, odor, music, color and lighting (Turley & Milliman, 2000).

Lighting and color are found as most effective interior atmospherics that have influences on customer behavior (Barlı et al.,2012; Chen et al., 2016; Chen et al., 2015). Over the last decade, relationships between atmospheric details and customer experiences are analyzed by researchers. Studies are conducted to analyze emotional and behavioral responses as if they are in correlations with each other or not. Researchers mainly focus on emotional responses of customer (Ampenberger et al., 2017; Bakker et al., 2014; Barlı et al., 2012; Bohl, 2012; Bustamante & Rubio, 2017).

Recent studies start to analyze lighting and color influences on emotional responses of customers (Ampenberger, Staggl, & Pohl, 2017; Bailey & Burch, 2017). Some of these studies mainly focus on detailed lighting analyze by researching the effects of lighting on emotions and behavioral intentions. To study on the influences of lighting on emotional responses, the lighting needs to be used as independent variable. This requires the control of all other parameters. It is difficult to keep sufficient experimental conditions in real store settings. Because of this reason, many of the studies that analyze the effect of lighting on emotions and behavioral intentions are conducted in virtual environments or in experimental setups. (Bercík , Horska, Wang, & Chen, 2016; Huang , Ali, & Liao, 2017; Jennings & Kingdom, 2017; Quartier, Vanrie, & Cleempoel, 2014). On the other hand, these experiments between lighting and emotional responses mainly use quantitative data to measure emotional and behavioral responses.

In addition, almost all of the lighting studies in the store environment consider the changes of general lighting conditions (Wang, Luo, Liu, Yang, & Zheng, 2014;

White, Rojas, Mappes, Rautiala, & Kemp, 2017; Yılmaz, 2018), a few of them focused on creating contrasts with general and accent lighting conditions.

This study presents the relationship between lighting color temperature with emotional and behavioral responses of customers in the real retail store setting.

1.1. Aim of the Study

The aim of this study is to analyze the effect of color temperature on customers' behavior and emotions in real retail store under different accent lighting conditions. For this purpose, three different color temperature of LED track spots are located to illuminate the specific area in real furniture store. 2700K, 5000K and 6500K color temperatures are preferred on LED track spots. General lighting color temperature is 5000K. 2700K and 6500K on accent lighting (LED track spots) creates contrast effect in environment. The contrast effect is also analyzed in the experiment. To analyze and understand the effects of color temperature of accent lighting on emotional and behavioral responses could be helpful for designers and marketers to create more powerful store environments that influence customers' emotional and behavioral responses in a positive way.

1.2. Structure of Thesis

This thesis mainly consists of five chapters. The first chapter is a brief introduction to study based on effect of store environment especially luminous environment of stores

on customers' emotion and behavioral analysis. In addition, lighting and emotion relationships are mentioned. This chapter also describes the aim of the study and the structure of the thesis.

The second and third chapters are detailed literature review. Second chapter consists of two main parts based on store lighting studies. In the first part, lighting parameters in store environment are explained. In the second part, researches about the lighting effects on customers' psychological reactions are mentioned.

The third chapter explains the literature about used methodology in this experiment. Firstly, Mehrabian-Russell method about measuring emotions in stores are explained and their questionnaire PAD scale is defined. Lastly, behavior mapping methodology to understand the behavioral analysis of customers is explained. For this methodology, usage of activity pattern maps in the literature is also defined.

The fourth chapter is the main part of the study based on the experimental study. In this chapter, firstly research questions and hypotheses are given. The method of the study is described by explaining the furniture store settings, identification of participant groups, and process of the experiment firstly. Then the design of the experimental study; behavior mapping method and Mehrabian-Russel PAD questionnaires are described respectively. Also, in this chapter, statistical analysis methods and evaluation of the data are presented. Lastly, findings of the study are discussed in relation to the previous studies about the topic mentioned in the second chapter.

The last chapter includes the conclusion and limitations of the study with further recommendations. This chapter contains the important aspects of results, summary of findings and limitations of the study with recommendations for further studies.

CHAPTER II

LIGHTING IN RETAIL STORE ENVIRONMENT

2.1. Lighting as an Atmospheric Tool

Since Kotler (1973) defined atmospherics to the marketing literature, there are several studies have discussed environmental cues effecting customers in a shopping environment (Bohl, 2012). They focused on environmental cues that influences customers' buying behavior.

Environmental psychology and retailing studies proves that environmental design characteristics are crucial for creating pleasurable customer experiences, conveying desired store image and promoting specific behaviors (Rompay, Tanja-Dijkstra, Verhoeven, & Es, 2012). Hull & Harvey (1989) also defines physical design qualities as properties that create unique and well defined environments. They consider design characteristics as micro and molar qualities (Hull & Harvey, 1989).

Light is a significant element for marketing that has crucial influences on customer emotions and retail environment that provides unique retail space. It is an important tool that can be controlled and measured by several parameters such as light intensity, color temperature, illumination angle and color rendering index. By only using the type of lighting like cove, accent and dramatic lighting, designer could

provide dynamic retail environments. Rompay et Al. (2012) claim that it is possible to attract attention, influence emotions and preferences by creating dramatic lighting effects in retail environment (Rompay, Tanja-Dijkstra, Verhoeven, & Es, 2012).

Turley & Milliman (2000) also consider lighting as an atmospheric characteristic and they include lighting under the title of general interior variables that influence customer behavior (Turley & Milliman, 2000). They explain that atmospheric influences have been researched on a wide variety of dependent variables, but sales, time in the store and approach-avoidance behavior are the most examined dependent variables. Beside these explanations they add that there is a gap in the researches about considering other methods beyond the approach-avoidance behavior that could be connected with emotions (Turley & Milliman, 2000). This study tries to understand if there is a connection between emotional responses and behavior mapping studies rather than exploring approach-avoidance behavior by recording the same activities that are used in previous studies.

Tantanatewin & Inkarojrit also uses color and lighting as atmospheric tools that have influence on retail impression and identity (Tantanatewin & Inkarojrit, 2016). Decré & Pras also consider lighting as a marketing tool that affects people's impression from brand and they support lighting color temperature is a strong tool for influencing customer's feelings. However, they create a virtual experiment setup to conduct their study (Decré & Pras, 2013).

Kumar & Kim also regard lighting as an environmental cue and atmospheric but they test if this environmental cues could be used to create a specific brand effect or not (Kumar & Kim, 2014). More recently, Murray et al (2017) consider design

elements of environment as atmospheric tools and they examine the complexity of these tools as the independent variables that have impact on customers' perception (Murray, Elms, & Teller, 2017).

2.1.1. Lighting Sources in Stores

Kruithof suggests a method for achieving a 'pleasing effect' based on a plot of the correlated color temperature (CCT) against the illuminance for indoor lighting design. He uses the illumination sources as fluorescent and incandescent lamps (Kruithof, 1941). The Kurithof Curve defines that color temperature between 2500K and 3000K considered as pleasing when the illuminance levels are between 200 and 500 lx. 5000K and 6500K color temperatures considered as pleasing when the luminance levels are between 300 and 50,000 lx (Figure 1).

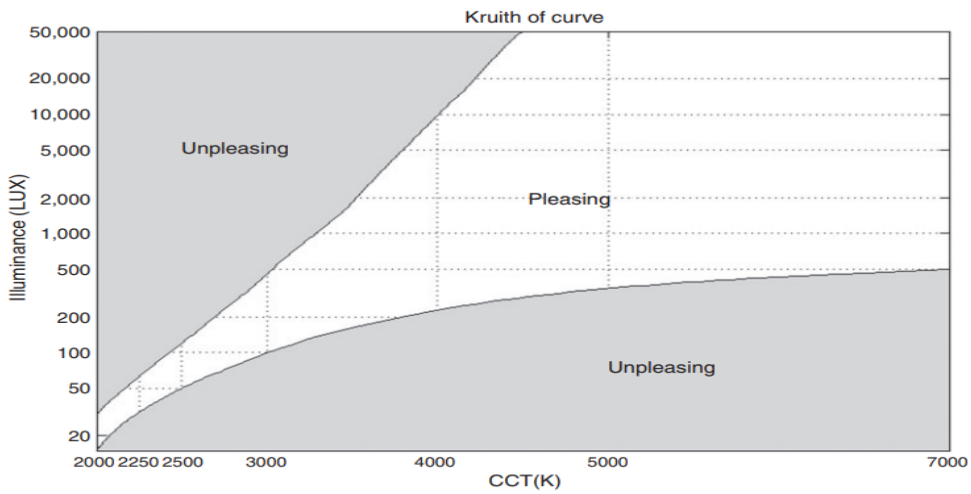


Figure 1: The Kurithoff Curve

Lately, Chen et al. (2016) conduct a study with LED lighting fixtures and they find that the pleasant zone found in this study partially agrees with Kruithof's rule. The

aim of their study is to analyze the emotional effects of museum lighting conditions with the usage of LEDs (Chen, Chou, Luo, & Luo, 2016).

According to US pattern institute, 6000K-6500K considered as Cool White color temperature (creates a cool, a refreshing atmosphere), 5000K color temperature considered as Natural Daylight color temperature (creates a natural atmosphere) and 2700K-3000K regarded as Warm White color temperature (creates a calm atmosphere) (US Patent No. 0264.193, 2004).

Ko et al. consider display lighting as accent lighting and they support that lighting influences product sales by enhancing perception and preference. They add accent lighting has greater impact on customer's reactions than general lighting (Ko, Kim, Choi, & Sung, 2016). They use 3000K and 4500K color temperature for the LED spot lights. They also change the angle of track spots as 20° and 30° search the effect of angle. They find that most preferred accent lighting condition is provided with 3000K and 30^{0} angle track spots (Ko, Kim, Choi, & Sung, 2016).

Hwang et al. also conduct a study in an experiment room to discuss the influence of lighting color on occupant comfort, they find that white tones color temperature of each lighting condition (red, blue, green) considered as more comfortable in an indoor environment (Hwang, Lee, & Kim, 2011). It means that white color temperatures are considered as more comfortable.

Another study again uses Warm (2700K) and Cool (6500K) White color temperatures to analyze color temperature effect on mood and feelings between genders (Kuijsters, Redi, Ruyter, Seuntie¨ , & Heynderickx , 2015). The aim of mentioned study is designing pleasant affective ambiences, using the psychological effects of colored lighting. They consider low (2700K) color temperature as low arousal ambience, as

cozy and higher color temperature as high arousal ambience as activating. They try to describe creation and evaluation the term of pleasant in cozy and activating environment. They try to analyze the CCT effects in these environment between younger and older participants. They find that younger people need higher temperature to feel pleasant than older people (Kuijsters, Redi, Ruyter, Seuntie¨ , & Heynderickx , 2015). Custers et al. also explain that “cool white light has also been shown to be arousing” (Custers, Kort, IJsselsteijn, & Kruiff, 2010).

Schielke and Leudesdorff also take an experiment to explore the influence of fashion retail store lighting on the brand classification and brand personality. They support that stores need to use general lighting, vertical illumination, accent lighting and projection to create high quality store image (Schielke & Leudesdorff, 2015).

In another study, difference correlated color temperature effects on participants are observed and the differences between younger and older people are found (Knez & Kers, 2000). The mood is considered as dependent variable while CCT considered as independent. Results show that the negative mood of younger people increased under warm white color temperature while they are working for 90 minutes while the negative mood of older adults increased under cool white color temperature (Knez & Kers, 2000).

Another study explains that the greatest emotional responses are gathered under color temperature between 2700K and 3000K for food stores. On the contrary, the least influence on the customers’ emotions under the cold light sources (6000K-6500K) with the light emitting sources: LEDs (Nagyová, Berčík, & Horská, 2014).

Yılmaz supports that usage of different color temperature increases the pleasure levels of customers. Accent lighting system is mostly preferred for creating contrast and

dramatic effects in stores because this type of lighting could provide an expressive alteration in brightness and shadows that highlight specific products (Yılmaz, 2018).

2.1.2. Contrast

Contrast is a comparison that identifies differences in every atmosphere experience. Recognizing details and understanding visuals in everywhere is provided by contrast. In the literature there is a differentiation between luminance contrast and color (chromatic) contrast. These definitions come from the Kaufman's explanations. He states that objects differentiate from their background because of the contrast. These contrasts could be resulted because of luminance contrast or color contrast (Kaufman , 1984).

Even the luminance contrast closely relats with the different brightness levels, under the same luminance levels there could be also contrast.

Another recent study tries to evaluate the contrast effect on (binocular rivalry) visual competition (Skerswetat, Formankiewicz, & Waugh, 2018). They find contrast creates more response on the brain than luminance. It proves that contrast increases the visual understanding of the objects around us (Skerswetat, Formankiewicz, & Waugh, 2018).

Kaufman (1984) mentions that contrast is also an outcome of chromatic information. The same illumination could create contrast because of the differences in wavelengths have reflectance of their own. If the light source has larger color saturation than the background light source even if it has the same chroma, this situation could create achromatic illuminance (Kaufman , 1984).

Contrast is the basic visual appearance which makes all tasks visible and visual behaviors possible. The human visual system derives no meaningful information unless there is a contrast in the environment. This means perception of contrast makes environment being viewed (Padgham & Saunders, 1975).

Padgham and Saunders (1975) add that contrast is the main effect that allows people to see, more specifically to differentiate a visual task from its surroundings. Beside the physical influences and definitions of contrast, there is also important psychological of it. They also add that built-in mechanisms could increase the perceived contrast. These mechanisms could relate with lighting and color qualities of environment (Padgham & Saunders, 1975). They explain that eye is not very capable of determining the intensity or intensity changes under uniformed illumination. However, visual system is much more sensitive to luminous changes, luminous discontinuities (Padgham & Saunders, 1975).

Jennings and Kingdom recently conduct a study to understand the contrast effect on perception, even if the picture is blurred Their findings demonstrate that contrast in Correlated color temperature and illuminance highly increased the perception of atmosphere (Jennings & Kingdom, 2017).

White et al. combine statistical models of visual perception with empirical data to understand how chromatic (hue/saturation) and achromatic (luminance) contrasts lead the detection and classification of stimuli in a complex forest environment. The data best proves a simple linear model of stimulus detection as an additive function of both luminance and saturation contrasts (White, Rojas, Mappes, Rautiala, & Kemp, 2017). Their findings support that visual perception of contrast could lead people's behavior and there is no significant difference on visual understanding and behavior for

luminous and saturation contrast cases (White, Rojas, Mappes, Rautiala, & Kemp, 2017).

Kim and Mullen also explore the influence of luminance and color contrast on visual perception. They explain that luminous contrast enhances perceived color contrast beside increasing the perception (Kim & Mullen, 2016).

Yılmaz (2018) highlights that to catch attention for marketing strategies, it is crucial that providing contrast rather than just a homogenous distribution of lighting in retail store atmosphere (Yılmaz, 2018).

Creating this contrast is possible to usage of general lighting with lower maintenance illuminance and combination with an accent lighting design strategy that has contrast color temperature. This accent lighting design strategy could increase the perception and attention of customers (Yılmaz, 2018). Another study also proves that contrast colored LED lighting increases perception and buying attitude of customer in food stores (Clare & Hancer, 2016).

Custers et al. mention that usage of contrast color temperature has significant influences on atmosphere perception of customers. They find that contrast lighting significantly reduces the feeling of tense (Custers, Kort, IJsselsteijn, & Kruiff, 2010).

Tantanatewin and Inkarojrit also explain that enhancing contrast makes products interesting and attractive (Tantanatewin & Inkarojrit, 2016). Ampenberger et al. (2017) also they conduct a research with the aim of investigating lighting concepts with various lighting distributions and color contrasts which are constructed in a perception study. This study finds that when it compared with the homogenous illumination, zonal contrast illumination increases the perception (Ampenberger, Staggl, & Pohl, 2017).

Gong et al. also claim that preference and emotions are in a strong relationship between contrast. Their study demonstrate that contrast increases the perception and emotion but hue plays more important role than Chroma and lightness (Gong, Wang, Hai, & Xiaopeng, 2017).

2.2. Psychological Aspects of Lighting in Retail Stores

Turley & Milliman (2000) indicate that there are several studies that explore the influence of environmental cues on shopping behavior (Turley & Milliman, 2000). Emotions, perceptions, mood and impression are some of the considerations that regarded as psychological factors influence the shopping behavior.

Lombana & Tonello support that activation and evaluation are the emotional dimensions that are desired in retailing. In their study, they try to analyze these emotional dimensions with creating different lighting and color schemes on computer simulation (Lombana & Tonello, 2017). They include that manipulation of lighting can influence perception and emotion by creating pleasant atmosphere suitable for spending time that is required for purchasing (Lombana & Tonello, 2017). DiLaura et al. also explain that "lighting can be used to create excitement, and exciting store design has been identified as a contributor to purchase" (DiLaura, Houser, Mistrick, & Steffy, 2011).

Quartier et al. (2014) also explore the impact of lighting on atmosphere perception, emotions and behavior of customer. They use realistic setting as a three-dimensional stimulated supermarket (Quartier, Vanrie, & Cleempoel, 2014). They create semi-realistic food supermarket and search about the influence of lighting color on

emotions and behavior. In another study, Quartier (2011) also supports that 3000K color temperature create more pleasurable environment (Quartier, 2011).

Positive emotional responses are considered as creating a high perception of product quality, high recommended intention and likelihood of purchase. In addition, these product quality perceptions have significant positive influence in behavioral responses (Ladhari, Souiden, & Dufour, 2017).

Another study analyses impacts of store characteristics that include product availability, product quality, store layout, employee politeness, décor, music, lighting, and aroma on the shopping experience of customers (Triantafillidou, Siomkos, & Papafilippaki, 2017). They consider various psychological components like hedonic, flow, escapism, challenge, learning, socializing, and communication for the shopping experience (Triantafillidou, Siomkos, & Papafilippaki, 2017). They find that product quality and in-store music were found to be the most influencing in-store characteristics that affected the majority of psychological dimensions. Other important store attributes that emerged are store layout and ambient scent. They include lighting under the title of ambient scent. (Triantafillidou, Siomkos, & Papafilippaki, 2017). Jang and Namkung (2009) use structural equation modelling and they find that increasing atmospherics qualities including lighting increases positive emotions of customer (Figure 2). Their results also support that positive emotions mediate the relationship between atmospherics/ services and future behavioral outcomes. (Jang & Namkung, 2009).

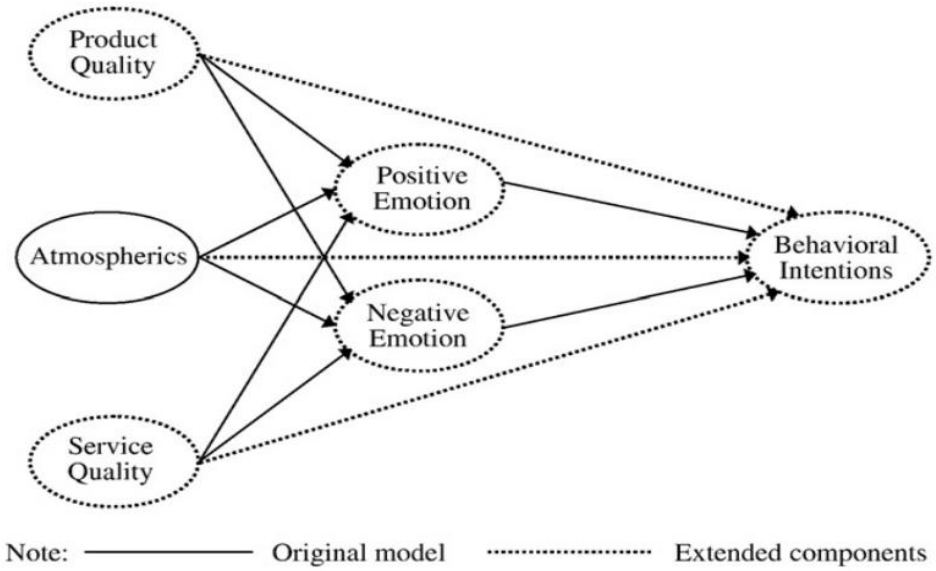


Figure 2: Jang & Namkung's Extended Emotion and Behavior Model

Yılmaz (2018) explains that with the consideration of literature review, it is obvious that lighting is a dominant component of retail environment and can influence not only brand image but also the level of perception toward the quality of atmosphere (Yılmaz, 2018). Yılmaz's study attempts to analyze how effective different lighting techniques in creating perception and the study tries to get quantitative results by gathering means of an environmental subject (Yılmaz, 2018).

Another study, that is conducted in a stimulated laboratory conditions, search about the color temperature and color rendering index on the attraction of customers. They state that by using accent and dramatic lighting, it is possible to create unique shopping environment that could lead customers to stay longer and return to the store (Bercík , Horska, Wang, & Chen, 2016). They support that visual stimuli have a potential to overcome all other senses and their paper deals with a comprehensive research on the influence of light and color on the emotional state of customers on the food market (Bercík , Horska, Wang, & Chen, 2016). They use 2700K, 3000K, 4100K and 5600K color temperatures and their findings support that "warm-white

color temperature positively affects the intensity of well-being and mental state and negatively affects the power of concentration" (Bercík , Horska, Wang, & Chen, 2016).

Bustamante & Rubio (2017) explain a review in their study and they measure customer experience to undertand the effects of in-store settings on the customer response and eventually on customer behavior (Bustamante & Rubio, 2017). They state that behavior of customer is strongly connected with the experiences of customer in-store and these experiences are related with atmospherics (Bustamante & Rubio, 2017). Wang et al. also support that LED light would lead to less tense, more cosy, more safe and more lively atmosphere perceptions (Wang, Luo, Liu, Yang, & Zheng, 2014).

Seo & Fiore use S-O-R model for explore the shopping experience on overall customer assessment about the store. Their focus group is "older" women (age 65 and older) and their focus space is fitting room. They examine the impact of the fitting room area on older female customers' perceptions and behavioral intentions (Seo & Fiore, 2016).

CHAPTER III

EMOTIONAL AND BEHAVIORAL RESPONSES OF COSTUMERS

3.1. Emotional Analysis of Customers

Emotional analysis of customers has been searched in several studies as it is considered influencing customers' behavior in commercial spaces. Mehrabian and Russell (1974) define an approach to psychology to measure emotions and most of the researches conducted in commercial spaces still use this method to measure emotions (Mehrabian & Russell, 1974).

Quartier et al. mention that designing commercial spaces is important for both psychological needs of customers and functional needs for the environmental requirements. They use Mehrabian and Russel's M-R model to analyze customer emotions and their questionnaire includes Pleasure and Arousal levels of emotional responses (Quartier, Vanrie, & Cleempoel, 2014).

Peng and Hung analyze customers' emotional reactions as loyalty for luxury restaurant and they also use extended Mehrabian- Russel M-R model as methodology (Chen, Peng, & Hung, 2015).

Krause and North also use the Mehrabian and Russel PAD scale to analyze emotions for the music concept and environmental context (Krause & North, 2014).

Mehrabian-Russel Model (M-R model) basically consists of three phases. These phases called Stimulus (S)- Organism (O)- Response (R) taxonomy. Lately, Donovan Rossiter (1980) modified and defined this taxonomy (Donovan & Rossiter, 1980). Several studies use this paradigm recently (Figure 3). This model basically covers the interactions between space and customer's emotion, mood and behavior. In this taxonomy, environmental stimuli (S) considered as the atmospheric cues that lead reactions in organism (O) and organism causes responses (R) of customer (Quartier, 2011).

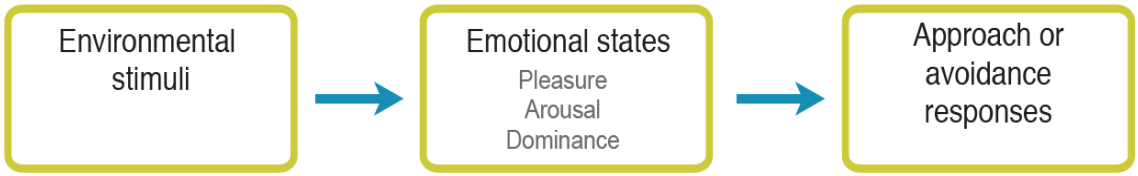


Figure 3: Stimulus-Organism-Response Taxonomy

Another interpretation of this S-O-R model is defined by Eroglu et al. they conduct a study for online shopping. They mention that usage of M-R model is still effective to measure reactions of people to analyze behavioral influences toward shopping (Eroglu, Machleit, & Davis, 2003).

There are several emotion measurement scale in marketing field (Machleit & Eroglu, 2000). The three categories of emotion that marketers mostly used in the marketing field are Izard's ten fundamental emotions from his Differential Emotions Theory (Izard, 1977), Plutchik's eight basic emotion categories (Plutchik, 1980) and Mehrabian and Russell's (Mehrabian and Russell, 1974) Pleasure, Arousal and

Dominance scale (Izard, 1977). Havlena and Holbrook (1986) compare these three typologies with the regard of consumption and they found (Havlena & Holbrook, 1986). That PAD scale questionnaire includes more information about the emotional characters rather than other two typologies (Machleit & Eroglu, 2000).

Mehrabian and Russel suggest that whatever the behavioral response is it is the result of basic emotional responses. They cover Pleasure, Arousal and Dominance (PAD) levels of feelings as emotional levels of responses (Mehrabian & Russell, 1974). There are several studies use PAD scale to measure emotional responses.

Huang et al. explain that pleasure is an emotion that reflects extreme unhappiness to extreme happiness. Arousal means to person's degree of excitement and stimulate. Dominance refers to the person's feeling of she/he control his reactions toward environmental stimuli rather than environmental stimuli controls his reactions. The PAD model suggests that environmental stimuli influence the three main emotions of customers and this influences the behavior of customers in the environment (Huang , Ali, & Liao, 2017). Another online study find that pleasure and arousal levels of emotions have positive influence of online shopping behavior (Richard & Chebat, 2016).

Baker et al. also demonstrate the original ideas of Mehrabian and Russel about pleasure, arousal and dominance levels. However, they connect PAD scale with feeling, thinking, acting. It means that rather than using S-O-R paradigm as stimulus-organism-response, they consider these actions as feeling, thinking and acting. In these scope, they regard PAD scale three dimensional graphic (Figure 4). They regard PAD scale as three dimensional model as tripartite view of experience (Bakker, Voordt, Vink, & Boon, 2014: 416).

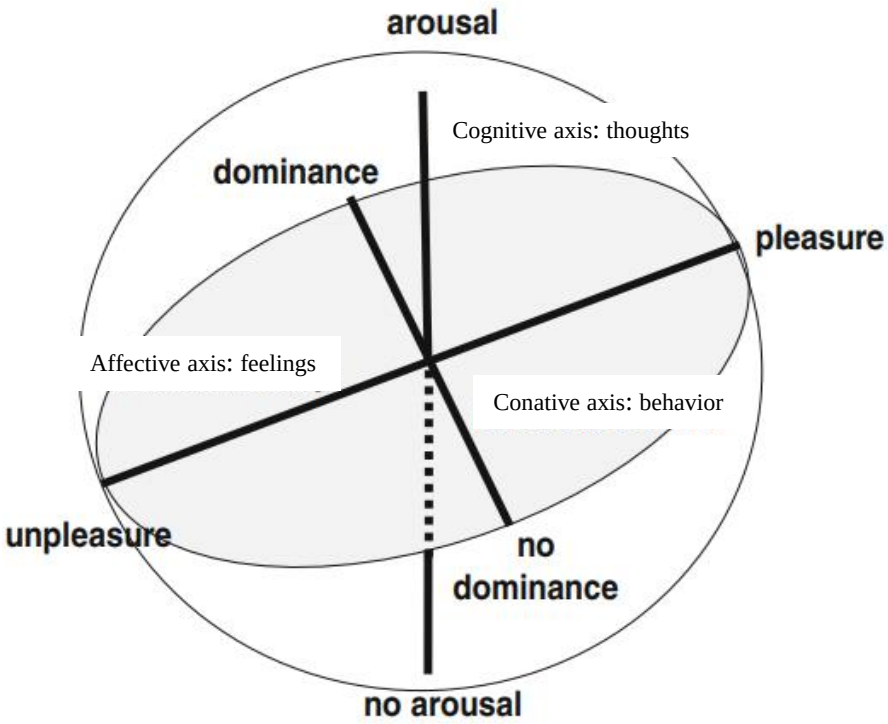


Figure 4: Three Dimensional Model as Tripartite View of Experience According to Bakker et al. (2014: 416).

3.2. Behavior Analysis of Customers

Most of the retail store studies which use M-R model as a methodology, used the suggested outcomes that model support. These outcomes are measurements of customer behavior. These behavior of customers considered as approach/avoidance behavior (Mehrabian & Russell, 1974).

Approach behavior are results of positive emotions that cause spent more time, return and buying intentions. Avoidance behavior are results of negative emotions that lead customer leave the store and not buying intentions (Tang & Zhang, 2018).

Nisco & Warnaby recently use the M-R model and test the effects of emotions on approach behavior. They test the time spent and spent money to understand the influence of pleasure and arousal levels on behavioral intentions (Nisco & Warnaby, 2014).

Tsaur et al. also conduct a study that uses M-R model and behavioral intentions of customers. They suggested that positive emotions influence behavioral intentions as spending more time in shopping environment (Tsaur, Luoh, & Syue, 2015).

To analyze the behavioral activity of customers, some studies use video camera tracking. Landmark and Sjøbakk use the technological method and prefer radio frequency (RFID) distribution (Landmark & Sjøbakk, 2017). In this study, there is only visual outputs that show the movement of customers. Beside the control area is limited with the fitting rooms. They basically introduce the usage of RFID usage to observe behavior (Landmark & Sjøbakk, 2017).

In another study, Barlı et al. (2012) record time spent to analyze behavior and find that white colored soft lighting conditions are positively associated with the increase of time spent but red colored lighting has negative association with behavior (Barlı, Aktan, Bilgili, & Dane, 2012).

Bailey and Burch mention that there are several ways to analyze behavior of people in public space. They explain that with the consideration of the target, visual cameras, sketches, drawings and coding methods could be preferred (Bailey & Burch, 2017; Larson, Bradlow, & Peter , 2005).

Marušić & Marušic (2012) explain that behavior mapping is a production of observation method. (Marušić & Marušic, 2012). Ittelson et al. (1970) first introduced the behavior mapping method to record behavior when it occurs in a design setting

(Ittelson, Rivlin, & Prohansky, 1970). In the literature, there some studies used behavior mapping to understand the interaction between user and environmental setting (Marušić, 2011) most of these studies conducted in outdoor environment but it suggested that behavior maps could be used in public areas (Albouy, Leibovici, & Warman, 2013).

In this thesis study, Mehrabian-Russel model and their PAD scale of adjective pairs are used as methodology. PAD scale used for emotional analysis and time spent. Activity coding and behavior maps are used for behavioral analysis. Time spent is measured to understand approach behavior of customer under three different lighting conditions. Beside this method, manual behavior mapping and activity coding study is also conducted.

Observing spaces via behavior mapping seems as a kind of optimal scanning process which can provide successful decision-making and designing process. Behavior maps could be considered as direct links between users and places in physical and functional ways (Marušić & Marušic, 2012).

Behavior mapping is the recording actions technique that requires observation. This observation includes spatial features and people activities in a link with time and space (Goličnik, 2005).

Marcus & Francis (1998) explain that behavior mapping is a valuable method that gives insight into the designed spaces and how designs work (Bechtel R. B., 1987; Marcus & Francis, , 1998). They add that this method “uses at the micro scale to map indoor and outdoor space” (Bechtel R. B., 1987).

Marušić & Marušic (2012) explain that there are some fundamental requirements that should be prepared before the any recording of behavior can initiate. These requirements;

- Map of the designed space that should be clearly defined
- The schedule of time that will be the same for each participant
- Table for coding, counting and analysing of the activities (Marušić & Marušic, 2012).

In another study, that uses behavior mapping method to analyze children behavior in open spaces, Cosco et al. observe the open space playground equipment design effects on children play activities (Cosco, 2006; Cosco et al., 2010). They regard behavior mapping as "unobstructive and objecticve observational method" for measuring the effects of design characteristics and space use on behavior. Cosco et al. add that behavior mapping is a space scanning method for pre-designed spaces and generally it is needed to record activities in this designed space for more adequate codding and examining activities (Cosco, Moore, & Islam, 2010). With this method, infleunces in an environmental setting on user behavior could be represented. These influences in designed environments are called affordances in open spaces but these forces that lead people to behave in different ways could be used as environmental stimuli in door environment as Mehrabian-Russel method previously defined (Mehrabian & Russell, 1974).

Behavior mapping comes through activity coding (in some references it called activity matrix) to draw the data on computer drawings as the output, there are maps with signals that reflects the activity intense and in some cases participant characteristics (Marušić, 2011).

Although a well-designed map could include information about activity, drawing a map could not be enough as recording board. Observer needs to take notes, make detailed schemes and record the time. To get adequate data and prepare well-defined behavior map, the literature shows that there is a need for activity coding and records (Marušić, 2011).

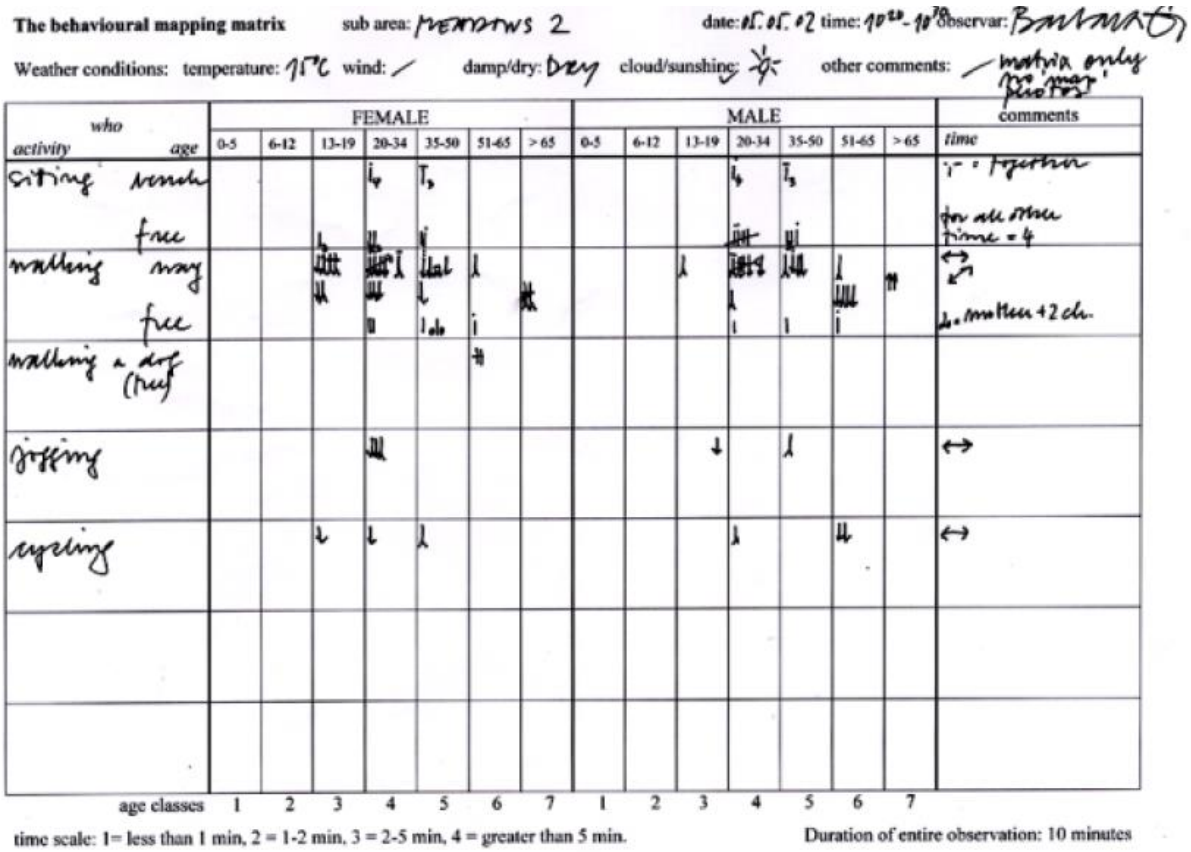
There could be different coding and mapping techniques depend on scale and the nature of the research (Goličnik, 2005). Ittelson et al. (1970) points out that is possible to include graphs, pictures, signs and other visuals in behavior maps (Ittelson, Rivlin, & Prohansky, 1970).

Behavior maps demonstrate people's behavior in real spatial settings with the consideration of design issues. These types of maps require specific data record and before mapping, the observer needs to record activity codes, draw signs and explain the activities in detail to draw trustable maps. Recently, most of researches use technological devices for recording like GPS cameras. However, these studies mostly related with urban scale (Chiesura, 2004; Dempsey, 2012; ElGindy & Abdelmoty, 2014).

Marušić & Marušic (2012) explain that behavior mapping is a recod method that allows researcher to understand the people actions in real spatial settings, in this way designers could read and talk with their designed spaces. Marušić & Marušic (2012) also highlight that this kinds of maps are visual data that allow designers and designers to modifications and reconciliations between design and research in the field of planning and designing the space again. To construct these kinds of complex relationships and read the people behavior in an efficient way, activity coding is a crucial step before the drawing of behavior map (Marušić & Marušic, 2012).

Literature review (eg. Bechtel et al., 1987) shows that activity tables are used often to recording behavior in indoor settings. Some tables rows representing physical locations and columns representing behavior (Table 1).

Table 1: Activity Coding Table Example



The behavioural mapping matrix sub area: MEADOWS 2 date: 05.05.02 time: 10:20-10:30 observar: BARBARA

Weather conditions: temperature: 15°C wind: / damp/dry: Dry cloud/sunshine: other comments: / matrix only pilot

who / activity / age	FEMALE 0-5	6-12	13-19	20-34	35-50	51-65	> 65	MALE 0-5	6-12	13-19	20-34	35-50	51-65	> 65	comments time
sitting bench															
free															
walking way															
free															
walking a dog (free)															
jogging															
cycling															
age classes	1	2	3	4	5	6	7	1	2	3	4	5	6	7	

time scale: 1= less than 1 min, 2 = 1-2 min, 3 = 2-5 min, 4 = greater than 5 min. Duration of entire observation: 10 minutes

Goličnik (2005) tested two types of activity codings that serve behavior maps, these are: behavioral matrixes and drawn activity patterns (Goličnik, 2005). Results show that there are only a few cases where mapping as behavioral matrix is efficient. These cases are quite simple square shaped open places like square shape streets with outdoor tables and chairs and people move only one circulation. In other cases, drawn behavioral maps by observer is more inappropriate (Marušić & Marušic, 2012).

CHAPTER IV

EXPERIMENTAL STUDY

The aim of the study is to understand whether different accent lighting conditions have influences on customers' emotional and behavioral responses. In experiment, LED track spot lights were used as accent lighting and general lighting conditions kept same. General lighting was provided with 5000K (artificial daylight) LED stripe lights. In this experiment, contrast was provided with accent lighting with keeping general lighting conditions same. Observation method and questionnaire with bipolar adjective pairs were provided for measurement of behavioral and emotional responses. Correlations between emotional and behavioral responses were also taken into the consideration.

4.1.1. Research Questions and Hypotheses

To achieve the aim of the study and to understand the correlations following research questions and hypotheses were set:

RQ1: What is the influence of color temperature on emotional and behavioral responses?

RQ2: What is the influence of contrast color temperature on emotional and behavioral responses?

RQ3: How emotional and behavioral responses are correlated with each other under three different lighting conditions?

RQ4: What is the influence of gender on emotional responses?

H1: Low color temperature have positive influence on emotional and behavioral responses.

H2: Contrast color temperatures have positive influence on emotional and behavioral responses.

H3: There is a correlation between emotional and behavioral responses under three different lighting conditions.

H4: There is a correlation between emotional responses and gender under three different lighting conditions.

4.2. Method of the Study

The survey was conducted with 90 participants who were customers visited the furniture store after 6 pm. Data were collected through a field study approach that involved observation and interviewing of subjects who aimed to buy furniture set. Participation was voluntary and customers who filled acceptance protocol were used as participant. Equal number of man and woman customers selected to evaluate if there was gender effect on emotions and behavioral intentions or not.

Analysis shows that mean age of the participants is 38.94. All participants have ages higher than 20 years and less than 65 years. The vast majority of the respondents (48 people, 53.3%) are in the 36-50 age range. Related to the education level of participants, the highest percentage (40 people, 44.4%) is university students. Table 2 summarizes the demographic profile of participants.

Table 2: Frequency Distribution of Participants

CHARACTERISTICS	CATEGORY	FREQUENCY	PERCENTAGE
GENDER	FEMALE	45	50
	MALE	45	50
AGE	20-35	32	35.6
	36-50	48	53.3
	51-65	10	11.1
EDUCATION	PRIMARY SCHOOL	8	8.9
	HIGH SCHOOL	34	37.8
	UNIVERSITY	40	44.4
	GRADUATE SCHOOL	8	8.9

4.2.2. Retail Store Settings

This study was conducted in a real furniture store in Etimesgut, Ankara, Turkey. The total area of the store is 230 m^2 with the 3,5 meters ceiling height. Walls were covered with matte natural grey paint and columns covered with dark gray marble. Floors were covered with beige marble with brown strips. Location of the furniture set was in middle of general lighting, not in the direct zone from the entrance. The store was located in mezzanine floor that cannot get direct daylight (Figure 5 and Figure 6: plan and section of the store).

The furniture store plan layout and color of furniture setting were not considered as variables in this study. Thus, layout and colors kept same for three lighting conditions. The name of the furniture set was Aybüke in Ladin brand. The furniture set includes three pieces with one armchair for two people and two armchairs for single person. This set was used for experiment because it was the most sold furniture set with natural beige color (Figure 9). All other furniture layout and the chosen furniture set kept same to use the color temperature of accent lighting as independent variable.

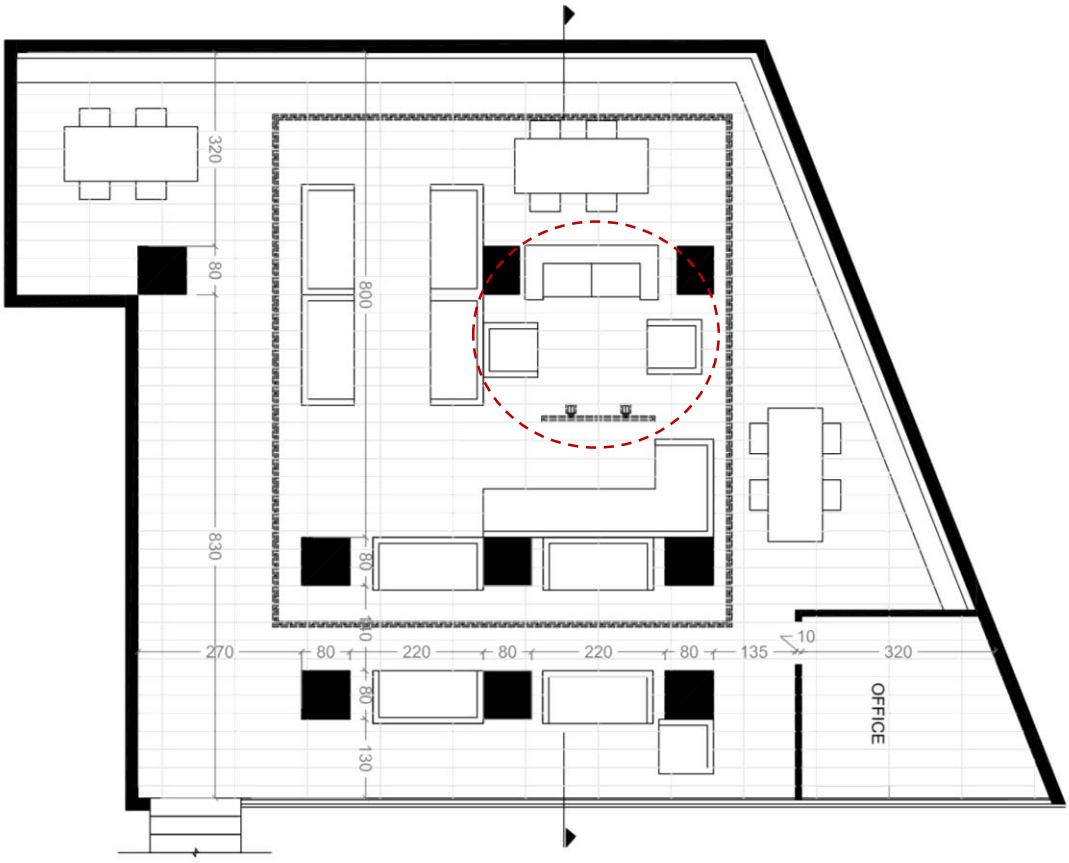


Figure 5: Plan of the Store (not to scale)

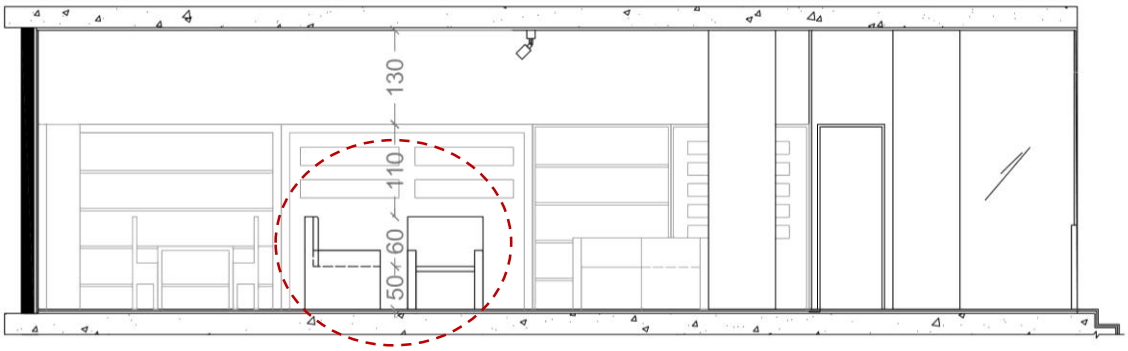


Figure 6: Section of the Store (not to scale)

General lighting was provided by LED strip lights with 5000K (artificial daylight) color temperature. LED strips were located as a rectangle with 5x3 meters dimensions. Axonometric view of the store shows the furniture layout (Figure 7). Columns are made invisible to show furniture layout clearly.

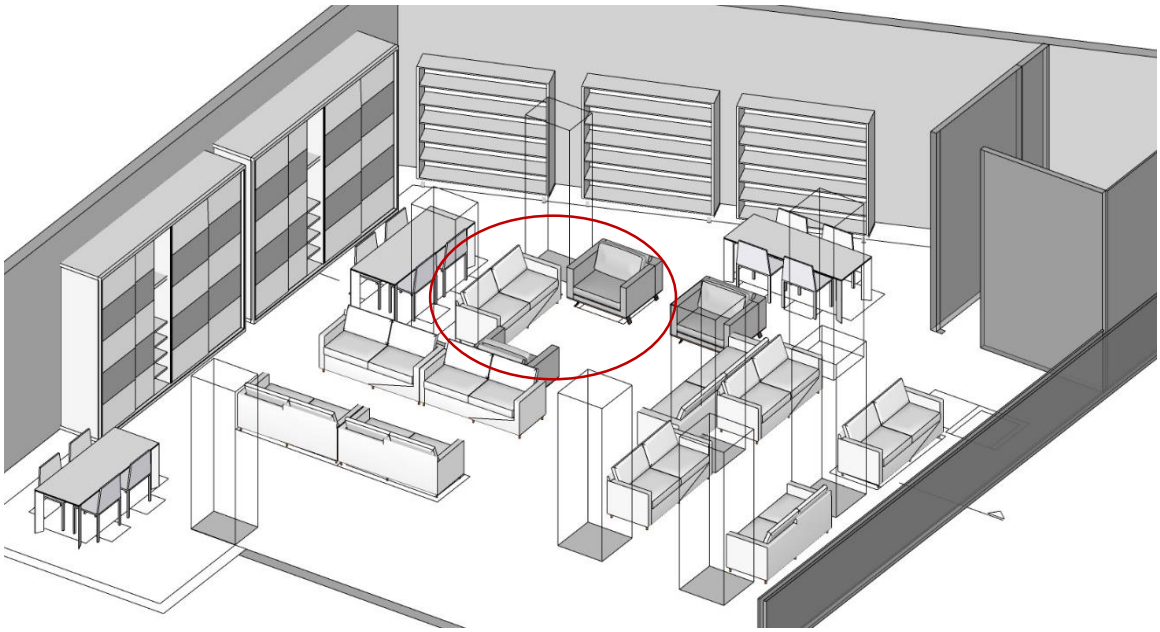


Figure 7: Axonometric Drawing of the Store

In this experiment, the color temperature of lights were changed on LED track spots that are shown in Figure 8. The angle of these track spots and the location was also important even if they were not considered as variables in the study as they were same for each color temperatured ligting fixture. The used angle of the fixtures was 45^0 with the horizontal axis (Figure 8).

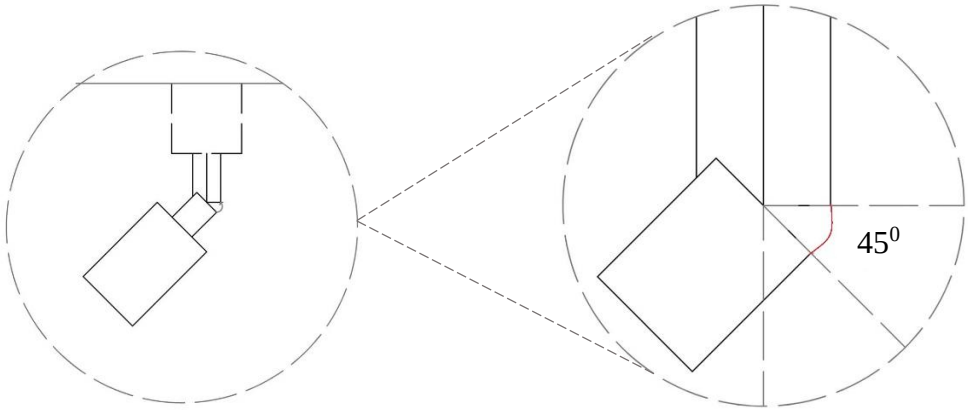


Figure 8: The angle of Spot Lights

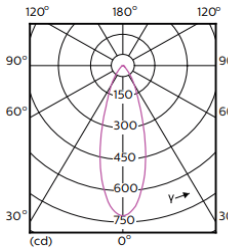
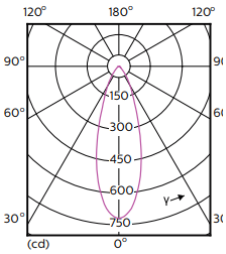
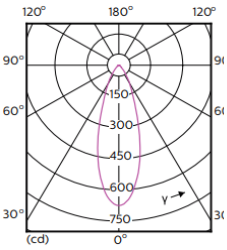
Ko et al. (2016) conducted a research on computer simulation of a retail setting and find that 45^0 angle for the products that with 120 cm and less height dimensions, mostly preferred by participants (Ko, Kim, Choi, & Sung, 2016). This finding was the guide for the usage of 45^0 vertical angle for the track spot lights. Because height of the furniture set was 110 cm from the floor. Okumura also found this angle suitable (US Patent No. 0264.193, 2004).

The illuminance levels for each color temperature were equal for each lighting conditions and illuminance was not considered as a variable in this study. Illuminance levels were mostly in between 300-400 lx.

Three different lighting conditions were used as independent variable that were considered as having influences on costumers' emotional and behavioral responses. These conditions provided by LED track spots as accent lighting on the specific furniture set. Color temperatures were 2700K (Warm White), 5000K (Artificial Daylight) and 6500K (Cool White). Table 3 shows technical data for each LED track spot.

Table 3: Technical data of LED track spots

Philips Master LED Track Spots Technical Data

	L1	L2	L3
Correlated Color Temperature	2700 K	5000 K	6500K
Lamp luminous flux (lm)	265lm	280lm	300lm
Luminaire wattage (W)	35watt	35watt	35watt
Luminaire Image			
Ra	≥ 80	≥ 80	≥ 80
Luminaire Luminous Intensity Distribution			

Three color temperature of LED track spots were chosen as they are mostly preferred ones in the market (DiLaura, Houser, Mistrick, & Steffy, 2011). General lighting color temperature was 5000K that is provided by LED strip lights in exist. Figure 9a, 9b, 9c reflects the store setting under 2700K, 5000K and 6500K color temperature conditions.

Figure 9 a, b, c : The Furniture Set Under 2700K (left), 5000K (middle), 6500K (right) Color Temperature

4.2.3. Procedure

Observation and questionnaire survey methods were used in this study. As the nature of observation, at the beginning, customers were not aware of the experiment and walked in the store freely. For three different lighting conditions, three different sample groups were chosen. After customers finished their walk, the experiment and process of the study told them. The participant acceptance protocol was given and if the customer wants to be participant, the observer data was taken into the consideration (Figure 10).

Experiment took one and a half months. Started on 7th November 2017 and 20th December 2017. To eliminate daylight conditions, experiment was conducted after 18.00. as the customers were real customers who visited the store, participants were chosen who came to the store after 18.00. customers were different for each lighting conditions. When the 30 people finished for each condition, other color temperature was mounted.

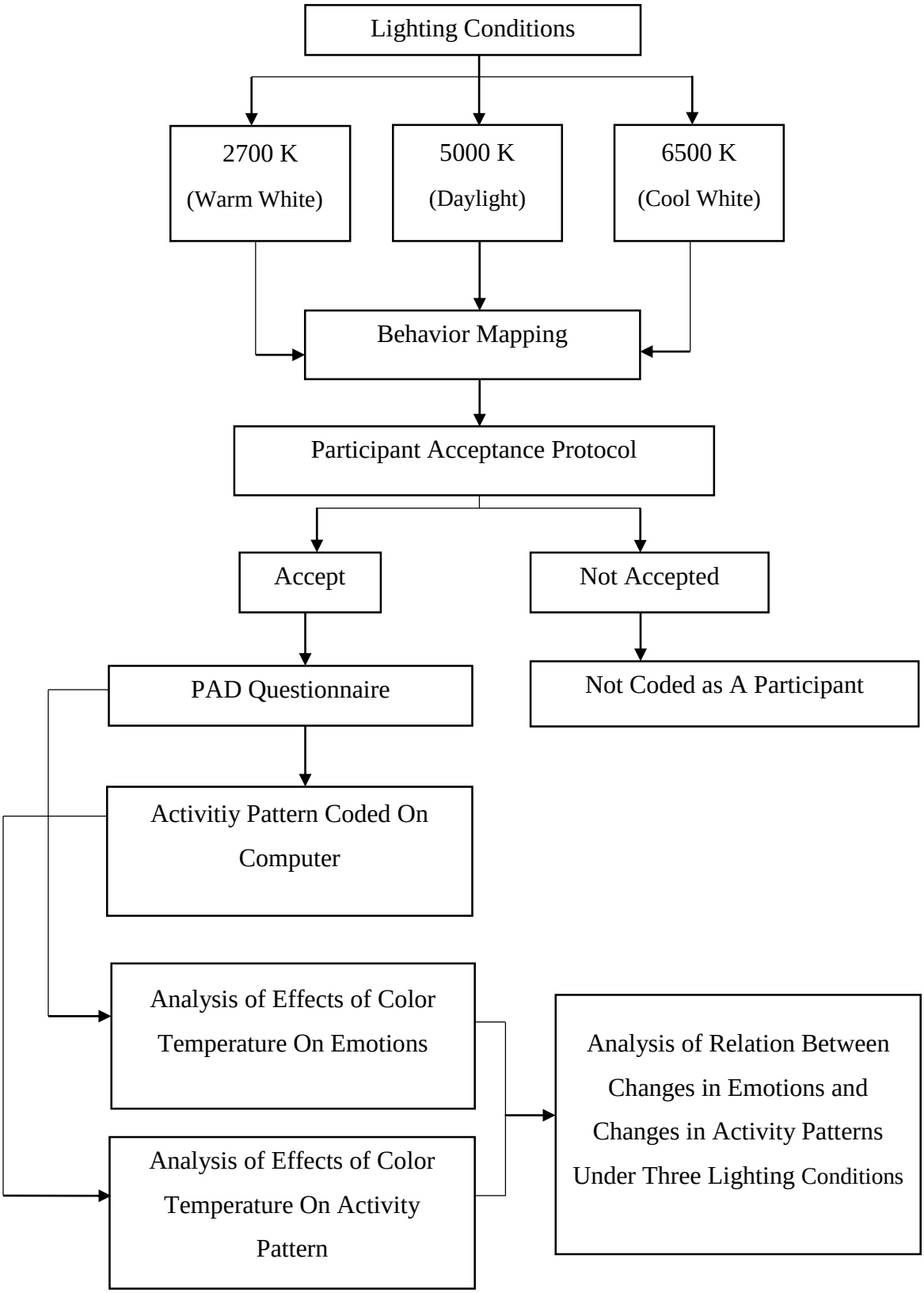


Figure 10: The Procedure

The experimental study consisted of two parts, behavior mapping and questionnaire. Activity coding study was drawn by the observer to analyze behavioral responses. To analyze emotional responses, the used Questionnaire is Mehrabian and Russel's Pleasure, Arousal and Dominance scale questionnaire and that is explained under PAD questionnaire section.

In this study, the observer coded each visited point of the customer and put dark dots for them and wrote time near the points as activity coding study (Figure 11). Figure 11 shows the example filled activity coding data sheet by the observer.

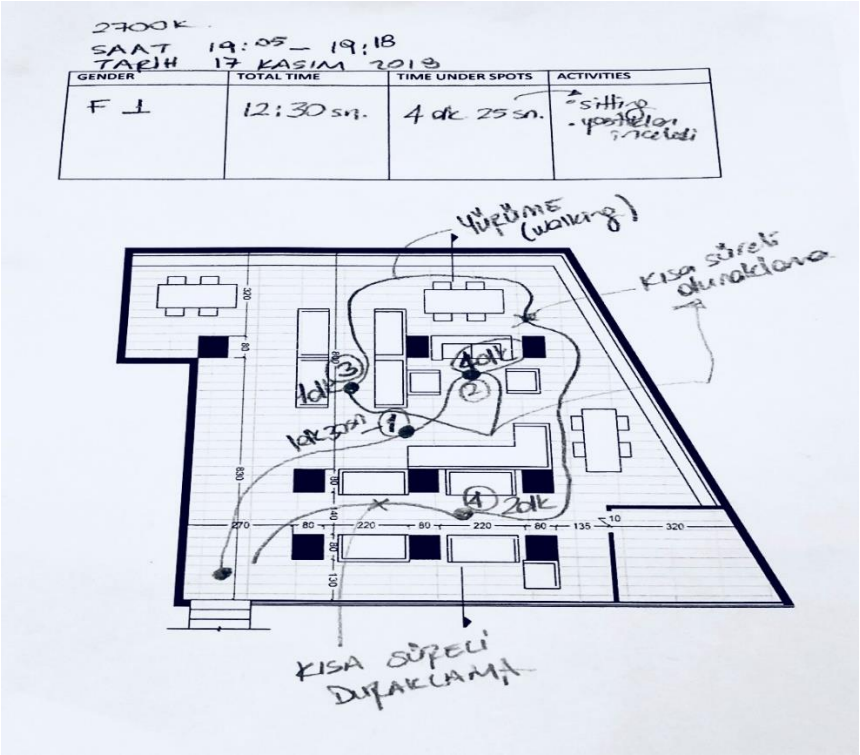


Figure 11:Example of The Observer's Activity Coding Data Sheet

If the customer accepted to be a participant of the study, each activity pattern drawn on digital data sheet for each lighting condition. The order of visited points was also written like 1, 2, 3, 4 and these kind of quantitative data was used in SPSS 24.0 program to analyze the effects of lighting color temperature on circulation patterns.

Activity coding was used for giving order to activities. Visited points were recorded and the order visited points were given. Activity coding were given in separate plans for female and male under three lighting conditions.

Activity coding data sheet was used by the observer and customers were not aware of it. It was used to construct behavior mapping. Activity pattern analyzed in statistics and recorded the detailed activity patterns.

After the experiment, all drawings were transferred illustrator program. Routes of customers and visited points were drawn in digital program one after the other. This study provided clean visualizations to understand the behavioral intentions (Appendix A. Figure 1, 2, 3, 4, 5, 6).

Before questionnaire, customers were not aware of the experiment and they walked in the store freely. Observer coded their activity and draw sketches on the store plan (Appendix A. figure 1). Observer also recorded customers' time spent and drew the points that customers walk, made low activity and vigorous activity. After hand drawing, the recorder drew the visited points of customers on illustrator program with giving color and gender codes. As it explained in the behavioral analysis section (part 3.2), behavior mapping method in the literature, mostly used in open places like public parks, children playground areas (Cosco, Moore, & Islam, 2010; Marušić & Marušic, 2012). To analyze the effects of enviromental settings on people's behavior, it was also mentioned that, using this method in indoor spaces was also possible (Marušić, 2011).

The usage of activity coding data sheet, circulation patterns, time spent and the route of the customer were drawn. These data was reflected on behavior mapping with symbols and colors. Different genders were drawn with different symbols.

Color code was used in behavior mapping. To draw three different behavior maps for three different lighting color temperature, three color and their tints were selected. Red color was chosen for mapping under 2700K (WW), yellow was used for 5000K (DL) and blue is preferred for 6500K (CL). Three color tints were also preferred to reflect the activity time in spaces. Lighest red, yellow and blue was used to reflect walking activity. Medium tints of red, yellow and blue was used to reflect acvities in between 1 and 3 minutes. Activities takes more than 3 minutes reflected with the existing hue of red, yellow and blue. Appendix B includes maps under 2700K (WW), 5000K (DL) and 6500K (CL). Appendix B1 demonstrates completed behavior map for 30 customers under 2700K, Appendix B2 reflects behavior under 50000K and Appendix B3 demonstrates behavior of customers under 6500K.

Gender also illustrated with different shapes, triangle demonstrates female and square shape demonstrates male. These behavior mappings are summaries of behavioral responses of customers undr 2700K, 5000K and 6500K color temperatures. Figure 12 is the behavior map with squares and triangles under 2700K (WW) color temperature.

Figure 12: Behavior Map of 30 Customers Under 2700K (WW) Color Temperature

After customers finished their walk, they asked if they were volunteer to join the experiment as a participants or not. If they accepted the protocol, their activity patterns and coding considered and they asked to fill the emotion questionnaire. This questionnaire included PAD scale of paired adjectives defined by Mehrabian and Russel (Mehrabian & Russell, 1974) and lastly modified by Donovan and Rossiter (Donovan R. J., Rossiter, Marcoolyn, & Nesdale, 1994).

PAD scale of measurement included Pleasure, Arousal and Dominance levels of emotions. Pleasure level has 6 items that consisted of adjective pairs that were considered as opposite. In the same way, Arousal level included 6 item and Dominance level had 4 items. Customers filled the 5 scale table as extremely

negative, negative, neutral, positive and extremely positive (Table 4). The table was constructed in English but in the experiment, Turkish translated version was preferred (see Appendix C).

Records come from activity coding and PAD questionnaire was used in statistical analysis and records come from drawings on plans reflected illustrator program to draw behavior mappings.

Before the correlation analysis and difference tests, Shapiro-Wilk normality test was conducted to understand if the variables distributed as a normal curve or not. Results revealed that samples were normally distributed ($p>0.05$). Because of the this finding, other tests were conducted as parametric tests.

In order to analyze the effect of color temperature on emotional responses, ANOVA Test of Independence was conducted. This test was used for Pleasure, Arousal and Dominance (PAD) scale of emotions separately under three different color temperature. To analyze if color temperature had influence Pleasure level, Arousal Level and Dominance level, descriptive statistics were also used to understand the changes in means under different color temperatures.

To analyze if there were influences of color temperature on behavioral responses, independence tests were used. As behavioral responses divided into two parts as circulation patterns and time spent, ANOVA tests were conducted both for circulation patterns and time spent under 2700K, 5000K and 6500K color temperature. ANOVA tests were preferred because there were multiple comparisons in this study. In the experiment, three different lighting conditions were prepared and analysis between three of them need to be conducted.

Table 4: PAD Adjective Pairs

How this space under spots make you feel?							
Pleasure:		1	2	3	4	5	
1	bored						entertained
2	despair						hopeful
3	unhappy						happy
4	melancholic						contented
5	annoyed						pleasure
6	dissatisfied						satisfied
Arousal:							
1	calm						excited
2	unaroused						aroused
3	dull						jittery
4	Relaxed (uninterested)						stimulated
5	sleepy						Wide awake
6	sluggish						wild
Dominance:							
1	dominance						submissive
2	In control						Cared for
3	autonomous						guided
4	influential						influenced

4.3. Results

4.3.1. Effects of Color Temperature on Emotional Responses

To understand if lighting color temperature has influence on emotional responses, the test was used to compare means of emotional responses under three different lighting conditions. ANOVA test was considered as suitable to compare means in between three different sample groups.

There are equal number of participants for each lighting condition and Argyrous explains that ANOVA F-test is appropriate for measuring equality of means (Argyrous, 2011). Statistical analysis for three different lighting conditions showed that there are differences on emotional responses under three different lighting conditions. ANOVA table ($F=34.753$, $df=2$, $p=0.0001$, $\alpha=0.05$, $p< \alpha$) shows that there is a difference on emotional responses under three different lighting conditions (Appendix A. table 1). After finding that lighting color temperature has influence on emotional responses, descriptive statistics and mean values examined in detail to understand if there is a contrast effect on emotional responses.

Emotional responses changed under all these three lighting conditions. 2700K (WW) and 6500K (CW) color temperatures considered as contrast color temperatures since general lighting color temperature is daylight color temperature (5000K). LED track spots with WW and CW color temperature had positive influence on emotional responses. WW color temperature increased pleasure, arousal and dominance levels more than CWcolor temperature. Mean value for emotional responses equals 54.10 under 2700K, 34.40 under 6500K and 29.30 under 5000K. this explains that total ranks of Pleasure, Arousal and Dominance levels are highest under 2700K and lowest

under 5000K color temperature. Table 5 shows mean values for each adjective pairs under three different color temperatures. Ratings between 1 and 5 were included in 5 scale Likert adjective pairs (eg. bored-entertained: 1-2-3-4-5). 1: extremely negative, 2: negative, 3: neutral, 4: positive and 5: extremely positive.

Table 5: Mean Values For Adjective Under Three Different Lighting Conditions

		2700K WW	5000K DL	6500K CW
PLEASURE	Bored-entertained	4.4	2.8	2.7
	Despair-hopeful	4.7	2.6	2.6
	Unhappy-happy	4.3	2.5	3.6
	Melancholic-contented	3.7	2.5	2.9
	Annoyed-pleasure	4.8	2.2	3
	Dissatisfied-satisfied	4.6	2.3	2.8
AROUSAL	Calm-excited	4	2.3	2.8
	Unaroused-aroused	4	2.5	2.4
	Dull-jittery	4.3	2.4	2.7
	Relaxed-stimulated	3.3	2.3	2.7
	Sleepy-wide awake	4	2.5	2.4
	Sluggish-wild	4	2.3	2.9
DOMINANCE	Dominance-submissive	3.4	1.9	2.5
	In control- cared for	2.8	2.2	3
	Autonomous-guided	3.3	2	2.73
	Influential-influenced	2.9	1.8	2.23
	TOTAL MEAN	3.9	2.3	2.7

Table 6 shows the semantic ratings of emotion ranks under three different lighting conditions. Red color reflects ranks under 2700K, blue reflects ranks under 6500K and yellow reflects ranks under 5000K (Table 6). It is shown that 2700K color temperature caused highest changes on emotional responses when the results are more similar under 5000K and 6500K color temperatures.

Table 6: Semantic Ratings Under 2700K (Red), 5000K (Yellow) and 6500K (Blue)

Pleasure:	Extremely Negative (1)	negative (2)	neutral (3)	Positive (4)	Extremely Positive (5)	
Bored						Entertained
despair						Hopeful
Unhappy						Happy
Melancholic						contented
Annoyed						Pleasure
dissatisfied						satisfied
Arousal:						
Calm						Excited
Unaroused						Aroused
Dull						Jittery
Relaxed						Stimulated
Sleepy						Wide awake
Sluggish						wild
Dominance:						
Dominance						Submissive
In control						Cared for
Autonomous						Guided
influential						influenced

4.3.2. Effects of Color Temperature on Behavioral Responses

Behavioral responses considered as customers' route when they were walking around, which is titled as circulation patterns, time spent under illuminated area with track spot lights and behavior maps which is the visual illustration that reflects the time spent and activity types of customers under three different lighting condition. ANOVA tests for independency, correlation coefficients and Scheffe analysis were conducted to understand the influence of color temperature on behavioral responses.

Circulation patterns evaluated with activity coding method. This method allowed observer to code visited spaces in store and these codes used for statistical analysis to understand if circulation patterns influenced from color temperature or there is not significant influence. Correlation coefficients and ANOVA test for independency tests are conducted for statistical analysis.

Circulation patterns evaluated with observation method. Activity coding and manual behavior mapping methods used for the study. Activity coding used to explore changes in visiting order of customers (changes in circulation paths). Specifically illuminated furniture set especially observed. Changes in activity patterns analyzed. Observer draw the route of each customer on map manually and noted visited products with the order of visiting (See Appendix B. figure 1, 2, 3, 4, 5, 6). Standardized coefficients beta equals .727 at 0.05 significance level and it explains that there is a strong, high, marked association between color temperature and visiting order of customers (Appendix A. Table 2).

This result demonstrates that circulation pattern of customers changed under different lighting conditions. It means that visiting order depends on color temperature. ANOVA test ($F=34.753$, $df=2$, $p=0.0001$, $\alpha=0.05$, $p< \alpha$) for dependency results also prove that circulation patterns and color temperature is not independent from each other.

Mean values and multiple comparisons show that people visited the furniture set in an early order when it illuminated with contrast color temperatures (Appendix A, Table 1). WW color temperature (2700K) and CW color temperature (6500K) are considered as contrast color temperatures for this study because general lighting condition has DL color temperature (5000K). Results show that WW color temperature had more significant influence on circulation path than CW color temperature. DL color temperature created at least significant influence when it compared with WW and CW color temperatures. For the understanding of relation between time spent and color temperature, total amount of time spent in store and time spent under illuminated area with the 15.22 minutes under when the color temperature is WW (2700K). When color temperature is CW (6500K) the average time spent is 11.18 minutes. The mean value is 9.69 when the color temperature is DL (5000K). correlation coefficients analysis is conducted to understand the relation between color temperature and total time spent. Correlation demonstrates that there is a negative, moderate association between color temperature and time spent (β value is -.339). It means that, people spent more time when the WW (2700K) color temperature used.

The mean value of time spent in front of the illuminated furniture set 6.01 minutes under when the color temperature is WW (2700K). When color temperature is CW (6500K) the average time spent under LED spots is 4.13 minutes. The mean value

is 3.41 in front of the illuminated furniture set when the color temperature is DL (5000K). Pearson correlation analysis is conducted to understand the relation between color temperature and total time spent ($r=-.344$, $\alpha=0.05$, two-tailed). Correlation demonstrates that there is a negative, moderate association between color temperature and time spent in front of the furniture set that illuminated with LED track spots. It means that, people spent more time when the WW (2700K) color temperature used.

ANOVA test results also conducted for test the dependency between total time spent and color temperature. The test conducted separately for total time spent and time spent in front of the furniture set under LED track spots. Results shows that time spent and color temperature are dependent on each other ($F=6.348$, $df=2$, $p=0.003$, $\alpha=0.05$, $p< \alpha$). It means that total time spent in the store and color temperature are not independent from each other.

Dependency between color temperature and time spent under LED track spots is again analyzed with ANOVA test for dependency. Results shows that time spent under LED track spots and color temperature are dependent on each other ($F=7.133$, $df=2$, $p=0.001$, $\alpha=0.05$, $p< \alpha$). It means that total time spent under LED track spots and color temperature are not independent from each other.

4.3.3. Effects of Color Temperature on Behavior Mapping

All variables that were mentioned, circulation patterns and time spent, used as data to draw behavior map. This map could be regarded as visualization of statistical data and records of observer.

Behavior mapping was drawn by considering activity duration and browsing times of customers. Most soft colors mean *walking activity*, medium soft colors reflect *low activity* and darker colors reflects *vigorous activity* (Cosco, Moore, & Islam, 2010). Low activity defined as spending time in front of the furniture set under LED track spots between one and five minutes. Vigorous activity considered as spending time in front of the furniture set under LED track spots more than five minutes. To gather this time data, observing method and analyses of video tracks was used. Color codes given with consideration of duration times under specially illuminated area. Lighter colors used when the customer only walk around the space. Medium dark color used when people spent time between one and five minutes. The darkest color used when customer spent five or more time in the space. Color coding and shape coding also illustrated. Red color scheme used for warm white color temperature (Appendix B1), yellow color scheme used for artificial daylight color (Appendix B2) temperature and blue color scheme used for cool white color temperature (Appendix B3). Woman customers illustrated with the shape of triangle and man customers illustrated with square shape.

Map illustrates that people visited the illuminated space for more time under warm white color temperature. Visiting density is not wide when using the artificial daylight color temperature used. Visiting time is also increased when the area illuminated with

cool white light but this effect is not obvious as under WW (2700K) color temperature. Appendix B1, B2 and B3 includes behavior mapping under WW, DL and CW color temperatures. In the behavior mapping, rectangle shape is preferred for women and square shape is preferred for men. Mapping demonstrates that under WW color temperature, highest density of participants was observed.

4.3.4. Correlations Between Emotional and Behavioral Responses

As behavioral responses included circulation patterns and time spent, correlation between emotional and behavioral responses is also divided into two main parts. Correlations between emotional responses and circulation patterns and correlations between emotional responses and time spent were tested separately.

Activity coding findings and questionnaire based rankings for Pleasure, Arousal and Dominance levels were tested to understand if there is a correlation between emotional responses and circulation patterns. For this analysis, color temperature was considered as independent variable and for each color temperature, correlations were tested separately.

Firstly, Pearson correlation test was conducted between total ranks for emotional responses (Pleasure, Arousal, Dominance) and activity codes. Findings ($r=-.661$, $\alpha=0.01$, two-tailed) shows that there is a significant, negative and moderate correlation between emotional responses and activity codes (considered as visiting order of customers for illuminated furniture set). Negative correlation reflects that when emotional responses increase, activity codes are decreased. In other words,

when the emotional responses increase, people visited the furniture set in an earlier order.

To understand the relationships between Pleasure, Arousal, Dominance levels and activity codes was tested separately under three lighting conditions. All items that are included under Pleasure, Arousal and Dominance levels take into correlation test to give deep understanding about the relationship between emotions and visiting order of the illuminated furniture set.

Correlations Between Emotional Responses and Activity Coding

Pearson test correlation analysis was conducted to understand the correlations between bipolar adjective pairs and activity coding as visiting order under different lighting conditions. Results shows correlations between each adjective pair of PAD scale measurement and visiting order of the illuminated furniture set (activity coding) in store. Table 7 demonstrates results for all ninety participants' visiting orders under three different lighting conditions. Correlation coefficients shows that except the item *autonomous-guided*, all adjective pairs have significant correlations between visiting order of illuminated furniture set. Negative correlations explain that when people rate lower for adjective pair, they visited the furniture set later. To explain other words, when the ratings for emotional responses increased, people visited the furniture set earlier. Results show that all adjective pairs in negative correlations with activity coding (visiting order). Almost all items have negative and moderate associations, Pearson correlation results are between -0.4 and -0.7, with visiting order according to Argryrous (2011). These correlations reflect results of all data for visiting order and emotional responses.

Table 7: Pearson Correlation Results Between Pleasure, Arousal, Dominance Scale Adjective Pairs and Activity Coding

		ACTIVITY CODING		
		Number of Respondents	P value (2-tailed)	Correlation Coefficient
PLEASURE	Bored-entertained	90	.000	-.392**
	Despair-hopeful	90	.000	-.582**
	Unhappy-happy	90	.000	-.482**
	Melancholic-contented	90	.001	-.332**
	Annoyed-pleasure	90	.000	-.690**
	Dissatisfied-satisfied	90	.000	-.665**
AROUSAL	Calm-excited	90	.000	-.493**
	Unaroused-aroused	90	.000	-.502**
	Dull-jittery	90	.000	-.558**
	Relaxed-stimulated	90	.000	-.661**
	Sleepy-wide awake	90	.000	-.636**
	Sluggish-wild	90	.000	-.690**
DOMINANCE	Dominance-submissive	90	.000	-.419**
	In control- cared for	90	.001	-.342**
	Autonomous-guided	90	.070	-.192
	Influential-influenced	90	.000	-.594**

**. Results are significant at the .001 level

Table 8 shows the results correlations for total data, to understand the correlations between emotional responses and visiting orders of illuminated furniture set, correlation tests are conducted for 2700K, 6500K and 5000K color temperatures separately. As the participant numbers are thirty for each lighting conditions, correlations are not significant like total data (See Appendix D, Table 3).

Pearson correlation coefficients demonstrates that results are similar under 2700K and 6500K color temperatures. Under these two color temperatures, there is no significant correlations between emotional responses and visiting orders of illuminated furniture set. Almost all adjective pairs have weak or very weak correlations with visiting order (for correlation coefficient results, see appendix D, Table 3). Under 5000K (DL) color temperature, there are four adjective pairs that have significant and moderate correlations between emotional responses and visiting order (Table 8).

Table 8: Significant Correlations Between Adjective Pairs and Activity Coding Under 5000K

	ACTIVITY CODING			
Adjective pair	P value	Correlation coefficient	Association Type	Direction
Melancholic- contented	0.003	-.523**	Moderate	negative
Sluggish-wild	0.006	-.491**	Moderate	negative
Calm-excited	0.006	-.448**	Moderate	negative
Dominance-submissive	0.025	-.408*	Moderate	negative

**. Results are significant at the .001 level, *. Results are significant at the .005 level

Table 8 shows correlation coefficients and association descriptions between adjective pairs and activity coding (visiting order). This means that, when people feel more *contented, wild, excited* and *submissive*, they visited the illuminated furniture set in an early order when furniture set illuminated with 5000K (DL) LED track spots. This results gathered when general lighting conditions are 5000K (DL).

Correlations Between Emotional Responses and Time Spent

Pearson test correlation analysis is conducted to understand the correlations between bipolar adjective pairs and time spent under different lighting conditions. Table 9 shows the correlation results between the total time spent and emotional responses for items about Pleasure, Arousal and Dominance (PAD) scales (Table 9). Results shows correlations between each adjective pair of PAD scale measurement and time spent in store.

Time spent under track spots and questionnaire based ratings for PAD levels were tested to understand if there is a correlation between emotional responses and time spent. For this analysis, color temperature is considered as independent variable and for each color temperature, correlations were tested.

Table 9 includes correlation results for ninety participants under three different lighting conditions. All ratings are considered and almost all adjective pairs are in significant correlations between time spent under LED track spots (Table 9).

For detailed results under 2700K (WW), 5000K (DL) and 6500K (CW) separately, different Pearson correlation tests were conducted (See Appendix D, Table 4).

Table 9: Pearson Correlation Results Between PAD Scale Adjective Pairs and Time Spent

		TOTAL TIME SPENT		
		Number of Respondents	P value (2-tailed)	Pearson Correlation Coefficient
PLEASURE	Bored-Entertained	90	.002	.318**
	Despair-Hopeful	90	.001	.339**
	Unhappy-Happy	90	.074	.189
	Melancholic-Contented	90	.000	.389**
	Annoyed-Pleasure	90	.001	.335**
	Dissatisfied-Satisfied	90	.000	.390**
AROUSAL	Calm-Excited	90	.205	.135
	Unaroused-Aroused	90	.003	.307**
	Dull-Jittery	90	.025	.237*
	Relaxed-Stimulated	90	.000	.379**
	Sleepy-Wide awake	90	.001	.356**
	Sluggish-Wild	90	.000	.445**
DOMINANCE	Dominance-Submissive	90	.005	.294**
	In control- Cared for	90	.322	.106
	Autonomous-Guided	90	.530	.067
	Influential-Influenced	90	.018	.248*

**. Results are significant at the .001 level, *. Results are significant at the .005 level

Results demonstrate that adjective pairs under Pleasure level of emotions are in weak, low associations between time spent under track spot lights except the item *happy-unhappy.* It explains that when people feel more entertained, hopeful, contented, pleasure and satisfied, they tended to spend more time in front of the furniture set that illuminated with the accent lighting. However, correlations are weak and this explains these levels of emotions do not have strong influence on time spent.

Items under Arousal level of emotions that are *unaroused-aroused*, *relaxed-stimulated* and *sleepy-awake* are in weak, low correlations between time spent under track spot lights. It demonstrates that when people feel aroused, stimulated and awake, they spend more time in illuminated area but this correlation is not strong. There is a moderate and positive correlation between the item *sluggish-wild* and time spent. It means that people spend more time when they feel wild in an illuminated area with accent lighting.

Table 9 also demonstrates that dominance levels of emotional responses are not in significant correlations between time spent in an illuminated area. *Dominance-submissive* item in a very weak and positive correlation with time spent in illuminated area. This means that when people feel submissive, they spend more time in an illuminated area with accent lighting but this correlation is very weak.

Table 9 demonstrates correlation coefficients for all data for ninety participants. For detailed analysis under three different accent lighting conditions, separate correlations were analyzed (Appendix D, Table 4).

Pearson correlation coefficients demonstrates that results are similar under 2700K (WW) and 6500K (CW) color temperatures. Under these two color temperatures, there is no significant correlations between emotional responses and time spent in

front of illuminated furniture set. Almost all adjective pairs have weak or very weak correlations with time spent (for correlation coefficient results, See appendix D, Table 4). Under 5000K (DL) color temperature, there are four adjective pairs that have significant and moderate correlations between emotional responses and visiting order (Table 10).

Table 10: Significant Correlations Between Adjective Pairs And Time Spent Under 5000K

	TIME SPENT			
Adjective pair	P value	Correlation coefficient	Association Type	Direction
Melancholic- contented	.009	.467**	Moderate	positive
Relaxed-stimulated	.049	.363**	Weak	positive
Sluggish-wild	.004	.506**	Moderate	positive
Calm-excited	.001	.564**	Moderate	positive

**. Results are significant at the .001 level, *. Results are significant at the .005 level

Under 5000K (DL) color temperature LED track spots, *melancholic-contented*, *relaxed-stimulated*, *sluggish-wild* and *calm-excited* are in correlation with time spent. This result explains that when general and accent lighting conditions are both 5000K (DL), if people feel more contented, stimulate, wild and excited, they tended to spent more time under accent lighting conditions.

4.3.5 Effects of Gender on Emotional Responses

To understand if gender has influences on emotional responses or not, independence samples T-Test was conducted. This tests allows researchers to understand these two variables (gender and emotional responses) are independent from each other or not. Results show that ($t=8.99$, $df=88$, $p=.010$, $\alpha=0.05$, $p> \alpha$) emotional responses and gender are independent from each other. This explains that hypothesis 4 is rejected (*H4: There is a correlation between emotional responses and gender under three different lighting conditions)*. However, there is a gender effect on emotional responses under 2700K (WW). In order to understand this effects detailed analysis for each three lighting conditions are conducted.

Under 2700K (WW) color temperature, overall rate for items are significantly increased. 6500K (CW) color temperature also created a contrast effect and it influenced some items in a positive way too.

Equal number of female and male customers participated in survey and this allows to explore if there is a gender effect on emotions or not. For each lighting condition, 30 participants were evaluated in terms of emotional responses.

Under WW track spots, Pleasure levels of female and male differ from each other ($t=5.059$, $df=28$, $p=0.001$, $\alpha=0.05$, $p< \alpha$). Therefore, it is there is a significant difference on Pleasure level between male and female.

T-test findings show that there is no significant difference on Arousal ($t=-.498$, $df=28$, $p=.623$, $\alpha=0.05$, $p> \alpha$) and Dominance ($t=-.386$, $df=28$, $p=.702$, $\alpha=0.05$, $p> \alpha$) levels

between female and male under WW color temperature. Table 11 demonstrates all ratings of emotional responses under 2700K (Figure 13).

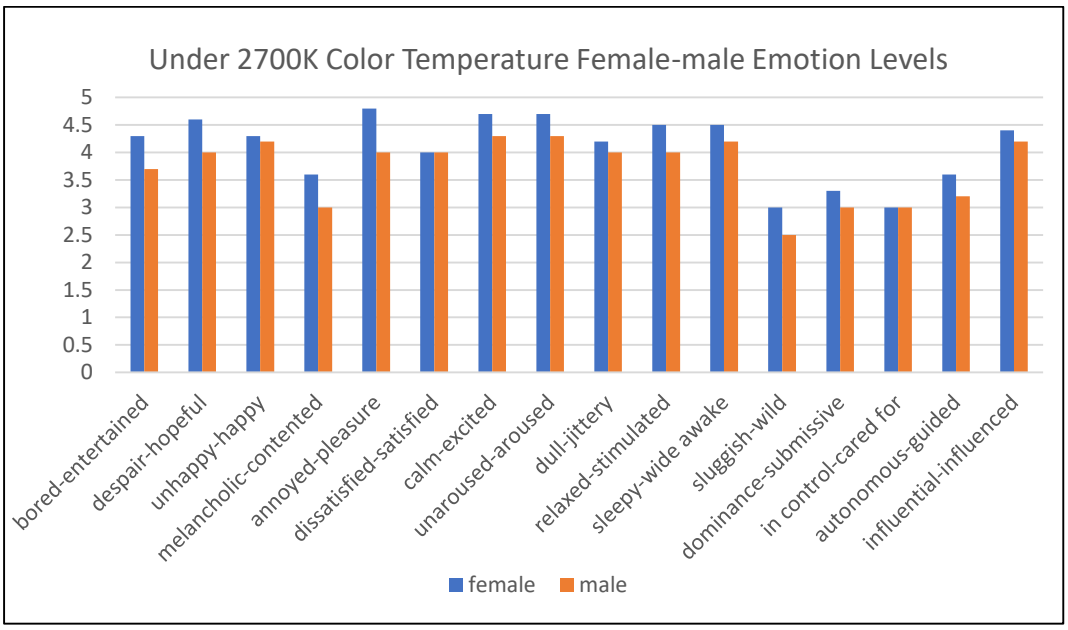


Figure 13: Emotional Responses According To Female And Male Customers Under 2700K (WW)

Under 6500K (CW) track spots, pleasure level of female and male are not significantly different from each other. It explains that there is no significant difference on pleasure level on customers between different genders (t=-.377, df=28, p=.709, α=0.05, p> α).

Arousal level of customers is also not significantly different between genders (t=-.377, df=28, p=.709, α=0.05, p> α). It is obvious that there is no significant difference on arousal level on customers between female and male customers.

Under 6500K color temperature, dominance level of customers is also not significantly different between genders (t=-.107, df=28, p=.915, α=0.05, p> α). It is obvious that there is no significant difference on arousal level on customers between female and male customers (Figure 14).

Gender has not significant impact on emotions 6500K (CW) color temperature. However, it has more differences on pleasure and arousal levels than dominance level.

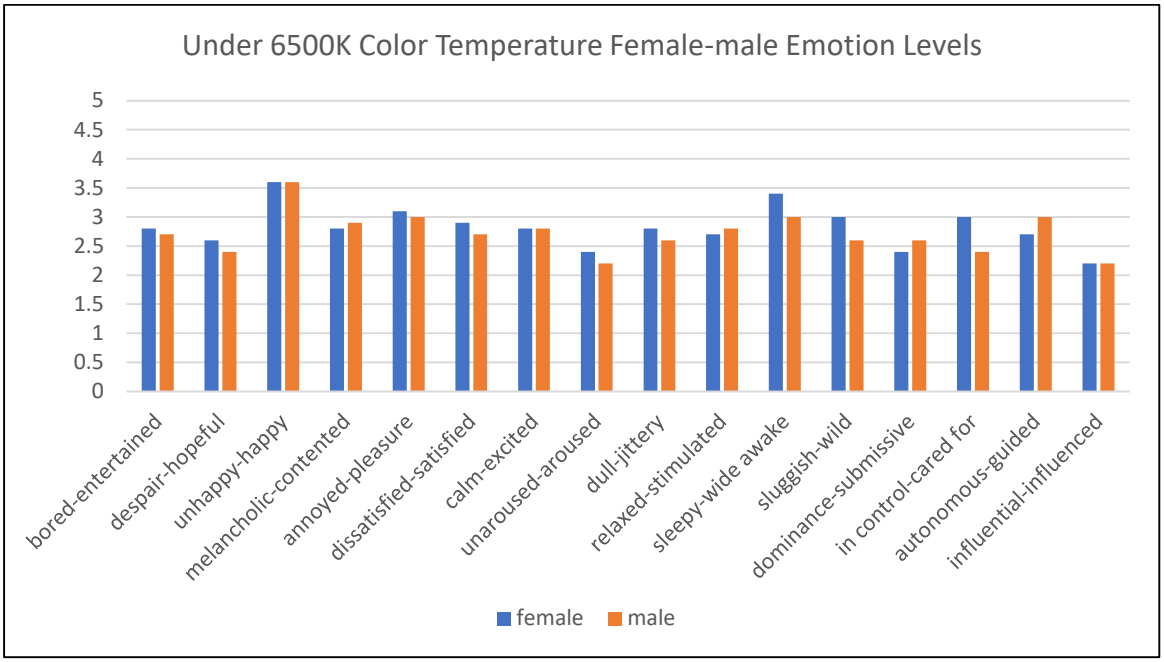


Figure 14: Emotional Responses According To Female And Male Customers Under 6500K

Under 5000K (DL) track spots, Pleasure level of female and male are not significantly different from each other. It explains that there is no significant difference on Pleasure level on customers between different genders (t=.121, df=28, p=.904, α=0.05, p> α).

Arousal level of customers is also not significantly different between genders (t=-.342, df=28, p=.735, α=0.05, p> α). It is obvious that there is no significant difference on arousal level on customers between female and male customers.

5000K (DL) color temperature, dominance level of customers is also not significantly different between genders (t=-.287, df=28, p=.776, α=0.05, p> α). It is obvious that there is no significant difference on arousal level on customers between female and male customers

Gender has not significant impact on emotions under 5000K color temperature. However, it has more differences on Pleasure and Arousal levels than Dominance level (Figure 15).

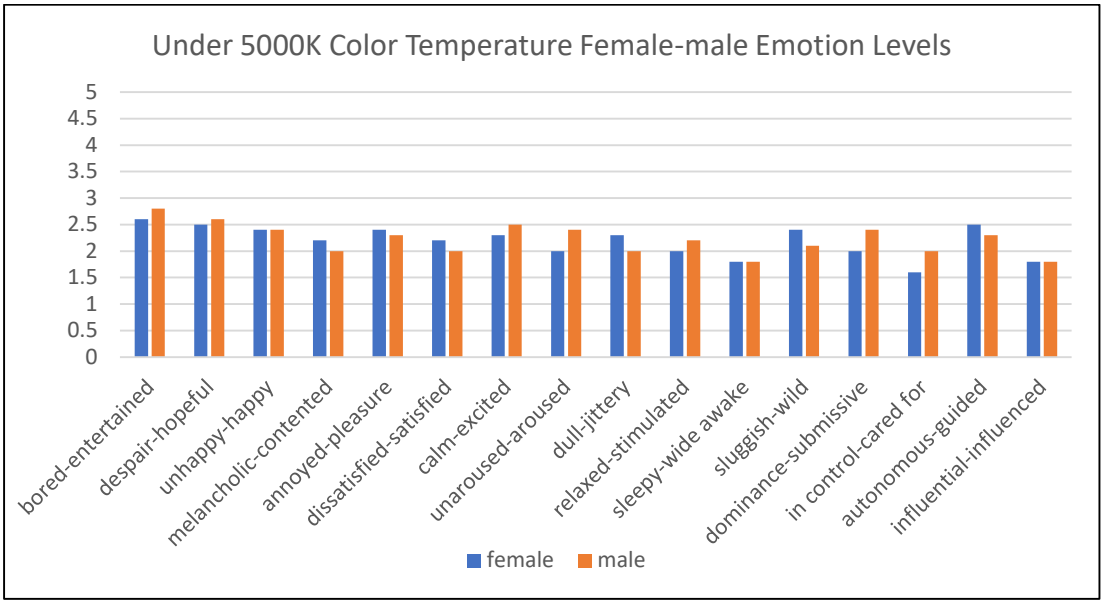


Figure 15: Emotional Responses According To Female And Male Customers Under 5000K

4.4. Discussion

Statistical Package for the Social Sciences (SPSS) 24.0 was used to analyze the data of the study. Findings of the statistical analysis were given in respect to the research questions of the study (See in Section 4.1.1).

Effects of Color Temperature on Emotional Responses

In this study, the comparison between emotional responses under three different color temperature (2700K, 5000K, 6500K). Firstly, ANNOVA test was conducted to understand if there are any differences on emotional responses under different color temperatures or not. H1 constructed as; ***H1****: Low color temperature have positive influence on emotional and behavioral responses.* Hypothesis 1 is accepted. This hypothesis comes with the understanding of literature. To understand if lighting color temperature has influence on emotional responses. The test was used to compare means of emotional responses under three different lighting conditions. ANOVA test is considered as suitable to compare means in between three different sample groups.

There are equal number of participants for each lighting condition and Argyrous explains that ANOVA F-test is appropriate for measuring equality of means (Argyrous, 2011). Statistical analysis for three different lighting conditions showed that there are differences on emotional responses under three different lighting conditions. ANOVA table ($F=34.753$, $df=2$, $p=0.0001$, $\alpha=0.05$, $p< \alpha$) shows that there is a difference on emotional responses under three different lighting conditions (Appendix C. Table 1).

After finding that lighting color temperature has influence on emotional responses, descriptive statistics and mean values examined in detail to understand if there is a contrast effect on emotional responses.

There are several researches that support lighting qualities of an environment has influences on emotional responses of people (Baker, Levy, & Grewal, 1992; Barlı, Aktan, Bilgili, & Dane, 2012; Chen, Peng, & Hung, 2015; Chen, Chou, Luo, & Luo, 2016). To understand changes on Pleasure, Arousal and Dominance (PAD) levels of emotions separately, mean values of each emotional responses under each lighting conditions are examined.

Effects on Pleasure Levels

Results shows that under 2700K (WW) mean value of Pleasure level is 26,5. While this value is 14,84 under 5000K (DL) and 17,64 under 6500K (CW) color temperatures. It shows that WW color temperature (2700K) is the condition that increased the level of pleasure most. Under CW color temperature (6500K) people also felt more pleasure than they feel under DL color temperature (5000K).

As opposite to previous studies that people feel more pleasure under warmer color temperatures than they feel under cooler color temperatures (Gong, Wang, Hai, & Xiaopeng, 2017; Hwang, Lee, & Kim, 2011; Decré & Pras, 2013).

Effects on Arousal Levels

When we compare the Arousal levels of emotional responses, again the highest score (M=23.8) is ranked under 2700K (WW). Again the second highest score is gathered under 6500K (CW) color temperature. However, difference between the ranks under 5000K (DL) and 6500K (CW) is very few. When the mean value differences on

Arousal levels under DL and CW color temperature, the difference is not significant as much as it is on the Pleasure levels of emotional responses.

Effects on Dominance Levels

The dominance level of emotional responses is the one that is not affected as much as Pleasure and Arousal levels under different lighting conditions. For three color temperatures, ranks for dominance levels are really close to each other (mean values for dominance levels were 2700K (WW): 12.45, 5000K (DL): 7.87, 6500K (CW):10.43). these values and statistical analysis shows that there is a very weak correlation between arousal level and color temperature of track spot lights.

This situation is caused the separation of Dominance level of emotions from Pleasure and Arousal levels of emotional responses (Bakker, Voordt, Vink, & Boon, 2014). Recent studies try to analyze dominance levels of emotions as if this level in correlation between pleasure level. It means that arousal level is thought as in correlation between pleasure levels (Decré & Pras, 2013).

As it mentioned, previous studies mostly find that emotional responses are higher under warmer color temperatures (Gong, Wang, Hai, & Xiaopeng, 2017; Hwang, Lee, & Kim, 2011; Decré & Pras, 2013). According to these references, under 5000K (DL) color temperature, it is expected to get second higher ranks for emotional responses but the ranks for emotional responses are higher under 6500K (CW) color temperature than 5000K (DL).

Decré & Pras (2013) find the opposite results that people find bright cool light more pleasant than soft warm light. However, they conducted their study in virtual environment and it is the limitation that they also mentined (Decré & Pras, 2013).

Moreover, they changed also the brightness of light sources. It also be the another parameter that changed the emotions of customers.

Another experimental study finds that WW (2700K) color temperature when the illuminance levels in between 300lx-500lx (Li, et al., 2015). Li et al. also add that 5000K (DL) color temperature is recommended. However, they conducted their study with open-window approach and it could be the difference between current study.

Effects of Contrast Color Temperatures on Emotional Responses

In this study, there is another variable that could have influence on pleasure levels of customers. That variable is contrast. As the general lighting condition is 5000K (DL) color temperature, 2700K (WW) and 6500K (CW) color temperature LED track spots created a contrast effect in the environment. This contrast effect influenced the pleasure levels of customers as H2 supported. ***H2****: Contrast color temperatures have positive influence on emotional and behavioral responses*. This finding proves that hypothesis 2 is accepted.

This finding supports the idea that providing contrast in store environment have positive influences on customers' reactions (Yılmaz, 2018). Yılmaz (2018) also found that usage of only accent lighting fixtures highly increased the perception and quality understanding of customers. However, she conducted her study in simulation (Yılmaz, 2018). In further studies this finding could be used as variable. Yılmaz (2018) also find that people feel more pleasure when the environment illuminated with general and accent lighting together when it compared with the environment illuminated with only general lighting. Current study strength this finding and supports that usage of different lighting color temperatures in the retail environment increases the pleasure and arousal levels of customer. Tantanatewin & Inkarojrit

(2016) also found that emotional responses of customers are highly increased when the general and accent lighting types is used together. They preferred WW on accent ligting and daylight as a general lighting color temperature (Tantanatewin & Inkarojrit, 2016). Schielke & Leuderdorf (2015) also suggest that general lighting and accent lighting considered as more pleasurable when they used together as DL and WW color temperatures (Schielke & Leudesdorff, 2015).

Effects of Color Temperature on Behavioral Responses

Circulation patterns of customer evaluated. Behavior mapping study allows the evaluation of circulation patterns under three different lighting conditions. circulation patterns are drawn for each participant and codes are given for the visiting order. The order of customers is coded in SPSS field. Statistical analysis revealed that people visited the illuminated furniture set in an early order when the contrast color temperature is used. It could be interpreted as customers recognized the furniture set more easily when accent lighting with contrast color temperatures are used (Chen, Chou, Luo, & Luo, 2016).

Current study demonstrates circulation patterns with the activity codes. Activity codes included actions of people like walking, sitting etc. and it also includes visited points with the order of the visit. It means in which order; the customer visits the each visited point.

Decré & Pras (2013) evaluate the circulation path of customers as in undertanding behavioral intentions. They find that bright cool light has positive influence on customers' behavioral intentions like visiting more spaces in the store (Decré & Pras, 2013). It is similar intention with the consideration of circulation pattern in this study. However in this study, WW (2700K) color temperature has greater

influence on circulation paths than CW (6500K) color temperatures. These changes could be related with the differences in experimental settings.

Another finding support that WW color temperature is changed circulation patterns more than CW color temperature (Custers, Kort, IJsselsteijn, & Kruiff, 2010).

In study, influence of color temperature on time spent is also evaluated. ANOVA test was conducted and finding supports that color temperature and time spent is not independent from each other. According to correlation analysis, there is negative and moderate association between color temperature and time spent. This means that when the color temperature decreased, time spent in the environment is increased. These findings support Decré & Pras's (2013) results.

This experiment find that the time spent records are almost same under 5000K (DL) and 6500K (CW) color temperatures. It could be the result of contrast issue. As 2700K (WW) created more dramatic contrast, people tend to spent more time under this color. This finding also proves Li et al.'s finding (2015). Li et al. (2015) found that people's reaction time as staying in the environment is increased when the color temperature decreased (Li, et al., 2015). This means that people tend to spent more time under low color temperature such as 2700K (WW).

Behavior mapping methodology was used to visualize the color temperature influences on customer activities in the furniture store. Results shows that people tend to spent more time under the furniture set. circulation patterns of customer are also changed with the effect of color temperature. Behavior mapping reveals that where people walk, spent time and make activities under different lighting color temperatures.

Under WW (2700K), illustrated map reflects that activity patterns are highly increased in front of the illuminated furniture set. It could be interpreted as WW color temperature is the one that has the strongest influence of people's behavior. This explains that hypothesis 2 (*H2: Contrast color temperatures have positive influence on emotional and behavioral responses*) is accepted.

Map reflects that CW (6500K) track spots did not created a dramatic effect on behavior like WW (2700K). However, when it compared with the map for artificial daylight color temperature, it is obvious that focus points of people's activities are limited. People spent more time in front of the illuminated furniture set and ones that are close to the illuminated areas by LED track spots. This effect could also be related with the contrast degree again. As the DL (5000K) track spots have the same color temperature with general lighting, this track spots could not change behavior of customers as much as WW (2700K). Behavior mapping illustrations could be understood as the evidence of previous findings that show the differences on time spent and circulation patterns of customers under three different accent lighting conditions.

Correlations Between Emotional and Behavioral Responses

In order to analyze the correlation between emotional responses and behavioral responses, PAD (Pleasure, Arousal, Dominance) scale rankings and behavioral analysis are tested. Behavioral aspects are considered as activity codes, time spent and behavior maps. Behavior mappings are kind of qualitative and visualization method that could not be put in statistical analysis. For this reason, PAD scales and activity codes beside it, PAD scales and time spent analyzed with correlation tests separately.

In order to understand the correlations between emotional responses and circulation patterns, Pearson correlation test was conducted. These tests firstly conducted for total ranks of emotions under all three lighting conditions and after this analyze, correlations under three different color temperatures evaluated separately.

Results shows that there is a significant, negative and moderate association between emotional responses and activity codes. This proves the hypothesis 3 is accepted (*H3: There is a significant correlation between emotional and behavioral responses under three different lighting conditions).* As Yılmaz (2018) find in her study, emotion of people affected the subjective responses (Yılmaz, 2018). Activity coding results in this study could be considered as subjective responses of customers. Activity coding reveals the order of visiting. For this study, visiting order of the illuminated furniture with accent lighting is taken in statistics.

Under 2700K (WW) color temperature, correlation results show that items for Pleasure, Arousal and Dominance levels of measurement have weak or very weak correlations with activity codes. In total correlation, there is a significant and moderate correlation but these results are not as significant as total ranks under warm white color temperature.

Under 6500K (CW) color temperature, correlations between items under emotional responses and activity coding are again weak or very weak as they are under 2700K (WW) color temperature.

Correlations between items under Pleasure, Arousal and Dominance levels are highest under 5000K (DL) color temperature. There are *positive and moderate correlations* between items *melancholic-contented*, *sleepy-wide awake*, *sluggish-wild* and activity codes.

Previous findings revealed that emotion levels are increased under contrast color temperatures and visiting orders are mostly changed. However, these correlations between items show that correlation between emotional responses and activity codes are more strong under DL color temperature. It could be explained as contrast color temperatures created more significant influences on emotional responses that they create influences on visiting order of the illuminated furniture set. Because emotional responses are highly increased under WW (2700K) color temperature when it compared with DL (5000K) color temperature. However, the correlation between emotional responses and activity codes are very weak under WW color temperature when it is moderate under DL color temperature.

Time spent is considered behavioral response in many studies (Barlı, Aktan, Bilgili, & Dane, 2012; Bohl, 2012; Landmark & Sjøbakk, 2017). Thus, this study also includes the time spent measurements as behavioral responses. Total time spent and time spent in front of the furniture set that illuminated with LED track spots are recorded seperately. To understand the correlation, Pearson correlation tests are used between total ranks for PAD (Pleasure, Arousal, Dominance) scale and time spent. Results shows correlations between each adjective pair of PAD scale measurement and time spent in store. This results (in Chapter 4.3.3) reveals that almost all items have significant correlations between time spent. Especially items under Pleasure and Arousal levels have significant correlations between time spent. However, it is obvious that dominance level of emotional scale has not significant correlation with time spent. It means that Dominance level of emotional scales is not effective on time spent in store as much as Pleasure and Arousal levels.

This finding supports Decré & Pras's (2013) findings. They explained that warm temperature had positive influences on positive emotions and this leads people to

spend more time in store. But they added that their experiment was conducted in a virtual context and this was the limitation of their study (Decré & Pras, 2013).

Donovan and Rossiter (1980) also suggested that when people feel more pleasure, they spent more time. Also when people feel more pleasure, the arousal level also increases. However, they found that the dominance has not strong influence on customer behavior (Donovan & Rossiter, 1980). This finding is also proved by current research. Dominance levels of emotional responses mostly have no significant influences on time spent in store.

In their later study Donovan et al. (1994) conducted a new study with elimination of dominance level (Donovan R. J., Rossiter, Marcoolyn, & Nesdale, 1994). They found that pleasure is highly associated with extra time spent. However, higher arousal reduces the time spent in unpleasant atmosphere and arousal does not have significant influence on time spent in pleasant atmosphere (Donovan R. J., Rossiter, Marcoolyn, & Nesdale, 1994). It means that pleasure level has more influence on time spent in store than the influence of arousal level. The current study has no significant finding about the negative influence of arousal levels on time spent in store.

Correlations Between Emotional Responses and Gender

There are equal numbers of female and male customers in this study. this situation allows researchers to analyze gender effect. Two sample T-test results show that emotional responses and gender are independent from each other. This finding

explains that hypothesis 4 is rejected *H4: There is a significant correlation between emotional responses and gender under three different lighting conditions.*

Some previous studies found a gender effect on emotional responses or they suggested the gender could cause the changes on emotional responses (Bakker, Voordt, Vink, & Boon, 2014; Bustamante & Rubio, 2017). Thus, to analyze emotion-gender relationship in detail, T-tests were conducted between emotional responses under three different lighting conditions and gender.

Detailed results revealed that gender has significant influence only on Pleasure level of emotional responses under WW (2700K) color temperature. Arousal and Dominance levels of emotional responses are independent from gender under all three different lighting conditions. Pleasure levels under CW (6500K) and DL (5000K) conditions are also independent from gender.

CHAPTER V

CONCLUSION

In this study, color temperature of LED track spots influences on customers' emotional and behavioral responses were investigated in real furniture store. General lighting conditions were kept same and color temperatures changed on track spot lights, which are considered as accent lighting in store environments. Three different lighting conditions were used. WW color temperature (2700K), CW color temperature (6500K) and DL color temperature (5000K) were used on accent lighting fixtures. WW and CW color temperatures are chosen as they are mostly preferred ones in the field. General lighting conditions was provided by LED strip lights and color temperature was 5000K (DL) in the existing store. Thus, 5000K (DL) color temperature is also used on track spots to analyze if there is a contrast effect on influences on dependent variables (emotional and behavioral responses) or not.

Previous studies in the marketing field are considered lighting as a strong atmospheric tool that influence customers' emotions and behavioral reactions (Bohl, 2012). Atmospherics are defined in the earliest as interior and exterior design characteristics that have influences on customers' buying behavior (Kotler, Atmospherics as a Marketing Tool, 1973). Lighting is considered as an atmospheric tool that has strong influences on customers' emotional and behavioral responses. Later studies supported

that in store environments, emotional responses are important to predict behavioral intentions of customers. Mehrabian and Russell defined stimulus-organism-response (S-O-R) model to understand the atmospheric effects on customers' reactions (Mehrabian & Russell, 1974). Donovan & Rossiter modified the S-O-R model and improved the measurement of pleasure, arousal and dominance levels of emotional responses (Donovan & Rossiter, 1980). This model is considered as psychological approach that could be used in studies to analyze the influences of atmospheric characteristics on customers emotional and behavioral responses.

In this study, PAD (Pleasure, Arousal, Dominance) scale of questionnaire and observation method was used. As an experimental procedure, the observer firstly recorded the activities of customers. Activity coding and behavior mapping techniques were used as tools of observation. The observer draws routes and circulation of each customer on map and coded visited products. Also time spent for each customer was noted. After the customer finished their visit, the observer gave the information about the experiment. If the customer accepts to be a participant of the experiment, they were asked to fill PAD questionnaire and the observer data sheet was transferred to the computer.

Results were analyzed on SPSS 24.0 program. Influences of color temperature on emotional responses were found with the ANOVA test for independency. Findings shows that color temperature has influences on emotional responses of customers. Descriptive statistics reveals that warm white color temperature of accent lighting has the strongest influence on emotional responses. Especially Pleasure level highly increased under WW (2700K) color temperature. CW (6500K) color temperature is also having stronger influence on customers' emotions that DL (5000K) color temperature. This considered as contrast effect because previous studies mostly

suggested that people feel positive emotions under lower color temperatures (Barlı, Aktan, Bilgili, & Dane, 2012; Yılmaz, 2018).

Influences of color temperature on behavioral responses were also evaluated. Behavioral responses includes activity codes and time spent were recorded in this study. Results support that color temperature has influence on behavioral responses too. People visited the illuminated furniture set in an early order when contrast color temperatures (WW and CW) are used as accent lighting. Also people spent more time in the store when contrast color temperatures are used. These findings support the idea of ligting color temperature has influences on customers' behavioral responses.

As a third step, correlations between emotional and behavioral responses were analyzed. For this purpose, correlations between emotional response and activity codes evaluated first. It is found that there is a significant, negative and moderate correlation between these two variables. In other words, when the emotional ranks of PAD (Pleasure, Arousal, Dominance) scale increased, people visited the illuminated furniture set in an early order. Secondly, correlations between emotional responses and time spent were evaluated. There is a significant, positive and low association is found between emotional responses and time spent. It means that when color temperature was increased positive emotions, it also increased the time spent of people.

Table 11: Comparisons of the Emotional Responses and Time Spent as a Summary

	Warm white	Artificial daylight	Cool white
Pleasure	highest	lowest	medium
Arousal	highest	lowest	medium
Dominance	highest	lowest	medium
Time spent	Maximum (average 6.01)	Minumum (average 3.41)	Minumum (average 3.63)

Lastly gender effect on emotional responses was analyzed. It is found that gender has no significant influence on the overall emotional responses of customers under three different accent lighting conditions. However, detailed analyze shows that gender has influence on pleasure level under WW (2700K) color temperature. Women feel more pleasure than men under WW (2700K) color temperature. Table 11 is the summary of emotional responses and mean values of time spent under three lighting color temperatures.

5.1. Limitations and Recommendations for Further Studies

The study has some limitations. As the experiment was conducted in real store, the observer could not change the whole lighting fixtures and color temperature of the general lighting. Also furniture layout needed to keep same as its existing layout and this created some difficulties to take pictures in every point of the store because there are several columns in the store environment. Also color could not be used as a variable and color of the walls, ceiling and floor needed to be kept same.

Familiarity is not considered as a variable in this study. There could be familiarity effects between responses of customers' who came into the store previously. In further studies, familiarity could also be used as another variable.

There are some recommendations for further studies. Color should be used as a variable in a real store setting because it is found that it is the atmospheric tool that has the strongest effect on people's emotions (Baker, Levy, & Grewal, 1992). Cultural effects also need to be taken into consideration because psychological aspects and emotions could change culture to culture. The study could be conducted in other environments like house work places etc. to understand the effects of contrast color temperatures on people's emotional and behavioral reactions.

REFERENCES

Albouy, D., Leibovici, F., & Warman, C. (2013). Quality of life, firm productivity, and the value of amenities across Canadian cities. *Canadian Journal of Economics*, 379-411.

Ampenberger, A., Staggl, S., & Pohl, W. (2017). Attention guidance, perceived brightness and energy demand in retail lighting. *8th International Conference on Sustainability in Energy and Buildings* (pp. 658-668). Turin, Italy: Elsevier.

Argyrous, G. (2011). *Statistics for Research* . London: SAGE.

Bailey, J. S., & Burch, M. R. (2017). *Research Methods in Applied Behavior Analysis.* New York: Routledge .

Baker, J., Levy, M., & Grewal, D. (1992). An experimental approach to making retail store environmental decisions. *Journal of Retailing*, 445-461.

Bakker, I., Voordt, T. v., Vink, P., & Boon, J. d. (2014). Pleasure, Arousal, Dominance: Mehrabian and Russell revisited. *Current Psychology*, 405-421.

Barlı, Ö., Aktan, M., Bilgili, B., & Dane, Ş. (2012). Lighting, indoor color, buying behavior and time spent in a store. *Color Research and Application*, 465-468.

Bechtel, R. B. (1987). Observation: the world under a glass. In R. W. R. B. Bechtel, *Methods in Environmental and Behavioral Research* (pp. 11-40). New York: Van Nostrand.

Bechtel, R. B., Marans, R., & Michelson, W. (1987). *Methods in Environmental and Behavioural Research.* New York: Van Nostrand Reinhold.

Bercík , J., Horska, E., Wang, R. W., & Chen, Y.-C. (2016). The impact of parameters of store illumination on food shopper response. *Appetite*, 101-109.

Bohl, P. (2012). *The Effects of Store Atmosphere on Shopping Behavior- A Literature Review*. Budapest: Corvinus Marketing Studies.

Bustamante, J. C., & Rubio, N. (2017). Measuring customer experience in physical retail environments. *Journal of Service Management*, 884-913.

Chen, A., Peng, N., & Hung, K.-p. (2015). The effects of luxury restaurant environments on diners' emotions and loyalty Incorporating diner expectations into an extended Mehrabian-Russell model. *International Journal of Contemporary Hospitality Management*, 236-260.

Chen, H.-S., Chou, C.-J., Luo, H.-W., & Luo, M. (2016). Museum lighting environment: Designing a perception zone map and emotional response models. *Lighting Research & Technology*, 589–607.

Chiesura, A. (2004). The role of urban parks for the sustainable city. *Landscape and Urban Planning*, 129-138.

Clare, G., & Hancer, N. (2016). The influence of tunable LED lighting systems on consumer food label perceptions. *Food and Nutrition Sciences*, 566-576.

Cosco, N. G. (2006). Motivation to Move: Physical Activity Affordances in Preschool Play Areas. School of Landscape Architecture, Edinburgh College of Art Heriot Watt University.

Cosco, N. G., Moore, R. C., & Islam, M. Z. (2010). Behavior Mapping: A Method for Linking Preschool Physical Activity and Outdoor Design. *Applied Sciences*, 513-519.

Custers, P., Kort, Y. d., IJsselsteijn, W., & Kruiff, M. d. (2010). Lighting in retail environments: Atmosphere perception in the real world. *Lighting Research & Technology*, 331-343.

Decré, G. B., & Pras, B. (2013). Simulating in-store lighting and temperature with visual aids: methodological propositions and S–O–R effects. *The International Review of Retail, Distribution and Consumer Research*, 363-393.

Dempsey, N. (2012). Neighbourhood design: Green space and parks. In S. J. Smith, *International Encyclopedia of Housing and Home* (pp. 12-20). San Diego: Elsevier.

Denk, E., Jimenez , P., & Schulz, B. (2015). The impact of light source technology and colour temperature on the well-being, mental state and concentration of shop assistants. *Lighting Research & Technology*, 419-433.

DiLaura, D., Houser, K., Mistrick, R., & Steffy, G. (2011). *The Lighting Handbook.* New York: Illuminating Engineering Society of North America.

Donovan, R. J., & Rossiter, J. R. (1980). *Store Atmosphere: An Environmental Psychology Approach.* New York: Graduate School of Business, Columbia University.

Donovan, R. J., Rossiter, J. R., Marcoolyn, G., & Nesdale, A. (1994). Store atmosphere and purchasing Behavior. *Journal of Retailing* , 283-294.

ElGindy E, A. E. (2014). Capturing Place Semantics on the GeoSocial Web. *Journal on Data Semantics*, 207–223.

Eroglu, S. A., Machleit, K. A., & Davis, L. M. (2003). Empirical Testing of a Model of Online Store Atmospherics and Shopper Responses. *Psychology & Marketing*, 139-150.

Findlay, A. M., & Sparks, L. (2002). *Retailing: Critical Concepts.* London and New York: Routledge.

Goličnik, B. (2005). People in place: A configuration of physical form and the dynamic patterns of spatial occupancy in urban open public space. *People in Place: A Configuration of Physical Form and the Dynamic Patterns of Spatial Occupancy in Urban Open Public Space*. Edinburgh: Edinburgh College of Art. Heriot Watt University.

Gong, R., Wang, Q., Hai, Y., & Xiaopeng, S. (2017). Investigation on factors to influence color emotion and color preference responses. *Optik*, 71-78.

Havlena, W. J., & Holbrook, M. B. (1986). The varieties of consumption experience: comparing two types of typologies of emotion in consumer behavior. *Journal of Consumer Research*, 394-404.

Huang , M., Ali, R., & Liao, J. (2017). The effect of user experience in online games on word of mouth: A pleasure-arousal-dominance (PAD) model perspective. *Computers in Human Behavior*, 329-338.

Hull, R., & Harvey, A. (1989). Explaining the emotion people experience in suburban parks. *Environment and Behavior*, 21 (3), 322-345.

Hwang, T., Lee, D. G., & Kim, J. T. (2011). Optimal illuminance of seven major lighting colours in LED: focus on occupant comfort and communication in an indoor environment. *Indoor and Built Environment*, 122-128.

Ittelson, W. H., Rivlin, L. G., & Prohansky, H. M. (1970). The use of behavioural maps in environmental psychology. In H. M. Prohansky, W. H. Ittelson, & L. G. Rivlin, *Environmental Psychology: Man and his Physical Setting* (pp. 658-668). New York: Holt, Rinehart & Winston,.

Izard, C. E. (1977). *Human Emotions.* New York: Plenum.

Jang, S. (., & Namkung, Y. (2009). Perceived quality, emotions, and behavioral intentions: Application of an extended Mehrabian–Russell model to restaurants. *Journal of Business Research*, 451-460.

Jennings, B. J., & Kingdom, F. A. (2017). Chromatic blur perception in the presence of luminance contrast. *Vision Research*, 34-42.

Kaufman , J. E. (1984). *IES Lighting Handbook.* New York: IESNA.

Kim, Y. J., & Mullen, K. T. (2016). Effect of overlaid luminance contrast on perceived color contrast: Shadows enhance, borders suppress. *Journal of Vision*, 1-14.

Knez, I., & Kers, C. (2000). Effects of Indoor lighting, gender, and age on mood and cognitive performance. *Environment and Behavior*, 817-831.

Ko, T.-K., Kim, I.-T., Choi, A.-S., & Sung, M. (2016). Simulation and perceptual evaluation of fashion shop lighting design with application of exhibition lighting techniques. *Building Simulation*, 641-658.

Kotler, P. (1973). Atmospherics as a Marketing Tool. *Journal of Retailing*, 48-64.

Krause, A. E., & North, A. C. (2014). Contextualized music listening: playlists and the Mehrabian and Russell model. *Psychology of Well-Being: Theory, Research and Practice*, 22-38.

Kruithof, A. (1941). Tubular luminance lamps for. *Philips Technical Review*, 65-96.

Kuijsters, A., Redi, J., Ruyter, B. d., Seuntie¨ , P., & Heynderickx , I. (2015). Affective ambiences created with lighting for older people. *Lighting Research & Technology* , 859–875.

Kumar, A., & Kim, Y.-K. (2014). The store-as-a-brand strategy: The effect of store environment on customer responses. *Journal of Retailing and Consumer Services*, 685-695.

Ladhari, R., Souiden, N., & Dufour, B. (2017). The role of emotions in utilitarian service settings: The effects of emotional satisfaction on product perception and behavioral intentions. *Journal of Retailing and Consumer Services*, 10-18.

Landmark, A. D., & Sjøbakk, B. (2017). Tracking customer behaviour in fashion retail using RFID. *International Journal of Retail & Distribution Management*, 844-858.

Larson, J. S., Bradlow, E. T., & Peter , F. S. (2005). An exploratory look at supermarket shopping paths. *International Journal of Research in Marketing*, 395-414.

Li, Y., Shi, W., Li, D., Luo, F., Su, X., & Cao, G. (2015). Study of healthy light-color parameters for LED lighting. *Optik*, 4887-4889.

Lombana, M., & Tonello, G. L. (2017). Perceptual and emotional effects of light and color in a simulated retail space. *Color Research & Application*, 619-630.

Machleit, K. A., & Eroglu, S. A. (2000). Describing and measuring emotional response to shopping experience. *Journal of Business Research*, 101-111.

Marcus, C. C., & Francis, , C. A. (1998). *People places: Design guidelines for urban open space (2nd ed.).* New York: Van Nostrand Reinhold.

Marušić, B. G., & Marušic, D. (2012). Behavioural maps and GIS in place evaluation and design, application of geographic information systems . In B. M. Alam, *Application of Geographic Information Systems* (pp. 113-138). IntechOpen.

Marušić, G. (2011). Analysis of patterns of spatial occupancy in urban open space using behaviour maps and GIS. *Urban Design International*, 36-50.

Mehrabian, A., & Russell, J. A. (1974). *An Approach to environmental psychology.* Cambridge: MIT.

Murray, J., Elms, J., & Teller, C. (2017). Examining the role of store design on consumers' cross-sectional perceptions of retail brand loyalty. *Journal of Retailing and Consumer Services*, 147-156.

Nagyová, Ľ., Berčík, J., & Horská, E. (2014). The efficiency, energy intensity and visual impactt of the accent lighting in the retail grocery stores. *Potravinarstvo Scientific Journal for Food Industry*, 296-305.

Nisco, A. D., & Warnaby, G. (2014). Urban design and tenant variety influences on consumers' emotions and approach behavior. *Journal of Business Research*, 211-218.

Okumura, Y. (2004). *US Patent No. 0264.193.*

Padgham, C. A., & Saunders, J. E. (1975). *The Perception of Light and Colour.* New York: Academic Press.

Plutchik, R. (1980). *Emotion: A Psychoevolutionary Synthesis.* New York: Harper and Row.

Quartier, K. (2011). *Retail Design: Lighting as a Design Tool for the Retail Environment.* Hasselt: Unpublished PHD thesis.

Quartier, K., Vanrie, J., & Cleempoel, K. V. (2014). As real as it gets: What role does lighting have on consumer's perception of atmosphere, emotions and behaviour? *Journal of Environmental Psychology*, 32-39.

Richard, M.-O., & Chebat, J.-C. (2016). Modeling online consumer behavior: Preeminence of emotions and moderating influences of need for cognition and optimal stimulation level. *Journal of Business Research*, 541-553.

Rompay, T. J., Tanja-Dijkstra, K., Verhoeven, J. W., & Es, A. F. (2012). On store design and consumer motivation: Spatial control and arousal in the retail context. *Environment and Behavior*, 44(6), 800-820.

Schielke , T., & Leudesdorff, M. (2015). Impact of lighting design on brand image for fashion retail stores. *Lighting Research and Technology*, 672-692.

Seo, K., & Fiore, A. M. (2016). Effect of the fitting room environment on older clothing shoppers. *Journal of Retailing and Consumer Services*, 15-22.

Skerswetat, J., Formankiewicz, M. A., & Waugh, S. J. (2018). More superimposition for contrast-modulated than luminance-modulated stimuli during binocular rivalry. *Vision Research*, 40-51.

Tang, J., & Zhang, P. (2018). The impact of atmospheric cues on consumers' approach and avoidance behavioral intentions in social commerce websites. *Computers in Human Behavior*, in press.

Tantanatewin, W., & Inkarojrit, V. (2016). Effects of color and lighting on retail impression and identitiy. *Journal of Environmental Psychology*, 197-205.

Triantafillidou, A., Siomkos, G., & Papafilippaki, E. (2017). The effects of retail store characteristics on in-store leisure shopping experience. *International Journal of Retail & Distribution Management*, 1034-1060.

Tsaur, S.-H., Luoh, H.-F., & Syue, S.-S. (2015). Positive emotions and behavioral intentions of customers in full-service restaurants: Does aesthetic labor matter? *International Journal of Hospitality Management*, 115-126.

Turley, L. W., & Milliman, R. E. (2000). *Atmospheric Effects on Shopping Behavior: A Review of the Experimental Evidence.* NewYork: Elsevier Science Inc.

Wang, H., Luo, M. R., Liu, P., Yang, Y., & Zheng, Z. (2014). A study of atmosphere perception of dynamic coloured light. *Lighting Research & Technology*, 661-675.

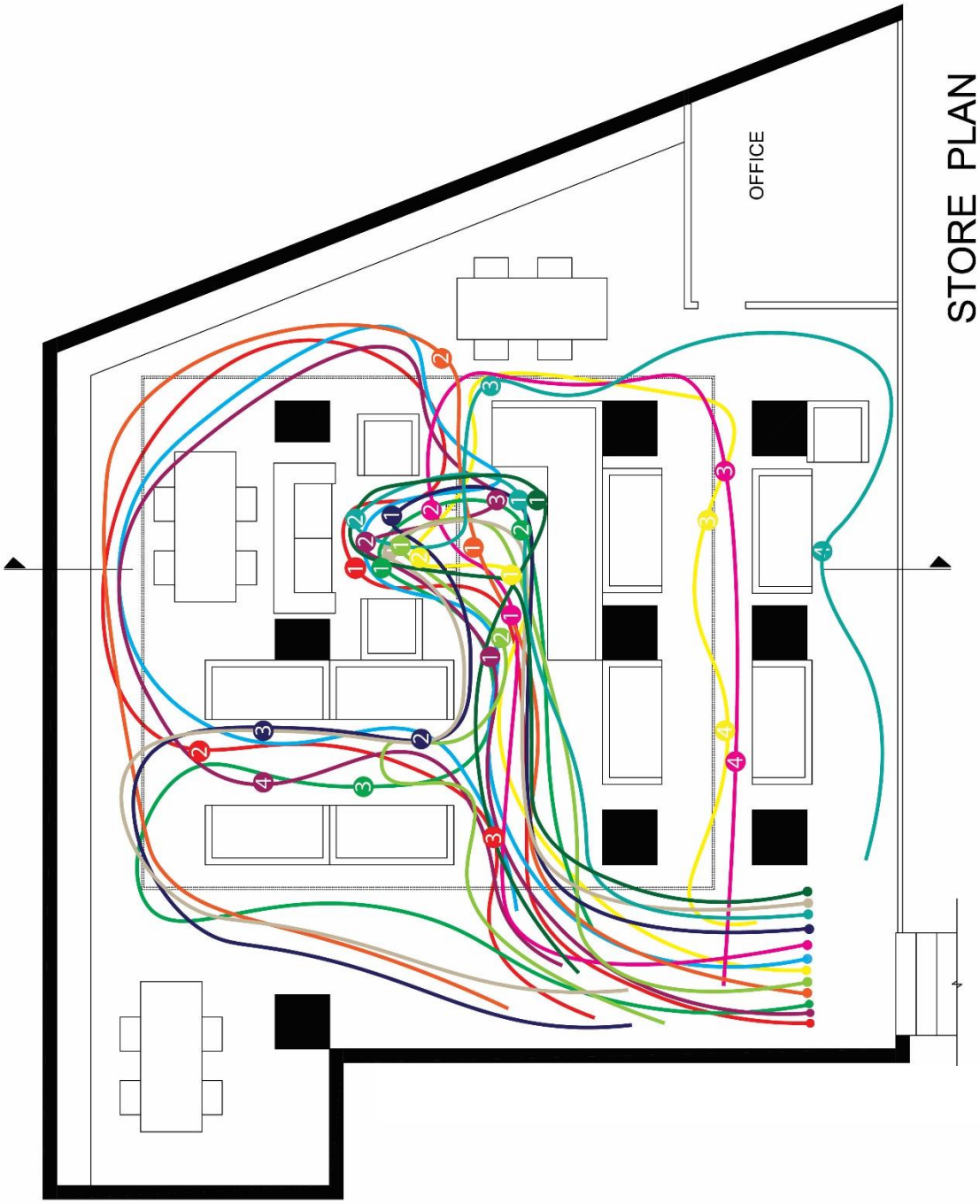
White, T. E., Rojas, B., Mappes, J., Rautiala, P., & Kemp, D. J. (2017). Colour and luminance contrasts predict the human detection of natural stimuli in complex visual environments. *Biol. Lett.*, 1-5.

Yılmaz, F. Ş. (2018). Human factors in retail lighting design: an experimental subjective evaluation for sales areas. *Architectural Science Review*, 156-170.

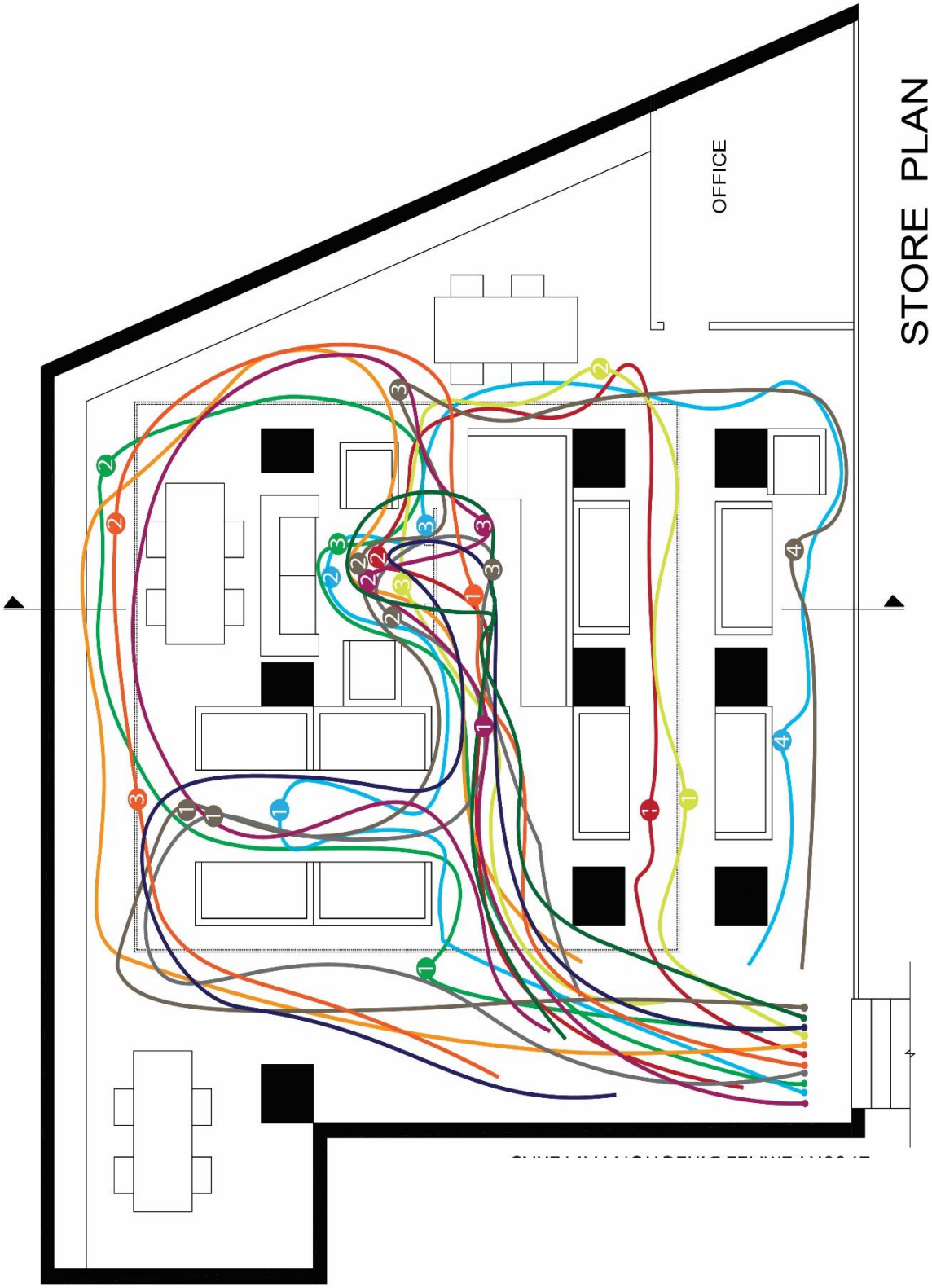
APPENDICES

Appendix A. Physical Activity Coding and Circulation Pattern

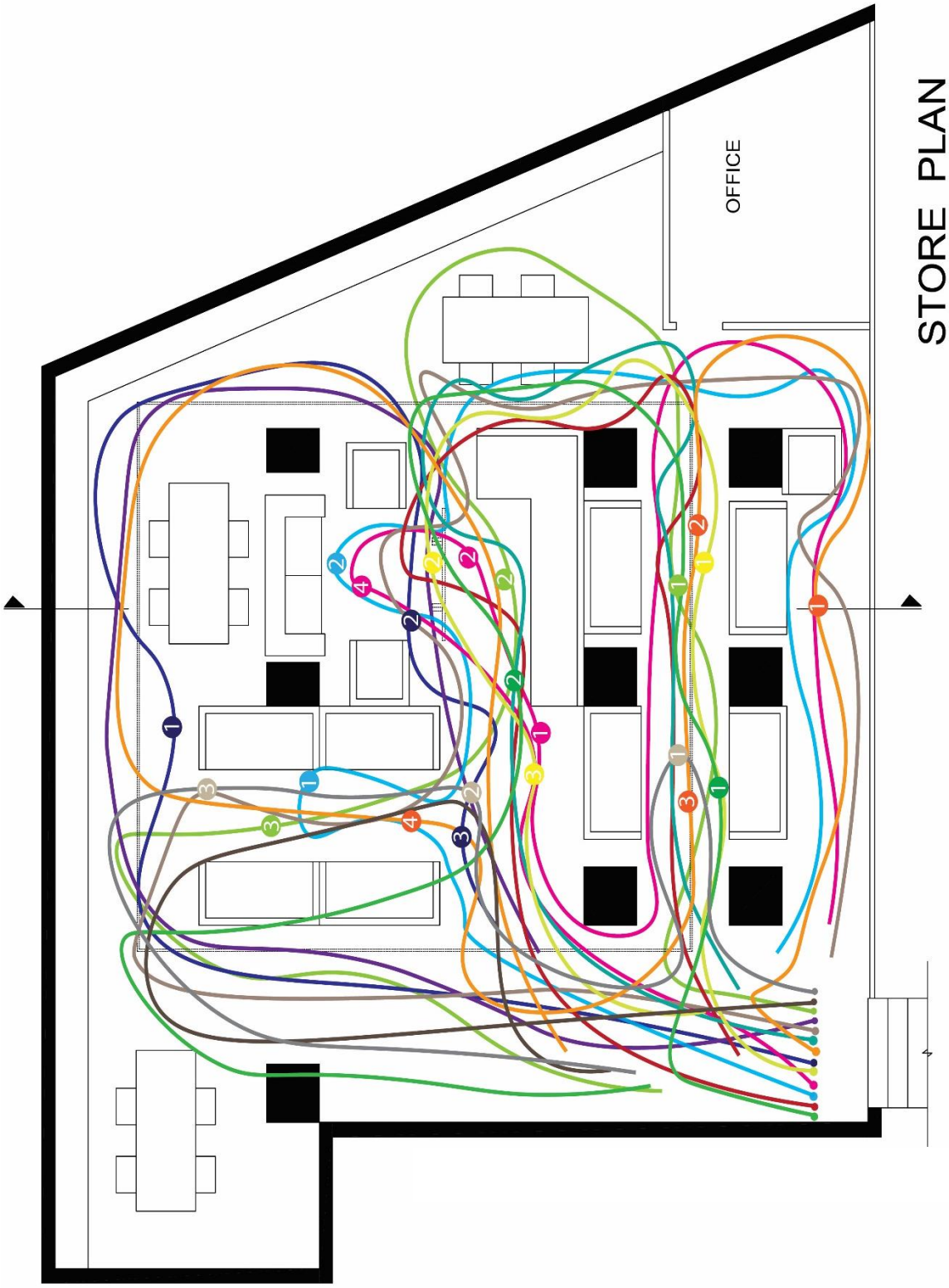
Appendix A1a. Female customers' patterns under 2700K



Appendix A1b. Male customers' patterns under 2700K

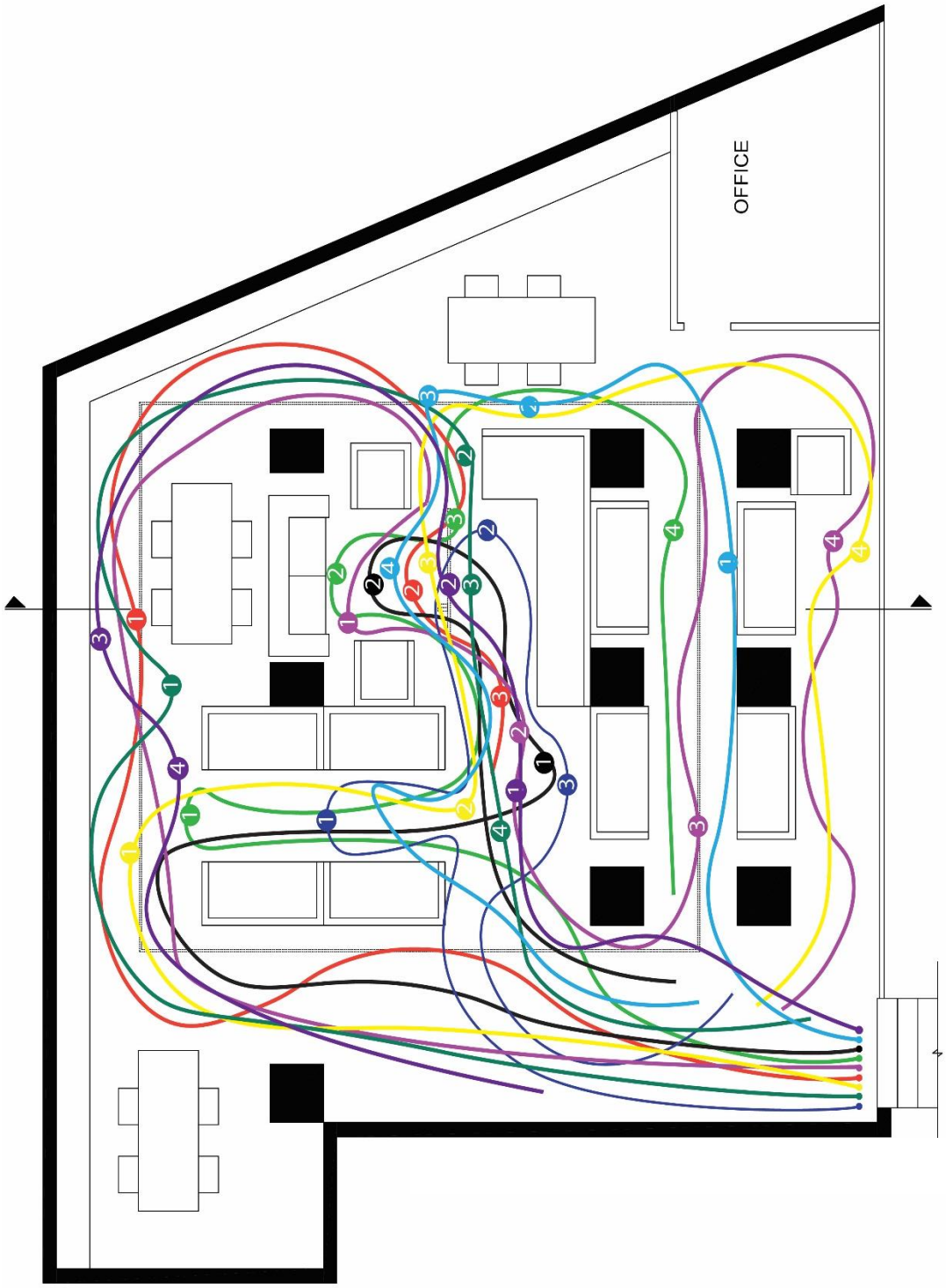


Appendix A2a. Female customers' patterns under 5000K

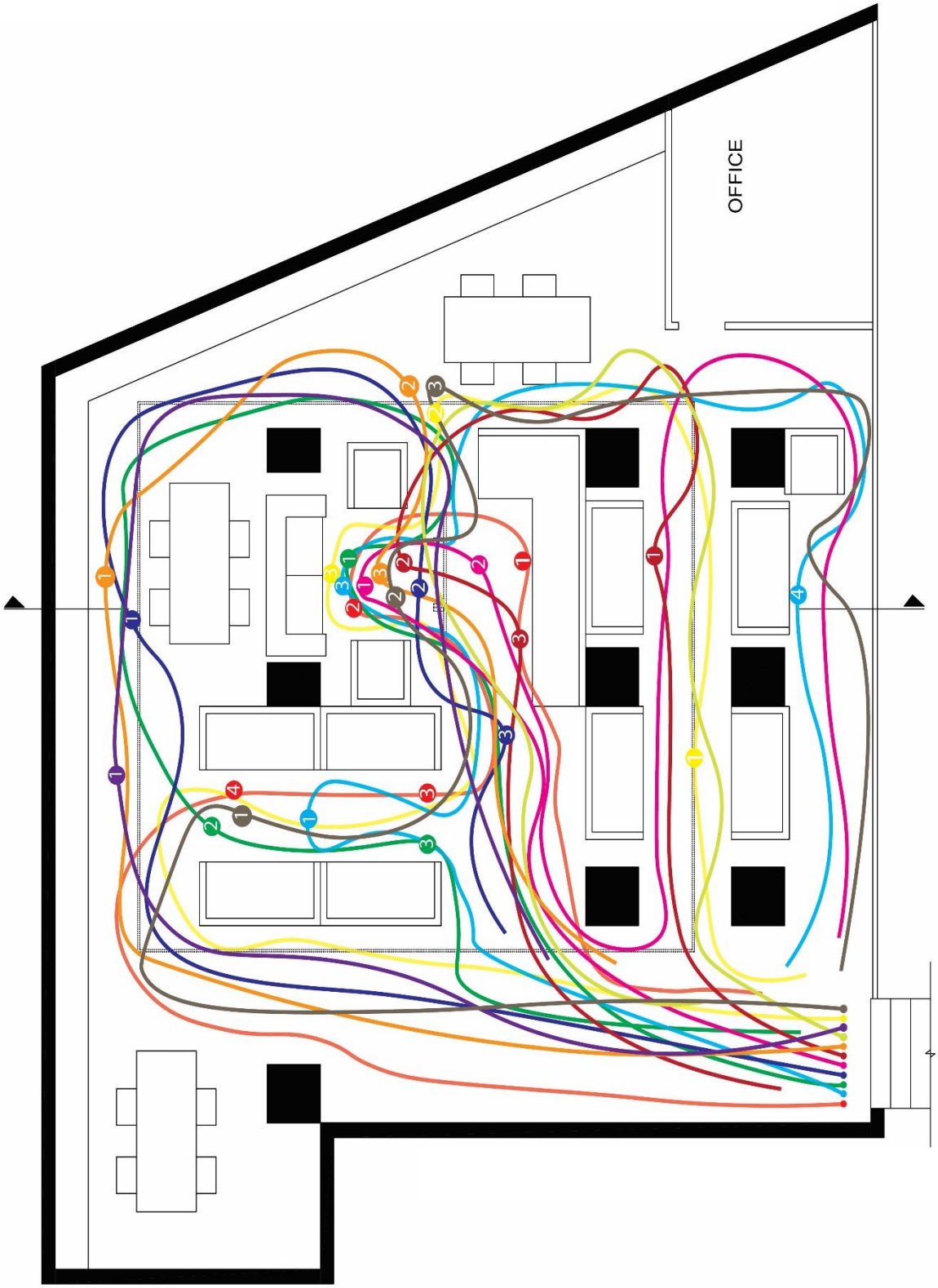


Appendix A2b. Male customers' patterns under 5000K

Appendix A3a. Female customers' patterns under 6500K

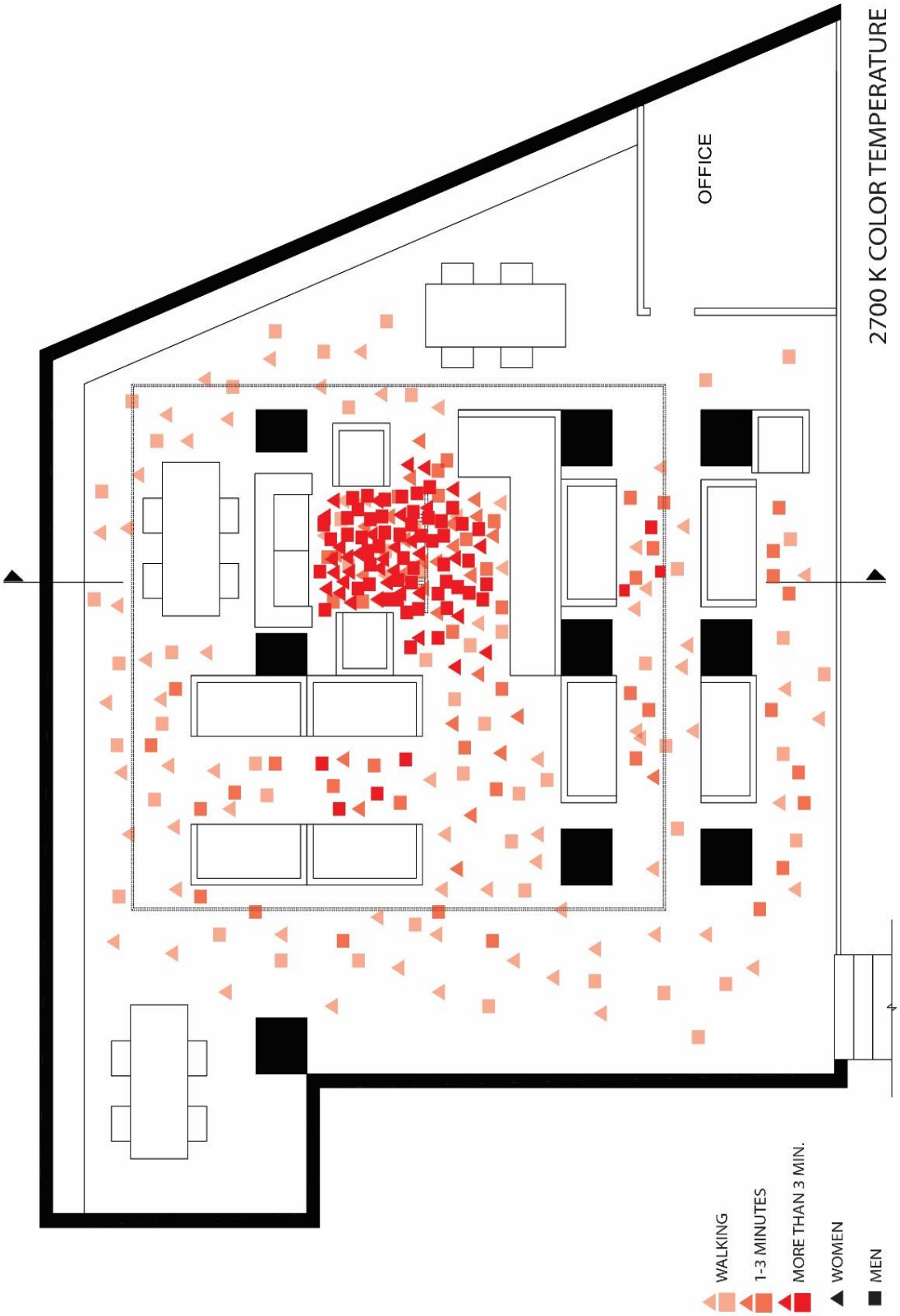


Appendix A3b. Male customers' patterns under 6500K



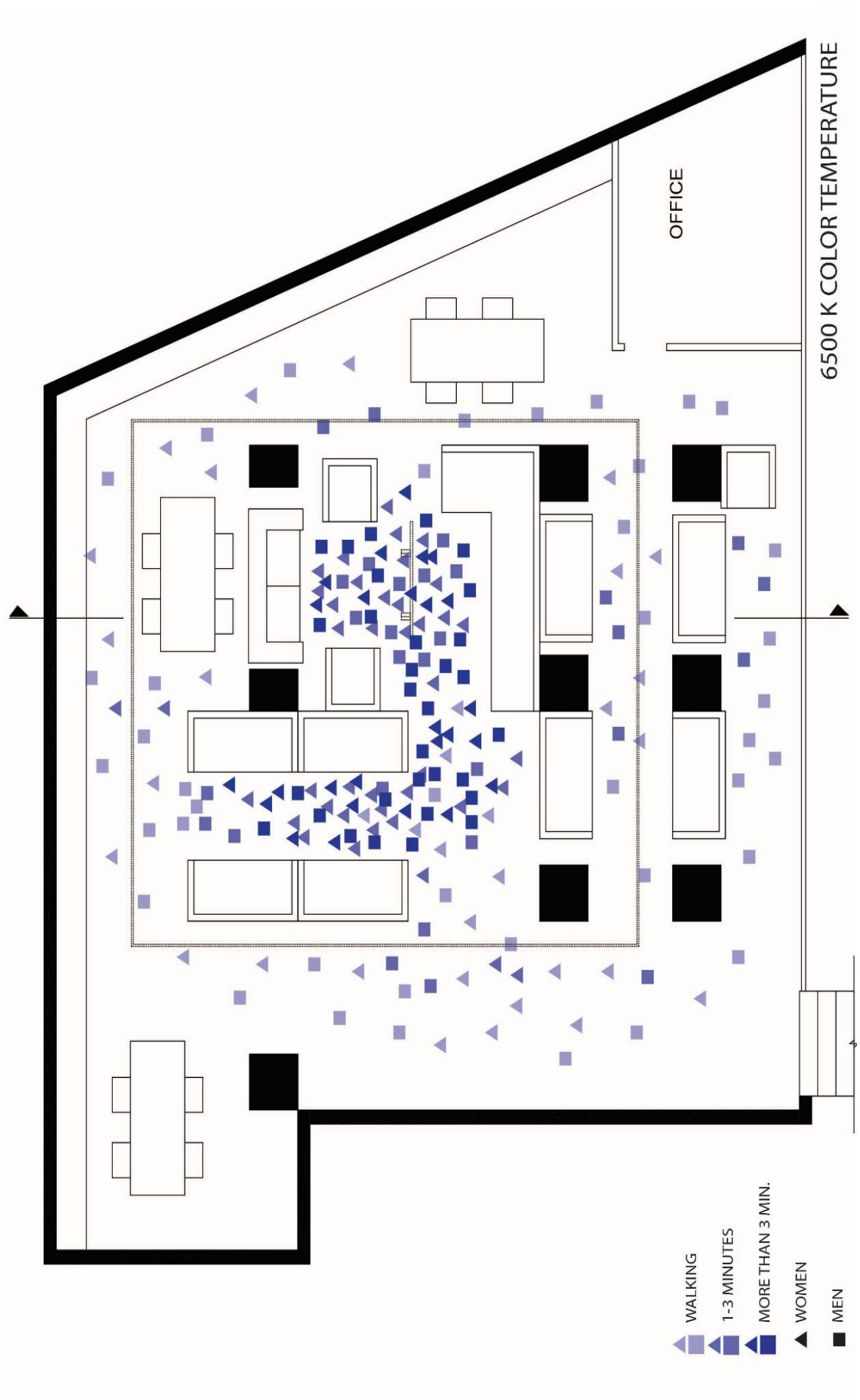
Appendix B. Behavior Maps Under Three Different Lighting Conditions

Appendix B1. Behavior Map Under 2700K



Appendix B2. Behavior Map Under 5000K

Appendix B3. Behavior Map Under 6500K



Appendix C. PAD Questionnaire Turkish Version

GÖZLEM SONRASI DEĞERLENDİRME ANKETİ

BİLKENT ÜNİVERSİTESİ İÇ MİMARLIK VE ÇEVRE TASARIMI BÖLÜMÜ'NDE YAZILACAK TEZ İÇİN KULLANILACAKTIR. BAŞKA HERHANGİ BİR PLATFORMDA BU BİLGİLER KESİNLİKLE SERGİLENMEYECEKTİR. LÜTFEN MAĞAZAYI DİLEDİĞİNİZ GİBİ GEZİNİZ VE BU ANKETİ CEVAPLAYINIZ.

Tarih:

Saat:

Kişisel Bilgiler

1. Cinsiyet:

2. Yaş:

3. Göz ve Renk Görme Bozukluğu

a. Herhangi bir göz bozukluğunuz var mı? Varsa, lütfen açıklayınız.

_____

b. Bu göz bozukluğunuzu giderecek herhangi bir araç (lens, gözlük, vb.) kullanıyor musunuz? Bu araç şu an üzerinizde mi?

E H

Ürün İzlenimi Değerlendirmesi

Lütfen gösterilen ürün grubuyla ilgili izlenimlerinizi 1den 7ye kadar numaralandırınız.

1. Belirtilen oturma grubu diğerlerinden daha etkileyicidir.

Kesinlikle katılıyorum				kesinlikle katılmıyorum
1	2	3	4	5

2. Belirtilen oturma grubu diğerlerinden ayırt edici özelliktedir.

Kesinlikle katılıyorum				kesinlikle katılmıyorum
1	2	3	4	5

3. Belirtilen oturma grubu üzerindeki ışık mobilyanın dokusunu ortaya çıkarmıştır.

Kesinlikle katılıyorum				kesinlikle katılmıyorum
1	2	3	4	5

4. Belirtilen oturma grubunun rengi ilgi çekicidir.

Kesinlikle katılıyorum				kesinlikle katılmıyorum
1	2	3	4	5

5. Belirtilen oturma grubunun aydınlatması yönümü belirlememe yardımı olmuştur.

Kesinlikle katılıyorum				kesinlikle katılmıyorum
1	2	3	4	5

Bu Mağaza ile ilgili hislerinizi işaretleyiniz.

Bu Mağazada memnuniyetle ilgili hislerinizi işaretleyiniz.

Memnuniyet		Son derece Olumsuz	Olumsuz	Kararsız	Olumlu	Son derece Olumlu	
1	Sıkıcı						Eğlenceli
2	Umutsuz						Umutlu
3	Mutsuz						Mutlu
4	Üzüntülü						Memnun
5	Rahatsız						Rahat
6	Keyifsiz						Keyifli

Bu Mağazada hangi duygularınızın harekete geçtiğini düşünüyorsunuz ?

Herekete geçme hissi		Son derece Olumsuz	Olumsuz	Kararsız	Olumlu	Son direct Olumlu	
7	Sakin						Heyecanlı
8	Hissiz						Aşırı Hisli
9	Donuk						Gergin
10	Uyuşuk						Uyanlmış
11	Uykulu						Canlı
12	Tembel						Coşkulu

Bu Mağazanın hareket veya davranışlarınızı nasıl etkilediğini düşünüyorsunuz?

Baskınlık		Son derece Olumsuz	Olumsuz	Kararsız	Olumlu	Son derece Olumlu	
13	Baskı altında						Rahat
14	Denetim altında						İlgilenilmiş
15	Özgür						Yönlendirilmiş
16	Etkilenen						Etkileyen

Appendix D. Tables for Statistical Analysis

Multiple Comparisons

Dependent Variable: EMOTIONS

Scheffe

(I) TEMPERATURE	(J) TEMPERATURE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2700 K warm white	6500K cool white	19.648*	1.572	.000	15.73	23.56
	5000K daylight	25.031*	1.599	.000	21.05	29.01
6500K cool white	2700 K warm white	-19.648*	1.572	.000	-23.56	-15.73
	5000K daylight	5.383*	1.586	.004	1.43	9.33
5000K daylight	2700 K warm white	-25.031*	1.599	.000	-29.01	-21.05
	6500K cool white	-5.383*	1.586	.004	-9.33	-1.43

*. The mean difference is significant at the 0.05 level.

Table 1: Shcheffe between emotional responses and color temperature

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.478	.199		2.399	.019
	temperature	.917	.092	.727	9.944	.000

a. Dependent Variable: order

Table 2: correlation coefficients between visiting order and color temperature

Correlations

		totaltime	temperature
Pearson Correlation	totaltime	1.000	-.339
	temperature	-.339	1.000

Table 2: Pearson correlation between total time spent and color temperature

		ACTIVITY CODING						
		N	P value (2-tailed)			Correlation Coefficient		
			2700K	5000K	6500K	2700K	5000K	6500K
PLEASURE	Bored-entertained	30	.379	.179	.195	.167	-.252	.243
	Despair-hopeful	30	.270	.051	.979	-.208	-.360	-.005
	Unhappy-happy	30	.640	.168	.476	-.089	-.258	.135
	Melancholic-contented	30	.402	.003	.624	.159	-.523**	.093
	Annoyed-pleasure	30	.	.319	.708	.[c]	-.188	-.071
	Dissatisfied-satisfied	30	.	.072	.296	.[c]	-.333	-.197
AROUSAL	Unaroused-aroused	30	.270	.598	.326	-.208	-.100	.185
	Dull-jittery	30	.	.754	.851	.[c]	-.060	.036
	Relaxed-stimulated	30	.	.185	.618	.[c]	-249	.095
	Sleepy-wide awake	30	.270	.385	.649	-.208	-.165	-.087
	Sluggish-wild	30	.640	.006	.359	.089	-.491**	-.174
	Calm-excited	30	.270	.013	.793	-.208	-.448**	.050
DOMINANCE	Dominance-submissive	30	.	.025	.719	.[c]	-.408*	.068
	Autonomous-guided	30	.559	.279	.214	.111	.204	.234
	Influential-influenced	30	.932	.161	.129	.016	.262	.283
	In control- cared for	30	.270	.056	.618	-.208	.353	-.095

Table 3: Correlation analysis under three lighting conditions between emotional responses and activity coding, **. Results are significant at the .001 level, *. Results are significant at the .005 level

		TIME SPENT						
		N	P value (2-tailed)			Correlation Coefficient		
			2700K	5000K	6500K	2700K	5000K	6500K
PLEASURE	Bored-entertained	30	.488	.134	.777	.132	.280	-.054
	Despair-hopeful	30	.061	.108	.324	-.346	.299	.186
	Unhappy-happy	30	.233	.993	.760	-.225	.002	.058
	Melancholic-contented	30	.266	.009	.123	.210	.467**	.288
	Annoyed-pleasure	30	.	.770	.217	.c	.056	-.232
	Dissatisfied-satisfied	30	.	.072	.713	.c	.333	.070
AROUSAL	Unaroused-aroused	30	.061	.426	-.107	-.346	.151	-.300
	Dull-jittery	30	.	.504	.308	.c	.127	-.192
	Relaxed-stimulated	30	.061	.049	.715	-.346	.363*	-.069
	Sleepy-wide awake	30	.233	.731	.541	.225	.066	.116
	Sluggish-wild	30	.061	.004	.272	-.346	.506**	.207
	Calm-excited	30	.	.001	.995	.c	.564**	-.001
DOMINANCE	Dominance-submissive	30	.551	.218	.120	.113	.232	.290
	Autonomous-guided	30	.551	.543	.523	-.113	-.116	-.121
	Influential-influenced	30	.764	.580	.755	-.057	-.105	-.059
	In control- cared for	30	.061	.406	.760	-.346	-.157	.058

Table 4: Correlation analysis under three lighting conditions between emotional responses and time spent, **. Results are significant at the .001 level, *. Results are significant at the .005 level