THE ANALYSIS OF STORE LIGHTING DESIGN: THE EMOTIONAL RESPONSES IN THE CONTEXT OF CUSTOMER CHARACTERISTICS

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ABSTRACT

THE ANALYSIS OF STORE LIGHTING DESIGN:
THE EMOTIONAL RESPONSES IN THE CONTEXT OF
CUSTOMER CHARACTERISTICS

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Lighting is a powerful tool to design a store and to create the atmosphere. Nowadays, it is not only a tool for seeing but also an affective tool to make spaces more interesting and to emphasize products and to create psychological influence affecting people's buying attitudes. This research is conducted to investigate how differences in regard to the customer characteristics affect the perception of store lighting. It reveals the effective role of characteristic differences, such as age, gender and educational level, in customers' perception of store lighting.

Keywords: Lighting, Perception, Store Lighting

ÖZET

MAĞAZA AYDINLATMA TASARIMININ ANALİZİ:
MÜŞTERİ KARAKTERİSTİKLERİNE BAĞLI İÇSEL TEPKİLER

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Aydınlatma atmosfer yaratmak ve mağaza tasarlamak için çok güçlü bir araçtır. Günümüzde, aydınlatma sadece görmeyi sağlayan bir araç değil aynı zamanda mekanları daha cazip hale getirmek, ürün özelliklerini ön plana çıkarmak ve insanların satınalma alışkanlıkları üzerinde psikolojik etki bırakmaya yarayan bir araç olarak da kullanılmaktadır. Bu araştırma mağaza aydınlatmasının müşteri karakteristiklerine bağlı algılanmasını incelemektedir. Araştırmanın sonucu yaş, cinsiyet ve eğitim seviyesi gibi müşteri karakteristiklerinin farklılıklarını mağaza aydınlatması üzerindeki etkisini ve algı biçimini ortaya koyar.

Anahtar Kelimeler: Aydınlatma, Algı, Mağaza Aydınlatması

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LIST OF ABBREVIATIONS

A	Arousal
CRI	Color Rendering Index
CCT	Correlated Color Temperature
D	Dominance
HID	High Intensity Discharge
LED	Light Emitting Diode
K	Kelvin
NA	Negative Affect
P	Pleasure
PA	Positive Affect
PANAS	Positive Affect, Negative Affect Scale
SAM	Self Assessment Manikin

CHAPTER 1

INTRODUCTION

1.1 The Purpose of the Study

The influences of store environments on customers are known for a long time. Besides the obvious functional factors of location, price ranges, and merchandise offerings. There is an effective role of a store interior in the determination of its customers. The store interiors can evoke emotional reactions with its customers, it can have an impact on the customers' satisfaction with the service and it can also affect the money and time spent in the store. Hence, providing the right environmental setting is very important for shop owners.

Turley & Miliman (2000) were the first researchers who conducted a literature review and listed forty three environmental cues inside a store that have the potency to affect consumer evaluations and behaviors. Some examples for these cues are design cues, like the colors and materials used for the walls, ceiling, floor, racks, and shelves; social cues, like crowdedness; and ambient cues like music, scent and especially lighting.

Lighting has a powerful impact on creating the space and on the humans. Mahnke (1987) indicates that: "For years, the lighting industry adhered to the belief that the only significant role of light is to provide adequate illumination that should be an aid in seeing." However, nowadays, lighting is not only a tool for "seeing", but also an important design element to emphasize products and to create psychological influence

affecting people's buying attitudes. Lighting also has an important role for the corporate identity; which means it can augment the communication of a brand's appearance. Therefore, there are three objectives of lighting in the stores:

1- The main scope of lighting is to attract the customers by providing the optimum desired appearance of the products.

2- The second aim is to initiate the purchase. As stated in IES Lighting Handbook (1987): "Buying decision starts when the customer is visually intrigued. The actual purchase is not accomplished until the customer can visually evaluate the product and labeling through adequate illumination."

3- The last aim is to complete the sales. Proper lighting is essential to constitute a suitable environment, so the customers can examine the product and give their decisions whether to buy or not. Thus, it enables the sales person to perform their duties in comfortable conditions.

Because of these importances of lighting on stores, many researches focused the effects of lighting on environmental impressions, on emotions, mood and cognition (Flynn, 1992; Fleischer, Krueger, & Schierz, 2001; Knez, 1995). However, there is no research addressing the store lighting design through the emotional responses in the context of customer characteristics. Although there are many factors which create the customer characteristics; only *gender, age and educational level* are considered as the main factors of customer characteristics in this study.

To investigate the effect of differences in customer characteristics on the perception of store lighting, a distinction can be made between the features which create customer characteristics. In this study, the effect of differences in customer characteristics on the perception of store lighting is investigated. The following question will be investigated.

How do the store lighting design analyze through the emotional responses in the context of customer characteristics?

1.2 The Methodology of the Study

To understand the meaning of lighting, firstly, the light and the technical aspects of lighting, including characteristics of lighting, lighting sources, types of lighting design and the lighting fixtures are researched.

Secondly, the effects of lighting on stores supported by previous literature are researched. In order to better understand the effects of lighting on stores, store design criteria and the lighting design criteria on stores are analyzed.

In addition, in order to answer the research question, a survey study is conducted in selected stores. In order to obtain objective results, two similar but totally different stores with the same product range and with different illuminations are selected. To prevent the stores from having big differences in terms of 'sold products' and thereby reducing the risk of its effect on the perceived atmosphere, only clothing stores, -not a supermarket or a restaurant- were selected. Minimizing the variables of stores, it was important to provide an objective comparison. First of all, all existing information about stores is collected; then the questionnaires are prepared in reference to the technical aspects of light and the previous researches. According to the survey results conducted with the customers/participants, several outcomes are evaluated to answer the research question. In this study, educational level differences, gender and age are considered as the most important customer characteristics. All these steps will be evaluated in detail in chapter 5.

All these characteristics are investigated in this study. The intention was to create a manual for designers that could guide the lighting decisions for stores. Consequently, consciously designed lighting plan does not only constitute the desired selling environment, but also provides economy from the lighting point of view.

1.3 The Structure of the Study

This study is composed of six chapters, including introduction and conclusion. The information presented has been obtained by a review of literature.

In the second chapter, in order to find the main purpose of the study, it should be analyzed the meaning of light and lighting features. Therefore, the study starts with the

technical aspects of lighting and grouped under three main parts: light and perception of lighting characteristics, lighting sources- luminaires and types of lighting design. Since comfortable and easy seeing is essential in stores, the determinants of lighting characteristics such as brightness, luminance and illuminance, correlated color temperature, color rendering index, spatial light distribution, glare and sparkle and grazing are analyzed in the first part. The second part presents lighting sources-luminaires that are relevant for the present study. The title named types of lighting design is analyzed in the third part under particular sub-titles.

The third chapter continues with previous studies on interior lighting. All the related previous researches created the background of the present study. Before stating the investigation, it must know all previous studies and the relation with the subject. Some related studies are analyzed under particular sub-titles: the effects of lighting on emotions, the effects of lighting on atmosphere perception, the effects of age, gender and educational level on lighting perception.

In the fourth chapter, some questions are aimed to be answered, such as how to choose the suitable lighting condition since there are variety of shops each selling different articles, or how to give the store its intended image and at the same time to reach the appreciation of the consumer target group. Thus, lighting design criteria of store interiors is analyzed.

Chapter five continues with the description of the experiment and its results. Finally, in the last chapter, the conclusions of the thesis are discussed suggestions for further researches are made.

CHAPTER 2

CONCEPTUAL AND TECHNICAL ASPECTS OF LIGHTING

Comfortable and easy seeing is the basic requirement in stores so that products can be viewed to its best appearance. In order to provide this best appearance, stores have to be equipped with proper lighting system.

To understand what lighting is exactly, firstly the light and the lighting characteristics need to be explained. In this chapter, these topics are discussed. It starts with what light is and continues with an overview of the lighting characteristics in detail.

2.1 Light and Perception of Lighting Characteristics

Light is the form of visible energy, getting from sunlight, or from a candle flame, or from an electric lamp. Light, either directly from a light source or reflected off an object, is perceived by human eyes and analyzed into images in the brain. “Normal” light is white, but it consists of different colors, the colors of the spectrum which are seen in the rainbow or in the science laboratory when light is passed through a triangular glass prism. So, if light defines with these words, what is lighting? The simplest explanation of “what is lighting” is the deliberate or controlled use of light.

This section provides an overview of the lighting characteristics *brightness, color rendering index, correlated color temperature, spatial light distribution, glare & sparkle* and *grazing*. Most retail lighting systems can be described in terms of these lighting characteristics. Another characteristic named *dynamic lighting*. As defined by Philips,

dynamic lighting can be determined as the rhythm of day and night, the seasons and weather conditions create ever-changing light situations during the day. With dynamic lighting, it can be brought the dynamic character of light –with its seamless changes in brightness and warmth indoors, allow enjoying the beneficial effects of natural light on the human body. For this study, because of the difficulty of controlling the dynamic lighting, it is not considered in present study; hence it is not relevant for the present study and therefore not involved in this overview.

2.1.1 Brightness, Luminance and Illuminance

Brightness is the subjective amount of light a source appears to emit. The amount of light can be expressed in terms of illuminance and luminance. *Illuminance* refers to the amount of light that falls on a surface, expressed in lumens per square meter or lux. Horizontal illuminance describes the amount of light landing on a horizontal surface, such a desk, and vertical illuminance describes the illuminance landing on a vertical surface, such as a wall or a face. *Luminance* refers to the amount of light that comes off a surface, expressed in candelas per square meter. The figure 2.1 illustrates the amount of light that can be expressed in terms of illuminance and luminance.

Stevens (1961, cited in Boyce, 2003) was the first to show that there is a consistent relationship between luminance and brightness. Furthermore, some different researches were done to investigate the relation and effect of illumination level in a space on perception of brightness. For instance, Davis and Ginthner (1990) found that participants approved a space with higher illuminance as brighter compared to a space with lower illuminance. Another research about the brightness of a space was conducted by Ishida and Ogiuchi (2002). They asked participants to evaluate the intensity of their sense of ‘the strength of the light source’, ‘the amount of light filling a space’ and ‘the brightness of the space’ for several light settings in a light box with objects, without being able to see the light source. As a result of this research, they found that the brightness of a space is highly related with the perceived amount of light in that space, not with the perceived strength of a light source.

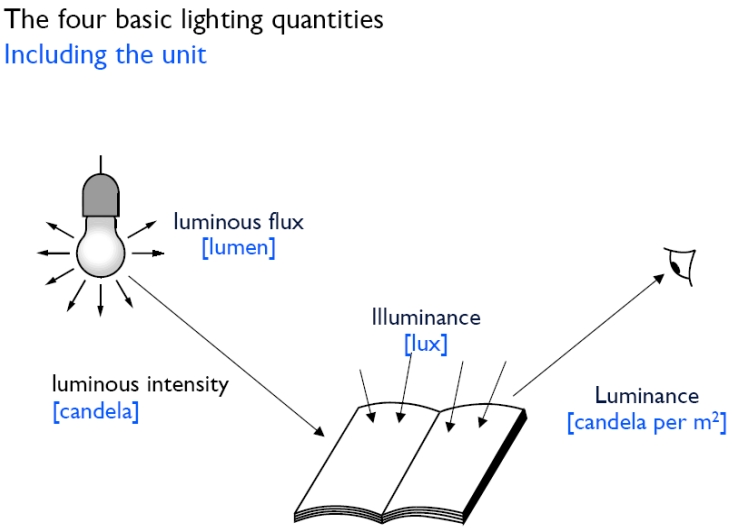


***Figure 2.1**: Lighting quantities (from Custers' study, 2008)*

Many other researchers showed that there is a relation between the brightness of a space and by the spatial distribution of the luminance. (Tiller & Veitch; 1995 and Kato & Sekiguchi; 2005) The experiment of Tiller & Veitch (1995) showed that keeping illumination values equal, a non-uniformly illuminated room is perceived brighter than a uniformly illuminated room. Kato et al. (2005) also found the same result. As a result, the research showed that even if the average luminance across the participant's field of view is the same, a space with a non uniform distribution appears to be brighter than a space with a uniform distribution.

However, the brightness of a space is not only affected by the spatial distribution of the luminance, but also the physical characteristics of the illumination. Researchers (Loe, Mansfield & Rowlands, 1994; Ishida & Ogiuchi 2000; Iwai and Kato & Sekiguchi; 2005) investigated that brightness relates to the average luminance within a person's field of view. Loe, Mansfield and Rowlands (1994) described an experiment wherein they showed participants eighteen different light distribution settings in the room and asked them to fill in a questionnaire about the perception of the room illumination. Participants observed the light settings from a fixed location. The result of the experiment showed that brightness perception was determined by the luminances present and the location of those luminances. Ishida et al. (2000) although the direction of the observer's seat was fixed, the experiment was in an actual space, which seeing the narrow area, where the target is a three-dimensional space. Ishida explained spatial impression of brightness from the

impression of quantity of light. According to Kato and Sekiguchi (2005), the direction of light relative to the visual direction of the observer had an impact on brightness impression. Light from a horizontal direction was evaluated as brighter than from a vertical direction. Furthermore, the average illuminance from the surface perpendicular to the viewing direction correlated very well with brightness impression.

According to Ginthner (1990) study, brightness can focus attention. In retail stores, when creating a focal point, increasing the brightness contrast between the object and the surround increases the impact. Another research related with the brightness of a space and the physical characteristics of the illumination, done by Hopkinson & Longmore (1959), has shown that higher brightness levels attract the attention of people, which is called 'human phototropism'. In retail stores, this frequently used by applying high brightness levels on a particular area of a shop to make sure that section receives extra attention. In generally, this area is located in the back of the shop to lead customers along as many products as possible.

The values of the terms "*luminance"* and "*illuminance*" are so important for the visual performance in store lighting. Rea & Ouellette (1991) and Blackwell's (1959) also revealed the importance of the luminance and illuminance in store lighting. Their researches proved the relationship between *luminance, illuminance* and *visual performance*, with the result how light levels affect visibility. Furthermore, the lighting source and the features of the surface (e.g. materials, colors, textures…) also affect *luminance* and *illuminance.* In the experiment of present study, the relation between customer characteristics and perceived brightness will be researched.

2.1.2 Color Rendering Index – CRI

The color rendering index (CRI) is a measurement of how well a light source represents color compared to an ideal source. Color rendering index (CRI) is measured on a scale of 0 to 100. A score of 100 indicates perfect agreement. Incandescent and tungsten halogen lamps have a CRI of 100, because their chromaticity coordinate lies on the black body curve, whereas the CRI of fluorescent lamps usually vary between 50 and 95.

The higher the CRI of a light source, the more “natural” colors will appear under it. -Natural, means as seen in daylight or sunlight. If an object looks different according to the color in the light illuminating it, because of this, it cannot be named true color-. Light sources with a low CRI will distort colors. For instance; Boyce’s experiments (2003) show that a light source with a CRI above 80 creates visual clarity and greater brightness perception; and a light source with a CRI below 60 produces an unattractive rendering of skin tones and a non-white color appearance of the lighting.

As a result of researches, it is understood that CRI is the most important characteristic to perceive color correctly. For this reason, CRI of the light sources should be selected carefully to present products to the customers effectively.

2.1.3 Correlated Color Temperature – CCT

Correlated color temperature is a characteristic of visible light that has important applications in lighting. The term correlated color temperature (CCT) is used for the color of the light emitted by a light source. This measure is based on Planck’s radiation law; it means black body’s spectral emission. Consequently, the chromaticity coordinates of a black body radiator are a function of its temperature. In figure 2.2, Planckian locus (or: black body curve) is shown in a section of the CIE 1931 chromaticity diagram.

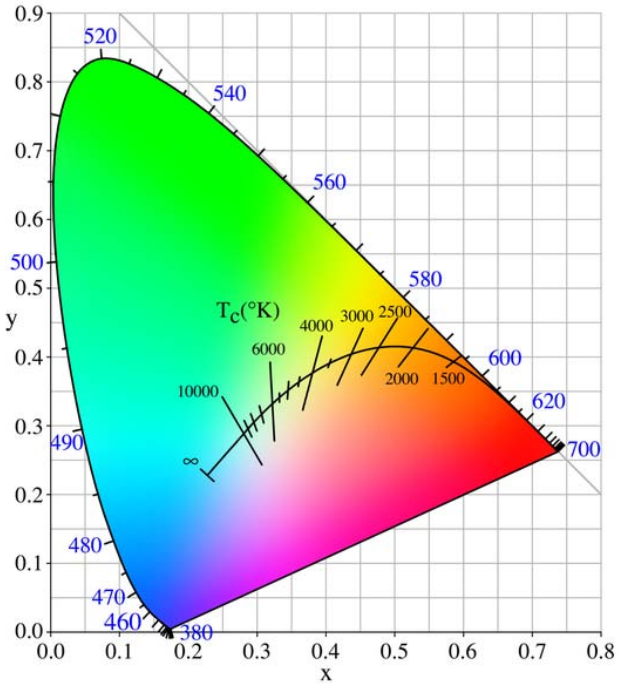


Figure 2.2: *The Planckian Locus. (http://www.wikipedia.org) The lines crossing the locus are the lines of constant correlated color temperature. Incandescent lamps usually have a CCT of 2700K, tungsten halogen lamps have a CCT of 2900K and the CCT of fluorescent tube lights varies over a wide range up to 17000K (Boyce, 2003).*

The lines crossing the locus are called the iso-temperature lines. This means, all colors on an iso-temperature curve have the same correlated color temperature (CCT) which corresponds to the CCT of the point on the locus. In other word, for light sources that have chromaticity coordinates that lie close to, but not exactly on the locus, the color can be expressed by the CCT and CCT are usually given in Kelvin [K]. Higher color temperatures (5,000 K or more) are called *cool colors*; lower color temperatures (2,700-3,000 K) are called *warm colors*. The "warmth" or "coolness" of light sources is quantified by the temperature of a blackbody that gives the same color light. For instance, a blackbody at 3000 K produces the same color of light as the warm white fluorescent, though their chromaticity coordinates differ. The halogen bulb is said to have a correlated color temperature of 4100 K. The CCT of the warm white fluorescent is 3000 K.

The experiment showed the significant effects of CCT on perception of a space. (Davis & Ginthner, 1990) In a later study, Knez and Enmarker (1998) found the effects of gender and Knez and Kers (2000) found the effects of age on the perception of a space. Furthermore, in the experiment of Knez et al. (2000), they found that younger participants assessed the room light as cooler as than older participants. They explained the effect of age by the fact that older people are less sensitive for light intensities due to age related impairments.

In accordance with all of this information, CCT has an important place between the characteristics of light. Therefore, to understand the effect of CCT on perception of spaces, the relation between customer characteristics and the warmth or coolness of light sources will be researched.

2.1.4 Spatial Light Distribution

Spatial light distribution refers to the way light is distributed from a light source. Also, spatial light distribution can be named as *"contrast"*. It is the difference in brightness of an object that makes this object distinguishable from other objects. In other words, a higher contrast makes easier to detect the target.

Spatial light distribution can be uniform or non uniform in a space. Its perceptual attribute is perceived uniformity. Loe, Mansfield and Rowlands (1994) did an extensive research about the spatial light distribution. They measured the perceived light pattern uniformity with a uniform and non-uniform scale. At the end, they found that perceived light pattern uniformity was related with the logarithm of the ratio of maximum to minimum luminance.

2.1.5 Glare and Sparkle

Glare refers to having difficulty seeing caused by bright light, means when there is an excessive contrast between the dark areas and bright areas in the direction of viewing, glare can result. Lighting professionals distinguish between two types of glare: *discomfort glare* and *disability glare* (Rea, 1993). Discomfort glare refers to the experience of physical symptoms associated with viewing bright sources, either in the

field of view or by reflection. Disability glare to some extent disables the visual system. This type of glare can be divided in glare caused by point sources (e.g. facing an oncoming vehicle on the road at night) or large area sources (e.g. a bright sky visible through a window). Thus, one could distinguish these two types of glare in terms of their behavioral effects: Disability glare is a visual performance effect, and evidence suggests a physiological basis for discomfort glare complaints (Berman, Bullimore, Jacobs, Bailey, & Gandhi, 1994). Furthermore, laypeople believe that glare can cause headaches (Veitch & Gifford, 1996). On the other hand, sparkle is a desired and pleasant form of glare, which is often created using accent lighting.

Nevertheless, *glare & sparkle* in stores are so important on perception of store lighting. *Glare & sparkle* can be an important factor for attracting attention of customers if they are used correctly. According to the some researches, more and correct *glare & sparkle* in a shop evokes an atmosphere that is perceived as more lively. Furthermore, using correct finishing materials (e.g. metals, wood coverings, polished paints, and polished floor coverings) also play an affective role for the correct and pleasant glare.

2.2 Lighting Sources - Luminaires

“In a store area, the professional concept of a modern light design is initiated with the choice of appropriate light sources.” (International Lighting Review, 1994). According to Parnes (1948), the selection of the light sources mostly depends upon the type of trade, the products and the customers and the importance of a true or special color rendering.

In general, it s possible to classify the light sources, which could be used in store lighting, under three main headings as: incandescent, fluorescent and HID lamps. For each one, there are various lamps which differ in the construction, wattage, luminous efficiency, color properties and price. Each one has their own advantages and disadvantages. Three main lighting sources are stated in the paragraphs below:

2.2.1 Incandescent Lamps

Incandescent lamps are the simplest type of lamp technology. They work by passing electricity through a thin filament, heating it to a temperature that produces light.

The enclosing glass bulb contains either a vacuum or an inert gas to prevent oxidation of the hot filament. A typical incandescent lamp is shown in figure 2.3.

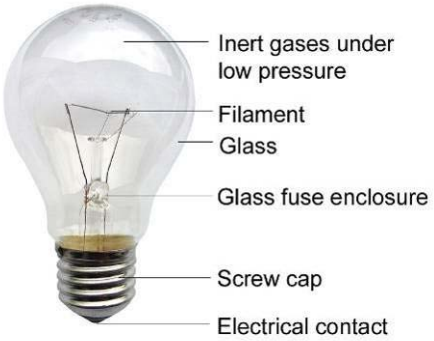


Figure 2.3: *An Incandescent Light Bulb*

As it is shown in previous figure, incandescent lamps include enclosures made from a ribbon of hot glass that is first thickened and then blown into molds. These glass enclosures are then cooled, cut from the ribbon, and coated with a finishing material. The filament is formed by drawing tungsten metal into a tightly coiled wire. The finished filament is then clamped or welded to leads which are embedded in a glass supporting structure. This structure is then inserted into the bulb and the parts are fused together. When most of the oxygen has been removed, the bulb opening is sealed and a base is attached.

Incandescent bulbs are made in a wide range of sizes and voltages, from 1.5 volts to about 300 volts. They require no external regulating equipment and have a low manufacturing cost, and work well on either alternating current or direct current. They are used mainly in residential applications because they emit a “warmer” light that contains less red and blue. As a result the incandescent lamp can be used in stores, for portable lighting such as pendant lamps, and for decorative and advertising lighting. Furthermore, the light produced by incandescent lamps has good color rendering.

According to Philips, there are some important specifications to choose an incandescent lamp. It has to include maximum overall length, light center length, life hours, watts, lumens and color temperature. Typically, maximum overall length is expressed in inches (in). Light center length is the distance between the center of the filament and the light center length reference plane.

Considering of all features, when using incandescent lamps on the right time and right place, it is a very important sort of lightings.

2.2.2 Fluorescent Lamps

A fluorescent luminaires or fluorescent tube is a gas-discharge lamp that uses electricity to excite mercury vapor. The excited mercury atoms produce short-wave ultraviolet light that then causes a phosphor to fluoresce, producing visible light. A fluorescent lamp converts electrical power into useful light more efficiently than an incandescent lamp. Lower energy cost typically offsets the higher initial cost of the lamp. The lamp is more costly because it requires a ballast to regulate the flow of current through the lamp (Inman, 1954). Figure 2.4 illustrates the construction of a typical fluorescent tube.

Fluorescent lamps use 25–35% of the energy used by incandescent lamps to provide the same amount of illumination (efficacy of 30–110 lumens per watt). They also last about 10 times longer (7,000–24,000 hours).

As for the investigation in the past, there is no noise problem with this type of light source. Fluorescent lamps are saving energy by working without vibration. They are preferred on the stores due to energy saving and their color selection. They are suitable because of giving homogenous light. It is more suitable for creating atmosphere when using together with incandescent lamps.

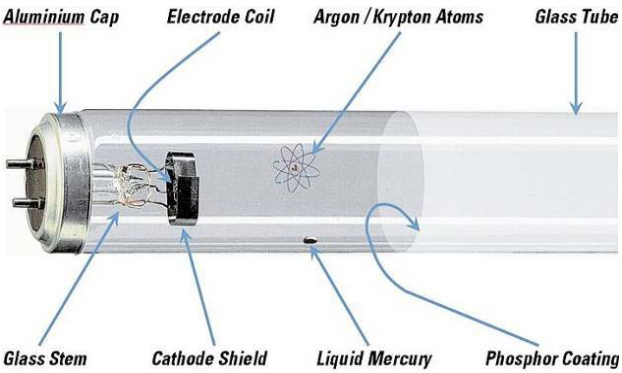


Figure 2.4: *A Fluorescent Lamp*
(http://www.daviddarling.info/encyclopedia/F/AE_fluorescent_tube.html)

Fluorescent light sources are good at illuminating large areas and have longer life than others. Moreover, it is possible to change the lamps easily and it offers the dimming property but that is expensive.

2.2.3 High Intensity Discharge (HID) Lamps – Mercury, Metal halide and High Pressure Sodium Lamps

High-intensity discharge (HID) lamps provide the highest efficacy and longest service life of any lighting type. They can save 75%–90% of lighting energy when they replace incandescent lamps. HID lamps use an electric arc to produce intense light. Like fluorescent lamps, they require ballasts. They also take up to ten minutes to produce light when first turned on, because the ballast needs time to establish the electric arc. A typical high intensity discharge lamp is shown in figure 2.5.

When HID lighting is considered; mercury, metal halide and high pressure sodium sources can be stated. They are more or less similar to fluorescent lamps in operation and efficiency, and to incandescent lamps in shape and size. (Green, 1986)

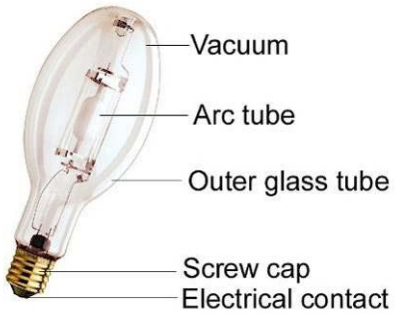


Figure 2.5: *In a high-intensity discharge lamp, electricity arcs between two electrodes, creating an intensely bright light. Mercury, sodium or metal halide gases act as conductor.*

They might not be so suitable for the lighting of retail establishments since they are not good at color rendering property, or can be used in stores where color discrimination is not necessary. Mercury based lamps mostly preferred for the outdoor

applications. However, as indicated in Green's research (1986), HID lamps can be used for the general diffuse illumination of the stores.

Consequently, when a light source is selected for the illumination of the store, the color of the product, the effect that is wanted to be created must be considered. If colors like red and yellow are to be accentuated and warm, intimate atmosphere is to be created, incandescent light sources will be the best selection. They provide glitter and sparkle in spaces where necessary. Since they emit directional and concentrated light, modeling effect occurs. Moreover, they have a low initial cost and good optical control capabilities. Nevertheless, fluorescent lamps mostly preferred for general lighting, but they could be used with incandescent light sources in order to achieve a balanced diffused and directional lighting. They mostly enhance the blue and green colors of the products on display. HID lamps are not highly preferred for illuminating stores because of their poor color rendering index, but depending on the situations some of them could be used.

2.2.4 Light Emitting Diode (LED)

A Light Emitting Diode (LED) is a semiconductor diode which converts electricity into light. It can be regarded as the most recent technology for the lighting. The following figure 2.6 illustrates a typical light emitting diode-LED lamp.

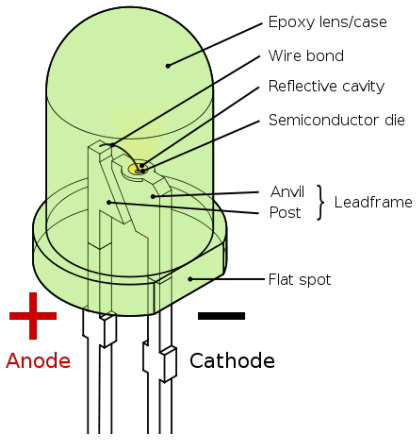


Figure 2.6: *Light Emitting Diode (LED)*
(From http://www.fiberopticproducts.com/Led.htm)

In simple terms, LEDs are solid-state semiconductor devices that convert electrical energy directly into light. LEDs' cold generation of light leas to high efficacy because most of the energy radiates within the visible spectrum (Bierman, 1998) Fukudo (1991), his book about semiconductors, explains a light emitting diode as an optical device in which spontaneous emission that originates from an injection excitation is efficiently applied to optical fiber transmission, display or illumination.

Encarta Encyclopedia describes the physical components of an LED as follows: Led's are made of a combination of elements from column III of the periodic table, such as aluminum, gallium and indium and column V of the periodic table, such as phosphorus, arsenic and antimony. LEDs are made of semiconductors called III-V compounds semiconductors. In order to change the characteristics of the LED, including color, the elements that compose the semiconductor and the ratio of column III elements are changing by the LED manufacturers (Light-emitting diode).

LED lamps do not produce heat rather than incandescent lamps and fluorescent lamps. Semi-conducting material converts electricity to light. These features provide to use LED lamps on the any sort of spaces, like interior-exterior, wet-dry i.e. The designers use LED lamps for particularly on the stores and the spaces which need to use lighting for decorative purposes.

LEDs are preferred for decorative purposes, on the shelves, and on the step lightings, due to quality of lighting. There are 16 million of varieties of LEDs color and this gives design flexibility. LED lamps are available for keeping in the closed area because of their long-life, low heat, resistance of impact and dust.

USA Lighting Research Center has researched effects of LED in the 700 different stores. In this study, the white background is placed in the shop window behind dummy. Halogen lamps, used for accent lighting are reduced and fluorescent lamps, used for general lighting are switched off. As a result of this study, energy consumption was decreased around 30-50%. Another result of this study, it has been investigated that customer perception on the products was increased.

2.3 Interior Lighting Systems

In stores, lighting systems can be named as *direct lighting systems* and *indirect lighting systems*. For the direct lighting systems, the lighting beam is directly concentrated on the product on display. For the indirect lighting systems, the light directed towards the ceiling or a wall, then to the object. Types of lighting systems that are mostly used in stores are analyzed in the following section:

2.3.1 Direct Lighting Systems

For the direct lighting sources, following could be considered: downlightings, wall washers and track lightings.

a- Downlightings

As Ketchum (1954) indicates that light from sources at ceiling level directed downwards to the products to the inspection level and to the circulation areas in the stores. Recessed incandescent downlights are shown in figure 2.7.

Figure 2.7: *Recessed Incandescent Downlights*

Downlights are one of the simplest and mostly used lighting systems among others. It has a very practical working principle. They can be suspended, surface mounted, or recessed into the ceiling. They could be adaptable, since it is possible to illuminate the large areas and focus onto the product itself with narrow beam spread.

b- Track lightings

Track lighting is composed of a continuous linear electric power source and hanging system, that is the track and the luminaires as can be seen from figure 2.8.

Figure 2.8: *A typical track lighting*

Track lighting is one of the mostly used lighting systems for the stores, because of their great flexibility as the direction and the location.

c- Wall washers

As Green (1986) indicates that wall washers consist of a fully metal housing that has a fixed socket with or without a built-in reflector. Therefore, they can house both reflector and non-reflector lamps. As understood with this explanation, wall washers provide diffuse and shadowless light.

Placement at greater distances will cause uneven illumination. They illuminate nearly 1.5 m down the wall (Nuckolls, 1983).

d- Pendant and surface mounted lightings

As Green (1986) indicates that pendant and surface mounted systems have exposed and finished housing. Pendants and surface mounted lightings are suspended from ceiling on rods and are used where ceilings are high. An example of pendant lighting can be seen in figure 2.9.

Figure 2.9: *A typical pendant lighting*

2.3.2 Indirect Lighting systems

Indirect lighting is used for having a general diffuse illumination. This is achieved by directing the light towards the ceiling; then light is reflected below, to the products. One important thing is the intense lighting level or the very high ceiling brightness must be avoided since too much ceiling brightness direct the attention away from the product.

a- Cove and bracket lighting

Cove lighting is diffuse illumination such that, the indirect light is emitted from a continuous niche and disturbed towards the ceiling. By using these systems, it is possible to obtain pleasing brightness level if the light is uniform enough.

These systems are mounted on a wall, nearly 0.40 to 1.00 meter below the ceiling. Inside this system fluorescent and incandescent lamps can be used. Figure 2.10 presents cove lighting.

Figure 2.10: *Vertical section of a cove lighting system*

Cove systems are preferred for the general lighting of a space. By hiding the systems behind a cove molding or lighting for linear decorative purposes. The material, the texture and color of spaces where light is reflected are determinant factors for the intensity and the quality of the light.

2.4 Types of Lighting in Interiors

Good quality lighting is for determining how things will look and feel in a space. For a given space, requirements and wants have to be understood to design a suitable lighting concept and translate it into a plan. Conceptual ideas are developed in a process which occurs with continuous observation and analyzing the space.

Lighting specialist categorize lighting types in four different groups: *general (ambient) lighting, task lighting, accent lighting* and *decorative lighting.* As Philips organization is defined types of lighting, they are stated in the paragraphs below.

2.4.1 General (Ambient) Lighting

General lighting provides the required horizontal illuminance over the total area with a certain degree of uniformity. Also known as ambient lighting, it radiates a comfortable level of brightness without glare and allows seeing and walking about safely. The most useful advantage of this type of lighting is the flexibility in rearranging the space. Since illumination is roughly equal everywhere, settlement is relatively easy.

2.4.2 Task Lighting

Task lighting provides to focus light onto a specific task the completion of visual tasks easier. Lighting at reading corner, drawing table or a specific object are all examples of task lighting. The common need of these is to detect and recognize very small parts of total visual effect.

Task lighting is differentiated from area and mood lighting, which are designed simply to illuminate various regions of a space, sometimes creating specific desired effects. The task lighting is also designed to work together with the general lighting to provide the correct quantity and quality of illumination for visual performance. In the book “The Design of Lighting”, task lighting is explained with the four important aspect; task illuminance–its level and distribution, contrast within the task, contrast between the task and its surroundings, absence of discomfort glare.

For task lighting the individual control is possible that have significant psychological benefits for people. To avoid darker surrounding areas and excessive brightness ratios some background illumination is required 1:3.

2.4.3 Accent Lighting

Accent lighting is directional lighting to emphasize a particular object or to draw attention to a part of the field of view. It creates atmosphere in the space by the help of visual interest; light and shadow. It is used to spotlight paintings, houseplants, sculpture, and other prized possessions, or to highlight the texture of a wall. Since it is a very powerful generator of the visual atmosphere it requires attention. Accent lighting requires at least ten times as much light on the focal point as the general lighting around it. Accent lighting is especially used as in the following titles: Modeling, silhouetting, down lighting, wall washing, up lighting and grazing.

2.4.4 Lighting in Decorative Purposes

Lighting for decorative purposes refers to attractive luminaries or lamps to provide a point of interest or an attractive feature in an interior. Here it is the light itself that provides the interest, and not the illuminated object.

2.5 Evaluation of Technical Aspects of Lighting in Store Environments

As a result, research related with the brightness proved that the average luminance in a person's field of view is a predictor for brightness. On the other hand, researches showed that average luminance in a person's field of view are not appropriate to get the determination of brightness impression between light settings with different luminance distributions. Another lighting characteristics, perceived CCT can be measured with a warm-cool scale. This scale does not always show the effects of changes in CCT, due to the fact that the differences between CCT levels were not extreme enough. The color rendering index has an effect on the visual clarity and greater brightness perception. It can be associated with the distortion of color (Boyce, 2003). Spatial light distribution has an effect on the uniformity of luminance distribution across the room surfaces (Loe, Mansfield and Rowlands, 1994). The perceptual attribute and perceived uniformity can be measured with a uniform and non-uniform scale.

To provide these lighting characteristics, lighting sources; included *incandescent lamps, fluorescent lamps, high intensity discharge (HID) lamps, light emitting diodes*

(LED),interior lighting systems; included *direct lighting systems*, *indirect lighting systems*, types of lighting in interiors; *general lighting, task lighting, accent lighting, lighting in decorative purposes* are used in interiors.

To be named store lighting as successful, all described lighting characteristics must be applied in correct form. (Veitch & Newsham, 1996b) In the line with these explanations, all characteristics will be evaluated and reviewed during the experiment. In the present study, *brightness*, *correlated color temperature*, *color rendering index*, *spatial light distribution, glare & sparkle* and *modeling* will be investigated.

CHAPTER 3

STUDIES AND METHODS ABOUT PERCEPTION OF INTERIOR LIGHTING

Literature about the effects of differences in customer characteristics on the perception of store lighting is limited. However, a number of studies have investigated topics that are related to the appraisal of retail environments and lighting systems. Relevant literature for the present study is discussed in this chapter. It starts with an overview of the effects of lighting on emotions and emotions on atmosphere perception. Subsequently, this chapter provides an overview about the relation between lighting perception and age, gender, educational level and association of daytime in all environments.

3.1 The Effects of Lighting on Emotions

In this section, the researches about measuring methods of emotional responses and the effects of lighting characteristics on emotions and behaviors is discussed.

3.1.1 Methods of Measuring Emotional Responses

Light has also an effect on people's mood and emotion. This section describes the concept emotion and emotion measurements. In this study, the evaluative approach of the customers would be emotional responses; therefore, the method measuring emotions is

crucial. In the literature, the following methods examined and the most applicable one has chosen.

Emotions are affective states which is a very broad term referring to the experience of feelings. Thus, this means that affective states which continue for a relatively short period of time and have very often clear causes. Whereas an emotion continues for seconds or minutes, a mood can last for hours and even days. (Lazarus, 1991) An emotion is the result of a cognitive appraisal, which is a person's assessment of the meaning of the current circumstances. These circumstances can be for instance an interaction with another person, with one self (e.g. thoughts), or an environment. If this situation is evaluated as important an emotion is experienced. Depending on the valence and importance of the situation a certain type of emotion with certain intensity is experienced (Lazarus, 1991).

The earliest theory of emotions, stated by Osgood (1957), described the emotions by the help of adjectives. This method was named "semantic differential". His "semantic differential" method measures scale of emotional responses basing on bipolar adjectives evaluated by people. Bipolar emotional scale the emotions are stated as pairs, like-dislike; attractive-unattractive, light-dark and similar in bipolar emotional scale.

Emotions can be measured in numerous different ways based on: behavioral variables, facial expression variables, physiological and cognitive variables. Several models of emotions are described in previous researches. Two different approaches are described in literature: a categorical approach and a dimensional approach.

According to Ekman (1992), categorical approach approves a number of universal basic emotions. These are emotions like fear, anger and enjoyment. Second approach is dimensional approach. According to this approach, an emotion can be described in a multidimensional space.

Watson, Clark and Tellegen (1988) proposed *the Positive Affect, Negative Affect Scale (PANAS)* model. In this model emotions are described by using the two dimensions positive affect (PA) and negative affect (NA). *The positive affect* dimension represents the extent to which a person feels alert, active and enthusiastic, while *the negative affect* dimension represents the extent to which a person feels distress, anger, guilt and fear. PA

and NA can be measured using a scale that is composed of ten unipolar scales representing PA and ten unipolar scales representing NA. (Watson et al. 1988). This method however provides inapplicable bipolar dimensions to our situation, rating of interior lighting by customers.

Another multidimensional model is PAD model proposed by Mehrabian and Russell (1974). In this model emotions are described in terms of three dimensions: *Pleasure (P), Arousal (A)* and *Dominance (D).* The first dimension *pleasure (P)* refers to the valence (positive-negative) of an emotion, *arousal (A)* is a state referring to the activity and alertness and ranges from arousal to non-arousal and the last dimension *dominance (D)* ranges from feelings of total lack of control or influence on events and surroundings to the opposite extreme of feeling influential and in control.

The PAD dimensions can be measured using different methods. For instance, the semantic differential method of Mehrabian and Russell (1974), consist of eighteen bipolar mood adjectives. Russell, Weiss & Mendelsohn (1989) proposed a single item scale to measure pleasure and arousal: the affect grid, which is a two-dimensional grid, with one axis indicating the experienced (un)pleasant feeling and the other axes indicating the experienced arousal or sleepiness. PAD dimension is not applicable to the present investigation either, since rating adjectives would not be suitable for the evaluation of interior lighting.

Another simplification was proposed by Bradley & Lang (1994), which is named as the self assessment manikin (SAM). SAM is a pictorial scale wherein all three major affective dimensions (Pleasure, Arousal and the Dominance) are measured.

Mehrabian (1997) compared the PAD model with the PANAS model and found that the positive affect (PA) and negative affect (NA) dimensions correspond to the diagonals of the pleasure (P) and arousal (A) axes. Furthermore he found that the PANAS model cannot distinguish between anxiety and depression, whereas the PAD model can. This method also cannot be applied to evaluate the investigation of this study.

Within the scope of this study, which is customer's responses on interior lighting, the method applied in atmosphere metrics study of Vogels (2008), found more convenient than the above mentioned methods. Thus while structuring the study and evaluation of it,

Vogel's "Atmosphere metrics" applied. Rhis' study basis on the fact that mood is affected by non-environmental factors such as cognition; therefore emotional scale research would not give satisfactory result. Vogels (2008), she explained "Experiments demonstrate that atmosphere can be described by four underlying dimensions, called *Coziness, Liveliness, Tenseness* and *Detachment*. The method is shown to be robust, sensitive and sensible."

3.1.2 The Effects of Lighting Characteristics on Emotions and Behaviors

Perception of lighting of interiors can also be evaluated with some other criteria as some researchers have found that lighting perception is related with some different physiological factors; the effects of intensity and CCT (Correlated Color Temperature) of illumination, the effects of color and the effects of daylight.

3.1.2.1 The Effects of Intensity and CCT on Emotions

In line with the research evidence indicating effects of intensity and CCT of illumination on lighting perception, national lighting standards gave recommendations about the choice of CCT for different illuminance levels to create pleasant light settings. These recommendations are based on the work of Kruithof (1941). As it is shown in the Kruithof curve, in figure 3.1, it is recommended not to use luminaires with high CCT below an illuminance level of 300-500 lux.

Combinations of CCT and illuminance levels that lie in the lower shaded area of the Kruithof curve are usually perceived as cold and dim. Combinations that lie in the upper shaded area are most perceived as overly colorful and unnatural. Only not shaded area is considered to be pleasant.

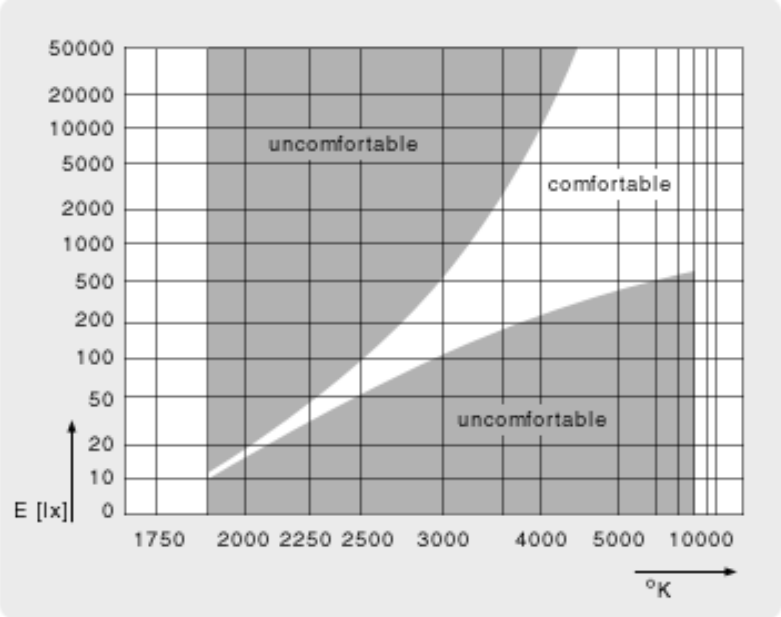


Figure 3.1: *The Kruithof curve. A lighting environment is perceived as comfortable in the white area, while it is perceived as unpleasant in the upper left area due the unnatural color reproduction. The lighting environment in the lowest area of the curve represents the lighting environment that should be perceived as dim at low CCT and cold at high CCT (Kruithof, 1941).*

McCloughan, Aspinall, and Webb (1999) found initial and longer-term effects of lighting on mood. They created average room illuminance on two levels (268 lux vs. 810 lux) and CCT on two levels (warm: 3000K vs. cool: 4000K). Also they assessed participant's mood on two moments in time: five and forty minutes after entering the experimental room. They assessed mood using a Multiple Affect Adjective Checklist. When mood was assessed after five minutes they found an effect of illuminance on sensation seeking, an effect of CCT on hostility and an effect of gender for Positive Affect (PA) and sensation seeking. After forty minutes, several significant changed; interaction between effect of illuminance and CCT was caused with anxiety and hostility. When illuminance increased, anxiety and hostility increased at low CCT levels and decreased at cool levels. Furthermore they found an interaction effect between CCT and gender on hostility and between illuminance and gender on dysphoria. For female participants hostility increased if CCT is more warm-white, whereas it stayed constant for male participants.

3.1.2.2 The Effects of Color on Emotions

Some different researches show that color has a significant effect on lighting perception. The color blue and violet blue are generally seen as pleasant. However, studies do not agree on the colors red, yellow and green. These differences might be due to dependant variables.

In one of the study, conducted by Mahnke (1996), relation between colors of light and emotions were investigated. Participants were asked to look into different colors of light and comment on the light. People found red light arousing without having a pleasure component. Furthermore, yellow and violet-blue were all found to be pleasant and calming.

In a similar study done by Yildirim, Akalin-Baskaya & Hidayetoglu (2007), the effect of the indoor color on mood was investigated. A restaurant was presented with yellow painted walls and with violet painted walls. Furniture and decorations remained the same. Customers found the violet walls more pleasant compared to yellow walls. In addition, younger people and male customers had a more positive attitude towards both environments.

Another study about relation between color and emotion was conducted by Valdez and Mehrabian (1994). They measured emotional reaction according to the PAD model in response to different colored patches according to the Munsell system. They found that brightness had a strong positive effect on pleasure and a negative effect on arousal and dominance. Saturation had a positive effect on pleasure, arousal and dominance. The effects emotion on hue tended to be weak. The most pleasant hues were: blue, blue-green, green, red-purple, purple, and purple-blue. The least pleasant hues were: yellow and green-yellow. The most arousing colors were green-yellow, blue-green and green. Purple-blue and yellow red were the least arousing. Greater dominance was induced with green yellow compared to red-purple.

Furthermore, with refers to ASISST, one of the lighting research centers, investigate the importance of color in spaces and the relation with appraisal. Color appearance plays a major role in retail merchandising; both for setting the atmosphere in the store and helping customers evaluate products for sale.

3.1.2. The Psychological Effects of Retail Environment on Emotions and Behaviors

It has been found that there is a relation between the environment and human behaviors and emotions. According to Machleit & Eroglu (2000), shopping environments can evoke emotional responses in costumers. Besides, they may even influence the shopper's ultimate satisfaction with the service provided.

An emotion will occur as a result of a situation if that situation is important for the person at that moment. (Lazarus,1991). In addition, to measure the effects of retail environment on emotion, it should be important for a person at the moment. As a result, it can be said that retail environment have a great effect on shopping behaviors. For instance, Donovan and Rossiter (1982) found that pleasure experienced in a shop has a strong effect on customers spending more money than intended and spending extra time in the shop. Furthermore, Underhill (1999) found that people spending more time in a store, purchase more products.

An environmental psychology model (M-R model) was proposed by Mehrabian & Russell (1974). As it is seen in figure 3.2., they proposed that individuals react to environments with two general forms of behavioral response: approach and avoidance, and they suggested that the three basic emotional response, pleasure-arousal-dominance. These emotional responses mediate the effect of environmental stimuli on behavior.

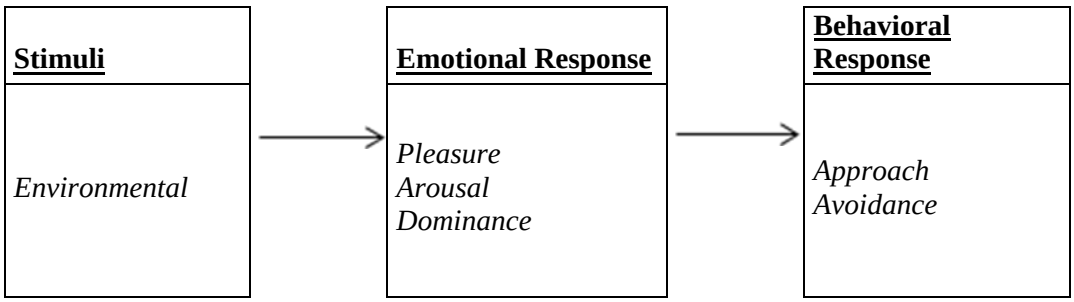


Figure 3.2: *M-R Model. The Environmental Psychology Model created by Mehrabian & Russell (1974)*

Nevertheless, according to some researchers, a retail environment consists of a lot of different environmental cues. A new literature was done by Turley & Milliman (2000) and they counted 57 different environmental characteristics that can influence shopping costumers' emotions and behavior. Hence, all these different environmental

cues, in order to make the study easier, several researchers provided categorizations (Bitner, 1992; Berman & Evans, 1995; Turley & Milliman, 2000; Baker et al., 1992).

For instance, a research was done by Berman & Evans (1995). They first included the research the exterior of the shops and then, they categorized the atmospheric elements in four groups: the general interior, the layout and design, the point-of purchase and decoration, and the exterior of the shop. Another research done by Turley & Milliman (2000), they categorized the atmospheric elements in five groups; they added human variables to the previous four groups. They found 57 atmospheric variables for these 5 groups. For example, human variables referred employee characteristics, customer characteristics and crowding. General interior variables referred the flooring and carpeting, color schemes, paint and wallpaper, lighting, music, merchandise, etc. Examples of layout and design variables were the placement of furniture, merchandise, equipment, racks and cases. External variables included entrances, height and size of building, surrounding area, etc. External variables included entrances, height and size of building, surrounding area, etc. Point-of-purchase and decoration variables included point-of-purchase displays, signs and cards, pictures and artwork.

In sum, all these individual environmental cues have been investigated on their potential influence on emotions and/or behavior. Russell & Mehrabian (1976) proclaimed that it is essential to seek general variables that grasp the main influence of the environment because environments include such an extensive variety of stimuli.

3.2 Emotions and Atmosphere Perception

In this section, the researches about relation between emotions and atmosphere perception are discussed.

As indicated in Vogels' research (2008), *atmosphere perception* is related to experienced emotions. However, both concepts differ in the sense that 'perceived atmosphere' is not an affective state, but the appraisal of an environment with respect to a potential affective effect. The difference between emotion and atmosphere can be described with the following example: "If I am thinking of all the work I have to do I would still feel pretty stressed in a relaxed environment. However, in a stressful environment I will never feel relaxed". Hence, atmosphere can have an influence on

one's affective state but it is not a necessary result. On the other hand, the perceived atmosphere with its environmental variables is expected to be independent of people's emotions. Perceived atmosphere is among other things dependent on personal differences like age, culture and experiences, but is expected to be stable over a period of time (Vogels, 2008).

One of the first researchers studying the evaluation of an environment was Vogels (2008). By using a measurement tool, Vogels measured the perceived atmosphere. It was named the atmosphere perception questionnaire, it comprised of atmosphere terms forming 38 semantic differential scales.

This questionnaire was developed consisting of 38 atmosphere terms that have to be rated on a 5-point Likert scale. These 38 atmosphere terms are; active, detached, terrifying, musty, threatening, oppressive, depressed, exciting, formal, hospitable, safe, tense, pleasant, inspiring, intimate, calm, chilly, cozy, cool, lively, luxurious, mysterious, inhibited, uncomfortable, restless, relaxed, personal, romantic, spatial, tranquil, boring, lethargic, stimulating, accessible, hostile, cheerful, warm, business.

De Vries and Vogels (2007) showed that light has an important effect on the perceived atmosphere, which shows that the questionnaire can discriminate different extreme light conditions. Additionally, Van Erp (2008) demonstrated that the atmosphere perception questionnaire can discriminate between the atmospheres of different environments and that perceived atmosphere can be described in terms of the four factors: *coziness, liveliness, tenseness* and *detachment. Coziness is related to terms like* safe, cozy, intimate and pleasant and *liveliness* is related to terms lively, inspiring and stimulating. Terms like terrifying, threatening, tense and oppressive are used to describe *tenseness* and terms like business-like, formal and chilly are used to describe *detachment.*

Up to the present, some studies about the effects of light and color on atmosphere were discussed. The next sub-sections describe an overview of the literature about the relation between colored and white light and atmosphere perception.

3.2.1 The Effects of Colored Light on Atmosphere Perception

In one of the study, conducted by Dijkstra, Pieterse and Pruyn (2008), relation between colored light and atmosphere perception was investigated. They researched the effect of colored light on patients in a hospital room. They concluded that wall color can alter the atmosphere of a space. They found that the color green created a more relaxing atmosphere while an orange room made the atmosphere more arousing.

Another research done by Kwallek, Soon and Lewis (2007), they used different colored offices. They investigated that cool colors, like green and blue, the environment was perceived as relaxed. On the other hand, with warm color, like red, made the environment more arousing compared to cool colors. On this research, they used painted walls to change atmosphere.

In other studies of Kwallek et al. (1996) and Moors (2009) investigated the atmosphere perception included colored lights instead of painted walls. They used red and blue colors at two saturation levels to create different atmospheres, with decorative lighting. This was always combined with general white lighting for which the CCT, intensity, and spatial distribution were varied. They found that hue has a significant effect on *coziness*; red was perceived as more *cozy* than blue and blue even gets less *cozy* when combined with cool white light. However, saturation has no effect on *coziness.* On the other hand, they investigated that saturation has a small effect on *liveliness*. High saturation was perceived as *tenser* than lower saturation, but no effect of hue on *tenseness* was found. The last atmosphere dimension *detachment* showed a main effect of saturation; high saturation was perceived as less *detached* than low saturation. Furthermore, the results revealed an effect of hue; blue was perceived as more *detached* than red. This effect was amplified by the color temperature of the white light; blue became more *detached* at cool white light than at warm white light.

In a similar study done by Moors (2008), he found that red has usually a higher luminance than blue, and blue has a higher saturation than red for LED lighting systems. So, comparing red to blue would be difficult because not only the hue is different but also the brightness and saturation.

3.2.2 The Effects of White Light on Atmosphere Perception

Flynn et al. (1992) studied the evaluation of an environment was measured for several lighting conditions. They found that non-uniform illuminated environments are perceived as interesting and relaxed, whereas uniform illuminated environments are perceived as spacious. Furthermore, illuminated environments, which are perceived as bright, are more preferred than environments which are perceived as dim.

In a research of Custers (2008), he found that brighter light was perceived as *tenser* and less *cozy* and when the perceived glare and sparkle of the lighting increased, the atmosphere was perceived as *livelier* and less *detached*.

In addition, Van Erp (2008) found in his research that the effects of the intensity, color temperature and spatial distribution of white general light on perceived atmosphere by the four atmosphere factors of the model of Vogels (2008). He found that non-uniform light was perceived as more *cozy*, livelier, less *tense* and equally *detached* compared to uniform distributed light with the same perceived room brightness and color temperature. In addition, uniform distributed light at low CCT was perceived as cozier, less *lively*, less *tense* and less *detached*. Furthermore, high intensity resulted in a livelier, less *tense*, less *cozy* (for low CCT) and more *detached* (for high CCT) atmosphere.

To sum up the main effects described in the literature, an overview summarized by Moors (2008) is presented in table 3.1.

Table 3.1: An Overview on Preferences, Emotions and Atmosphere. (Moors, 2008)

	Preferences	Emotions	Atmosphere
White light			
Low illuminance	less preferred	more calm low pressure low dominance	less detached more tense
High illuminance	more preferred	more pleasant	more lively
Low CT	more preferred	more pleasant	more cozy less tense
High CT	less preferred	more arousing more stressful	more detached less lively
Colored light			
Bright colors	preferred	more pleasant less arousing less dominant	more lively more arousing
Saturated colors	preferred	more pleasant less arousing less dominant	more lively more arousing
Red *Purple* *Blue* *Green* *Yellow* *Orange*	most preferred least preferred	pleasant	less lively more cozy more detached more relaxing more arousing
Warm colors *Cold colors*	preferred preferred	pleasant	more arousing more relaxing

The data on the above table is obtained by the result of investigation in experimental environment. The results in experimental environment are match up with the other investigations from the real world on the same subject. Depending on design concept, lighting design can be decided with the help of above table.

3.3 The Effects of Gender on Lighting Perception

The literature is changeable concerning gender differences in lighting perception. In some studies, researchers found some effects of gender on lighting perception; in other studies they found some complex interaction effects between CRI, CCT, illuminance and gender on PA and NA.

Knez (1995) conducted two different experiments related with the gender and lighting perception. He varied illuminance and lamp type, and measured mood and task performance for both male and female participants. In first experiment, females found the lighting as more intense and glaring than males. In second experiment, he found an interaction effect between CCT and gender on Negative Affect. Negative Affect of males increased in the warm, compared to the cool-white light. On the other hand, Negative Affect of females decreased in warm-white light and increased in the cool-white light. This means that females and males may differently appraise the cool and the warm white lighting emotionally. In other words, the coloring quality of indoor lighting has different meanings and affective loadings to different genders. (Buck, 1984)

According to Leslie and Hartleb (1990), a trend that suggests possible gender differences in illuminance preference; with another words, the male participants preferred much higher levels than the female participants.

In the literature, gender is one of the most important factors to determine of behavioral differences. Putrevu (2001) investigated, that the abilities and the identification in between male and female, mostly gives impression of gender roles. Costa et al. (2001) found in his study, males have an analytical and logical approach because of focusing on the several elements in the same time but females have more subjective approach. Females are more careful on the elements unless written or verbally. When compares with males, females have more visual orientation, intensive motivation, and also more romantic than males. (Holbrook, 1986)

Dube and Morgan (1996) investigated the first impression of the spaces for males and females. In the result of the study, they found that pleasure decisions of males is higher level than females'. With this reason, as determined in the literature of social

psychology, males or females may present different behaviors and thoughts in accordance with the different roles. In this point, hypothesis will be investigated in the present study.

3.4 The Effects of Age on Lighting Perception

In the studies related with age and lighting perception, Holbrook & Schindler (1994) found that there was an important relation between age and esthetical preferences. In addition, they investigated that lighting is one of the most important factor for store selection by the customers.

In the research by Barnaby (1980) and Hughes & McNelis (1978), they found that older persons show stronger preferences for higher illuminance than younger ones. However, Boyce (1973) did not find that age influenced illuminance preferences. In sum, it can be said that age-related increases in illuminance preference would be consistent with known age-related decrements in vision, but it may be that the overall preference for higher illuminance masks this effect. In this point, hypothesis related with age will be investigated in the present study.

3.5 The Effects of Educational Level on Lighting Perception

There is no sufficient research about the effects of educational level on lighting perception. The educational level is precious on the society.

Education in Turkey has more effect on perception and cognition of people, thus customers of shops, besides culture and value systems of educated persons are different than the uneducated persons. (Holbrook &Schindler, 1994 and Ekman, 1970)

In a research of Yıldırım (2005), found that the educational level is important for customer perception on the stores. The research has been done on the group of which were 610 people equal number of females and males, in a store. Educational level factor was reviewed in two categories as low and high educated people. According to the result of the research, low educated people perceived a store image attributes including store atmospherics and salesperson behaviors more positive than high educated people. This result can be explained as for deep knowledge, experience, life style depending the status and difference of expectations.

Another remark of Yıldırım's study was; changing level of knowledge and experience depends on the age of the customer could be caused to act attitude and behaviors perceiving the image factors as more critical. Education is also important in terms of economic condition of the customers, though it is not a necessity, more educated people means working in regular jobs; thus, their economic situation is better than the uneducated persons, who are expected to work in service sector or working for lower wages.

Nevertheless, educational level, which occur differences between the customers, is a criterion for several classifications to define socio-economical level. For this reason, hypothesis related with educational level will be investigated in the present study.

In line with above mentioned explanations, the method to confirm the determined hypothesis, which has been developed in accordance with the aim of the study, is given in the following chapters.

3.6 Evaluation of Studies and Methods About Perception of Interior Lighting

In sum, all these literature shows that lighting has a potential influence on emotions, behaviors and atmosphere perception.

As determined in the literature of social psychology, males or females may present different behaviors and thoughts in accordance with the different roles (Dube and Morgan; 1996). On the other hand, educational level, which occur differences between the customers, is a criterion for several classifications to define socio-economical level (Yıldırım; 2005). In the studies related with age and lighting perception, it was found that there was an important relation between age and esthetical preferences. In addition, lighting is one of the most important factors for store selection by the customers. (Holbrook & Schindler; 1994)

In line with above mentioned explanations, effects of lighting in store environments will be evaluated and reviewed during the experiment. In addition, hypothesis and the method to confirm the determined hypothesis, which has been developed in accordance with the aim of the study, will be investigated in the present study.

CHAPTER 4

LIGHTING DESIGN CRITERIA OF STORE INTERIORS

"Lighting means, to provide a visibility of any kind of objects as sending a light source. In this case, the aim of the lighting is to make visible environments and object but not to see the light source. Lighting technique is to use of light-eye-object together.

In order to provide good quality lighting in a space, there are some criteria to specify general lighting design. Firstly, the aim of lighting should be examined, means what mission of space is (living space, circulation or working). Other criteria are the function and atmosphere of the space. The third criterion is the quantity and quality of light, means what needed is to perform the tasks. In addition, the last criterion is the architecture and décor of space. This criterion is considered the aesthetic of space. With these criteria, a designer should be predicted the creating the total environment. For getting this goal, ensuring the safety of people in the interior, facilitating the performance of visual tasks and aiding the creation of an appropriate visual environment which named three major functions for lighting of an interior should not be forgotten.

In order to provide good quality of general lighting in stores, detailed criteria of lighting design can be classified in five main categories given by Green(1986), Illuminating Engineering Society of North America(1988 and 1986) and Lewis (1945):

a. Basic Requirements

1. By the use of appropriate lighting the product must seem to be appealing tempting and must appear in its best appearance since it is stated as most people purchase just because they are impressed, without having buying decision in their minds.

2. The most important requirement for the stores is the comfortable and easy perception of the goods on sale. However glare, the greatest enemy of the visual comfort, mostly occurs in shops obscuring the appearance of the products.

3. Flexibility is an important consideration for the lighting of stores. The lighting system must be flexible so that whenever the product is changed or replaced, lighting could serve the changing needs of the selling areas.

4. The lighting that used for the stores must never catch the attention to itself more than the products. It must be noted that the main thing is to sell the product not the lighting elements

b. Good Visibility Requirements

1. The lighting elements must be located out of the visual field.

2. Reflectance values of the materials have to be considered since too much bright surfaces cause glare. And it is important that dark colored products need more illumination than white ones.

3. Lighting level inside the stores must be adequate for the customer's eyes to readapt the inner situation since they are coming from the outside condition.

4. The lighting units must be screened with baffles, louvers, etc. in order to protect the viewer from the direct glare and to reduce the extreme luminaires brightness.

5. While illuminating the desks or countertops, the location of the light sources on the ceiling must be front of the customer so that the reflected light is kept away from the customer's eyes and her shadow does not fall upon the products.

6. The luminance levels in stores must be controlled. The ratio between the displayed surface and the near surrounding must be at least 3:1 and must not

exceed 4:1. If it is a noticeable transition between one area and another, one of them could be 10 times bright than the other.

c. Lighting Requirements for Color Appearance

1. Colored light should be used carefully on the stores because it distorts the exact color of the products. However, it is mostly preferential for creating different background effects.

2. When too much impulse colors are used in the background, they clash with the color of products.

3. By the use of appropriate lighting, colors and materials it is possible to create different optical illusions as if small stores are seem to look larger or lower ceiling are made to appear higher. In order to make a small space look larger, bright light colors are to be used and the ceiling height is emphasized by using lightings.

d. Lighting Requirements for the Selection of Light Sources and Lighting Systems

1. In order to understand the most suitable types of lighting for the stores; character of the store, the type of the products and the image of the store are determining points.

2. General lighting must be used with the accent lighting; because of being so diffuse the goods need to be accentuated by accent lighting. Incandescent light sources are used for general lighting in places where they sell luxury goods whereas fluorescent are preferred mostly for the supermarkets.

3. Human appearance is important for some stores especially for the cloth or cosmetics shops. In these kinds of stores, the customer wants to see him/herself with the product if it suits or not, and inspect color, form of the product from the mirror. Thus, lighting of mirrors needs a special consideration. First, light sources chosen to be used must flatter the skin tones. Secondly, the illumination quality must be nearly the same as the place that the product to be appeared. Thirdly, the light has to illuminate the customer, not the mirror.

4. The light source that is going to be used in stores should be selected so that the product can be viewed in its best appearance.
5. Incandescent light sources produce bright, sparkling quality of light and casts shadows that could aid for the perception depth of the product. The generally used as a point source illuminating a specific objects or a product.
6. HID sources must be chosen for the areas where the necessary color discrimination is not important because of their poor color rendering quality.
7. Halogen lamps should not be used in series because they produce so much heat.

CHAPTER 5

MODELING OF INVESTIGATION STUDY

In the previous chapter, conceptual and technical aspects of lighting, studies and methods about perception of interior lighting and lighting design criteria of store interiors were investigated. In the line with these chapters, a study about store lighting design will be investigated in this chapter.

In literature; it is stated that, the lighting is one of the most important case for creating space atmosphere because it has positive effects on the perception of customers (Sharma & Stafford, Baker & Grewal & Levy, 1992, Bitner, 1992). However, there are a few researches on the effects of differences in customer characteristics on the perception of store lighting. Therefore, it is still wondered that how lighting is perceived by different customer segments, if it is changed or not according to different cultural groups and if there is any statistical differences between the perceptions of these groups. The decision of targeted population of customer is very important while designing a store. In the above studies, there are some suggestions about design; however, there are not enough suggestions about customer characteristics that are aimed on this study. Therefore, in this study, it is focused on the effects of age, gender and educational level differences on the perception of store lighting and the effect of light on the perception of spaces. In order to answer the research questions as stated in the introduction, a survey is programmed basing on the studies explained in the literature.

This chapter first presents the method, and then it continues with the results of the study. Subsequently, discussion and suggestions are presented.

5.1 Modeling the Research

In the first part, the participants, questionnaire and research shops are described. Thereafter, the procedure of measuring the lighting characteristics is explained. Lastly, the process of development is explained in the paragraph ‘measurements’.

In addition, in order to find out the proof of hypothesis, a survey study is carried out in selected stores. In order to obtain objective results, two similar but totally different stores with the same product range and with different illuminations are selected. To prevent the stores from having big differences in ‘sold products’ and thereby reducing the risk of ‘sold products’ having an effect on the perceived atmosphere, only clothing stores, not a supermarket or a restaurant, were selected. By minimizing the variables of stores, it is provided to get objective comparison. First of all, all existing information about stores is collected; then the questionnaires are prepared depending on the information of the technical aspects of light and the previous researches. Survey was carried out with the customers/participants and results are evaluated with statistical methods. In this study, educational level differences, gender and age are considered as the most important customer characteristics, as it was stated in chapter 1.

Effects of these customers’ characteristics are investigated, with the hope of obtaining useful results for store designers. Consequently, consciously designed lighting plan does not only constitute the desired selling environment, but also provides economy from the lighting point of view.

5.1.1 Interview Programming of the Survey

Sample of 120 with equal gender sizes, namely 60 each were selected, totaling 240 participants were decided to be interviewed. And, for interviewing, 5 week days starting from 10:00 am (opening time) to 10:00 pm (closing time) were carried out. The participants are given the questionnaire to be filled up and before starting the surveys, participants received a short briefing about the subject and questionnaire; the stores have been walked around with the participants. Participants completed the questionnaires

approximately in 20 minutes. All data were obtained as an in depth interview for a period of 2 weeks in November 2010.

5.1.2 Participants

Customers who had been participated in this study are selected according to some criteria. Questionnaire was carried out in the stores where customers had close and/or slightly different socio-cultural and socio-economical levels. So, it had been provided that the survey expresses the same meaning for all participants.

Two different stores have slightly different customer characteristics in terms of target customers of the stores' management where first store targeting wealthier group and second store targets medium and high income customers though there are no apparent selections. It was expected that, more affluent people may have higher educational level comparing to medium income people, so that the results would contribute the affect of education on lighting perception.

5.1.3 Designing Questionnaire - Measurements

Participants were asked to fill in four groups of questionnaire: a customer characteristics questionnaire, a time of association with the day questionnaire, a lighting appearance questionnaire and an atmosphere perception questionnaire. The questionnaires can be found in appendix A.

Customer characteristics questions

In the customer characteristics questionnaire, participants were asked to describe their age, gender, educational status and socio-cultural level. (See appendix A)

Association with the time of the day questions

In the time of day questionnaire, participants were asked to indicate which part or parts of the day they associated with the presented light setting. Participants had the choice between: morning, afternoon, evening and night. (See appendix A)

Lighting appearance questions

The lighting appearance questionnaire measured how participants perceived the lighting characteristics that were experienced in this investigation scopes existing light setting. The presented light setting had to be rated on three word pairs, using *a five point semantic differential scale* (Snider &Osgood, 1969) with the end points labeled: “little - a lot”, “cold - warm” and “disturb - not disturb”. (See appendix A)

Types of lighting questions

Lighting specialist categorizes lighting types in four different groups; general lighting, accent lighting, architectural lighting and lighting for decorative purposes. (See chapter 2)

The presented types of lighting had to be rated on two word pairs, using a five point semantic differential scale with the end points labeled: “little - a lot” and “attractive - not attractive”. (See appendix A)

Atmosphere perception questions

The atmosphere perception questionnaire, developed by Vogels (2008) which is based on Osgood’s semantic differential scale, measures how participants perceive the atmosphere in an environment. The atmosphere questionnaire, which consists of thirty-eight atmosphere words (see appendix B), had to be scored on five point bipolar Likert scales (Likert, 1932). Finally, the scale point labels were adjusted in order to improve reliability, and the understandability of the scale points. Instead of labeling only the ending points of the scale, scale points were now labeled as “Strongly disagree”, “Disagree”, “Neither agree nor disagree”, “Agree” and “Strongly agree” (Likert, 1932).

5.1.4 Analysis of Research Stores

This investigation was carried out at Vakko and Boyner stores, in Ankara. These stores are designed according to the standard TS 7281 and are designed as luxury places, were used as research environment.

Some criteria are considered to be same or similar for both selected stores. These are;

- Both are designed by the architects in the shopping mall center,
- They have almost same area (m^2),
- They have almost same customer profile in terms of age and gender,
- Both sell almost same range of products,
- Both stores are lighted by ***artificial lightings*** and no daylight.
- Customer target population is similar but Vakko target's is little bit higher level of customers.

Although all these similarities between both stores, the pricing policy is different. However, this is disregarded during the investigation since the pricing assumed not be so effective on customer perceptions. The general information has been given in the following sections.

5.1.4.1 Vakko in Armada Mall Center

This luxury store is approximately 3000 m^2 and situated in the first floor of the mall. Vakko is a luxury chain store having 17 chain stores in Turkey and overseas. In this store offers seven different categorizes of products: shoes and bags, women and men clothing, home decorative, special chocolates, special fabrics and perfumes. The layout plan and ceiling plan is shown in figure 5.1. On the plan there are axes which define the pictures coordinates. Below the figures, the coordinates are determined with axes numbers and codes.

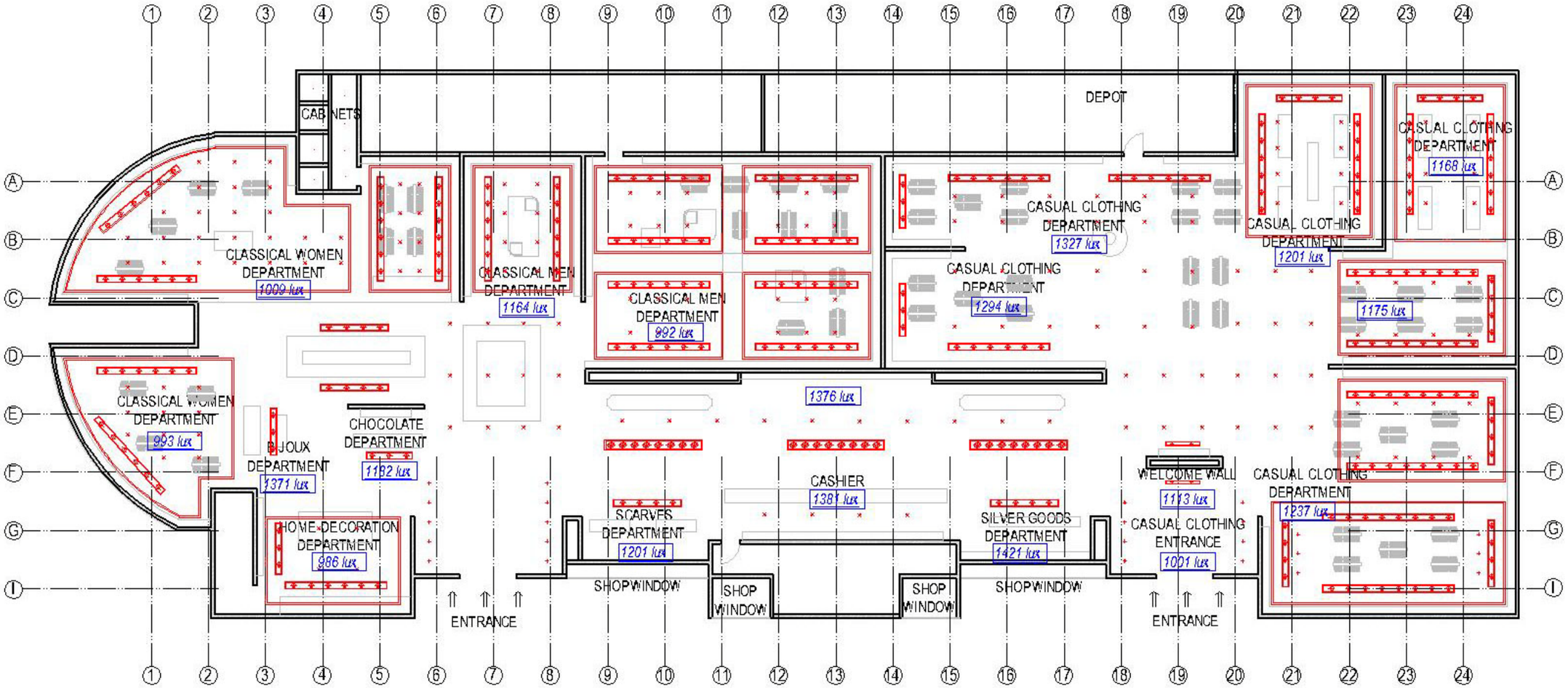


Figure 5.1: *Settlement and ceiling plan*

The finishing materials used for the store are; white glossy lacquer paint and wood veneer are used for the walls of store. On the ceiling, white decorative suspended plaster ceiling is used. All floor surfaces are coated with polished granite ceramic. Still some of the exhibition units on walls are wood veneered and some of them are white glossy lacquer paint. Mostly white glossy lacquer paint is preferred all over exhibition units.

As for the layout plan of the store, there are two entrances which have different concepts according to the product plate. As informed by the Marketing administrator and Brand Manager of the store that there are different styles of product. Hence, designer has created two different concepts in one store. One of the entrances is more dynamic, and the other one is more classical. As seen in the figure 5.2, those two different spaces are connected by cashier space.

Figure 5.2: *General view of cashier and its features- Coordinates on plan E18*

This cashier space is lighted by spot lights and track lightings for general lighting on the ceiling. During the store visit, there was a special occasion (New Year), therefore it has been used red LED lights for decorative purposes above cashier and behind of the desk.

Figure 5.3: *A view from the facing wall of cashier and its features – Coordinates on plan E16*

On this decorative wall, track lightings are used for obtaining accent lighting on the wall surface. (Figure 5.3) Measuring illuminance in cashier area is 1376 lux. The highest level of illuminance is in this space in order to be aware of the security because of monetary items and finishing sales space.

Special designed silver goods of “Christofle” are exhibited on the right side of cashier desk. In this space, for the lighting, direct light system and colored task lighting are used (Figure 5.4.).

Due to finishing materials, the glare is occurred on the floor and on the wall. In spite of this, sparkling is used consciously on the products to put up more attraction on the products.

Figure 5.4: *A view from silver goods department in 3 different times-3 different colors- Coordinates on plan F15*

As seen in the figure 5.5, there is a “welcome wall” in the dynamic space. Colored diffuse lighting is put on the “welcome wall”. It has a color scale which is converting the colors on the mentioned wall every 10 seconds. The used lighting gives the impression that this space is dynamic.

Figure 5.5: *A view from the entrance in 3 different times-3 different colors- Coordinates on plan G19*

In this area, more sportive and casual dressings are exhibited. White color is used as a finishing material. However, it has been used the light color variations for coloring the atmosphere. (Figure 5.6)

Figure 5.6: *General view from the casual department in 3 different times-3 different colors- Coordinates on plan C21*

General lighting is provided by spot lights and track lightings on ceiling. Beside of this, as spotted on the figure 5.7 and figure 5.8, daylight fluorescent lamps are used for

task lighting under the shelves. Also, fluorescent lamps are used for accent lighting on the white glossy lacquer painted walls. On the other walls, colored light system is used for coloring the space atmosphere and to obtain a colored surface on the wall by using grazing.

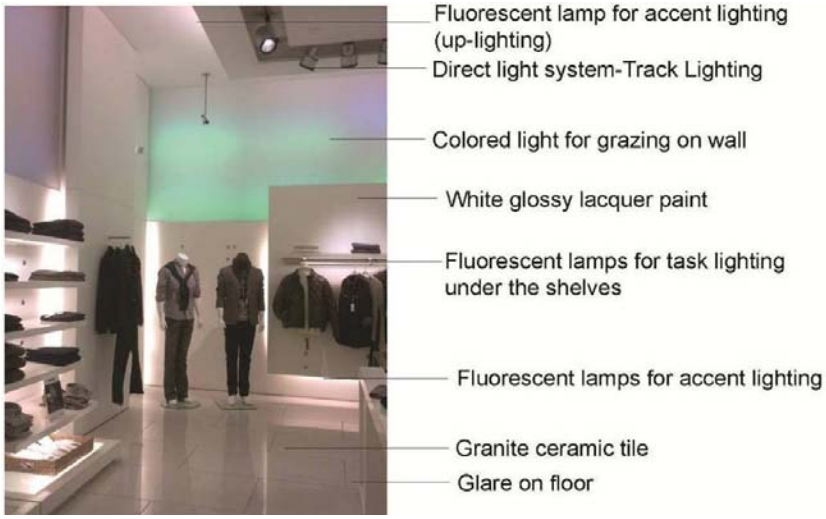


Figure 5.7: *A view from the casual department and its features- Coordinates on plan A24*

Due to finishing materials of the floor and wall, glare occurs. This feature is a part of design and concept of the store. Measuring illuminance level in this area is 1175 lux.

Figure 5.8: *A view from the casual department and its features- Coordinates on plan B19*

As it is seen on the layout plan in figure 5.9, special designed scarves are exhibited on the left side of cashier desk.

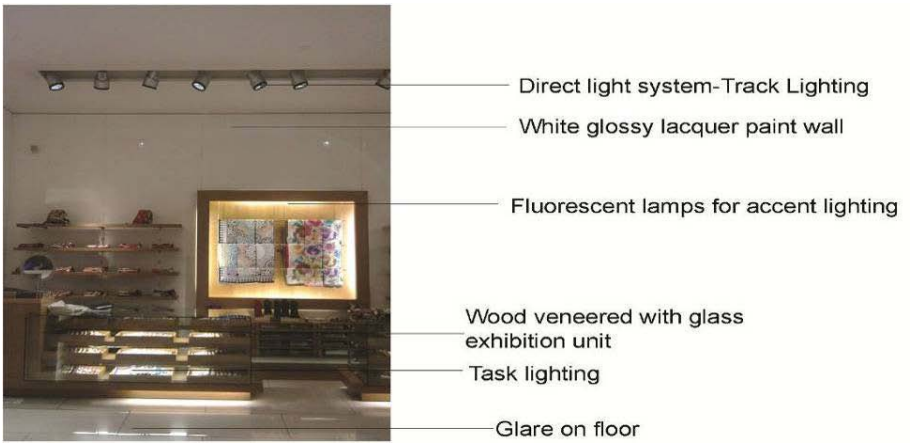


Figure 5.9: *A view from the scarves department and its features-*

Coordinates on plan F9

In this area, track lighting on ceiling, task lighting on exhibition unit and accent lighting with fluorescent lamps are used. The exhibition units are wood veneer. The unit on the wall is white glossy lacquer painted and on the floor polished granite ceramic is used. Due to finishing materials the glare is occurred on the floor and the wall.

On the left side of the classical area entrance, there is an exhibited home decoration goods. (Figure 5.10)

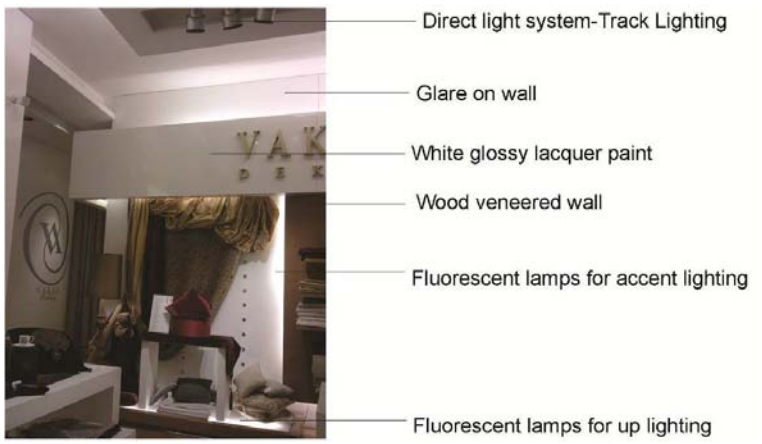


Figure 5.10: *A view from the decoration department and its features-*

Coordinates on plan G5

The surfaces of exhibition units are covered by white glossy lacquer paint and wood veneer. In this department, accent lighting and up lighting with fluorescent lamps are used. For general lighting, direct light system is provided with track lightings.

On the chocolate department, track lightings are used for ambient lighting, and as seen in figure 5.11, glare is occurred on the wall surface. Measuring illuminance level of this department is 1182 lux.

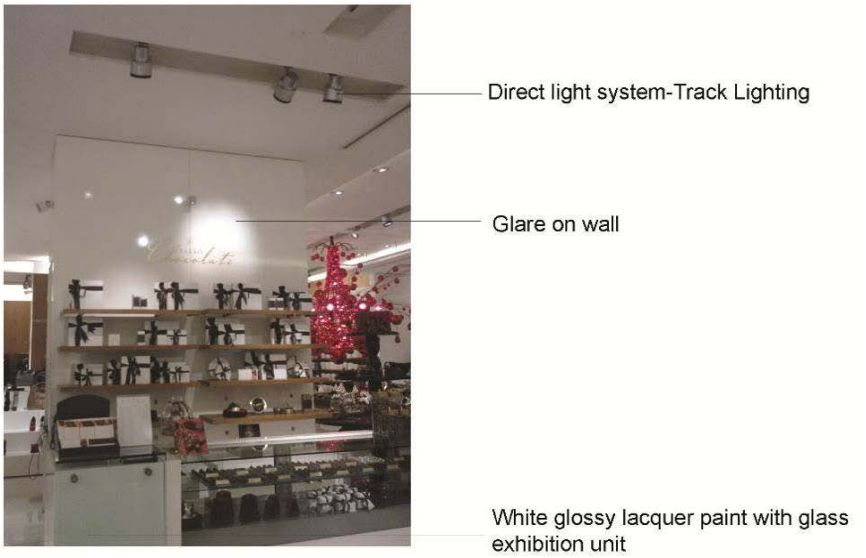


Figure 5.11: *A view from the chocolate department and its features-*

Coordinates on plan F5

As seen in the figure 5.12, the exhibited of bijoux desk can be defined as entrance of ladies wearing. The illuminance level is 1371 lux. The reason of why it is used so high illuminance level is to give more perception of product details by the customers.

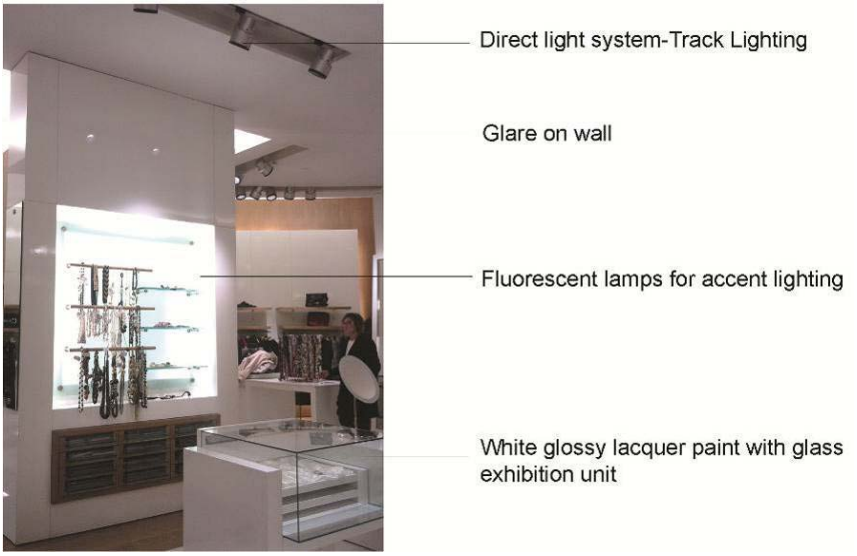


Figure 5.12: *A view from the accessories department in classical section and its features- Coordinates on plan E4*

Men and women wearing space have same design concept. For both areas, brown oak wood veneer and white glossary lacquer paint are used as wall covering. (Figures 5.13 & 5.14)

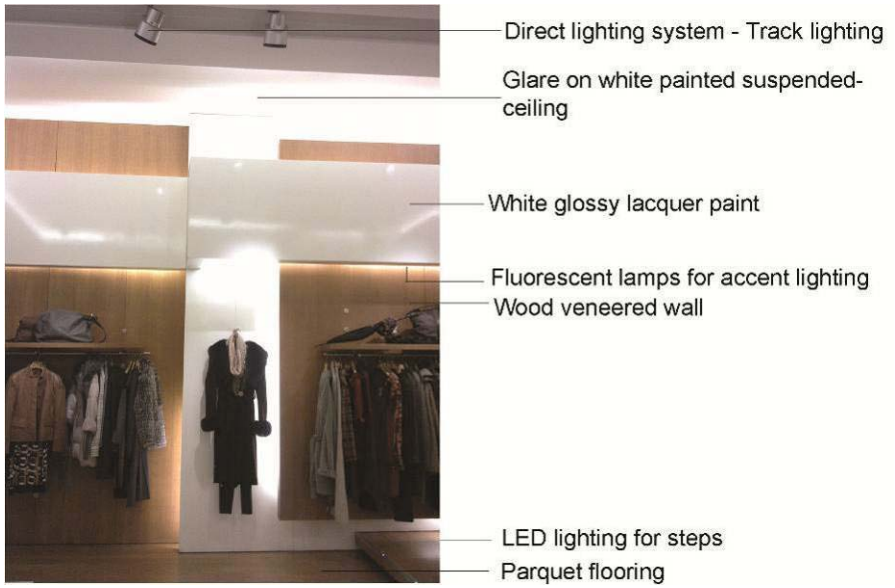


Figure 5.13: *A view from the classical department for women and its features- Coordinates on plan C3*

Figure5.14: *A view from the classical department for men and its features- Coordinates on plan C12*

These walls are lighted by both direct lighting system and accent lighting with fluorescent lamps. As seen in figure 5.13, for the steps lighting on women section, LED lamps are used.

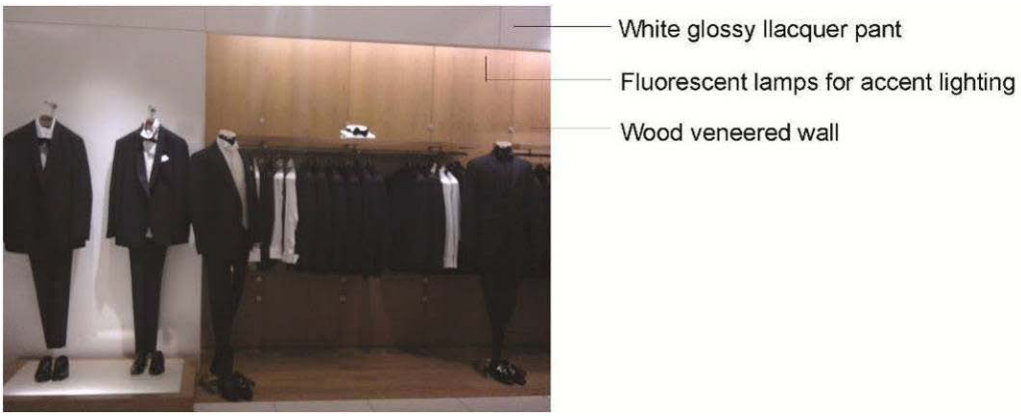


Figure 5.15: *A view from the classical department for men and its features- Coordinates on plan B9*

On the exhibitions units, brown oak wood veneer and white glossary lacquer paint are again used; special lighting elements are not designed for these units.

5.1.4.2 Boyner in Cepa Mall Center

This store is approximately 3200 m² and situated on the first floor of the mall, but it has two floors in itself. In this store offers six different categorizes of products: shoes and bags, women and men clothing, sports, accessories and cosmetics. Boyner, as one of the important retail chain store with 56 stores in domestic and overseas; is a typical example for departmental store. As defined in Chaney's research (1983), a department store is a large retail establishment with an extensive assortment in variety and range of the consumer's personal and residential durable goods product needs; and at the same time offering the consumer a choice of multiple merchandise lines, at variable price points, in all product categories organized into separate departments. All departments are housed under the same roof to facilitate buying, customer service, merchandising, and control.

As in all stores of Boyner, interior and lighting design has been specified by the same team who are prepared the general architectural practice of the all stores and applied in the line with that concept. The settlement and ceiling plans are shown in the next figure 5.16 and figure 5.17. On the plans there are axes which define the pictures coordinates. Below the figures, the coordinates are determined with axes numbers and codes.

As for the formation of the general store, the columns and beams are covered with wood. The walls are painted with colored and white paint. On the ceiling, white decorative suspended plaster ceiling is used. All floor surfaces are coated with parquet and matt marble.

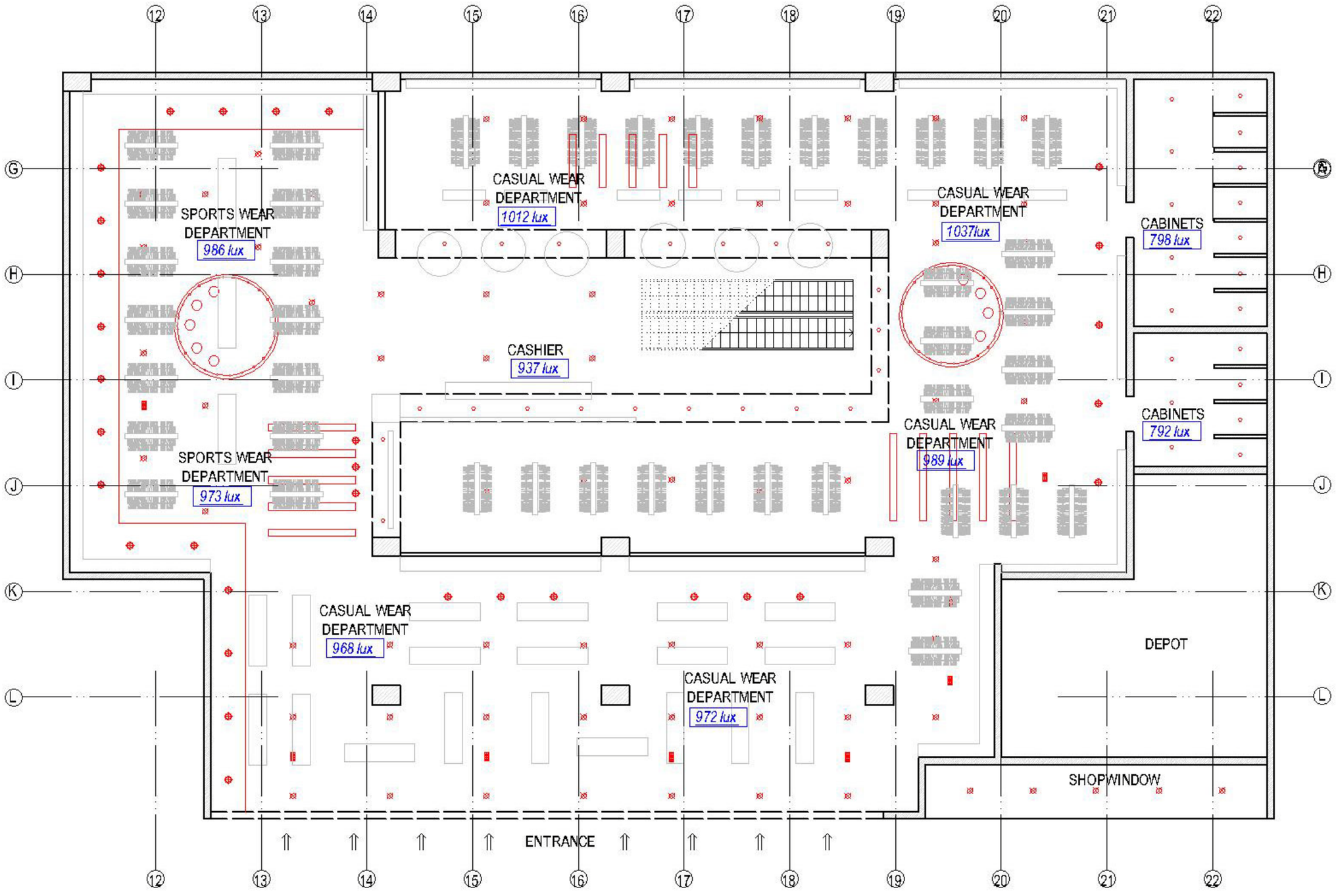


Figure 5.16: *First Floor Plan*

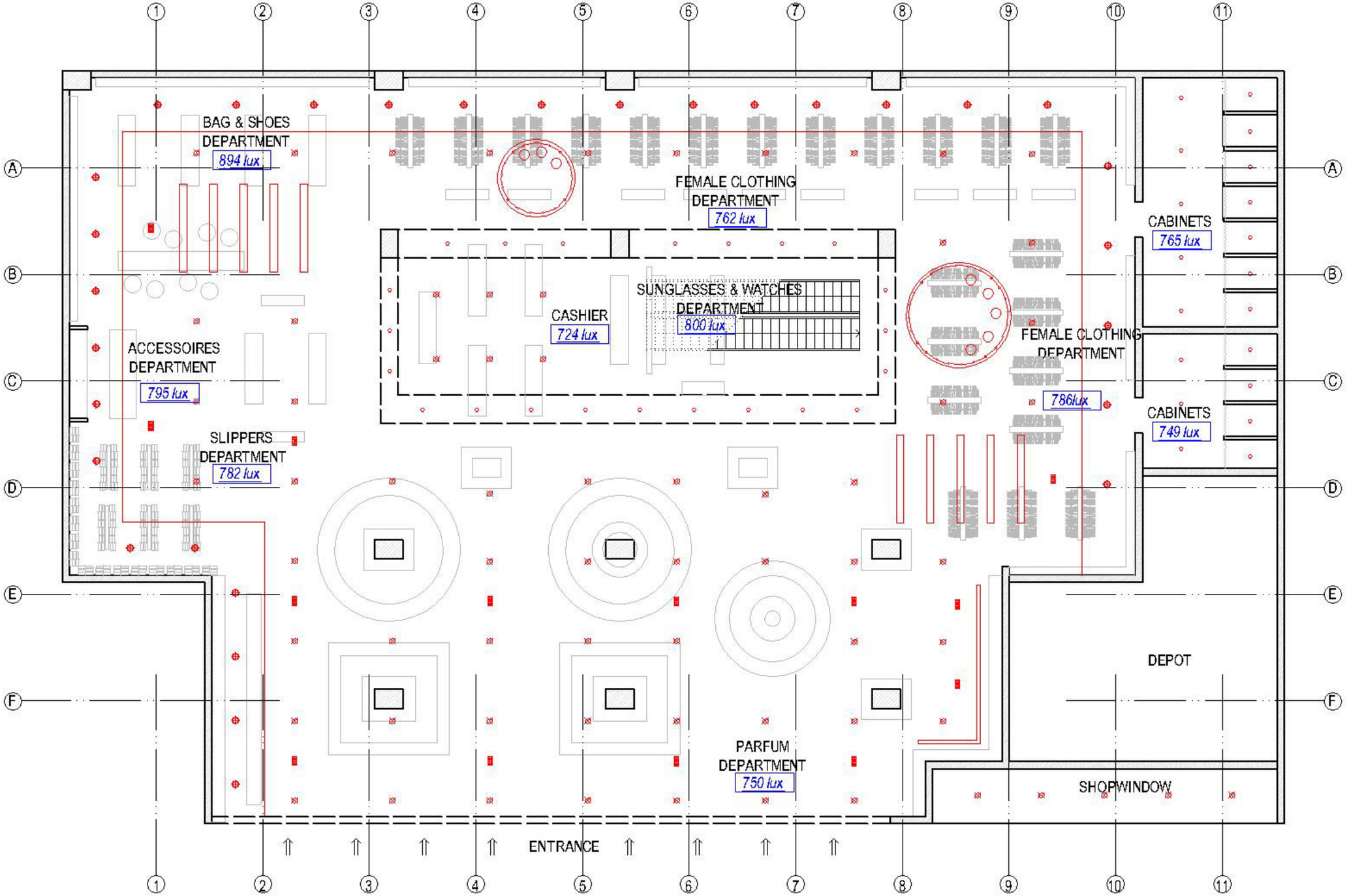


Figure 5.17: *Second Floor Plan*

The space where all brands are exhibited is designed and colored in accordance with the each brands of corporate identity. In spite of these differences, there is a collaborated harmony in the store. This feature will be described more clearly in the following paragraphs.

As for the general layout plan, the store is with 3 floors. There is only one entrance for the each floors of shopping mall. The first floor entrance is opened to the cosmetic area. All the desks of the cosmetic goods are designed, lighted and colored in accordance with the each brands of corporate identity. (Figure 5.18)

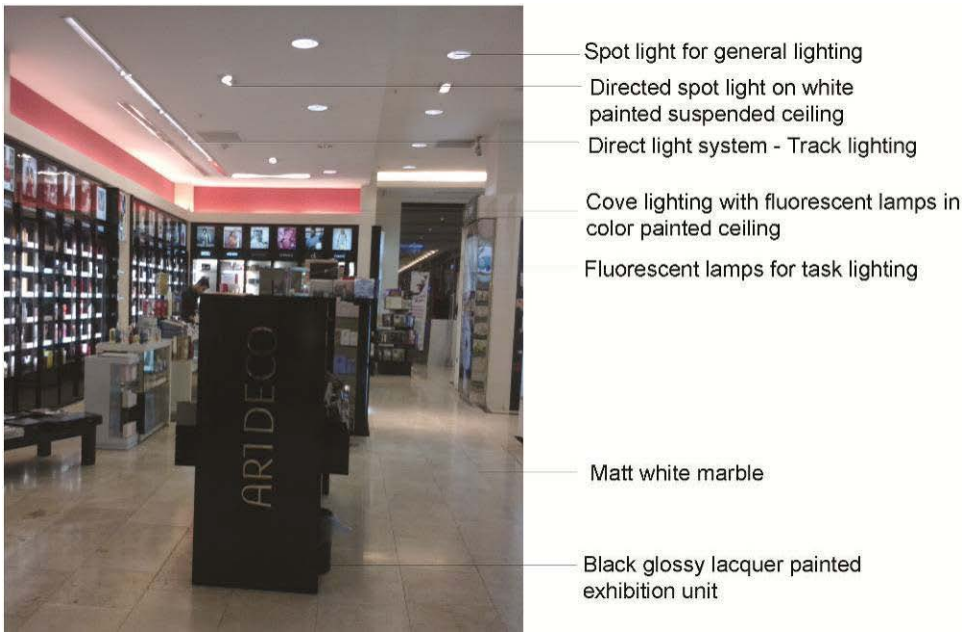


Figure 5.18: *A view from the cosmetics department and its features-*

Coordinates on plan E8

For cosmetic space, illuminance level is targeted around 750 lux. The transparent glass stable and adjustable 30º angled reflector spot lights are used for applying determined illuminance level.

For the showcases, two times higher illuminance level, around 1000 lux daylight fluorescent and red lighting are used to call customer's attention to the products.

Figure 5.19: *A view from the slippery department and its features-*

Coordinates on plan D2

Next to the desk, there is slipper department. In this space, adjustable 30º angled reflector spot lights are used in accordance with the general lighting design of the store. The entire wall surface is painted with matt white paintings, floor is laid white marble. As it is seen in the picture 5.19, glare is not occurred on the floor due to material is not glossary. Glare and the efficiency of the lighting will be reviewed in the following sections.

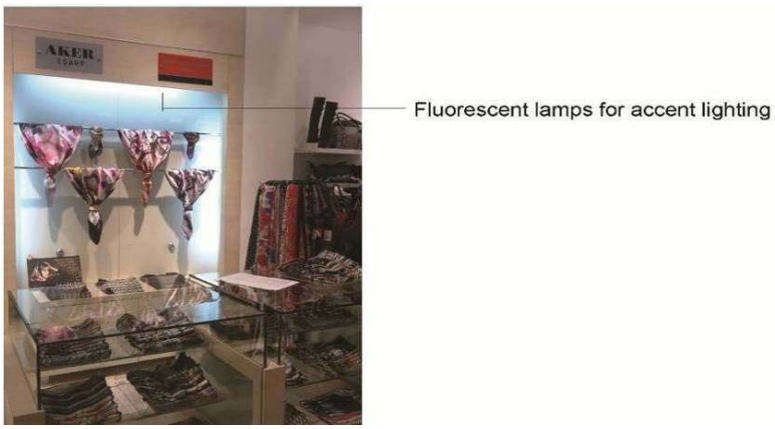


Figure 5.20: *A view from the scarves department and its features-*

Coordinates on plan C1

Next to the store, there is another unit which has the scarf with different brands (Figure 5.20). In this space, it is provided 90 for color rendering index as using white cold colored short fluorescent with energy-smart lights. Thus, it is aimed to perceive the color of the products, like under the daylight in this department.

As it is seen in following picture 5.21, at the sun glasses department, “warm daylight” light color is used to call attention on the products and reached at the 800 lux as determined illuminance level.

Figure 5.21: *A view from the sunglasses department and its features- Coordinates on plan C6*

Figure 5.22: *A view from the cashier and its features- Coordinates on plan B5*

There is no any specific lighting at the cashier area, compatible to the corporate identity of the store. It has been painted with store colors. This area is lighted by spot lights. As seen on the figure 5.22, LED lamps are use as decorative purposes.

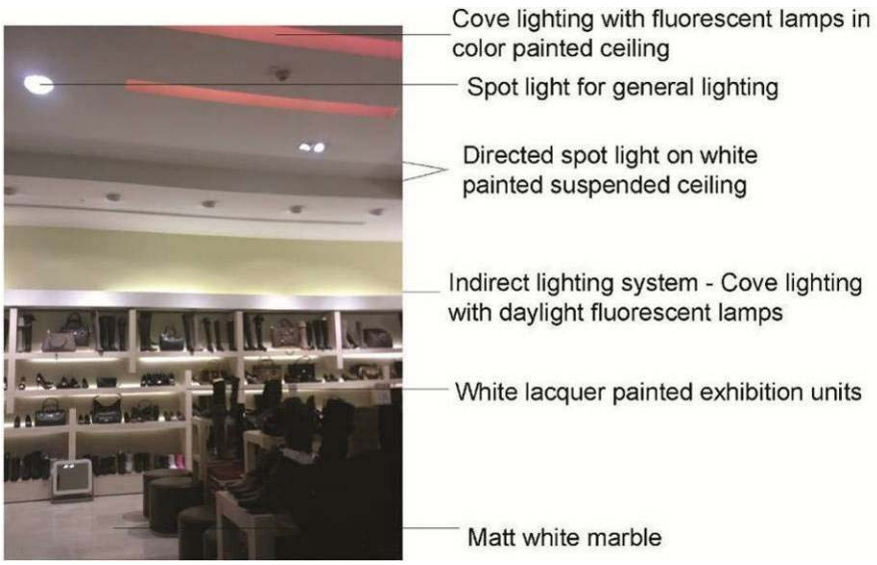


Figure 5.23: *A view from the shoes & bag department and its features- Coordinates on plan B2*

In this store, matt lacquer paint exhibition units and wall coverings are used at the clothing and shoe & bag departments. White marble and parquet are used for the floors. Directed spot lights and spot lights are used or the general lighting in the store. Additionally, cove lighting with fluorescent lamps are used on the colored ceiling. The cove lighting with daylight fluorescent lamps is used for the exhibition units next to the wall. (Figure 5.24)

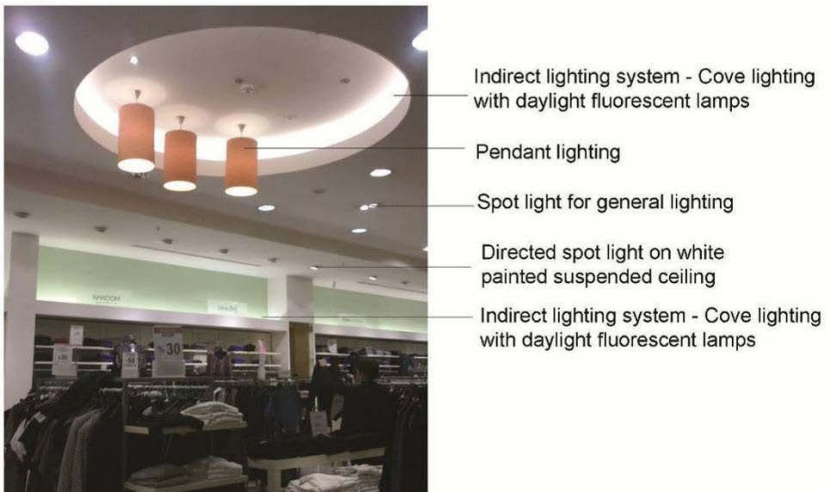


Figure 5.24: *A view from the women clothing department and its features- Coordinates on plan A4*

The orange colored pendant lighting systems are used for decorative purposes but they cause different perception of space and product colors. The measured general illuminance level is 762 lux. (Figure 5.25)

Figure 5.25: *A view from the sport wearing department and its features- Coordinates on plan H13*

Figure 5.26: *A view from the women clothing department and its features- Coordinates on plan A4*

Figure 5.27: *A view from the sport wearing department and its features- Coordinates on plan J13*

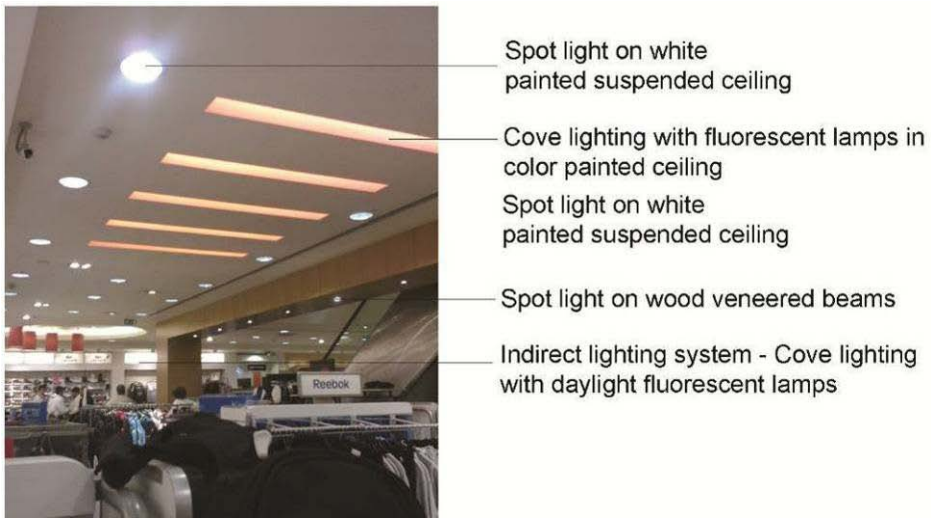


Figure 5.28: *A view from the sport wearing department and its features- Coordinates on plan G17*

Figure 5.29: *A view from the casual clothing department and its features- Coordinates on plan K17*

5.2 Survey Results

In this section, participants, reliability of questions and survey results will be analyzed.

5.2.1 Analysis of participants

240 people participated in this survey and they have been chosen randomly among the customers who are inside these stores. The general distribution ratio of customer characteristics and Turkiye Population is shown in table 5.1.

As shown in table, the education distribution is 145 university educated and above education group constitutes 60.41% of the total interviewers. Complaining 39,59% persons having higher education in total population show that the group investigated are quite above the normal population which is congruent with the stores planned target customer group. As it has seen to the official website of Turkish Statistical Institute, updated on 27.5.2010, survey results about the distribution ratio of educational level are higher than existing statistics in Turkiye. (Table 5.1)

Table 5.1: Distribution Ratio of Customer Characteristics and Turkiye Population

Customer Characteristics		N	%	% of Turkiye
Age	20-30	59	24,6%	27,5%
	31-50	98	40,8%	43,2%
	50 and over	83	34,6%	29,3%
Gender	Male	120	50%	49,8%
	Female	120	50%	50,2%
Educational Level	Primarily-Secondary school	4	1,7%	65,6%
	Lycée	94	39,2%	23,6%
	University	117	48,7%	9,9%
	Master & Ph.D	25	10,4%	0,9%

5.2.2 Analysis of questions reliability

Before analyzing all results, it needs to be measured of the reliability of questions and its results. “The measure of the reliability” which is using for the questionnaire is internal consistency. There are various reliability methods for “The measure of the reliability”. Considering the similar researches, it is understood that the more convenient method is the *Cronbach Alpha* for the present study (Cronbach, 1951).

Cronbach's α (alpha) is a coefficient of reliability. It is commonly used as a measure of the internal consistency or reliability of a psychometric test score for a sample of examinees. There are some formulas to find this coefficient. This “α coefficient” has value in between 0-1 (Cronbach, 1951). α values and explanations are shown in table 5.2.

Table 5.2: α Values and Explanations

α Values	Explanations
0,00 – 0,40	Not reliable
0,40 – 0,60	Low reliability
0,60 – 0,80	Reliable
0,80 – 1,00	High reliability

5.2.2.1 Inter-rater reliability

An inter-rater reliability analysis was performed to determine the level of agreement among the participants. This was done by determining Cronbach’s Alpha

between participants' scores for each individual item. Table 5.3 demonstrates the results per item of the lighting characteristics, ranging from 0.694 to 0.987, with an average of 0.868. These results prove that the responses of the survey are high reliability.

Table 5.3: Inter-Rater Reliabilities About Lighting Characteristics

Item	**Cronbach's Alfa**
Day time feeling	0,987
Total brightness	0,952
Perception of glare on floor	0,694
Discomfort of glare on floor	0,862
Perception of total glare	0,901
Discomfort of total glare	0,719
Sparkle	0,876
Effect of correlated color temperature	0,879
Effect of color rendering index	0,924
Effect of contrast	0,822
General lighting	0,828
Task lighting	0,908
Accent lighting	0,766
Lighting for decorative purposes	0,921
Average	**0,859**

Table 5.4 demonstrates the results per item of the atmosphere questions, ranging from 0.685 to 0.989, with an average of 0.859. These analyses prove that the responses of the survey are high reliability.

Table 5.4: Inter-Rater Reliabilities About Lighting Characteristics

Item	Cronbach's Alfa		Item	Cronbach's Alfa
Active	0,921		Lively	0,879
Detached	0,865		Luxurious	0,989
Terrifying	0,862		Mysterious	0,822
Musty	0,685		Uninhibited	0,828
Threatening	0,952		Uncomfortable	0,889
Oppressive	0,956		Restless	0,917
Depressed	0,719		Relaxed	0,694
Exciting	0,857		Personal	0,987
Formal	0,933		Romantic	0,912
Hospitable	0,909		Spatial	0,875
Safe	0,854		Tranquil	0,687
Tense	0,762		Boring	0,753
Pleasant	0,854		Lethargic	0,924
Inspiring	0,901		Stimulating	0,712
Intimate	0,689		Accessible	0,824
Calm	0,876		Hostile	0,892
Chilly	0,789		Cheerful	0,963
Cozy	0,899		Warm	0,957
Cool	0,773		Business	0,766
			Average	**0,851**

5.2.3 Statistical analysis of survey results

In this section, the results of questionnaire will be analyzed. The first part is included distribution ratios of all questions. In the second part, comparisons of extreme results will be examined.

5.2.3.1 Distribution ratio of variables

In this section, all distribution ratios of variables were defined for two different stores by charts in two parts: time of day and lighting appearance.

a- Time of day

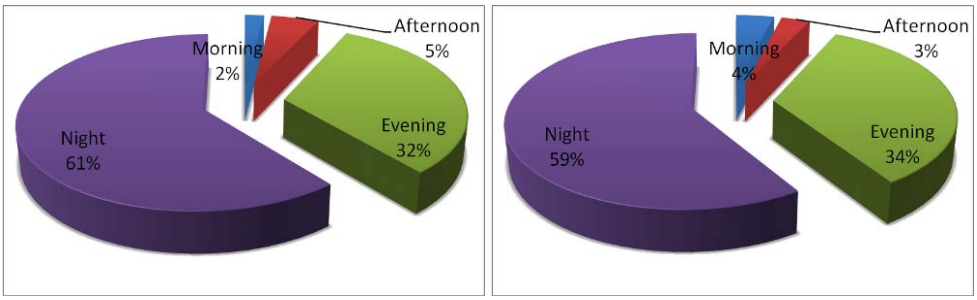


Figure 5.30: *Distribution ratio of time of day in VAKKO and BOYNER*

The distribution ratio graphics in figure 5.30 show the results of answer to "Which time zone, the lightings in the store recalls?" question by customers of Vakko and Boyner. As shown in the figure 5.30, the big amounts of participant (93%), both Vakko and Boyner, realize that the time is evening and/or night in the stores if there is no daylight and if the light is provided by only artificial lighting.

b- Lighting appearance

The distribution ratio of brightness level is shown in Figure 5.31. The graphics show the results of the evaluation of brightness level in the store by customers of Vakko and Boyner.

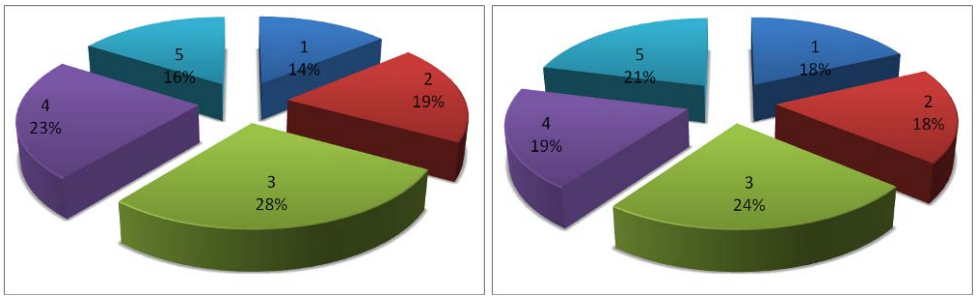


Figure 5.31: *Distribution ratio of brightness level in VAKKO and BOYNER*

As seen in the above figure, participants' perception of the brightness level is almost equal to each other in both stores. This result is occurred because of the differences between the customer characteristics. As seen in the figure 5.31, the decision of participant, 19% in Vakko and 18% in Boyner, is average for the perception of brightness level. They noted 3, means "neither agree nor disagree", for the brightness

level according to five point Likert scales. According to these results, it is seen that brightness levels in both stores have the same effect. The distribution ratio of glare on floor and discomfort of glare on floor in Vakko (figure 5.32) and Boyner (figure 5.33) are shown in the following figures.

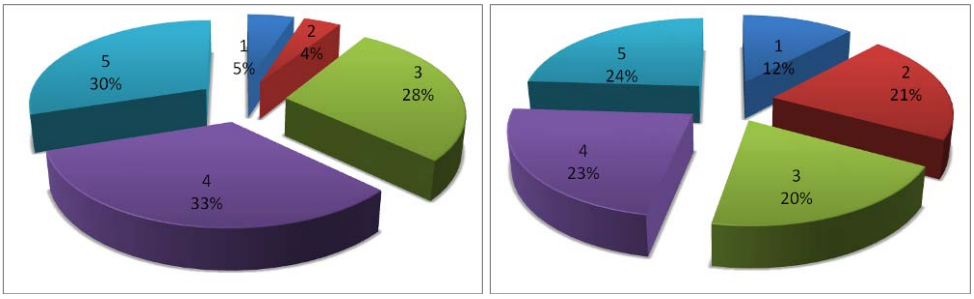


Figure 5.32: *Distribution ratio of glare and discomfort of glare on floor in VAKKO*

The above graphics consist of the evaluation results of glare and the results of answer to “How much glare on floor disturbs you?” question by customers of Vakko. And the next graphics consist of the evaluation results of glare and the results of answer to “How much glare on floor disturbs you?” question by customers of Boyner.

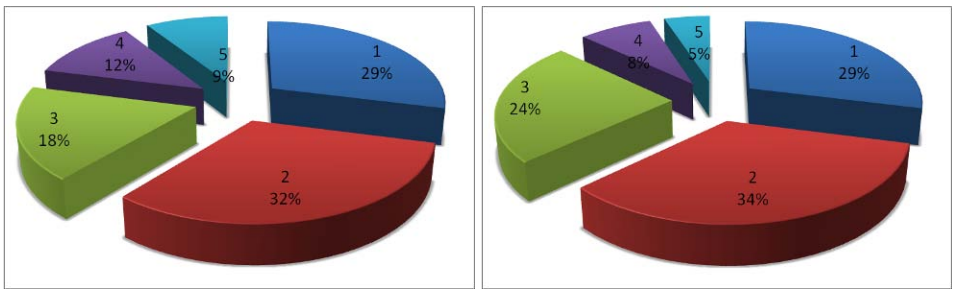


Figure 5.33: *Distribution ratio of glare and discomfort of glare on floor in BOYNER*

Glare is an important feature for the perception of a store. However, as seen in figure 5.32, the participants who are attended to the experiment are indecisive about glare on floor. A big majority of the customers (33%) are not disturbed with glare on floor. On the other hand, 20% of the customers have no idea about the discomfort of glare on floor in Vakko. In contrast to Vakko, in Boyner a minority of the customers are disturbed with glare on floor. The distribution ratio of glare and discomfort of glare in Vakko are shown in Figure 5.34. The graphics show the evaluation results of glare and the results of answer to “How much glare disturbs you?” question by customers of Vakko.

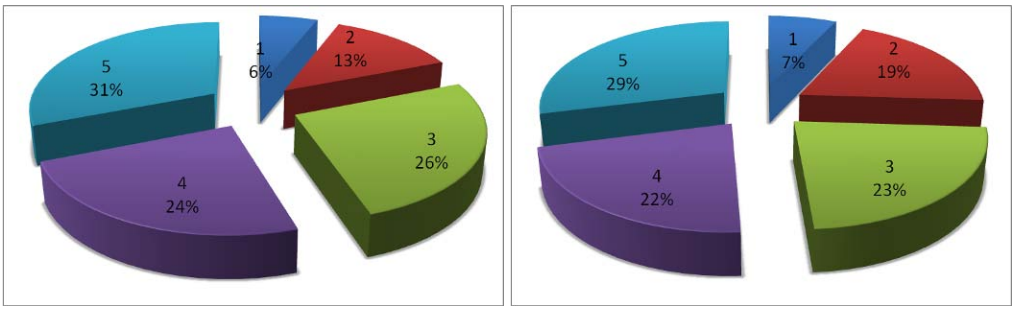


Figure 5.34: *Distribution ratio of glare and discomfort of glare in VAKKO*

As it is shown in figure 5.34, customers are aware of glare in the stores. %34 participants noted the glare as 1 means “strongly disagree”, 2 means “disagree”, %33 noted as 4 means “agree”, 5 means “strongly agree”, and %33 noted as “neither agree nor disagree”. The percentage of discomfort of glare is 37%, but comfortable is 27%. According to this result, the customers are sufficient with the general lighting in the stores. The distribution ratio of glare and discomfort of glare in Boyner are shown in Figure 5.35.

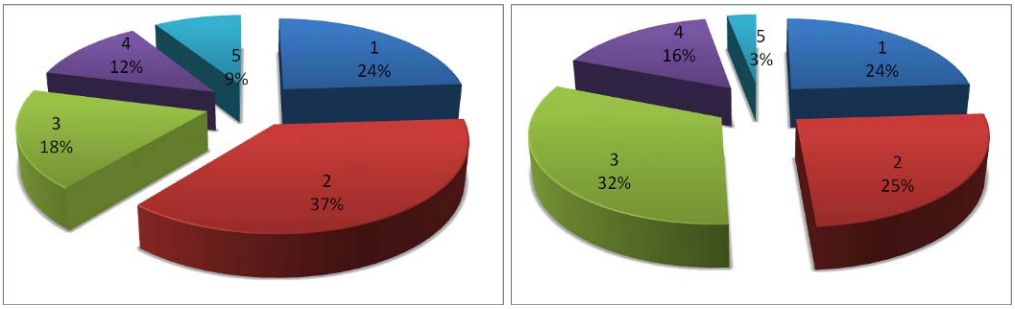


Figure 5.35: *Distribution ratio of glare and discomfort of glare in BOYNER*

The above graphics consist of the evaluation results of glare and the results of answer to “How much glare disturbs you?” question by customers of Boyner. The distribution ratio of sparkle in both stores is shown in Figure 5.36.

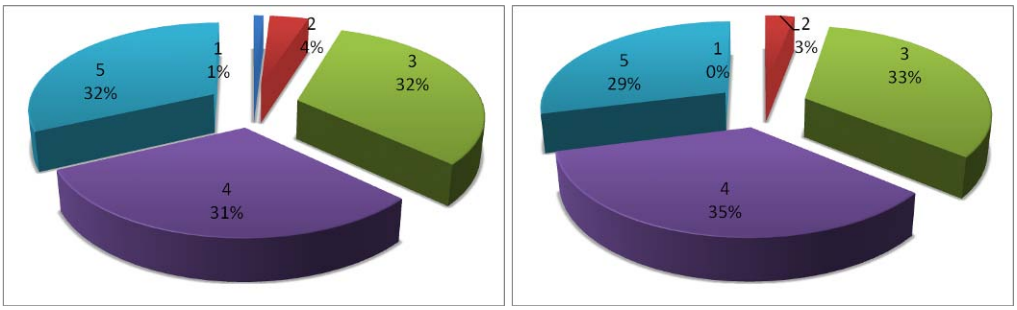


Figure 5.36: *Distribution ratio of sparkle in VAKKO and BOYNER*

The above distribution ratio graphics show the results of answer to "There are particularly sparkled products in the store. How much this technique makes the products more attractive?" question by customers of Vakko and Boyner. According to the results shown in previous figure, the 5% participants in Vakko and 4% participants in Boyner decided that the sparkle does not make the objects attractive. The rest of the participants the 63% in Vakko and 64% in Boyner decided that the sparkle is an effective method to make the objects more attractive. As a result, it can be said that **sparkle has an efficient role on the customer perception to make the objects in the store more attractive.** The distribution ratio of correlated color temperature in both stores is shown in figure 5.37.

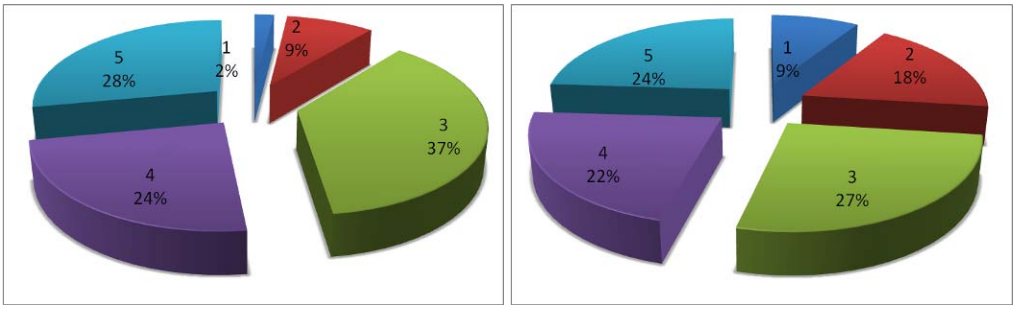


Figure 5.37: *Distribution ratio of correlated color temperature in VAKKO and BOYNER*

The above graphics consist of the evaluation results of created atmosphere by using correlated color temperature by customers of Vakko and Boyner. According to the above figure, it is very clear to say that, in minority of participants in both stores evaluated the store atmosphere as cold. On the other hand, 52% in Vakko and 46% in Boyner of the participants evaluated the store atmosphere as warm, 37% in Vakko and 27% in Boyner of the participants remained as "neither cold nor warm". However, when looking at the general results, it can be said that neutral participants also evaluated the

store atmosphere as warm. The distribution ratio of color rendering index in Vakko and Boyner is shown in figure 5.38.

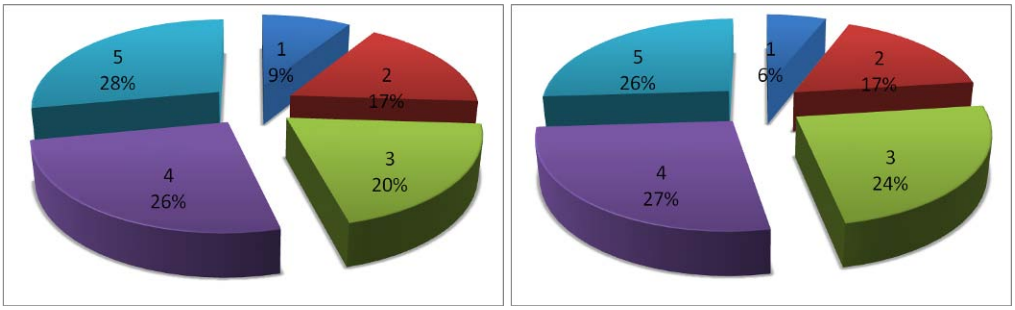


Figure 5.38: *Distribution ratio of color rendering index in VAKKO and BOYNER*

The above graphics consist of the evaluation results of the question "During the spending time in the store, do you think that the used light colors are qualified to change the products color?" by customers of Vakko and Boyner. According to the figure 5.38, it is very clear to say that the CRI of light sources is definitely perceived consciously by the customer. This can be explained, in both stores, **there is a big amount of customer rate 74% in Vakko and 77%in Boyner who evaluated that CRI causes changing of color on the products.** The rest of the customer rate can be disregarded. The next figure is shown the distribution ratio of contrast in both stores.

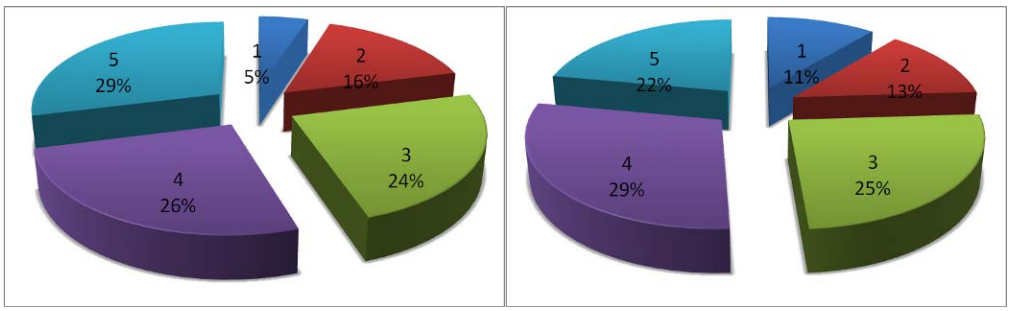


Figure 5.39: *Distribution ratio of contrast in VAKKO and BOYNER*

The distribution ratio graphics in figure 5.39 show the results of answer to "How the differences between the lightings affect to perceive the products?" question by customers of Vakko and Boyner. A type of lighting technique of contrast is corroborated once more by research that it is an important technique for defining the products. As

shown on the figure, **the majority of customer rate, who considers that the contrast makes the product more attractive, is not underestimated.**

5.2.3.2 Comparisons of Age, Gender and Educational Level Effect on Lighting Perception in Stores

In this section, time of day and lighting appearance questions are compared with the characteristics of customers; gender, age and educational level. The highly different results are shown in below, and the other results can be found in Appendix C. The following figure shows the comparison of brightness level vs. age.

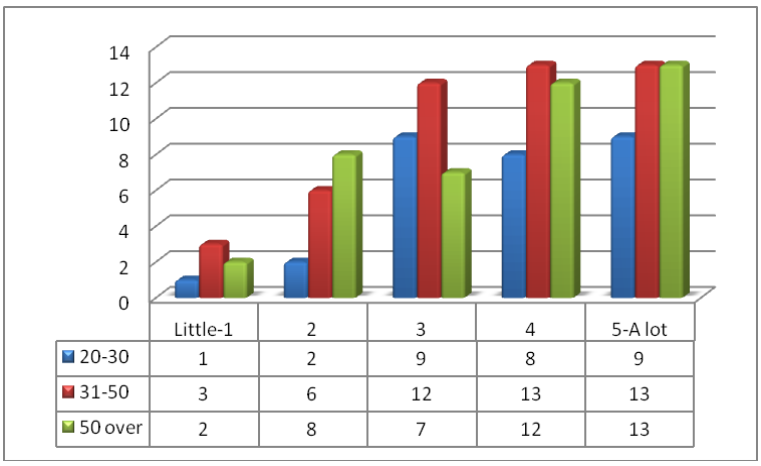


Figure 5.40: *Comparison of Brightness Level vs. Age in Vakko*

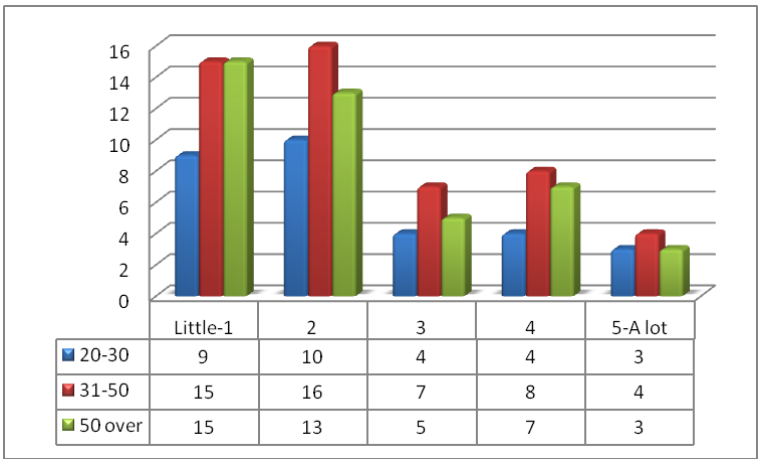


Figure 5.41: *Comparison of Brightness Level vs. Age in Boyner*

In below graph, it is clear to say that **older people need more brightness level in stores.** Over 51 years-ages of 48 participants have found brightness level less, 35 participants have found it more. In spite of this, just 20 young participants (between 20-30 ages) have found brightness level less. The above mentioned result is the same as the result of researches by Barnaby (1980) and Hughes & McNelis (1978). In their research, they found that older persons show stronger preferences for higher illuminance than younger ones. The comparison of brightness level vs. gender is shown in the following figures.

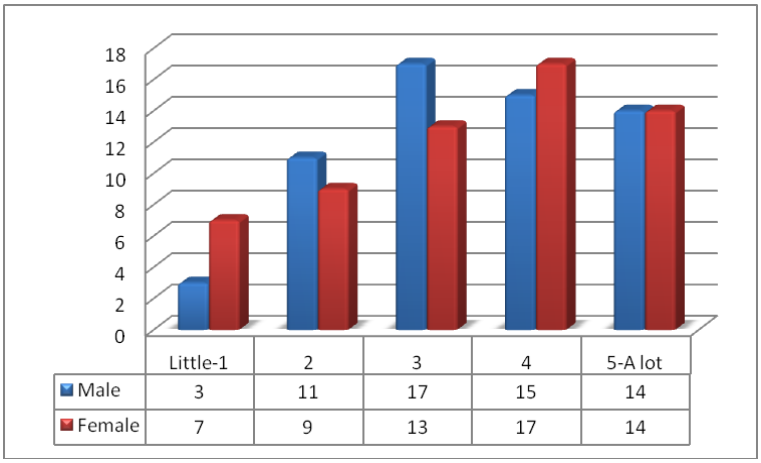


Figure 5.42: *Comparison of Brightness Level vs. Gender in Vakko*

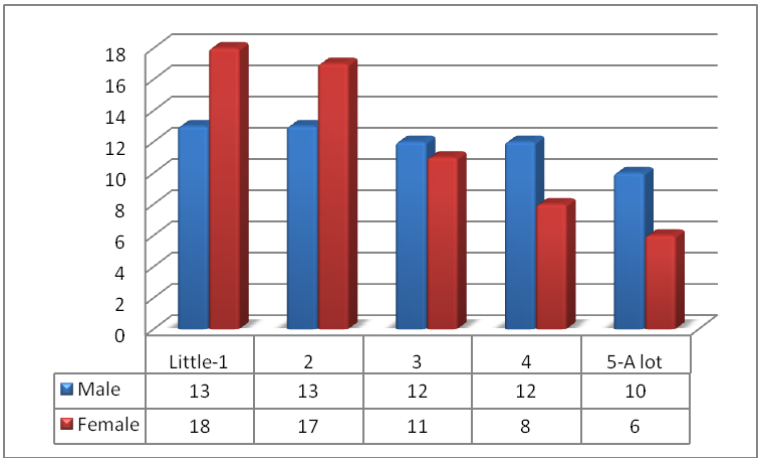


Figure 5.43: *Comparison of Brightness Level vs. Gender in Boyner*

It can be said, as Leslie and Hartleb (1990) found in their study, **male participants preferred much higher brightness levels than the female participants.**

As it is shown in the graph above, 81 male participants rated that the brightness level of the stores are not sufficient, but, 102 female participants rated that brightness level in the stores are a lot for them. The comparison of glare on floor vs. gender and the comparison of discomfort of glare on floor vs. gender are shown in below figures.

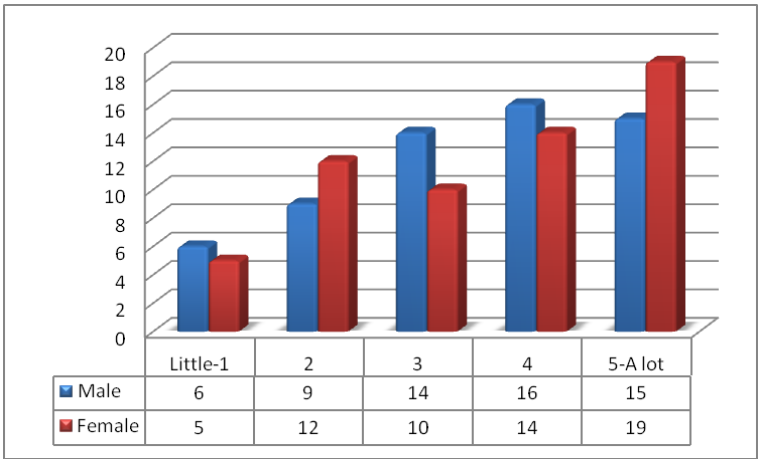


Figure 5.44: *Comparison of Perception of Glare on Floor vs. Gender in Vakko*

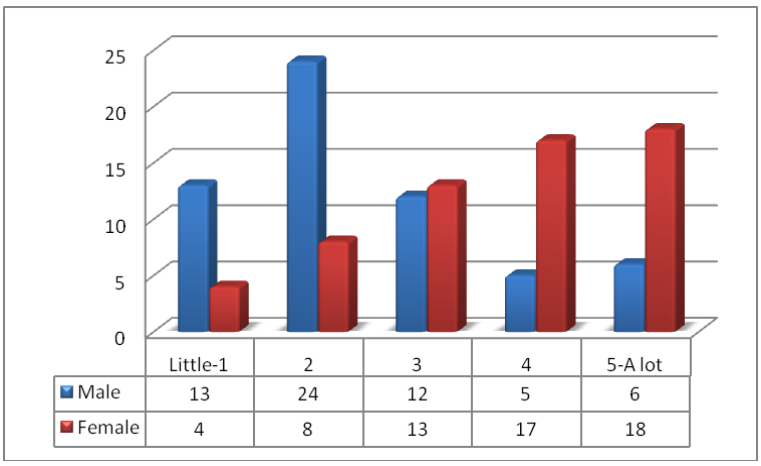


Figure 5.45: *Comparison of Discomfort of Glare on Floor vs. Gender in Vakko*

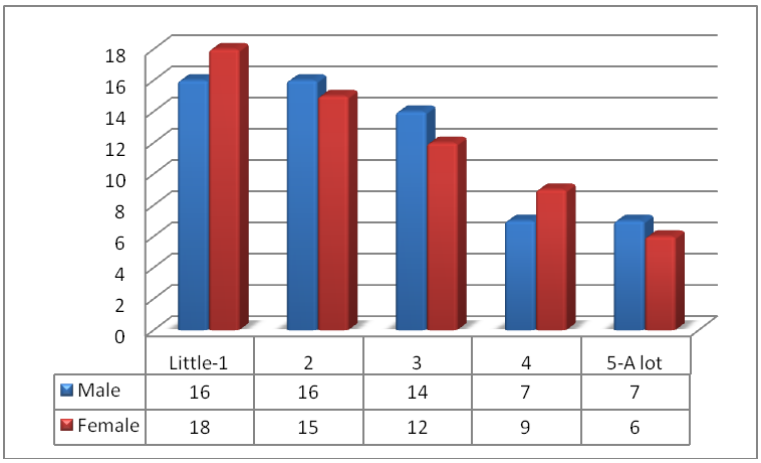


Figure 5.46: *Comparison of Perception of Glare on Floor vs. Gender in Boyner*

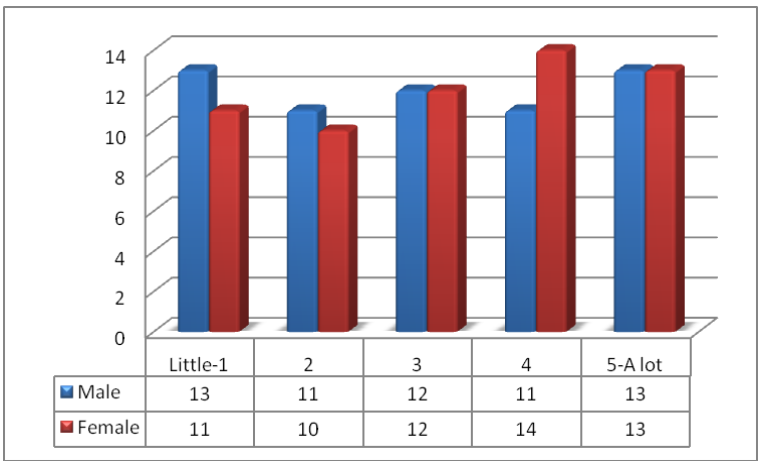


Figure 5.47: *Comparison of Discomfort of Glare on Floor vs. Gender in Boyner*

According to the above figures, females are more affected by the finishing materials and glare on floor than males. As seen on the both graphics, rate of perception of glare and discomfort of glare are almost the same. As understood from the interviews during the questionnaire, **discomfort of glare is related to the high heel of females, because glare on floor gives the feeling of slipperiness.** Next six figures show the comparison of glare vs. gender, vs. age and vs. educational level.

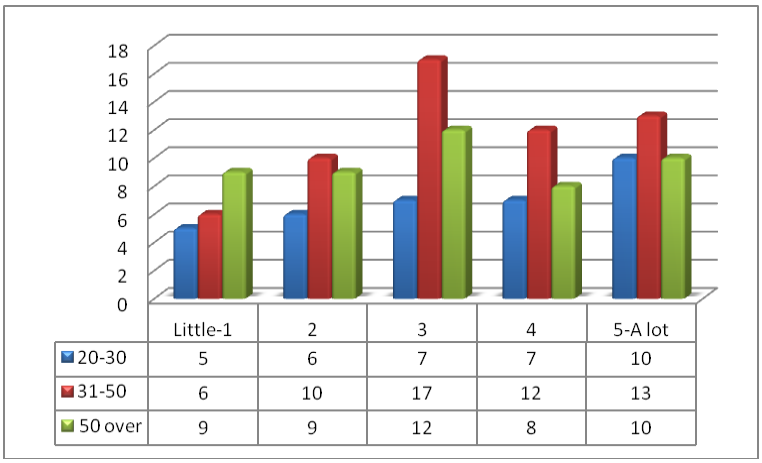


Figure 5.48: *Comparison of Perception of Glare vs. Age in Vakko*

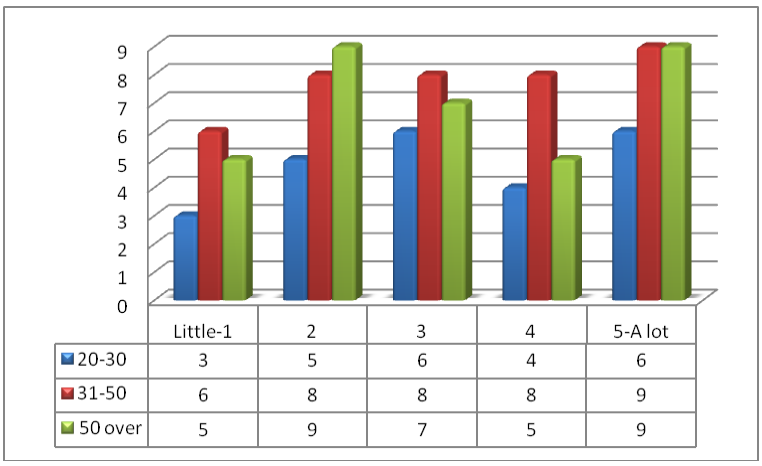


Figure 5.49: *Comparison of Perception of Glare vs. Age in Boyner*

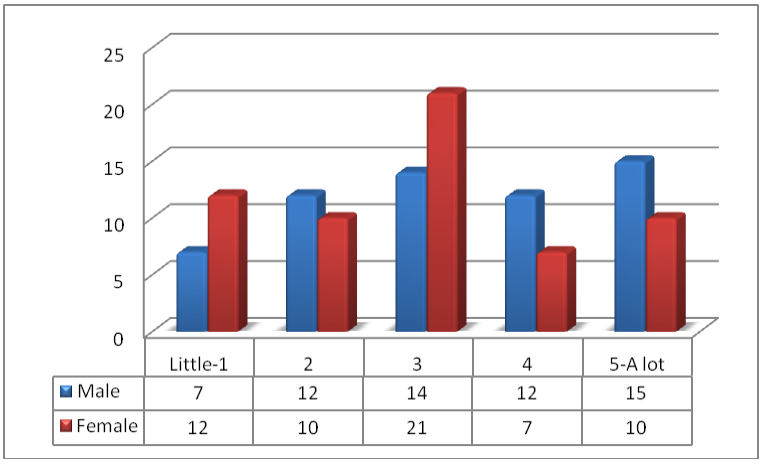


Figure 5.50: *Comparison of Perception of Glare vs. Gender in Vakko*

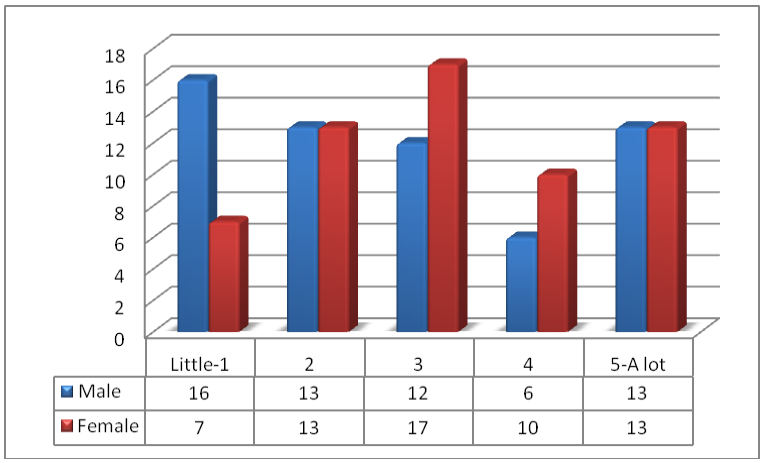


Figure 5.51: *Comparison of Perception of Glare vs. Gender in Boyner*

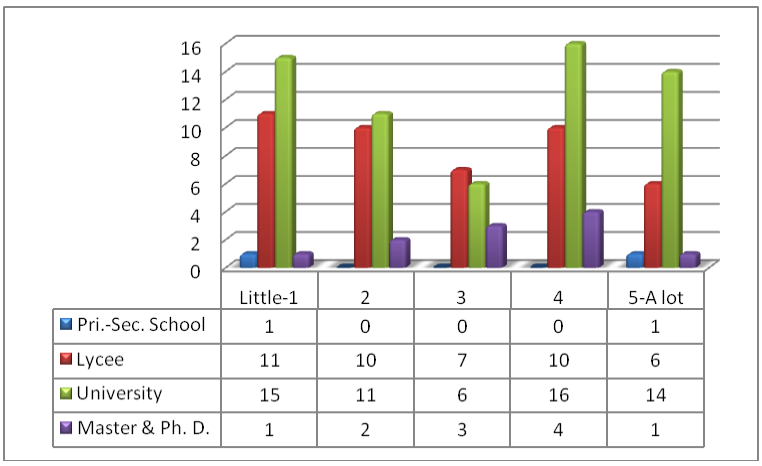


Figure 5.52: *Comparison of Perception of Glare vs. Educational Level in Vakko*

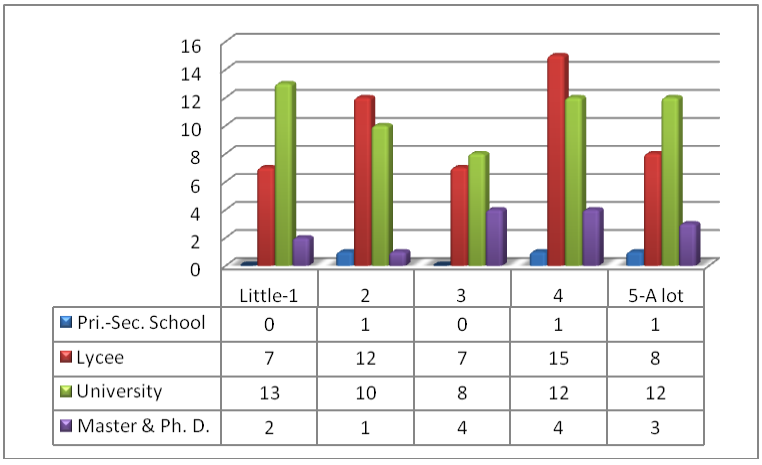
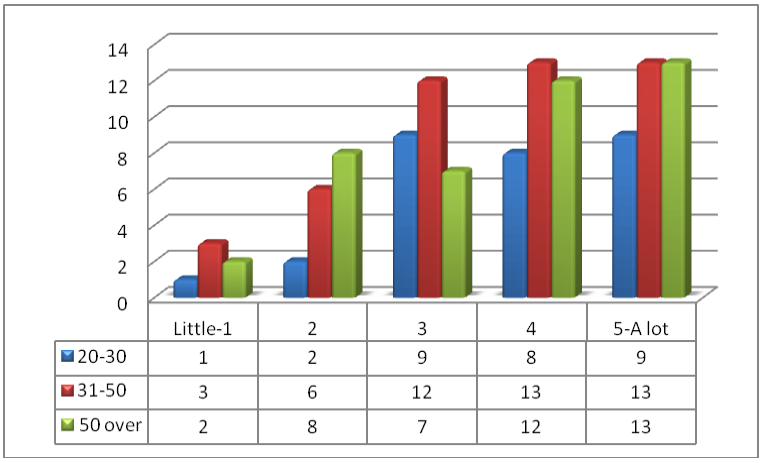


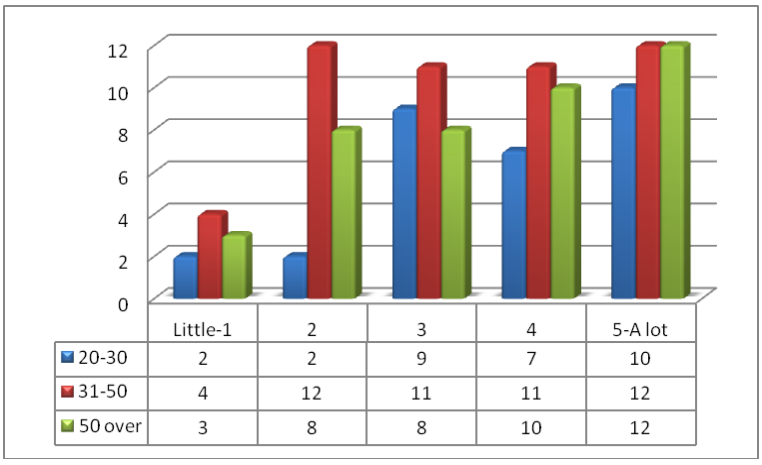
Figure 5.53: *Comparison of Perception of Glare vs. Educational Level in Boyner*

As seen in figures 5.44, 5.45, 5.46, there is no relation between customer characteristics and perception of glare. It can be said that the perception of glare is related with personal preferences. The comparisons of sparkle vs. age, vs. gender and vs. educational level are shown in below figures.



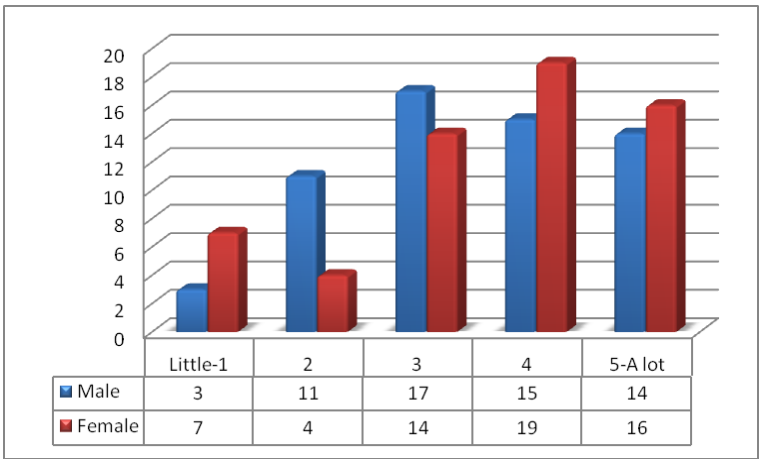
	Little-1	2	3	4	5-A lot
20-30	1	2	9	8	9
31-50	3	6	12	13	13
50 over	2	8	7	12	13

Figure 5.54: *Comparison of Sparkle vs. Age in Vakko*



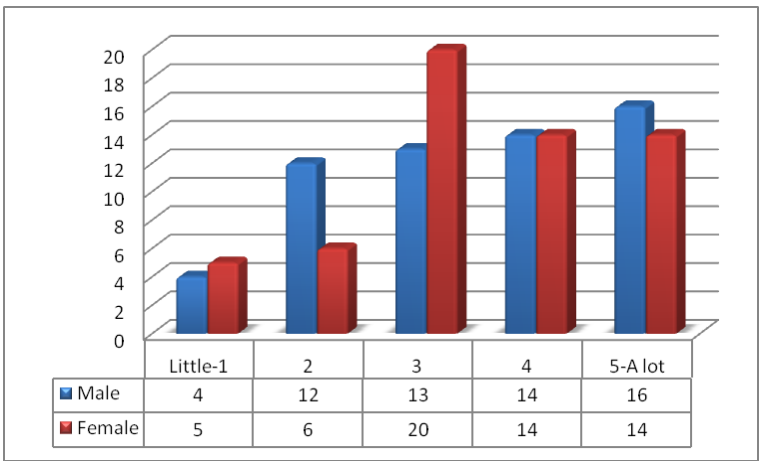
	Little-1	2	3	4	5-A lot
20-30	2	2	9	7	10
31-50	4	12	11	11	12
50 over	3	8	8	10	12

Figure 5.55: *Comparison of Sparkle vs. Age in Boyner*



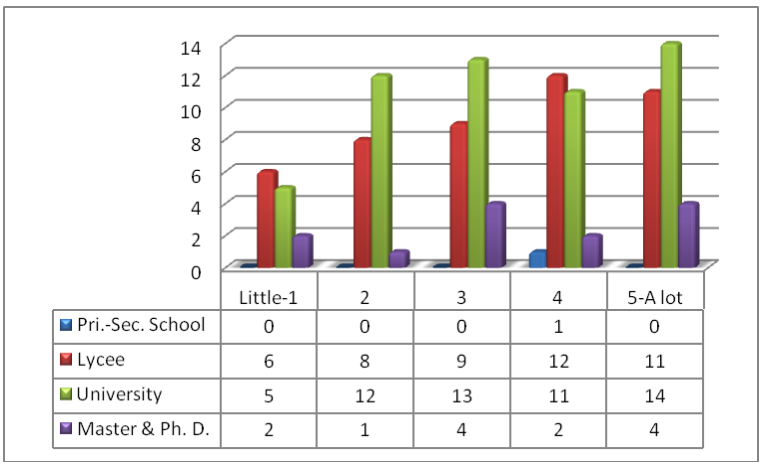
	Little-1	2	3	4	5-A lot
Male	3	11	17	15	14
Female	7	4	14	19	16

Figure 5.56: *Comparison of Sparkle vs. Gender in Vakko*



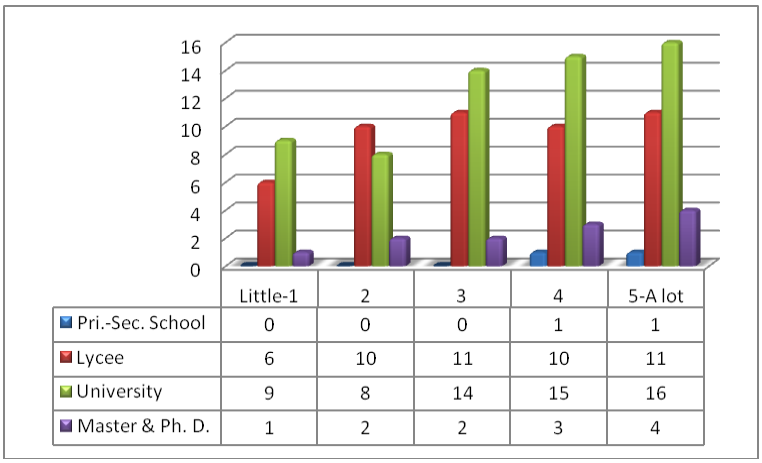
	Little-1	2	3	4	5-A lot
Male	4	12	13	14	16
Female	5	6	20	14	14

Figure 5.57: *Comparison of Sparkle vs. Gender in Boyner*



	Little-1	2	3	4	5-A lot
Pri.-Sec. School	0	0	0	1	0
Lycee	6	8	9	12	11
University	5	12	13	11	14
Master & Ph. D.	2	1	4	2	4

Figure 5.58: *Comparison of Sparkle vs. Educational Level in Vakko*



	Little-1	2	3	4	5-A lot
Pri.-Sec. School	0	0	0	1	1
Lycee	6	10	11	10	11
University	9	8	14	15	16
Master & Ph. D.	1	2	2	3	4

Figure 5.59: *Comparison of Sparkle vs. Educational Level in Boyner*

As shown in the 3 graphics, sparkle is an important factor for the perception of product and has a linear increase. With regard to these data, **sparkle makes the products more attractive for the each group of customers i.e. age, gender, educational level.**

5.2.3.3 Results of atmosphere perception questionnaire

The Atmosphere Metrics method, developed by Vogels (2008) based on Osgood's semantic differential scale, is used to measure how participants perceive the atmosphere in the selected stores. Participants rated for thirty-eight atmosphere words (See Appendix B) on five point bipolar Likert scales. (See chapter 3)

This thirty-eight atmosphere perception terms is divided in three groups: positive meanings, negative meanings and neither positive nor negative meanings. However, in questionnaire, they were mixed in order to force the participants to think and evaluate the environment. (See appendix A)

Graphics below shows the rating of atmosphere perception in the Boyner and Vakko stores. The first graphic is shown the positive meaning words ratings according to different genders.

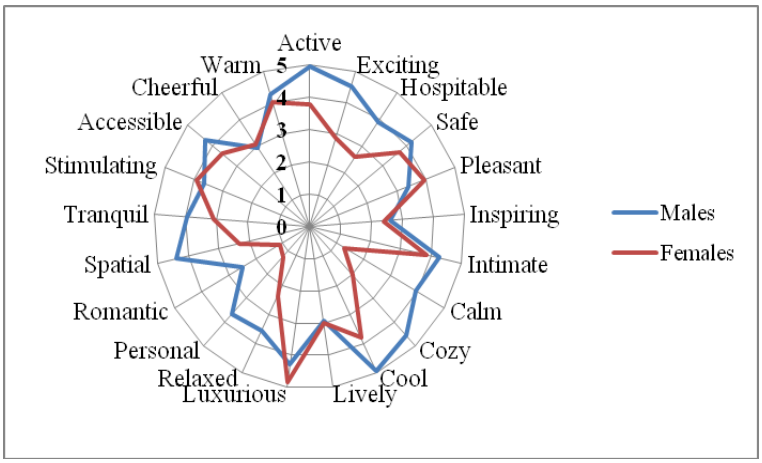


Figure 5.60: *Positive meaning words ratings according to gender*

According to the figure 5.60, males have evaluated the store atmosphere more positive than females. The rating of males is including the female's. As a result, **the lighting has positive effect on males rather than females on perceived store atmosphere.**

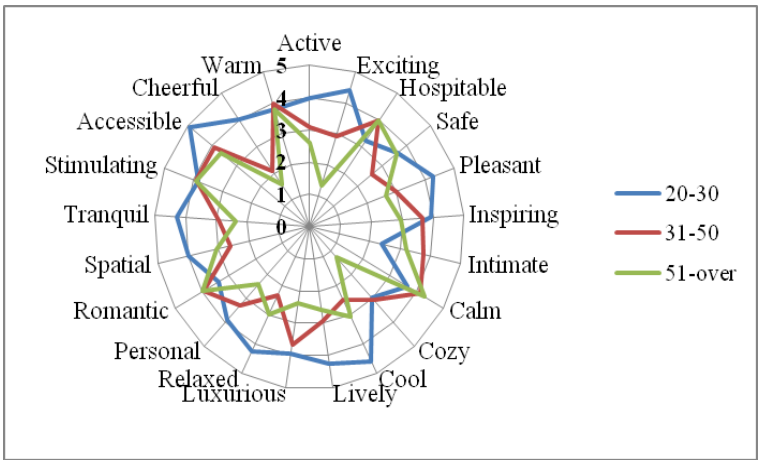


Figure 5.61: *Positive meaning words ratings according to age group*

According to the below graphic, **between the ages 20-30 has evaluated the store atmosphere more positive than over 30 ages. Between the ages 31-50 has evaluated the store atmosphere more positive than over 51 ages. This case can be explained with variation of the customer expectation depending on experience and acknowledgement in their life period.** This result has been corroborating with Yıldırım's study (2005).

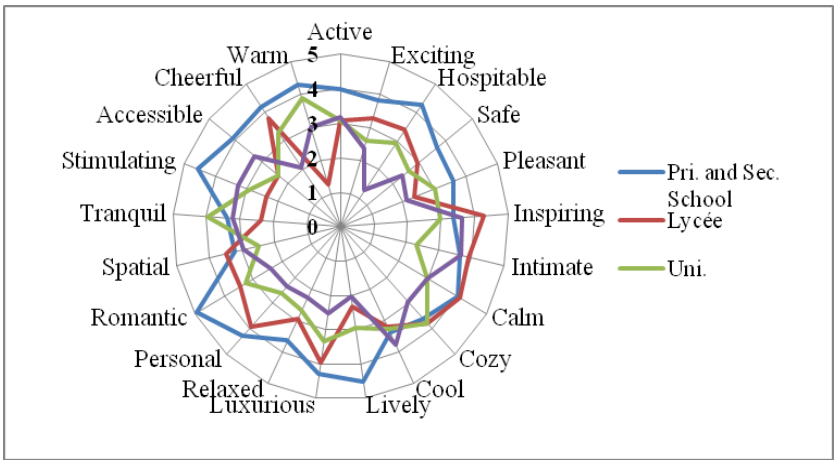


Figure 5.62: *Positive meaning words ratings according to educational level*

As for the figure 5.62, it has seen that the rating of positive atmosphere perception is decreasing when the educational level is higher. **Low educated customers perceive the store atmosphere more positive than high educated customers.** This result has been corroborating again with Yıldırım's study (2005)

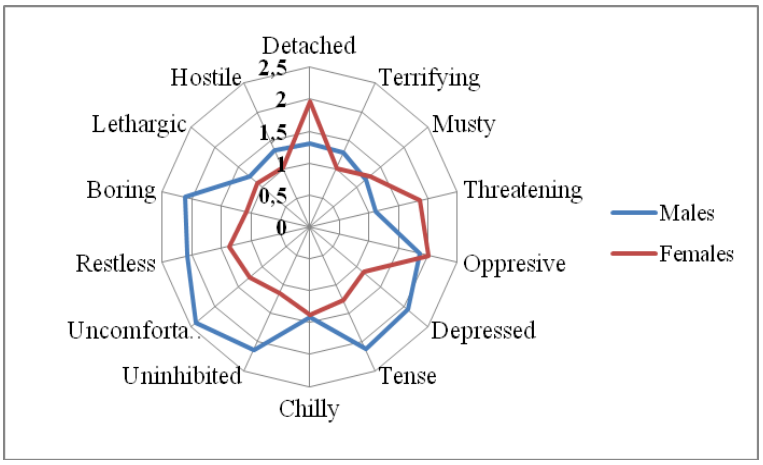


Figure 5.63: *Negative meaning words ratings according to gender*

As for the figure 5.63, negative meaning ratings of males and females for store atmosphere indicate different values. For instance, males evaluated the stores more oppressive, depressed, tense uninhibited, uncomfortable and restless but females evaluated detached and threatening.

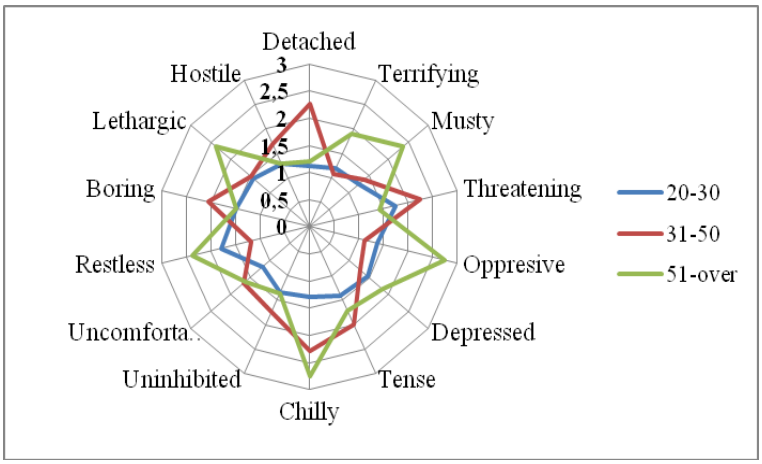


Figure 5.64: *Negative meaning words ratings according to age group*

As seen from the figure 5.64, **between ages of 20-30 is a group who perceived store atmosphere less negative. Over age 51 is a group who perceive atmosphere more negative because of the expectations depending on experience and acknowledgement in life period.**

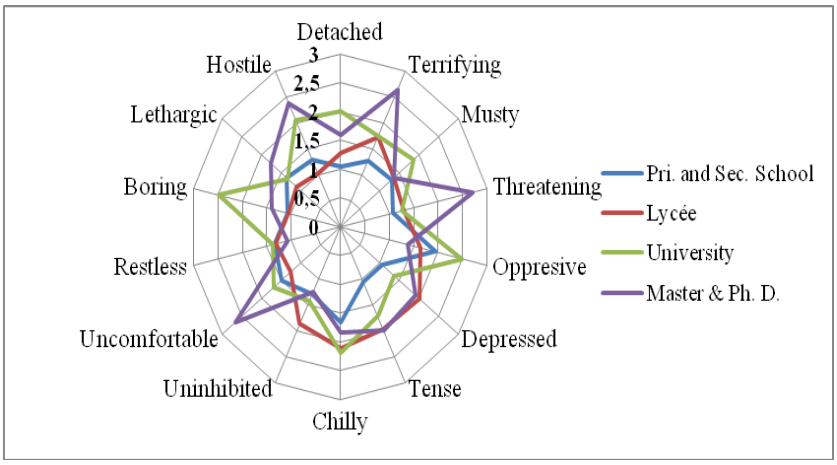


Figure 5.65: *Negative meaning words ratings according to educational level*

As shown in figure 5.65, **negative perception of the store atmosphere is subjected while education level increased. This case could be certified by the expectations rising.**

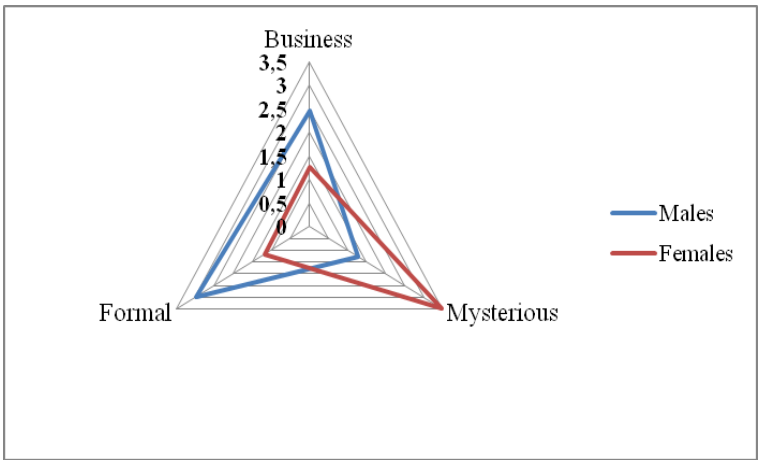


Figure 5.66: *Negative/Positive meaning words ratings according to gender*

It is possible to see that three different atmosphere perception terms has various rating for both genders and also could be defined with difference of expectations between genders.

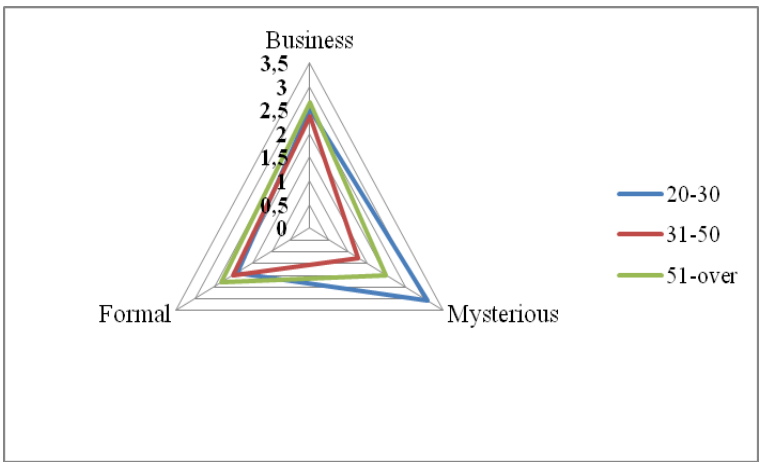


Figure 5.67: *Negative/Positive meaning words ratings according to age group*

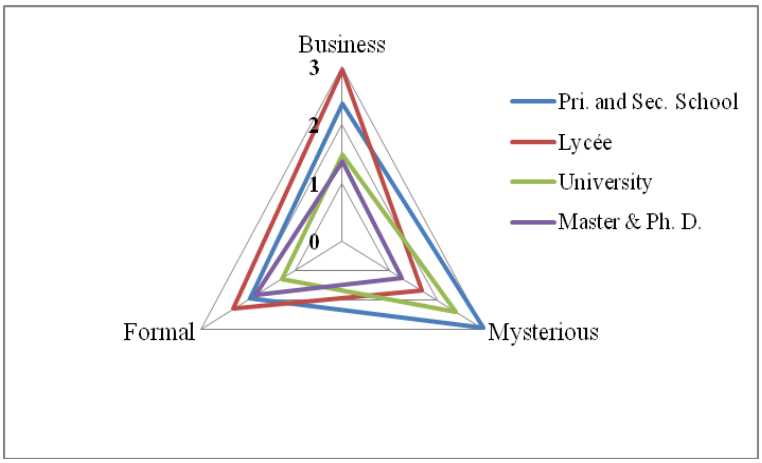


Figure 5.68: *Negative/Positive meaning words ratings according to educational level*

5.2.4 Interviews with shop directors and staffs – In depth interviews

During the survey, in-depth interview has been done in the both stores with the directors regarding to the store lighting.

With regard to the results of this in-depth interview, the illuminance level of the store effects negatively to the staff for both physically and psychologically during the long working hours like headache. The staff has indicated that the applied lighting systems at the stores occur air dryness. Depending on the applied lighting systems, air dryness harms their skins and eyes; they get difficulties to see properly.

Psychological effects are indicated that their perceived time zone is as a night time due to the effective lighting systems during their working hours from 10.00 am to 18.00 pm. This means, they spend the time more than 24 hours without sunshine. They have said that they were nervous and stressful with these working conditions.

As a result of the interview with the staff at the silver department in Vakko, the data is obtained that used lighting system causes some changes besides of oxidation on the colors of products. According to the research with the brand competent, they understood that the spot lights affect the products. Hence, they placed a filtering system in front of the spots. Thus, the products prevented from damages caused by lighting. Nonetheless, it is not observed such a problem on other products.

5.3 General Evaluation of Survey

In this study, the effects of age, gender and educational level on perception of store lighting were investigated. Furthermore, it was aimed to show significant effects of lighting characteristics on perceived atmosphere. To reach these goals a study was conducted in 2 different department stores. As it has been explained in the previous parts, the results show that not only the lighting characteristics have an effect on perceived atmosphere, but also customer characteristics; age, gender and educational level have an important role on perceived atmosphere. The results of the investigation are summarized and discussed in the following section.

Lighting appearance assessment

For characterizing the lighting in stores, a questionnaire was developed. In stores this questionnaire, filled in by participants, eleven lighting characteristics measured: perception of day time feeling, brightness level, glare, sparkle, correlated color temperature, color rendering index, contrast, general lighting, task lighting, accent lighting and lighting for decorative purposes. The results had a distribution ratio and a score for these eleven lighting characteristics. In below, there are remarkable results about lighting characteristics and customer characteristics.

- In both stores, big majority of customers feel the time as night.
- Older people need more brightness level in stores.
- Male participants preferred much higher brightness levels than the female participants.
- Sparkle has an efficient role on the customer perception to make the objects in the store more attractive.
- A big amount of customer who evaluated that CRI causes changing of color on the products.
- The majority of customer rate, who considers that the contrast makes the product more attractive, is not underestimated.

These results made it possible to relate the lighting to the customer characteristics

Perceived atmosphere assessment

For measuring the atmosphere perception a measuring method developed by Vogels (2008) was used. This measurement consisted of a questionnaire that was filled in by participants visiting each shop. The questionnaire resulted in a score for 2 different department stores on three meaning groups' *positive meaning, negative meaning* and *positive and/or negative meaning*. The lighting has positive effect on males rather than females on perceived store atmosphere. In below, there are remarkable results about lighting, perceived atmosphere and customer characteristics.

- Between the ages 20-30 has evaluated the store atmosphere more positive than over 30 ages. Between the ages 31-50 has evaluated the store atmosphere more positive than over 51 ages. This case can be explained with variation of the customer expectation depending on experience and acknowledgement in their life period.
- Low educated customers perceive the store atmosphere more positive than high educated customers.
- Between ages of 20-30 is a group who perceived store atmosphere less negative. Over age 51 is a group who perceive atmosphere more negative because of the expectations depending on experience and acknowledgement in life period.
- Negative perception of the store atmosphere is subjected while education level increased. This case could be certified by the expectations rising.

Representing the perceived atmosphere by means of scores on these three groups made it possible to relate the atmosphere perception to the customer characteristics.

CHAPTER 6

CONCLUSION

As understood from the study, in the past, lighting was used as a tool for seeing but nowadays, it is used as an important design element to emphasis products and to create psychological influence affecting people's buying attitudes. Lighting also has an important role on corporate identity; means it can augment the communication of a brand's appearance.

To understand the meaning of lighting, first of all the light and the technical aspects of lighting included characteristics of lighting, lighting sources, types of lighting design and the lighting fixtures were explained. In addition, it was researched the effects of lighting on stores supported by previous literature. In order to better understand the effects of lighting on stores, store design criteria and the lighting design criteria on stores were analyzed. In below, there are some remarkable results about the lighting researches:

- Emotions can be measured in numerous different ways based on: behavioral variables, facial expression variables, physiological and cognitive variables. (Ekman,1992; Watson et al.,1988; Mehrabian and Russell,1974)
- Brightness had a strong positive effect on pleasure and a negative effect on arousal and dominance. Saturation had a positive effect on pleasure, arousal and dominance. (Valdez and Mehrabian, 1994)

- Shopping environments can evoke emotional responses in costumers. (Machleit & Eroglu, 2000),
- Pleasure experienced in a shop has a strong effect on customers spending more money than intended and spending extra time in the shop. (Donovan and Rossiter, 1982)
- Non-uniform light was perceived as more *cozy*, livelier, less *tense* and equally *detached* compared to uniform distributed light with the same perceived room brightness and color temperature. In addition, uniform distributed light at low CCT was perceived as cozier, less *lively*, less *tense* and less *detached*. Furthermore, high intensity resulted in a livelier, less *tense,* less *cozy* (for low CCT) and more *detached* (for high CCT) atmosphere. (Vogels, 2008)
- Females and males may differently appraise the cool and the warm white lighting emotionally. In other words, the coloring quality of indoor lighting has different meanings and affective loadings to different genders. (Buck, 1984)
- Gender is one of the most important factors to determine of behavioral differences. (Putrevu, 2001 and Costa et al., 2001)
- When compares with males, females have more visual orientation, intensive motivation, and also more romantic than males. (Holbrook, 1986)
- There was an important relation between age and esthetical preferences. In addition, lighting is one of the most important factor for store selection by the customers. (Holbrook & Schindler, 1994)
- Older persons show stronger preferences for higher illuminance than younger ones. (Barnaby, 1980 and Hughes & McNelis, 1978)
- The educational level is important for customer perception on the stores. Educational level factor was reviewed in two categories as low and high educated people. According to the result of the research, low educated people perceived a store image attributes including store atmospherics and

salesperson behaviors more positive than high educated people. This result can be explained as for deep knowledge, experience, life style depending the status and difference of expectations. (Yıldırım, 2005)

- In the studies related with age and lighting perception, there was an important relation between age and esthetical preferences. In addition, lighting is one of the most important factors for store selection by the customers. (Holbrook & Schindler; 1994)

In addition, in order to answer the researched question of this study, the effects of customer characteristics on perception of store lighting were investigated. To provide getting objective comparison, two similar but totally different stores with the same product range and with different illuminations were selected. To minimize the variables of stores, only clothing stores, not a supermarket or a restaurant, were selected.

This study was aimed to show significant effects of lighting characteristics on perceived atmosphere. The study gives insight in the relation between lighting, atmosphere perception and customer characteristics.

In this study, three important determinants of customer characteristics were defined as *age, gender* and *educational level.* In order to reach the goals of this study, a survey was carried out which included customer characteristics questions, lighting characteristics questions and perceived atmosphere questions. The study demonstrates the following important results:

1. Gender and educational level are important variables in perception of interior lighting.

   Perception lighting characteristics were determined as brightness-luminance and illuminance, color rendering index, correlated color temperature, spatial light distribution, glare and sparkle. (Figures; 5.42, 5.43, 5.44, 5.45, 5.46, 5.47, 5.50, 5.51, 5.52, 5.53, 5.56, 5.57, 5.58, 5.59) The investigation results about this subject are in below:

- Sparkle has an efficient role on the customer perception to make the objects in the store more attractive.

- There is a big amount of customer who evaluated that CRI causes changing of color on the products.
- The majority of customer rate, who considers that the contrast makes the product more attractive, is not underestimated.
- Discomfort of glare is related to the high heel of females, because glare on floor gives the feeling of slipperiness.
- Sparkle makes the products more attractive for the each group of customers i.e. age, gender, educational level.

2. However, it is seen that age is as important as gender and education level while perceiving lighting characteristics. (Figures; 5.40, 5.41, 5.48, 5.49, 5.54, 5.55) The investigation results about this subject are in below:

- Older people need more brightness level in stores.
- Male participants preferred much higher brightness levels than the female participants.

3. In the atmosphere perception results, it is seen that all three determinants of customer characteristics are effective. (Figures; 5.60, 5.61, 5.62, 5.63, 5.64, 5.65, 5.66, 5.67, 5.68) The investigation results about this subject are in below:

- The lighting has positive effect on males rather than females on perceived store atmosphere.
- Between the ages 20-30 has evaluated the store atmosphere more positive than over 30 ages. Between the ages 31-50 has evaluated the store atmosphere more positive than over 51 ages. This case can be explained with variation of the customer expectation depending on experience and acknowledgement in their life period.
- Low educated customers perceive the store atmosphere more positive than high educated customers.

- Between ages of 20-30 is a group who perceived store atmosphere less negative. Over age 51 is a group who perceive atmosphere more negative because of the expectations depending on experience and acknowledgement in life period.
- Negative perception of the store atmosphere is subjected while education level increased. This case could be certified by the expectations rising.

Study gives advices to lighting and interior design of stores which would be a good base for the designs and also gives information to shop keepers while determining target customer group. Results effect decision on the lighting design in stores especially while determining glare for female weighted customer portfolios.

This study would open new investigations on the similar subjects; such as:

1. Emotional response adjectives must be tested for bigger group for different perceptional areas, in order to find out the most effective bipolar adjectives, which might change depending on the culture.
2. After determination of these adjectives the general atmosphere or ambient lighting perception study would be repeated for more different type of stores.
3. Culture seems one of the most important factors of atmosphere perception; however, in this study only education is taken as one of the main determinants. In the further studies, different values of different social groups must be investigated in terms of interior lighting.
4. Similar studies for each lighting characteristics would be investigated in detail, such as task lighting in various different situation.

The outcomes, Cronbach alpha values and expected effect on design decisions make this study valuable.

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