PEOPLE'S EXPERIENCE OF URBAN LIGHTING IN PUBLIC SPACE

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ABSTRACT

PEOPLE'S EXPERIENCE OF URBAN LIGHTING IN PUBLIC SPACE

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This thesis aims to create new perspectives in urban lighting design by discovering people's preferences in urban lighting through an exploratory research on people's perceptive experience of urban space at night. In this study, I aim to analyze the common approaches and methods of urban lighting design and make their critique through my research results. Primary research objectives include the evaluation of what people perceive from the urban lighting design and how they feel about the design outcomes. In order to explore people's experience of lit urban space at night, my research comprises a survey that aims to discover people's opinions on certain lit urban scenes collected from the city of Ankara.

Urban lighting design is a discipline that emerged to improve the aesthetic quality of urban space. It has significant effects on people and consequently on urban life. However, in this discipline, exploration of people's needs and preference is a neglected phenomenon. Therefore, this study suggests that it is necessary to review the designer-centered perspective on urban lighting design and question whether existing approach to this discipline has preferable outcomes for people. Through this research I aim to test whether it is appropriate to pursue and carry out the existing type of lighting design, and propose new perspectives to urban lighting.

Keywords: People's Preference in Lighting Design, People's Psychological Reactions to Lighting, Lighting Techniques for Urban Exteriors, Light Pollution, Crime Prevention, Lighting Design Master Plans

ÖZ

İNSANLARIN KAMUSAL MEKANDAKİ KENTSEL AYDINLATMA DENEYİMLERİ

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Bu çalışma insanların kentsel aydınlatmadaki tercihlerini, geceleri kent mekanındaki algısal deneyimi keşfetmeyi amaçlayan bir araştırma yolu ile saptayarak, kentsel aydınlatma tasarımında yeni perspektifler oluşturmayı amaçlamaktadır. Bu çalışmada, kentsel aydınlatma tasarımında yaygın yaklaşımların ve methodların analiz edilmesi ve yapılan araştıma sonuçları ile karşılaştırmalı olarak bu bulguların eleştirilmesi hedeflenmektedir. İnsanların kentsel aydınlatmada algılarının ne olduğunu ve bu algının ne tür duygusal etkiler yarattığı değerlendirmek araştımanın öncelikli hedefleri arasındadır. İnsanların aydınlatılmış kentsel mekanda gece deneyimlerini keşfedebilmek amacıyla, bu çalışma insanların Ankara şehrinden toplanmış 'aydınlatılmış kentsel mekan görüntüleri' hakkındaki görüşlerini inceleyen bir araştırma içermektedir.

Kentsel aydınlatma tasarımı, kent mekanının estetik kalitesini arttırabilmek için gelişmiş bir bilim dalıdır. İnsanlar üzerinde, ve bağlantılı olarak kentsel yaşam üzerinde önemli etkilere sahiptir. Fakat, bu bilim dalında insanların ihtiyaçlarının ve tercihlerinin keşfedilmesi ihmal edilmiş bir olgudur. Bu nedenle, bu çalışma aydınlatma tasarımında tasarımcı-merkezli bakış açısının gözden geçirilmesinin gerekli olduğunu ve bu bilim dalındaki mevcut yaklaşımların insanların için tercih edilebilir sonuçlar yaratığının sorgulanması gerektiğini ileri sürmektedir. Bu çalışma, mevcut aydınlatma tasarımı yaklaşımını sürdürmenin uygunluğunu test test etmeyi ve aydınlatma tasarımında yeni yaklaşımlar önerebilmeyi hedeflemektedir.

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INTRODUCTION

1.1. DEFINITION OF THE PROBLEM

In this study, I aim to create new perspectives in urban lighting design by discovering people's preferences in urban lighting through an exploratory research. This thesis defines the urban lighting design as a discipline that aims at improving the quality of urban space for the good of public; yet has struggled in achieving this goal due to the lack of exploration of and in accordance with the preferences of people. In this sense, this thesis aims to focus on the preferences of people in urban lighting to make a critique of the existing urban lighting design discourse. The research question of this thesis is: what is the people's evaluation of urban lighting and what are the perceived attributes that elicit certain emotional reactions: preference, interest, comfort and safety? The sub-questions of this research question are: what is the relationship between the perceived attributes of lighting and emotional appraisals, and which variables of lighting are salient to people for prefering and disliking a lit urban scene.

Light is an indispensable environmental input for human beings. According to Wurtman (1967), light is the most important environmental input, after food, in controlling the basic functions of the human body. The presence of light, its color and warmth, and the illumination created by it have physiological and psychological effects on human beings (Birren: 1969, 12). Primary importance of light for human beings is that it helps create the vision. Through vision people perceive and use the space. Perceiving the physical surrounding is also vital for the safety of orientation. On the other hand, light induces psychological effects on people. The amount of information received by people in space increases through light, hence fosters the sense of security in people. In addition, the color of light also have psychological effects on people and on their bodily functions. Color of light arouses definite emotional an aesthetic reactions, likes and dislikes, pleasant and unpleasant associations. All these effects of light on human beings make light a significant element of urban life. For this reason, this thesis defines light as a significant parameter in built environment.

For millennia human beings have sought to transcend the limits of the cycle of day and night by artificially lighting essential spaces. (Narboni: 2004, 32) Therefore, lighting of space has always been an important element of urban life. Historic illustrations of ancient cities display that roads and paths were illuminated for orientation and for festive ephemera even before the invention of artificial light (vanSanten: 2006, 70). In the 20^{th} century, the development of artificial light sources and accompanying luminaries have greatly increased the possibilities of using illumination in urban environment. Especially after the 1940s, urban lighting emerged as a tool for improving the aesthetic quality and security of the nocturnal urban environment. In addition to lighting of roadways and pedestrian paths for orientation, artificial urban lighting began to be used for the illumination of buildings, historical structures, parks, and landscape elements to improve the aesthetic quality of urban space at night. (Sirel: 2006, 64) Nevertheless, it was after the 1980s that urban lighting was designed with a comprehensive approach under the so-called urban lighting masterplans.

Urban lighting design has became a popular component of urban design projects in the last three decades. During this period, many cities in Western Europe, mostly in France, and in North America began to realize more comprehensive urban lighting design schemes. These lighting schemes aimed at illuminating roadways, pedestrian zones, landmarks and green areas with both functional and aesthetic concerns. These attempts have strictly emphasized the historical heritage, the increase in the sense of security and restructuring the nocturnal landscape by creating urban spectacles. Local authorities and lighting designers aimed at creating authentic nocturnal identities by benefiting from comprehensive urban lighting design schemes. (Narboni; 2004, 66)

Comprehensive urban lighting design schemes, which are also known as urban lighting master plans, have had very successful outcomes in some cities of Europe and North

America. The best example is the French city of Lyon which pioneered the masterplan preparation for urban lighting design. Implementation of lighting masterplan of Lyon has created an artistic nocturnal landscape. In addition to increasing the aesthetic quality of urban space, Lyon also benefited from economic regeneration. Owing to its genuine nocturnal scene, Lyon stepped out of the shadow of overwhelmingly popular Paris and became an alternative tourist destination in France. Success of Lyon encouraged many other cities to implement urban lighting masterplans. However, there was a downside of the new urban lighting approach. Not every city was able to benefit from similar aesthetic improvement on the quality of space that Lyon derived from urban lighting.

Downside of the new approach to urban lighting design has been the 'stereotypical nocturnal scene' created by floodlighting of every historic edifice and pouring excessive light on roadways and pedestrian zones to increase safety and security. The new urban lighting approach made its mark by going beyond the pure functional and incrementalist perspective on urban lighting. However, the city governing authorities in Europe, North America and in many developing countries failed to focus on the needs and preferences of the people in terms of urban lighting. City governing authorities have chosen to adapt the "successful formula of the other city" over discovering the local needs. Hence, urban lighting efforts have been overruled by blueprints of the famous lighting schemes. Consequently, urban lighting design has struggled to address the question whether the existing type of lighting design meet the needs of and feel pleasing to all segments of the public.

The Bosphorus Bridge in Istanbul is one of the most recent examples of how an urban lighting design might fail to seek for the exploration of needs and preferences of the public. A lighting project was carried out for the Bosporus Bridge in 2007. The bridge has a functional importance in national and international transportation networks as one of the two highway connections between Asia and Europe in Turkey. On the other hand, as being the first of the two bridges, it is a part of national urban memory. Illumination project of the bridge was carried out under the partnership of a world leader electronics company and General Directorate of Highways of Turkey. Design process of the lighting of Bosporus Bridge was isolated from the public, academic institutions, governmental and non governmental institutions including the "Directorate of Urban Lighting and Energy of Istanbul". Even the announcement of implementation was not properly done, inhabitants of the city learned about the project when they witnessed climbers installing LED modules on the bridge during a commuting traffic jam. There hasn't been a scientific study to evaluate the impacts of this lighting design project. However, urban lighting professionals, urban designers, architects and some journalists criticized the outcome and claimed that one of the oldest and strongest images of the modern Istanbul turned into a "glowing mass" at night, that changes color with no good reason. Honest enough, the media described the new illumination of Bosporus Bridge as "Amusement of Colors."

Since the priority of the public good is neglected, an urban lighting design process which is led by the private sector and which by-passes the exploration of preferences and needs of the public draws a problematic picture for urban planning discipline. Another problem about this lighting project is that neither city governing authorities nor planning authorities seeks to assess its impacts on the nocturnal scene perceived by the public. As the Bosphorus Bridge lighting design project portraits, exploration of people's preference in urban lighting and their perception of the design outcome is a neglected phenomenon in urban lighting design discipline.

These discussions stated above picture the impasse of urban lighting design: the existing perspectives on urban lighting design have flaws as it produces standardized solutions which are incongruous with the needs and preferences of people. For this reason, it is crucial to make a critical reflection on these perspectives via benefiting from researches on people's preference in urban lighting design. In this sense, an evaluation of the existing know-how of urban lighting design in terms of its accordance with people's needs and expectations is the main emphasis of this study. In this respect, I aim to provide new perspectives on urban lighting design via discovering the preferences of people through an exploratory research on people's perceptive experience of nocturnal urban space.

CHAPTER 2

DEFINING LIGHT AS AN URBAN DESIGN PARAMETER

Light has always been considered not only as a physical phenomenon but also an essential input for life. (Brandi: 2006, 8) At the beginning of the modern civilization, human beings were bound to the day and night cycle; and the length of the day was determined with the hours people could get sunlight. After human beings learned to use the natural light sources for illumination, lighting has been an essential component of the human-made environment. Later light has been a fascination in fields such as science, art and literature. The systematic use of lighting in exterior space and the first nocturnal landscape images conceived by human beings date back to 17th century lighting for Baroque festivals. (Narboni: 2004, 12)

After the invention of electric lighting in 19th century, lighting the built environment became more popular and convenient; however, it was the 20th century that both interior and exterior spaces were illuminated by electric lighting. (Mahkne: 1987, X) The 1940ies introduced the improvement in the artificial lighting technologies; innovations and new industrial materials made it possible to use the light more efficiently and less expensive. Until the 1970ies the artificial lighting was used as means for safety and security of the urban dwellers at night. (Ritter: 2006, 56) Since the beginning of 1970ies, the symbolic meaning and the aesthetic emphasis of the artificial lighting has increased. The popularity and use of urban lighting expanded with the introduction of annual urban lighting festivals in the 1980s, and production of urban lighting master plans in the 1990s. Today, it is well accepted that light is one of the major factors in creating the human-made environment and its impact influences people's experience of the urban environment at night. (Narboni: 2004, 12; Mahnke; 1987; Ritter: 2006, 57)

The relation of light and nocturnal urban environment raises psychological, aesthetic, and environmental discussions. In this chapter, I aim to critically these discussions to help reveal the role of light in nocturnal urban life. I divided the review of lighting in literature with respect to the urban environment to three categories: light and its effects (in the urban environment), lighting of the urban sections and emotional reactions of people, and lighting and urban design. These three sections aim to help reveal the effects of lighting on the human beings with respect to their physical environment.

2.1. LIGHT AND ITS EFFECTS

The effects of light on people and the urban environment are reviewed under three categories: psychological effects of light and color on human beings, effects of lighting on crime prevention, environmental effects of light on air pollution.

2.1.1. Psychological: The Effects of Light and Color on Human Beings

In this section I present the review of the literature and previous studies on human response to and preference of lighting and color, in order to present certain relations between perceived attributes and emotional appraisals within the spatial context. The literature review in this section is categorized under two main sections: the effects of light intensity and distribution, and the effect of colors on human beings.

Research reveals that there has been limited scientific research on the effects of light and color on human beings in the urban exterior space. Majority of the studies that aimed to systematize the relation between perceived attributes of lighting and emotional reactions are carried out for the interior spaces. Although the existing researches on the effects of light and color on human beings do not focus directly on the urban exteriors, the field of environmental psychology presents a considerate knowledge about this topic.

2.1.1.1. Review on the Effects of Light Intensity and Distribution

This section comprises the review of scientific studies on the human response to and preference for the intensity and distribution of lighting in interior space, and in exterior space. In this section, I reviewed the major studies on the effects of light intensity and distribution on human beings and I categorized the literature review under two subtopics as interior spaces and exterior spaces, with regards to the spatial context of the researches and literature findings.

Review on the previous researches, which aimed to discover the human response to and preference of lighting in interior space, reveals that people use the brightness and distribution of lighting as basis for their judgments about an interior space. The classical study of Flynn (1979) concludes that lighting condition affects the mood: non-uniform lighting cues relaxation, perceptual clarity is reinforced by higher central and horizontal lighting and the feeling of spaciousness is boosted by bright and uniformly lit interiors. Studies of Smith (1989), Baron & Rea (1991), and Loe (1993) concludes that people report more positive feelings under low brightness and warm light. Nevertheless, Gifford (1988) concludes that low brightness creates more intimate environments. On the other hand, the study of the Bartlett group concludes that people generally prefer brightly lit interiors and distribution of light significantly effects on how people feel about the space.

Review on the effects of lighting on human beings in exterior space concludes that there are certain relations between perceived attributes of lighting and emotional reactions. Moyer (1992) states that brightly lit objects draw the attention of the viewer more than softly lit objects. It is also stated by Moyer (1992) that walking towards a brightly lit area feels comfortable for people. According to Moyer (1992) too high contrast between brightly lit spots creates confusion and between brightly lit spots there should be lower light fills that form visual bridges in the view. On the other hand, Moyer (1992) and Michel (1996) conclude that regardless of the intensity of light, defining the boundaries of a space creates a comfortable environment for people in urban exteriors.

Since the 1970s, there has been an increasing interest in the studies that aimed to explore the effects of light on the experience of people in built-environment. (Yücetaş: 1997, 8) Research reveals that there have been several researches on the effects of light and color on human beings; however only a limited number of these researches include the relation within the spatial context. These studies which aimed at discovering the effects of light and color on human beings in spatial context have certain limitations. Veitch (2001) stresses that independent replication of the existing studies and further work in this area using adequately large sample sizes and different techniques (such as both exploratory and confirmatory factor analyses with independent samples) is precisely what is needed to advance the understanding of the effects of luminous conditions on aesthetic judgments. Boyce (1981), Gifford (1994), Kaye (1992), Veitch & Newsham (1998) and Tiller (1990) stress that poor quality research is a major impediment to understanding the effects of light on human beings.

Interior Spaces: A series of studies conducted by Flynn and his colleagues on the effect of lighting patterns in interior space (in a conference room) had gained significant acknowledgment in 1970s. (Veitch, J. A.: 2001, 124-140; Yücetaş: 1997, 17) Flynn and his colleagues initially obtained ratings on 34 semantic differential scales in response to six lighting configurations, and separate ratings of the similarity or difference between pairs of lighting configurations (Flynn & Spencer & Martyniuk & Hendrick: 1973, 87-94). They used factor analysis to reduce the semantic differential scales to three interpretable factors: perceptual clarity, evaluative impressions, and spaciousness. Multidimensional scaling was used to identify three dimensions (lighting modes) that accounted for the judgments of similarity or difference: uniformity, brightness, and overhead/peripheral. Later, they presented a technique for relating the lighting modes to the factors. (Flynn & Hendrick & Spencer & Martyniuk: 1979, 95-110)

The series of studies conducted by Flynn concluded that lighting conditions affected moods (Rea, 1992, 435-442). His researches pointed out that relaxation is said to be cued by non-uniformity, particularly non-uniform wall lighting. Perceptual clarity is said to be reinforced by higher horizontal lighting in a central location. Spaciousness is cued by uniform lighting and bright walls (Veitch: 2001, 124-140). Veitch and Danford et al. (quoted in Yücetaş: 1997, 19) points out that Flynn's work suffered from several serious limitations with respect to his invariably too small sample size, the unclearness of how the initial semantic differential scales were set, whether participants judged the appearance of the lighting or the appearance of the room. However, the findings of his research were published in subsequent editions of the "IESNA Lighting Handbook" with little modification and these guidelines were adopted by many lighting designers in the fallowing years. (Rea: 1993; Kaufman & Christensen: 1987; Kaufman & Haynes: 1981; Yücetaş: 1997, 17)

Studies of Smith (1989), Baron & Rea (1991) and Loe (1993) on the evaluation on the relation and the user performance in interior space draw similar conclusions to Flynn. They concluded that people reported more positive feelings under low illuminance level and warm light. Smith (1989) also concluded that as the illumination level on a surface increases the space looks more spacious. (Yücetaş: 1997, 17)

The research group at the Bartlett School of Architecture at University College London undertook a similar series of experiments in interior spaces, beginning concurrently with Flynn's work and using similar methodology. (Veitch: 2001, 124-140; Loe: 1993, 52-53) The Bartlett Group reported that perceptions of 18 lighting configurations for a windowless two-person office could be described along two independent dimensions: brightness and interest (derived by non-uniformity). The Bartlett Group has obtained similar findings in several separate studies and using a wider range of luminous conditions and settings than Flynn's group. These features strengthen the confidence in the brightness and uniformity dimensions of lighting appraisal. The experiments showed that people prefer higher illumination levels in interiors and the light pattern has a significant effect on how people feel about the interior space. (Veitch: 2001, 124-140)

In another study on the effects of light on the interpersonal communication and mood of the users in interior spaces, Gifford (1988) concluded that light level (brightness) have an effect on communication levels. According to his research findings, general communication occurred in brighter settings, and the demand for both general and intimate communications are greater in home-like dim lit settings. (Yücetaş: 1997, 20)

Veitch (2001) points out that the existing studies on the lighting of interior space indicates that people use luminance distributions as a basis for judgments about the appearance of space. The prevalent dimensions of these judgments appear to be brightness (intensity), and interest (variability).

Exterior Spaces: There are limited research and scientific knowledge about the effects of light on human beings in exterior space. Landscape architect Moyer stressed a set of relations between lighting and emotional reactions in his well-acknowledged book in 1992. Moyer (1992) systematized relations between perceived attributes of lighting (based on direction and brightness of light) and emotional reactions of people. According to Moyer (1992), the combination of the eye admitting light and the brain interpreting this visual information provides cues and direction to people at night and they create emotional reactions such as comfort, interest, pleasantness etc.

According to Moyer (1992) lighting design of an exterior space can direct how people see and feel about space by controlling the brightness introduced into the space. Controlling brightness can direct people's attention and movement through an exterior. The attention and interest of the viewer is drawn to the distant object, given that a softly lit object or area is placed in the front of the viewer and a more brightly lit object or area is placed farther into the space. If a person is heading toward an area with higher light level visible to the viewer from the outset, walking through a dimly lit area feels comfortable.

Moyer also stressed that level of light from one area to another too high contrasts introduces confusion in space. When two objects are lit as focal objects in an area the eye “bounces” from one to another, which results is an unpleasant spotty effect. This kind of light distributions might lead to the perception of gloom if they cause an adaptation shift from too bright to dark and then bright again. (Perry et al: 1987) Lighting feels comfortable when a lower fill light level between the objects provides a bridge from one object to the next. It is also stated by Moyer that people feel comfortable when they can see the boundaries of a space. The intensity of light is not the subject matter, for the feeling of comfort the edges of the space should be identified. Michel (1996) also states that seeing the boundaries of an area of an object is important for the perception since the outlines are seen first, than the eye scans the surfaces within outer contours.

2.1.1.2. Review on the Effects of Color

This section comprises the review of the effects of color on human beings and raises the issues of the effect of different colors (and light in different colors) on human beings, and the need of human beings for unity and complexity balance in the built environment.

Review on the effect of different colors on human beings reveals that people give similar emotional reactions to different colors. Many psychologists hypothesized that the relation between different colors and emotional reactions are resulted from cultural learning. However, cross-cultural studies and studies on humans at different age groups conclude that emotional reaction of people to the colors are more innate than learned. These studies also conclude that people give similar reactions and attributions to certain colors.

Review on unity and complexity balance concludes that senses of people should be moderately stimulated in the built-environment. Neutral environments, where stimulation of senses are below the moderate, have negative effects on people (such as high stress levels, restlessness, irritation, loss of concentration etc.) rather than neutral. Provision of stimulation by light and color, on the other hand, does not guarantee positive outcomes. A good balance of variety and contrast is required to obtain the favorable color and lighting effects for human beings in the built-environment.

Human beings are immediately, instinctively and emotionally moved when they are exposed to color. Every human being gives psychological reactions such as sympathy, antipathy, pleasure or disapproval as soon as he/she perceives a color or color combinations. (Mahnke: 1996, 6; Beer 1992, 11) Mahnke (1996) stresses that color, which is created by light, is a form of energy, and this energy affects body function, mind and emotion. Color affects cortical activation (brain waves); functions of the autonomic nervous system (which regulates the body's internal environment), and hormonal activity; and that color arouses definite emotional and aesthetic associations.

Birren (1969) points out that response to form seems to arouse intellectual processes, while reactions to color are more impulsive and emotional. Birren stresses that in classical experiments devised by Gestalt psychologists, the task of matching a green disk against an assortment of red disks and green triangles will readily be attempted on a basis of color by children. Adults will be hesitant and will point to the discrepancy. In this respect, the emotional effect of color is more prevalent in for small children in tasks as such, compared to adults where the form is prevalent. David Katz (quoted in Birren: 1969, 29) points out that color, rather than shape, is more closely related to emotion.

Effect of Different Colors on Human Beings: Freiling (quoted in Mahnke 1996, 39-40) presented the findings of a study on the psychological effects of colored light on human beings in 1990. The subjects of this study were asked to look into red, yellow, green, and blue light. Their comments were tape-recorded and presented in accordance with Wundt's "wind rose of emotions." The windrose separates emotions into the categories of arousing-calming, pleasant-unpleasant, tension-release. The findings of the research showed that all statements of the participants actually distributed themselves among all “wind rose” directions, indicating a balance. Major psychologic reactions of this study are as follows:

Red Light was found to be arousing, with blood pressure becoming inconstant, pulse increasing, and an unpleasant feeling of tightness gripping the throat. The dazzling glare was found unpleasant and produced headaches (one test subject asked for a discontinuation of the experiment after only two minutes). Pleasure components were not detected. Yellow Light was felt to be "mighty," "sunlike," with respect to the tension aspect. They stated that there was a vibration within the core. Calming and pleasant components were not detected. Violet-Blue Light was found to be pleasant. In regard to the calming effect, subjects pointed out that it was very restful; and the blue color was defined a good object for concentration. Unpleasant and arousing components were not found. Green Light was to be pleasant, agreeable, and in reference to the calming effect, more calming (in comparison to red). Subjects found it to have "something compelling."

The findings of Freilling's study reveals that red is a stimulating color and acts more like darkness, yellow is a tensing color but releasing at the same time, violet-blue increases the inner reactivation and ability to concentrate and leads to calm, and green stimulates similar to balanced and diffused light.

Mahnke (1996) stresses that psychological reactions of human beings to color is both innate and learned, but perhaps to greatest extent innate. Küller (1981) points out that, although emotional reactions to colors are claimed to be subjective, it is possible to find universal appeal in color application. Küller (1981) stresses that there has been a great number of cross-cultural studies comparing subjects with nationalities from North America, Europe, Africa and Middle East. In addition, according to Küller these studies compared different participant groups such as: men have been compared to woman, children to adults, layman to architects. Küller (1981) reaches to the conclusion that, either human beings learn the correct responses or there is an innate mood reaction to different colors.

Two same studies, one being conducted in United States and other in Europe between 1991 and 1993, also reveals that although people have different background and raised in different cultures can have common appeals on which emotions different colors are related with. The participants of the study carried out in United States came from US, Canada, Australia and Japan with ages ranging from 25 to 60. Participants of the study carried out in Europe came primarily from Germany, Austria, and Switzerland with ages ranging from 20 to 60. Participants asked to assign colors to the listed terms and they were encouraged to pick more than one color for every term. The findings of the studies are listed in the table below, with the highest combinations added together and consequently sums reaching above 100 per cent (Mahnke: 1996, 55-58)

Although these two participant groups come from different cultural groups, the results of these studies show striking similarities in the dominant color groups that are chosen by participants. The findings suggest that certain emotions are linked with certain colors or color combinations for the majority of the human beings regardless of their cultural background. Mahnke (1996) also emphasizes that the findings of these two studies correspond with the general selections made in color-psychology test on their associative-symbolic content.

Table 2.1. The Findings of Researches in Unites States and Europe

United States			**Europe**		
Term	**Colors Chosen**	**Percentage**	**Term**	**Colors Chosen**	**Percentage**
Love	Red, Red-Violet	81%	Love	Red, Red Violet	99%
Hatred	Black, Red	89.6%	Hatred	Black, Red	94%
Peace /Tranquility	Blue, Blue-Green, Green	93.6%	Peace /Tranquility	Blue, Green	98%
Mourning /Sorrow	Black, Gray	86%	Mourning /Sorrow	Black, Gray	106%
Happy	Yellow, Orange	63%	Happy	Yellow, Orange	105%
Jovial	Orange, Yellow	50%	Jovial	Orange, Yellow	68%
Life	Green	73%	Life	Green	68%
Luminous	Yellow	65%	Luminous	Yellow	62%
Noble	Blue, Blue-Violet, Violet	81%	Noble	Violet, Red-Violet, Blue	82%

Source: Mahnke, Frank H. (1996). "Color, Environment, and Human Response: An Interdisciplinary Understanding of Color and Its Use as a Beneficial Element in the Design of the Architectural Environment", John Wiley and Sons

Birren (1969) also stresses that many psychologists have hypothesized the cultural learning as the main reason underneath the psychological reaction of human beings to different colors. However working with infants proves that psychological reactions to colors might not be learned behaviors. Josephine M. Smith (quoted in Birren: 1969, 18) worked on the effects of different colors on infants, who obviously had no prior experience with color, and she noted that blue light tended to lessen activity and crying. Another research carried out by Ataöv (1998) found that the preference of 9 to 11 years old children increased with the prominence of clear and bright colors, but decreased with unclear, dark, and extinct colors. These findings also corresponds with the findings of the studies reviewed in this section, and further studies with infants may help reveal whether the psychological reactions to different colors are extensively innate or learned trough society.

Unity and Complexity Balance: Human beings require a balance of unity and complexity in their environment in terms of light and color. Birren (1983) stresses that people expect all of their senses to be moderately stimulated at all times in the built-environment. Birren states that for human beings, this moderate stimulation is a natural need, and this is what happens in the nature itself. Mahnke states that people commonly consider white and neutral environment as are neutral in their psychological effects on people. However, research reveals that lack of complexity is not preferable for human beings and they result in adverse psychological reactions. On the contrary, Ellinger (1963) points out that human beings tend to get easily confused when they are subjected to visual stimuli. According to Ellinger, disorder occasioned by unrestrained diversity can be emotionally repellent and human beings have a limited tolerance for diversity. There should be a balance of unity and complexity in the built-environment with reference to color and light. This also applies to other variables of the environment such as temperature and sound. The natural condition is the balance of changing variables and unnatural condition is one that is static. Therefore, the variety and balance are needed substance of human life. (Birren 1983, 167)

In order to discover the effects of unity and complexity on human beings in built-environment, Küller (1981) conducted an experiment on the effects of two opposite environments. For three hours, six men and six women were placed in two rooms that had different visual complexity and visual unity. One of the environments was a room which was gray and sterile; the other, colorful and diversified. The experiment demonstrated that the coloring and visual patterning of a space has a profound effect on physiological and psychological levels.

The findings of the Küller (1981) revealed that the chaotic visual impact in the more complex and colorful room made the subjects feel silent and subdued. The alpha brain-wave activity, which is higher when human beings are in a more alert condition, was lower in the complex room. The subject's electrocardiogram, showing heart rate, was slower in the more colorful room than in the gray room, which Küller explains "is in agreement with the hypothesis of Lacey, Kagan, Lacey, and Moss, 1963, i.e., intense attention might be accompanied by cardiac deceleration." The subjects in the grey room had higher stress levels. (Küller: 1981, 101) According to Mahnke (1996), the findings of this study suggests that human beings who are subjected to understimulation show symptoms of restlessness, excessive emotional response, difficulty in concentration, irritation, and in some cases, a variety of more extreme reactions.

Within this perspective, Vernon (quoted in Birren 1969, p. 28) points out that human beings can maintain normal consciousness, perception and thought only in a constantly changing environment. When there is no change, a state of "sensory deprivation" occurs; the capacity of adults to concentrate deteriorates, attention fluctuates and lapses and normal perception fades. Mahnke (1996) stresses that in the total environment there must be colors in changing degrees of lightness (light and dark), temperature (warm and cool), and intensity (strong and weak), and the complementary of the dominant color should be present to some extent.

While psychological stimulation is provided by light and color in the built-environment, stimulation might not assure the positive emotional reactions. According to Birren (1969) stimulation by itself does not compose the whole reaction. Mahnke states that (1996) how the light and color used makes a difference in built environments that serve a specific function. However, the use of color does not work through the method of trying to create a stimulus that only calls forth a physiological reaction of some type.

Favorable color and lighting effects for human beings in the built-environment depend on variety and contrast, considering that a good balance of these variables is provided. Crewdson (1953) states that balance secures the unity in the midst of variety. Both variety and unity are necessary to sustain interest, and these opposing forces must be balanced. Variety is necessary to attract and arouse interest; and unity is essential to create a favorable impression and to satisfy the moods and desires of human beings. When variety is overdone the environment becomes confusing and unpleasant; on the other hand, when unity is overdone it is monotonous.

2.1.2. Urban Life: The Effects of Light on Crime Prevention

In this section I categorized the findings on the effect of light on crime prevention under two categories: review of relations between lighting and crime prevention and review of the previous studies. The first section concludes that lighting has positive effects on reducing the crime rates. Ligthing reduce the crime by psychally improving the space and increasing the visibility, hence decreasing the opportunities for criminal acts. Improving the environmental quality of the streets through street lighting also strengthens community confidence, cohesion and social control which boost the informal survailence. On the other hand, efficient street lighting reduces the fear of crime, which human beings tend to feel disproportionately higher than normal with regards to their actual chances of being victimized. The second part reviewes the significant studies carried out since the 1970s in United Kingdom and North America on the effects of street lighting in crime prevention. This subsection concludes that efficient street lighting is a feasible, inexpensive and effective method of reducing crime.

The term crime prevention is generally defined as the attempt to deter crime and reduce victimization. Brantingham and Faust (1976) make a useful definition of types of crime prevention as primary, secondary and tertiary. Primary prevention refers to reducing opportunities for crime without reference to the individuals who commit it. Secondary prevention refers to measures that aim to prevent risk carrying individuals from committing a crime. Tertiary prevention refers to preventing further criminal behavior by those who have already offended. Street and public space lighting, or so-called security lighting, falls under the category of primary crime prevention measure. Lighting has been considered as an effective crime prevention measure and its effectiveness is studied since the begging of the 1970ies. (Farrington&Welsh: 2002, 1) Review of the existing researches reveals that improved street lighting has positive effects on decreasing the crime rates. Moreover, the lighting is effective in reducing the fear of crime and increasing the comfort in the public space.

2.1.2.1. Relation of Lighting and Crime Prevention in Literature

Street lighting enhances the visibility, contributes to the social surveillance, reduces the fear of crime and decreases the criminal opportunities (Farrington&Welsh: 2002, 5). Clark (1995) points out that crime prevention can be sustained and opportunities of crime can be reduced through modification of the physical environment. Street lighting constitutes a tangible alteration to the built environment but it does not constitute a physical barrier to crime. However, it can reduce crime through a change in the perceptions, attitudes and behavior of residents and potential offenders (Farrington&Welsh: 2002, 5).

Primary crime prevention can be acquired through physical improvement of the built-environment. Increased visibility in the urban-environment at night strengthens informal social control; and less crime would be committed in areas with an abundance of potential witnesses (Jacobs, 1961; Angel, 1968). Enhanced visibility and increased street usage may interact to heighten possibilities for informal surveillance. Pedestrian density and flow and surveillance have long been regarded as crucial for crime control since they can influence potential offenders' perceptions of the likely risks of being caught (Newman, 1972; Bennett and Wright, 1984).

On the other hand, improving the environmental quality of the streets through street lighting strengthens community confidence, cohesion and social control (Wilson and Kelling, 1982; Skogan, 1990). As a highly visible sign of positive investment, improved street lighting might reduce crime if it physically improved the environment and signaled to residents that efforts were being made to invest in and improve their neighborhood. In turn, this might lead them to have a more positive image of the area and increased community pride, optimism and cohesion (Farrington&Welsh: 2002, 5).

Improved illumination may reduce fear of crime because it physically improves the environment and alters public perceptions of the public space. People tend to have a fear of crime that is disproportionate compared to their actual chances of being victimized; this exaggeration is actually greatest amongst those who are least likely to become victims (Putwain: 2002, 25-26) Improving the physical conditions contributes to reducing of fear of crime since People sense that a well-lit environment is less dangerous than one that is dark (Warr: 1990, 891-907). The positive image of the night-time environment in the relit area is shared by residents and pedestrians. As actual and perceived risks of victimization lessen, the area becomes used by a wider cross-section of the community. The changed social mix and activity patterns within the locality reduce the risk and fear of crime (Farrington&Welsh: 2002, 5).

Finally, the renovation of a highly noticeable component of the physical environment combined with changed social dynamics may act as a psychological deterrent for the possible offenders (Farrington&Welsh: 2002, 5). Potential offenders may judge that the image of the location is improving and that social control, order, and surveillance have increased (Taylor&Gottfredson: 1986, 387). Crime in the illuminated or re-lit location becomes riskier and this can influence behavior in two ways. First, potential offenders living in the area will be deterred from committing offences or escalating their activities. Second, potential offenders from outside the area will be deterred from entering it (Wilson&Kelling: 1982, 29-38). However, lighting does not eliminate the crimes but generally displace it from the illuminated or re-lit area to other places (Farrington&Welsh: 2002, 6; Repetto: 1976, 166-177).

2.1.2.2. Review of the Previous Studies

In this section I present the review of scientific researches carried out in United Kingdom and North America so as to present the relation of lighting and crime prevention.

Although there have been several studies on the effects of lighting on crime prevention, certain studies which were carried out in United Kingdom and North America have established the consensus on this topic since the late 1970s. (Farrington&Welsh: 2002, 1-6; Pease: 1999, 4; Painter: 1996, 318) This section aims to review these studies so as to reveal the effects of lighting on crime prevention. In this respect, this section critically reviews the studies of Tien at al. (1979), Atkins et al. (1991), Pease (1999) and Farrington & Welsh (2002) in chronological order and with reference to the researchers.

The interest in investigating the effects of street lighting on crime began in North America during the dramatic rise in crime which took place in the 1960s. (Farrington&Welsh: 2002, 1) Many towns and cities of North America established major street lighting programs so as to reduce crime, and initial results were encouraging (Wright et al., 1974). The increase in the number and the scope of the projects across North America led to a detailed review of the effects of street lighting on crime funded by LEAA (Law Enforcement Assistance Agency of USA), and carried out by Tien *et al.* (Farrington&Welsh: 2002, 1)

The review of Tien and his colleagues scanned 103 street lighting projects originally identified, and reached a final sample of only 15, which were considered by the review team to contain sufficiently rigorous evaluative information. With regards to the impact of street lighting on crime, Tien et al. (1979) concludes that the results are mixed and generally inconclusive. The review considers each project to be seriously flawed due to their weak project designs; misuse or complete absence of sound analytic techniques; inadequate measures of street lighting; poor measures of crime; and insufficient appreciation of the impact of lighting on different types of crime. According to Painter (1996) and Farrington&Welsh (2002) instead of encouraging better researches on the effects of lighting on crime prevention, the results of the Tien et al. (1979) review was interpreted as showing that street lighting had no effect on crime and, in turn, killed research on the topic in the United States.

In the United Kingdom, very little research was carried out until 1980ies, most of which concluded that disorder and fear of crime declined and pedestrian street use increased dramatically after the lighting improvements (Fleming and Burrows, 1986; Farrington&Welsh: 2002, 2). In contrast to these generally positive results, the review of Atkins et al. (1991), which was funded by the Home Office of United Kingdom, presents an opposing view to the positive effects of lighting of public space in crime prevention. In 1985 the London Borough of Wandsworth commenced a program to re-light the complete borough to a very high standard, partly with the aim of crime prevention. Atkins and his colleagues (1991) carried out a study that investigated the effect of street lighting on crime prevention in this area. As a result of this study, Atkins et al (1991) stresses that no evidence could be found to support the hypothesis that improved street lighting reduces reported crime. According to Atkins et al. (1991) although some areas and some crime types did showed reductions in night-time crime relative to the daylight control, the dominant overall pattern was of no significant change. Although Atkins and his colleagues (1991) claim that lighting of public space is not an effective crime prevention measure, they point out that the perceived safety of women walking alone after dark in the re-lit areas improve. Moreover, the reaction of residents to the re-lighting scheme is overwhelmingly favorable. It was concluded by Atkins et al. (1991) that street lighting was welcomed by the public and provided reassurance to some people who were fearful in their use of public space

However, as further evidence accumulated, there were more signs that improved street lighting could have an effect in reducing crime. (Farrington&Welsh: 2002, 2) According to Pease (1999), the findings of Atkins and his colleagues were left unchallenged and remained as a dominant view until the end of 1990ies. In his publication which reviews the previous studies until 1998, Pease (1999) states that previous researches remain skeptical about the effects of lighting on crime prevention. Pease (1999) stresses that the study of Atkins et al. (1991) reduced complex material on effects of light on crime prevention to a few simple observations and reached oversimplified conclusions. Pease (1999) also stresses that review of Atkins et al. (1991) later cited as inimical to the cause of lighting as a crime reduction measure.

In his review report of the previous studies until 1998, Pease (1999) draws the conclusions that precisely targeted increases in street lighting generally have crime reduction consequences. The improvement of lighting in such specific locations, which are the scenes of repeated crime, generally reduce reported crime. Moreover, Pease (1999) points out that crime prevention by street lighting generally make residents less fearful of crime or more confident of their own safety at night. On the other hand Pease reports that more general increases in street lighting have crime prevention effects, yet this outcome is not universal.

A more recent study, carried out by Farrington and Welsh in 2002, reviewed USA and UK researches. This study concludes that improvements in street lighting offer a cost-effective crime reduction measure and should be considered an important element in situational crime reduction programs.

Farrington and Welsh (2002) eliminated the existing researches up to the date, and reviewed the researches from USA and UK which provided that; the main intervention was lighting, there was at least one experimental area and one control area, there were before and after measures of crime, and the total number of crimes in each area before the intervention was at least 20. Within this definition, sixteen potentially relevant studies were screened but excluded for various reasons, including the lack of a comparable control condition, no outcome measurement of crime and too small numbers. Eight American evaluation studies and five -more recent- British studies met the criteria for inclusion in the review.

Unlike the British studies, only half of the American researches gave positive results on the effect of lighting on crime prevention. Four of these studies found that improved street lighting was effective in reducing crime, while the other four found that it was not effective. A meta-analysis found that the 8 studies, taken together, showed that improved street lighting led to a near-significant 7 per cent decrease in crime. The review of British cases showed that lighting was effective in crime prevention. Improved lighting in British cases led to a significant 30 per cent decrease in crime. Meta-analysis of the review or American researches is presented in Table 2.1, and British in Table 2.2. The odds ratio of meta-analysis displayed in the tables indicates the proportional change in crime in the control area compared with the experimental area. An odds ratio greater than 1.0 indicates a desirable effect of improved lighting, while an odds ratio less than 1.0 indicates an undesirable effect.

Table 2.2. Meta-analysis of American Street Lighting Evaluations (odds ratios)

Location, Date	Context of Intervention	Odd Ratios	Conclusion
1. Atlanta (1974)	City Centre	1.39	Effective
2. Milwaukee (1973,1974)	Residential and Commercial Area	1.37	Effective
3. Portland (1974)	Residential Neighborhood	0.94	Not Effective
4. Kansas City (1974)	Residential and Commercial Areas	1.24	Effective
5. Harrisburg (1976)	Residential Neighborhood	1.02	Not Effective
6. New Orleans (1977)	Residential and Commercial Areas	1.01	Not Effective
7. Fort Worth (1979)	Residential Neighborhood	1.38	Effective
8. Indianapolis (1998)	Residential Neighborhood	0.75	Not Effective
Total		**1.08**	

Source: Farrington, David P. & Welsh, Brandon C. (2002), "Effects of improved street lighting on crime: a systematic review", Home Office Research Study 251, Development and Statistics Directorate, UK

Table 2.3. Meta-analysis of United Kingdom Street Lighting Evaluations (odds ratios)

Location, Date	Context of Intervention	Odd Ratios	Conclusion
1. Dover (P)	Parking Garage (in town centre)	1.14	Effective
2. Bristol	Residential Neighborhood	1.35	Effective
3. Birmingham (P)	City-centre Market	3.82	Effective
4. Dudley	Local Authority Housing Estate	1.44	Effective
5. Stoke-on-Trent	Local Authority Housing Estate	1.72	Effective
Total		**1.42**	
Total		**1.25**	

Source: ibid. Table 2.2

The eight American studies could be divided into two blocks of four, one block showing that crime reduced after improved street lighting and the other block showing that it did not. The odds ratios confirm that total crimes reduced significantly after improved street lighting in Atlanta, Milwaukee, Kansas City and Forthworth. The lighting effort for crime prevention did not have a significant effect for the other four locations and research could not provide a sound explanation for the ineffectiveness of lighting in crime prevention in these areas. The more recent British studies agree in showing that improved lighting reduces crime. Combining the eight American and five British studies, crimes decreased by 20 per cent in experimental areas compared with control areas. This percentage confirms the conclusion of Farrington and Welsh that improved lighting has a significant effect on crime prevention.

As a result of this study it is concluded by Farrington & Welsh (2002) that majority of the results suggests improved street lighting is followed by a decrease in crime. Farrington & Welsh (2002) points out that improved lighting should be included as one element of a primary crime reduction program. Lighting of public space and streets is an inclusive intervention benefiting the whole of a neighborhood and leads to an increase in perceived public safety. Therefore, improved street lighting is associated with greater use of public space and neighborhood streets by law abiding citizens. Especially if well targeted to a high-crime area, improved street lighting can be a feasible, inexpensive and effective method of reducing crime.

2.1.3. Environmental: The Effects of Light on Air Pollution

This section focuses on the aspects of the light pollution problem with respect to the urban life and people's experience of nighttime urban environment. Light pollution, or luminous pollution, is an environmental problem and the term is used to describe the air pollution resulting from the undesired effects of artificial lighting in the urban environment. Direction of the light source, shielding of the lighting fixture, intensity of the light source and the general lighting composition of the urban area may result in light pollution. (NLPIP: 2008) Light pollution has negative effects on the ecology since it disturbs the rhythm of life of plants and animals by interrupting their biological clocks and creating microclimates. (Moyer: 1992, P; vanSanten: 2006, 116; Yavuz: 2004, 79) On the other hand, ineffective use of lighting results in high energy cost and ineffective use of energy sources. (NLPIP: 2008, ILE: 2008, Yavuz: 2004, 79) Light pollution also has negative effects on the observation of the celestial objects and hinders the astronomical studies. (IDA: 2008) Nevertheless, light pollution has negative effects on the urban environment since it reduces the quality of the living environment. (Çam: 2004, 17; vanSanten: 2006, 122) In this respect, this section focuses on the aspects of light pollution that has negative outcomes on urban life, which are sky glow, glare and light trespass.

Research reveals that artificial lighting that is emitted skywards results in the brightening of the sky, which is called sky glow. Sky glow has negative outcomes for people such as reducing the ability to experience the natural view of the sky and decreasing the contrast of light and darkness, in turn, decreases the visual quality and legibility of the nocturnal urban landscape. Glare is a visual sensation which causes visual discomfort, reduction of visibility, and annoyance. Glare is casued by excessive and uncontrolled brightness. Light trespass is defined as the cast of light in unwanted and unneeded directions and it results in discomfort.

2.1.3.1. Sky Glow

Sky glow is an effect of light pollution which is the brightening of the sky caused by artificial lighting. Light that is either emitted directly upward by luminaires or reflected from the ground is scattered by dust and gas molecules in the atmosphere, producing a luminous background. (NLPIP: 2008) It has the effect of reducing one's ability to view the stars and it decreases the natural contrast of the dark and light in the urban environment. (Phillips: 2004, 12) Without air pollution, sky glow would not be observable. Sky glow is highly variable depending on immediate weather conditions, quantity of dust and gas in the atmosphere, amount of light directed skyward, and the direction from which it is viewed. (NLPIP: 2008; Narboni: 2004, 116) If the terrestrial air were perfectly clear, given its immaterial nature light would simply pass through it. In poor weather conditions, more particles are present in the atmosphere to scatter the upward-bound light, so sky glow becomes a very visible effect of wasted light and wasted energy. (NLPIP: 2008) Narboni (2004) reports that the light diffused by the Parisian metropolis is visible from 150km distant owing to the combination of air pollution, high level of illumination and escaping light skywards.

The sky glow is generally considered as a concern for the astronomers because it reduces their ability to view celestial objects. (IDA: 2008) Sky glow increases the brightness of the dark areas of the sky, which reduces the contrast of stars or other celestial objects against the dark sky background. This loss of contrast reduces the effective use of observatories situated in urban regions. Several initiatives today, such as UNESCO, CPCN (Centre pour la Protection du Ciel Nocturne), ADEME (Agence De l'Environnement et de la Maftrise de l'Energie), IDA (The International Dark Sky Association) and ILE (The Institution of Lighting Engineers), aim at reducing the negative effects of lighting by promoting the introduction of laws and regulations that controls the lighting fixtures occupied in the lighting of urban exterior.

Controlling the direction of the lighting and reducing the light intensity to an efficient level are key elements for minimizing the sky glow. Direction of the light is mostly debated as the best solution to prevent sky glow. The use of full cut-off lighting fixtures which focus the light only on the area that is needed, decreases the majority of the light that escape skywards (NLPIP: 2008). In this subject matter, vanSanten (2006), ILE (2008, NLPIP (2008) and FGL (1993) presents regulations that minimize the escape of light to unwanted directions. Vertical surfaces, such as building façades are recommended to be lit downwards whenever possible (see Figure 2.1a). Downwards directed light minimizes the escape of light skywards. On the other hand, light sources which are directed downwards should also be designed to minimize the spill of light near to and above the horizontal. Downwards lighting should enable the illumination of the desired area, either vertical or the horizontal surface or the both, and should avoid excessive angling of the fixtures (see Figure 2.1b). If the downward lighting is not possible, upwards lighting should be used carefully; light flow should be aimed onto the surface to minimize the loss of light by light reflectors, screens and asymmetrical optics. For street and public space lighting, fixtures should avoid loss of light by using reflectors or reflecting louvers (see figure 2.1c). Especially in street lighting use of drop-lens lighting fixtures should be avoided and flat-lens fixtures should be introduced (see Figure 2.1d).

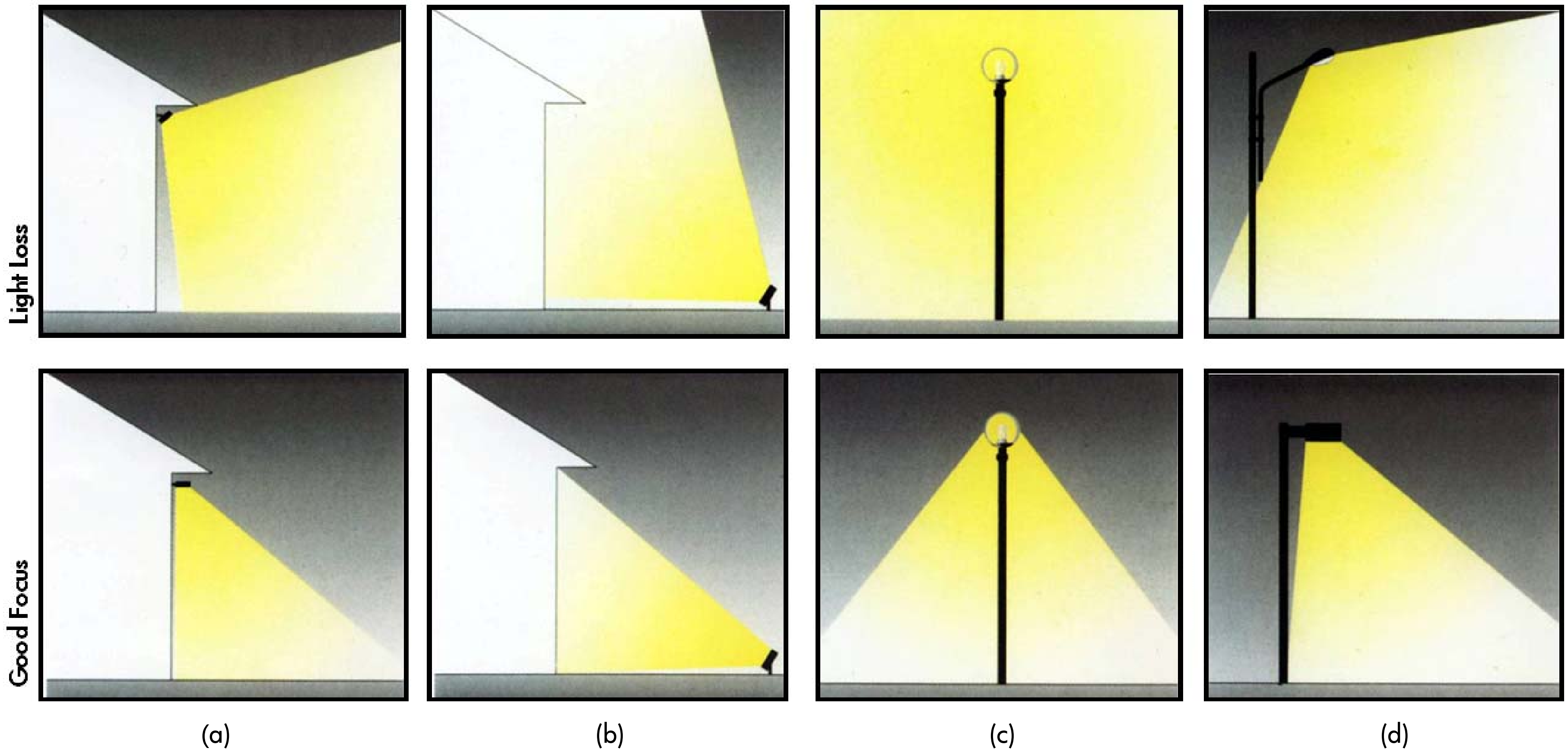


Figure 2.1. Schemas of Light Loss and Good Focus
(a) Downwards Lighting, (b) Upwards Lighting, (c) Opaque Globes, (d) Street Lighting
Source: vanSANTEN, Christa (2006); *"Light Zone City",* Brikhauser – Publishers for Architecture, Basel, Switzerland, p123)

2.1.3.2. Glare

Glare is a visual sensation caused by excessive and uncontrolled brightness. Glare can be defined as the most serious form of light pollution and can cause a general visual discomfort, which can seriously impair vision with poorly designed lighting installations. The impact of glare is dependent upon the quantities and directional nature of the glare source, on the physiological status and age of the person affected, the general nature of the area in which the glare effects occur, and the surrounding levels of ambient lighting. (SSSE: 2007, 6) Glare is subjective and sensitivity to glare can vary widely. Older people are usually more sensitive to glare due to the aging characteristics of the eye. (NLPIP: 2008)

The effect of glare can be divided to two categories: disability glare and discomfort glare. Disability glare is the reduction in visibility caused by intense light sources in the field of view, while discomfort glare is the sensation of annoyance or even pain induced by overly bright sources (NLPIP: 2008). The effect of glare, as viewed by an external observer, can be controlled by limiting the viewed intensity. This control can either be done by shielding the light source or decreasing the intensity of the light source. How the light sources can be shielded is briefly discussed above. The same principals also apply for the prevention of glare since most of the glare in the urban environment is caused by obtrusive light. Reducing the light intensity as an overall intervention or dimming the lights when the intensity is not needed serve greatly to prevention of glare. Reducing the flickering advertisement lighting and controlling the security lighting that direct to the human beings also has positive effects in glare prevention (vanSanten: 2006, 122, ILE: 2008).

According to Narboni (2006), the effects of shielding and use of reflectors to prevent glare and light pollution is relatively overemphasized compared to the control of the overall light intensity. The role of the intensity of light in glare is at least as significant as direction and focusing. Narboni (2006) states that today, manufacturers have made real progress in optic technology, diffusers and refractors, and thus in the control of luminous flux emitted by equipment. However, light pollution and glare problems are becoming more acute in spite of the efforts to focus the light. Narboni (2006) points out that the installation of reflectors and louvers on street lighting fixtures would have a counter effect, resulting in directing the totality of the luminous flux towards the ground, thus reinforcing luminous diffusion towards the sky, instead of reducing it. According to Narboni (2006) directing the light downwards can not be an effective solution all by itself. In order to minimize the glare problem unnecessary light intensity should be reduced and number of lighting fixtures should be minimized to an efficient level. (Narboni: 2006, 118) Minimizing the excessive light intensity is a cost-efficient solution. Furthermore, reducing the unnecessary lighting intensity and lighting fixtures also reduces the discomforting luminous cacophony.

2.1.3.3. Light Trespass

Light trespass is light being cast where it is not wanted or needed, such as light from a streetlight or a floodlight that illuminates a residential unit and making it uncomfortable for the use of indoors. Light trespass is a subjective aspect since it is not easily defined when, where, and how much light is unwanted. However the most common example of light trespass is the light entering the residential dwellings from road lighting, sports lighting or floodlighting of buildings. (NLPIP: 2008)

The general suggestions provided by the IESNA (1999, Illuminating Engineering Society of North America) provide a set of precautions to prevent light trespass. The key element of prevention is minimizing the spill light onto adjacent properties. Lighting fixtures that control the intensity distribution and that are well-shielded diminish the light spill. Keeping floodlight aiming angles low also works effectively since the entire beam falls within the intended lighted area.

2.2. LIGHTING OF THE URBAN SECTIONS AND ITS PSYCHOLOGICAL EFFECTS ON PEOPLE

Review of scientific inquiries and design applications show that lighting is dealt with respect to various aspects and for various urban sections. In this study, I grouped the lighting aspects in two categories. These categories of aspects of lighting are 'luminous composition' and 'overall composition'. Review also shows that lighting becomes significant in various sections of the public space. In this study I categorized the public space under four urban sections including (1) buldings, (2) raods and pathways, (3) pedestrian areas and squares, and finally (4) parks and landscape elements. The section of 'buildings' consists of lighting of the façade and the immediate surroundings of the buildings that shape the public space. In that sense, buildings are seen as a part of the public space and lighting of this urban section is reviewed in that extend. This section will introduce these lighting aspect groups and will systematize the relationship between these indicators and different urban sections. Nevertheless, this review section will extract the relations between these various aspects of lighting and people's psychological responses to them.

Moyer (1992) stresses that light has the capability to create shape, emotional response, even a new reality to a familiar space through the use of compositions. Luminous composition consists of the organization of lighting element using one or more design principals. Light can shape how a space is viewed. Light also introduces emotional qualities to the space such as romance, mystery, drama and excitement. Light sculpts the focal object by emphasizing specific aspects of the urban environment or altering the daytime appearance. Absence of light as well can create a part of the luminous composition. Three lighting elements control the effects of the luminous composition: direction, intensity and color of light. In this study, indicators and effects of luminous compositions will be reviewed and discussed under these three categories. (Moyer: 1992, 21-247)

The combination of the lit elements with each other and with the urban environment pictures the overall composition of the urban lighting. Overall composition of lighting creates lighting effects in a larger scale than the luminious composition focuses. This aspect of lighting raises the issues of how the location and different views affect experience of people; how the relation of daytime and nighttime appearance affect the perception; and how the appearance and placement of lighting eqiupments affect the appearance of the structure; how the level of light affects the light pollution; and how the lighting affects the fear of crime. The review of these issues applies to specific urban sections, and every urban section has a different focus in the overall composition.

Location of the illuminated element affects the lighting effect created since the location of the urban element determines the perceivability and also its significance in the overall composition. Lighting design seeks to establish a priority of importance of the views of an urban scene. (Phillips: 2002, 17) The relation of daytime and nighttime appearance of the urban elements affects how people experience an urban element/section. Lighting efforts should not create a completely different image because it can jeopardize their orientation. The appearance of the lighting equipment, the luminaires during the daytime is also important in the relation of daytime and nighttime appearance. Lighting design of the urban environment should not compromise the daytime appearance. (Phillips: 2002, 16) Lighting pollution is a result of excessive lighting and lighting effect would be preferable and pleasant if the illuminated elements fit in the existing atmosphere by either creating harmony or creating contrast. Research reveals that fear of crime can exist altough the crime rates are low. The knowledge of the spatial environment decreases the fear of crime. The overall lighting composition of an urban section can reduce the fear of crime and, in turn, it can increase the comfort.

Brief Summary of Findings: In this part I present the brief summary of the findings of this section. I will present the percieved attributes and related emotional appraisals specific to each urban section. Then, I will present the major commonalities and differences.

Literature review reveals that there are several perceived attributes of light in lighting of all four urban sections. The attributes that are brought out in this review for lighting of the buildings are: brightness/shadowing, coherence, contrast, distribution of light, legibility, variety of color, novelty and harmony. The attributes that are brought out for lighting of the roads and pathways are legibility, contrast, brightness/intensity, distribution of light and orientation. The attributes that are brought out for lighting of the pedestrian areas and squares are brightness, sufficiency of light, softness, distribution and direction of light, color and legibility. The attributes of the urban parks that this review brings out are brightness, shadowing, distribution of light, color and legibility.

The literature review reveal that there are certain commonalities amongst the perceived attributes of these urban sections in spite of some minor differences. Findings of this section shows that every urban section has a specific focus on these mentioned common perceived attributes. Their significance in how people experience the urban lit environment varies depending on the urban section. However, there common attributes for all four section than specific ones. I extracted those certain attributes that are common for all four urban sections. These common attributes are (1) brightness, (2) contrast, (3) distribution of light, (4) legibility and (5) color.

The review also reveals that people's reaction to the perceived attributes of lighting have commonalities. Emotional appraisals for the perceived attributes of light in lighting of buildings are stated as Lik, dislike, interest, comfort, and discomfort in literature. For roads and pathways, these emotional appearals are safety, fear, anxiety, confusion, discomfort and interest. For pedestrian areas and squares these emotional appearals are safety/security, distraction, discomfort, interest, like, dislike. For urban parks these emotional appreasals are comfort, discomfort, interest, dislike, like, fear and security. I extracted four common emotional appraisals in this review and these are: (1) liking, (2) interest, (3) comfort and (4) safety.

2.2.1. Buildings

Buildings are the most significant masses in the built environment. Their appearance during the night dominates the urban nocturnal scene of the cities. They have significant role of people's perception of the space at night since they create the nocturnal landmarks of the city. Therefore, lighting of buildings has always been a component of urban life. Even before the invention of artificial light sources, buildings were illuminated for functional and aesthetic reasons. The historic illustrations of cities display that buildings were illuminated with natural light sources such as candles, torches and gas lamps for special events and festivals in the past (van Santen: 2006, 70).

This study is limited in its attention to the interior architectural lighting discussion of buildings and focuses on the building façade lighting which has a significant effect in the urban context. The major findings on the principals of lighting of building include (vanSanten: 2006, 78; Moyer: 1992, 245-250; Phillips: 2004, 15-45): (1) The characteristic features of the architecture are valuable for lighting; (2) Uniformity and cohesive image should be preserved and no distraction should be caused by illumination of details; (3) Perceivability of three-dimensional shape of buildings is a valuable asset and it should be preserved at night; (4) Lighting of buildings should be integrated and it should be moderate, otherwise relationship with the environment is disturbed; (5) If the use of colored light is overdone, it creates an undermining and unnatural lighting effect, which becomes the aim itself instead of accentuation of the architecture; (6) Lighting fixtures and sources should be concealed and the operation of lighting should never be distracting.

This section critically reviews these principals and seeks to systematize the perceived attributes of building lighting and emotional reactions that people give. The table below summarizes the findings of this section.

Table 2.4. List of Perceived Attributes and Emotional Reactions for Lighting of Buildings

	Perceived Attributes	Emotional Reactions	Source
Luminous Composition, Intensity	Order of brightness Uniformity, cohesive image	-	Moyer: 1992, 248 vanSanten: 2006, 52
	1:10 ratio of illuminance between surfaces	Pleasantness	vanSanten:2006, 53
	Partial glare & Dark areas Large contrasts, and fragmentated view	Unpleasantness/Distraction (too bright surfaces takes immediate attention)	vanSanten: 2006, 52
Luminous Composition, Direction	Floodlighting - Flattening effect and shadowlessness Even Distribution of Light, Strong shape Appearance similar to daytime look	Interest	vanSanten: 2006, 75 Moyer: 1992, 248
	Floodlighting - Excessive flattening Inconsistent reflections/Lack of Reflections	Disliking	vanSanten: 2006, 70
	Floodlighting - Unrecognizable appearance Loss of background immediate attention to lit building	-	vanSanten: 2006, 74 Moyer: 1992, 248
	Grazing – Emphasized texture Strong shadows Pattern of Scallops on a plain surface	Interest	Moyer: 1992, 248
	Grazing - Emphasized texture Emphasized imperfections on the façade	- (Drawing attention to negative aspects)	Moyer: 1992, 248
	Interior Lighting – Dramaticness Accentuation of depth	Interest (Draws attention)	Maile: 2006, 35 Moyer: 1992, 249
	Outlining - Unperceivable three-dimensional shape	-	Schimpf: 2006, 71

Table 2.4. List of Perceived Attributes and Emotional Reactions for Lighting of Buildings (continued)

	Perceived Attributes	Emotional Reactions	Source
Luminous Composition, Color	Use of colored light – Accentuation Depth	Interest	Moyer: 1992, 250
	Use of pastel colors – Harmonious appearance with the environment	Pleasantness	Moyer: 1992, 250
	Excessive variety and intensity of colored light Theatrical effect	Disliking/Unpleasantness (disturbing)	Phillips: 2004, 18
Overall Composition, Location and Different Views	Integration to the overall nocturnal landscape Aesthetic appearance	Comfort	Moyer: 1992, 245
	Unblocked vista - Percievability of lighting effect	Interest (takes attention)	Phillips: 2004, 16
	Incoherency with its lit environment Glare	Unpleasantness Discomfort	Moyer: 1992, 245 Phillips: 2004, 17
Overall Composition, Relation between Daytime-Nighttime	Experiencing the same structure with a new aesthetic emphasis at night	-	Phillips: 2004, 16 Moyer: 1992, 21
	Creation of an entirely new appearance	-	Phillips: 2004, 16 Schanda: 2001, 3
Overall Composition, Lighting Equipments	Ill-considered locations Obtrusive and disharmonious lighting equipments	Unpleasantness	vanSanten: 2006, 78 Moyer: 1992, 71

Luminous Composition, Intensity: Moyer (1992) stresses that intensity of light is used to balance the importance of the various parts of a building as well as the rest of the site. Effect of lighting is expected to display an order of brightness planned according to the rank of importance of the façades and parts of a building. Planned pattern of brightness needs to complement the building and create a cohesive image.

According to Van Santen, there is no imperative that every surface on the building should be lit evenly. On the contrary, it is the combination of light and dark sections that allows forms to be shown to their best advantage. Uniformity of the lit object should be aimed because large contrasts fragment the architecture. Large contrasts resulting from uncohesive intensity of light creates an unpleasant appearance. Research shows that, the ratio of illuminance for a pleasant appearance should be 1:10. (vanSanten: 2006, 53) The building in the Figure 2.2 is the Dome des Invalides of Paris. The light is distributed uniformly on the structure. Differences on the surfaces help the three-dimensional perception of the building and luminance values of differently lit objects do not exceed 1:10 ratio. (vanSanten: 2006, 53)

Figure 2.2. Dome des Invalides, Paris
Source: vanSANTEN, Christa (2006); "Light Zone City", Brikhauser – Publishers for Architecture, Basel, Switzerland, p66)

As stated above, if not planned correctly, lighting creates undesirable effects such as partial glare and undesirable dark areas on the surfaces of buildings. The photographs below display the undesirable effects that might be created by excessive direct lighting. The building in the photograph below is the French Church of Berlin. The figures indicate the level of luminance. It can be seen that from one surface to another, luminance jumps from 1 cd/m² to 26 cd/m², and than to 2,6 cd/m². This type of difference is undesirable since the bright surfaces draws immediate attention and the rest of the structure is lost in the background. (vanSanten: 2006, 52)

Figure 2.3. French Church, Berlin
Source: vanSANTEN, Christa (2006); *"Light Zone City"*, Brikhauser – Publishers for Architecture, Basel, Switzerland, p52

Luminous Composition, Direction: Direction of light affects the appearance of texture, shadows and highlights. This tool can emphasize the three-dimensional aspects of a building or add depth to the view of the building. Considering the direction of light, lighting methods of building façade lighting are floodlighting, grazing, interior lighting and outlining.

Floodlighting: The most common method to light buildings today is directing light sources to the building façade, which also known as floodlighting. In many cities of Europe, historic buildings are emphasized with floodlighting method. (vanSanten: 2006, 70) Floodlighting, which is also described as a wash of light, provides an even, flat effect, with the lighting fixture located away from a building and directly in front. The flat and shadowless effect created by floodlighting works well when a building has a strong shape, with a lot of detail to hold the viewer's interest. (Moyer: 1992, 247)

Floodlighting is a simple and economic lighting method since it minimizes the number of lighting fixtures used for illumination. However, it does not work well when the building is plain or when the surface to be lit has imperfections that should not be emphasized. (Moyer: 1992, 248)

The photograph below shows the successful illumination of Gaudi's Casa Milá, Barcelona. Lighting design of this building is described by van Santen as a design with no pretension. The buildings architectural form and details of the building is remarkable and she states that lighting design does justice to the architecture. The nighttime appearance of the building is more or less in line with daytime. The incidental light from the inside of building is in harmony with the exterior lighting.

(a) (b)

Figure 2.4. Casa Mila of Gaudi, Barcelona
(a) Casa Mila under the natural daylight, (b) Casa Mila illuminated with floodlighting
Source: vanSANTEN, Christa (2006); *"Light Zone City",* Brikhauser – Publishers for Architecture, Basel, Switzerland, p75

However, this type of floodlighting might not be the best solution for every building. Although, direct lighting emphasizes the details of Casa Milá dexterously, this type of lighting might result in loss of architectural details. The photographs below display how the Casa Battlo of Gaudi is illuminated at night. Due to the excessive floodlighting of the façade, inconsistent reflections are created from differently colored tiles. The night appearance of the building is almost unrecognizable. (vanSanten: 2006, 75)

(a)

(b)

Figure 2.5. Casa Battlo, Barcelona
(a) Casa Battlo under the daylight, (b) Casa Battlo illuminated with floodlighting
Soruce: vanSANTEN, Christa (2006); *"Light Zone City",* Brikhauser – Publishers for Architecture, Basel, Switzerland, p88

<u>Grazing:</u> Grazing method requires use of multiple lighting fixtures sit close to the façade. Grazing lighting emphasizes the texture and creates strong shadows. As a result of lighting fixtures aiming up or down or across the façade, light scallops are created on

the surface of the building. These lighting scallops and lighting pattern created by them might be an effect that lighting designer avoids or intentionally creates. The introduction of carefully positioned scallops can add interest to a large, plain wall. On the other hand, when the surface has any defects, including ripples, dents, chips, misalignment, cracks or patches, grazing will emphasize the imperfection.

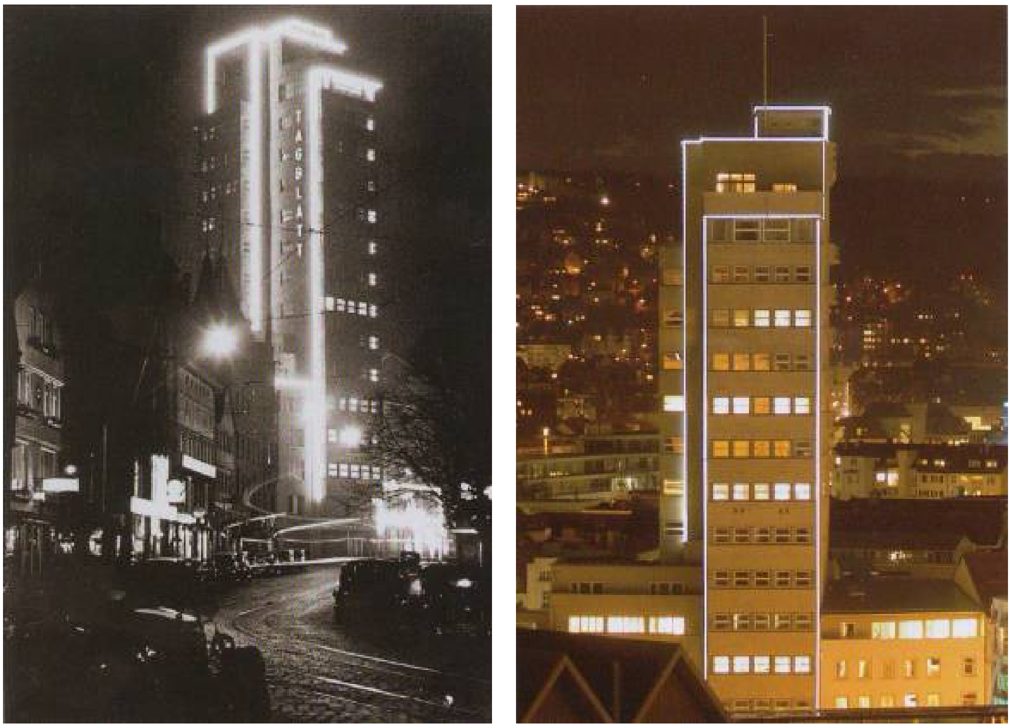
Interior Lighting: Buildings with glazed form, in which the window forms the entire façade whether at single or multistory level, give the opportunity to use all or a proportion of the interior lighting as an exterior lighting system. The appearance during the day where the façade perceived as dark, changes during the nighttime as the transparent façade lets the interior light through. For this reason, illumination of the glazed formed buildings does not require exterior lighting. The surfaces chosen to be illuminated take the attention of the viewer. This type of lighting accentuates the depth of the interior space. (Moyer: 1992, 249) Interior lighting also dramatizes the appearance of the building by emphasizing the structure. (Maile: 2006, 35)

One of the best examples of this type of illumination is the pioneering lighting design of Seagram Building, New York City. Lighting designer Richard Kelly created a lighting scheme which would both be used as office lighting and also construct a light tower at night. Building is illuminated by the vinyl panels at the ceilings of every storey. These translucent panels diffuse the light of the fluorescent lamps. This indirect lighting conceals the lighting device and emphasizes the main structure of the architecture. The bottom of this tower is illuminated with wall-washing system that draws attention to the 7 meters high entrance and bronze columns. Owing to its lighting design that renders the building as a light tower, Seagram Building was a landmark in the nocturnal landscape of New York in 20th century (Maile: 2006, 35)

Figure 2.6. Seagram Building, New York City
Source: Stoller, Ezra (2006), Professional Lighting Design Turkey, v10-p34

<u>Outlining:</u> Outlining, which is also named as contour lighting, was popularly used before the 1940ies. Outline lighting lost its popularity after the introduction of new lighting devices. In this method, the outline of a building is fallowed with a string of individual bulbs. The light strings emphasize the contours, the outlines of the structure. Effect of lighting created by this type is not desirable since the three-dimensional shape can not be perceived by the viewer. People only perceive two dimensional lines of light at night and the opportunity to create a dramatic and pleasant night appearance of the building is missed. (Schimpf: 2006, 71)

According to Schimpf (2006) building lighting history marked its turning point with illumination of the Tagblatt-Turm in Stuttgart, Germany in 1928. The building became the new prestigious image of Stuttgart and it boosted the popularity of outline lighting. Today, Tagblatt-Turm is one of the very few buildings still lit by the till same lighting scheme, as a tribute to its history.



(a) (b)

Figure 2.7. Taggblat Turm of Stuttgart
(a) A view of the building in the early 20th Century, (b) The view of the building today
Source (Figure 2.7-2.8): Schmit, Ute (2006), Professional Lighting Design TR, v12-p40

Luminous Composition, Color: Color of light can enhance a building's appearance and complement or contrast with other elements of design. The technological possibilities of the lighting devices enable the use of one or more color in illumination. Indeed the color of the light is easily altered by filtering wheels or use of led lights, benefiting from the color changing systems. (Phillips: 2004) Color on a building can be used to add interest, increase or decrease psychological depth, or distract from other elements in the composition. According to Moyer (1992), pastel colors or low intensity fit into a composition most easily. Excessive variety and intensity of color creates a theatrical effect, which has limited appeal for the viewer unless used at an entertainment location, nightclub or ephemera.

Figure 2.8. Glare resulted from use of various colors: Piccadilly Circus, London
Source: http://www.flicker.com

According to vanSanten (2006), colored light must fit in with the surrounding in a natural way. Whatever form of illumination is used, the character of the architecture needs to remain intact. Similarly, Phillips (2004) underlines the danger of the technical availability of options in colored lighting at present. He states that emotive variety of the color can be disturbing.

Overall Composition: The overall composition of lighting of buildings raises the discussions how the location and different views affect experience of people; how the relation of daytime and nighttime appearance affect the perception; and how the appearance of lighting equipments affect the appearance of the structure.

The Effect of Location and Different Views: Moyer (1992) states that the buildings on a site represent an element in the nocturnal landscape that should be integrated into the overall lighting design of the urban environment. Successful building lighting not only sculpts an aesthetic appearance, but also integrates the structure into the overall nocturnal landscape design and creates a comfortable environment free of light-source glare. (Moyer: 1992, 245) Phillips also points that the context in which the building will be seen needs to be understood to create a successful overall composition of lighting. There is a great difference between how an illuminated building is experienced at night in an isolated location where there is no other environmental light and in a city center. Lighting of a building should prevent the unpleasant glare resulted from excessive lighting which is caused by incoherency with its lit environment. (Phillips: 2004, 17)

Figure 2.9. The first sketches of the Millenium Dome (I)
Source: Narboni, Roger (2004), "Lighting the Landscape: Art, Design and Technologies", Birkhäuser, Germany, p164

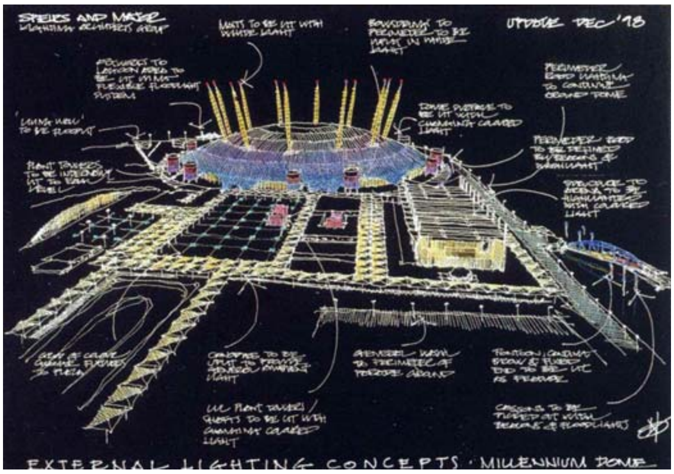


Figure 2.10. The first sketches of the Millenium Dome (II)
Source: ibid Figure 2.9, p164

According to Phillips, an enjoyable view of a building is not only obtained by illumination considering the proper level of light. The effect of illumination changes depending on the direction from which views of the building can be obtained. Owing to their location, views from all sides cannot be obtained. In this case, illumination can not take attention and be perceived and the effects of lighting on people would be insignificant. On the other hand, some buildings, define an important side to a square or a shopping street. In this case the effect derived from the lighting of the building increases and the lighting design takes attention. Therefore, lighting design should establish a priority of importance of the views of a building to be emphasized at night considering its effects. (Phillips: 2004, 16)

Figure 2.11. Millenium Dome and Thames River
Source: Source: Narboni, Roger (2004), "Lighting the Landscape: Art, Design and Technologies", Birkhäuser, Germany, p165

Lighting design of the Millenium Dome in London is a good example how location of the urban element can be used as an advantage. Design team of the structure analyzed the site and made good use of the assets provided by the Thames River. The first image produced for the lighting project was a drawing of the site as seen from the other side of the Thames. (See Figure 2.9, Figure 2.10) The reflection of the dome on the dark waters of the river was illustrated. The illustration was also displaying how the structure would be seen with the silhouette of Greenwich. These initial visions transformed into a real lighting design. (See Figure 2.11) Lighting of the structure is accepted to be a very good use of the location and the effect of lighting can be perceived by several points along the Themes. (Narboni: 2004, 164)

The Effect of Relation Between Daytime and Nighttime Appearances: Phillips (2004) emphasizes the importance of the relation between daytime and night-time appearance of a building in overall lighting composition. As he stresses, although the appearance of the building changes at night, manifestly it should remain the same structure. At night, people should be experiencing the same structure with a different aesthetic emphasis. According to Moyer, lighting design is expected to search for the evaluation of the daytime composition. Organization of elements such as walls, pavings, stairs and architectural structure are the properties of the structure that lighting will emphasize. Strength of lighting can be used to create an effect that fallows the natural appearance or use its capabilities to create a new scene. (Moyer: 1992, 21) The appearance of the building during daylight hours should be taken as a reference point. The lighting task is to emphasize the good points of the building and exclude its less desirable aspects, and not reinvent the architectural characteristics of the building. (Phillips: 2004, 16; Schanda: 2001, 3)

The Effect of Lighting Equipments: The lighting equipments affect the appearance of the building both during night and during the day. Lighting equipments can be used in two basic ways in building lighting, as a decorative element which carries out the lighting task and can be seen by the viewer, or as a functional device which is concealed and only responsible from illumination. If the lighting equipments is not concealed and can be seen by people, the lighting equipments should complement the building’s architectural style. (Moyer 1992, 71) Lighting equipments in ill-considered locations may easily ruin the appearance of a building both during the night and during the day. During the night accent falls on the effect of light; during the day lighting equipments should not compromise the pleasantness of the appearance. (vanSanten: 2006; Moyer 1992, 71)

2.2.2. Roads and Pathways

Roads and pathways provide paths for movement in the urban environment. For the urban environment to be usable at nigth, these paths need to be illuminated. According to Phillips (2002, XVIII), until recently urban designers and architects considered road and pathway lighting as an engineering task. A good road and pathway lighting is acquired through utilization of engineering know-how. However, this subject is also the concern of urban design since road and pathway lighting have significant effect on how the nocturnal landscape of a city is experienced. Primary role of road lighting is ensuring safety of movement at night. In addition to ensuring traffic safety, road and pathway lighting has roles in creating secure night environments and improving the aesthetic quality of the urban space.

On main roads (thoroughfares), visual conditions need to be tuned to the needs of the motorists, who need to identify and judge the course of the road, traffic signs, other vehicles and road users. Lighting is necessary for the motorist so he/she makes out the obstacles on the road and hazards from the side. In daylight, all of these mentioned details are precisely discernable. In daylight, colors are easily distinguished; hence objects and details are clearly made out. During the night time, colors are more difficult to make out, yet our eyes adapt to darkness and become highly sensitive to brightness. In the adaptation zones, however, visual performance might be impaired. Poor visual conditions reduce the amount of information that reaches to the brain. Considering that humankind rely on its eyes for more than 80 percent of the sensory impressions he/she register, impairment of visual performance is extremely dangerous in road traffic. Thus, lighting of main roads makes for greater safety at night because it helps or even actually enables people to fill the gaps in the information received. (FGL: 2000)

On the collector roads that give service to motorists, cyclists and pedestrians in residential areas, visual conditions should be tuned to the needs of a variety of users. A mix of slow-moving and parked motor vehicles, presence of cyclists and pedestrians on collector roads brings about the need to make necessary arrangements to reduce the risk of accidents at nights. Hence, lighting or collector roads should consider the different needs of all the users and provide solutions that would not result in conflicts. In addition, lighting of the collector roads provide the security o pedestrians and provides the atmosphere of residential areas at night. On pathways, which are structured as pedestrian walks separate from collector roads, requirement are less light intensity and good light distribution for easy navigation and psychological comfort. (FGL: 2000, Moyer: 1992, 229)

This section aims to reflect on the effects of lighting of roads and pathways through the previously defined lighting aspects, luminous composition and overall composition. Most of the findings of this section reveal that fundamental aim of road lighting is to provide road safety. So as to assure the road safety at night lighting aims at ensuring: visibility of objects, safety and orientation; the ability to create three-dimensional shapes not only for the recognition of people and objects but also for general comfort (plasticity), prevention of glare. On the other hand, this section reveals that collector roads and pathway lighting aims at providing both safety and security. For pedestrian pathways, illumination for orientation and creation of the sense of security is required.

Table 2.5. List of Perceived Attributes and Emotional Reactions for Lighting of Roads and Pathways

	Perceived Attribute	**Emotional Reactions**	**Source**
Luminous Composition, Intensity	Increasing visibility Increasing contrast between object and the background	Safety (Feeling safe while driving)	FGL: 2000 vanSanten: 2002, 36-39 Moyer: 1992, 229
	Unlit pathway	Anxiety, Fear of Crime	Moyer: 1992, 230
	Visible pathway, Visible surroundings Visible boundaries	Comfort Security	Moyer: 1992, 230
	Walking towards a higher light level	Comfort	Moyer: 1992, 19
	Shift in brightness	Interest (adds interest to a scene)	Moyer: 1992, 234
	Glare, Visual Impairment Limitation of sight (driving)	Discomfort	FGL: 1993
Luminous Composition, Direction	Disharmonious distribution of light Dark patches on a lit road	Discomfort	FGL: 1993
	Closer spacing on the curve Guidance effect	Interest (Drawing driver's the attention)	FGL: 1993
	Even light distribution on pathway Shorter lighting fixtures for pedestrians	- (pedestrian friendly atmosphere)	Phillips: 2004, 55 Moyer: 1992, 239 FGL: 2000
	Uneven distribution Distortion of the walk surface	Confusion Distraction (from enjoying the landscape)	Moyer: 1992, 232
Luminous Composition, Color	Visual hierarchy of road system Different color temperatures for roads of different hierarchical rank	-	Phillips: 2004 Bayliss et al.: 2008
Overall Composition, Light Pollution	Excessive Intensity of Light Light Pollution Sky Glow	Discomfort	Sunay: 1999, 2

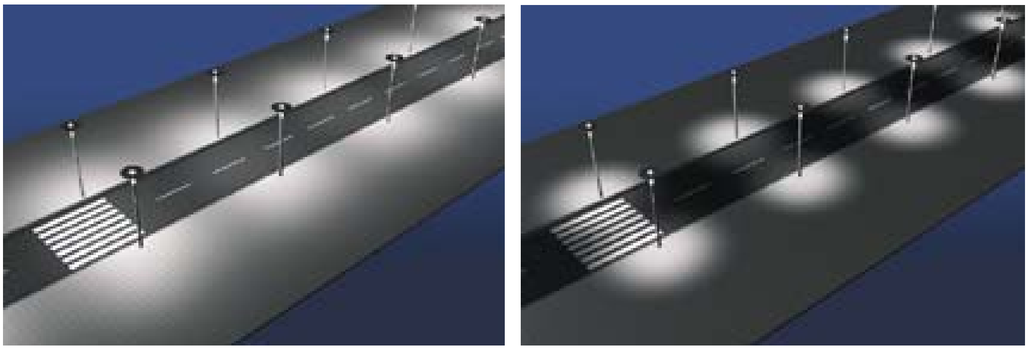
Luminous Composition, Intensity: Visibility of the objects is one of the main concerns of the lighting of the main roads. For this reason lighting of the main roads aims at increasing visibility with specialized lighting fixtures and high level of light. Objects are only visible if their luminance contrasts are created adequately with that of their surroundings, which from the motorist's viewpoint is mainly the roadway. Luminance depends on the type of surface of the road: light or dark paving stones, asphalt, etc. Dark road surfaces reflect less light than brightly colored road surfaces. The effect comes from the interaction between lamp and luminaries on the one hand and color and texture of the road surface on the other. Luminance should create the sufficient contrast, considering the inputs stated above. In this respect, lighting of roads aims to increase the contrast sensitivity of the road; making objects stand out visually from their surroundings. Thus people feel safe while they are driving since they are able to differentiate the objects from the background. (FGL: 2000; vanSanten: 2002, 36-39)

Light intensity required for collector roads is lower than thoroughfare roads. Lights of shops or the residential buildings illuminate the collector roads to an extent. For this reason, lighting complements the existing illumination. Although required light intensity is lower, visibility also plays an important role in lighting of the collector roads since they have a varied user profile ranging from automobiles to pedestrians and bikers. For pathways, it is vital to introduce enough lighting to signify the path to fallow and also possible obstacles on this path for the people's safety. Visibility is important to make out the shapes, steps, changes on the surface which might create an obstacle. Lighting for all types of pedestrian routes requires providing good visibility on the path surface. (Moyer: 1992, 229; Phillips: 2004, 55; FGL: 2000)

As mentioned above providing safety is one of the main concerns of road and pathway lighting. On the other hand, providing security is another important concern. In pedestrian movement at night, in addition to safety, people require security. Lighting can achieve a certain level of sense of security at night. Primarily a psychological concern, brightness contrast between areas can add either to the feeling of security or to unease. Walk areas need enough light so that pedestrians do not have to think consciously about using the path. An unlit road at night provokes anxiety and the fear of crime. People chose to avoid using spaces that gives such feelings. People feel secure and comfortable when they see the path, the area around them, and if possible the boundaries. However, that does not suggest that a pathway should float in the light. On the other hand, dimly lit roads can also achieve the sense of security. People feel comfortable walking along a dimly lit path as long as they are surrounded by or walking toward a higher light level. It might also be preferable to use dim light or lighting with various intensities since shifts in brightness adds interest to a scene. (Moyer: 1992, 234)

Another concern of road and pathway lighting is to avoid the glare. The effect of glare on people can be both physiological and psychological. The effects of glare on people are impairment of the visual performance and psychological discomfort. Direct glare resulting from the light device itself or the reflected glare might hinder perception and identification. Physiological effect of glare limits the sight of the driver and it might temporarily block the vision. Psychological effect of glare causes discomfort which affects the concentration. Distraction as such might lead to accidents and disorientation in traffic. In pedestrian use, distraction caused by glare hinders the orientation. Also glare discourages people to use the space or the pathways. Glare cannot be avoided completely; however, it can be greatly limited. (FGL: 2000)

Luminous Composition, Direction: Distribution of light plays an important role in making out the surroundings and enjoying the environment at night. In lighting of roads, harmonious distribution of light is significant in carrying out visual tasks efficiently. Depending on the height of the luminaries and the distance between the lampposts, there must always be a measure of uniformity in road lighting. The cones of light must overlap with each other. (vanSanten: 2002, 36) Brightness needs to be distributed evenly and dark patches should be avoided. Disharmonious distribution results in dark patches that act as camouflage. These dark patches creates discomfort since they make obstacles and hazards difficult to make out or completely conceal them from the view. (FGL: 2000) In the Figure 2.12, the graphic on the left displays how overlapping cones of light creates harmonious distribution of lighting. In the Figure 2.12, the graphic on the right displays how disharmonious distribution of light creates undesired dark patches.



(a) (b)

Figure 2.12. Distribution of Light in Road Lighting
(a) Harmonious Distribution of Light, (b) Disharmonious Distribution of Light
Source: FGL (1993), *"Lighting with Artificial Light"*, Frankfurt, Germany

In addition to creating harmonious distribution of light, spacing between lighting fixtures also helps people understand the course of the road. In the Figure 2.13, the graphic on the left displays how a guidance effect is created by changing the spacing of the lighting fixtures. Closer lighting fixture spacing in the middle of the bend and positioning on the outside of the bend, as it is displayed in the figure, creates a better "guidance" effect. (FGL: 1993) The additional lighting fixtures also work for drawing the attention of the driver for a change in the course of the road. As it is displayed in the graphic on the right in Figure 2.13, additional luminaires makes for highlighting the hazard zones on the intersection.

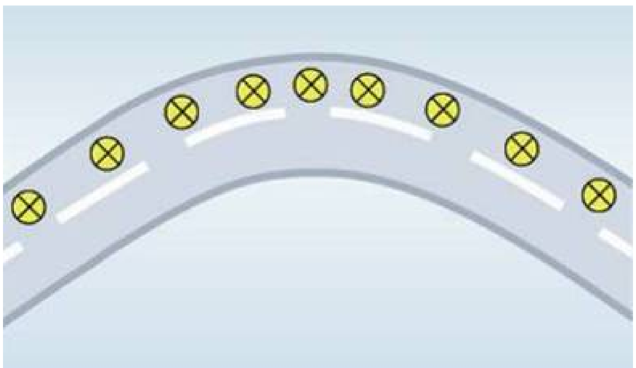


Figure 2.13. Use of lighting fixtures for emphasizing the change of course
Source: ibid Figure 2.12

In the lighting of pedestrian pathways, lighting can either aim providing safe and secure pedestrian environment by harmonious distribution on the path surface or introduce variety to the distribution of light to increase the interest. The character of the pathway determines the requirements. Also, the requirements change depending on whether pathways are adjacent to or separate from the roads. If pathways are adjacent, providing lanterns that have different heights for the motor vehicles and for pedestrians and cyclists creates a pedestrian friendly environment. Often, light coming from the lighting fixture designed for traffic lighting is assumed to provide enough light on the adjacent pedestrian pathway. However, the light fixtures directed to road do not efficiently illuminate the pathways. Lanterns with lower height and higher frequency create an even distribution of light, which is more preferable for people. (Moyer: 1992; FGL: 2000)

Figure 2.14. Lighting Fixtures at Different Heights, Oxford Street, London
Source: Phillips, Derek (2002); "The Lit Environment", Bath Press, Glasgow, UK, p53

The lighting of Oxford Street is a good example of how lighting fixtures of different heights can be used for lighting. The figure 2.14 displays the use of lighting fixtures at different heights in Oxford Street. Lighting fixtures designed for cars have higher level of light and they are placed with nominal distance for road lighting. Height of the lighting fixtures for pedestrians and cyclists is lower, and the light emitted has a warmer color. The warm light emitted from the shorter lighting fixtures creates a more pedestrian friendly atmosphere. Both collector road and pedestrian path is efficiently lit without causing glare or dark patches. (Phillips: 2004, 53)

Pathways which are not adjacent to a road are generally lit by small-scale columns or low-level bollards. In these separate pathways, even distribution of light is aimed to create a guiding path. Uneven distribution can hide obstacles, distort the walk surface or confuse pedestrians, causing them to concentrate on the path rather than looking at and enjoying the landscape around them. (Moyer: 1992, 230) Also, people require a similar guidance effect in their pedestrian movement at night. On the other hand, according to Moyer, while an even light distribution is preferable, more informal types of paths can tolerate more variation.

Luminous Composition, Color: Use of colored light is utilized to add interest and accentuate specific aesthetic properties of the urban environment. Traffic safety is the main concern of the road lighting and the color of light used in road lighting varies between different temperatures of white or yellow light, depending on the light fixture utilized. Road lighting aims to illuminate the road surface for the best perception possible. Hence, lighting roads with light of different colors is unpractical. It also has undesirable effects since colored light in road lighting lowers the visual comfort by distracting and confusing the driver. (FGL: 2000) However, color of light can display a visual hierarchy of road system in the nocturnal urban environment. The difference of color temperature of white or yellow light can create different lighting effects that would create a legible difference between lighting of roads. High intensity and bright white light emphasizes the thoroughfare character of the main roads. Warmer colored lights and lower levels of illuminance are used for collector roads to emphasize that road belongs to a lower order in the hierarchy of the whole urban road system. Also, lighting in collector roads shape the face of a street and warm color temperatures contribute significantly to a better residential environment. (Phillips: 2004, 56)

The new development area in Liverpool emphasizes the significance of light color in creating a legible hierarchy in the urban space. On the verge of being the European Capital of Culture 2008, Liverpool carried out a comprehensive urban regeneration project named “Paradise Street Development Area Project” in the old Albert Docks neighborhood. The aim was to establish a new district to enhance the image of the city where residential uses, hotels, commerce and leisure time activities were introduced. Planning and design process of this new development involved preparation and implication of a lighting design masterplan.

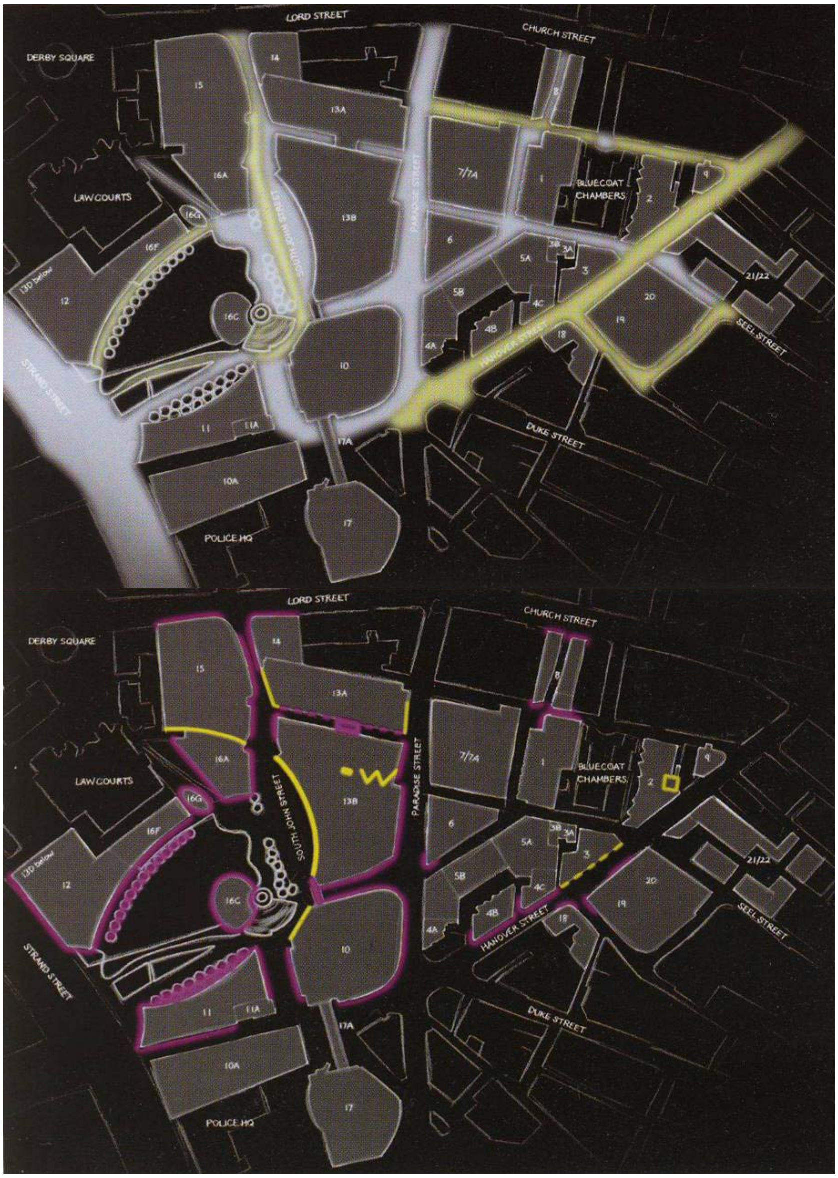


Figure 2.15. Lighting Plans of New Development Area in Liverpool, England
Source: Bayliss et al. (2008), Professional Lighting Design Turkey, v12-p36

In this project, lighting designers proposed the use of different color temperature for the lighting of the streets that passes around or trough the district. With this strategy, designers aimed at displaying a hierarchy of streets. As it is displayed in the figure, the main streets and the collector streets can clearly be distinguished by the viewer owing to the difference of the color temperatures. The reason why designers aimed at displaying such a hierarchy is to make for a nocturnal environment where people would link the new district with the existing areas more easily by the help of visual relation of the light temperature. The lighting design also aims to create a more navigable structure in a completely new urban district. (Bayliss et al.: 2008)

Overall Composition: The overall composition of lighting of roads and pathways rasises the issues of how the level of light affects the light pollution; how the location of lighting equipment affects the use of roads and streets by people; and how the appearance of lighting eqiupments affects the appearance of roads and pathways.

Effect of Road Lighting on the Light Pollution: Road and pathway lighting are one of the main reasons of light pollution. The high intensity lighting sources and unsuitable type of lighting fixtures that are used for traffic lighting result in undesirable excessive level of lighting and discomforting light pollution. (Sunay: 1999, 2) The light intensity is an important variable for lighting of roads since it provides for the road safety. However, when the level of light emitted to provide road safety is excessively high, it compromises the overall comfort of the nocturnal urban environment and creates glare and an unnatural glowing sky. Lack of optical properties and lack of screening of the lanterns also results in light pollution. The lanterns without necessary optical devices and shields let the light escape upwards unintentionally. In order to avoid glare and light pollution, lighting devices should be shielded and height of the light source should not be too low to avoid excessive reflection. Many public initiatives, mostly led by astronomers, today seek to decrease the illumination level by law and reclaim the dark sky in Europe and North America (NLPIP: 2008). Also research reveals that residents reporting complaints of light trespass has increased in European and North American cities. (ILE: 2008) The figures below displays the undesired lighting effect resulted by the use of unshielded light sources. , *__The Effect of Location of the Lighting Equipments:__* Lighting equipments of roads and pathways are significant in size. In some roads, the physical conditions of the roadside may restrict the placement of lighting poles. However, placement of lighting equipments should not hinder the movement of motorist and pedestrians. Especially in pathways, the placement of lanterns can have a negative effect on the pedestrian environment. If there are physical restrictions in the roadside or the roadway is too narrow to place lanterns, luminaires can be hung up on cables strung between buildings. In situations where it is preferable not to place lampposts in the streets, wall-mounted luminaires also offers a solution. (vanSanten: 2006, 46) Figure 2.16 is a good example of how luminaires can be placed in a narrow street without blocking the movement.

Figure 2.16. Wall-mounted and cable luminaires, Benghazi, Libya
Source: Personal Archive

2.3.3. Pedestrian Areas and Squares

Pedestrian areas and public squares are auto-free hardscapes that are structured for the use of citizens for various activities. These areas picture the character of the social structure and their vibrant character defines the identity of towns. Safe and pleasant use of these areas by people both during day and night has a significant effect on how people experience their urban environment. Lighting plays an important role on how pedestrian areas and town squares are experienced by people at night.

Phillips (2004) points out that pedestrian areas and squares of a town are very special areas, which should provide an atmosphere of welcome, warmth and relaxation at night. The lighting of the area should provide a sense of welcome, in addition to ensuring safety and security. It is also stressed by Phillips (2004) that lighting for pedestrian areas and town squares must form a balance between good seeing conditions over the entire area and a light pattern that provides an attractive and welcoming visual environment. According to van Santen, lighting of pedestrian areas and squares can create a relationship between the light of the illuminated buildings and objects. In spite of all the random factors in the illuminated areas of a city, a composition can be achieved that makes it possible to experience the image of the city at night as a pleasant whole. Phillips also points out that an overall bland lighting scheme of municipalities derived from tall lighting fixtures, will not entice people to visit and revisit the area unless additional accent lighting is provided. Lighting design of the area should introduce variety aiming at increasing the interest in the place.

In this section, lighting of pedestrian areas and squares are critically reviewed to discover the how people's experience is defined in literature resulting from certain perceived attributes in pedestrian areas and squares. In this section, the lighting fixtures are also reviewed with respect to the difference they create on the perceived attribute.

Table 2.6. List of Perceived Attributes and Emotional Reactions for Lighting of Pedestrian Areas and Squares

	Perceived Attribute	**Emotional Reactions**	**Source**
Luminous Composition, Intensity	Sufficiency light on the street Not too many dark areas	Safety Security	vanSanten: 2006, 40
	Being able to recognize people at a distance of four meters	-	vanSanten: 2006, 40
	(Glowing opaque globes) Too high a brightness Loss of light skywards	Distraction	Moyer: 1992, 239 vanSanten: 2006 Boduroğlu, 2001 Phillips: 2004
	(Old transformed lighting fixtures) Ample light and glare	Discomfort (Nuisance and dazzling)	vanSanten: 2006, 12-37
	(Indirect lighting) Bright reflecting surface	Unpleasantness/Disliking (Annoying)	vanSanten: 2006, 45
Luminous Composition, Direction	Incompatible tall lighting fixtures, Too soft light fill	-	ILE: 2008 Moyer: 1992
	Light trespass	Discomfort	ILE: 2008
	Human scaled medium-height lighting fixtures	-	Phillips: 2004
	(bollards) Announcing, marking	Interest (draw attention, call for caution)	Moyer:1992, 240
	Close spacing of lighting fixtures Visual rhythm and unifying effect	-	Moyer: 1992, 239
	Creating sparkle	Interest (adds interest to the scene)	Moyer: 1992, 239
	(Squares) Carpet of Light – Uniform light fill	-	FGL: 2002 vanSanten: 2006
	(Squares) Light Zones – Different Emphasis Points	-	FGL: 2002
	(Squares) Pools of light – Punctual Illumination	-	Phillips: 2004, 58 FGL: 2002

Table 2.6. List of Perceived Attributes and Emotional Reactions for Lighting of Pedestrian Areas and Squares (continued)

Luminous Composition, Direction	(Tunnels and paths with overhead structure) Use of colored light	Security/Secureness	vanSanten: 2006, 110
Luminous Composition, Color	Use of color blue	Pleasantness (Inspiring) Peacefulness, Calmness	vanSanten: 2006, 110
Overall Composition, Relation between daytime - nighttime	Loss of daytime character and atmosphere at night Unrecognizable appearance	Unpleasantness Confusion (difficult to navigate)	Phillips: 2004, 18 Björklund: 2007
Overall Composition, Lighting Equipments	Visual integration of lighting equipments to the urban environment	Pleasantness (positive psychological effects)	Boduroğlu: 2001, 115

Luminous Composition, Intensity: Light intensity plays a key role in creating safe and secure pedestrian environments. People require certain amount of light at night to be able to use the space safely and comfortably. Hazards, obstacles, changes of texture should be lit for the safety of the pedestrian movement. (FGL: 2002) Research reveals that lighting also deters the crime and decreases the fear of crime. In this respect, lighting intensity is required for security and sense of security. However, research reveals that the importance of the light intensity for pedestrian areas and town squares is often overrated. Providing safety and security can not be acquired by solely introducing high level of light in an urban environment. Desired effect of safety and security can be created with nominal lighting intensity, close spacing and specially modified lighting fixtures designed for exterior lighting. (Moyer: 1992; Phillips: 2004) Right combination of lighting intensity with direction, distribution and color of light creates the desired effects. Excessively high levels of light can not be a design solution; on the contrary, it becomes a problem itself with discomforting glare and high energy costs.

There is limited scientific research on how much light is needed to create a safe environment and the recommendations for pedestrian areas are different for every country (Moyer: 1992). vanSanten (2006) points out that regardless of the lighting levels recommended, the focus is always on the feeling of safety and security acquired through sufficient light on the street and not too many dark areas. A criterion that is currently applied is that people should be able to recognize each other at a distance of four meters. There is a common conception that the light is sufficient when there is no excess of light in the surrounding area; it's about the balance of brightness instead of ample light to flood the pedestrian are or the square. (vanSanten: 2006, 40) People adapt to the light that is present and as it is stated previously, human eye adapts to brightly lit environments after a dark environment. Adapting darker environment after a brightly lit one relatively takes longer time (FGL: 2002) Where there is a lot of light, the immediate surroundings appear darker and transition between different places with different levels of light becomes more difficult. Changes of lighting intensity should account the difficulty people might encounter in adaptation zones. (vanSanten: 2006, 40)

Lighting of pedestrian areas and squares aims at increasing the aesthetic quality of the place by the effect of light and also the quality of the lighting fixture. In order to reach these goals various types of lighting fixtures are used in the cities today. Although light intensity id directly related to the light source used for the lighting fixture, the fixture itself is also a determining factor of the intensity. Different types of lighting fixtures can create different levels of lighting intensity with the same light source owing to their optical devices and shielding. Certain types of lighting fixtures which are popularly used in pedestrian areas and squares result in problems of glare and discomfort. The types that are popularly used and often critically reviewed in literature are the opaque globes, transformed old lighting fixtures and indirect lighting devices.

Opaque globes: They are often used in pedestrian areas and squares as a decorative lighting fixture. In spite of being a very popular choice in exterior lighting, opaque globe is just a covering of the lamp with no further optical devices. This lighting fixture lights itself up more than the surroundings. Therefore, these globes do not provide effective lighting and their best serve is to provide orientation with dim light. However, high intensity light sources often used to increase the lighting capacity of opaque globes. Since these fixtures neither have shielding nor reflectors, emitted light goes all the directions with a high degree of loss of light skywards. Glowing white globes typically create too high a brightness similar to directly exposed lamps, and they distract the viewer rather than adding interest. (Moyer: 1992, 239; vanSanten: 2006; Boduroğlu: 2001; Phillips: 2004)

Transformed Old Lighting Fixtures: The old lighting fixtures which were designed for gas mantles and later for incandescent lamps are often used in pedestrian zones and squares in the historic quarters of the cities today. These lighting fixtures are designed for low levels of light emitted from candles, gas or incandescent lamps; hence they lack optical devices and shielding. In the last decades, these lighting fixtures are used for accommodating stronger light sources, modern gaseous discharge lamps, without proper modification. These light sources provide ample light and without proper modification on lighting fixture to prevent glare, they are often so bright that they become a nuisance or are even dazzling. Excessive amount of light in the field of vision of people results in glare and discomfort. (vanSanten: 2006, 12-37) These old fixtures need to be shielded, for example, by placing slats over the light source. It is also possible to replace the glass with structured plastic, which diffuses the light emitted. (Moyer: 1992, 70)

Figure 2.17. Old Lighting Fixture, Passeig de Garcia, Barcelona
Source: vanSANTEN, Christa (2006); *"Light Zone City",* Brikhauser, Basel, Switzerland, p37

The lighting fixture in Figure 2.17 is from Passeig de Garcia in Barcelona. With its imaginative design and historical importance, Gaudi heritage lighting fixture is really hard to replace although it no longer meet the modern road lighting requirements. These lighting fixtures had been adapted as well as possible through the change from candles to oil lamps, to gas lights and more recently incandescent lamps. However it is no longer possible to adapt them for the requirements of today. Nevertheless, city of Barcelona preserves the Gaudi heritage lighting fixtures with using nominal lighting sources for the fixtures and makes up for the lack of lighting by introducing additional and neutral lighting fixtures. (vanSanten: 2006, 37)

Indirect Lighting Fixtures: Indirect lighting sources are popularly used in the last decades because they are known to be glare-free since they conceal the light source and diffuse the reflected light. (vanSanten: 2006) Exterior indirect lighting means no bulb or part of bulb or source of light can be seen by the viewer. Indirect lighting fixtures are comprised of indirect optical control system for decorative and glare-free lighting in pedestrian precincts and town squares. These fixtures diffuse light through surface mounted above the light source which is directed skywards. The effect created by the light diffusion depends on reflecting surface: how it is bent or shaped, and to the structure of the surface. Since the light bulb is not directly visible, these fixtures are successful in reducing glare. If it is in a good balance with direct light, diffused light emitted from indirect lighting can create a good modeling of the shapes and creates a glare free and clear view. (FGL: 2002, vanSanten: 2006) However, indirect light surfaces has the disadvantage that it reflecting surface may become dirty and is sometimes annoyingly bright against a dark sky. (vanSanten: 2006, 45)

Luminous Composition, Direction: Direction of light plays an important role in shaping the nocturnal appearance and atmosphere of the urban environment since it covers the issues of the height of lighting fixtures and distribution of light. Different height of lighting accentuates different properties of the space. Distribution of lighting creates the pattern of illumination, which creates the visual organization of the space at night. In addition, type of lanterns also changes the effect of lighting since the direction of the light projected is controlled by the lighting fixture. In this part, the lighting and its effects in pedestrian areas and squares are reviewed under the two categories: height and distribution.

Height: Moyer (1992) groups the lighting equipments of street and pedestrians areas under three categories with regards to their heights: tall pole fixtures, medium-height pole fixtures and bollards. Tall lanterns range in height from 6 meters to 9 meters. This group is used in road lighting and is not preferred for the lighting of squares and pedestrian areas. Tall lanterns are accepted to be incompatible with pedestrian areas because: the light fill created is softer than needed owing to the height, light trespass decreases the comfort of the people who use or reside in the buildings that define these pedestrian areas, and poles are not in human scale. (ILE: 2008, Moyer: 1992) Phillips (2004) points out that open spaces are the places where needs of pedestrians have the highest priority and thus lighting should be created in human scale. On the contrary, several case specific statements of vanSanten (2006) underlines that depending on the scale and character of the pedestrian area or square, tall lanterns can create attractive lighting effects and not necessarily disturb the viewer.

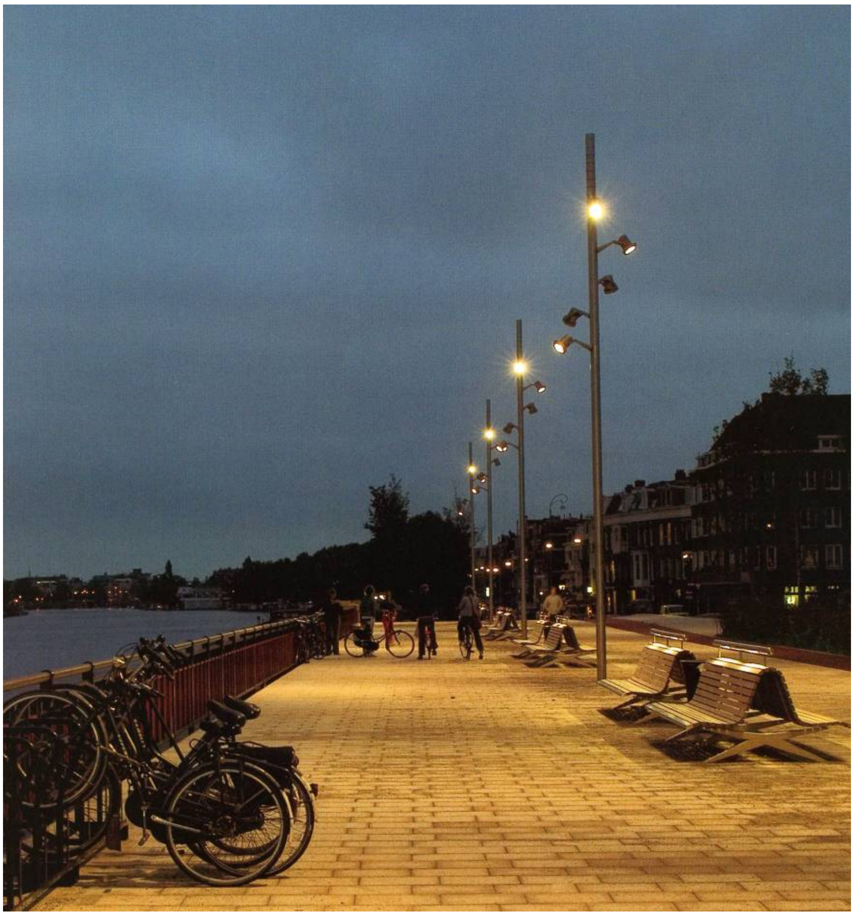


Figure 2.18. Use of tall lanterns in a pedestrian area, Amsterdam.
Source: vanSANTEN, Christa (2006); *"Light Zone City",* Brikhauser, Basel, Switzerland, p37

Medium height fixtures range in height from 2.5 meters to 4.5 meters. They are commonly used in lighting of pedestrian areas and squares and they serve both for functional and aesthetic purposes. (Moyer: 1992, 239) The functional purposes that fixtures of this group serve for are the provision of safety and security. Lighting equipments in this group provide for the safety of the pedestrian movement by illuminating the boundaries of the place, texture of the pavement, changes in the elevation, obstacles on the path and also the points of interest in pedestrian areas and squares. (Moyer: 1992, 240; FGL: 2002) On the other hand, lanterns at this group have an aesthetic emphasis and they present a decorative appearance that helps identify or enhance a city's image. Owing to their human scale sizes, they are perceived as urban furniture. Thus, the material, type and design of the light source and its integration to the architectural characteristics affect the appearance of the urban environment.

Bollards and path fixtures are the third group of lighting fixtures. They typically have a substantial size and strong construction to withstand physically rough situations. Their general use is to draw the attention of people to point out a specific happening, space or define a path. They can incorporate signage to direct pedestrians such as announcing bus stops with schedules incorporated into their body. Bollards and path fixtures provide physical as well as psychological cues to areas of interest along the street. They can mark areas of caution, such as warning of approaching traffic from underground parking garages or indicating separations between vehicle and pedestrian areas. (Moyer: 1992, 240-76; FGL: 1993)

As it is stated above, lighting fixtures at different heights creates different lighting effects. Tall lighting fixtures are defined as better equipments for road illumination although they can be utilized in pedestrian areas and squares. Medium height lighting fixtures are the most common type for pedestrian areas and squares and they provide visibility, safety, enjoyable atmosphere. Bollards and path fixtures are used for signage and orienting people. Although lighting effects differ depending on the height of the lighting fixture, the overall lighting effect depends on how these lighting elements come together. The effects of distribution of light can be reviewed separately of pedestrian areas and squares.

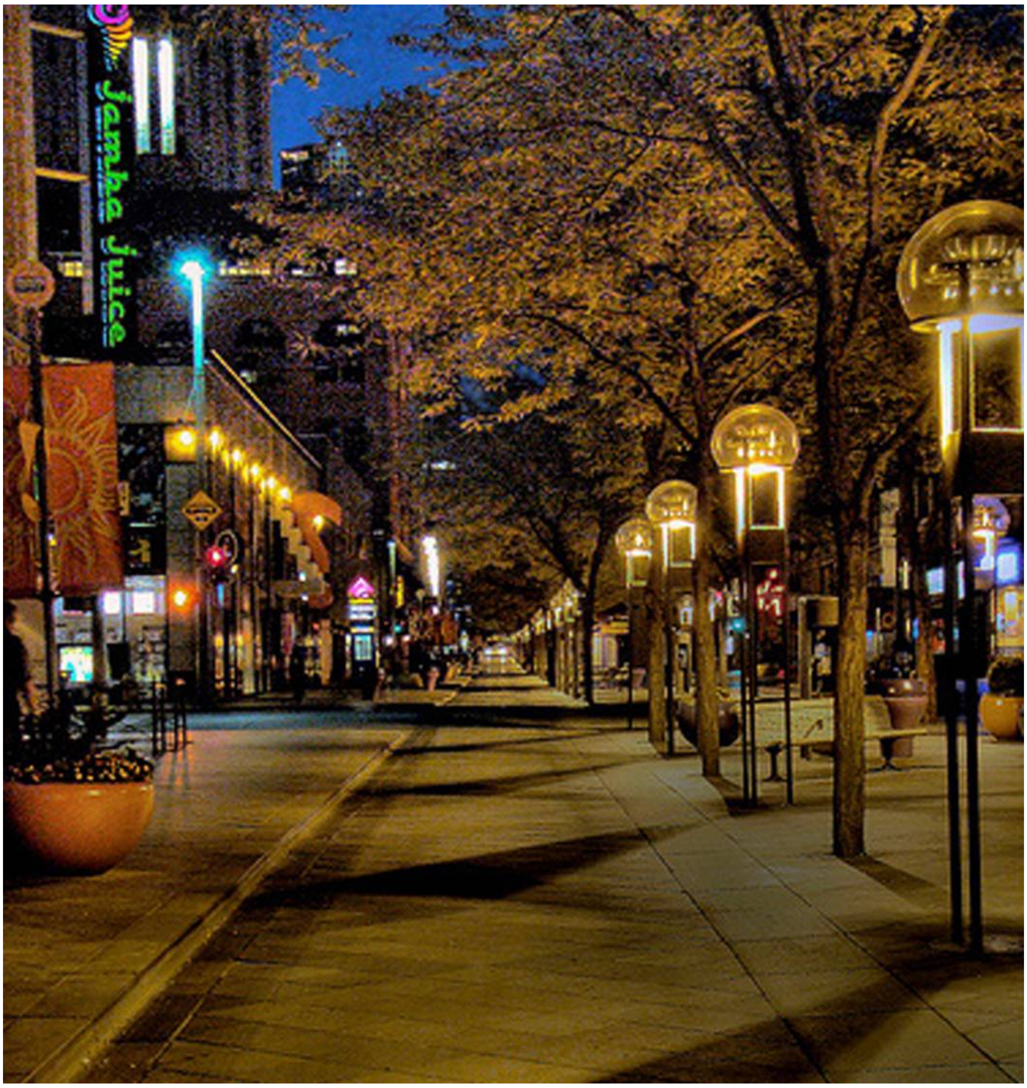


Figure 2.19. 16th Street Mall Denver at Night, USA
Source: http://www.flickr.com

Pedestrian areas of informal structure such as small paths in parks or green areas within residential uses can tolerate uneven distribution of light. However, pedestrian areas at urban scale should not be lit by uneven lighting that creates undesired dark patches and disunified visual appearance. In order to achieve an even light distribution, the lighting fixtures must be located closer. The close spacing creates a visual rhythm and unifying effect along the path for the viewer. They can also add interest to the street scene by creating sparkle or a small area of brightness that calls attention to the luminaire.

(Moyer: 1992, 239) The custom fixtures designed for 16th Street Mall, Denver, include a high intensity discharge source with a ring of incandescent lamps for sparkle effect. The fixtures visually create a line, drawing the pedestrian's eye through the plaza. The columns give warm yellow light to the area and the whole design benefits from the use of landscape to give it a human scale. (Phillips: 2004, 58; Moyer: 1992, 239)

Squares require a different approach in lighting owing to their physical shape and the functions they posses such as furnishing space for assemblies, for markets and cultural events. The function or functions the square performs should be considered while selecting the scheme for the distribution of light for a square. (FGL: 2002) A square which is frequently used for events requires uniform lighting. This uniform lighting is acquired by close spacing between lighting fixtures. This type of uniform effect created by lighting is called "carpet of light." A square with multiple functions can be divided into different "lighting zones". And in a square originally designed to underline the importance of buildings fronting onto it, the main emphasis is on illuminating those buildings; lighting for the square itself is confined to a few "pools of light". (FGL: 2002)

Carpet of light: This lighting effect is created by closely spaced lighting fixtures that create a uniform light fill. Light sources are mounted high and outside the field of vision of people. Facades which define the square are only illuminated by stray light.

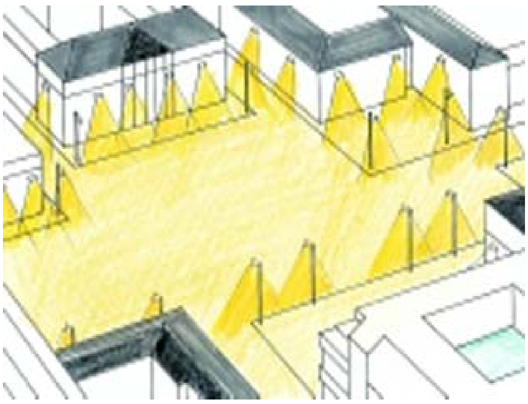


Figure 2.20. Carpet of Light
Source: Fördergemeinschaft Gutes Licht (2002), *"Urban Image Lighting"*, Frankfurt, Germany

Figure 2.21 displays how a uniform lighting effect is created in Piazza del Popolo, Rome. This square is a large recreational square with traffic circulating around the outside. Relatively low number of lighting fixtures provides ample lighting for the whole area and the surrounding walls. The reflections on the wet floor add on to the scene and alter the uniformity.

Figure 2.21. Uniform Distribution of Light, Piazza Del Popolo, Rome
Source: vanSANTEN, Christa (2006); "Light Zone City", Brikhauser – Publishers for Architecture, Basel, Switzerland, p13

Figure 2.22 displays is the Place Vandome in Paris. This figure demonstrates how an effort for uniform distribution of light might result in an undesired appearance. The pedestrian square is illuminated by several lampposts to achieve a uniform light fill. However, according to vanSanten (2006), an excess of lamppost has been used to create the desired uniformity. The several lamposts in the square become superflous. According to vanSanten (2006) viewers are inevitably bothered by the numerous light sources entering their field of vision.

Figure 2.22. Superfluous Lights, Place Vandome, Paris
Source: vanSANTEN, Christa (2006); "Light Zone City", Brikhauser – Publishers for Architecture, Basel, Switzerland, p12

Lighting zones: Depending on the different needs of multiple uses, a square can be lit with different emphasis on different points. An agreeable atmosphere can be created by using a large number of low light sources to divide the square into different zones. In this case, the tops of facades surrounding the square are not illuminated. (FGL: 2002)

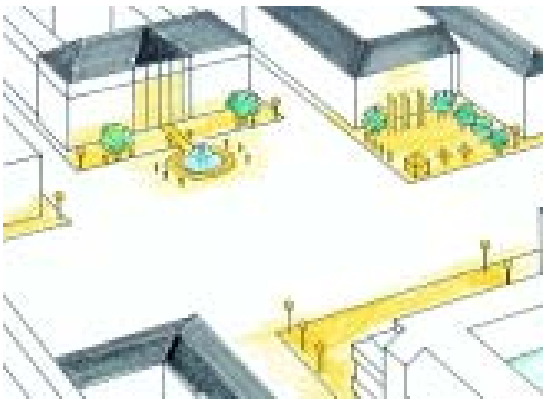


Figure 2.23. Lighting Zones
Source: Fördergemeinschaft Gutes Licht (2002), *"Urban Image Lighting"*, Frankfurt, Germany

Figure 2.24 is the Place Bir-Hakeim, Lyon, and it displays the two different light zones that define two separate urban spaces at night. This square experiences relatively low pedestrian traffic. Design of lighting reflects the limited use and defines two lit strips and a dark patch which is a green are and used for recreational means during the day.

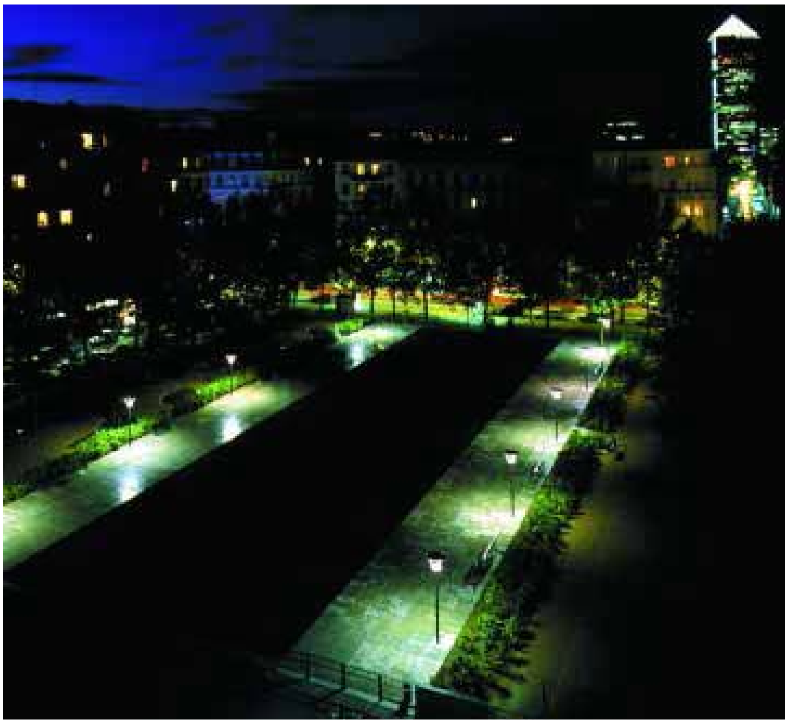


Figure 2.24. Lighting Zones, Place Bir-Hakeim, Lyon
Source: http://www.flicker.com

Pools of light: An alternative method for lighting squares is installing relatively low level lights giving emphasis or pools of light at functional points such as seating or landscaping, with which it may be associated. In other words, the square itself is of minor importance, so it is only punctually illuminated. The facades of buildings fringing the square might be floodlit. Although lighting aims primarily at accentuating, it is important that dark, shadowed areas are avoided. (Phillips: 2004, 58; FGL: 2002)

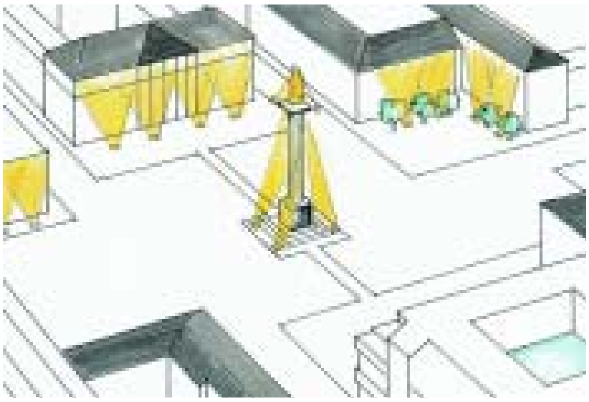


Figure 2.25. Pools of Light
Source: Fördergemeinschaft Gutes Licht (2002), *"Urban Image Lighting"*, Frankfurt, Germany

The square in figure 2.26 is the Market Square of Dessau, Germany which also hosts the Rathaus (German word for City Hall). Poles of light are created to identify the market place and the place where leisure activities take place. Pavements are defined by medium height lighting fixtures and some of the significant buildings are floodlit with colored light. This type of lighting does not draw the attention to the square itself but to other structures and activities that define this place.

Figure 2.26. Market Square of Dessau, Germany
Source: Source: Fördergemeinschaft Gutes Licht (2002), *"Urban Image Lighting"*, Frankfurt, Germany

Luminous Composition, Color: Use of color in public space has increased with the possibilities that new technologies offer. The use of blue, red, green, yellow etc. for lighting of public space is approaching levels that used to be common only in advertisements. (vanSanten: 2006, 110) The use of color can be used to create a better and more exciting appearance of the space. According to vanSanten (2006), today many lighting designers demonstrate sensitive use of various options that can be created with colored light. vanSanten points out that especially blue is a color that inspires people. It is a color of peace and calm: it gives a feeling of detachment and depth, in contrast with the active colors of red and yellow. Sometimes in unexciting and monotonous environment such as pedestrian tunnels or paths with overhead structure, use of color can create a sense of security. Although different colors create different effects on people, as it is stated in the previous section, it's the balanced composition of colors that makes an environment interesting for people.

Pavements are not the only application area of colored light in pedestrian areas: decorative elements, statues and other plastic design elements can be lit with colored light to increase the aesthetic appeal. According to Philips (2004), much of the delight in the nightscape of the cities derives from these design elements which create lighting opportunities. When these are disregarded in lighting they disappear at night, and an opportunity missed. On the other hand, use of various colors in lighting of the urban environment disturbs the neutrality and anonymity of the evening atmosphere. Unnatural colored light nullifies the atmosphere of the space and undermines its character. (vanSanten: 2006, 110)

Overall Composition: The overall composition of lighting of pedestrian areas and squares raises the issues of how the relation of daytime and nighttime appearance affect the perception; and how the appearance of lighting equipments affect the appearance of the structure.

The Effect of Relation Between Daytime and Nighttime Appearances: Most of the cities of Europe are famous for their unique identities derived from their characteristic urban environment. Their atmosphere however, changes at night and sometimes this change can be unpleasant. The famous city of Venice in Italy is known to be one of the most attractive tourist destinations in Europe. However, according to Björklund (2007) the vibrant face of the city changes at night and city becomes relatively less alive. Although the crime rates are low, Björklund points out that sense of security is low due to poor lighting. The existing lighting in Venice creates unpleasant glare and insufficient lighting. Figure 2.27 and Figure 2.28 display the effect existing lighting creates in two squares in Venice. Uneven distribution creates too brightly lit edges and relatively dark patches at centre. Harmony and coherence of the daytime is lost in both of these squares due to lighting: in addition, glare results in discomfort. (Björklund: 2007, 30)

Another famous tourist attraction of Europe is the Lisbon, the "white city" of Mediterranean cost. The light colored pavements of the historical quarter of Lisbon create bright and warm white reflections during the daytime. However, Becker (2006) points out that after the sunset, this romantic appearance of the city disappears as the artificial lighting floods the streets of the city with warm yellow light. The primary lighting principal of the city is pointed out by Becker as "lighting for security." This approach causes the loss of the visual character of the city and decreases the pleasantness of the spatial experience of the people.

Although the character of pedestrian areas and squares would be different at night, it should not conflict with the daytime atmosphere. According to Phillips (2004) and Björklund (2007), if the nighttime atmosphere of a city is completely lost during the night, it might make the city unrecognizable, unpleasant and difficult to navigate.

Figure 2.27. Campo Santa Maria Farmosa, Venice
Source: Björklund, Erika (2007), *"Urban revitalization through lighting design: environmental lighting plan for Venice"*, Master Thesis, SLU Uppsala, p30

Figure 2.28. A Square in Venice; edges are brightly lit yet center is relatively dark.
Source: ibid Figure 2.27.

The Effect of Lighting Equipments on the Appearance: The aesthetic quality of the lighting equipments affects the overall appearance of pedestrian areas and town squares. Research reveals that, lighting fixtures are expected to complement the appearance and character of its environment. Some European cities have considered the lighting of roads and pathways as an architectural problem and have provided solutions which are harmonious to the character of the urban environment and which have better aesthetic emphasis in the last centuries. City governing authorities of North America and Europe have been aiming to improve the modern lighting equipments since the 1950ies to integrate the lighting equipments successfully to the urban environment. Boduroğlu (2001) points out that visual integration of lighting equipments to the roads, pathways and architectural character of the built environment has positive psychological effects on people. The existing variety in the supply market of lighting equipments increases the possibilities of finding the right equipment for the existing character of the space. Moreover, today lighting equipment manufacturers can produce products specially designed for the specific urban environments. (vanSanten: 2006, 38)

The accent is mostly on the effect of lighting rater than the lighting fixture itself. During the daytime it is the lighting fixtures that play a part in determining the appearance of the city. One year has 8,760 hours: and public lighting is on for approximately 4,100 hours of this time. In the evening, attention is focused on the effect of the light. The luminaire is visible in daylight for 4,660 hours. According to vanSanten (2006), the appearance of lighting fixtures gain importance in pedestrian areas and squares depending on whether they are intended to be unobtrusive or conversely, to be a striking addition to the other street furniture.

2.2.4. Urban Parks and Soft Landscape Elements

Parks are protected green areas within the urban tissue, structured for the recreation and enjoyment of people. Parks vary in type as urban parks, wilderness parks, national parks, natural, semi-natural or planted parks etc. This section focuses on the urban parks which are recreational green spaces within the urban environment, and the landscape elements that they consist. Urban parks are areas of open space usually owned and maintained by a local government. Use of some of the parks in European cities are limited to daytime hours and entrances of parks are closed in most of the parks. However, majority of the parks and public gardens are open to the use of public during day and night. Parks commonly resemble savannahs or open woodlands, the types of landscape that human beings find most relaxing. Parks also accomodate other elements of interest such as sculptures, fountains, architectural structures and amenities for the use of people. However, according to Philips (2004) parks where people can wander after dark and enjoy the open space, add immeasurably to the quality of town life.

Use of parks at night is another area of lighting where safety and security are important, but where lighting can provide more than this. (Phillips: 2004, XVIII) The illumination of town parks demands special attention. In parks that are still open after sunset, the visitor needs to know what happens where. There must be a good view of the pathways, and that also applies to any cycle paths. (vanSanten: 2006, 62) On the other hand, landscape elements can be lit in a park to define the boundaries of the space and increase the interest in the area. The areas of lighting which urban environment provides are generally static: such as building façades, pavements, obelisks and sculptures etc. Parks, however, provides more dynamic areas of lighting like water, trees and plants. Also, in order to create a peaceful atmosphere, trees and bushes are often illuminated. (vanSanten: 2006, 62; Phillips: 2004, XVIII)

Nevertheless, lighting of parks and green areas within the urban environment requires attention to energy efficiency and light pollution issues in addition to people's needs and expectations. In a park or a grassy area with trees and bushes, the choice of the right light source is precise work. According to vanSanten (2006), quite a lot of light is lost in the illumination of trees and wooded areas due to the ignorance of the nature of plants and trees. It is also a misconception that every element in a park should be illuminated and a well-lit park is preferable by everyone. On the contrary, trees with interesting shapes can just as well be left in the dark and be used as a silhouette, creating a feeling of depth and making the whole scene more lively.

This section aims to review the lighting of parks and landscape elements within the urban design context. Lighting of landscape is a wide subject and it is narrowed down to fundamental discussion points that are salient to the discussion of people's experience of urban environment at night. In this respect, this section reviews the general lighting discussion, lighting of plants and trees, and other plastic elements which are commonly situated in parks and green areas. Lighting of walkways is already discussed in previous sections and lighting of these pedestrian paths does not provide a new discussion within the subject of lighting of the parks and green areas.

Table 2.7. List of Perceived Attributes and Emotional Reactions for Lighting of Parks and Landscape Elements

	Perceived Attribute	**Emotional Reactions**	**Source**
Luminous Composition, Intensity	(In informal pathway settings) Higher light level on pavement surface	Comfort	Moyer : 1992, 235
	Major focal points appear brighter Landscape elements become landmarks	Interest	Moyer: 1992, 185-204
	Landscape elements left in dark and perceived as silhouettes	-	Phillips: 2004 Moyer: 1992, 204
Luminous Composition, Direction	Uplighting (plants) – dramaticness Unnatural shadows Difference from the daytime look	Disliking/Unpleasant (Undesirable appearance)	Moyer: 1992, 204-7 FGL: 2005, V16, p19
	Downlighting (plants) – natural appearance Shadows underside the leaves Echoing of sun lighting	-	Moyer: 1992, 204-7 FGL: 2005, V16, p19
	Composition of uplighting and downlighting (plants) More visual definition	Interest	Moyer: 1992, 204-7
	Backlighting (plants) – Depth Separation from the background Emphasize the shape by halo technique Dramaticnes by silhhoutee technique	Interest	Moyer: 1992, 204-7
	Frontlighting (plants) – Provision of details of plants Tied areas of composition	-	Moyer: 1992, 204-7
	Sidelighting (plants) – Emphasize texture Create shadows on adjacent surfaces	Interest Dislike (or distract from composition)	Moyer: 1992, 204-7 FGL: 2005, V16, p19
	Downlighting (sculptures) – Natural Appearance	-	Phillips: 2004 Moyer: 1992

Table 2.7. List of Perceived Attributes and Emotional Reactions for Lighting of Parks and Landscape Elements (continued)

	Perceived Attribute	Emotional Reactions	Source
Luminous Composition, Direction	Downlighting (sculptures) – Undesired Shadows Unfriendly, ugly appearance of faces	Dislike Fear	Moyer: 1992, 214-215
	Single light source under a jet of water (fountains) Attractive effect without external lighting	Interest/Cheerfulness (Liveliness, attraction and cheerfulness)	vanSanten: 2006, 62
Luminous Composition, Color	Use of color in empty parks	Comfort and liking (eliminate sinister and dismal, lively)	vanSanten: 2006, 29
Overall Composition, Location and Dif. Views	Imbalance of light from different sources (plant)	Uneaseness/Fear	Moyer: 1992, 207
	Balanced/carefully planned lighting (plant)	Enjoyment (of the plant and of the park)	Moyer: 1992, 207
Overall Composition, Fear of Crime	Seeing the boundaries of a park	Secureness (Decrease of fear of crime)	Moyer: 1992, 62
	Low visibility Desolate areas Lack of knowledge about surroundings	Fear of crime	Kubat & Kaya: 2007

Luminous Composition, Intensity: Parks can be utilized as enjoyable open spaces and safe pedestrian pathways at night trough an efficient lighting scheme. Research reveals that providing safety and decreasing the fear of crime are key elements in park lighting. Phillips (2004) states that so many open spaces are lit in such a way that they do little to encourage their use by members of the public at night because people perceive them as threatening. To encourage the use, vanSanten (2006) states that parks should not be dark patches within the urban tissue; lighting level of parks should be in harmony with the surrounding lit environment. The transition from the well-lit street to the park must not be abrupt as far as light is concerned, but naturally tuned to the adaptation of the human eye. Human eye requires relatively longer time to adapt from a lit area to a dark area than the opposite. (FGL: 2002; vanSanten: 2006, 62) On the other hand, this is not to say that open spaces should be lit with high levels of light. Phillips (2004) points out that so long as the needs of safety and security are met, there should always be places for people to enjoy dark.

Lighting of pathways that have formal settings has the same principals with pathways that are discussed in "roads and pathways" section. Parks, however, generally have more informal pathways than organized pedestrian areas or walkways. These informal settings might provide change of elevation, steps and difference in the pavement surface. Pads of concrete or large flat stones can be placed individually to be used as the pathway. These areas require more attention from people in order to navigate it safely. People might need to give all their attention to the course of path and they miss the chance to enjoy more interesting visual aspects of the landscape. Thus, this type of path requires a higher light level for psychological comfort. (Moyer: 1992, 235)

Lighting of plants reflects the approach for the overall design of the park. The amount of light refers to the importance of the plant or the tree in the overall design. As the importance of a plant increases in the composition, so should the light level of the luminance of the tree or plant. How a plant fits into the composition determines the quantity of light the plant should receive and how the plant should be treated with light. Moyer (1992) states that a tree that forms the heart of a daytime view may need to blend into the background, leading the viewer's eye to another location in the landscape at night. The characteristics of the tree, location in a landscape, and requirements of the composition dictate this shift. Trees that act as a major focal point should be lit so that they appear brighter than less important elements in the composition. (Moyer: 1992, 185)

Figure 2.29. Angel of North, Gateshead, England.
Source: http://www.antonygormley.com/

The intensity of light creates major focal points; this also applies for the plastic elements, sculptures or small scaled architectural structures in urban parks. Intensity of light determines whether these elements will be perceived as focal points or landmarks. Introduction of change of intensity of light increases the interest in an area and lit elements as such becomes landmarks in parks and gardens. (Moyer: 1992, 204) Since not lighting an object is also a lighting decision, these elements can also be left in the dark as silhouettes. (Moyer: 1992, 204; Phillips: 2004, 78) The Figure 2.29 is the "Angel of the North" which is a contemporary sculpture designed by Antony Gormley and located in Gateshead, England. The tall metal sculpture is placed on a hill overlooking a motorway and it can be seen from a considerable distance under the daylight. There is no lighting for this sculpture with regards to the decision that it will remain “unlit” at night -to be experienced by daylight during the day and seen in silhouette, by the moon and the stars at night.

Luminous Composition, Direction: As it is stated in the previous chapter, pedestrian areas require even lighting for the safety and security of the pedestrian movement. Even light provides a harmonious illumination without camouflages that might conceal obstacles. The informal structure of the pathways of parks may tolerate disharmonious illumination. Depending on the importance, a pathway can introduce uneven lighting to increase interest and mystery. These pathways serve as places to wonder at night for people who are interested. In these areas people would not need a higher level of light and even distribution since they are night-adapted (Phillips: 2004, 55) The primarily important pathway in parks, however, should not create a feeling of unease and should not hinder the enjoyment of the walk by drawing all the attentions to the pathway itself and possible surrounding obstacles.

For the illumination of trees, the selection of direction affects the appearance of the tree. The plant and tree illumination consists of uplighting, downlighting, frontlighting, backlighting and sidelighting. The chosen lighting direction affects the shape, color, detail, three-dimensionality, and texture of the plant being lit. (Moyer: 1992, 185) Uplighting creates dramatic effects on plants. It makes tree foliage glow when light shines up through the leaves. Creating a glowing canopy on a tree with translucent leaves emphasizes the foliage shape and color, as well as the overall canopy shape. While dramatic, it produces unnatural shadows, and often undesirable appearance. Uplighting changes the plant's appearance from its daytime look. Downlighting, following the direction of the sun, provides a natural appearance. Downlight produces shadows on the underside of leaves of plants, echoing how the sun lights the plant. As with most design, visual compositions often incorporate several effects and techniques. For example, the utilization of both uplighting and downlighting in one composition provides more visual definition and interest in the view. (Moyer: 1992, 204-7)

Frontlighting of plants creates the shape, ties areas of a composition together, and provides detail and color to the view of a tree or a plant. Backlighting of plants brings interest to the scene: it can add depth by separating a plant from the background. It can either complete the shape created by frontlighting, or emphasize shape when using the halo technique. With the silhouette technique, backlighting creates drama by eliminating color and detail and showing only form. Sidelighting emphasizes texture on plants and creates shadows on either vertical or horizontal adjacent surfaces. These shadows either add interest or distract from the composition. (Moyer: 1992, 204-7)

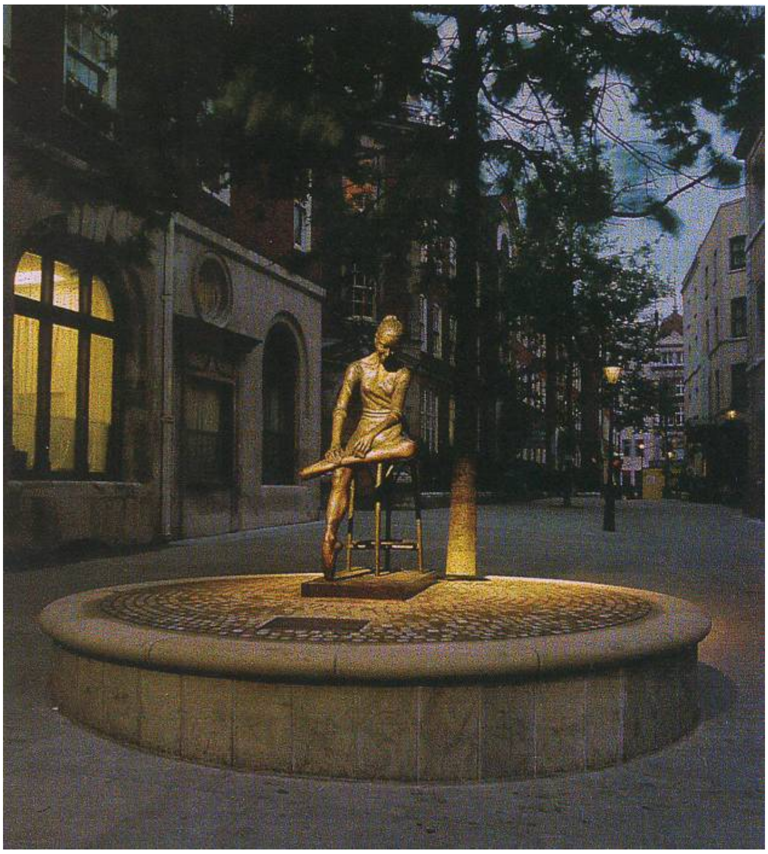


Figure 2.30. Little dancer, Covent Garden, England
Source: Phillips, Derek (2004); "The Lit Environment", Bath Press, Glasgow, UK

The size, physical characteristics, and special features of the sculpture directly affect the lighting effect created. Highlighting features of a sculpture can convey important information to the viewer or lead the viewer's interpretation. Line can communicate emotion or movement; positive and negative space creates form or detail; texture shows detail; facial expressions provide emotion. Due to the familiarity of sunlight on objects, downlighting maintains the natural appearance of the sculpture more easily than does uplighting. (Moyer: 1992, 215) The sculpture in the Figure 2.30 is "The Little Dancer" in Covent Garden demonstrates a good application of downlighting. The single metal halide lamp situated 7 meters above the sculpture creates no glare and throws an acceptable pool of light on the front of the statue. (Phillips: 2004, 76)

However, mimicking daylight by downlighting creates shadows on the underside of textural details. For example, shadows introduced onto human faces or animal figures from directly above can alter the sculpture's appearance, transforming friendly faces into frightening, unfriendly, or ugly forms (see Figure 2.31) (Moyer: 1992, 214-215)

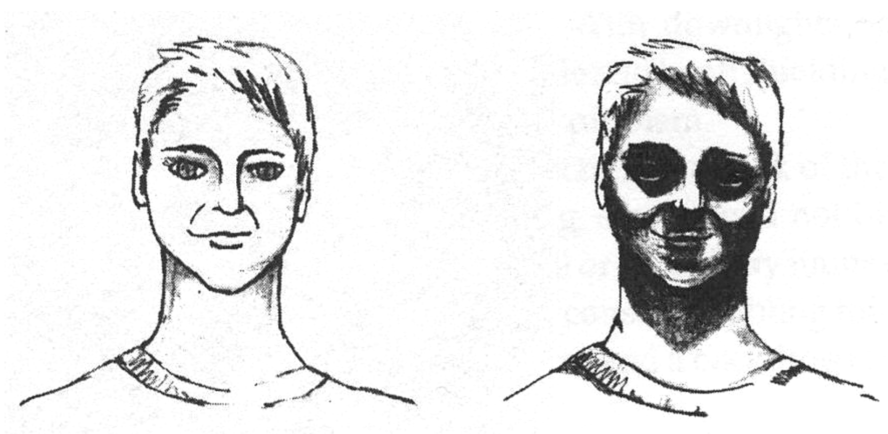


Figure 2.31. The Effect of light on a human face: from the front (left) versus from above (right)
Source: Moyer, Janet Lennox (1992), *"The Landscape Lighting Book",* John Willey & Sons, Inc. New York, p215

Fountains are pleasant additions to the lit environment of parks. Stretches of water and fountains create liveliness and make the surroundings look particularly cheerful. Illuminated fountains look best against a backdrop that is as dark as possible, particularly when colored light is used. Jets of water and vapor act as diffusers, absorbing and dispersing the light that is directed at them. It is best to position luminaires under the water surface; just a single light source under a jet of water procedures an attractive effect. External light weakens the effect of the fountain illumination. (vanSanten: 2006, 62)

Luminous Composition, Color: Use of colour in lighting of parks affects how people perceive and feel about the space and landscape elements. Color of light can create lively environments by introducing variety to the lit environment. (vanSanten: 2006, 29) Also, color of light has significant effect on how people perceive the soft landscape elements. The color of light a lamp produces determines the color a soft landscape element will appear. (Moyer: 1992, 118)

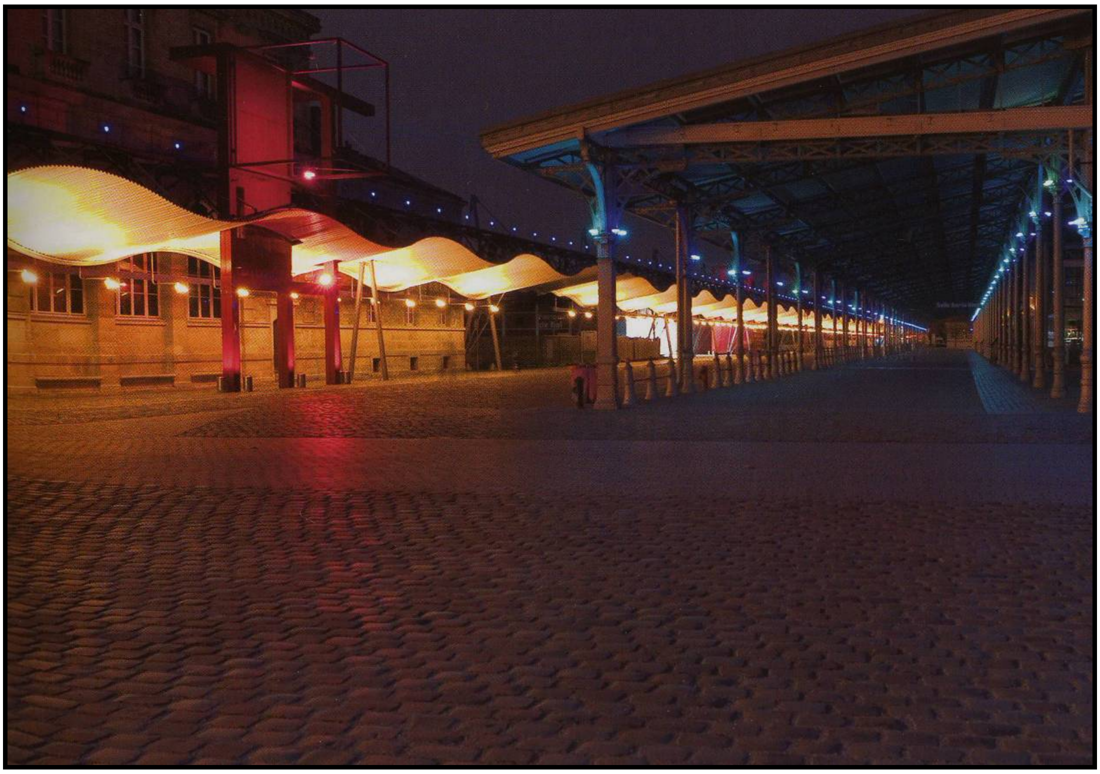


Figure 2.32. Parc de La Villette at Night, Paris
Source: vanSANTEN, Christa (2006); *"Light Zone City",* Brikhauser – Publishers for Architecture, Basel, Switzerland, p29

The Figure 2.32 displays the illumination of Parc de la Villette in Paris. The illumination of this park demonstrates that color and a large amount of light, combined with a large scale urban park, eliminates the sinister and dismal of an empty park. The passage in the photograph is a popular area in park: it is a pedestrian thoroughfare during the day and occasionally at night. Color works effectively here and makes the area lively even there are no people using it. (vanSanten: 2006, 29)

The color-producing characteristics of lighting sources can be used to influence how people feel about their surroundings and landscape elements. Variation in color from one light source to another can be used to expand or limit depth in a space or add a creative touch. The lighting effect created in parks alters through the seasons. Colour, shape, texture of plants, and foliage of trees show difference in every season, hence the lighting effect created by the illumination of these elements show significant differences. The variation of landscape colours, following season or flowering period, may modify the visual perception of foliage. It is therefore a matter of choosing lamps that best render the different seasonal colours or, if this is not possible, to privilege one seasonal scheme over the others.

Overall Composition: The overall composition of lighting of parks and landscape elements raises the discussions of how the location and different views affect experience of people, and how the lighting affects the fear of crime.

The Effect of Location and Different Views: At some settings, lighting fixture also defines the entrances in addition to the effect of light. The lighting of trees and plants are the element in the landscape that must be integrated with the rest of the composition. Landscape elements are lit considering how people will view them. The views from different angles are aimed to look pleasant: all the setting should not be prepared for a pleasant appearance from an only single point. Lighting design in parks also aims to make sure that the appearance of a tree is accentuated and it becomes pleasing to the eye of a viewer. With an imbalance of light on a tree or surrounding the tree, the lighting can become eery or frightening. According to Moyer, carefully planned lighting design adds to the beauty of plant material and increases the enjoyment and value of the park or the garden. (Moyer: 1992, 207)

The Effect Lighting in the Fear of Crime: Feeling safe depends on the knowledge of the environment which needs the awareness of where you are in the space (Lang: 1994) Research reveals that overall composition of lighting of the parks and landscape elements can provide for the knowledge that people need to obtain about their environment at night, and in turn, reduce the fear of crime. Crime relates to a certain situation or material, whereas fear of crime depends on the perception of the environment. It is defined as a reaction to the attributes of the space and is more common than the crime itself (Hutchings: 1994). The urban parks which provide positive psychological effects on humans are defined as not-to-go places due to the fear of crime. According to Kaya & Kubat (2007), numerous studies investigating the relation between fear of crime and space share the conclusion that fear is more related to the spatial configurations than the crime itself. Kaya & Kubat (2007) also states that limitation to the visibility properties of an area is defined as "desolate" areas by people. It is also stressed by Kaya&Kubat that areas which have high visibility and which attract the pedestrian movement (which are not desolate) are percieved as secure areas by people. Thus, the fear of crime can be decreased by increasing visibilty in the parks through overall composition of lighting. The overall composition of lighting of parks can define the boundaries of the park and visually link the routes and accentuate entrances. People feel comfortable when they can see the boundaries of a place. (Moyer: 1992, 19) Lighting can define the edges and entrances of a park effectively.

2.3. LIGHTING AND URBAN DESIGN

This section aims to present how the lighting of different urban sections 'come together' in a comprehensive lighting plan in order to create a cohesive and strategically designed nocturnal landscape. In this sense, this section presents the review of the existing approach to urban lighting master plans in literature. This section reviews two prominent world examples: The New Lighting Plan of Lyon *(La Nouveau Plan Lumière de Lyon)* and Lighting Master Plan of Downtown Stuttgart *(Lichtmasterplan Innenstadt Stuttgart)* so as to help reveal the components that formulate the urban lighting master plans.

Research reveals that, urban lighting master plans have been attributed to innovation, attraction and improvement in the development and renovation of urban environments in the last two decades; and will reinforce its significance for the upcoming three decades (Tellini&Ianone: 2006, 48). As Narboni (2004) points out, 'urban lighting master plan' has been popular component of 'reformation of urban identities' since the 1980ies. Prominent and pioneer projects such as the Lyon, France have proved that the systematic use of light is excellently suited as a means for positively improving a city's image. Urban lighting master plans contribute to creating of the urban image by providing nocturnal visual master plans of cities which have visibly constructive and conceptual approach. (Phillips: 2004, 12; Tellini&Ianone: 2006, 49) Urban lighting master plans provide a harmonious combination of basic principals in lighting design and they aim at presenting coherent and clear nocturnal structures, attractive themes, and safe and secure urban environments at night. In addition, urban lighting master plans concern the issues of energy efficiency, low-cost solutions for urban exteriors and environmental friendly recycling of lighting sources.

2.3.1. Existing Approach to Urban Lighting Master Plans

This nightscape of the city is composed of numerous illuminated urban sections of widely varying size and intensity. Public lighting, the interiors of dwellings and offices, and illuminated structures create the nocturnal composition of the urban landscape. Without an overall approach it is very difficult to create the composition that permits a better reading of the site, of the morphology or the urban form, of the depth and topography of the city. (Narboni: 2004) Public lighting has been illuminating the streets, squares, buildings and important structures of cities with artificial light since the beginning of the 20^{th} century. Although it stagnated during the war and post-war periods between 1930ies and 1950ies, nocturnal composition of the urban landscape has been continiously evolving in Europe and North America (Ritter: 2008) Until the late 1980ies, the illumination of the city was realized through incrementalist lighting projects that focused on parts of the city rather than the whole. (Ritter: 2008) Comprehensive urban lighting plans are pioneered in France in the late 1980ies as a result of the "festive lighting" event carried out in Paris in this period, which encouraged the urban economies for further investments on urban lighting. (Enginöz: 2004) Since the 1980ies, lighting designers and urban planners are seeking to establish composed, appealing, functional and flexible urban images at night through urban lighting master plans.

Research reveals that, designers who create the urban lighting master plans aim at highlighting certain sections of the urban environment at night. These sections are the contents of the city images: paths, edges, districts, nodes and landmarks, which are classified by Kevin Lynch (1960) based on his study on the people's percetion of the city image. The findings of Lynch's study reveales that the perceptions, bearings and memories of people moving in an urban environment are essentially shaped by these five basic elements. The Eiffel Tower in Paris, the Space Needle in Seattle, the Brandenburg Gate of Berlin or the Bosphorus Bridge in İstanbul -no matter the size of the a town or city- residents and visitors constitute a distinctive image of it in their mind. Different people asked to make a sketch of a town or borough will draw the same basic structures: roads, paths, a central square, an outstanding building or a sculpture. Urban lighting highlights these elements and urban lighting master plans pattern these elements together to provide a satisfying composition.

Urban lighting master plans present lighting schemes for **paths** which not only provide illumination for safety of the movement and secuirty of people, but also consider the energy efficiency and respond to the heightened aesthetic requirements of people. Urban lighting masterplans provide cohesive and hierarchical the street lighting that increases the legbility of the city. On the other hand, these plans illuminate the **edges** of the city to define the boundaries of the urban space, and differentiate between the areas that have different functional uses or aesthetic emphasis. The unique experience of **districts** of the daytime is transformed to the nighttime via urban lighting master plans. Definition of districts is majorly based on the atmosphere and character of the area, and urban lighting significantly determines the nocturnal character of the distrcits and emphasizes their unique character with light. Moreover, urban lighting master plans notify the important 'happenings' in the **nodes** by using lighting, such as marking the transportation lines and transition areas from one transport mode to another or one level of hierarchy to another. Lighting also defines the areas of different functions in nodes (such as squares), and emphasizes and boosts the aesthetic properties of nodes. By lighting the urban **landmarks** under a lighting master plan and maintaining their significant character during the night helps create a well-composed urban silhouette. Instead of presenting a set of singular points that draw the attention of people in an unorganized nocturnal layout, urban lighting master plans present composed nocturnal silhouettes at night with lit landmarks that clue of the nightscape composition of the city.

Research reveals that, the lighting principals that are reviewed specific to different urban sections can lead to creating of pleasant nocturnal scenes in the city; whereas urban lighting master plans create the cohesive nocturnal city image by interacting these parts within a conceptual and comprehensive framework. Nevertheless, urban lighting master plans are long-term instruments for city governing authorities: lighting plans provide flexibility and staging to reach the objectives of lighting design over a period of several years in a strategic approach. Moreover, implementation of urban lighting under a masterplan more dexteriously handles the environmental issues such as: replacement and recycling of the mercury lamps, using energy efficient light sources and lighting schemes, and controlling the overall light intensity to avoid light pollution. In the fallowing sections these issues will be reviewed through the urban lighting master plan cases of Lyon in France and Stuttgart in Germany.

2.3.2. The New Lighting Plan of Lyon - *Le Nouveau Plan Lumière de Lyon*

Lyon is the second largest city in France and capital of the Rhône-Alpes region. The city of Lyon has a unique character owing to the well-preserved renaissance heritage of the built-environment, the water channels and the topographical properties. Since the beginning of 1990ies, on the other hand, the significance of the city in world arena has significantly increased owing to the urban lighting master plan that gave a fresh and inspiring image to Lyon. In 1989, city has implemented an urban lighting master plan to enhance the buildings and monuments of Lyon. Artistic lighting designs showcased monuments and public spaces around Lyon: City Hall, Hôtel Dieu, the universities, bridges, banks of the Rhone, Gerland Park, etc. (ADERLY: 2008) For Henry Chabert, who was the deputy mayor of town planning and public spaces during the early 1990ies, stated that the lighting plan formed a part of the general strategy to enhance the urban environment and improve life in the city. (Laganier: 2008)

The first urban lighting master plan was a political, artistic and technical pioneer. The organization of the permanent lighting gave the city a new image and led to the lighting of more than 250 sites throughout the City. Since then, lighting has been more than just a tool for assuring the nighttime security: it has become an essential aspect of urban development. (Lyon.Fr: 2006) The success of the first lighting plan reached to such a level that since 1995, Lyon has been exporting its expertise in urban lighting. The lighting projects: the Hermitage Winter Palace in St. Petersburg, Russia, the Castillo del Morro in Havana, the Ho Chi Minh City Museum in Vietnam, are carried out by Lyonnais lighting designers and the shareholders of the Lyon's urban lighting master plan. Nevertheless, Lyon has been evolving its nocturnal image and developing its nightlife since the nightscape of the city has become one of the most important elements in its tourism activities. (Laganier: 2008)

In this respect, the first urban lighting master plan was updated so as to keep the lighting a dynamic component of the city in 2004. Fifteen years later, in 2004, the second Light Plan of Lyon was prepared to invite even more creativity, to integrate new techniques with better use of lighting as an element of urban, social and environmental development tool. (ADERLY: 2008) The second urban lighting master plan of Lyon modulated lighting to harmonize it with the activities and rhythms of the City, focusing on the physical properties such as rivers, hills, silhouettes and main arterial roads. The new urban lighting plan of Lyon aimed at creating a vision for the city. It also aimed at developing lighting techniques, focusing on the ecology of lighting and succesfull implementation of the lighting plan. (Laganier: 2008)

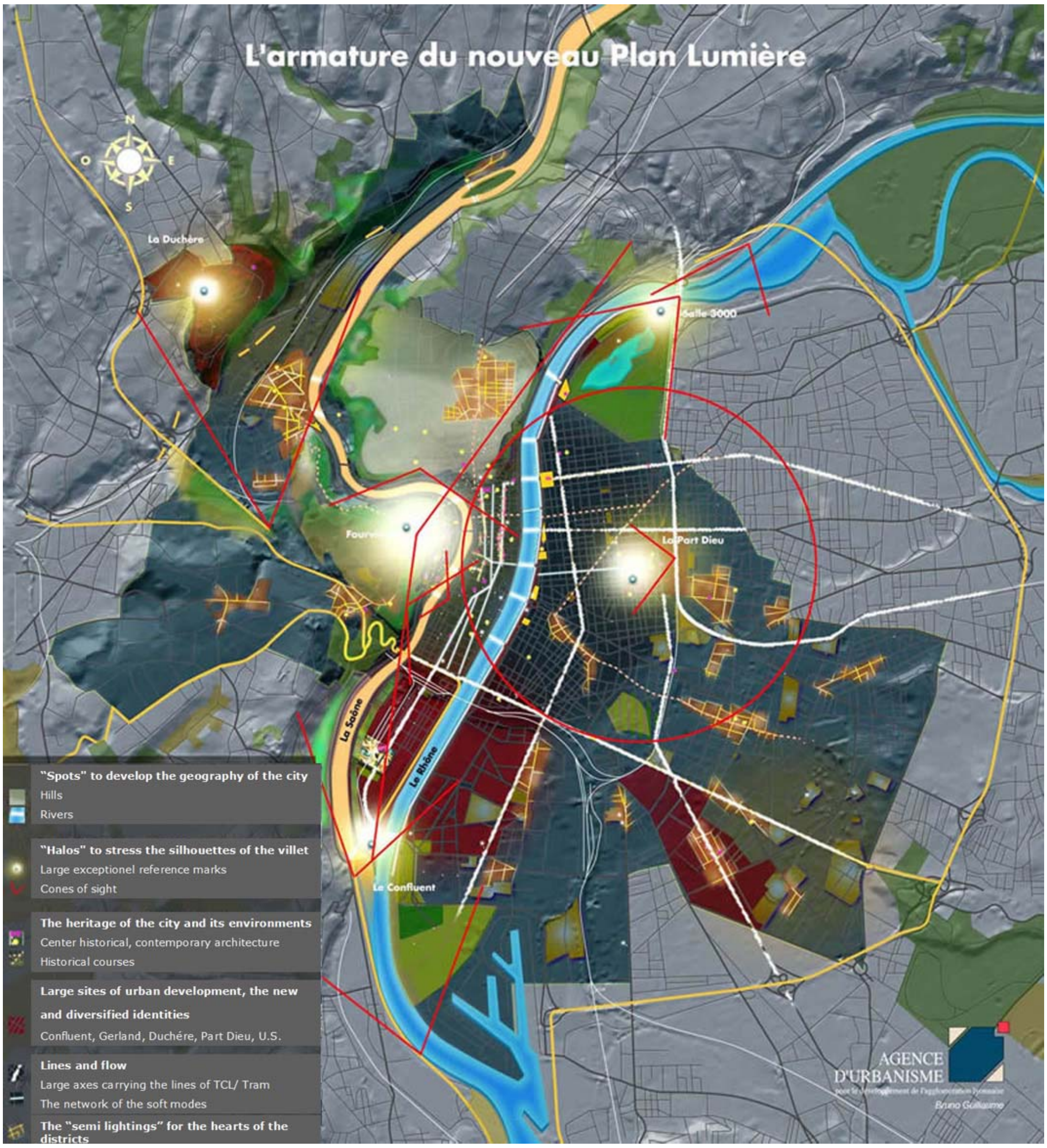


Figure 2.33. The New Lighting Plan of Lyon
Source: http://www.lyon.fr

The figure 2.33 displays the existing urban lighting master plan of Lyon. The lighting plan is composed of five basic elements: spots, halos, heritage areas, urban development areas, and lines of movement. This categorization corresponds to the Lynch's model of the city image with "spots" being either the landmarks or the edges, halos being the "landmarks", "heritage areas and urban development areas" being the nodes and the districts and "lines of movement" being the paths. The urban lighting plan provides development strategies based on these urban sections.

Paths: The transportation network of the city is divided into two hierarchical levels in the urban lighting master plan. The major axes that consist the routes of the light rail system or the trams are identified as broad paths of light. Major axis of transportation and city entrances are elements to highlight; the approaching lines and station of the TGV will become major points. The lower hierarchical roads are defined as the network of the soft modes of transportation. The lighting plan proposes the suppression of horizontal flow and aims at avoiding light trespass to residential units and escape of light skywards. (Lyon.Fr: 2008)

Bridges, on the other hand occupy a central place in the writing of the history of Lyon. The bridges portray the "crossing" theme in the lighting plan which symbolizes Lyonnais being played an important role in the great hemispheric projects as the Suez Canal or Paris-Lyon-Marseille Line. Some of these bridges offers exceptional panorama of the city at night, in that sense these paths gain a different character. (Lyon.Fr: 2008)

Edges: Redevelopment is in progress on the banks of the Rhône, where lighting heralds a new future. Lighting plan presents a five kilometers long redevelopment of the bank with lighting in the city centre. A different luminous atmosphere is designed for this edge of the city and the river bank is illuminated like it is moonlit. On the other hand, the urban lighting master plan defines the rivers zones of calmness and breathing. They are part of the few spaces, with the parks, which is designed to respect the darkness. The public lighting in these areas are designed to be less pretentious. However, it will seek to create differentiated ambiances to characterize the banks of the Rhône and the Saône. (Lyon.Fr: 2008)

Districts: The new lighting plan proposes suitable illumination to underline the essential nature of urban life and district activity. Lighting is used a mean of revealing the identity of a place and it enriches the development and renovation policy. (Lyon.Fr: 2008) Urban lighting plan emphasizes nocturnal identities of major districts. Besides, the projects also bring emphasis on the built-up heritages which are often considered as minor urban values. (Lyon.Fr: 2006)

The developments of Lyon in the last three decades created new identities. The new urban lighting plan is therefore presented new territorial plans as Lyon-Confluence site, which is set to undergo significant development in the next 20 years (see figure 2.34), Vaise Industry, and the Grand City Project Lyon. In these territorial plans, the new identities and ambiances of these new development areas are reflected on the lighting design. (Lyon.Fr: 2008) On a different scale, experimental lighting projects will largely target local neighborhoods. They will be conducted over short periods in, for example, the heart of the Vaise district, or the Part-Dieu project which will be realised in further steps of the developed. (Lyon.Fr: 2006)

Nodes: The urban lighting master plan also presents territorial lighting schemes which give more detail about the lighting strategies (see figure 2.34). Nodes of the neighborhoods are emphasized by different colored lighting designs which are defined as “point of color” in the urban lighting master plan. The urban lighting master plan presents the different nodes which are given different color emphasis to define their character.

Landmarks: Landmarks are defined as halos that stress the silhouette of the city. There are five landmarks defined on the lighting plan: the Musée des Confluences, La Part Dieu, le Hall 3000, La Duchère and The Basilica Notre-Dame de Fourvière. The Musée des Confluences in the Le Confluent neighborhood will be lit to increase the attractiveness of the core and lighting will benefit from the visibility of the structure from distance and also the reflections on the river. (Laganier: 2008) The towers of Part-Dieu, La Duchère will and the Hall 3000 in the Cité Internationale will be lit as landmarks to improve the silhouette of the city and to present dramatic panoramas from different directions. Owing to it topographical position and its historic structure, The Basilica Notre-Dame de Fourvière will also be lit to enhance the dramatic emphasis on the nightscape. (Lyon.Fr: 2008)

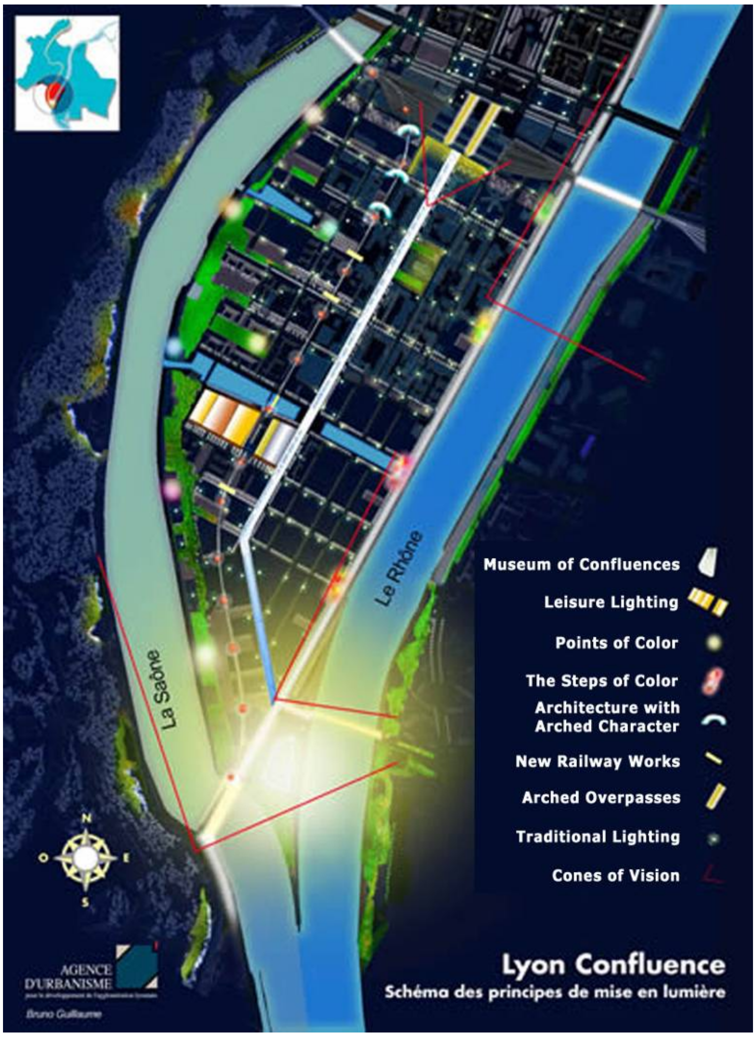


Figure 2.34. Lyon-Confluence Territorial Plan
Source: http://www.lyon.fr

In addition to these specific strategies, the urban lighting master plan presents other strategies to assure the sustainable and innovative development. These strategies focus on enhancing creativity and design quality, increasing chances for research on lighting, and reducing environmental pollution and energy costs.

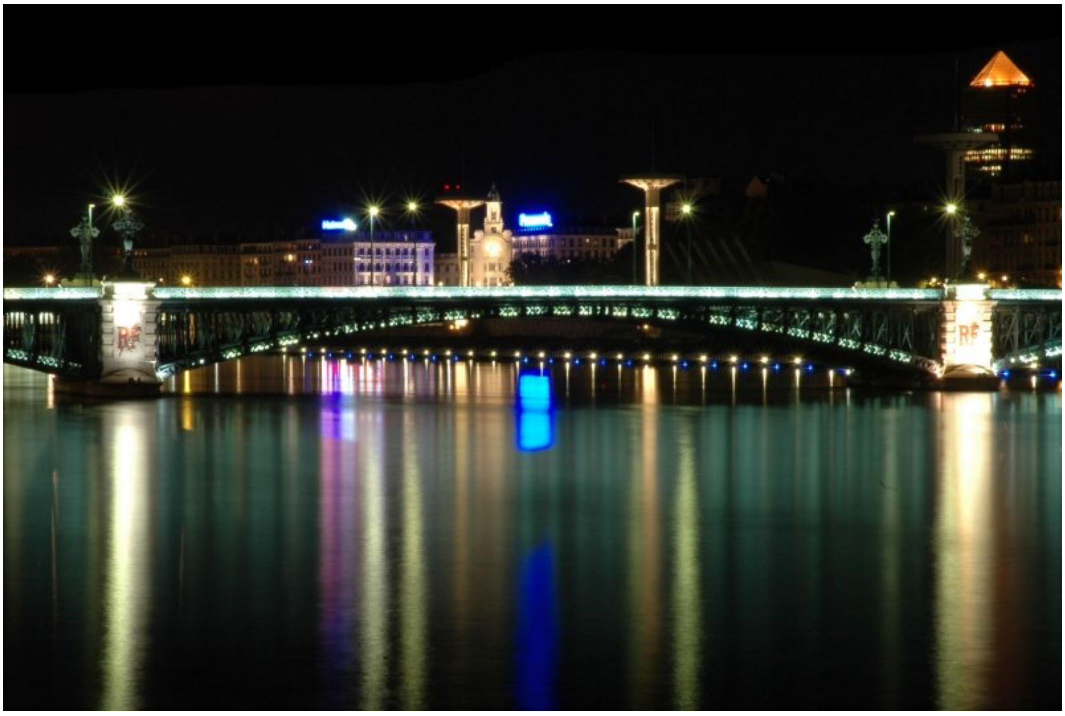


Figure 2.35. View of Lyon at Night, France
Source: http://www.pbase.com/franck_perichon/image/105188011

In order to avoid producing fixed images, urban lighting master plan presents strategies to blend permanent operations with temporary events. The permanent city lighting will therefore be composed of a basis together with temporary lighting effects. On the other hand, the new lighting plan sets long term goals with permanent designs and day-to-day lighting levels will be relatively reduced. (Laganier: 2008) In order to invite more creativity and keep Lyon's leading innovative position in the world market, urban lighting master plan encourages the experimental efforts. The professional environment of the lighting designers in Lyon and in Rhône-Alpes region is encouraged to establish new actions, new developments of coherent programs with the participation of both private and public stake holders. (Lyon.Fr: 2008) One of the proposals of the urban lighting master plan is establishing an 'art department' within the City of Lyon and launching a study into discovering combination of aesthetic and technological considerations in urban lighting. (Laganier: 2008)

Figure 2.36. The View of the Major Landmarks and Distrcits
Source: http://www.lyon.fr

The new urban lighting master plan raises the concerns about the sustainable development. The environmental pollution caused by lighting is put under the magnifier and strategies are produced such as the recycling of materials used in lighting, decreasing the energy-consumption and avoiding the pollution of the night sky. In the category of recycling, the new plan proposes that all of the lamps which are used in the lighting of the city will be recycled. Plan also proposes to quit using lamps with mercury and lead since these materials are difficult to dispose and they have serious negative effects on the environment. On the other hand, some experts denounce the violation of night sky, the waste of the electrical energy, the detrimental effects on human beings and nature. The experts stress that the number of 'points of light per capita' has progressed considerably in last ten years. The new plan proposes that a considerable amount of lamps in service can be replaced by the lamps that consume less for the same illumination. (Lyon.Fr: 2008) The plan also presents a solution to environmental problems such as participation in the European 'Green Light' program to reduce energy consumption. The program includes the use of more energy-efficient lighting systems, the gradual installation of lamps with better light quality or superior efficiency, and the use of LEDs. (Laganier: 2008)

2.3.3. The Lighting Master Plan of Downtown Stuttgart - *Lichtmasterplan Innenstadt Stuttgart*

Inspired by the many impressive examples of urban illumination, especially by the city of Lyon, the civic authorities of Stuttgart took the decision to implement a comprehensive lighting design in year 2004. (Knappschneider&Becker: 2008) The City Council of Stuttgart aimed at elevating the image of the regional capital, Stuttgart, by using the medium of light. The main concerns of the City Council were to portray how attractive the city is for its residents and visitors, and also how safe the inner-city was. During the design stage, the lighting consultants benefited from existing data and field studies to define of the existing lighting in the city. The team was able to examine how the aspects of urban space, the effect of light at night, the technical condition of the functional lighting, the architecture, spatial usage and the general esprit of the city are seen through the eyes of town planners, lighting consultants and tourists. The analysis of the team showed that there was a considerable impairment in how the urban space was perceived at night due to the then existing lighting. (Knappschneider&Becker: 2008) The urban lighting master plan of Stuttgart, with giving reference to Kevin Lynch, described the city as a whole comprised of paths, edges, nodes, districts and landmarks. The urban lighting master plan of Stuttgart defined its goal to make these urban structures possible to experience also at night by the support of lighting. (LRS: 2007)

The pre-design survey showed the impairment in how the urban space was perceived was due to the closely spaced and low mounting lighting fixtures of the city. The lighting fixtures led to a peculiar spatial structure in which the vertical plane was simply cut in half. The vertical fragmentation caused by the lighting fixtures had a negative effect on the appearance of the city at night. On the other hand, the light emitted by the mercury vapor lamps did not meet the requirements of the centre, and the energy consumption of these lamps could no longer be justified either economically or environmentally.

Furthermore, the high level of light emissions whitewashed the building facades with a pale, undifferentiated light, which also resulted in undesirable light pollution.

The designing team developd the urban lighting master plan on lighting strategies that address both functional and accent lighting for Stuttgart. The lighting plan is not only about the visual components, such as the scenic architectural lighting, the light art and the luminaire design, but also about seeing the master plan as a complex model that has to take smart use of the resources and energy efficiency into consideration by using new and appealing technologies and methods. The urban lighting master plan of Downtown Stuttgart aims at a differentiated reworking of the nocturnal cityscape in order to meet up to the demands of a clear civic profile, the inhabitants' to identify themselves with their hometown and the city's outward image. (Knappschneider&Becker: 2008)

Having described the major problems of the lighting, the designer team of the urban lighting master plan of the downtown Stuttgart, presented three main themes: the City Ring Road, the Stuttgart Miles and the "Diving Boards". These three main themes were supported by illumination of the certain buildings and squares in the city. The lighting master plan notes presents the relation between the the urban components of Kevin Lynch and the new lighting design of the city. (LRS: 2007) In this sense, I cetagorized the lighting master plan under these five components: the city ring road being as "edge" (and also a path), the Stuttgart Miles as "districts", Diving Boards as "paths" of a special kind, squares as "nods" and buildings as the "landmarks." These components are presented with reference to the Knappschneider & Becker (2008) and "Lighting Masterplan of Stuttgart Plan Notes" of the desiging Licht|Raum|Stadt-planung (2007).

Edges: In geographical terms, Stuttgart is characterized by its location within a basin. People who drive to the city perceive that city down below them in the valley. The urban lighting master plan proposes a modification to the city ring road lighting to emphasize it as an edge of the downtown. The lighting of the ring road aims to make the limits of the city centre clearly visible for drivers who drive into the downtown from a distance (see Figure 2.37). The limits of the city centre are thereby can easily be a recognizable landmark and an orientation aid that constantly refers to the city centre. Colored LED pins are to be fitted to the ring road's lighting fixtures, mounted at a uniform height according to the local road situation (see figure 2.38). These will then trace the curvature of the ring road. On all adjoining roads relevant to the ring road, these red pins will lead in the appropriate direction, thereby giving direction to drivers.

Figure 2.37. The View of the Downtown Stuttgart and the Ring Road
Source: Knappschneider et al. (2008); *"Lighting Masterplan of Stuttgart",* Professional Lighting Design Turkey, N:7, Ağustos Yayın Tanıtım, Istanbul, Turkey, p41

Figure 2.38. Lighting Fixtures with red LED lightings
Source: LRS (2007), "Lichtmasterplan Innenstadt Stuttgart: Gesamtkonzept zum Umgang mit Licht in der Innenstadt-Kurzfassung", Wuppertal, Germany, p10

Districts: The four longitudinal axes in the city centre have been known as the 'Stuttgarter Meilen' (Stuttgart Miles). These axes have specific and unique daytime characters. Hence, these districts presented perfect material to create scenic lighting for the hours of darkness. These four districts are: the Leisure Mile, the Shopping Mile, the Green Mile and the Culture Mile (see Figure 2.39). These districts diversify the night of the Stuttgart with their unique characters and they are significant for the image that city aims to convey.

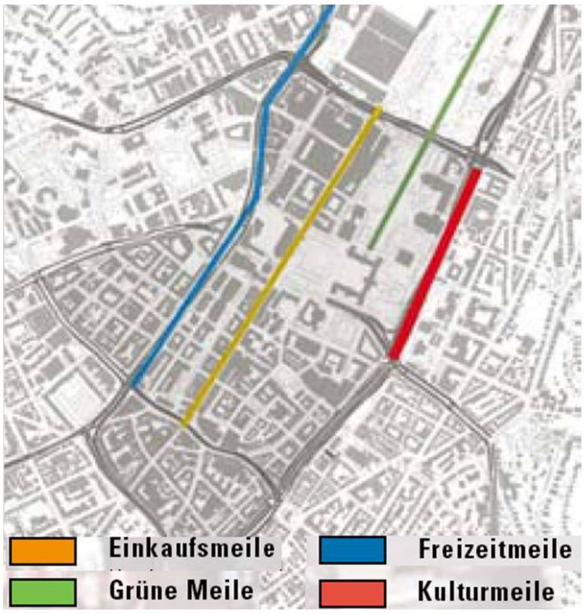


Figure 2.39. The Stuttgart Miles
Source: LRS (2007), "Lichtmasterplan Innenstadt Stuttgart: Gesamtkonzept zum Umgang mit Licht in der Innenstadt-Kurzfassung", Wuppertal, Germany, p10

The Shopping Mile (Einkaufsmeile) is the Königstraße. This district forms the backbone of the city centre and, as the central pedestrian zone, has massive potential for the retail trade. Retail outlets and shop windows are the dominant feature of the street and its immediate side roads. The beginning and end of the Königstraße are each marked by a tower lying exactly within the line of sight. As a main artery for the city, the lighting plan proposes a lighting fixture that fits to the characteristics of the area. The lighting fixtures have convincing specifications in terms of illuminance, quality of light, height of light source, quality of materials and quality of design. During the hours of darkness, public lighting together with the lighting of the shop windows creates an attractive and pleasant atmosphere (see Figure 2.40).

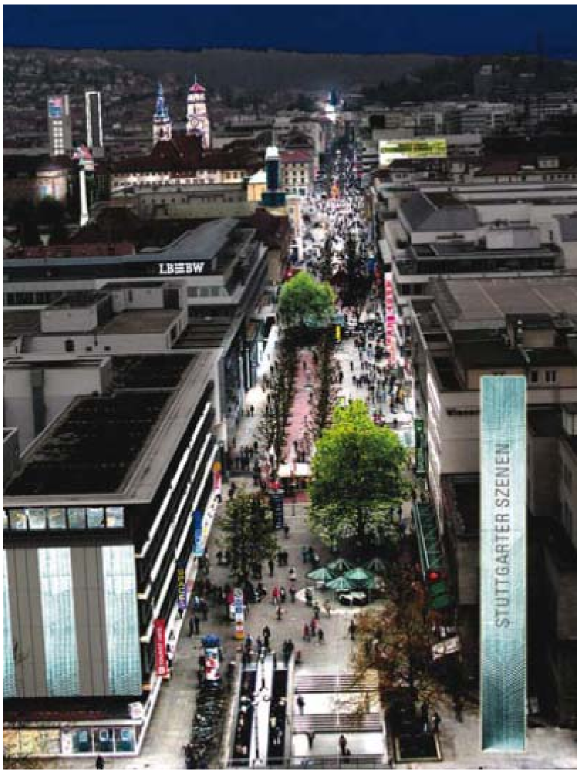


Figure 2.40. The Shopping Mile
Source: LRS (2007), "Lichtmasterplan Innenstadt Stuttgart: Gesamtkonzept zum Umgang mit Licht in der Innenstadt-Kurzfassung", Wuppertal, Germany, p13

The Leisure Mile along the Theodor-Heuss-Straße is also part of the city ring road with its high traffic levels. Lighting plan presents a new social scene in this area, being typified by lounges with open-air restaurants and large terraces. The restaurants and bars open after the shops are closed or in the early evening and therefore extend the usage of the urban space into the hours of darkness. The lighting plan proposes an eclectic and innovative design which is modeled upon the Hollywood, Las Vegas or Miami, where the focus of the design is seeing and being seen.

The revitalization and reinterpretation of the current park areas with reference to their historical design is planned under a project entitled the Green Mile (see Figure 2.41). The three sections of the park are to be interconnected with the help of lighting with an artistic emphasis. Lighting plan aims to give a differentiated character to the castle gardens without intervening the existing usage, the layout of paths or the landscape gardening. The plan envisages a new illumination of existing routes in view of several criteria including improved safety. The lighting design of these routes will present lighting installations which can be experienced from different angles. In this way the axis will link up the different sections of the castle gardens and thus become a new highlight for the night walk to the opera, theatre or museum.

Figure 2.41. The Green Mile, Stuttgart, Germany
Source: LRS (2007), "Lichtmasterplan Innenstadt Stuttgart: Gesamtkonzept zum Umgang mit Licht in der Innenstadt-Kurzfassung", Wuppertal, Germany, p19

The "Culture Mile" features a wealth of high-grade architecture and a concentration of important cultural facilities in a central city-centre location. These cultural facilities make the area highly important for the whole city. The building complex of theater is cut in two by the Konrad-Aden-auer-Straße. Lighting plan aims to re-establish a visual link between the two halves separated by the city ring road. This includes clearly bringing out the subways and footbridges of the Konrad-Adenauer-Straße. The building sections on the Staatsgalerie side are already well defined and form an optical boundary to the city centre. The lighting plans aim at presenting a suitable counterpart.

Paths: The "Diving Boards" are intended to extend the city centre optically at night, carrying the central identity beyond the center's peripheral ring road. The Diving Boards add rhythm to the linearity of the Königstraße by creating cross-relationships and by subdividing the road into definable sections with markers. These optical extensions of the city centre are to be implemented by adding scenic lighting to the architectural end points on the Diving Boards. These end points are easily recognizable buildings with strikingly unique characters that define the completely new atmosphere of these paths. The markers picked out with light will provide visual reference points that will considerably ease orientation within the city centre. A further Diving Board element is constituted by those lanes and passages within the urban structure which unrealized potentials. Lighting plan brings emphasis to minor paths which are neglected due to their small entrances and the overwhelming popularity of Königstraße.

Nodes: The lighting plan defines the squares as the heart of the city. The characters of the squares are determined by the defining structures and functions that they posses. The character of the squares, in turn defines the identity of the cities. In this respect, lighting plan aims at presenting lighting schemes for the squares of the Stuttgart with regards to their unique characters. Lighting plan underlines the importance of the height of lighting fixtures and importance of the area-specific lighting; the plan avoids football stadium-like lighting and aims at differentiated atmospheres with respect to the use of the square.

Landmarks: The urban lighting master plan presents the landmarks for an architectural lighting installation in many different points of the city. The structures which are defined as landmarks for the nocturnal environment are places such as the Königsbau, which together with the New Castle, form a unit expansion across the Schlossplatz. When illuminated at night, the building takes on a silhouette-like appearance due to the lighting of the arcade passage with its dark, protruding supports. As one of the most important buildings in the Stuttgart city centre, its neoclassical architecture is emphasized by the lighting plan. The area situated between the New Castle, the Königsbau and the New Art Museum, the Old Castle and the Art Building, makes up the central architectural core of the city centre. This unique constellation of landmarks dominates the nocturnal landscape of the city.

In addition to the area-specific strategies stated above, the lighting plan also deals with the problem of vertical fragmentation and too-close spacing of the lighting fixtures across the city. The custom-developed lighting fixtures are maintained because the satisfied the high expectations in terms of luminaire design, lighting technology, materials and quality. The lighting plan proposed the renewal of the luminaires by retaining the existing masts and relatively low luminaire height is raised to about 4.7 meters. (See Figure 2.42) In the process, the old lamping (50/80W HME) is to be replaced by new lamps with 3000 Kelvin (35W HCI-T), giving a brilliant and also more pleasant lighting quality. The improved luminous efficacy enables the luminaire spacing at the existing installations to be doubled from 7 to 14 meters. This luminous efficacy helps removal of almost every second lighting fixture and, in turn, it presents a reduction in energy consumption of up to 50%. The reflector technology ensures the emitted light is directly only to where it is needed and unpleasant spill of light on nearby building facades or skywards is avoided.

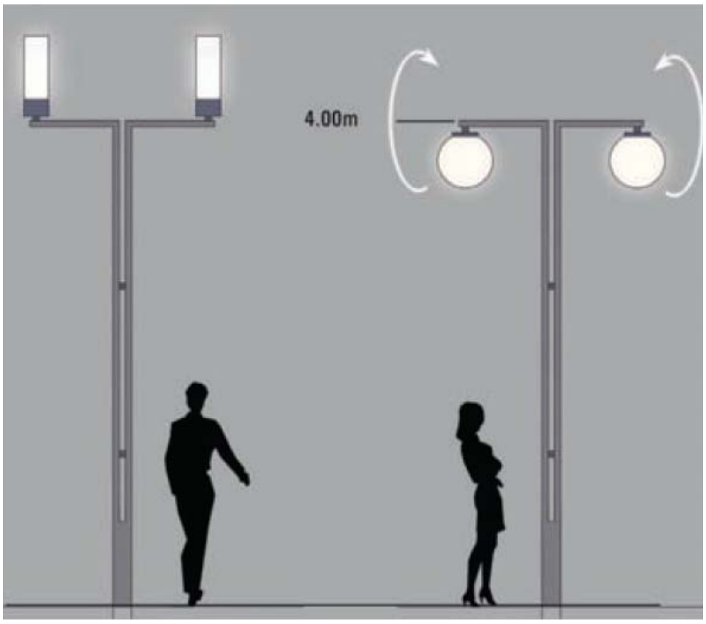


Figure 2.42. The New Cylindrical Luminaires, Stuttgart, Germany
Source: LRS (2007), "Lichtmasterplan Innenstadt Stuttgart: Gesamtkonzept zum Umgang mit Licht in der Innenstadt-Kurzfassung", Wuppertal, Germany, p19

The urban lighting master plan of Downtown Stuttgart has a future-orientated design and it has also taken many additional areas of lighting into consideration. Due to the considerable costs that will be incurred during the implementation of temporary and permanent lighting schemes, the lighting plan aims at actualizing a phased project. The time frames that have been drawn up for the implementation of the projects also include cost estimates that enable the civic investors both to plan for the required financial resources and to make these funds available. Majority of the lighting projects are based on public investments, yet some of the projects are depending on the support of the private initiatives.

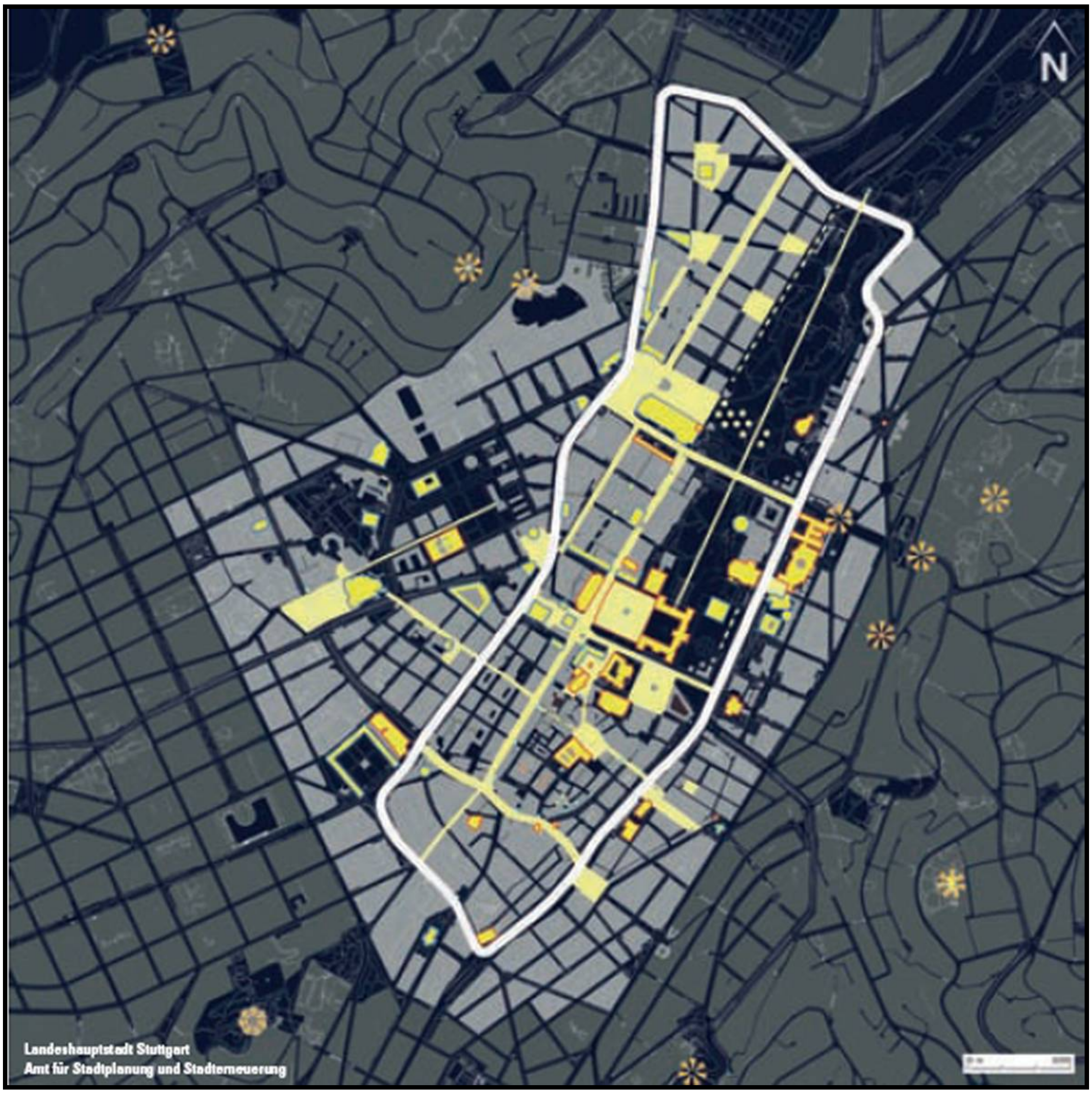


Figure 2.43. Urban Lighting Master Plan of Downtown Stuttgart
Source: Knappschneider et al. (2008); "Lighting Masterplan of Stuttgart", Professional Lighting Design Turkey, N:7, Ağustos Yayın Tanıtım, Istanbul, Turkey, p44

CHAPTER 3

METHODOLOGY OF THE STUDY

This chapter presents the methodology of my exploratory research which is carried out with 30 university students in Middle East Technical University in order to discover people's preferences on urban lighting. The research question of this thesis is: **what is the people's evaluation of urban lighting and what are the perceived attributes that elicit people's preference, interest, comfort and safety?** This research question aims to help reveal whether the existing perspectives on urban lighting are congruous with the user needs and preferences. Furthermore, this will help explore people's experiences in certain urban sections in nighttime and test the existing arguments about that. In this context, this thesis carries both exploratory and experimental research studies.

The research question comprises three sub-questions: what is the relationship between the perceived attributes of lighting and emotional appraisals, which variables of lighting are salient to people for liking a lit urban scene, and which variables of lighting are salient to people for disliking a lit urban scene. The Table 3.1 presents these three sub-questions and the research approach, variables, method of data collection and method data analysis for each of these three sub-questions.

In order to reveal the relationship between the perceived variables of lighting and emotional appraisals, I used quasi-experimental research approach. I tested the relations between the perceived attributes of brightness, contrast, distribution of light, legibility, color and emotional appraisals of liking, interest, comfort and safety by using Likert scaling method. In analyzing the data of this section, I used regression analysis method which revealed the relation between variables and emotional appraisals.

Table 3.1. The Design of the Research

Sub-Questions	**Research Approach**	**Variable**	**Data Collection**	**Data Analysis**
1. What is the relationship between the perceived variables of lighting and emotional appraisals?	Quasi-experimental (Testing)	Perceived attributes: Brightness, Contrast, Distribution of Light, Legibility, Color Emotional Appraisals: Preference, Interest, Comfort, Safety	Likert Scaling	Multiple Regression Analysis
2. Which variables of lighting are salient to people for liking a lit urban scene?	Exploratory	Like (Preference)	1. Ranking 2. Open-ended questions	Content Analysis
3. Which variables of lighting are salient to people for liking a lit urban scene?	Exploratory	Dislike	1. Ranking 2. Open-ended questions	Content Analysis

In order to explore which variables of lighting are salient to people for liking and disliking a lit urban scene, I used ranking and open-ended questions. I applied content analysis to the data of second and third sections. Through using the content analysis method I presented the frequency of mention for the variables of lighting which revealed the significance of each variable.

Revealing the preferences and expectancies of people through this research, I aim to generate certain design criteria which might be useful for urban designers in shaping the nocturnal urban scene. The design of the nocturnal urban scene requires a good understanding of urban lighting. The city of Lyon marketing its expertise of urban lighting all around the world points out that urban designers and decision makers do need in-depth knowledge of urban lighting design to illuminate their city. Although there are several examples in the world where urban lighting is dexterously used to improve the aesthetic quality of the urban space, boosted the nighttime urban activities, there are also several examples where urban lighting could not have significant positive effects. The design of the nocturnal urban landscape requires a good understanding of the local taste, from the method of illumination to the choice of warmth of colors, cultural values and varying local expectancies.

In this sense, this thesis aims to test the urban lighting attributes and emotional appraisals that are stated to upgrade the nighttime urban life by designers and planners and to validate the existing argumentation with scientific outcomes. Furthermore, the study aims to scientifically explore the kinds of attributes that may be significant for the people's preference in the locality of study. Certain urban lighting attributes may be common for urban lighting; however, their significance may vary in accordance to the context, culture, age, and gender. Urban designers might benefit from discovering new variables and understanding their importance of them for people, and in turn, present urban lighting designs which have good public appeal.

I organized this chapter under five sections which systematically defines the design of the structure of my research. These sections include: perceived attribute and emotional appraisal variables, stimuli, respondents, data collection and data analysis. In the first section I discuss how I utilized the findings of my literature review to derive the variables used in this research. The 'stimuli' section describes the selection criteria of the urban scenes that are used in this research. In the 'respondents' section, I explain how I selected the sample group for this study. In this section, I also present the background information of the sample group. In the 'data collection' section, I discuss the survey technique which I used to fulfill both the exploratory and experimental characteristics of the study: Likert scaling questions and open-ended questions. The last section describes the data analysis methods and techniques used to analyze the collected data. In this context, content analysis systematized the descriptive data gathered through open-ended survey; multiple regression analysis technique revealed the relationship between perceived urban lighting attributes and emotional appraisals.

3.1. VARIABLES

Under the four categories of urban sections that I defined as (1) buildings, (2) roads and pathways, (3) pedestrian areas and squares, (4) parks and landscape elements, I reviewed the literature to bring out the perceived attributes and people's emotional reactions to them. Literature review reveals that there are several perceived attributes for all four urban sections such as: brightness, shadowing, sufficiency, coherence, contrast, distribution of light, legibility, variety of color, novelty, harmony and orientation. Literature review also reveals that people give certain emotional reactions to these perceived attributes such as: like, dislike, interest, comfort, discomfort, safety, fear, confusion, security, orientation and distraction.

I grouped the literature findings under content groups specific to four urban sections. This brought out commonalities amongst the perceived attributes of these urban sections despite some minor differences. Although there exist different techniques in lighting of different urban sections, and approach to each urban section differs from each other owing to the design objectives, my summary reveals that certain attributes are common for all four urban sections. These common attributes are (1) brightness, (2) contrast, (3) distribution of light, (4) legibility and (5) color.

Literature findings showed that every urban section has a different focus on these mentioned common perceived attributes. Their significance in how people experience the urban lit environment varies depending on the urban section. For example, brightness and distribution of light are discussed as prevalent perceived attributes for pedestrian areas and squares; whereas, contrast and color are stated to be more prevalent attributes for lighting of buildings or parks and landscape elements. Although the significance of each of these five common perceived attributes changes from one urban section to the other, literature findings reveal that these five attributes are the most salient attributes to people in how they experience the lit urban environment.

I used these common attributes as variables in my research to explore people's preferences in urban lighting design. Via testing these variables, I aimed to systematize a relation between certain variables of urban lighting and people's emotional reactions to them. I used these variables to structure my stimuli, and my survey with which I aimed to test these identified attributes. In the open-ended questions section of my survey, I aimed to explore other possible variables that literature findings did not put forward.

3.2. STIMULI

In this research I used photographs of urban scenes as stimuli with which I aimed to represent previously identified variables. For this research I presented 20 photographs of lit urban night scenes of the city of Ankara to each respondent. These 20 photographs are used as stimuli for the survey which is comprised of ranked questions section and open-ended questions section. There are five photographs for each of the four urban sections. These categories are buildings, pedestrian roads and squares, roads and pathways, and parks. In groups of five, which are categorized specific to four urban sections, each photograph represents one of the five identified variables in urban lighting: (1) brightness, (2) contrast, (3) direction and distribution of light, (4) legibility and (5) color. In every photograph, I aimed to represent only one prevalent variable.

I chose to use the images that represented the common variables of lighting of urban sections. The reason why the representative images were used in this study is that: the research aims to test various lighting variables in various specific nocturnal settings of the urban realm. Using photographs as stimuli makes it possible to test several variables in a limited time with every respondent. Nevertheless, the research reveals that use of representative images as stimuli is a scientifically relaible method.

Flynn and his colleagues conducted a series of studies to reveal the relations between lighting conditions and the moods of people in 1973. (Rea: 1992, 435-442) Two different type of stimulus were used in these series of studies: a conference room that had various lighting systems, and slides of these different light settings. (Hendrick et al. 1977, 491-510) The studies of Flynn tested six different lighting arrangements and respondents of this study were asked to evaluate the room on the rating scales. (Yücetaş: 1997, 10) These six different lighting arrangements were tested both using the conference room settings and the slides. Flynn concluded that these studies scientifically proved the reliability of using slides as stimulus in researches on lighting and human reaction to it. These studies, both the ones that used spatial settings and the other group that used representative slides, presented **identical** results. The results of the Flynn's studies showed that the reliable judgments of a space were not stimulus bound by that space. Hence, this scientific fact validates the choice of stimulus in this research.

I collected all of the 20 urban scenes from the city of Ankara, with respect to the fact that all of my respondents would be living in Ankara and their minimum duration of stay in the city would be at least 12 months. In choosing urban scenes from Ankara, I aimed to minimize a bias on the outcomes of this research which might be resulted from an interest and liking of the respondent related to him/her seeing an urban scene for the first time. I aimed to pick urban scenes which would be familiar to majority of the people who lives in Ankara for more than a year. By picking these widely experienced and well-known scenes of the city, I aimed to assure that respondents would focus on the effect of lighting rather than the general appearance of the urban section. All of the urban scenes used in this research as stimuli are places which a citizen of Ankara would experience for several times during the daytime owing to their central location. All of the photographs are taken from central districts of Ankara, and most of them are located on the major transportation axis, where most of the people who live in this city would like to experience several times during the day, and probably during the night.

I took the photographs of approximately 30 urban scenes of Ankara and collected approximately 35 photographs from internet digital photograph sharing platforms (Wow.Turkey: 2008, Fotokritik: 2008). First I evaluated the image quality of the photographs in terms of image resolution, blur, clarity and composition. The photographs of which image resolution was lower than 200 dpi were eliminated. I also eliminated the photographs which differentiated from the others with respect to the depth of the scene that entered the frame of the image. Also, the images which conveyed a relatively deeper perspective were excluded. Following this step, an expert and I judged the images based on the perceived attributes mentioned in previous studies and selected the representative images. Finally the representative images included five photographs for the each urban section. In the Table 3.2 I present a listed information about the represented variables, name of the place, location, lighting method and source of photographs for each of the 20 urban scenes.

This reseach recognizes that other variables co-exist in each image since they are taken from real life environments. However, the representative images of this research **predominantly** contains one of the identified five variables. This research also recognizes that in a further scientific research, the representative images could be selected by a larger group of experts to eliminate possible biases. Nevertheless, the selection method of the representative images is suitable for the scale of this research

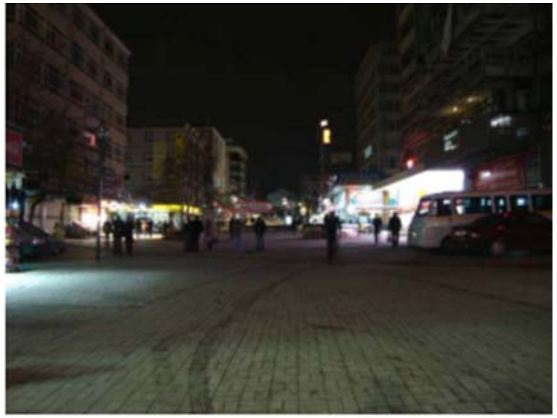
Table 3.2. Information About Visual Stimuli

Photograph Title	Urban Section	Name of the Place and Location	Represented Variable	Lighting Method	Source
A	Buildings	Is Bank, Ulus	(2) Contrast	Grazing	http://wowturkey.com/
B	Buildings	Garanti Bank, Ulus	(5) Color	Grazing & Colored Light	http://wowturkey.com/
C	Buildings	Ankara House, Ulus	(1) Brightness	Floodlighting	http://fotokritik.com
D	Buildings	Turkish State Railways Main Station, Ulus	(4) Legibility	Downlighting & Interior Lighting	http://wowturkey.com/
E	Buildings	*'Devlet Tiyatroları'*, Ulus	(3) Distribution of Light	Downlighting & Uplighting	http://wowturkey.com/
F	Pedestrian Areas	Sakarya Boulevard, Kızılay	(1) Brightness	Overlaping Light Fills	Personal Archive
G	Pedestrian Areas	Yüksel Boulevard, Kızılay	(2) Contrast	Lighting with Opaque Globes	Personal Archive
H	Pedestrian Areas	Sakarya Boulevard, Kızılay	(3) Distribution of Light	Pools of Light	Personal Archive
I	Pedestrian Areas	Selanik Avenue, Kızılay	(4) Legibility	Lighting with Shop Lights	Personal Archive
J	Pedestrian Areas	Konur Street, Kızılay	(5) Color	Lighting with Colored Light	Personal Archive
K	Parks	Botanical Garden, Kavaklıdere	(3) Distribution of Light	Colored Light, Silhouette Lighting	http://wowturkey.com/
L	Parks	Urban Park, Keçiören	(1) Brightness	Uplighting, Colored Light, Outlighting, Opaque Globes	http://wowturkey.com/
M	Parks	Dikmen Vadisi, Dikmen	(5) Color	Colored Lights, Uplighting	http://wowturkey.com/
N	Parks	Kuğulu Park, Kavaklıdere	(4) Legibility	Harmonious Light Distribution	Personal Archive
O	Parks	Abdi İpekçi Park, Sıhhiye	(2) Contrast	Uplighting	http://wowturkey.com/
R	Roads & Pathways	Atatürk Boulevard, Kavaklıdere (2008)	(1) Brightness	Double Row Lighting, Overlapping Light Fill	Personal Archive
S	Roads & Pathways	Atatürk Boulevard, Bakanlıklar	(4) Legibility	Single-row Lighting Light Sources at Different Height	Personal Archive
T	Roads & Pathways	Cinnah Boulevard, Kavaklıdere	(5) Color	Colored Lighting	http://ankara-bel.gov.tr
U	Roads & Pathways	51st Street, Çankaya	(2) Contrast	Single-row Lighting	Personal Archive

Figure 3.1. Visual Stimuli: Buildings
Source: Refer to Table 3.2 in page 116

Photograph F

Photograph G



Photograph H

Photograph I

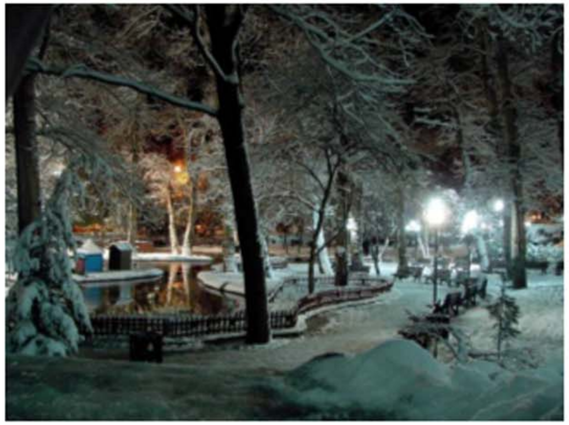
Photograph J

Figure 3.2. Visual Stimuli: Pedestrian Areas and Squares
Source: Refer to Table 3.2 in page 116

Photograph K

Photograph L

Photograph M



Photograph N

Photograph O

Figure 3.3. Visual Stimuli: Urban Parks
Source: Refer to Table 3.2 in page 116

Photograph P

Photograph R

Photograph S

Photograph T

Photograph U

Figure 3.4. Visual Stimuli: Roads and Pathways
Source: Refer to Table 3.2 in page 116

3.3. RESPONDENTS

I chose to carry out my research with students of the Middle East Technical University. The aim at choosing to carry out the research with university students was to create a respondent group which had variety of perspectives in terms of academic and professional background. Choosing the respondents of my research amongst the students of the university also gave the opportunity to reach people at a certain age group. The survey was carried out amongst 30 university students of Middle East Technical University in one week. 30 students of the university, ranging from the age of 18 to 31, voluntarily participated in the research. The mean age of the respondents is 22,5, and the number of female and male participants are equal (15 female, 15 male).

In my research, I aimed to minimize a biased outcome, which would be dominated by a certain perspective of a certain group. I aimed to create a respondent group comprised of people with various academic and professional perspectives. Therefore, my aim was to reach as many students from different facilities as possible. The university library is one of the major centers in the university campus where students with many different academic focuses, ages and socio-cultural backgrounds can be reached. In this respect, I chose to carry out my research in the university library. The university library also provided an environment which was suitable for carrying out an attention-demanding survey without external distractions. I chose the respondents on a random basis and involved the volunteered respondents in the survey. I systematically interviewed next respondent when I completed the interview with the previous one. I continued interviewing everyday during the survey week until I reached an equal number of male and female respondents.

The respondents of this research were students from different facilities: 15 of them were studying at the Faculty of Arts and Sciences, 10 studying at the Faculty of Engineering and 5 studying at the Faculty of Economic and Administrative sciences (see the annex for the list of departments). The respondent group of my research does not include students who study at the faculty of architecture or already had an education in the fields of architectural, urban and landscape design. Students who already studied the design of the built-environment would normally have pre-conceived judgments about the urban environment. Their existing knowledge about design would create a bias in the outcomes of the study and might impose some of the existing design criteria that are already reviewed in the previous chapter. Since my major aim in this research is exploration, I avoided duplication of the existing design know-how through this survey. The Table 3.3 presents more detailed information about each respondent.

Table 3.3. List of Respondents

No of Respondent	**Sex**	**Age**	**Stay***	**Department of Study**
1	M	21	5	Physics
2	F	18	7	Philosophy
3	F	18	12	Philosophy
4	M	25	25	Mathematics
5	M	23	23	Business Administration
6	F	25	25	Molecular Biology-Genetics
7	F	20	20	Mechanical Engineering
8	F	24	24	History
9	F	19	5	History
10	F	20	11	Chemistry
11	F	18	1	Business Administration
12	M	18	1	Computer Engineering
13	F	20	3	Philosophy
14	M	19	19	Aerospace Engineering
15	F	18	18	Biology
16	M	23	4	International Relations
17	F	25	14	Civil Engineering
18	M	20	1	Mining Engineering
19	F	23	5	Mathematics
20	M	21	3	Molecular Biology-Genetics
21	F	25	7	Political Science and P.Adm.
22	F	22	15	Industrial Engineering
23	M	22	18	Industrial Engineering
24	M	21	21	E. & Electronics Engineering
25	M	31	4	Sociology
26	F	31	31	Civil Engineering
27	M	28	28	Civil Engineering
28	M	25	25	Biology
29	M	26	26	International Relations
30	M	27	7	Psychology
	Mean Values	22,5	13,6	

*Total duration of stay in Ankara (years)

The stimuli of my research comprised of urban nighttime scenes collected from popular urban sections of Ankara. In order to help respondents focus on the effect of lighting rather than the design of the urban sections, I chose to pick respondents who are already familiar with the city. In determining their familiarity with the city, I proceeded to complete the surveys with students whose duration of stay in Ankara was at least 1 year. Majority of the respondents stayed more than 1 year in Ankara: only 3 respondents stayed only 1 year and the rest stayed at least 3 years. The average stay of 30 respondents in Ankara is 13,6 years: average stay of female participants is 13,2 years, and average stay of male participant is 14 years.

3.4. DATA COLLECTION

I collected the data by carrying out a survey on one by one basis with each respondent. I used four sets of photographs, specific to four urban sections, printed on A4 paper as stimuli for the survey. In the survey, I collected the data in two different methods: Likert scaling questions and open-ended questions. The first section of the survey aims to test the five identified variables through ranking 9 statements per photograph. The second section aims to discover the prevalence of these variables by making respondents chose the most and least liked photograph for every urban section and explain their criteria in making that selection. All the data was collected in one week and the average time for each respondent to complete the survey was 25 minutes.

Each respondent was shown 20 photographs one by one in the first section and asked to rate 9 statements with Likert scaling. I used Likert scaling based on the literature findings that define this type of measuring as the most common method to test the intensity of feelings about certain variables. (Bryman: 2004, 68) The statements of the first section of the survey are derived from the common perceived attributes and common emotional reactions that are summarized in my literature review. The first five statements aim to test the photographs which represent certain variables in terms of sufficiency of “brightness”, efficiency of “distribution of light”, “legibility”, the effect of “contrast” and sufficient use of “color” in lighting. The other four statements aim to test the emotional reactions of people to certain variables. These emotional variables are ‘liking’, ‘interest’, ‘comfort’ and ‘security’. The statements are ranked with Likert items with 1 being “do not agree” and 5 being “strongly agree.” Each respondent’s reply on each item is scored so as to work all the scores through multiple regression analysis. The statements are presented in the Table 3.4 (see Appendix A for the original form of survey).

Each respondent ranked the statements represented in Table.3.4 twenty times in total, with respect to the twenty photogpraphs presented. Hence, each variable was tested for four times, being tested once in each four urban sections. Thus, each five variable is tested for 120 times in this section: resulting from each of the 30 respondents testing every variable for four times. This multiplication increased the actual size of the respondent group and helped reach more significant outcomes.

Table 3.4. List of Statements in the Likert Scaling Questions

#	Statements	Variable
1	The building / space is adequately illuminated	Brightness
2	Light is distributed efficiently on the building / space	Distribution of Light
3	There are places that cannot be seen but should be made visible with lighting	Legibility
4	Lighting creates a contrast effect for the building / space	Contrast
5	The colors of light are efficiently used	Color
Considering the effect of lighting…		
6	…I like the appearance how this building / space is	Preference
7	…I find this building / space interesting	Interest
8	…I would feel comfortable around this building / in this space	Comfort
9	…I would feel safe around this building / in this space	Safety

In the second section, respondents were asked to pick the urban scenes they liked the most and they disliked the most for every category of urban sections. For the selection, five of the photographs for every urban section are shown to the respondent all together at once. As a result of the second section, every respondent picked a total of 4 photographs as their most prefered and 4 as most disliked; and explained under which criteria they made their decision. I aimed to discover the significance of the variables which I already brought up with my literature findings and discover new variables in how people judged the scenes they liked and they did not by asking them to write down their explanations of their selection. As a result of the second section, I collected 120 commentaries about preference and 120 commentaries on dislikes.

3.5. DATA ANALYSIS

In this research I collected two types of data: Likert scaling scores from the ranking of the statements, and subjective descriptions derived from the open-ended section. For analyzing the first group of data aggregated through Likert scaling method, I used the multiple regression analysis method. Through this method, I presented the changes in the dependent variable in response to changes in the several dependent variables. For the second group of data I used content analysis method. Through this method, I presented the frequency of mentioning of the identified variables and discovered some other variables which were not prevalent in the literature findings.

In order to explore how much an emotional appraisal for lighting of different urban sections (buildings, urban parks, pedestrian roads, and vehicle roads) vary through the linear relationships of the attribute variables (brightness, distribution of lighting, legibility, contrast, and color) to each other and to the tested emotional appraisal, I conducted a stepwise regression analysis for the overall sample. I used this method because literature defines multiple regression analysis as 'very useful' for predicting the amount or magnitude of the dependent variable in relation with independent variables. (Hair et al.: 1995, 93) In this regression analysis one independent variable which makes the largest contribution to R^2 is entered into the model first. For the regression model of each emotional appraisal, I treated the tested emotional appraisal as the dependent variable and the attributes as independent variables. In order to assure that the models are not affected by multicollinearity, I checked the correlation between independent variables.

In the analysis of the subjective descriptions of respondents I used the content analysis method. Literature defines content analysis as any technique for making inferences by objectively and systematically identifying specified characteristics of messages. (Holsti: 1969, 14) Content analysis is particularly well studied to the study of communications and to answering the classic question of communications research: "who says what, to whom, why, how and with what effect?" (Babbie: 2002, 312) In my research, finding the answers of these questions effectively would provide me the aimed research findings in this section. In this respect, I chose to use content analysis method because by coding the whole data, derived from second section of survey, under certain content titles would bring about the common variables that are expressed by respondents. Nevertheless, coding the data and presenting the frequency of mention by content analysis method would provide me the significance of the variables, which I aim to help reveal with this research.

CHAPTER 4

RESEARCH FINDINGS and DISCUSSION

4.1. RELATIONSHIP BETWEEN URBAN LIGHTING ATTRIBUTES AND EMOTIONAL REACTIONS

4.1.1. 'Like' and Urban Lighting Attributes

In this section I present the findings of the multiple regression analysis where the 'preference' is treated as the dependent variable. In this section I also present my discussions on the findings this analysis. This section comprises two sub-sections: multiple regression analyses and discussions for 'preference'.

4.1.1.1. Multiple Regression Analyses Results

To explore how much preference for lighting of difference urban patterns (buildings, urban parks, pedestrian roads, and vehicle roads) vary through the linear relationships of the attribute variables (sufficient lighting, efficient distribution of lighting, legibility, contrast, and use of colored lighting) to each other and to preference, I conducted a stepwise regression analysis for the overall sample, where the one independent variable making the largest contribution to R^2 is entered into the model first. For the regression model of preference, I treated preference as the dependent variable and the attributes as independent variables.

The analyses revealed that 'use of colored lighting' and 'contrast' significantly explain the preference for lighting of all studied urban patterns. For buildings and urban parks, people also significantly indicated 'legibility' as a reason for preference. The variable of 'use of colored lighting' made the most contribution to explaining the variance in preference for buildings and pedestrian roads. For urban parks and vehicle roads, this is replaced with 'contrast'.

Table 4.1 shows that the model of preference for **buildings** (*Adjusted* R^2 *=0.488, F=6.86, p<0.01*). In the model, three of the five attributes made significant contribution to explaining the remaining variance in preference. These attributes include 'use of colored lighting', 'contrast', and 'legibility' (*p*'s < 0.01). When considered all, they explained almost 50 percent of variance in preference. The 'use of colored lighting' made the most contribution to explaining the variance in preference by 44 percent (See Section 1.1 in Appendix B for more results of this analysis).

Table 4.1. Results of Regression Analysis of Preference for Lighting of Buildings for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Color	.443	.443	.558	6.240	.000
Contrast	.474	.031	.312	3.501	.001
Legibility	.498	.024	.139	2.619	.010
(constant)			.131	.364	.716

Standard Error = .93
Adjusted R^2= .488
df1=1; df2=146
For model: F = 6.86, p < .01

Then, I analyzed the multicollinearity between variables. Table 4.2 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model. However, other variables including 'sufficient lighting' and 'efficient distribution of lighting' strongly correlate (*r*'s › .70) with 'contrast'. This indicates that these variables are included in the preference model through 'contrast'. For example, people may relate contrast to sufficient and efficient distribution of lighting.

Table 4.2. Pearson Correlation for Preference for Lighting of Buildings and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
LIKE (C)	1.000	.458	.518	-.110	.591	.666
Brightness (V1)	.458	1.000	.644	-.472	.732	.595
Distribution of Light (V2)	.518	.644	1.000	-.451	.723	.674
Legibility (V3)	-.110	-.472	-.472	1.000	-.372	-.324
Contrast (V4)	.591	.732	.723	-.372	1.000	.699
Color (V5)	.666	.595	.674	-.324	.699	1.000

Table 4.3 shows that the model of preference for **urban parks** (*Adjusted* $R^2 = .356$, $F=4.97$, $p<.03$), four of the five attributes made significant contribution to explaining the remaining variance in preference. These attributes include 'contrast', 'use of colored lighting', 'legibility', and 'efficient distribution of lighting' (*p*'s < 0.01). When considered all, they explained 37 percent of variance in preference. The 'contrast' made the most contribution to explaining the variance in preference by 28 percent (See Section 1.2 in Appendix B for more results of this analysis).

Table 4.3. Results of Regression Analysis of Preference for Lighting of Urban Parks for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.283	.283	.372	3.200	.002
Color	.319	.036	,250	2.858	.005
Legibility	.352	.032	.218	3.232	.002
Distribution of lighting	.373	.021	.237	2.229	.027
(constant)			-.165	-.342	.733

Standard Error = 1.045
Adjusted R^2= .356
df1=1; df2=145
For model: F = 4.97, p < .03

Table 4.4 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). However, variables including 'brightness' and 'contrast' strongly correlate (*r*'s › .70) with 'distribution of light'. This indicates that these variables are included in the preference model through 'distribution of light'.

Table 4.4. Pearson Correlation for Preference for Lighting of Urban Parks and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
LIKE (C)	1.000	.394	.480	-.153	.532	.481
Brightness (V1)	.394	1.000	.735	-.666	.648	.568
Distribution of Light (V2)	.480	.735	1.000	-.558	.745	.560
Legibility (V3)	-.153	-.666	-.558	1.000	-.531	-.421
Contrast (V4)	.532	.648	.745	-.531	1.000	.625
Color (V5)	.481	.568	.560	-.421	.625	1.000

Table 4.5 shows that the model of preference for **pedestrian roads and squares** (*Adjusted* $R^2 = .418$, $F=10.087$, $p<.00$), two of the five attributes made significant contribution to explaining the remaining variance in preference. These attributes include 'use of colored lighting' and 'contrast' (*p*'s < 0.01). When considered both, they explained 43 percent of variance in preference. The 'use of colored lighting' made the most contribution to explaining the variance in preference by 39 percent (See Section 1.3 in Appendix B for more results of this analysis).

Table 4.5. Results of Regression Analysis of Preference for Lighting of Pedestrian Roads and Squares for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Color	.387	.387	.369	5.408	.000
Contrast	.426	.039	.835	3.176	.000
(constant)			.212	5.671	.002

Standard Error = .775
Adjusted R^2= .418
df1=1; df2=147
For model: F = 10.087, p < .00

Table 4.6 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.62). This shows that multicollinearity does not constitute significant problem in this model.

Table 4.6. Pearson Correlation for Preference for Lighting of Pedestrian Roads and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
LIKE (C)	1.000	.490	.500	-.305	.559	.622
Brightness (V1)	.490	1.000	.852	-.630	.687	.620
Distribution of Light (V2)	.500	.852	1.000	-.616	.677	.643
Legibility (V3)	-.305	-.630	-.616	1.000	-.504	-.469
Contrast (V4)	.559	.687	.677	-.504	1.000	.658
Color (V5)	.622	.620	.643	-.469	.658	1.000

Table 4.7 shows that the model of preference for **roads and pathways** (*Adjusted R^2 = .922, F=13.732, p<.00*), two of the five attributes made significant contribution to explaining the remaining variance in preference. In line with the results for preference for pedestrian roads, these attributes include 'contrast' and 'color' (*p*'s < 0.01). When considered both, they explained 40 percent of variance in preference. The 'contrast' made the most contribution to explaining the variance in preference by 35 percent (See Section 1.4 in Appendix B for more results of this analysis).

Table 4.7. Results of Regression Analysis of Preference for Lighting of Vehicle roads for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.345	.345	.427	5.219	.000
Color	.401	.056	.292	3.706	.000
(constant)			.441	1.941	.054

Standard Error = .922
Adjusted R^2= .393
df1=1; df2=147
For model: F = 13.732, p < .00

Table 4.8 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.68). This shows that multicollinearity does not constitute significant problem in this model.

Table 4.8. Pearson Correlation for Preference for Lighting of Urban Parks and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
LIKE (C)	1.000	.464	.469	-.366	.588	.539
Brightness (V1)	.464	1.000	.756	-.509	.681	.565
Distribution of Light (V2)	.469	.756	1.000	-.496	.613	.663
Legibility (V3)	-.366	-.509	-.496	1.000	-.424	-.300
Contrast (V4)	.588	.681	.613	-.424	1.000	.593
Color (V5)	.539	.565	.663	-.300	.593	1.000

4.1.1.2. Discussions: Preference-Liking

Buildings: The findings of the analysis reveal that 'color' significantly explains the preference in lighting of buildings. The findings of the literature review show that use of pastel colors in buildings lighting, and harmonious appearance of colored light with the environment elicit liking in people. (Moyer: 1992, 250; Phillips: 2004, 18) However, literature findings do not suggest that 'color' is the most significant variable in preference of lighting of buildings. This research puts forward the significance of 'color' variable of lighting for preference. Although being less significant, 'contrast' and 'legibility' variables also explain preference of people in lighting of buildings. Literature findings also suggest that these two variables are prevalent in eliciting liking: excessive contrast that fragments the view and loss of details due to lack of contrast decrease liking. (vanSanten: 2006, 52-70) In the sense, efficient use of color and good contrast can create preferable outcomes in lighting of buildings.

Roads and Pathways: The findings of the analysis reveal that 'contrast' makes the most significant contribution in explaining the preference in the lighting of roads and pathways. Analysis also reveals that after 'contrast', color is the most significant variable in explaining preference. The literature findings bring out the variables that elicit other emotional reactions than liking, which are safety, comfort and interest. The literature does not review the lighting of roads and pathways in terms of preference. In this respect, this research introduces the variables of 'contrast' and 'color' to explain preference in lighting of roads and pathways.

Pedestrian Areas and Squares: The findings of the analysis show that 'color' is the most significant variable in explaining the preference in lighting of pedestrian areas and squares. Literature review findings reveal that use of certain colors such as blue, increases the preference of lighting. (vanSanten: 2006, 91) However the findings of the literature review show that, designers suggest several methods for the lighting of pedestrian areas and squares: however, most of these methods are related with the distribution of light. In addition, literature review findings do not suggest any emotional appraisals related to these lighting methods. The 'distribution of light' variable is not significant in the findings of this research. On the other hand, this research introduces the significance of 'color' and also 'contrast' variables. According to the findings of this analysis, the efficient use of colors and good contrast in lighting of the pedestrian areas and squares increase the preference of people in lighting.

Urban Parks: The findings of the analysis show that, variable of 'contrast' significantly explains preference in lighting of urban parks. Literature findings also overlap with this finding: excessive dramaticness created by unnatural shadows, unfriendly and ambiguous appearance of landscape objects due to undesired shadows (such as on trees and sculptures) decrease the liking. (Moyer: 1992, 204-7; FGL: 2002) On the other hand, balanced and carefully planned lighting of urban parks increases the enjoyment. (Moyer: 1992, 207) According to the findings of this researc, color is the second most significant variable in explaining the preference for this urban section. Literature findings also corresponds with this finding: use of colored light eliminates sinister and dismal, and increases the preference in empty parks (vanSanten: 2006, 29) According to the findings of the analysis, the variables of 'legibility' and 'distribution of light' also explain the preference. The literature findings do not suggest a direct relation between these two variables and preference. Hence, the analysis findings broaden the explanation of preference in lighting of urban parks by revealing the significance of 'contrast' and 'color' and also introducing the variables of 'legibility' and 'distribution of light'.

4.1.2. 'Interest' and Urban Lighting Attributes

In this section I present the findings of the multiple regression analysis where the 'interest' is treated as the dependent variable. In this section I also present my discussions on the findings this analysis. This section comprises two sub-sections: multiple regression analyses and discussions for 'interest'.

4.1.2.1. Multiple Regression Analyses Results

To explore how much interest for lighting of difference urban patterns (buildings, urban parks, pedestrian roads, and vehicle roads) vary through the linear relationships of the attribute variables (brightness, contrast, distribution of lighting, legibility, and color) to each other and to interest, I conducted a stepwise regression analysis for the overall sample, where the one independent variable making the largest contribution to R^2 is entered into the model first. For the regression model of interest, I treated interest as the dependent variable and the attributes as independent variables.

The analyses revealed that 'contrast' and 'color' significantly explain the interest for lighting of all studied urban patterns. For buildings and urban parks, people also significantly indicated 'legibility' as a reason for their interest. The variable of 'color' made the most contribution to explaining the variance in interest for buildings and pedestrian areas. For urban parks and vehicle roads, this is replaced with 'contrast'.

Table 4.9 shows that the model of interest for **buildings** (*Adjusted* $R^2 = 0.415$, $F=6.244$, $p<0.01$). In the model, three of the five attributes made significant contribution to explaining the remaining variance in interest. These attributes include 'color', 'contrast', and 'legibility' (p's < 0.01). When considered all, they explained almost 43 percent of variance in interest. The 'color' made the most contribution to explaining the variance in interest by 35 percent (See Section 2.1 in Appendix B for more results of this analysis).

Table 4.9. Results of Regression Analysis of Interest for Lighting of Buildings for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Color	.353	.353	.422	4.529	.000
Contrast	.402	.049	.371	3.992	.000
Legibility	.427	.025	.138	2.499	.014
(constant)			.317	.843	.401

Standard Error = .97
Adjusted R^2= .415
df1=1; df2=146
For model: F = 6.24, p < .01

Then, I analyzed the multicollinearity between variables. Table 4.10 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model.

Table 4.10. Pearson Correlation for Interest for Lighting of Buildings and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
INTEREST (C)	1.000	.406	.450	-.093	.574	.594
Brightness (V1)	.406	1.000	.644	-.472	.732	.595
Distribution of Light (V2)	.450	.644	1.000	-.451	.723	.674
Legibility (V3)	-.093	-.472	-.451	1.000	-.372	-.324
Contrast (V4)	.574	.732	.723	-.372	1.000	.699
Color (V5)	.594	.595	.674	-.324	.699	1.000

Table 4.11 shows that the model of interest for **roads and pathways** (*Adjusted* $R^2 = 0.310$, $F=10.702$, $p<0.01$). In the model, two of the five attributes made significant contribution to explaining the remaining variance in interest. These attributes include 'contrast' and 'color' (*p*'s < 0.01). When considered all, they explained almost 32 percent of variance in interest. The 'contrast' made the most contribution to explaining the variance in interest by 27 percent (See Section 2.2 in Appendix B for more results of this analysis).

Table 4.11. Results of Regression Analysis of Interest for Lighting of Roads and Pathways for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.269	.269	.376	4.198	.000
Color	.319	.050	.283	3.271	.001
(constant)			.249	1.001	.318

Standard Error = 1.01
Adjusted R^2= .310
df1=1; df2=147
For model: F = 10.702 p < .00

Table 4.12 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model.

Table 4.12. Pearson Correlation for Interest for Lighting of Roads and Pathways and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
INTEREST (C)	1.000	.391	.383	-.324	.519	.487
Brightness (V1)	.391	1.000	.756	-.509	.681	.565
Distribution of Light (V2)	.383	.756	1.000	-.496	.613	.663
Legibility (V3)	-.324	-.509	-.496	1.000	-.424	-.300
Contrast (V4)	.519	.681	.613	-.424	1.000	.593
Color (V5)	.487	.565	.663	-.300	.593	1.000

Table 4.13 shows that the model of interest for **pedestrian areas and squares** (*Adjusted R^2 =0.310, F=10.702, p<0.01*). In the model, two of the five attributes made significant contribution to explaining the remaining variance in interest. These attributes include 'color' and 'contrast' (*p*'s < 0.01). When considered all, they explained almost 33 percent of variance in interest. The 'color' made the most contribution to explaining the variance in interest by 29 percent (See Section 2.3 in Appendix B for more results of this analysis).

Table 4.13. Results of Regression Analysis of Interest for Lighting of Roads and Pathways for the overall sample

VARIABLES	R^2	R^2change	b	t	p
Color	.294	.294	.315	4.172	.000
Contrast	.332	.038	.213	2.873	.001
(constant)			.816	4.998	.000

Standard Error = .86
Adjusted R^2= .323
df1=1; df2=147
For model: F = 8.253 p < .00

Table 4.14 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model.

Table 4.14. Pearson Correlation for Interest for Lighting of Pedestrian Areas and Squares and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
INTEREST (C)	1.000	.385	.377	-.242	.503	.543
Brightness (V1)	.385	1.000	.852	-.630	.687	.620
Distribution of Light (V2)	.377	.852	1.000	-.616	.677	.643
Legibility (V3)	-.242	-.630	-.616	1.000	-.504	-.469
Contrast (V4)	.503	.687	.677	-.504	1.000	.658
Color (V5)	.543	.620	.643	-.469	.658	1.000

Table 4.15 shows that the model of interest for **urban parks** (*Adjusted* R^2 *=0.335, F=8.302, p<0.01*). In the model, four of the five attributes made significant contribution to explaining the remaining variance in interest. These attributes include 'contrast', 'color', 'legibility' and 'distribution of light' (*p*'s < 0.01). When considered all, they explained almost 35 percent of variance in interest. The 'contrast' made the most contribution to explaining the variance in interest by 24 percent (See Section 2.4 in Appendix B for more results of this analysis).

Table 4.15. Results of Regression Analysis of Interest for Lighting of Urban Parks for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.237	.237	.294	2.482	.014
Color	.274	.037	.248	2.780	.006
Legibility	.316	.042	.256	3.731	.000
Distribution of Light	.353	.037	.313	2.881	.005
(constant)			-.394	-.802	.424

Standard Error = 1.07
Adjusted R^2= .335
df1=1; df2=145
For model: F = 8.302 p < .00

Table 4.16 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). However, 'distribution of lighting' strongly correlates with 'brightness' (*r*'s › .70). This shows multicollinearity between these two variables. This indicates that people may relate sufficient brightness to efficient distribution of lighting in their interest to urban parks.

Table 4.16. Pearson Correlation for Interest for Lighting of Urban Parks and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
INTEREST (C)	1.000	.355	.472	-.108	.487	.454
Brightness (V1)	.355	1.000	.735	-.666	.648	.568
Distribution of Light (V2)	.472	.735	1.000	-.558	.745	.560
Legibility (V3)	-.108	-.666	-.558	1.000	-.531	-.421
Contrast (V4)	.487	.648	.745	-.531	1.000	.625
Color (V5)	.454	.568	.560	-.421	.625	1.000

4.1.2.2. Discussions: Interest

<u>Buildings:</u> Color of light is defined as one of the perceived attributes of lighting which elicit interest in literature (Moyer: 1992, 250); however, it is not defined as the most significant variable. The findings of this research brings out that in evaluation of the effects of lighting in terms of 'interest', people see the 'color of light' as the most important variable. The review of the literature on the effects of color on human

psychology underlines that color is an attribute that nobody could be neutral about and every person would naturally give emotional reaction. (Mahnke: 1996, 6; Beer 1992, 11) This research pinpoints that, if it is used effectively, color can increase the interest in the lighting of buildings.

This research also reveals that variables of contrast and legibility are other significant variables that elicit interest. This finding also corresponds with the literature findings: strong shadows, patterns of scallops, which creates high contrast on the façade, elicit interest (Moyer: 1992, 248) Legibility of the lighting of building are also defined to increase the interest in buildings lighting. (Phillips: 2004, 16) On the other hand, even distribution of light and flattening effect (strong brightness and lack of shadows) are defined to elicit interest. (vanSanten: 2006, 75; Moyer: 1992, 248)

Roads and Pathways: The findings of the analysis brings out the variabel of 'contrast' as the most significant variable in explaining the interest in lighting of roads and pathways. This finding corresponds with the literature: the shift of brightness is defined to add interest in the scene. (Moyer: 1992, 127) Differently from literature, the findings of analysis reveal that 'color of light' is also a significant variable in eliciting interest in people. On the other hand, different from the litterature findings, the variable of 'distribution of light' is not found as a significant variable. (FGL: 2002)

Pedestrian Areas and Squares: The findings of the analysis reveal that 'color' variable significantly explains interest in lighting of pedestrian areas and squares. Although literature defines that color elicit certain emotional reactions in lighting of pedestrian areas and squares, color is not defined a variable that elicit interest. The variable of 'contrast' is also a significant variable in explaining the interest: which also corresponds with the findings of the literature. Creating contrast effect with lighting for announcement or marking is defined to draw the attention of people and call for their caution. (Moyer: 1992, 240)

Urban Parks: Findings of the analysis puts forward the 'contrast' as the most significant variable in explaining the interest of people in lighting of urban parks. The findings of this research also define 'color', 'legibility' and 'distribution of light'. Contrasting effect created by brighter major focal points in urban parks, and lighting of landscape elements against a dark background is defined to elicit interest of people. (Moyer: 1992, 185-204-207) The distribution of light is defined as one of the four significant variables in explaining interest: however, its significance is low compared to contrast. In this sense, this research emphasizes a different approach to the explanation of interest.

4.1.3. 'Comfort' and Urban Lighting Attributes

In this section I present the findings of the multiple regression analysis where the 'comfort' is treated as the dependent variable. In this section I also present my discussions on the findings this analysis. This section comprises two sub-sections: multiple regression analyses and discussions for 'comfort'.

4.1.3.1.Multiple Regression Analyses Results

To explore how much comfort for lighting of difference urban patterns (buildings, urban parks, pedestrian roads, and vehicle roads) vary through the linear relationships of the attribute variables (brightness, contrast, distribution of lighting, legibility, and color) to each other and to comfort, I conducted a stepwise regression analysis for the overall sample, where the one independent variable making the largest contribution to R^2 is entered into the model first. For the regression model of comfort, I treated comfort as the dependent variable and the attributes as independent variables.

The analyses revealed that 'contrast' is the most common variable to explain the comfort for lighting of all studied urban patterns. For buildings people significantly indicated 'color' as a reason for their comfort. For roads and pathways people significantly indicated 'distribution of light' as a reason for their comfort. For both buildings and roads people indicated 'contrast' as the second most significant variable. For pedestrian areas and squares, and urban parks people significantly indicated 'contrast' as their reason for comfort. Variables of 'brightness' for pedestrian areas and squares, and 'color' for urban parks also indicated as the reason for comfort.

Table 4.17 shows that the model of comfort for **buildings** (*Adjusted* R^2 *=0.402, F=13.275, p<0.01*). In the model, two of the five attributes made significant contribution to explaining the remaining variance in comfort. These attributes include 'color' and 'contrast' (*p*'s < 0.01). When considered all, they explained almost 41 percent of variance in comfort. The 'color' made the most contribution to explaining the variance in interest by 36 percent (See Section 3.1 in Appendix B for more results of this analysis).

Table 4.17. Results of Regression Analysis of Comfort for Lighting of Buildings for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Color	.352	.356	.390	4.190	.000
Contrast	.402	.053	.331	3.643	.000
(constant)			.671	2.461	.015

Standard Error = .97
Adjusted R^2= .402
df1=1; df2=147
For model: F = 13.275, p < .00

Table 4.18 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model.

Table 4.18. Pearson Correlation for Comfort for Lighting of Buildings and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
COMFORT (C)	1.000	.410	.563	-.176	.582	.597
Brightness (V1)	.410	1.000	.644	-.472	.732	.595
Distribution of Light (V2)	.563	.644	1.000	-.451	.723	.674
Legibility (V3)	-.176	-.472	-.451	1.000	-.372	-.324
Contrast (V4)	.582	.732	.723	-.372	1.000	.699
Color (V5)	.597	.595	.674	-.324	.699	1.000

Table 4.19 shows that the model of comfort for **roads and pathways** (*Adjusted R^2 =0.215, F=8.099, p<0.01*). In the model, two of the five attributes made significant contribution to explaining the remaining variance in comfort. These attributes include 'distribution of light' and 'contrast' (*p*'s < 0.01). When considered all, they explained almost 23 percent of variance in comfort. The 'distribution of light' made the most contribution to explaining the variance in interest by 18 percent (See Section 3.2 in Appendix B for more results of this analysis).

Table 4.19. Results of Regression Analysis of Comfort for Lighting of Roads and Pathways for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Distribution of Light	.182	.182	.239	2.901	.004
Contrast	.225	.043	.256	2.846	.005
(constant)			.733	2.931	.004

Standard Error = .99
Adjusted R^2= .215
df1=1; df2=147
For model: F = 8.099, p < .00

Table 4.20 shows moderate to substantial correlation between the two variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model. However, 'brightness' strongly correlate with 'distribution of light' (*r*'s › .70). This indicates that people may relate brightness to distribution of light in their comfort.

Table 4.20. Pearson Correlation for Comfort for Lighting of Roads and Pathways and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
COMFORT (C)	1.000	.377	.427	-.351	.425	.396
Brightness (V1)	.377	1.000	.756	-.509	.681	.565
Distribution of Light (V2)	.427	.756	1.000	-.496	.613	.663
Legibility (V3)	-.351	-.509	-.496	1.000	-.424	-.300
Contrast (V4)	.425	.681	.613	-.424	1.000	.593
Color (V5)	.396	.565	.663	-.300	.593	1.000

Table 4.21 shows that the model of comfort for **pedestrian areas and squares** (*Adjusted $R^2 = 0.329$, $F = 4.290$, $p < 0.01$*). In the model, two of the five attributes made significant contribution to explaining the remaining variance in comfort. These attributes include 'contrast' and 'brightness' (*p*'s < 0.01). When considered all, they explained almost 34 percent of variance in comfort. The 'contrast' made the most contribution to explaining the variance in interest by 32 percent (See Section 3.3 in Appendix B for more results of this analysis).

Table 4.21. Results of Regression Analysis of Comfort for Lighting of Pedestrian Areas and Squares for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.319	.319	.376	4.698	.000
Brightness	.338	.019	.156	2.071	.040
(constant)			.883	5.184	.000

Standard Error = .9
Adjusted R^2= .329
df1=1; df2=147
For model: F = 4.290, p < .04

Table 4.22 shows moderate to substantial correlation between the two variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model. However, 'brightness' strongly correlate with 'distribution of light' (*r*'s › .70). This indicates that people may relate brightness to distribution of light in their comfort.

Table 4.22. Pearson Correlation for Comfort for Lighting of Pedestrian Areas and Squares and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
COMFORT (C)	1.000	.377	.427	-.351	.425	.396
Brightness (V1)	.377	1.000	.756	-.509	.681	.565
Distribution of Light (V2)	.427	.756	1.000	-.496	.613	.663
Legibility (V3)	-.351	-.509	-.496	1.000	-.424	-.300
Contrast (V4)	.425	.681	.613	-.424	1.000	.593
Color (V5)	.396	.565	.663	-.300	.593	1.000

Table 4.23 shows that the model of comfort for **urban parks** (*Adjusted* $R^2 = 0.356$, $F=4.181$, $p<0.01$). In the model, three of the five attributes made significant contribution to explaining the remaining variance in comfort. These attributes include 'contrast', 'color' and 'distribution of lighting' (*p*'s < 0.01). When considered all, they explained almost 36 percent of variance in comfort. The 'contrast' made the most contribution to explaining the variance in interest by 31 percent (See Section 3.4 in Appendix B for more results of this analysis).

Table 4.23. Results of Regression Analysis of Comfort for Lighting of Urban Parks for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.309	.309	.323	2.665	.009
Color	.338	.029	.196	2.136	.034
Distribution of light	.356	.018	.221	2.045	.043
(constant)			.517	1.745	.083

Standard Error = 1.1
Adjusted R^2= .343
df1=1; df2=146
For model: F = 4.181, p < .04

Table 4.24 shows moderate to substantial correlation between the two variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model. However, other variables including 'contrast' and 'brightness' strongly correlate (*r*'s › .70) with 'distribution of light'. This indicates that these variables are included in the comfort model through 'distribution of light'. For example, people may relate distribution of light to contrast and brightness.

Table 4.24. Pearson Correlation for Comfort for Lighting of Urban Parks and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
COMFORT (C)	1.000	.452	.524	-.308	.556	.480
Brightness (V1)	.452	1.000	.735	-.666	.648	.568
Distribution of Light (V2)	.524	.735	1.000	-.558	.745	.560
Legibility (V3)	-.308	-.666	-.558	1.000	-.531	-.421
Contrast (V4)	.556	.648	.745	-.531	1.000	.625
Color (V5)	.480	.568	.560	-.421	.625	1.000

4.1.3.2. Discussions: Comfort

Buildings: The findings of the analysis brings out that 'color' of light is the most significant variable in explaining comfort of lighting in this urban section. The variable of 'contrast' also explains the feeling of comfort for lighting of buildings. Literature findings pinpoint the integration of lighting of the building to the overall nocturnal landscape, and suggest that coherency elicits comfort. (Moyer: 1992, 245; Phillips: 2004, 17) On the other hand, the relation of other perceived variables and emotional appraisals are not brought out in the literature findings. Therefore, this research introduces the variables of 'color' and 'contrast' in explaining the feeling of comfort in lighting of buildings. Based on the findings of this analysis and in addition to the coherency variable, this research suggests that the efficient use of color and good contrast that brings out the shapes and visual characteristic of the buildings do elicit the feeling of comfort in people.

Roads and Pathways: The findings of the analysis reveal that the variable of 'distribution of light' significantly explains the comfort in lighting of roads and pathways. Literature findings also suggest that 'distribution of light' variable has a relation with the feeling of comfort in lighting of this urban section. Literature findings show that: disharmonious distribution of light, and in turn, dark patches on a lit road decreases the comfort. (FGL; 2000, 10) Furthermore, findings of the analysis reveal that 'contrast' also explain the comfort in lighting of this urban section. On the contrary, literature findings also underline the importance of brightness, visibility and legibility: excessive intensity of light, visual impairment and glare decrease comfort (FGL: 2002; Moyer: 1992, 67; Sunay: 1999, 2) Visible pathway, surroundings, and boundaries increases the comfort in people for this urban section. (Moyer: 1992, 204) In this sense, this research only corresponds with the literature in the importance of 'distribution of light' variable and suggests the significance of 'contrast' in explaining comfort in this urban section.

Pedestrian Areas and Squares: The findings of the analysis reveal that 'contrast' variable significantly explain the comfort in lighting of the pedestrian areas and squares. The findings reveal that 'brightness' also explain the feeling of comfort in people. Limited literature findings on this subject suggest that level of brightness has a relation with the feeling of comfort; findings reveal that ample-dazzling light and glare decreases the comfort. (vanSanten: 2006, 37) However, the literature findings do not form any relation between other perceived variables of lighting and 'comfort'. In this sense this research introduces the significance of the 'contrast' variable, and also validates the importance of the 'brightness' variable. When the lighting of the pedestrian environment provides good contrast and sufficient brightness at night (by making object visible and not let them blend in the background), people feel comfortable in that area.

Urban Parks: The findings of the analysis reveal that 'contrast' significantly explain the comfort in lighting of the urban parks. According to the findings of this research, 'color' and 'distribution of light' also explain the feeling of comfort in lighting of this urban section, although being less significant variables. The limited literature findings in 'comfort' also correspond with the findings of the analysis. According to the literature findings, distributing more light on the pavement or the path surface, and using colored light in empty parks elicit comfort in people. (Moyer: 1992, 235; vanSanten: 2006, 29) In this sense, this research suggests the significance of the 'contrast' variable, and also efficient use of colored light and efficient distribution of light in making people feel comfortable in urban parks at night.

4.1.4. 'Safety' and Urban Lighting Attributes

In this section I present the findings of the multiple regression analysis where the 'safety' is treated as the dependent variable. In this section I also present my discussions on the findings this analysis. This section comprises two sub-sections: multiple regression analyses and discussions for 'safety'.

4.1.4.1. Multiple Regression Analyses Results

To explore how much safety for lighting of difference urban patterns (buildings, urban parks, pedestrian roads, and vehicle roads) vary through the linear relationships of the attribute variables (brightness, contrast, distribution of lighting, legibility, and color) to each other and to safety, I conducted a stepwise regression analysis for the overall sample, where the one independent variable making the largest contribution to R^2 is entered into the model first. For the regression model of safety, I treated safety as the dependent variable and the attributes as independent variables.

The analyses revealed that 'contrast' significantly explain the safety for lighting of roads and pathways, pedestrian areas and squares, and urban parks. For buildings, variable of 'distribution of light' significantly explain safety. For roads and pathways, and pedestrian areas and squares people also significantly indicated 'legibility' as a reason for safety. The variable of 'color' made the most contribution to explaining the variance in safety for buildings. For urban parks, this is replaced with 'distribution of light'.

Table 4.25 shows that the model of safety for **buildings** (*Adjusted* $R^2 =0.272$, $F=8.507$, $p<0.01$). In the model, two of the five attributes made significant contribution to explaining the remaining variance in safety. These attributes include 'distribution of light' and 'color' (p's < 0.01). When considered all, they explained almost 28 percent of variance in safety. The 'distribution of lighting' made the most contribution to explaining the variance in interest by 24 percent (See Section 4.1 in Appendix B for more results of this analysis).

Table 4.25. Results of Regression Analysis of Safety for Lighting of Buildings for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Distribution of Light	.240	.240	.314	3.214	.002
Color	.282	.042	.283	2.917	.004
(constant)			1.035	3.532	.001

Standard Error = 1.05
Adjusted R^2= .272
df1=1; df2=147
For model: F = 8.507, p < .00

Table 4.26 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model. However, the variables of 'brightness' and 'distribution of lighting' strongly correlate (*r*'s › .70) with 'contrast'. This indicates that these variables are included in the safety model through 'contrast'.

Table 4.26. Pearson Correlation for Safety for Lighting of Buildings and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
SAFETY (C)	1.000	.354	.490	-.239	.447	.481
Brightness (V1)	.354	1.000	.644	-.472	.732	.595
Distribution of Light (V2)	.490	.644	1.000	-.451	.723	.674
Legibility (V3)	-.239	-.472	-.451	1.000	-.372	-.324
Contrast (V4)	.447	.732	.723	-.372	1.000	.699
Color (V5)	.481	.595	.674	-.324	.699	1.000

Table 4.27 shows that the model of safety for **roads and pathways** (*Adjusted* R^2 *=0.442, F=5.445, p<0.01*). In the model, three of the five attributes made significant contribution to explaining the remaining variance in safety. These attributes include 'contrast', 'legibility' and 'brightness' (*p*'s < 0.01). When considered all, they explained almost 45 percent of variance in safety. The 'contrast' made the most contribution to explaining the variance in interest by 33 percent (See Section 4.2 in Appendix B for more results of this analysis).

Table 4.27. Results of Regression Analysis of Safety for Lighting of Roads and Pathways for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.326	.326	.302	3.557	.001
Legibility	.433	.107	-.267	-4.278	.000
Brightness	.453	.020	.210	2.333	.021
(constant)			1.616	3.956	.000

Standard Error = .86
Adjusted R^2= .442
df1=1; df2=146
For model: F = 5.445, p < .02

Table 4.28 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model. However, the variables of 'brightness' and 'distribution of lighting' strongly correlate (*r*'s › .70). This indicates that people may relate brightness to distribution of lighting in their comfort.

Table 4.28. Pearson Correlation for Safety for Lighting of Roads and Pathways and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
COMFORT (C)	1.000	.567	.522	-.539	.571	.440
Brightness (V1)	.567	1.000	.756	-.509	.681	.565
Distribution of Light (V2)	.522	.756	1.000	-.496	.613	.663
Legibility (V3)	-.539	-.509	-.496	1.000	-.424	-.300
Contrast (V4)	.571	.681	.613	-.424	1.000	.593
Color (V5)	.440	.565	.663	-.300	.593	1.000

Table 4.29 shows that the model of safety for **pedestrian areas and squares** (*Adjusted* $R^2 = 0.302$, $F=11.377$, $p<0.01$). In the model, two of the five attributes made significant contribution to explaining the remaining variance in safety. These attributes include 'contrast' and 'legibility' (*p*'s < 0.01). When considered all, they explained almost 31 percent of variance in safety. The 'contrast' made the most contribution to explaining the variance in safety by 26 percent (See Section 4.3 in Appendix B for more results of this analysis).

Table 4.29. Results of Regression Analysis of Safety for Lighting of Pedestrian Areas and Squares for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.258	.258	.319	4.707	.000
Legibility	.311	.053	-.220	-3.373	.001
(constant)			2.232	6.004	.000

Standard Error = .9
Adjusted R^2= .302
df1=1; df2=147
For model: F = 11.377, p < .00

Table 4.30 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model.

Table 4.30. Pearson Correlation for Safety for Lighting of Roads and Pathways and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
COMFORT (C)	1.000	.459	.436	-.455	.508	.409
Brightness (V1)	.459	1.000	.852	-.630	.687	.620
Distribution of Light (V2)	.436	.852	1.000	-.616	.677	.643
Legibility (V3)	-.455	-.630	-.616	1.000	-.504	-.469
Contrast (V4)	.508	.687	.677	-.504	1.000	.658
Color (V5)	.409	.620	.643	-.469	.658	1.000

Table 4.31 shows that the model of safety for **urban parks** (*Adjusted* R^2 *=0.425, F=4.447, p<0.01*). In the model, three of the five attributes made significant contribution to explaining the remaining variance in safety. These attributes include 'contrast', 'distribution of light' and 'legibility' (*p*'s < 0.01). When considered all, they explained almost 44 percent of variance in safety. The 'contrast' made the most contribution to explaining the variance in safety by 38 percent (See Section 4.4 in Appendix B for more results of this analysis).

Table 4.31. Results of Regression Analysis of Safety for Lighting of Urban Parks for the Overall Sample

VARIABLES	R^2	R^2change	b	t	p
Contrast	.378	.378	.380	3.633	.000
Distribution of Light	.420	.041	.256	2.530	.012
Legibility	.437	.017	.136	-2.109	.037
(constant)			1.132	2.509	.013

Standard Error = 1.00
Adjusted R^2= .425
df1=1; df2=146
For model: F = 4.447, p < .04

Table 4.32 shows moderate to substantial correlation between the three variables of the model (*r*'s < 0.69). This shows that multicollinearity does not constitute significant problem in this model. However, the variables of 'brightness' and 'contrast' strongly correlate (r's › .70) with 'distribution of light'. This indicates that these variables are included in the comfort model through 'distribution of light'. People may relate distribution of light to brightness and contrast.

Table 4.32. Pearson Correlation for Safety for Lighting of Roads and Pathways and Attribute Variables

	Pearson Correlation					
	C	V1	V2	V3	V4	V5
COMFORT (C)	1.000	.459	.436	-.455	.508	.409
Brightness (V1)	.459	1.000	.852	-.630	.687	.620
Distribution of Light (V2)	.436	.852	1.000	-.616	.677	.643
Legibility (V3)	-.455	-.630	-.616	1.000	-.504	-.469
Contrast (V4)	.508	.687	.677	-.504	1.000	.658
Color (V5)	.409	.620	.643	-.469	.658	1.000

4.1.4.2. Discussions: Safety

Buildings: The findings of the analysis bings out that 'distribution of light' significantly explains the safety in lighting of buildings. The variable of 'color' also explains safety; however it's a less significant variable with respect to the prevalence of 'distribution of light'. The literature findings show that safety is not related with any of the perceived variables of lighting. This research introduces the relation of the emotional appraisal 'safety' and attributes of lighting: 'distribution of light' and 'color'. The appearance of the lit building elicits the feeling of safety for people when the light is efficiently distributed on the façade of the building, and the colored light is efficiently used.

Roads and Pathways: The findings of the analysis reveal that 'contrast' and 'legibility' significantly explain the safety in lighting of roads and pathways. Although the significance of 'legibility' is lower compared to 'contrast' their contribution to explaining in the model are closer compared to other first and second significant variables in different urban sections. Literature findings overlap with this finding: increasing visibility, increasing contrast on the road, and contrast between the objects on the road and background increase the feeling of safety in people. (FGL: 2000; vanSanten: 2002, 36-39) Furthermore, increasing visibility of pathway, the surroundings and the boundaries of the road and pathway increases the security, comfort and safety (Moyer: 1992) Nevertheless, brightness also explains the safety in for this urban section: which corresponds with the literature findings that suggest unlit pathways and roads elicit anxiety and fear of crime. (Moyer: 1992) In this respect this research corresponds with the literature findings.

Pedestrian Areas and Squares: The findings of the analysis reveal that 'contrast' and 'legibility' significantly explain the safety in lighting of pedestrian areas and squares. Literature findings also suggest that too many dark areas in a lit pedestrian environment decrease the feeling of safety. (vanSanten: 2006, 40) On the other hand, literature findings suggest that brightness elicit the feeling of safety in people for this urban section: sufficiently lit streets elicit the feeling of safety in people in pedestrian environments. (vanSanten: 2006, 40) In this respect, this research brings out that people do not refer to 'brightness' directly when they explain the feeling of safety in this urban section. This research suggests that people feel safe in pedestrian areas and squares when legibility and good contrast are provided with lighting; only providing high intensity of light is not sufficient for creating safe pedestrian environments.

Urban Parks: The findings of the analysis reveal that 'contrast' significantly explain the safety in lighting of urban parks. The variables of 'distribution of light' and 'legibility' also explain the feeling of safety for this urban section. Literature findings also overlap with these findings. Literature findings suggest that: undesired shadows which change the appearance of the objects and the space elicit fear. (Moyer: 1992, 214-215) Inefficient distribution of light and excessive contrast change the shapes of shadows dramatically, and creates ambiguous appearances of familiar objects. On the other hand, low visibility and not being able to know about the surroundings due to obscurity decreases the feeling of safety and increases the fear of crime. (Kubat & Kaya: 2007) In this sense, the findings of the analysis validate the literature findings.

4.2. DESCRIPTIVE ATTRIBUTES OF URBAN LIGHTING

In order to obtain the prevalent perceptual attributes of respondents for the most liked and the least liked scenes, I grouped their subjective descriptions under certain categories. In determining these groups I aimed to create distinctive categories that do not overlap in terms of content. I also aimed to be as exhaustive as possible so as not to lose the richness of the subjective descriptions. I used two different attribute groups for likes and dislikes. After this grouping I conducted my content analysis and derived the frequency of mentioning data that I will use in further stages of my research.

4.2.1. 'Preferred' Urban Lighting Attributes

In this section I introduce the content of each group for the preferef urban scene. I grouped the subjective descriptions of respondents under 12 categories. These 12 categories cover all of the 120 descriptions of 30 respondents for their most liked nocturnal urban scene. The Table 4.33 displays the attribute categories and frequency their being mentioned in the descriptions of the respondents.

Table 4.33. Attribute Groups and Frequency of Mentioned for the Preference

Attribute Variable	**Percent of Total Citations %**	**Frequency of Mention**
Emotional / Behaviour	30	56
Level of Brightness	17	32
Accordance with Visual, Functional or Historic Identity	17	32
Color	11	21
Level of Complexity and Variety	6	12
Distribution of Light	6	11
Legibility	6	11
Contrast	3	6
Lighting Source	3	6
Total	100	187

Source: Personal Research

Attribute categories comprise seemingly similar citations. For example, "emotional" group comprises emotional reactions of respondents such as fear, comfort and peace. The "level of brightness" group comprises the descriptions about the level of brightness, whether the level of brightness is sufficient, whether the lighting is glare-free etc. The content analysis reveal that, based on the frequency of mention of attribute variables, people most frequently used the variables of "emotional / behavior", "level of brightness", "accordance with visual, functional or historic identity" and "color" to explain their reasoning in their 'preference'.

Emotional / Behaviour includes components of liking, interest, welcoming, safety, security, calmness, peace, warmth, relaxation and admiration. Level of Brightness includes such components as the intensity level of illumination and sufficiency of the brightness with regards to the environment. Accordance with Visual, Functional or Historic Identity include components of accordance with the physical characteristics, harmony with the physical appearance, harmony with its surroundings, and accordance with the identity of the place or the building. Respondents used their existing knowledge of function and identity of the places while they were making descriptions about how lighting fit the character and identity. Color includes components of the choice of color which is used for illumination, the warmth of color, saturation of the color, and its relation with the lit object, all which lead to a positive outcome for the respondents.

Level of Complexity and Variety includes such components of the complexity or simplicity of the lighting design and variety of the light sources and lighting methods. Respondents used both complexity and simplicity as their explanations for their preference. Legibility includes components of legibility, visibility, clarity and orderliness. Distribution of Light includes components of distribution and direction of the light that created appealing outcomes for the respondents. Contrast includes components of the contrasting effect of light, and distinguishability of the lit object from its surroundings. Lighting Fixture includes components of the evaluations design quality and appearance specific to the lighting fixtures. In the Table 2, some of the descriptions of respondents for the 'preference' are presented.

Table 4.34. Samples of Descriptions for the Preference

EMOTIONAL

"It looks like a big gate with this lighting, that's why it looks welcoming"

"It is very natural and comforting."

"It looks very calm and peaceful because the lighting is used efficiently."

"I feel that with this lighting, this place would be the most secure place for a pedestrian."

"Lighting is utilized nicely."

LEVEL OF BRIGHTNESS

"It is nice that this street is not illuminated too much."

"It is nice that there is no glare."

"This place is sufficiently lit both for cars and pedestrians."

"This lighting provides adequate amount of light for this park."

ACCORDANCE WITH VISUAL, FUNCTIONAL OR HISTORIC IDENTITY

"Lighting is in harmony with its historical appearance and it makes it look mysterious"

"I think lighting is in harmony with the warm character of this street."

"Although it looks classical, this is the street lighting that we all recognize."

LEVEL OF COMPLEXITY AND VARIETY

"It is nice not having unnecessary lighting tricks; it helps create a safe and comfortable environment."

"It is nice that there is variety of colors and different lights."

LEGIBILITY

"It looks very orderly, there is no chaos."

"Lighting makes it easy to understand everything."

DISTRIBUTION OF LIGHT

"Lighting of the ground floor presents a convenient environment for the pedestrians."

"The combination of the lights and shadows look interesting."

CONTRAST

"Lighting makes building noticeable in the dark."

"Lighting makes it stand out..."

Source: Personal Research

In the Table 4.35 findings of the content analysis is presented specific to each urban section. Frequency of mention and percentage in the all citations for each urban section is presented in the table. People most significantly explained their preference in lighting of buildings with 'emotional/behaviour' (33%) and 'accordance with identity or characteristics' (29%) variables. For pedestrian areas, the most significant variables are 'level of brightness' (28%) and 'emotional/behaviour' (24%). For urban parks, the most significant variable was 'emotional/behaviour' (37%); the other variable -which has a relatively less significance- is 'level of brightness' (16%). People most significantly explained their preference in lighting of 'roads and pathways' with 'emotional/behaviour' (30%) variable. The rather less significant variables for this urban section are 'level of brightness' (17%) and 'Accordance with Visual and Functional Identity or Characteristics' (17%).

Table 4.35. Attribute Groups and Frequency of Mention for Preference, Specific to Urban Sections

Attribute	**Buildings**	**Pedestrian Areas**	**Urban Parks**	**Roads and Pathways**	**Total**
	Percent % (F.Mention)	Percent % (F.Mention)	Percent % (F.Mention)	Percent % (F.Mention)	Percent % (F.Mention)
Level of Brightness	8 (4)	**28 (14)**	**16 (7)**	16 (7)	**17 (32)**
Emotional / Behaviour	**33 (16)**	**24 (12)**	**37 (16)**	**27 (12)**	**30 (56)**
Color	6 (3)	14 (7)	9 (4)	16 (7)	11 (21)
Level of Complexity and Variety	2 (1)	12 (6)	12 (5)	0 (0)	6 (12)
Distribution of Light	12 (6)	0 (0)	0 (0)	11 (5)	6 (11)
Accordance with Visual and Functional Identity or Characteristics	**29 (14)**	8 (4)	12 (5)	**20 (9)**	**17 (32)**
Legibility	2 (1)	2 (1)	12 (5)	9 (4)	6 (11)
Contrast	8 (4)	0 (0)	2 (1)	2 (1)	3 (6)
Lighting Source	0 (0)	12 (6)	0 (0)	0 (0)	3 (6)
Total	100 (49)	100 (50)	100 (43)	100 (45)	100 (187)

Source: Personal Research

4.2.2. 'Disliked' Urban Lighting Attributes

In this section I introduce the content of each group for the most disliked urban scene. I grouped the subjective descriptions of respondents under 14 categories. These 14 categories cover all the 120 descriptions of 30 respondents for their most disliked nocturnal urban scenes.

The table 4.36 displays the attribute categories and frequency their being mentioned in the descriptions of the respondents. The list of frequency of attributes which were mentioned for the most disliked urban scene displays that "level of brightness", "emotional" and "color" are the attributes people most frequently use to define their reasoning for their choice of the most disliked urban scene. Furthermore, the attributes "Conflicting or Misrepresenting Visual Character" and "Distribution of Light" share a close proportion in the frequency of mentioned attributes.

Table 4.36. Attribute Groups and Frequency of Mention for the Dislike

Attribute	**Percent of Total Citations**	**Frequency of Mention**
Emotional / Behaviour	23	49
Level of Brightness	17	36
Color	15	31
Conflicting or Misrepresenting Visual Character	10	21
Distribution of Light	9	19
Level of Complexity and Variety	7	15
Legibility	6	12
Physiological Effects	4	8
Ineffective Use of Resources	4	8
Lighting Fixtures	3	7
Contrast	2	4
Total	100	210

Source: Personal Research

Emotional / Behaviour includes components of dislike, insecurity, unattractive, frightening, boring, heavy, dangerous and threatening. Level of Brightness includes components of insufficient brightness and excessive brightness. Color includes components of dislike and disharmony of choice, tone and combination of colors. Conflicting or Misrepresenting Visual Character includes components such as lighting design which is not compatible with the identity of the place or the building and lighting design that changes the perceived characteristics of the structure. Respondents expressed that with inelaborate lighting design, the characteristics of the place are lost and the building or the space gained a new and not preferable identity.

Distribution of Light includes components of scallops, distribution and direction of light, and accentuation with lighting which all created negative feelings for respondents. Level of Complexity and Variety includes components such as excessive simplicity, and excessive complexity. Respondents expressed their dislike with regards to both complexity and simplicity. Legibility includes components such as illegibility, lack of visibility, clarity and order. Physiological Effects includes components such as glare, nausea, exhaustion and distraction. Respondents expressed that if they were to experience the presented nocturnal urban scene, they would endure such physiological problems. Ineffective Use of Resources includes components of the ineffective use of energy resources due to inelaborate lighting design, costs of lighting design installations and light pollution. Contrast includes components of the lack of contrasting effect of light, or excessive contrast between the lit and unlit objects. Lighting Fixture includes components of the evaluations on the lack of design quality and disharmony of the appearance of lighting fixtures. In the Table 4.37, some of the descriptions of respondents for the 'dislike' are presented.

Table 4.37. Samples of Descriptions for the Dislike

EMOTIONAL / BEHAVIOUR

“One would not feel safe in here.”

“I like dark places yet this area does not look secure at all for a pedestrian.”

“It might look ok for one scene, but if I were to experience it in reality I know it would be very boring and very heavy on me.”

“There is not a special arrangement for the lighting of this area, it does not look aesthetic.”

LEVEL OF BRIGHTNESS

“Considering the pedestrian safety, amount of light is insufficient”

“The amount of brightness is far beyond what is needed for this area.”

“It looks very dark and very desolate.”

COLOR

“I don’t think the colors of these lights go well together.”

“Blue-purple color of light is not attractive.”

“Colors of this scene does not look like the real world, it looks like a Lego world.”

CONFLICTING OR MISREPRESENTING VISUAL CHARACTER

“Lighting of the first floor makes it look like an ordinary shop lighting.”

“The avenue looks like a fairground with this lighting.”

“The appearance of this park is no longer natural, lighting gives it a very unnatural appearance”

DISTRIBUTION OF LIGHT

“The dark areas in this scene draw my attention directly.”

“Lights and shadows create shapes that I believe not very necessary.”

“Defining with straight lines of light stands out way too much.”

LEGIBILITY

“People look like shadows in the distance, I cannot make out anything”

“There are way too many things that it is impossible to understand the whole.”

PHYSIOLOGICAL EFFECTS

“I think in these green lights, one would feel sick and have a bad headache.”

“This lighting would exhaust anyone, one might even live shorter with this kind of view at his window.”

Source: Personal Research

In the table 4.38. findings of the content analysis is presented specific to each urban section. Frequency of mention and percentage in the all citations for each urban section is presented in the table. People most significantly explained their disliking in lighting of buildings with the variables of 'color' (27%) and 'distribution of light' (16%). For pedestrian areas and squares people most significantly used the variables of 'emotional/behaviour' (32%) and 'level of brightness' (28%). For urban parks people most frequently used the variable of 'emotional/behaviour'. For this urban section other variables of 'color', 'distribution of light' and 'conflicting or misrepresenting visual character' were mentioned evenly frequent (12%). People most frequently used the variables of 'emotional/behaviour' (25%) and 'level of brightness' (20%) to explain their disliking in the lighting of roads and pathways.

Table 4.38. Attribute Groups and Frequency of Mention for Dislike, Specific to Urban Sections

Attribute	**Buildings**	**Pedestrian Areas**	**Urban Parks**	**Roads and Pathways**	**Total**
	Percent % (F.Mention)	Percent % (F.Mention)	Percent % (F.Mention)	Percent % (F.Mention)	Percent % (F.Mention)
Level of Brightness	11 (6)	**28 (13)**	10 (5)	**20 (12)**	**17 (36)**
Emotional / Behaviour	11 (6)	**32 (15)**	**27 (13)**	**25 (15)**	**23 (49)**
Color	**27 (15)**	2 (1)	12 (6)	15 (9)	15 (31)
Level of Complexity and Variety	9 (5)	11 (5)	6 (3)	3 (2)	7 (15)
Distribution of Light	**16 (9)**	0 (0)	12 (6)	7 (4)	9 (19)
Conflicting or Misrepresenting Visual Character	15 (8)	6 (3)	12 (6)	7 (4)	10 (21)
Physiological Effects	0 (0)	0 (0)	10 (5)	5 (3)	4 (8)
Contrast	5 (3)	0 (0)	0 (0)	2 (1)	2 (4)
Lighting Source	0 (0)	11 (5)	0 (0)	3 (2)	3 (7)
Legibility	4 (2)	11 (5)	6 (3)	3 (2)	6 (12)
Ineffective Use of Resources	2 (1)	0 (0)	4 (2)	8 (5)	4 (8)
Total	100 (55)	100 (47)	100 (49)	100 (59)	100 (210)

Source: Personal Research

4.2.3. Discussions

4.2.3.1. Buildings

This analysis brings out that preference is most significantly explained by emotional appraisals and 'accordance with visual and functional identity or characteristics'; whereas, dislike is explained by 'color' of light and 'distribution of light'.

Content analysis suggests that when people evaluate the lighting of buildings, they significantly base their evaluations of preference on the feeling that the appearance of the building elicits. The frequency of mention reveals that emotional/behaviour variable is used the most to explain preference. The descriptions of the respondents show that preference of people in the lighting is strongly based on emotional appraisals than the perceived attributes of lighting. The emotional reactions people used for explaining their preference are interest, liking, and aesthetic appeal. The literature findings neither denies nor suggests the significance of emotional/behaviour sensations that lighting of buildings elicit. This research reveals that when people are asked to explain their evaluation of the lighting of buildings, they primarily refer to their emotional reactions for the appearance of the scene.

The other most significant variable that explains the preference of people in lighting of buildings is 'accordance with visual and functional identity or characteristics'. While they were evaluating the lighting of their preferred image, respondents used their existing knowledge of the identity of the place, its historical importance, functional value in urban life and also the daytime appearance of the structure. Based on such variables, they stated that they liked the lighting of the building because it complemented the characteristics of the structure. The literature states the importance of designing lighting that complements the relation between the daytime use, daytime appearance and also other identical characteristic. Schanda (2001) states that lighting might lead to creation of an entirely new appearance; Moyer (1992) and Phillips (2004) stress that lighting should provide experiencing the same structure with a new aesthetic emphasis at night.

This research overlaps with the literature findings in this subject and introduces the significance of creating lighting designs which are in accordance with visual and functional identity or characteristics of the buildings.

The variables, which are also stated as significant variables of lighting in literature, 'distribution of light', 'contrast' and 'color' are also mentioned by the respondents to explain their preference. However, these variables were relatively less significant for respondents than 'emotional/behaviour' and 'accordance with visual and functional identity or characteristics'.

On the other hand, content analysis also reveals that when people evaluate the lighting of buildings; they explain dislike with the 'color' of the light. The literature findings suggest that using color can create positive outcomes; every person who is subjected to colored light show an emotional reaction. (Mahnke: 1996, 6; Beer 1992, 11) However, literature findings also suggest that not every 'emotional reaction' that people would give to the colored light could be positive. The choice and use of colored light affects how people feel about the lighting of buildings. Küller (1981) stresses that although the taste of people in colors are hypothesised to be very subjective, most people react the same way to certain colors. However, there is not a 'safe' or 'right' color to create lighting designs that has good public appeal. The descriptions of respondents also suggest that even though the choice of color is right, its use in the overall composition might create unpreferrable outcomes. One of the respondents makes this statement for her disliked image for building lighting: *I really like this color blue, but considering how it comes together with the white light and other aspects of building, I can tell that this color is no match for this building.* The literature findings also correspond with the findings of the content analysis that wrong use of color damages the aesthetic quality. Phillips (2004) states that excessive variety and intensity of colored light, and theatrical effect created with color disturb people and, in turn, elicit disliking.

The other significant variable, which people referred to when they explained their dislike in the lighting of buildings, is the 'distribution of light'. The literature findings also pinpoint the significance of this variable. People mostly refer to the shadows that distribution of light creates on the buildings. When the shadows on the façade that creates high contrast (like dazzling areas and dark patches in the view), or creates ambiguous shapes, people do not like the appearance of the building. One of the respondents states that: *"lighting creates unusual and unnecessary shapes on the building"*, as another respondents states that: *"lighting looks very disorganised and it does not emphasize anything particular."* Therefor, this research suggests that people would prefer to see a sufficiently distributed light. If the light is designed to create shadows to increase dramaticness, people prefer to see an order of emphasis.

The variable of 'conflicting or misrepresenting visual character' is the opposing category of 'accordance with visual and functional identity or characteristics' in preference. This variable is also frequently mentioned by people in explain their dislike. In this sense, this finding suggests that people prefer to see a relation and harmony between the lighting and the visual, functional and historic character of the building. One of the respondents stated that: *"choice of color and lighting is incoungrious with the character of the building: it destroys the historic character of the structure. Its character with this lighting does not look any different than a night club."*

4.2.3.2. Roads and Pathways

This analysis brings out that both preference and dislike are most significantly explained with 'emotional appraisals' in lighting of this urban section. The variable of 'accordance with visual and functional identity or characteristics' is also significantly mentioned to explain preference by respondents. The variable of 'level of brightness' is also mentioned by respondents significant for explaining dislike in lighting of roads and pathways.

The variable of 'emotion/behavior' is most significantly mentioned by respondents. The emotional appraisals of calmness, interest and liking were being referred to by respondents, whereas, fear, insecurity, mystery, gloom, boredom and disliking were mentioned for dislike. Literature findings about this urban section have a limited focus on the emotional dimension of the road lighting. The primary goal is to provide the road safety in road lighting and literature findings provide relations between lighting and comfort. However, road lighting also affect the experience of people in urban life and this research reveals that although providing road safety is important, the emotional dimension of the inner city roads is also very significant to people.

The significance of the variable of 'accordance with visual and functional identity or characteristics' in explaining preference shows that people have certain perspectives about how an inner city street should look like. When the lighting serves to create the expected appearance of the street at night, people like the lighting design. One of the respondents stated that: *"the lighting of this area makes it look like a calm and nice neighborhood and I think it goes well with everything around it."* Another respondent stated that: *"the lighting fits the streets character; it looks like a casual avenue and not like a circus."* Although being less significant, opposite of this variable also mentioned for dislikes. One of the respondents stated that: *"The avenue looks like a fairground with this lighting and I do not mean it well".* Another respondent draw attention to the identity issue. She underlined that using same type of lighting fixture might overrule the visual identity by stating: *"with this new lanterns Eskişehir Road, Esenboğa Road, Atatürk Boulevard, they all look the same."* Literature findings suggest little about the visual identity of the road lighting. Phillips (2004) states that lighting can give a warm character to the residential streets and can make the environment more comfortable and preferable. However, literature findings are limited in their attention to how road lighting shapes the appearance of the city. In this sense this research draws the attention to the importance of visual identity that road lighting is capable of creating.

Another significant variable for both explaining preference and dislike is 'color' of light. Literature findings are limited in their attention to the color of light; the color of light is referred to the use of light source (sodium discharge, metal halide etc.) However, this research suggests that people prefer warmer colors for road lighting. Most of the respondents disliked bright and white lights for road lighting, and stated bright white lights created an ambiguous appearance. One of the respondents stated that: *"this tone* *of white (cool-bluish white) is so unattractive; it makes the place look like a corridor in a hospital."* Use of different colors than tones of white gave mixed reactions. Some of the respondents liked the use of indirect green lighting for road (in Cinnah Boulevard), whereas, some respondents strongly disliked the use of other colors than white or bright orange. One respondent stated that experiencing the road for several times would decrease the interest in lighting of the road by saying: *"this scene look ok for the first time, but I use this road everyday and after a while, especially when I wait for a long time in the bus, it becomes very disturbing and gloomy."* The literature review does not focus use of different colors such as green. Hence, this research suggests that use of different colors in road lighting might results in mixed responses.

4.2.3.3. Pedestrian Areas and Squares

This analysis brings out that people most significantly base their evaluation on 'emotional appraisals' and 'level of brightness' both for preference and dislike. Content analysis reveals that when people evaluate the lighting of pedestrian areas and squares, they significantly base their evaluations of preference on the feeling that the appearance of the lit pedestrian environment elicits in them, and also the level of brightness of the lit environment. The emotional appraisals people used for explaining their preference are liking, safety, security, peacefulness, calmness, and warmth. The emotional appraisals people used for explaining the dislike are insecurity, gloom, fear and unattractedness. The descriptions of respondets correspond with the literature findings that people like the lighting of the pedestrian environment when they feel safe and secure about the area.

People also referered to the 'level of brightness' variable in explaining their preference in lighting of this urban section. The descriptions of respondents for dislike also address the 'level of brightness' as the second most significant variable. All of the respondents refer to darkness and insufficient lighting as their explanation for dislike. In this sense, and with correspondance to the literature findings: this resaerch suggests that 'level of brightness' is a signifficant variable for the lighting of pedestrian environments. Nevertheless, this study does not necessarily suggest that high intesity of light for pedestrian environment is the most preferable choice for people. People preferes sufficient lighting that would provide needed visibility and feeling of secuirty in pedestrian environments.

The variable 'level of complexity and variety' is a significant variable that people refered to for explaining both preference and dislike in lighting of pedestrian environments. The improtance of level of complexity also corresponds with the literature findings. When the design of lighting is too complex people would dislike it because human beings tend to get easily confused when they are subjected to visual stimuli and it results in unpleasentnes (Elinger: 1963): yet, people require certain amount of complexity in their environment (Birren: 1969) In this sense, judging the right level of complexity is an important design decision. The significance of 'color' variable for preference can also contribute to 'level of complexity and variety' variable in a sense that almost all of the respondets refered to the 'existince of color variety' rather than preference for a particular color tone. In this sense, this research suggests that people requires certain amount of variety and comlexity; however, understanding and making an in-depth explanation for this phenomenon is beyond the framework of this research.

Another significant variable that people refered to for explaining both preference and dislike is lighting source. The findings of this analysis about lighting source corresponds with the literature findings: visual integration of lighting equipments to the urban environment increases the pleasentness for people. (Boduroğlu: 2001, 115) Respondents state that they like the lighting because lighting fixtures create a warm environment and it complements the character of the street. This research also brings out that people prefer to see systematised lighting installations for pedestrian environments. When the pedestrian area is lit by shop lightings and billboards but not with specific lighting fixtures, people dislike the lighting of that area even though they state that it is lit sufficiently. One of the respondents explains his dislike in lighting of an urban scene: "*Lighting is limited to the commercial uses in this area. After these shops are closed, this place will not look attractive.*" In this sense, this research suggests that specialized lighting installations increase the preference of people in lighting of pedestrian environments.

4.2.3.4. Urban Parks

This analysis reveals that people most significantly base their evaluation on 'emotional appraisals' both for preference and dislike. The variable of 'level of brightness' is also mentioned by respondents significantly for explaining preference. The other variables are evenly mentioned in explaining dislike by respondents.

Content analysis reveals that when people evaluate the lighting of urban parks, they significantly base their evaluations of preference and dislike on the feeling that the appearance of the lit urban park elicits in them. The emotional appraisals people used for explaining their preference are calmness, relaxation, attraction and safety. The findings of content analysis correspond with the literature findings: people prefer urban parks when the lighting provides relaxation, attraction and safety. However, literature findings mostly point the importance of increasing the interest by using landscape objects and various lighting methods. This research suggests that primary preference of people would be relaxation and calmness in urban parks. When they explain their dislike, respondents refer to emotional appraisals such as gloom, fear and boredom.

The variable of 'level of brightness' is also significantly mentioned by respondents to explain their preference. Different from other urban sections, respondents preferred sufficient and abundant amount of light for urban parks. This research reveals that in lighting of urban parks, people require a higher level of lighting. In that sense, I would also like to discuss the prevalence of 'legibility' for urban parks in preference. The variable of 'legibility' is also significantly used by respondents to explain their preference. When respondents explained their preference, they referred to the high visibility. One of the respondents stated that: *"being able to see what happens where makes me feel safe about this park."* The variable of 'distribution of light' also serves to explaining the importance of high visibility: respondents referred to the uneven distribution of light in explaining their dislike for the lighting design of urban parks. The possibility of crime, and also the fear of crime hinder the use of urban parks at night. In correspondence with the literature findings, this research suggests that moderate to high level of light intensity can be utilized to increase the use of urban parks. Although shifts of brightness increase the interest, lighting design should avoid deep contrast and provide even distribution of light to increase the preference.

This research brings out that another important issue about the lighting of urban parks is the nocturnal visual character and lighting of specific landscape elements. Both in preference and dislike, people significantly evaluated how lighting design complemented the natural character of the urban park and landscape elements. Respondents preferred lighting settings which brought out the 'natural beauty' of the urban parks at night. The lighting settings which created a complete new appearance of the park at night are not preffered by respondents. The research reveals that the lighting of the landscape elements also affect the nocturnal character of the urban parks. The lighting settings which created completely new appearance of the familiar objects of daytime are criticized by respondents. The elements that created ambigious and unnatural appearance in parks are disliked by respondents. One of the respondents stated that: *"not everything in a park has to be lit I think… lighting of camellias and bridges like this (with outlining) and lighting of trees with green light; they all together point too many spots in such an inelaborate way that whole park looks just cheap."*

CHAPTER 5

CONCLUSIONS

In this thesis I aimed to discover people's evaluation of urban lighting and I aimed to form relations between the perceived attributes that elicit certain emotional reactions. This thesis resulted that amongst the tested all five variables, 'contrast' and 'color' are the most significant in people's evaluation of the urban lighting. Moreover, the results also introduced relations between emotional appraisals and certain perceived attributes which are frequently mentioned in literature regardless of the emotional appraisals they elicit.

Urban lighting affects the quality of the urban design. It is vital for the nocturnal use of urban exteriors. People prefer the environments where they can see what happens where; it is a survival instinct. In that sense, one can justify the significance of light with common sense that people need lighting to use urban exteriors at night. On the other hand, seeing the urban lighting solely as an effort to see the surroundings would be a very survival point of view. The emotional value of light in the urban space can not be denied. The light is no longer stands for the sake of lighting; it puts an aesthetic emphasis on the space and it has emotional dimension for people who experience it. The findings of this thesis reveal that people respond to the lit urban scene in several different dimensions. The lighting to see at night, in other words, the functional significance of urban lighting is only one of these many dimensions. In this sense, this thesis presents a scientific falsification of the common misconception about urban lighting: *"the brighter, the better."* The sufficient amount of light is not the only variable people refer to in their preference for the lit environment. There are several other variables of lighting that construct pleasant urban spaces at night. These variables create the difference between 'the mere act of putting light against obscurity' and 'illumination'. All in all, what people expect from lighting is that it would illuminate the public space by providing legible, balanced, harmonious and creating cohesive nocturnal landscape.

This thesis results that people refer to the variable of 'contrast' very significantly in evaluating the lighting of the urban sections. Contrast in lighting is very important since it boosts the perception of the three dimensional shapes. With contrast the shapes of three dimensional objects, texture and other physical details are comfortably recognized. This thesis results that, feelings of preference, interest, safety and comfort in lighting of all urban sections are related to contrasting effect of light. In addition, the results also show that high level of contrast is seemingly more problematic than lack of it. The findings of this thesis correspond with the literature findings in the importance of 'contrast' variable in lighting of the urban space; moreover, this thesis underlines its significance.

On the other hand, this thesis results that 'color' is another significant variable of lighting. The use of 'color' in lighting is a subject which is popularly discussed by designers of the public space. The practice of urban lighting includes and promotes the use of colored lights. The designers, on the other hand, argue about the aesthetic impression that colored lights create in the urban realm. The use of color in lighting is mostly promoted as source that introduces variety, cheerfulness and liveliness to the urban environments. Yet, it is also criticized for dramatically changing the appearance of the structures and urban space in a sense that they claim lighting creates an entirely ambiguous view of urban realm at night. This thesis resulted that emotional responses of people are highly affected by the use of color in lighting of the urban space. The research reveals that when lighting provided an effective use of color, people did not approach the lighting conservatively and they felt positive about the design outcome. However, color can also be the main reason why people do not like the lighting at all. This results show that use of color in lighting brings about certain risks that, the design outcome might have a limited appeal in public. Yet, avoiding the use of color in lighting design would be 'too safe': the emotional value of color in urban environment is undeniable.

People give similar responses to major hues: the inspiration and calmness is linked with the color blue, whereas, red is known to be the most arousal yet, in long term, gloomy color of light. Furthermore, the saturated and vivid colors are known to be more disliked compared to pastel colors. However, scientific findings about color and emotional appraisals can not give designers the right choice of color in lighting design. The results, in correspondence with the literature findings, show although the hues of color are important, people are affected by how different colors come together to create the whole appearance.

Nevertheless, this thesis results that legibility is a significant variable in how people evaluate the lighting of urban sections. Research revealed that people agreed not being able to see 'everything' around them at night. Yet, if an object enters their field of vision, people seek to make sense of its appearance in the whole composition. Ambiguous nocturnal appearances of the familiar objects of the daytime did elicit negative emotional reactions in people such as fear, gloom and distraction.

Moreover, this thesis resulted that people significantly valued the relation of lighting design with the function, historic background, architecture and daytime appearance of the urban sections. The literature findings raise the importance of forming this relation; however, this relation is analyzed with respect to people's preference. The research resulted that people did not prefer a completely new appearance of well-known urban spaces at night: they preferred lighting designs that complemented the visual, historical and functional characteristics of the space. Ambitious and unusual lighting designs stand out from their surroundings at first glance. Use of distinctive and vibrant colors in lighting, flickering light bulbs, high intensity light sources immediately take people's attention. However, drawing the attention of people does not necessarily increase the aesthetic appeal of urban environments.

The variety in the market of lighting has been increasing parallel to the innovations in lighting technology. Actors of the lighting industry introduce new lighting methods and materials every year. The new technology provides variety to the use of urban lighting, as it decreases the installation and maintenance costs. The options that lighting industry strongly encourages designers to use variety of source and show off how strikingly the lighting technologies evolve. The strength and variety of the lighting industry should be seen as an advantage by urban designers to create such design that would have good public appeal. This thesis brings out that although, innovation is an inseparable component of design, lighting should not create 'alien appearances' out of familiar structures and places.

On the other hand, the results show that protecting the darkness of the night in the city and its visual and emotional qualities appear to be essential to the long-term composition of a well-conceived and attractive nocturnal city. Without the contrasting and mystifying effect of darkness, creation of pleasant nocturnal urban landscapes can not be possible. It is also necessary that zones of darkness should be protected in the urban realm where people can enjoy the natural view of the sky. However it should be noted that obscure darkness is not a natural state either. The night is not necessarily experienced as darkness neither in rural nor in urban environment, even if it is closely associated with it. In nature, night consists of natural light sources such as moon and other celestial objects. City at night is more luminous compared to the nature; public lighting, diffusive ground surfaces, reflective façades of buildings and the glowing sky render the urban night as a luminous being. Hence, the illuminated city is not necessarily unnatural and unpleasant.

Urban public lighting is considered as an asset that is not easily disputed or challenged from the point of view of the nocturnal functionality of the urban space, the safety of roadways, the feeling of security, the quality of urban social life. Therefore, it is necessary to be concerned with the quality of the lighting and its impact on the urban environment, at the same level and from initial conception. Technical ingenuity and the provision of rules must contribute to the harmony and aesthetics of the nocturnal urban scene, which are necessary conditions for the quality of the living environment.

This thesis represented a scientific way of approaching to the design of urban lighting. This study presented how a research on discovering the preferences of people on urban lighting design can reveal the significance of certain variables of lighting. The findings of this thesis are derived from literature review and a scientific research; hence the findings of this thesis are scientifically reliable. However, so as to broaden the understanding of the preference of people in lighting of the urban space, and reaching concrete resolutions about lighting design, further scientific study with the participation of larger respondent groups should be carried out. The effect of the variables of 'contrast', 'color' and 'accordance with the visual, functional or historic identity' on how people feel about the lighting of specific urban sections should be studied in further detailed scientific studies.

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APPENDIX A

ORIGINAL SURVEY FORM

Adı, Soyadı	:		
Cinsiyeti	: K E	Yaşı	:
Okuduğu / Mezun Olduğu Bölüm		:	
Mesleği		:	
Ankara'da Bulunduğu Toplam Süre		:	
E-mail Adresi*		:	

* Araştırma sonucu hakkında bilgilendirme almak isteyen katılımcıların doldurması gerekmektedir.

Kentsel mekanın aydınlatmasında kullanıcı deneyimini ve beklentilerini keşfetmeyi amaçlayan araştırma iki bölümden oluşmaktadır.

Ilk bölümde katılımcının 20 fotoğraf üzerinden verilmiş ifadeleri 1'den 5'e kadar verilen rakamlar ile değerlendirmesi beklenmektedir.

A	B	C	D	E	=> **Fotoğrafın Etiketi**
1	1	1	1	1	=> Katılmıyorum
2	2	2	2	2	
3	3	3	3	3	
4	4	4	4	4	
5	5	5	5	5	=> Kesinlikle Katılıyorum

Ikinci bölümde katılımcının seçtiği fotoğraf üzerinden gözlemlenen özellikler ve bunların yarattığı duyguları belirtmesi beklenmektedir.

Anketin tamamlanması ortalama **30 dk** sürmektedir.

Bu bölümde gösterilen 20 fotoğraf için aşağıdaki 9 ifadeyi değerlendirmeniz istenmektedir.																				
1 – Katılmıyorum ….. 5 – Kesinlikle Katılıyorum																				
	Binalar					**Yaya Alanları**					**Parklar**					**Yollar**				
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**R**	**S**	**T**	**U**
Yapı / mekan yeterince aydınlatılmış	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Işık yapının üzerine / mekana etkin ve verimli bir şekilde dağıtılmış	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Bu yapıda / mekanda mevcut aydınlatma ile görünmeyen fakat görünür kılınması gerekli yerler var	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Aydınlatma yapının / mekanın ayırt edilebilir olmasını sağlamış	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Bu yapının / mekanın aydınlatılmasında ışık renkleri yeterli olarak kullanılmış	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Aydınlatmanın yarattığı etkiyi düşünerek…																				
…bu yapının / mekanın görünüşünden hoşlanıyorum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
…bu yapıyı / mekanı ilgi çekici buluyorum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
…bu mekanda kendimi rahat *(comfortable)* hissederim	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
…bu mekanda kendimi güvende hissederim	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Bu bölümde her kategoriden **en beğendiğiniz** ve **en beğenmediğiniz** fotoğrafı seçmeniz, fotoğrafın etiketini form üzerindeki kutucuklara işaretlemeniz ve bu fotoğrafı seçme nedenlerinizi belirtmeniz beklenmektedir.				
Lütfen seçtiğiniz fotoğrafın etiketini işaretleyin	En beğenilen		En Beğenilmeyen	
Binalar	A		A	
	B		B	
	C		C	
	D		D	
	E		E	
Yaya Alanları	F		F	
	G		G	
	H		H	
	I		I	
	J		J	
Parklar	K		K	
	L		L	
	M		M	
	N		N	
	O		O	
Yollar	P		P	
	R		R	
	S		S	
	T		T	
	U		U	

APPENDIX B

RESULTS OF MULTIPLE REGRESSION ANALYSIS

Table B.1. Preference, Results Of Multiple Regression Analysis for Buildings

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.666(a)	.443	.439	.97148	.443	117.779	1	148	.000
2	.689(b)	.474	.467	.94714	.031	8.705	1	147	.004
3	.706(c)	.498	.488	.92880	.024	6.860	1	146	.010

Coefficients(d)

Model		Unstandardized Coefficients		Stndardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.140	.243		4.688	.000			
	Color	.722	.067	.666	10.853	.000	.666	.666	.666
2	(Constant)	.782	.266		2.939	.004			
	Color	.535	.091	.493	5.899	.000	.666	.438	.353
	Contrast	.262	.089	.247	2.950	.004	.591	.236	.176
3	(Constant)	.131	.360		.364	.716			
	Color	.558	.089	.514	6.240	.000	.666	.459	.366
	Contrast	.312	.089	.294	3.501	.001	.591	.278	.205
	Legibility	.139	.053	.166	2.619	.010	-.110	.212	.154

Correlations

		Like	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Like	1.000	.458	.518	-.110	.591	.666
	Brightness	.458	1.000	.644	-.472	.732	.595
	Distribution of Light	.518	.644	1.000	-.451	.723	.674
	Legibility	-.110	-.472	-.451	1.000	-.372	-.324
	Contrast	.591	.732	.723	-.372	1.000	.699
	Color	.666	.595	.674	-.324	.699	1.000
Sig. (1-tailed)	Like	.	.000	.000	.091	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.091	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Like	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Color
b Predictors: (Constant), Color, Contrast
c Predictors: (Constant), Color, Contrast, Legibility
d Dependent Variable: Like

Source: Personal Research

Table B.2. Preference, Results Of Multiple Regression Analysis for Urban Parks

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.532(a)	.283	.278	1.10636	.283	58.444	1	148	.000
2	.565(b)	.319	.310	1.08179	.036	7.797	1	147	.006
3	.593(c)	.352	.338	1.05943	.032	7.272	1	146	.008
4	.611(d)	.373	.356	1.04532	.021	4.969	1	145	.027

Coefficients(e)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.408	.279		5.043	.000			
	Contrast	.574	.075	.532	7.645	.000	.532	.532	.532
2	(Constant)	1.163	.287		4.059	.000			
	Contrast	.410	.094	.380	4.362	.000	.532	.339	.297
	Color	.247	.089	.243	2.792	.006	.481	.224	.190
3	(Constant)	.164	.465		.353	.725			
	Contrast	.511	.099	.474	5.143	.000	.532	.392	.343
	Color	.279	.088	.275	3.190	.002	.481	.255	.213
	Legibility	.177	.066	.214	2.697	.008	-.153	.218	.180
4	(Constant)	-.165	.482		-.342	.733			
	Contrast	.372	.116	.345	3.200	.002	.532	.257	.210
	Color	.250	.087	.246	2.858	.005	.481	.231	.188
	Legibility	.218	.067	.263	3.232	.002	-.153	.259	.213
	Distribution of Light	.237	.106	.232	2.229	.027	.480	.182	.147

Correlations

		Like	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Like	1.000	.394	.480	-.153	.532	.481
	Brightness	.394	1.000	.735	-.666	.648	.568
	Distribution of Light	.480	.735	1.000	-.558	.745	.560
	Legibility	-.153	-.666	-.558	1.000	-.531	-.421
	Contrast	.532	.648	.745	-.531	1.000	.625
	Color	.481	.568	.560	-.421	.625	1.000
Sig. (1-tailed)	Like	.	.000	.000	.031	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.031	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Like	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Color
c Predictors: (Constant), Contrast, Color, Legibility
d Predictors: (Constant), Contrast, Color, Legibility, Distribution of Light
e Dependent Variable: Like

Source: Personal Research

Table B.3. Preference, Results Of Multiple Regression Analysis for Pedestrian Roads

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.622(a)	.387	.383	.79879	.387	93.356	1	148	.000
2	.653(b)	.426	.418	.77534	.039	10.087	1	147	.002

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.035	.137		7.553	.000			
	Color	.511	.053	.622	9.662	.000	.622	.622	.622
2	(Constant)	.835	.147		5.671	.000			
	Color	.369	.068	.449	5.408	.000	.622	.407	.338
	Contrast	.212	.067	.263	3.176	.002	.559	.253	.198

Correlations

		Like	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Like	1.000	.490	.500	-.305	.559	.622
	Brightness	.490	1.000	.852	-.630	.687	.620
	Distribution of Light	.500	.852	1.000	-.616	.677	.643
	Legibility	-.305	-.630	-.616	1.000	-.504	-.469
	Contrast	.559	.687	.677	-.504	1.000	.658
	Color	.622	.620	.643	-.469	.658	1.000
Sig. (1-tailed)	Like	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Like	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Color
b Predictors: (Constant), Color, Contrast
c Dependent Variable: Like

Source: Personal Research

Table B.4. Preference, Results Of Multiple Regression Analysis for Roads and Pathways

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.588(a)	.345	.341	.96131	.345	78.118	1	148	.000
2	.634(b)	.401	.393	.92245	.056	13.732	1	147	.000

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	.676	.227		2.976	.003			
	Contrast	.606	.069	.588	8.838	.000	.588	.588	.588
2	(Constant)	.441	.227		1.941	.054			
	Contrast	.427	.082	.414	5.219	.000	.588	.395	.333
	Color	.292	.079	.294	3.706	.000	.539	.292	.236

Correlations

		Like	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Like	1.000	.464	.469	-.366	.588	.539
	Brightness	.464	1.000	.756	-.509	.681	.565
	Distribution of Light	.469	.756	1.000	-.496	.613	.663
	Legibility	-.366	-.509	-.496	1.000	-.424	-.300
	Contrast	.588	.681	.613	-.424	1.000	.593
	Color	.539	.565	.663	-.300	.593	1.000
Sig. (1-tailed)	Like	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Like	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Color
c Dependent Variable: Like

Source: Personal Research

Table B.5. Interest, Results Of Multiple Regression Analysis for Buildings

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.594(a)	.353	.349	1.02154	.353	80.733	1	148	.000
2	.634(b)	.402	.394	.98531	.049	12.085	1	147	.001
3	.653(c)	.427	.415	.96819	.025	6.244	1	146	.014

Coefficients(d)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.402	.256		5.486	.000			
	Color	.629	.070	.594	8.985	.000	.594	.594	.594
2	(Constant)	.964	.277		3.482	.001			
	Color	.399	.094	.377	4.233	.000	.594	.330	.270
	Contrast	.321	.092	.310	3.476	.001	.574	.276	.222
3	(Constant)	.317	.376		.843	.401			
	Color	.422	.093	.399	4.529	.000	.594	.351	.284
	Contrast	.371	.093	.358	3.992	.000	.574	.314	.250
	Legibility	.138	.055	.169	2.499	.014	-.093	.203	.157

Correlations

		Interest	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Interest	1.000	.406	.450	-.093	.574	.594
	Brightness	.406	1.000	.644	-.472	.732	.595
	Distribution of Light	.450	.644	1.000	-.451	.723	.674
	Legibility	-.093	-.472	-.451	1.000	-.372	-.324
	Contrast	.574	.732	.723	-.372	1.000	.699
	Color	.594	.595	.674	-.324	.699	1.000
Sig. (1-tailed)	Interest	.	.000	.000	.129	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.129	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Interest	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Color
b Predictors: (Constant), Color, Contrast
c Predictors: (Constant), Color, Contrast, Legibility
d Dependent Variable: Interest

Source: Personal Research

Table B.6. Interest, Results Of Multiple Regression Analysis for Urban Parks

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.487(a)	.237	.232	1.14559	.237	46.055	1	148	.000
2	.523(b)	.274	.264	1.12156	.037	7.411	1	147	.007
3	.562(c)	.316	.302	1.09234	.042	8.968	1	146	.003
4	.594(d)	.353	.335	1.06601	.037	8.302	1	145	.005

Coefficients(e)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.431	.289		4.951	.000			
	Contrast	.527	.078	.487	6.786	.000	.487	.487	.487
2	(Constant)	1.184	.297		3.984	.000			
	Contrast	.362	.097	.334	3.714	.000	.487	.293	.261
	Color	.250	.092	.245	2.722	.007	.454	.219	.191
3	(Constant)	.040	.479		.083	.934			
	Contrast	.478	.102	.441	4.662	.000	.487	.360	.319
	Color	.287	.090	.281	3.175	.002	.454	.254	.217
	Legibility	.203	.068	.244	2.995	.003	-.108	.241	.205
4	(Constant)	-.394	.491		-.802	.424			
	Contrast	.294	.119	.272	2.482	.014	.487	.202	.166
	Color	.248	.089	.243	2.780	.006	.454	.225	.186
	Legibility	.256	.069	.308	3.731	.000	-.108	.296	.249
	Distribution of Light	.313	.109	.305	2.881	.005	.472	.233	.192

Correlations

		Interest	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Interest	1.000	.355	.472	-.108	.487	.454
	Brightness	.355	1.000	.735	-.666	.648	.568
	Distribution of Light	.472	.735	1.000	-.558	.745	.560
	Legibility	-.108	-.666	-.558	1.000	-.531	-.421
	Contrast	.487	.648	.745	-.531	1.000	.625
	Color	.454	.568	.560	-.421	.625	1.000
Sig. (1-tailed)	Interest	.	.000	.000	.094	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.094	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Interest	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Color
c Predictors: (Constant), Contrast, Color, Legibility
d Predictors: (Constant), Contrast, Color, Legibility, Distribution of Light
e Dependent Variable: Interest

Source: Personal Research

Table B.7. Interest, Results Of Multiple Regression Analysis for Pedestrian Areas and Squares

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.543(a)	.294	.290	.88008	.294	61.749	1	148	.000
2	.576(b)	.332	.323	.85928	.038	8.253	1	147	.005

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.016	.151		6.730	.000			
	Color	.458	.058	.543	7.858	.000	.543	.543	.543
2	(Constant)	.816	.163		4.998	.000			
	Color	.315	.076	.373	4.172	.000	.543	.325	.281
	Contrast	.213	.074	.257	2.873	.005	.503	.231	.194

Correlations

		Interest	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Interest	1.000	.385	.377	-.242	.503	.543
	Brightness	.385	1.000	.852	-.630	.687	.620
	Distribution of Light	.377	.852	1.000	-.616	.677	.643
	Legibility	-.242	-.630	-.616	1.000	-.504	-.469
	Contrast	.503	.687	.677	-.504	1.000	.658
	Color	.543	.620	.643	-.469	.658	1.000
Sig. (1-tailed)	Interest	.	.000	.000	.001	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.001	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Interest	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Color
b Predictors: (Constant), Color, Contrast
c Dependent Variable: Interest

Source: Personal Research

Table B.8. Interest, Results Of Multiple Regression Analysis for Roads and Pathways

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.519(a)	.269	.264	1.04409	.269	54.523	1	148	.000
2	.565(b)	.319	.310	1.01146	.050	10.702	1	147	.001

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	.477	.247		1.934	.055			
	Contrast	.550	.075	.519	7.384	.000	.519	.519	.519
2	(Constant)	.249	.249		1.001	.318			
	Contrast	.376	.090	.355	4.198	.000	.519	.327	.286
	Color	.283	.087	.277	3.271	.001	.487	.261	.223

Correlations

		Interest	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Interest	1.000	.391	.383	-.324	.519	.487
	Brightness	.391	1.000	.756	-.509	.681	.565
	Distribution of Light	.383	.756	1.000	-.496	.613	.663
	Legibility	-.324	-.509	-.496	1.000	-.424	-.300
	Contrast	.519	.681	.613	-.424	1.000	.593
	Color	.487	.565	.663	-.300	.593	1.000
Sig. (1-tailed)	Interest	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Interest	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Color
c Dependent Variable: Interest

Source: Personal Research

Table B.9. Comfort, Results Of Multiple Regression Analysis for Buildings

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.597(a)	.356	.352	1.01029	.356	81.919	1	148	.000
2	.640(b)	.410	.402	.97083	.053	13.275	1	147	.000

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.124	.253		4.446	.000			
	Color	.626	.069	.597	9.051	.000	.597	.597	.597
2	(Constant)	.671	.273		2.461	.015			
	Color	.390	.093	.371	4.190	.000	.597	.327	.266
	Contrast	.331	.091	.323	3.643	.000	.582	.288	.231

Correlations

		Comfort	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Comfort	1.000	.410	.563	-.176	.582	.597
	Brightness	.410	1.000	.644	-.472	.732	.595
	Distribution of Light	.563	.644	1.000	-.451	.723	.674
	Legibility	-.176	-.472	-.451	1.000	-.372	-.324
	Contrast	.582	.732	.723	-.372	1.000	.699
	Color	.597	.595	.674	-.324	.699	1.000
Sig. (1-tailed)	Comfort	.	.000	.000	.016	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.016	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Comfort	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Color
b Predictors: (Constant), Color, Contrast
c Dependent Variable: Comfort

Source: Personal Research

Table B.10. Comfort, Results Of Multiple Regression Analysis for Urban Parks

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.556(a)	.309	.304	1.13649	.309	66.206	1	148	.000
2	.581(b)	.338	.329	1.11641	.029	6.374	1	147	.013
3	.597(c)	.356	.343	1.10452	.018	4.181	1	146	.043

Coefficients(d)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	.839	.287		2.927	.004			
	Contrast	.627	.077	.556	8.137	.000	.556	.556	.556
2	(Constant)	.611	.296		2.066	.041			
	Contrast	.474	.097	.420	4.892	.000	.556	.374	.328
	Color	.231	.091	.217	2.525	.013	.480	.204	.169
3	(Constant)	.517	.296		1.745	.083			
	Contrast	.323	.121	.286	2.665	.009	.556	.215	.177
	Color	.196	.092	.185	2.136	.034	.480	.174	.142
	Distribution of Light	.221	.108	.207	2.045	.043	.524	.167	.136

Correlations

		Comfort	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Comfort	1.000	.452	.524	-.308	.556	.480
	Brightness	.452	1.000	.735	-.666	.648	.568
	Distribution of Light	.524	.735	1.000	-.558	.745	.560
	Legibility	-.308	-.666	-.558	1.000	-.531	-.421
	Contrast	.556	.648	.745	-.531	1.000	.625
	Color	.480	.568	.560	-.421	.625	1.000
Sig. (1-tailed)	Comfort	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Comfort	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Color
c Predictors: (Constant), Contrast, Color, Distribution of Light
d Dependent Variable: Comfort

Source: Personal Research

Table B.11. Comfort, Results Of Multiple Regression Analysis for Pedestrian Areas

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.565(a)	.319	.315	.90640	.319	69.382	1	148	.000
2	.582(b)	.338	.329	.89649	.019	4.290	1	147	.040

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	.995	.163		6.093	.000			
	Contrast	.490	.059	.565	8.330	.000	.565	.565	.565
2	(Constant)	.883	.170		5.184	.000			
	Contrast	.376	.080	.434	4.698	.000	.565	.361	.315
	Brightness	.156	.075	.191	2.071	.040	.489	.168	.139

Correlations

		Comfort	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Comfort	1.000	.489	.448	-.334	.565	.457
	Brightness	.489	1.000	.852	-.630	.687	.620
	Distribution of Light	.448	.852	1.000	-.616	.677	.643
	Legibility	-.334	-.630	-.616	1.000	-.504	-.469
	Contrast	.565	.687	.677	-.504	1.000	.658
	Color	.457	.620	.643	-.469	.658	1.000
Sig. (1-tailed)	Comfort	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Comfort	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Brightness
c Dependent Variable: Comfort

Source: Personal Research

Table B.12. Comfort, Results Of Multiple Regression Analysis for Roads and Pathways

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.427(a)	.182	.177	1.01854	.182	33.020	1	148	.000
2	.474(b)	.225	.215	.99495	.043	8.099	1	147	.005

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.080	.224		4.826	.000			
	Distribution of Light	.383	.067	.427	5.746	.000	.427	.427	.427
2	(Constant)	.733	.250		2.931	.004			
	Distribution of Light	.239	.083	.267	2.901	.004	.427	.233	.211
	Contrast	.256	.090	.262	2.846	.005	.425	.229	.207

Correlations

		Comfort	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Comfort	1.000	.377	.427	-.351	.425	.396
	Brightness	.377	1.000	.756	-.509	.681	.565
	Distribution of Light	.427	.756	1.000	-.496	.613	.663
	Legibility	-.351	-.509	-.496	1.000	-.424	-.300
	Contrast	.425	.681	.613	-.424	1.000	.593
	Color	.396	.565	.663	-.300	.593	1.000
Sig. (1-tailed)	Comfort	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Comfort	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Distribution of Light
b Predictors: (Constant), Distribution of Light, Contrast
c Dependent Variable: Comfort

Source: Personal Research

Table B.13. Safety, Results Of Multiple Regression Analysis for Buildings

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.490(a)	.240	.235	1.07277	.240	46.779	1	148	.000
2	.531(b)	.282	.272	1.04656	.042	8.507	1	147	.004

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.310	.284		4.608	.000			
	Distribution of Light	.506	.074	.490	6.840	.000	.490	.490	.490
2	(Constant)	1.035	.293		3.532	.001			
	Distribution of Light	.314	.098	.304	3.214	.002	.490	.256	.225
	Color	.283	.097	.276	2.917	.004	.481	.234	.204

Correlations

		Safe	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Safe	1.000	.354	.490	-.239	.447	.481
	Brightness	.354	1.000	.644	-.472	.732	.595
	Distribution of Light	.490	.644	1.000	-.451	.723	.674
	Legibility	-.239	-.472	-.451	1.000	-.372	-.324
	Contrast	.447	.732	.723	-.372	1.000	.699
	Color	.481	.595	.674	-.324	.699	1.000
Sig. (1-tailed)	Safe	.	.000	.000	.002	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.002	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Safe	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Distribution of Light
b Predictors: (Constant), Distribution of Light, Color
c Dependent Variable: Safe

Source: Personal Research

Table B.14. Safety, Results Of Multiple Regression Analysis for Urban Parks

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.615(a)	.378	.374	1.04887	.378	90.040	1	148	.000
2	.648(b)	.420	.412	1.01685	.041	10.467	1	147	.002
3	.661(c)	.437	.425	1.00514	.017	4.447	1	146	.037

Coefficients(d)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	.538	.265		2.031	.044			
	Contrast	.675	.071	.615	9.489	.000	.615	.615	.615
2	(Constant)	.354	.263		1.347	.180			
	Contrast	.426	.103	.388	4.114	.000	.615	.321	.259
	Distribution of Light	.317	.098	.305	3.235	.002	.594	.258	.203
3	(Constant)	1.132	.451		2.509	.013			
	Contrast	.380	.105	.346	3.633	.000	.615	.288	.226
	Distribution of Light	.256	.101	.246	2.530	.012	.594	.205	.157
	Legibility	-.136	.065	-.161	-2.109	.037	-.482	-.172	-.131

Correlations

		Safe	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Safe	1.000	.546	.594	-.482	.615	.502
	Brightness	.546	1.000	.735	-.666	.648	.568
	Distribution of Light	.594	.735	1.000	-.558	.745	.560
	Legibility	-.482	-.666	-.558	1.000	-.531	-.421
	Contrast	.615	.648	.745	-.531	1.000	.625
	Color	.502	.568	.560	-.421	.625	1.000
Sig. (1-tailed)	Safe	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Safe	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Distribution of Light
c Predictors: (Constant), Contrast, Distribution of Light, Legibility
d Dependent Variable: Safe

Source: Personal Research

Table B.15. Safety, Results Of Multiple Regression Analysis for Pedestrian Areas and Squares

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.508(a)	.258	.253	.93454	.258	51.388	1	148	.000
2	.558(b)	.311	.302	.90341	.053	11.377	1	147	.001

Coefficients(c)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1.105	.168		6.563	.000			
	Contrast	.435	.061	.508	7.169	.000	.508	.508	.508
2	(Constant)	2.232	.372		6.004	.000			
	Contrast	.319	.068	.373	4.707	.000	.508	.362	.322
	Legibility	-.220	.065	-.267	-3.373	.001	-.455	-.268	-.231

Correlations

		Safe	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Safe	1.000	.459	.436	-.455	.508	.409
	Brightness	.459	1.000	.852	-.630	.687	.620
	Distribution of Light	.436	.852	1.000	-.616	.677	.643
	Legibility	-.455	-.630	-.616	1.000	-.504	-.469
	Contrast	.508	.687	.677	-.504	1.000	.658
	Color	.409	.620	.643	-.469	.658	1.000
Sig. (1-tailed)	Safe	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Safe	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Legibility
a Dependent Variable: Safe

Source: Personal Research

Table B.16. Safety, Results Of Multiple Regression Analysis for Roads and Pathways

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.571(a)	.326	.321	.95225	.326	71.451	1	148	.000
2	.658(b)	.433	.425	.87613	.107	27.832	1	147	.000
3	.673(c)	.453	.442	.86318	.020	5.445	1	146	.021

Coefficients(d)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	.542	.225		2.408	.017			
	Contrast	.575	.068	.571	8.453	.000	.571	.571	.571
2	(Constant)	2.091	.359		5.820	.000			
	Contrast	.420	.069	.417	6.079	.000	.571	.448	.378
	Legibility	-.316	.060	-.362	-5.276	.000	-.539	-.399	-.328
3	(Constant)	1.616	.408		3.956	.000			
	Contrast	.302	.085	.300	3.557	.001	.571	.282	.218
	Legibility	-.267	.062	-.306	-4.278	.000	-.539	-.334	-.262
	Brightness	.210	.090	.207	2.333	.021	.567	.190	.143

Correlations

		Safe	Brightness	Distribution of Light	Legibility	Contrast	Color
Pearson Correlation	Safe	1.000	.567	.522	-.539	.571	.440
	Brightness	.567	1.000	.756	-.509	.681	.565
	Distribution of Light	.522	.756	1.000	-.496	.613	.663
	Legibility	-.539	-.509	-.496	1.000	-.424	-.300
	Contrast	.571	.681	.613	-.424	1.000	.593
	Color	.440	.565	.663	-.300	.593	1.000
Sig. (1-tailed)	Safe	.	.000	.000	.000	.000	.000
	Brightness	.000	.	.000	.000	.000	.000
	Distribution of Light	.000	.000	.	.000	.000	.000
	Legibility	.000	.000	.000	.	.000	.000
	Contrast	.000	.000	.000	.000	.	.000
	Color	.000	.000	.000	.000	.000	.
N	Safe	150	150	150	150	150	150
	Brightness	150	150	150	150	150	150
	Distribution of Light	150	150	150	150	150	150
	Legibility	150	150	150	150	150	150
	Contrast	150	150	150	150	150	150
	Color	150	150	150	150	150	150

a Predictors: (Constant), Contrast
b Predictors: (Constant), Contrast, Legibility
c Predictors: (Constant), Contrast, Legibility, Brightness
d Dependent Variable: Safe

Source: Personal Research