

THE EFFECT OF CHROMATIC AND ACHROMATIC COLOR
SCHEMES ON CHILDREN'S EMOTIONS IN A PRESCHOOL
CLASSROOM

A Master's Thesis

by
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Ankara
May 2016

To my parents



THE EFFECT OF CHROMATIC AND ACHROMATIC COLOR SCHEMES ON
CHILDREN'S EMOTIONS IN A PRESCHOOL CLASSROOM

The Graduate School of Economics and Social Sciences
of
İhsan Dođramacı Bilkent University

by

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THE DEPARTMENT OF
INTERIOR ARCHITECTURE AND ENVIRONMENTAL DESIGN
İHSAN DOĐRAMACI BİLKENT UNIVERSITY
ANKARA

May 2016

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



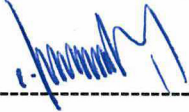
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ABSTRACT

The Effect of Chromatic and Achromatic Color Schemes on Children's Emotions in a Preschool Classroom

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Color is a salient design element that can influence people's behaviors and emotions in the interior space, it can also trigger specific physical and psychological responses in human beings. Therefore, its proper use in the interior space can lead to positive outcomes such as creating a healthier environment. In that regard, this research examines the effect of chromatic and achromatic color schemes on color-emotion associations in children in the interior space of a general classroom. The goal of this study is determining whether the responses caused by color are strong enough to create a positive or negative emotion in a child. Furthermore, saturation maybe more effective than hue in determining whether a color is calming or exciting, in addition, children prefer brighter and more saturated colors to less saturated ones. In that sense, high and low saturated blue, high and low saturated red as chromatic colors and high and low saturated grey and white were selected as achromatic colors. This study was conducted on eighty preschool children with 5 years of age, from two private preschools in Ankara,

Turkey. Photographic simulations were used as the tool to create different views of the classrooms and the children were asked to match each view to one facial expression representing anger, sadness, neutral and happiness. The results indicated that classrooms with high saturated blue, low saturated red and white as the wall colors elicited positive emotions in the child while the rest were associated with either negative emotions or no emotions at all.

Keywords: Children, Color, Emotion, Interior Space, Preschools

ÖZET

Anaokullarında Kromatik ve Akromatik Renk Şemalarının Çocukların Duyguları Üzerindeki Etkisi

Daliraghdeh, Donya

İç Mimarlık ve Çevre Tasarımı Yüksek Lisans Programı

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Renk insanların iç mekânlarda duygu ve davranışlarını etkileyen dikkat çekici bir tasarım elemanıdır. Renk, aynı zamanda insanlarda belirli fiziksel ve psikolojik tepkilere yol açmaktadır. Bu nedenle, renklerin iç mekânlarda doğru kullanımı daha sağlıklı bir ortam yaratmak için olumlu sonuçları beraberinde getirmektedir. Bu bağlamda, bu araştırma sınıf iç mekânlarında, kromatik ve akromatik renk şemalarının çocukların renk-duygu ilişkilendirmelerindeki etkisini inceler. Bu çalışmanın amacı rengin yol açtığı etkilerin çocuklarda olumlu ya da olumsuz duygu yaratmada yeterince güçlü olup olmadığını belirlemektir. Ayrıca, bir rengin doygunluğunun; o rengin sakinleştirici ya da heyecan verici olup olmadığı konusunda, rengin kendisinden daha etkili olabileceğini araştırmaktadır. Bu anlamda, yüksek ve düşük doygunluklu mavi renk, ve kırmızı renkler kromatik renkler olarak ve yüksek ve düşük doygunluklu gri ve beyaz renkler akromatik renkler olarak seçilmiştir. Sınıfların farklı görünüşleri yaratmak için fotografik simülasyon kullanılmıştır ve çocuklardan her bir görüntüyü, öfke, üzüntü,

nötr ve mutluluğu temsil eden yüz ifadelerinden biri ile eşleştirmeleri istemiştir. Bu çalışmanın sonuçlarına göre, yüksek doygunlukta mavi, düşük doygunlukta kırmızı ve beyaz olan dersliklerin çocuklarda olumlu duygular ortaya çıkarırken, diğer renk ve tonların çocuklarda olumsuz ya da nötr duygular uyandırdığı gösterilmiştir.

Anahtar Kelimeler: Anaokulu, Çocuklar, Renk, Duygu, İç mekân



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CHAPTER 1

INTRODUCTION

Color is in everything we perceive; it is an inseparable part of our lives that has been surrounding us since the day we were born. Most people think that the responses towards colors are simple and innate, however, a complex interplay between light, eyes and the brain are required to elicit a response in the human being (Luke, 1996).

Furthermore, color is one of the most critical design elements that can modify the characteristics of the physical environment easily (Jalil, Yunus & Said, 2012). Despite attributing unique dimensions to a space, color is useful in influencing human behavior, wellbeing, health and decision making. In other words, color impacts human lives physically, psychologically, physiologically and sociologically (Jalil, Yunus & Said, 2012; Manke, 1996). Moreover, color is a salient factor in a child's life. Children are subjected to a wide variety of colors embedded in their toys, clothes and belongings; these objects and the environment as a whole, convey specific meanings and psychological messages to the child (Boyatzis & Varghese, 1994; Pope, Butler & Qualter, 2012). As a result, color's unique characteristics present significance in educational settings including preschools.

Physiological and psychological balance is enhanced when the physical environment provides positive stimulations, in addition poor design can have negative impacts on human's well-being (Ulrich, 1991). A good design with positive stimulations has the ability to reduce negative thoughts and stress while holding the user's interest and focus (Ulrich, 1991). Color as a design element can have both positive and negative impacts on the child. Awareness of the impact of color in interior space can help professionals in clinical and educational settings, come up with the best solutions in order to help children to explore and to achieve high developmental accomplishments (Pope, Butler, & Qualter, 2012).

Children are color dominant, as a result, use of color in spaces for children requires extensive care and consideration (Sanoff, 1994). The time spent in educational settings is very long and it is very effective in shaping a human's identity and characteristics. Among the educational settings, preschools have a great impact on an individual's development and accomplishments. Since the development process takes place mostly during ages of 0-6, early childhood education is more important than other education periods (Şahin & Dostoğlu, 2012). In that sense, process of preschool education tends to have short and long term impacts not only on the child but also on the society as well, because childhood development is directly associated with social developments (Şahin & Dostoğlu, 2012). The quality of the social and physical environment in preschools influences the development level of the child during the education process. As a result, designers and professionals have tried to grasp the best solutions for designing

children's spaces that match children's needs, demands and spirit (Birren, 1963).

Furthermore, according to Sanoff (1994), a positive stimulation in the learning environment can lead to an increase in the ability to learn, perform, explore and interact, in addition to effecting the child's emotions and behaviors.

Recent studies have analyzed the association between color and emotions; the knowledge gathered from these studies can be put in effective use in various fields such as marketing, advertising, architecture and industrial design. In that sense, it is important to create products and environments that increase user's affection, admiration and appreciation by eliciting positive emotional responses (Norman & Ortony, 2003).

Studies regarding the association between color and emotions have mostly been carried out on the effect of colors used in isolation on emotional responses in adults. The studies that take the interior space into account are very few and they do not control color attributes such as brightness and saturation (Boyatzis & Varghese, 1994; Child, Hansen, & Hornbeck, 1968; Meerum Terwogt & Hoeksma, 1995; Zentner, 2001). As explained above, a positive stimulation in the physical environment can enhance child's development and performance while reducing stress. If appropriate colors can elicit positive emotions, then those colors will hold the child's attention and interest, improve psychological and physiological balance and enhance learning outcomes and performances. Regarding the lack of literature concerning the effect of color attributes on child's emotions in preschool environments, this study aims to fill the gap about children's color-emotion association in interior spaces.

1.1 Aim of the Study

The main purpose of this study is analyzing the effect of achromatic and chromatic color schemes on children's emotions in a preschool classroom. In the existing literature, there are very few studies exploring the association between color and emotion in preschool children in interior spaces. These studies have applied papers or small color chips, which is completely different from applying the color to a surface in the interior space. Additionally, the existing studies fail to control brightness and saturation, furthermore, the difference between achromatic and chromatic color schemes has not been analyzed. In that sense, this study would try to analyze the difference between high and low saturated colors in both achromatic and chromatic schemes, by using photographic simulations in a preschool classroom. The findings of this study would be useful for interior architects and professionals to select the most appropriate colors for preschool classrooms.

1.2 Structure of the Thesis

This thesis is made up of four chapters. The first chapter talks about the background of the study, by discussing the importance of color in the physical environment and its role in effecting the emotional responses, with briefly going over the importance of the preschool's physical environment in shaping the child's identity. In addition, the aim of the study, its significance and the structure of the thesis are explained in this chapter.

The second chapter discusses all the relevant literature in the field of color, emotion, physical environment in preschools and research methodologies in color studies and it

consists of five sections. The first section, review of color studies, begins with definition of color, its characteristics, color order systems, physiological and psychological responses to color and finally it would discuss preference to color in terms of different factors effecting it, namely age and gender. The second section begins with the definition of emotion and its characteristics, emotional knowledge of children, and finally it would discuss methods of measuring emotion with a focus on non-verbal pictorial scale measurements. The third section would go over the existing literature regarding color-emotion associations of children. The fourth section talks about the impact of color in educational settings with a focus on preschool facilities. the final section would discuss methodologies in color studies.

The experiment is described in the third section. First, aim of the study, research questions and hypotheses are explained. Afterwards, the method of the study, including the sample, selection of the child population and the variables are discussed. Then, the procedure of the study is explained, regarding how the colors were chosen, why photographic simulations were an appropriate tool for this study and finally the phases of the experiment are explained. Finally, the findings are statistically analyzed in this chapter and they are examined in relation to the relevant literature.

In the last chapter, conclusion of the study, along with limitations and suggestions for further studies are stated.

CHAPTER 2

LITERATURE REVIEW

2.1. Review of Color Studies

There are various studies that try to explain the association between color and human behavior in the field of psychology. However, these studies are rare in the field of environmental design. In that sense, this part of the literature review would try to go over the available literature regarding the definition of color, its characteristics, color order systems, human physiological and psychological responses to color and color preference.

2.1.1 Definition of color and its characteristics

Color is an effective element in our everyday life, however, in order to understand the reasons behind its importance as a design element it is important to go over its definition. There are physical, chemical, physiological and psychological approaches in order to explain color's definition (Burnham, 1963). In that sense, scientifically speaking, color stimulus is created when light from a natural or artificial object is

interrupted by a dust particle (Meervein, Rodeck, & Mahnke, 2007). Moreover, the physiological aspect of color focuses on the association between particular amounts and kinds of color stimuli and specific color responses; the psychological aspect concerns the behaviors and responses caused by color stimuli that influence attention, memory, motivation, and emotion (Burnham, 1963). In that sense, the focus of this study is on the concept of color “an inherent property of all materials and surfaces including everything from light and paint to art, from aesthetics to functionality and as an inseparable element of design” (Dalke, Little, Niemann, Camgöz, Steadman, Hill, & Stott, 2005, p. 343).

Color is characterized by three dimensions: hue (the pigment of the color, e.g., blue, red, etc.), saturation (chroma of color), and brightness (value or degree of darkness or lightness of the color) (Fehrman & Fehrman, 2000). Hue is the attribute of a color by which it is discernable from another such as red from blue, or orange from green. In that sense, achromatic colors, black, white and grey, lack hue and are considered neutrals (Wallach, 1963). Saturation, is the strength or vividness of a hue and it discerns a weak color from a strong one. It also presents the amount of pigment in a specific color, as an example the color red can increase in saturation from a pale pink to a vivid vermillion (Fehrman, 1986). The third dimension of color, brightness, also known as lightness and value, distinguishes a light color from a dark one, in other words, it is the lightness value as compared with black or its darkness value as compared with white (Munsell, 1988). Moreover, brightness is the amount of black that exists in a color (Melara, Marks & Potts, 1993).

The studies regarding color attributes are generally carried out on color preferences. The findings of these studies demonstrate that at a constant saturation and brightness short-wave length colors are preferred to long-wave length colors (Granger, 1955; Guilford, 1934; Guilford & Smith, 1959; Sivik, 1974). In addition to studies done on color preference, there are also scholars that have investigated the effect of color attributes on emotional responses. The results indicate that saturation is the most effective element in comparison to hue and brightness in altering people's perception of which color is more pleasurable more calming or exciting (Mikellides, 1990). Furthermore, brighter colors are associated with positive emotions whereas dark colors are associated with negative emotions, among samples of all ages and genders (Boyatzis & Varghese, 1994; Zetner, 2001). The studies regarding the effect of colors on preferences and emotions would be further explained in sections 2.1.4 and 2.3.

2.1.2 Color Order Systems

A color order system is a way of specifying and ordering object colors according to different schemes (Wyszecki & Stiles, 1982). There are three methods of distinguishing these models from each other; color order systems based on subtractive mixture, color order systems based on additive mixture, and color order systems based on perceptual evaluation (Kuehni, 2000; Wyszecki, 1986). In that sense, systems such as Munsell Renotations (REN), Optical Society of America Uniform Color Scales (UCS), Munsell Re-renotations (RERE), Natural Color System (NCS), Color-curve System (CC), CIELAB, and RGB Color Model, have been developed over the years and are regular in use (Kuehni, 2000). These systems usually take hue, brightness and saturation as major

attributes of color. Some of these systems will briefly be explained under the scope of this study.

2.1.2.1 CIELAB

This system is “based on spectrophotometric measurements of color samples illuminated by specific types of lighting and related to the visual response of a *standard observer*” (Fehrman & Fehrman, 2000, p. 209). Color attributes, hue, saturation and brightness have X, Y, Z values in this system (Agoston, 1987). As a result, color space has been used to demonstrate these dimensions graphically (See Figure 1).

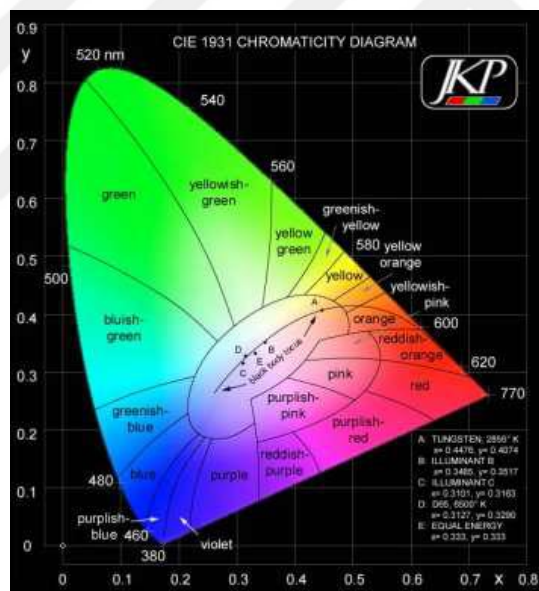


Figure 1. The CIE chromaticity diagram.

http://www.cs.berkeley.edu/~sequin/CS184/TOPICS/ColourSpaces/Colour_0.html

Furthermore, this system has been developed in order to sustain a uniform color scale to distinguish industrial color differences (Agoston, 1987). As a result, this system is

widely used by researches conducting scientific experiments with instruments (Grandis, 1986).

2.1.2.2. RGB Color Model

This model has been developed by using primary colors of red, green and blue. A combination of red and green makes yellow, red and blue makes magenta, green and blue makes cyan and a combination of all these colors make the white light (See Figure 2) (Feisner, 2006).

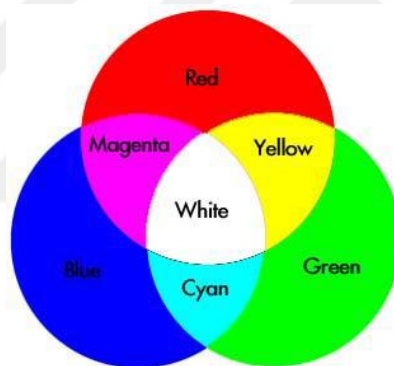


Figure 2. RGB color mixture.
(<http://www.d.umn.edu/~mharvey/th1501color.html>)

As seen in Figure 2, there are three primary and three secondary colors in this system, in addition to primary and secondary colors, there are also colors that are a mixture of a primary and a secondary color, in that sense, yellow, cyan and magenta are the secondary colors, whereas orange, yellow-green, cyan-green, cyan-blue, blue-magenta and red-magenta are the tertiary colors.

2.1.2.3. The Munsell color system

The Munsell color system has been widely used by a wide variety of researchers because of its feasibility and international acceptance (Indow, 1988). This system defines colors by hue, value and chroma. Hues are demonstrated by letters, there are five major hues, including red, green, yellow, purple and blue, five intermediate hues including yellow-red, green-yellow, blue-green, purple-blue, and red-purple. There are also colors that are located between principle and intermediate colors. Hues in this system are arranged on a circle with radii of 0 to 10. Value of the color is indicated by numbers ranging from 1 to 10, 1 representing the value of black and 10 representing the value of white, with grey falling in between these value. Chroma is also demonstrated with numbers ranging from 2 to 14, 2 as the least saturated color and 14 as the most saturated color (Beach, Wise, & Wise, 1988) (See Figure 3).

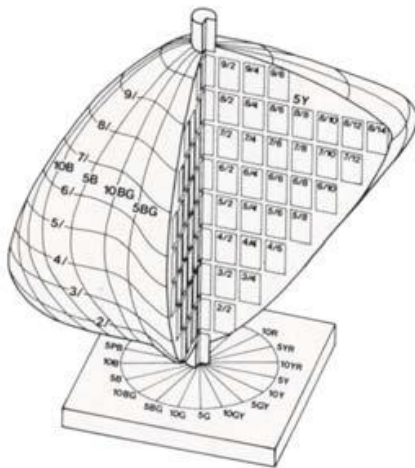


Figure 3: Munsell Color Solid.
Source: Adapted from Luke, 1996.

2.1.2.4 Natural Color System

NCS (Natural Color System) is in the form of a color atlas and has been developed as the practical application of Hering's color theory (Hård & Sivik, 1981). This color system provides a wide range of opportunities to describe colors and the relationships between them (Sivik, 1997). In order to understand the framework of this color system the idea behind Hering's theory would briefly be explained. According to Hering, yellow, red, green and blue are primary colors since they are not made up combinations of other colors (Hunt, 1987). As an example, the color orange can be described as a yellowish red or a reddish yellow or the color purple can be described as a reddish blue or a bluish red. As a result, this color system is based on these four primary colors, arranged in a circle with nine steps between each, resulting in 40 hues in total (See Figure 4). Furthermore, each individual hue is designated into color triangles consisting of the pure hue along with its relationship with black and white (Swedish Standard Institution, 1996) (See Figure 5).

As it can be seen in Figure 4, all hues are represented with a combination of the primary hues such as YR (Yellow-Red), RB (Red-Blue), BG (Blue-Green), and GY (Green-Yellow). In addition, the numbers between the letters demonstrate the percentage of the combination of primary colors for creating other colors. For example, B10G is a color created with 90 percent blue and 10 percent green. Moreover, by adding other numbers, the level of blackness and lightness of the color would be indicated, as an example S2050-B10G, indicates a 30 percent whiteness (W), 20 percent blackness (S) and 50 percent hue (C) (Hard, 1981).

As seen in Figure 5, the color triangle is a vertical cut through the center of the color circle (Hard, 1981). The color triangle demonstrates attributes of blackness, whiteness, and chromaticness. Furthermore, each triangle of each hue is made up of 66 colors which adds up to over 2000 colors in total (Kuehni, 2005).

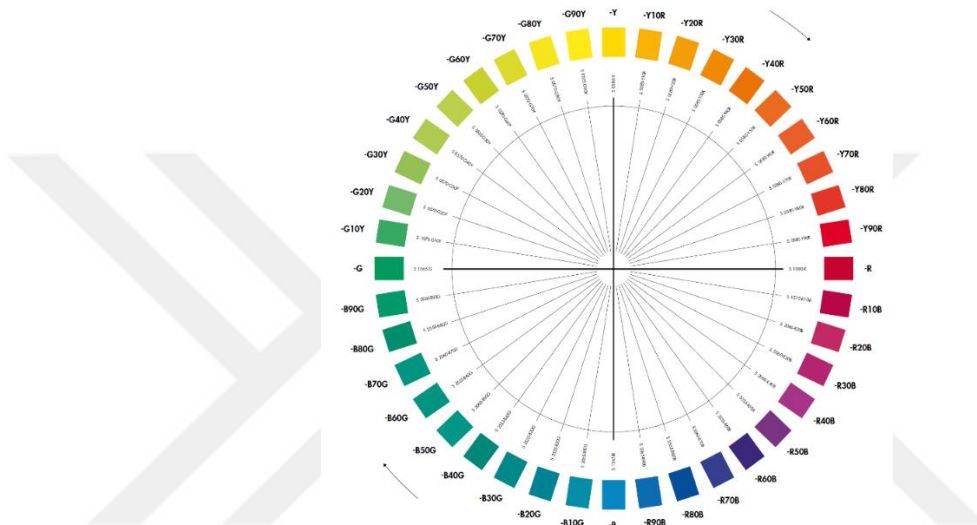


Figure 4. NCS Color System.
From Swedish Standard Institution. (1996). Natural Color System Atlas. Stockholm, Sweden

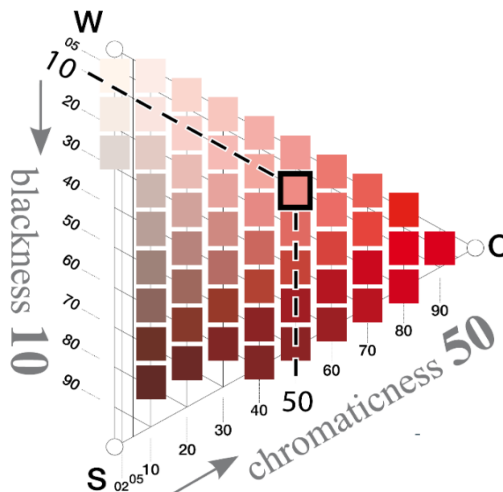


Figure 5. NCS Triangle.
From Swedish Standard Institution. (1996). Natural Color System Atlas. Stockholm, Sweden

The Natural Color System is one of the most well-known systems and it is widely used by architects and designers because it is based on uniform experiences of observers when dealing with the color stimuli, regardless of the sources (Kuehni & Schwarz, 2008), plus it enables the observer to evaluate colors without color measurement instruments (Agoston, 1987). In conclusion, this system can be used by people with no particular knowledge about colors (Agoston, 1987), in addition it is the only system in psychology domain that focuses on color perception (Tonnquist, 1988).

2.1.3 Human Responses to Color

Color is a tool in design that can influence psychological and physiological responses in humans (Gaines & Curry, 2011). A vast majority of literature have been focused on the association between color preferences, emotions and academic performances of both children and adults (Boyatzis & Varghese, 1993; Karp & Karp, 1987; Meerum Terwogt & Hoeksma, 1995). However, in order to understand the reasons behind the impact of color on psychological and physiological responses, it is important to understand color perception and theory. In that regard, when a wavelength of light shines on an object, the surface absorbs everything except for the one reflected from the object. Afterwards, this color would enter the eye and be deciphered according to one of the red, blue or green cones of the eye (Morton, 1995). After the hue is absorbed by the cells a message would be sent to the brain and the color would be interpreted. In addition, the glands that receive these brain impulses cause physiological and psychological responses (Nielson & Taylor, 2007).

2.1.3.1 Physiological responses to color

Responses caused by color can either be physical (physiological) or emotional (psychological). According to Engelbrecht (2003), genetic evolutions taken place in order to increase the chance of survival and reproduction have led to hormonal responses to color in all people. As an example, the color red improves the sense of smell, raises blood pressure and pulse and densifying the muscles (Gaines & Curry, 2011). In contrast, the color blue would lead to a slower heartbeat, a reduced appetite and a lower body temperature (Gaines & Curry, 2011). Other colors such as yellow and green are associated with positive effects on breathing and an increase in speech skills respectively (Gaines & Curry, 2011). Furthermore, orange and pink have comforting effects because of the changes they cause in the circulation and the nervous system (Gaines & Curry, 2011). As a result, the positive impacts of color on physiological responses of the body have been used in medical fields as a medium for therapy for patients of depression and cancer. However, all these changes in the physiological responses are associated with the level of development in the person's eye and brain. In addition, the lightness and the saturation of the color are also responsible in physiological responses (Gaines & Curry, 2011). In that sense, bright and high saturated colors are easier to elicit a change in the human-being (Zemach, Chang & Teller, 2007). In conclusion, the changes in human's vision, the level of development of the brain and color interpretation would lead to physical responses that are different from one individual to the other. The following paragraphs would go over some of the studies done on the effect of color on physiological functions of the body.

The effect of red, blue and white light was analyzed on twenty-four male participants on a study carried out by Gerard (1958; 1959). Physiological changes in blood pressure, heart rate, respiration rate and eye blink were observed under colored screen for a period of ten minutes. The results demonstrate a significant difference between red and blue regarding all physiological dimensions except for the heart rate. Gerard (1959) argued that the reason behind the significant differences in physiological responses were in the arousing nature of the color red on visual cortical activities and nervous system. He found that the color red increased the frequency of eye blink, blood pressure and respiration whereas the color blue had the opposite impacts. He also stated that the physiological responses towards colors are predictable because of the changes they impose on the whole organism.

Another study analyzed the effect of red and green slides on participants for a period of ten minutes (Wilson, 1966) and the results showed a higher level of Galvanic skin response under the red color due to the arousing and stimulating characteristics of the color red. This finding is consistent with those of Jacobs and Hustmyer's (1974). They examined heart rate, respiratory responses and GSR under red, yellow, green and blue color slides for a period of one minute on twenty-four participants. The results indicated a significant difference in GSR, however no difference was detected in respiration and heart rate. They stated that red was the most arousing color followed by green, yellow and blue as the least arousing color.

In a study done by Grangaard (1995), blood pressure and off-task behaviors of 6-year-old children were being investigated in rooms with different colors and lighting. White

walls and cool-white fluorescent lighting were used in the first room whereas the second classroom had light blue walls and full-spectrum lightings. The results indicated a 22 percent decrease in off-task behaviors in the second classroom, additionally, the blood pressure had decreased by 9 percent in the light blue classroom.

Fehrman and Fehrman (2004) investigated the effect of hue on performance and arousal in the interior space by controlling brightness and saturation of the colors. The GSR (Galvanic skin response) and pulse rate of the participants were measured while they performed different exercises in each colored room. The results indicated comparable performance and arousal scores in participants who had experienced colors with equal saturation and brightness. In contrast to the above mentioned studies, this study does not support that red is more arousing than blue.

Moreover, it should be mentioned that the physical changes caused by color in the body are not permanent (Adler, 1999). Even though the color might cause physical responses in the body accompanied by an imbalance, the brain would gradually adjust these changes and sooth the responses, that would eventually neutralize the effect of color after a period of time (Adler, 1999).

2.1.3.2 Psychological Responses

The changes caused by color in physiological functions of the body would lead to psychological responses and bodily reactions (Birren, 1988). Furthermore, since color is a form of energy, it would not only affect the body but also the mind, the mood and the

emotions (Birren, 1988). In that sense, the light of the colors that enters the eye would affect the center of emotions in the hypothalamus. The gland produced by this center regulates the hormone level of the endocrine system that would result in a change in the moods and psychological emotions (Helen, 1983; Jin, Yu, Kim, Kim & Chung, 2009). This characteristic of the color makes it a powerful medium in the medical field. Furthermore, this quality of color has been studied in the literature regarding the changes in anxiety, performance, productivity, stress, aggression and happiness levels.

All people assign symbolic meanings to colors, these associations are universal regardless of gender, race, culture, age and geography (Mahnke, 1996). Studies done on children and adults demonstrate a stronger correlation between colors and emotional responses in children in comparison to adults, in addition a strong preference has been detected for brighter colors (Boyatzis & Varghese, 1993; Valdez & Mehrabian, 1994; Zetner, 2001). These studies would be further investigated in section 2.3.

The studies comparing the preference towards muted colors in children and adults indicate that adults are more inclined towards colors of white, black, grey and brown, in comparison to children, however, even in adults these colors are mostly associated with negative emotions (Gaines & Curry, 2011). As an example, in a study done on college students, colors of red, white, green, orange, yellow, blue, beige, gray, and purple were used for the interior walls and the door of offices (Kwallek, Lewis, Lin-Hsiao & Woodson, 1996). The mood, the performance and the color preference of the students was examined in each classroom. The results indicated gender differences in color preferences. White, green, blue and grey offices were preferred in males, whereas

yellow, orange and purple offices were not. In the case of females, green, red and beige work spaces were preferred whereas grey and orange offices were the least preferred ones. Overall, white, blue and green offices were the most preferred working spaces whereas purple and orange offices were the least preferred ones. Gender differences regarding mood in different colored offices were also observed. Females felt more depression, confusion, and anger in offices of white, grey and beige that had low saturated colors. However, males had more negative emotions in green, blue, purple, red, yellow, and orange offices that had high saturated interior spaces. Overall, all participants stated that they preferred to work in white or beige offices. Even though the white office was preferred over blue or red offices, more errors on task performance were detected in the white working space.

The negative impacts of neutral colors such as white and grey should be taken into consideration since these colors are widely used in spaces such as schools, hospitals and offices (Dijkstra, Pieterse & Pruyn, 2008; Kaya & Crosby, 2006). As an example, the effect of color white was compared to green and orange in a healthcare environment in a study done by Dijkstra, Pieterse & Pruyn (2008). The participants were students who were randomly exposed to photographic simulations of a hospital room with either green walls (as the experimental setting) or white walls (as the control setting). The participants were asked to imagine being hospitalized after a successful surgery in one of the above mentioned rooms after looking at them for at least 15 seconds. Afterwards, the participants were asked to complete a stress arousal checklist. The results indicated that the wall color was only affective in determining the level of stress in participant with a low stimulus screening ability (low-screener). Low-screening participants,

experienced more stress in the white room in comparison to the green room. The second phase of the experiment used orange as the wall color (as the experimental setting) and white (as the control setting) and the results indicated that the orange room was more arousing and more attractive than the white room.

Other studies carried out on the effect of white demonstrate a lower productivity and efficiency, more errors, and lower levels of happiness in the users (Kwallek, Woodson, Lewis, & Sales, 1997). This study contrasted a red office with a green/blue office and a white office. The results of the comparisons between red and blue office indicated that participants experienced more dysphoria when in the red room. In addition, the results demonstrated a significant difference between low screeners and high screeners in dysphoria with respect to anger and depression. The anger and depression rates were higher in the white room in comparison to the red room. The authors explained this observation by stating that that color white lacks contrast and pigment that can be disturbing for participants with lower screening abilities (Kwallek et al., 1997).

A later study done by Kwallek, Lewis, and Robbins (1988), investigated the effect of red and blue offices on productivity and mood. The main focus of the study was comparing warm colors and cool colors to see which one is more arousing. The participants were university students who were placed in one of the red or blue offices and were given typing tasks. After the first set of experiment was over, each participant was either placed back in the same colored office or moved to a different office and followed the same procedure. The results indicated a greater number of errors in the participants who had switched offices. Specifically, the participants who moved from

the blue room to the red room made greater number of errors compared to any other group. The researchers also found higher anxiety levels for the participants who stayed in the red room, higher depression level for the participants in blue room and higher arousal levels for the participants who had switched offices. Overall, the red room was associated with anxiety, the blue room with depression and changing the environment was associated with arousal that leads to more errors (Kwallek et al.1988).

While the above mentioned studies focus on adults, the study done by Kruczek and Zentall (1988), has focused on the effect of color on activity levels and attentions of hyperactive children. This study examined the difference between black and white stimuli with colored ones. The results demonstrated that color stimuli slowed hyperactive children and increased their attention (Kruczek & Zentall, 1988).

Additionally, it was indicated that color stimulation in learning environments would enhance attention, motor processes and a better academic performance whereas monotone spaces created restlessness, excessive emotional reactions, irritation and difficulty in concentrating. (Engelbrecht, 2003; Kruczek & Zentall, 1988). Similar to the study done by Kruczek and Zentall (1988), Torrice and Logrippo (1989) investigated the effect of cool and warm colors on activity levels of hyperactive children. The results demonstrated an incline towards cool colors for active children and an inclination towards warm colors for passive children.

Since the focus of this study is on the color-emotion association, the following paragraphs would go over the literature concerned with the effect of color on emotions.

As an example, Weller and Livingston (1988) investigated the association between color

and emotional responses on university students by using colored papers. The participants were asked to fill out a questionnaire after hearing stories of rape or murder, the questionnaires were ordered in pink – guilty, pink – not guilty; blue – guilty, blue – not guilty; white – guilty and white – not guilty. The results demonstrated that subjects answering the pink questionnaire were less upset than those of blue and white.

Hemphill (1996), analyzed the association between colors and emotions on adults. The participants were asked to answer questions regarding their favorite color, the reasons for their choices, the major colors they wore, and their emotional reactions to colors. The result of the study indicated a preference towards bright colors, additionally, bright colors were associated with positive emotions whereas dark colors were associated with negative emotions. The researcher also found gender differences; females responded more positively towards bright colors in comparison to males. Red was associated with excitement and blue was stated as the most preferred color both in preference rating and as clothing choices.

Going over the literature measuring physiological responses (Gerard, 1958; Jacobs & Hustmyer, 1974; Wilson, 1966;) and psychological responses (Kwallek, Lewis, & Robbins, 1988), the arousing effect of the color red was supported. However, it should be mentioned that the arousing effects of colors are not permanent and no long-term impacts would be warranted (Beach, Wise, & Wise, 1988).

The existence of an association between emotions and colors was also supported by various studies. Brighter colors elicited positive emotions whereas dark colors evoke

negative emotions both in children and adults (Boyatzis & Varghese, 1994; Hemphill, 1996). Emotional associations and preferences are influenced by saturation and brightness (Boyatzis & Varghese, 1994; Guilford & Smith, 1959; Hemphill, 1996). As a result, these variables should be controlled in order to have a successful color study.

In conclusion, similar to the effect of color on physiological functions of the body, the psychological responses are associated with the level of individual development and character. This can be seen in the case of extraverts and introverts; extraverts are more inclined towards warm, bright colors and highly stimulated environments whereas introverts prefer cool colors (Gaines & Curry, 2011; Manhke, 1996). Other confounding variables such as culture, background colors, lighting and context can affect people's perception about colors, their emotional responses and preferences. As a result, the findings of color studies are not definite and prescriptive. In that sense, Table 1, presents a review of the effects of color on physiological and psychological responses.

Table 1. Physiological and Psychological responses to different colors

Category		Findings	Source
Red	Physiological	Increase in heart beats Raises blood pressure Increase respiration Increase in sense of smell	Engelbrecht, 2003
	Psychological	Associated with excitement and happiness Positive reaction - girls more positive than boys	Boyatzis & Varghese, 1993
		High preference for 7- year-olds	Terwogt, & Hoeksma 2001
		Associated with anger, pain, happiness, and love in 4 th grade students	Karp & Karp, 1987
Blue	Physiological	Lower body temperature Reduced appetite Calming effects on heart rate and respiratory system	Morton, 1998
			Walker, 1991
			Engelbrecht, 2003
			Torrice & Logrippo, 1989
Psychological	Positive reaction (girls more positive than boys) Associated with sadness in 4 th grade students	Boyatzis & Varghese, 1993	
		Karp & Karp, 1987	
Black	Psychological	Negative emotion (males more positive than females)	Boyatzis & Varghese, 1993
		Associated with fear in 4 th grade students	Karp & Karp, 1987
Pink	Physiological	Soothing effect	Morton, 1995
	Psychological	Positive reactions; females more positive than males	Boyatzis & Varghese, 1993

Table 1 (cont'd)

Cool colors	Psychological	Preferred by active children Recommended for secondary classrooms	Torrice & Logrippo, 1989 Engelbrecht, 2003
Warm colors	Psychological	Preferred by passive children Recommended for preschool and elementary students	Torrice & Logrippo, 1989 Engelbrecht, 2003

2.1.4 Preferences to Color

A major number of color studies have found differences in color preference regarding color attributes, age, culture, and gender. However, this study would only focus on the effect of color attributes (hue and saturation), age and gender on color preference. The first intention of this study was carrying out a cross-cultural study between Iranian and Turkish children, however after further investigations, it was found that any finding that suggests a difference in color preference across different cultures is not pervasive because there are other factors, such as background, language, context, light sources and psychological status involved in determining color preference (Manav, 2006). In that sense the following paragraphs would try to go over the studies regarding the effect of color attributes, age and gender on color preference.

Scholars such as Guilford (1934) have tried to demonstrate the effects of the dimensions of color on preference. In that regard, a linear relationship between brightness and saturation was found under a constant hue (Guilford, 1934). Guilford found that lighter

and more saturated colors were preferred to darker and less saturated ones, when the hue was kept at a constant rate. At a constant brightness and saturation, blue, green, and red were the most preferred colors whereas yellow and orange were the least preferred ones.

Guilford and Smith (1959) analyzed the effect of hue, saturation and brightness on pleasantness and the results demonstrated that at a constant brightness and saturation a range of green to blue colors were preferred over a range of yellow and yellow-green. They also found a positive relationship between brightness and saturation. Sivik (1974), investigated 71 colors selected from NCS on differential scales, regarding four factors of excitement, evaluation, potency, and temperature. He found that as the brightness decreased, colors were less preferred. He also found that brighter and more saturated colors were preferred over less bright and less saturated colors. Another interesting finding of the study was that blue was found as the most preferred color regardless of the changes made to its brightness and saturation.

In line with the above mentioned studies, Camgöz, Yener and Güvenç (2002), investigated the effects of hue, saturation, and brightness on preference. They found that hue, brightness and saturation were all important in determining color preference. Moreover, brightest and most saturated colors were preferred over any other combinations of brightness and saturation. Consistent with other studies, blue was stated as the most preferred color. Overall, the results of these studies indicate that among color attributes, saturation has been the most effective element in comparison to hue and brightness in altering people's perception of which color is more pleasurable more calming or exciting (Mikellides, 1990).

Smets (1982) analyzed, the effect of hue, saturation and brightness on pleasantness using colors with different brightness and saturations selected from Munsell color system. The result of the study indicated that brightness and hue were not effective factors in determining pleasantness. However, the researcher stated that saturation was positively associated with pleasantness of a color. The interesting result of the study was that the least known color attribute (saturation) has the greatest impact on color pleasantness. There is only a slight relationship between brightness and pleasantness of a color whereas the effect of hue is negligible.

Children's color preference was examined on a study carried out by Child, Hansen, and Hornbeck (1968). The participants were over 1,100 students with ages between 6 to 18. The findings of this study was parallel with those mentioned above, in that sense, high saturated colors were preferred over low saturated colors and blue and green were the most preferred colors. The results also demonstrated that with increasing age, hue of the color gets more important than saturation in determining preference to colors. This study indicated no significant effect of brightness, however a slight inclination was observed towards brighter colors. Additionally, other studies have suggested a preference towards long-wavelength colors to short-wavelength ones. In that sense, a range of red and yellow is preferred over blue and green. (Adams, 1987; Zentner, 2001). The details of these studies are presented in Table 2. In conclusion, saturation and brightness determine color preference within a specific hue in a way that highly saturated and bright colors are mostly preferred. In addition, when saturation and brightness are controlled, short wavelength colors are preferred over long wavelength colors. In other

words, high saturated, bright and short wavelength colors are mostly preferred and are associated with positive emotions.

Color preference studies have been done on samples ranging from infant participants to children and adults. The following paragraphs would go through these studies. As an example, studies done on infants, show an inclination towards chromatic colors over achromatic ones (Adams, 1987). Furthermore, studies done on children and adults demonstrate a bias towards red in early childhood, however, as the child grows up, blue tends to be preferred over other colors (Zentner, 2001).

The effect of ageing was analyzed on a study done by Dittmar (2001). The study was done on younger and older adults with ages between 19-90. The results of this study indicated that blue was the most preferred color and yellow was the least preferred color for younger adults. However, with increasing age, the inclination towards blue decreased whereas the preference towards red and green increased. The researcher concluded that color preference is a phenomenon that changes throughout the life span (Dittmar, 2001).

Manav (2007) analyzed color preferences in residential buildings with samples with different ages. The age groups were divided into three categories, 18-32, 33-47 and 48-62. The results demonstrated that gender and age are important factors in determining the preference towards color black. Black was preferred by all the participants in the 48-62 age group. No difference was detected between different ages in chromatic colors of green, red, brown, blue, orange, pink, and violet and the achromatic color of white.

A more recent study investigated the effect of age on color-emotion, preference and harmony (Ou, Luo, Sun, Hu, & Chen, 2012). The aim of the study was analyzing whether preferences and color-emotion responses would change with the increase in age. Single colors and pair colors were both assessed under 4 different word pairs, warm-cool, heavy-light, active-passive, and like-dislike. The sample included 20 young participants and 20 older ones. The results demonstrated that single colors tended to be less active, less liked and cooler for older participants in comparison to younger adults. A significant difference was detected in dark colors, white and achromatic colors that were less liked for older participants. In the case of color pairs, it was found that light colors tended to be less active and cooler for older adults. Achromatic color pairs were also rated as less liked, less active and cool for older participants (Ou et al. 2010).

In addition to age, gender is the other variable that is often analyzed in preference studies. The studies carried out on color preference do not support a gender difference in samples of less than 24 months (Jadva, Hines, & Golombok, 2010), however this difference becomes more significant with the advancement of age (Karniol, 2011). As an example, preschool boys show a tendency towards green in computer presentations whereas girls prefer red (Passig & Levin, 1999). Another study focusing on gender differences was carried out by Turgeon (2008). She investigated the difference in children's drawings regarding gender differences in preschools. The results demonstrated that girls use more colors, especially warm colors of pink and purple, in their drawings in comparison to boys.

Gender stereotypes is another issue that is often discussed in color studies. As an example Lobur and Deloache (2011) analyzed the early development of gender-stereotypes color preferences in samples of 7 months to 5 years. The results indicated that by the age of 2, girls tended to choose pink objects more than boys, and by the age of 2.5, this tendency had become more significant in a way that pink was preferred over other colors. As the inclination towards pink increase for girls, boys tend to show more avoidance in the usage of pink.

Color preference studies in adults also demonstrate a gender difference, as an example, in a study done on college students, it was found that males prefer cool colors such as green and blue whereas females prefer warm colors of yellow and red (Ellis & Ficek, 2001). A number of studies detecting gender differences in adults explain this phenomenon in reference to the hunter-gatherer theory (He, Zhang, Zhu, Xu, Yu, & Chen, 2011; Hurlbert & Ling, 2007). Females prefer pink, purple, red, yellow that can be explained by their role as gatherers of yellow fruit, red and purple berries and red leaves. On the other hand, males prefer green and blue, calm colors of nature, that refers to their role as hunters (He et al, 2011).

In contrast to the studies mentioned above, there are studies that have not support a significant gender difference regarding color preference (Child, Hansen, & Hornbeck, 1968; Dittmar, 2001, Zentner, 2001). These studies suggest a slight preference towards bright colors in females in comparison to males (Valdez & Mehrabian, 1994; Zetner, 2001). Moreover, it should also be mentioned that gender differences regarding

emotional associations have also been found in some studies. This difference has been observed in the case of pink and purple (girls rating them as happy, boys rating them as unhappy colors), brown and red (boys rating them as happy, girls rating them as unhappy) (Pope, Butler & Qualter, 2012; Zenter, 2001). Based on the literature mentioned above, the current study would investigate the difference between genders in color preference and emotional responses.

Table 2. Studies done on color preference in children

Variables	Subjects	Findings	Authors
Green, Red, Grey, Blue, Yellow	80 children and adults	Chromatic colors were preferred over achromatic colors Long-wavelength colors are preferred in children, whereas adults prefer short-wavelength colors	Adams, 1987
Black, Grey, Red, Brown, Blue, Green, Yellow, Pink, Purple	60 children	Females preferred pink Males preferred blue Positive responses were shown towards bright colors in comparison to dark ones. Children's responses towards bright colors are positive.	Boyatzis & Varghes, 1994
Red, Yellow, Blue, White, Black, Green	72 children and adults	Blue was the most preferred color for both children and adults Black was the least preferred color for both children and adults	Meerum Terwogt & Hoeksma, 1995

Table 2 (cont'd)

<p>Multiple color pairs</p>	<p>More than 1,100 children</p>	<p>Blue and green were the most preferred colors</p> <p>Saturation had a positive influence on preference</p> <p>Brightness had no influence on color preference, however, an inclination was observed towards brighter colors</p> <p>As the age increased, hue became more important than saturation in determining color preference</p> <p>No gender difference</p>	<p>Child, Hansen, & Hornbeck, 1968</p>
<p>Blue, Yellow, Red, Green, Brown, Black</p>	<p>89 children</p>	<p>Blue was the most preferred color</p> <p>No gender difference</p>	<p>Fleming, Holmes, Barton, & Osbahr, 1993</p>
<p>Yellow, Dark and Bright Blue, Dark and Bright Green, Red, Black, Brown, Pink</p>	<p>106 children</p>	<p>Red and pink was the most preferred color for children, brown and black were the least preferred colors.</p> <p>Dark blue and bright blue were the most preferred colors for adults, pink and brown were the least preferred ones.</p> <p>No gender stereotype was observed.</p> <p>Both genders preferred bright colors over dark ones.</p> <p>Yellow was mostly associated with happiness and blue was mostly associated with sadness.</p>	<p>Zentner, 2001</p>

2.2 Emotion Studies

The second part of the literature review starts with defining emotions and its categories. Afterwards, it would go over the literature concerning the emotional knowledge of children and finally it would mention different methods of measuring emotions with a focus on none-verbal scale measurements.

2.2.1 Definition of Emotion and its categories

Even though the literature is replete with psychological definitions of affect, there is no single definition of the term emotion, therefore it has to be clearly defined (Cabanac, Guillaume, Balasko & Fleury, 2002; Chapman & Nakamura, 1998). Emotion has been described as a sudden trouble, ephemeral upheaval caused by an incident of joy, fear, happiness, surprise, etc. (Larousse Dictionary, 1990), or a ‘mental feeling or affection (e.g. pain, desire, hope, etc.) as distinct from cognitions or volitions’ (Oxford English Dictionary, 1987). Moreover, in the field of psychology, emotion has been defined as a mental state that involves cognition and psychological arousal (Plutchik & Ax, 1967; Scherer, 1993). Emotion is a key element in the psychological process and it defines man’s perception of reality, in addition, it expresses an alteration in neuropsychological activity that is reflected in various aspects of the human psyche (Chapman & Nakamura, 1998). All feelings and experiences ranging from deep pain and suffering to inflated stages of joy can be expressed as emotions (Cardinal, Parkinson, Hall & Everitt, 2002).

Emotions are intentional states that are dependent on something or someone, in other words, one would be angry at a person or be happy about an incident, rather than just feeling angry or happy (Cardinal et al., 2002). Therefore, emotions are associated with a certain object, person or event that might be real, remembered or imagined (Parkinson, 1997). Furthermore, the association between response and consciousness causes emotions and the bodily responses to emotions (Ekman, Levenson & Friesen, 1983) According to Ekman (1983), six kinds of emotions create distinguished bodily patterns.

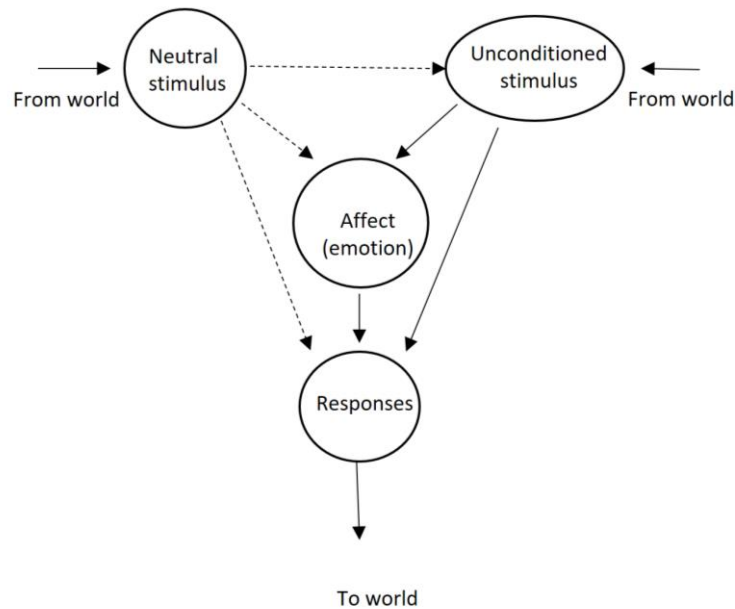


Figure 6. Cause of emotional responses.

(Source: Cardinal, R. N., Parkinson, J. A., Hall, J., & Everitt, B. J. (2002). Emotion and motivation: the role of the amygdala, ventral striatum, and prefrontal cortex. *Neuroscience & Biobehavioral Reviews*, 26(3), 321-352.

According to the literature, some emotions are regarded as basic whereas others are not, as an example, Evans (2002), has defined joy, fear, disgust, surprise, anger and distress as basic, universal and intuitive emotions. Being innate and universal are two main characteristics of basic emotions (Evans, 2002). On the other hand, Ekman and Friesen (1971), have described happiness, sadness, fear, anger, surprise and disgust as basic emotions, in addition they have assigned specific facial expressions for each of these emotions.

Other than categorizing emotions as either basic or not, other viewpoints have been taken in order to categorize emotions. As an example, Ortony and Turner (1990), define emotions as either positive or negative. In their definition, surprise, regraded as a basic emotion by various literature (Ekman and Friesen, 1971; Izard, 1971), is not considered a basic emotion, because in contrast to emotions such as shame, relief, happiness, anger and fear no valenced state can be attributed to surprise. In other words, they believe that being valenced is a key characteristic in making a state an emotion.

2.2.2. Emotional Knowledge of Children

Awareness of the development level of children's emotional knowledge is critical for professionals working with children (Pope, Butler, & Qualter, 2012; Weare & Gray, 2003). This awareness can help professionals discern how children of a certain age understand and explain their surroundings, and how they manage their feelings in emotional situations (Cutting & Dunn, 1999). This knowledge can be put in effective use in clinical and educational contexts in order to help children explore and achieve

their developmental accomplishments (Pope, Butler, & Qualter, 2012). Furthermore, this knowledge would contribute to children's ability to manage displays of emotional experiences and emotions in themselves, recognize, decipher and react to other people's emotional displays along with helping them understand how situations would affect someone's feelings (Harris, 1985).

Moreover, emotional understanding in children is concerned with their ability to recall, describe and recognize emotions and emotional experiences both in themselves and in others (Nannis, 1988; Pope, Butler, & Qualter, 2012; Seja & Russ, 1999). This ability would be achieved through understanding emotional experiences along with a cognitive social-emotional proficiency (Pope, Butler, & Qualter, 2012). Moreover, studies have demonstrated that this knowledge becomes apparent in children of two to three years of age (Flavell, 1999). A dearth of emotional understanding, reaction to social clues or recognizing other people's reaction to situations in the child by the end of the second year can be a signal of a low emotional growth (Flavell, 1999).

Studies show that verbal ability is in direct correlation with emotional understanding (Pope, Butler, & Qualter, 2012; Seja & Russ, 1999), in other words, children use language both as a communication tool and as a medium of shaping their thoughts (Pope, Butler, & Qualter, 2012). Furthermore, females often function better than males when it comes to verbal and language skills, they also perform better on emotional understanding tests. Studies have shown that girls with only three years of age, exhibit a high level of proficiency in labelling different emotions along with understanding convoluted emotions (Bosacki & Moore, 2004; Dunn, 1988).

Studies on basic emotions have demonstrated that children first understand a happy situation, followed by sad, angry and finally fearful. Contextual information is used in children's everyday experiences in order to help them figure out the reasons behind the occurrence of their emotions. Their understandings of the basic emotions help them come up with explanations both for themselves and others. Studies have shown that preschool children have the ability not only to understand emotions in themselves but also in their friends and family members (Bosacki & Moore, 2004; Broderick, 1991; Hughes & Dunn, 1998; Pope, Butler, & Qualter, 2012; Zenter, 2001). As an example, the study done by Widen and Russell (2008), investigated the development of emotion categories in 168 preschool children, between the ages of 2 and 5. The children were asked to label emotions of happiness, surprise, fear, anger, disgust and sadness with emotional facial expressions. The results indicated that labels for happiness, sadness and anger were frequently used whereas labels for fear, surprise and disgust were used less frequently. This study states happiness, sadness and anger as early-emerging emotions whereas disgust, fear and surprise are regarded as later-emerging ones. Additionally, this study found that children tend to use incorrect facial expressions to label emotions of fear, disgust and surprise.

As a result, the sample group of this study is made of 5-year-old preschool children who have been asked to match emotions of happiness, sadness and anger, defined as basic by Ekman and Friesen (1971), with different colors. The reason behind the exclusion of other basic emotions (disgust, surprise and fear), as mentioned above is that preschool children have not reached the development level to distinguish these emotions from each other (Widen & Russell 2008).

2.2.3 Measuring Emotion

In order to measure emotions, one must first characterize and differentiate emotions from other states (Desmet, 2003). As explained at the beginning of this chapter, there is no single definition to describe the term emotion, therefore, there are a variety of definitions about the term, each focusing on a distinct aspect of emotion (Desmet, 2003). As a result, emotion is best described as a multifaceted phenomenon with the following elements; “behavioral reactions (e.g. retreating), expressive reactions (e.g. smiling), physiological reactions (e.g. heart pounding), and subjective feelings (e.g. feeling amused)” (Desmet, 2003). As a result, the instruments applied to measure emotion focus on one of these elements. These instruments can be categorized as either non-verbal or verbal ones that vary from simple questionnaires to high-tech tools that measure brain waves (Desmet, 2003). The following paragraphs would briefly go over non-verbal methods of measuring emotions, with a focus on pictorial scale measurements that have been applied in this study.

This method is widely used and it can measure subjective feelings (Desmet, 2003). Subjective feelings (feeling sad or feeling inspired), are conscious awareness of an emotional state that a person is in (Desmet, 2003). Self-report method would provide a chance for the participant to express a great deal of information that only he/she has access to, by using different types of rating scales, checklists or open-ended questions (Desmet, 2003).

Under the scope of this study rating measures would be explained further. Rating measures ask the participants how they feel during a certain occasion. Rating measures provide the opportunity to analyze the effect of a certain object on the participant. These rating scales might be unipolar or bipolar. The unipolar scales are focused on a single concept like extremely happy to not happy at all whereas bipolar scales, such as the ones used in Mehrabian-Russel Model, use different adjectives at each end of the scale.

According to Desmet (2003), the advantage of rating scales is that they can easily measure individual or mixed emotions. However, usage of them across different ages and cultures is not so easy. As a result, non-verbal methods using pictures have been developed in order to ease this process across all ages and cultures.

As explained above non-verbal instruments measure physiological or expressive dimensions of emotion. Expressive reactions (smile, grin or frown) are facial, postural and vocal characters that come along with emotions (Desmet, 2003). According to Ekman (1994), each emotion has its own distinctive facial expression, as an example, anger is accompanied with contracted eyebrows, brisk movements, compressed lips and raised voices (Ekman & Friesen, 1975). Tools that are used to measure this characteristic of emotion focus on either facial or vocal expressions (Desmet, 2003). Instruments that focus on facial expressions are based on theories that associate specific emotions to distinctive facial features such as Facial Action Coding System (Desmet, 2003). As seen in Figure 7, the non-verbal pictorial scale instruments use universally accepted facial expression. The advantage of the non-verbal measurements is that they are independent of language, which provides an opportunity to use them across all

cultures and ages. In addition, they do not distract the participants during the experiment because of their low-key characteristic (Desmet, 2003).

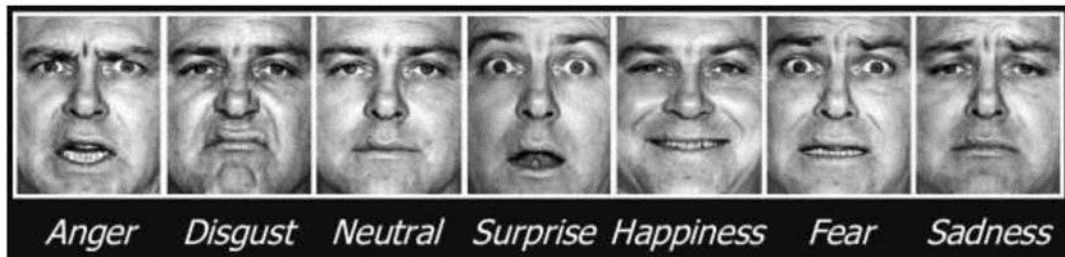


Figure 7. Facial expressions of emotions designed by Paul Ekman.

(Source: Cardinal, R. N., Parkinson, J. A., Hall, J., & Everitt, B. J. (2002). Emotion and motivation: the role of the amygdala, ventral striatum, and prefrontal cortex. *Neuroscience & Biobehavioral Reviews*, 26(3), 321-352).

This study applies schematic facial expressions instead of photographs of actual expressions because according to Sullivan, Kirkpatrick, & MacDonald, (1995) under certain conditions, assessing photographs of adult models might provoke anxiety for children. Therefore, schematic facial expressions developed by Sullivan et al. (1995), were used in this study. Studies done by Camras and Allison (1985) and MacDonald, Kirkpatrick, & Sullivan (1996), indicate the validity of schematic facial expressions. As an example, in the study done by Camras and Allison (1985), it was found that happiness and sadness were easily identified by preschool children. Furthermore, anger was the most accurately defined emotions by children of 5 to 9 years of age (Camras & Allison, 1985; MacDonald, Kirkpatrick, & Sullivan, 1996). As a result, basic emotions of anger, sadness, neutral and happiness were chosen in this study (See Figure 8).

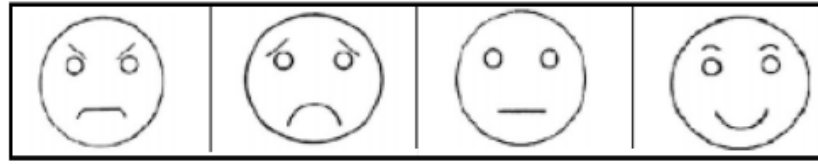


Figure8. Schematic facial expressions of emotions.

(Source: Sullivan, L. A., Kirkpatrick, S. W., & MacDonald, P. M. (1995). Interpretations of facial expressions of emotion by sexually abused and non-abused girls. *Journal of Child Sexual Abuse*, 4(1), 45-62. DOI:10.1300/J070v04n01_03

2.3. Color-Emotion Associations of Children

Children use color in their drawings as a medium to describe and emphasize their emotional states (Burkitt, Barrett & Davis, 2003). Studies demonstrate that use of bright colors is an indication of positive emotions whereas dark colors indicate negative qualities (Lev-Wiesel & Dapna-Tekoha, 2000). Furthermore, studies done on both preference and emotional associations show that children link their least preferred colors with negative emotions and their most preferred color to positive emotions (Pope, Butler & Qualter, 2012). This observation suggests that the use of color is translated into emotional responses in both an objective and subjective way, as a result, judgements on the association between colors and emotions should be made in reference to color preference (Burkitt, Barrett & Davis, 2003).

The association between specific colors with meanings and emotions start developing from infancy. This knowledge on pairing colors with emotions can extend throughout a person's life and it would cause specific emotional reactions and responses without a conscious awareness (Boyatzis & Varghese, 1994). In that regard, children are subjected

to a wide variety of colors embedded in their toys and belongings, that each carry specific meanings and associations (Boyatzis & Varghese, 1994; Pope, Butler & Qualter, 2012). The society and family members play an active role in developing children's emotional association to colors, as an example gender stereotypes such as pink for girls and blue for boys can be mentioned (Boyatzis & Varghese, 1994; Zetner, 2001). Furthermore, it has been stated by clinicians that children's use of color in their drawings is an indicator of their emotional status, in that sense, color red is correlated with excitement, anger or aggression; dark colors such as black are associated with anxiety and depression (Boyatzis & Varghese, 1994). In line with these explanations, the following paragraphs would discuss the studies done on the association between colors and emotions in children.

A variety of studies have investigated the association between colors and emotions in children. In a study done by Cimbalò, Beck, and Sendziak (1978, cited in Boyatzis & Varghese, 1994), pictures rated as either happy or sad were presented to second and third graders and they were asked to color in a shape with a color of their preference while looking at each picture. The results demonstrated a strong color emotion association. Orange, yellow, blue and green were used with happy scenes, whereas brown, red and black were used for sad ones.

An earlier study done by Lawler and Lawler (1965, cited in Boyatzis & Varghese, 1994), found that children used "a yellow crayon after hearing a happy story and a brown crayon after hearing a sad story". Moreover, in another study done by Buckalew and Bell (1985), children were presented faceless figures wearing either blue, red,

yellow, green, white, brown and black clothes and they were asked to draw facial expressions of either happy, sad or indifferent on each figure. The results did not show a significant difference between the facial expressions and the color of the clothing.

Boyatzis and Varghese (1994), examined children's color-emotion association. The participants were 60 children between the ages of 5 to 6.5. In the first part of the experiment children's favorite color was asked and afterwards nine different colors were shown to the child. For each individual color children were asked "how does this color make you feel?". After answering the questions, children were asked why they felt that way towards each color. the colors were coded as dark or bright and the emotions were coded as positive (happiness, strength, and excitement) and negative (sadness, anger, and boredom). The results demonstrated distinct color-emotion associations for colors of pink, red, yellow, blue, purple, green, brown, black and grey. Light colors, such as blue yellow and pink tended to elicit positive emotions whereas dark colors, such as black and grey evoked negative ones.

Zentner (2001), also investigates preference for colors and color-emotion combinations in early childhood. The participants were Swedish children between the ages of 3 to 4. In addition to this sample, an adult sample, between the ages of 18 to 39 was added to compare the data between children and adults. The material used was small chips colored in red, yellow, dark and bright blue, dark and bright green, pink, brown and black. The children were asked to match each color with three schematic faces, expressive of happiness, sadness and anger. In the first phase of the experiment, nine colors were shown to the child and he/she was asked to arrange the colors from the most

preferred one to the least preferred one. A practice matching task was conducted after this phase to see whether children are able to understand metaphors involving emotions. The children who were successful in the practice matching task were exposed to three schematic faces and were asked to match each color to one of the faces. The same procedure was conducted for the adult sample. The results indicated that bright colors of yellow, red and green evoked happiness whereas dark colors of brown, black and dark blue evoked sadness. However, in adults red was associated with anger, black was associated with sadness and yellow was associated with happiness. Even though in this study red was associated with happiness and it was the most preferred color for children, there are studies that suggest red is an ambivalent color in comparison to blue across cultures (Adams & Osgood, 1973; Elliot, Maier, Moller, Friedman and Meinhardt, 2007; Helvacioğlu, 2011). According to these studies, red is both associated with positive emotions of love, warmth and happiness, in addition to negative emotions of danger, sadness and anger.

A more recent study done by Gil and Le Bigot (2015), investigated the association between color red and children between the ages of 5 to 10. The children were asked to rate how ambiguous faces felt against backgrounds of green, red and grey by using card-sorting tasks. The result of the study indicated a strong negative valence with the color red. Another finding of the study was that emotional associations of a color are independent of color preference. Red and green were both preferred over grey, so it was hypothesized that grey would elicit more negative emotions, however the negative valence of color red was higher than green and grey (Gil & Le Bigot, 2015).

Overall, based on the literature, we can conclude that there is a correlation between colors and emotions. The effect of brightness and saturation on emotional responses is also apparent. However, studies on these matters concerning children are very few and they fail to control color attributes of brightness or saturation (Boyatzis & Varghese, 1994; Child, Hansen, & Hornbeck, 1968; Zentner, 2001). As a result, a controlled study on the color-emotion association of preschool children seems necessary.

2.4. Color in Preschool Facilities

The time spent in learning environments, from early childhood to adulthood is very long and therefore it plays a significant role in shaping humans. Furthermore, the quality of life and education is associated with the learning environments' physical setting (Sanoff, 1994). The educational settings, act as an important cultural force in children's lives, however they have been designed according to the needs of adults rather than concerning children (Read, Sugawara & Brandt, 1999). Moreover, the educational settings must have positive impacts on the child in order to enhance their ability to perform, explore and interact with others (Read et al., 1999). The application of correct and preferred colors in educational settings is a medium to decrease a lack of interest while improving learning opportunities and performance in the children (Birren, 1988).

Colors in the interior space influence biological changes in children such as brain activity, respiration rates and blood pressure (Olds, 1989). Moreover, considering the fact that small children are outwardly directed and nervous (Birren, 1963), the educational settings should be designed in order to match the child's spirit. As an

example, actively colored settings help the child to relax and concentrate because that sort of spaces match the needs and the spirit of the child (Birren, 1963). On the other hand, use of cool and passive colors, would make children more anxious and nervous (Birren, 1963). As an example, putting a child in a blue room in order to quite him down can result in bitter crying (Birren, 1963), on the other hand, use of bold and vivid colors can achieve the goal of comforting the child (Birren, 1963). In line with these explanations, Moore, McCarty, and Jelin (1995), recommend warm tones for spaces that require a calmer atmosphere. On the contrary, Olds (1989), suggests warmer tones for high activity environments and cool colors for resting, soothing and quite areas. Furthermore, use of warm colors has been recommended in order to increase a sense of security in the children (Moore et al., 1995).

Regarding that children with different ages respond differently to the use of color, it is important to take this into consideration during the design process. Younger children are active and have high spirits therefore, the colors applied in preschool environments should reflect these characteristics. In that sense, bright warm colors are recommended for interior spaces (Birren, 1963). These colors are mostly used on the walls, followed by floors, accessories, furniture, ceiling and finally windows (Torrice & Logrippo, 1992). Studies regarding the use of color in children spaces are focused on cooperative behavior, gender, age and emotion. In that sense, studies on gender demonstrate that girls show a bias towards dramatic, more intense and brighter hues than boys (Cohen & Trostle, 1990). This indicates that girls prefer a more diverse and dramatic stimulus in the environment. Furthermore, Karp and Karp (1987) investigated the association

between color's names and emotions, the results associated red with pain, anger, love and happiness; blue with sadness, yellow with honesty and black with death and fear.

Moreover, studies concerning age, demonstrate that children prefer brighter and more intense colors in comparison to adults in interior spaces (Cohen & Trostle, 1990).

Studies done on the relationship between color and affect in the interior space, relate red with excitement and stimulation; blue with security, comfort and tenderness; orange with distress; yellow with happiness; white with tenderness; grey with unhappiness and melancholy and black with distress (Schaie, 1961; Wexner, 1954). In conclusion, regarding the available literature on the use of color in preschool environments, the effect of saturation and brightness on emotional response, the ambivalent effect of red on emotion and color preference of children, it seems necessary to conduct a research that takes all the above mentioned elements into consideration.

2.5 Methodology in Color Studies

Experiments are carried out by manipulating an independent variable and examining the cause and effect associations between that independent variable and a dependent variable (Sommer & Sommer, 1997). According to the subjects and conditions of each experiment, the method can be categorized under "true experiments, quasi-experiments and single- subject experiments" (Sommer & Sommer, 1997).

Going over the methods applied in similar color studies would enable the researcher to choose the most appropriate method for conducting a research. According to the available

literature, experiments with questionnaires are the most frequent ones (See Table 3).

Questionnaires are commonly-used tools that are efficient in cost, time and effort and they can provide useful data for the researcher (Zeisel, 1981). Questionnaires mostly focus on opinions rather than behaviors (Sommer & Sommer, 1997). In addition, the data gathered from questionnaires is consistent because all subjects have been asked the same questions, the disadvantage however, is the limitation in use with subjects who are very young or very old (Sommer & Sommer, 1997).



Table 3: Review over research methodologies in color studies

Methodologies	Literature Examples
Questionnaires	<p>Adams, 1987</p> <p>Boyatzis, & Varghese, 1994</p> <p>Camgöz, Yener, & Güvenç, 2001</p> <p>Child, Hansen, & Hornbeck, 1968</p> <p>Dittmar, 2001</p> <p>Hemphill, 1996</p> <p>Kwallek & Lewis, 1990</p> <p>Kwallek, Lewis, & Robbins, 1988</p> <p>Meerum, Terwogt, & Hoeksma, 1995</p> <p>Valdez & Mehrabian, 1994</p> <p>Zentner, 2001</p>
Physical measures	<p>Fehrman &Fehrman, 2004</p> <p>Gerard, 1958, 1959</p> <p>Jacobs & Hustmyer, 1974</p> <p>Wilson, 1966</p>
Luscher Color Test	Fleming, Holems, Barton, & Osbahr, 1993
Interview	Karp & Karp, 1987

CHAPTER 3

METHODOLOGY OF THE EXPERIMENT

3.1 Aim of the Study

As explained in the introduction section, color is one of the design elements that evokes physiological, psychological and emotional responses in the users (Boyatzis & Varghese, 1994). Color should be applied carefully in spaces that occupy children in order to reduce threats, stress, and negative thoughts in the children while holding their interest and attention and promoting learning outcomes, wellbeing and cognitive developments. Considering the lack of studies on the effects of color on children in interior spaces this study would try to analyze the effect of high and low saturated colors in achromatic and chromatic schemes on emotions of preschool children in interior spaces.

3.1.1. Research Questions

1. Is there a significant difference between achromatic and chromatic color schemes on preferences and emotional responses in preschool children?
2. Is there a significant difference in color-emotion associations and color preferences between two genders?

3.1.2. Hypotheses

1. High saturated red is associated with positive emotions.
2. High saturated blue is associated with positive emotions.
3. Low saturated red is associated with negative emotions.
4. Low saturated blue is associated with negative emotions.
5. High saturated red and blue are preferred over less saturated red and blue.
6. Chromatic color schemes are associated with positive emotions.
7. Achromatic color schemes are associated with negative emotions.
8. Gender affects children's color-emotion associations and color preferences.

3.2. Method of the Study

The following section would go over the sample size and the demographic information of the participant. Afterwards it would talk about the child population and the reasons behind why this age group was selected, and finally it would discuss the independent and dependent variable.

3.2.1. Participants

Eighty Turkish children were recruited from two private preschools in Ankara, Turkey. The preschools used as research sites were Cekirdek Yuva va Aile Danismanligi Merkezi and Nesibe Aydin Cankaya Anaokulu. Since gender differences in color-emotion associations were being analyzed, the sample group is balanced to sex (forty boys and forty girls). Demographic information about the participants is summarized in Table 4. Parental permission forms were sent to the parents to be signed and returned prior to participation. Data collection of the study was mainly conducted from February to March, 2016.

Table 4. Number of subjects by age and gender.

Age (Years)	Gender		Preschool	Total
	Boys	Girls		
5	20	20	Cekirdek	40
5	20	20	Nesibe Aydin	40
Total	40	40		80

3.2.2. The Child Population

Age group is important because of the crucial effect of children's capability to interact with the research tool. According to Piaget's cognitive developmental theory and the theory of dual representation, children below a certain age lack the ability to reference

symbols, or in this case, photographs (Brainerd, 1978). Therefore, the children's age group of five years (the pre-operational stage according to Piaget's cognitive-developmental theory) (Brainerd, 1978) were chosen in this study. The pre-operational stage lasts from about two to seven years of age and during this time, with high levels of physical accuracy, children are able to relate symbols to reality. In a study done by DeLoache, Peralta de Mendoza, and Anderson (1999), it was determined that three-year-olds could understand symbols accurately when received explanations, but failed to make connections between the symbol and referent when not fully informed. Therefore, with high levels of physical accuracy in the photographs, the experiment ensures that the child participants can reference the photographs akin to the adult's capacity.

3.2.3. Variables

The independent variable in this study are the wall colors and the dependent variables are children's emotional responses and their preferences. The views with modified colors in floors and furniture were created as well, but upon further considerations, it was decided to only change the wall colors and keep the furniture, floors and ceilings the same color as the original picture (See Figure 12), in order to achieve a more realistic photograph. The Natural Color System (NCS), developed and revived by Trygve Johansson, has been used as the source for determining the wall colors. For information regarding The Natural Color System (NCS), refer to Section 2.1.2.

As discussed in the literature section, there is a controversy between the most preferred hue, brightness and saturation for wall colors in children. Whilst psychologist

recommend the use of pastel tones in interior spaces that occupy children (Ajilian Abbasi, Talaei, Talaei & Rezaei,2014), children tend to be more inclined towards brighter and more saturated colors (Boyatzis & Varghese, 1994; Child, Hansen, & Hornbeck, 1968; Cohen & Trostle, 1990). Additionally, since saturation is an effective factor in eliciting emotional responses in children both high saturation and low saturation colors were selected as independent variables for this study (Child, Hansen, & Hornbeck, 1968; Guilford & Smith, 1959).

3.3. Procedures

This section of the methodology discusses the chromatic and achromatic colors that were selected in this study based on the available literature. Furthermore, it talks about photographic simulations that were chosen as the research method. The validity and reliability of simulations according to age group are also discussed in this section. Finally, the phases of the experiment are explained.

3.3.1. Specifying the Colors

Our experience of color takes place in the real environment, therefore, in order to study and analyze color's influence on human responses, it should be studied in real contexts where complex patterns interact with behavior and perception (Tofle, Schwarz, Yoon, & Max-Royale, 2004). However, the majority of the available literature on color studies have used small chips or pieces of paper rather than applying the color to interior surfaces, these studies often lack control over variables such as brightness and

saturation; in other words, brightness and saturation must be controlled if the hue effect is going to be investigated (Meerum Terwogt & Hoeksma, 1995).

The majority of the available literature mention red and blue as children's most preferred colors (Adams, 1987; Bornstein, 1975; Choungourian, 1968; Eysenck, 1941; Meerum Terwogt & Hoeksma, 1995; Zentner, 2001), therefore, pure red (-R) and pure blue (-B) from the chromatic color schemes along with grey (N) and white from achromatic color schemes, all chosen from NCS, were applied for the interior wall surfaces. Pure colors in the NCS have no mark of any other color in them, as an example, pure red has no mark of yellowness or blueness or whiteness or blackness in it and it is defined as having a redness of 100% (Agoston, 1987).

In addition, preferences and emotional associations related to a color can be influenced by brightness and saturation (Guilford & Smith, 1959; Sivik, 1974); however, saturation has been found to be more important than hue in terms of affecting people's perception of which color is more calming or exciting (Mikellides, 1990). This is one of the reasons that both high and low saturated colors were tested in this study. The other reason, as explained earlier, is children's incline towards high saturated colors in comparison to low saturated colors and pastel tones. In that sense both low and high saturated red, blue and grey were examined in this study (See Figure 9 and 10). Moreover, in order to examine the effect of hue and saturation, lightness of colors was adjusted to 10. In order to have perceivable differences between high and low saturated colors, this lightness was found suitable. As a result, S 1020. R, S 1060. R, S 1020. B, and S 1060. R were

selected as the chromatic colors for the wall surfaces in a preschool classroom. In addition, in the case of achromatic color schemes, high (S 6000 N) and low (S 1500 N) saturated grey, with similar lightness to high and low saturated red and blue were selected as the wall colors (See Figure 11).

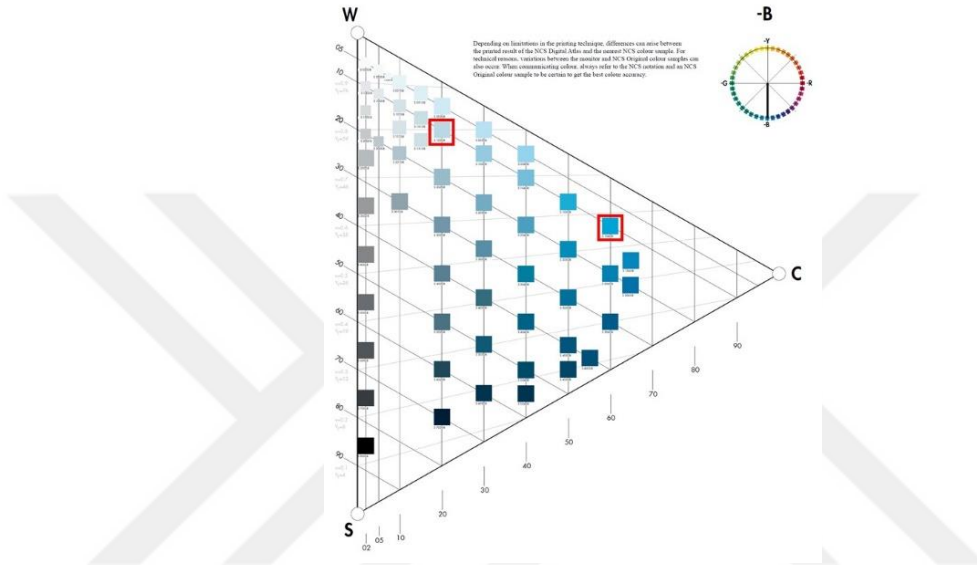


Figure 9. High saturated and Low saturated blue chosen from NCS.
http://www.ncscolour.co.uk/information/ncs_system.html

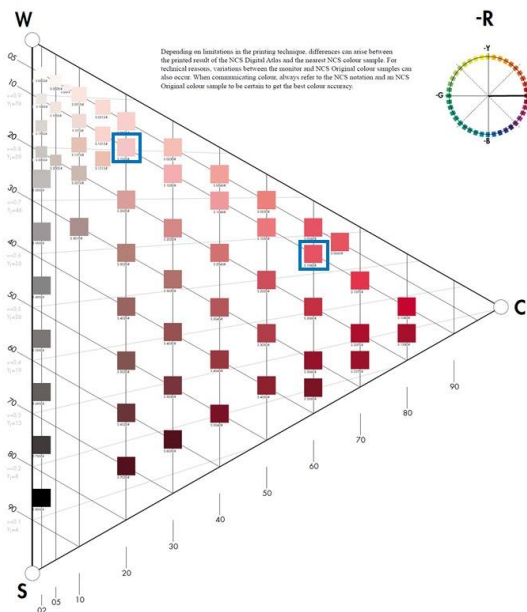


Figure 10. High saturated and Low saturated red chosen from NCS.
 triangle. http://www.ncscolour.co.uk/information/ncs_system.html

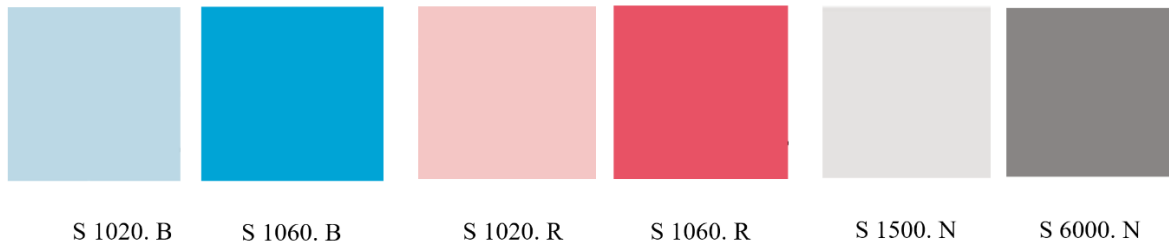


Figure 11. The selected wall colors.

3.3.2 Photographic Simulations

This study uses a simulation design to investigate the effect of color on children's emotions in various environments. Simulations provide an opportunity to investigate the value of color in real contexts because of their feasibility and reliability, in addition, they enhance dealing with environments where responses are sought regarding different styles of environment or views (Sanoff, 1991). Moreover, data gathered from photographic simulations and small scale models have been compared to those gathered from real settings and the findings of these studies provide proof for simulations reliability (Baird, Cassidy, and Kurr, 1978; De Long, 1976). In addition, Lozar's (1974) review on age-appropriate research methods in environmental design research show that photographic simulations are one of the suitable methods in gathering data in studies concerning pre-school children (See Table 5).

Table 5. Age-appropriate research methods.

Source: Adapted from Lozar, 1974.

Age-Appropriate Research Methods in Environmental Design Research				
Survey instruments	Infants	Preschool Children	School Children	Adults
Open-ended questions				●
Direct questions				●
Likert scales				●
Semantic differentials			●	●
Cognitive mapping			●	●
Photographic simulation		●	●	●
Games		●	●	●
Scale model simulations		●	●	●

According to Sheppard (1988) accuracy, representativeness, interest, visual accuracy and legitimacy are five characteristics of a valid simulation. Moreover, the appearance of simulations need to be clear and realistic in detail in order to provide data similar to those gathered from real settings. As a result, realistic photographs of a general classroom of a pre-school were selected as the base for creating photographic simulations (See Figure 12). Over 20 pictures of preschool classrooms were analyzed in order to choose a suitable picture for the study. The picture in Figure 12 was chosen based on a clear space in the floor and ceiling area, in addition, it was not crowded with furniture, that might distract the children from focusing on the wall color. This picture

was taken from Eiffel Tower Montessori Preschool and Daycare in San Leandro, California. Permission regarding the use of picture was granted via online communications with the preschool.



Figure 12. Original picture of a pre-school classroom. (Retrieved from <http://www.eiffeltowermontessori.com/>)

After selecting the original picture, Photoshop software was used to create different views of the classroom by changing the wall colors. The original picture was modified to obtain more wall surfaces and less of a window area to exclude the colors of window view but also to have a realistic space. The seven different specified colors were applied to the interior space and the following perspectives were created (See Figures 13 and 14).



Figure 13. Chromatic colors applied as interior wall surfaces.



Figure 14. Achromatic colors applied as interior wall surfaces.

In similar studies, in order to eliminate the effects of furniture, ceiling and floor colors, these elements were colored in grey (Helvacioğlu, 2011), however, in this study, the color of the furniture, ceilings and floor were kept in the same color in order to provide accurate and more appealing views for the children. Additionally, when the colors of ceilings, floors and furniture were changed to a neutral grey, the environment became unrealistic.

3.3.3. Phases of the Experiment


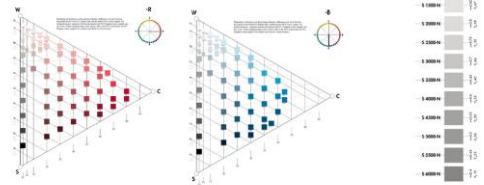
All the participants were handed out questionnaires and were asked to fill them out at the comfort of their homes, without any kind of distractions, and under supervision of their mothers. In order to fix the variables in all experiment settings, the mother was asked to conduct the study under artificial lighting of a minimum of 300 lux (recommended by CLEAResult, 2013). This could be provided in a regular living room after the sunset, so that there was no interference of daylight. The questionnaires were handed to the children on Friday and they were asked to work on them during the weekend and return them the next week, there were no time constraints on the amount of time spent on each question and children could answer the questions at their own pace.

The study was conducted with a questionnaire made up of four sections; in the first section, the mother was asked to provide personal information about the child's age, gender and nationality. In the second section, the mother was asked to supervise her child in order to match each classroom with only one of the schematic faces,

representing emotions of anger, sadness, neutral and happiness. These emotions are defined as basic emotions by Ekman and Friesen (1978) and they are easily understood even by very young children (Harris, 1989; Stein & Levine, 1987). Schematic faces were preferred instead of real human models (Sullivan, Kirkpatrick, & MacDonald, 1995). Moreover, the validity of the color and emotion matching task by children between 30 and 45 months of age has been proved by the available literature (Burkitt & Newell, 2005; Green & Ekman, 1973).

In the third section, the children were asked to describe how they felt towards each individual color, by matching the color to one of the four schematic faces expressive of anger, sadness, neutral and happiness. This question provides information on whether colors in isolation evoke the same emotions when used in interior spaces. In the final section of the questionnaire, the children were asked to select the most and least preferred colors for a classroom. In all sections, instead of randomizing subjects to experiments, color samples and views of the classrooms were displayed randomly in a way that each questionnaire was different from others. The following table provides a step by step summary of the experiments (See Table 6).

Table 6. Summary of experiments.

Experiment	Main Study
Purpose	To explore the effect of color as an element of the physical environment on children’s emotion in interior spaces.
Methods	Photographic simulations were used with seven different wall colors. <div data-bbox="636 506 1317 751" style="display: flex; flex-wrap: wrap; justify-content: space-around;">  </div>
Independent Variables	High and low saturated red, high and low saturated blue, high and low saturated grey and white configured by the available literature. <div data-bbox="636 890 1325 1178" style="display: flex; align-items: center; margin-top: 10px;"> <div style="display: flex; justify-content: space-around; width: 100%;">  </div> <div style="display: flex; justify-content: space-around; width: 100%; margin-top: 10px;"> <div style="border: 1px solid black; padding: 5px; text-align: center;">High and low saturated Red</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">High and low saturated Blue</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">High and low saturated Grey</div> <div style="border: 1px solid black; padding: 5px; text-align: center;">White</div> </div> </div>
Subject Groups	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Healthy Children of 5 years of age</div> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px;">Color-Emotion association</div> <div style="border: 1px solid black; padding: 5px;">Preference Rating</div> </div>
Dependent Variables	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px;">Emotional Responses</div> <div style="border: 1px solid black; padding: 5px;">Preference Ratings</div> </div>
Data	<div style="border: 1px solid black; border-radius: 50%; padding: 10px; display: inline-block;">Hypotheses 1 to 8</div>

3.4. Findings

To analyze the data, Statistical Package for the Social Sciences (SPSS) 23.0 was used. Data assessment was achieved through using Chi-Square Goodness-of-Fit Test, Wilcoxon signed ranks with applying Bonferroni correction, Friedman's Repeated Measures one-way Anova and frequency tables. Results of the statistical analysis are presented regarding the research hypotheses of the study (See hypotheses in Section 3.1.2). In that sense, the Chi square test was used to compare the frequency of emotional responses between genders within each color. This test was also used to evaluate the association of colors with the emotions by assuming equal outcomes for all categories. In addition, Wilcoxon Signed Rank was used for pairwise comparisons by applying Bonferroni correction to adjust for statistical significance for multiple comparisons. This test is a nonparametric technique to explore an outcome across two within-group conditions (Mayers, 2013). This test is similar to a related t-test, however since the data in this study are ordinal, nonparametric tests are more suitable. In that regard, nonparametric tests such as Wilcoxon Signed Rank test rank the data and compare them between groups or conditions. Therefore, the medians are compared instead of the means because ordinal data may not have an objective mean score (Mayers, 2013).

Friedman's Repeated Measures one-way Anova has been used in order to compare the emotional associations in respect to different colors in each of the achromatic and chromatic schemes. This test is also a nonparametric one that explores the differences of a dependent variable (the emotions and preferences in this study) across three or more conditions of a single independent variable (the wall colors).

The findings of the study on achromatic and chromatic color schemes were analyzed individually. The findings related to each color scheme is presented in the following order, the effect of gender on emotions, the effect of color on emotions, the most and the least preferred classroom, and finally, the effect of saturation on emotions.

3.4.1. Chromatic color schemes

The Chi square test was used to evaluate the effect of gender on emotions for all wall colors. The results showed that there is no significant association between gender and emotions in chromatic color schemes, therefore the emotional association to each chromatic color has been given regardless of gender differences (See Table 7).

Table 7. Gender difference in emotional responses under different wall colors.

	High saturated blue	High saturated red	Low saturated blue	Low saturated red
Emotional association	df= 3, p=0.269	df= 3, p=0.335	df= 3, p=0.255	df= 3, p=0.376

The Chi square test was used to evaluate the association between colors and emotions in chromatic color schemes by assuming equal outcomes for all categories. Chi-square goodness-of-fit test is a nonparametric test that considers multinomial frequency distribution of more than two points on a scale (Argyrous, 2005). It explores whether the distribution of the observed counts matches the distribution of the expected counts. In

that sense, the frequency of the distribution of the four emotions across chromatic colors were analyzed. The results of the analysis show that the parameters are not equal in the high saturated blue ($\chi^2= 54.200$, $df=3$, **$p=0.000$**), high saturated red ($\chi^2= 10.200$, $df=3$, **$p=0.017$**) and low saturated red ($\chi^2=16.800$, $df=3$, **$p=0.001$**). Therefore, it can be concluded that for the above mentioned classrooms, the proportion of the participants with four emotions is not the same and the distribution of the emotions among the participants is different. On the other hand, the analysis for the low saturated blue indicates that there is no significant association between this color and emotions ($\chi^2= 2.600$, $df=3$, $p=0.457$). In other words, low saturated blue does not elicit an emotion in the child (See Table 8. and Figure 15. for the frequency distribution of emotional responses in each classroom).

Figure 15 demonstrates that for the high saturated blue and low saturated red, the frequency of happiness is significantly larger than the other emotions. Moreover, according to the figure, the number of participants who associate the emotion of anger with high saturated red is larger than other emotions. It should also be mentioned that in the case of high saturated red, happiness (35%) is the second emotion with the highest frequency after anger (40%).

Table 8: The frequency distribution of emotions on each colored classroom in chromatic color schemes.

Emotions	High saturated blue		High saturated red		Low saturated blue		Low saturated red	
	n	%	n	%	n	%	n	%
Anger	4	10.00	16	40.00	7	17.50	10	25.00
Sadness	5	12.50	5	12.50	14	35.00	8	20.00
Neutral	1	2.50	5	12.50	10	25.00	2	5.00
Happiness	30	75.00	14	35.00	9	22.50	20	50.00

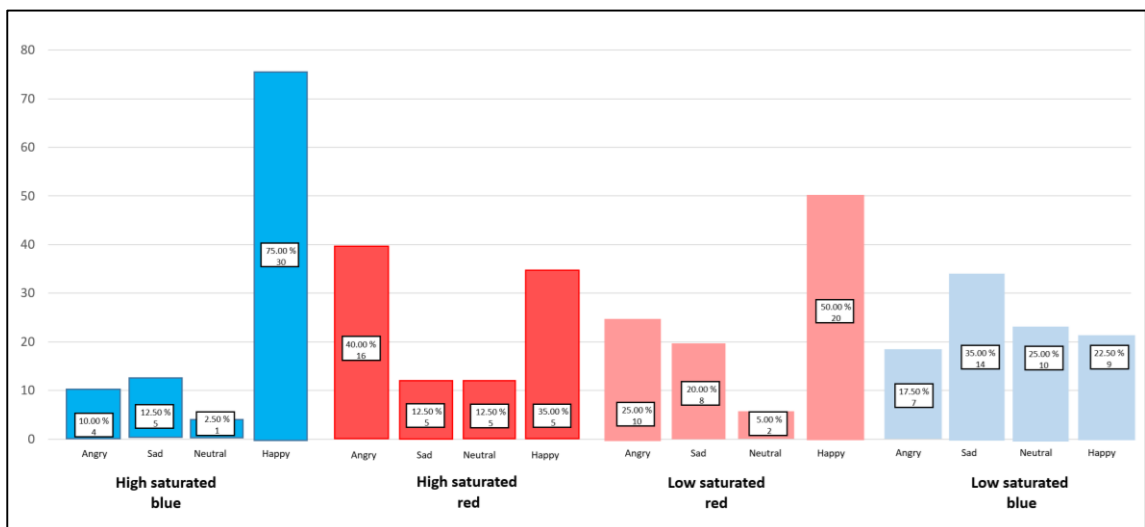


Figure 15. The frequency distribution of emotions on each colored classroom in chromatic color schemes.

The Chi square test was used to explore whether there was a significant difference between the most and the least preferred classrooms regarding different gender groups. The results showed that there is no significant association between gender and preferred classrooms in chromatic color schemes ($\chi^2= 4.062$, $df=3$, $p=0.255$) ($\chi^2= 7.743$, $df=3$, $p=0.052$), therefore the data has been presented regardless of gender differences.

Furthermore, Chi-square-goodness-of-fit test was used to explore the distribution of colored classrooms across preference. The results of the analysis show that the parameters are not equal in the most preferred classroom ($\chi^2= 48.600$, $df=3$, $p=0.000$) and the least preferred classroom ($\chi^2= 10.000$, $df=3$, $p=0.019$). Therefore, it can be concluded that the proportion of the participants choosing either of the colored classrooms as the most and the least preferred one is not the same and the frequency distribution of the classrooms among the participants is different. In that sense, high saturated blue was the most preferred classroom whilst high saturated red was the least preferred classroom (See Table 9. and Figure 16. for the frequency of the selected classrooms).

Table 9: The frequency distribution of preferred classrooms.

Preference rating	High saturated blue		High saturated red		Low saturated blue		Low saturated red	
	n	%	n	%	n	%	n	%
Most preferred	29	72.50	5	12.50	2	5.00	4	10.00
Least preferred	3	7.50	17	42.50	11	27.50	9	22.50

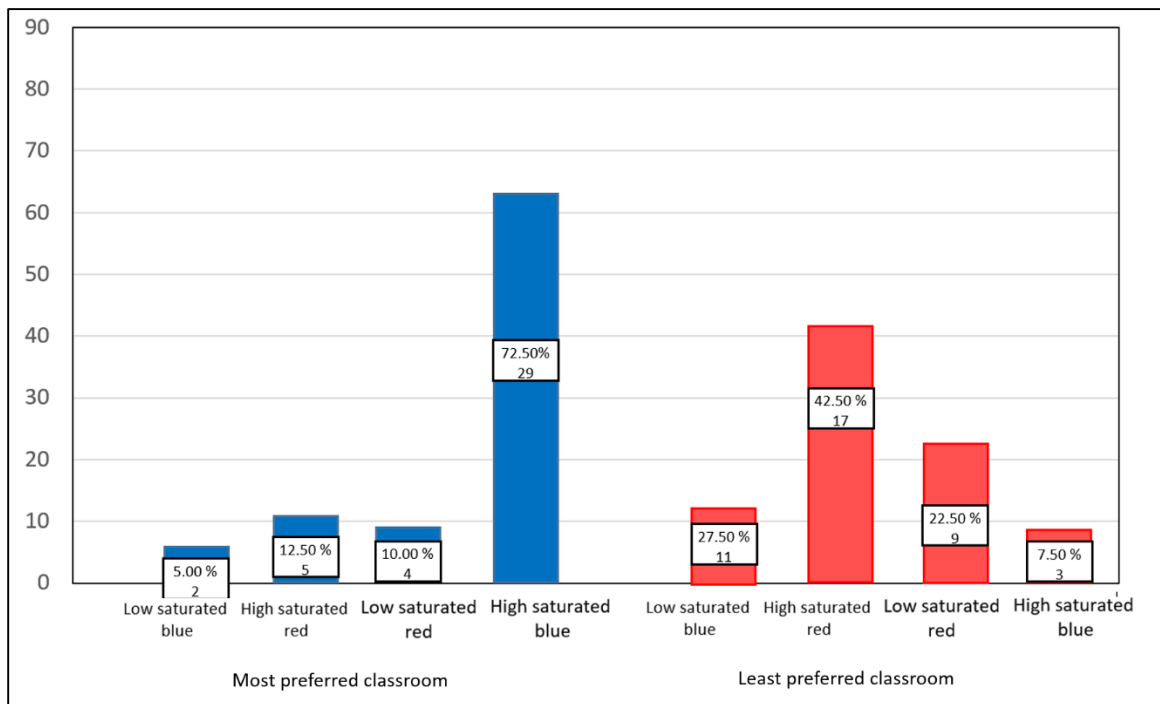


Figure 16. The frequency distribution of preferred classrooms.

Wilcoxon Signed Rank was used for pairwise comparisons in order to compare the effect of saturation. In that sense, high saturated blue and low saturated blue, high saturated blue and high saturated red, high saturated red and low saturated red, and low saturated red and low saturated blue were compared. The results showed no significant difference between low saturated red and high saturated red ($z=-1.353$, $p=0.176$) and low saturated blue and low saturated red ($z=-0.988$, $p=0.323$), however, there was a significant difference between high saturated red and high saturated blue ($z=-3.191$, $p=0.001$) and high saturated blue and low saturated blue ($z=-3.376$, $p=0.001$).

Furthermore, Friedman's repeated measures was used in order to compare the emotions in respect to different colors by comparing the medians and in that regard, high saturated blue (Median of 4.00) was significantly associated with happiness, high saturated red (Median of 1.00) was significantly associated with anger and low saturated blue (Median of 2.00) was significantly associated with sadness.

3.4.5. Achromatic color schemes

The Chi square test was used to evaluate the effect of gender on emotions for all wall colors. The results showed that there is no significant association between gender and emotional responses in high and low saturated grey, however there was a significant gender difference in the color white (See Table 10.). This difference would be explained in the following section.

Table 10. Gender difference in emotional associations under different wall colors.

	High saturated grey	Low saturated grey	White
Emotional association	df= 2, p=0.322	df= 2, p=0.360	df= 2, p=0.008

The Chi square test was used to evaluate the association between colors and emotions in achromatic color schemes by assuming equal outcomes for all categories. The results of the analysis showed that the parameters were not equal in the high saturated grey ($\chi^2= 13.400$, $df=2$, **p=0.001**) and white ($\chi^2= 26.600$, $df=2$, **p=0.000**). Therefore, it can be concluded that for the above mentioned classrooms, the distribution of the emotions among the participants is different. On the other hand, the analysis for the low saturated grey indicates that there is no significant association between this color and emotions ($\chi^2= 3.400$, $df=2$, $p=0.334$). In other words, low saturated grey does not elicit an emotion in the child (See Table 11. and Figure 17. for the frequency distribution of emotions in each classroom).

Figure 17 presents the frequency distribution of each emotion in reference to gender. The figure demonstrates that for high saturated grey, the frequency of anger is significantly larger than the other emotions, whereas, the number of participants who associate the emotion of happiness with white is significantly larger than other emotions.

Table 11. The frequency distribution of emotions on each colored classroom in achromatic color schemes.

Emotions	High saturated grey		Low saturated grey		White	
	n	%	n	%	n	%
Anger	24	60.00	8	20.00	0	0
Sadness	10	25.00	15	37.50	2	5.00
Neutral	6	15.00	8	20.00	10	25.00
Happiness	0	0	9	22.50	28	70.00

As seen in Figure 17, the color white is associated with happiness in both genders, however as can be seen the percentage of female participants (42.50 %) that have associated white with happiness is more than males (27.50 %), this difference is also apparent in neutral, 22.5 % of male participants have associated white with neutral whereas only 2.50 % of females have associated white with neutral.

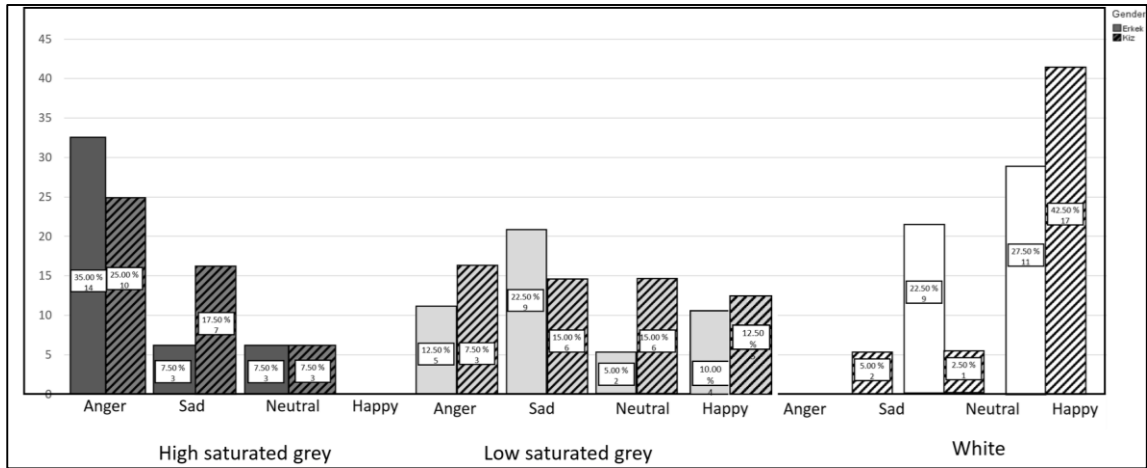


Figure 17. The frequency distribution of emotions on each colored classroom in achromatic color schemes.

The Chi square test was used to explore whether there is a significant difference between the most and the least preferred classrooms regarding different gender groups. The results showed that there is no significant association between gender and preferred classrooms in achromatic color schemes ($\chi^2= 5.714$, $df=2$, $p=0.057$) ($\chi^2= 0.173$, $df=1$, $p=0.677$), therefore the data has been presented regardless of gender differences.

Furthermore, Chi-square-goodness-of-fit test was used to explore the distribution of colored classrooms across preference. The results of the analysis show that the parameters are not equal in most preferred classroom ($\chi^2= 52.850$, $df=2$, $p=0.000$) and least preferred classroom ($\chi^2= 16.900$, $df=1$, $p=0.000$). Therefore, it can be concluded that the proportion of the participants choosing either of the colored classrooms as the most and least preferred one is not the same and the frequency distribution of the selected classrooms among the participants is different. In that sense, white was the

most preferred classroom whilst high saturated grey was the least preferred classroom
 (See Table 12. and Figure 18. for the frequency of the selected classrooms).

Table 12. The frequency distribution of preferred classrooms.

	High saturated grey		Low saturated grey		White	
	n	%	n	%	n	%
Preference rating						
Most preferred	2	5.00	3	7.50	35	87.50
Least preferred	33	82.50	7	17.50	0	0

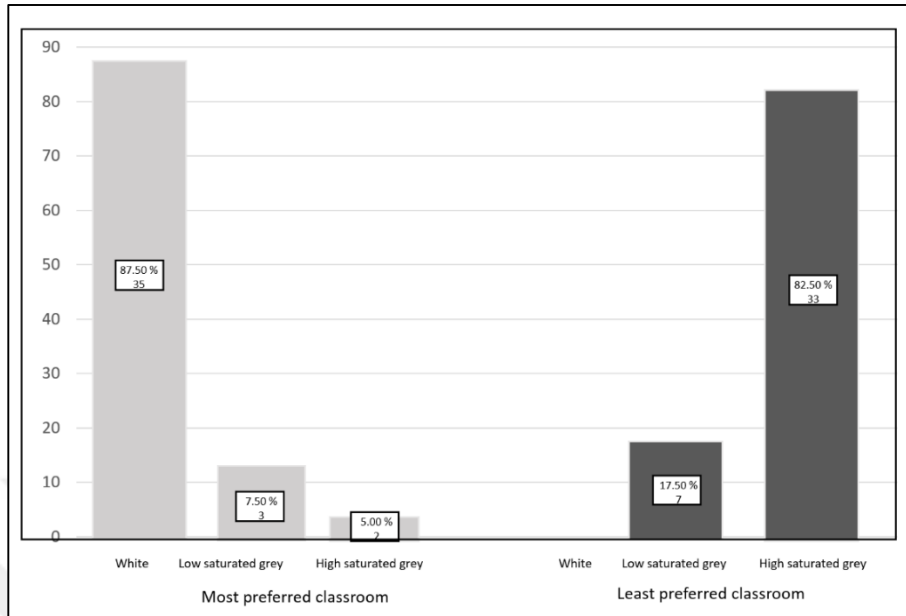


Figure 18. The frequency distribution of preferred classrooms.

Wilcoxon Signed Rank was used for pairwise comparisons in order to compare the effect of saturation. Since gender had a significant effect on the emotions elicited in the color white, males and females were compared individually. In that sense, high saturated grey and low saturated grey, low saturated grey and white and high saturated grey and white were compared. The results showed no significant difference between high saturated grey and low saturated grey neither in males ($z=-2.555$, $p=0.066$) nor in females ($z=-2.609$, $p=0.054$), however, there was a significant difference between high saturated grey and white in both males ($z=-3,191$, $p=0.001$) and females ($z=-3,191$, $p=0.001$). In addition, there was also a significant difference between low saturated grey and white in males ($z=-3,191$, $p=0.001$) and females ($z=-3,191$, $p=0.001$).

Furthermore, Friedman's repeated measure was used in order to compare the emotional responses in respect to different colors by comparing the medians and in that regard, high saturated grey (Median of 1.00) was significantly associated with anger for both males and females, white (Median of 4.00) was significantly associated with happiness for both males and females and low saturated grey (Median of 2.00) was significantly associated with sadness for males and neutral in females (Median of 2.00).

3.5. Discussion

This study was looking at the association between the concepts of "color", "emotion", "children" and "interior space of preschools". The main objective of the study was analyzing the effect of chromatic and achromatic color schemes on emotions of preschool children. In that sense, emotional associations with different saturations of four different colors (two chromatic colors and two achromatic colors), were examined in this study. It was hypothesized that the emotional reactions towards different colors would differ in the interior space. Based on the literature, it was expected that high saturated colors in the chromatic color schemes would elicit positive emotions and the achromatic color schemes would evoke negative emotions in the children (Boyatzis & Varghese, 1994). Additionally, according to the literature, it was expected that the classroom ranked as the most preferred one would be associated with positive emotions and the classroom ranked as the least preferred one would be associated with negative emotions (Pope, Butler & Qualter, 2012). Gender differences were also examined in this study. Red and blue were the chromatic colors selected in this study, the color blue is among the most preferred colors across all ages, genders and cultures (Child, Hansen, &

Hornbeck, 1968; Granger, 1955; Guilford, 1934), furthermore, the ambivalent nature of the color red (being associated with both positive and negative emotions) (Boyatzis & Varghese, 1994; Elliot et al, 2007; Gil & Le Bigot, 2015; Helvacıoğlu, 2011) made these two colors appropriate choices for the study. In the case of achromatic color schemes high saturated grey, low saturated grey and white were selected. Overall, the study examined the associations of high and low saturated blue, high and low saturated red, high and low saturated grey and white with basic emotions of anger, sadness, neutral and happiness.

The chromatic and achromatic color schemes were analyzed individually. In that sense, the effect of gender on emotions in chromatic color schemes was analyzed first. The Chi square test showed no significant difference in the emotional reactions to colors between two genders. The available literature regarding gender differences are in contrast, some suggest a difference in color preference and emotional responses (Ellis & Ficek, 2001; Karniol, 2011; Kwallek et al. 1996; Lobur and Deloache, 2011; Passig & Levin, 1999; Turgeon, 2008) whereas others do not (Child et al. 1968; Fleming et al. 1993). The literature that have found a gender difference in color preferences and emotional responses, also suggest a gender stereotype for colors of pink and blue (Karniol, 2011; Lobur and Deloache, 2011; Passig & Levin, 1999; Zentner, 2001). In that sense, girls are more inclined towards the color pink and they show more positive emotions towards this color, whereas boys tend to show a strong avoidance towards pink. The low saturated red that has been analyzed in this study looks like the color pink. Thus, it was expected that girls find it more appealing and associate more positive emotions towards

this color in comparison to boys. However, the results demonstrated no gender difference in color-emotion associations in low saturated red.

The effect of each individual color on emotions was analyzed by applying the Chi-square goodness-of-fit test (Refer to Section 3.4.2. for findings). The results indicated that high saturated blue and low saturated red were associated with happiness, high saturated red was associated with anger and low saturated blue did not evoke a specific emotion in children. Further statistical analysis demonstrated that high saturated blue was the most preferred classroom and high saturated red was the least preferred classroom among others. According to the literature, preferences and emotional associations related to a color can be influenced by brightness and saturation (Guilford & Smith, 1959; Sivik, 1974); however, saturation has been found to be more important than hue in terms of affecting people's perception of which color is more calming or exciting (Mikellides, 1990).

Based on the studies on the importance of saturation, in determining pleasantness of a color (Camgöz et al. 2002; Guilford & Smith 1959; Sivik, 1974; Smets, 1982), it was hypothesized that classrooms with high saturated colors would be preferred over classrooms with low saturated colors and that high saturated classrooms would elicit positive emotions in children. However, as discussed above, high saturated blue was the most preferred classroom and it was associated with positive emotions whereas high saturated red was associated with anger and it was the least preferred classroom. As a result, it can be concluded, that in interior space, using high saturated colors does not

necessarily evoke positive emotions in the users and hue is just as important as saturation.

Based on Mikellides (1990), it was expected that classrooms with low saturated colors do not evoke a specific emotional response in children, however, this was only true for the classroom with low saturated blue as the wall colors and as it was discussed above, the classroom with low saturated red was associated with positive emotions. Therefore, it can be concluded that low saturated colors can also elicit emotional responses in the users. Moreover, the difference between classrooms with low saturated blue and low saturated red as interior walls can be explained by the available literature. Red is the color that creates the highest number of emotional responses (Boyatzis & Varghese, 1994). It is both associated with positive emotions of happiness and love and negative emotions of fear, danger and anger (Meerum Terwogt & Hoeksma, 1995). Thus, the color red is more powerful in terms of evoking an emotion in comparison to blue, this can explain why the classroom with low saturated blue does not elicit an emotion in children whereas the classroom with low saturated red does. Furthermore, the ambivalent nature of the color red can be seen in this study as well, the classroom with low saturated red as the wall color is associated with the positive emotion of happiness whereas the classroom with high saturated red as the wall colors is associated with the negative emotion of anger.

All the studies that were mentioned above, found blue as the most preferred color across all genders, ages and cultures regardless of its brightness and saturation (Boyatzis &

Varghese, 1994; Camgöz, Yener and Güvenç, 2002; Child, Hansen, & Hornbeck, 1968; Granger, 1955; Guilford & Smith, 1959; Meerum Terwogt & Hoeksma, 1995; Smets, 1982). Additionally, emotional associations are a function of preference, in other words, the preferred colors are associated with positive emotions and the colors that are not preferred are associated with negative emotions (Terwogt & Hoeksma, 1995; Pope, Butler & Qualter, 2012). In this study high saturated blue was found as the most preferred classroom and it was associated with happiness, and high saturated red was the least preferred color and it was associated with anger, a negative emotion. Therefore, the results of this study are in consistency with the literature mentioned above.

The same statistical analysis was applied for achromatic color schemes. In that sense, first the effect of gender was analyzed. The results showed that there is no significant association between gender and emotional responses in high and low saturated grey, however there was a significant gender difference in the color white. This finding is in contrast with the existing literature that suggest boys tend to associate more positive emotions with dark colors in comparison to girls (Boyatzis & Varghese, 1994; Pope, Butler & Qualter, 2012; Zetner, 2001). However, the data of this study shows no difference in the case of the color grey, both in high and low saturation tones.

The results of the Chi-square goodness-of-fit test (Refer to Section 3.4.6. for findings) indicated that high saturated grey was associated with anger, white was associated with happiness and low saturated grey did not evoke an emotional response in children. The difference between high and low saturated grey can be explained by the statement that saturation is more important than hue in electing an emotional response (Boyatzis &

Varghese, 1994; Camgöz, Yener and Güvenç 2002; Guilford and Smith, 1959; Mikellides, 1990; Sivik, 1974; Smets, 1982).

According to the literature that examine the effect of colors in isolation, the color white is associated with tenderness, cleanness, innocence, peace, purity, surprise, sadness, anger, boredom and fear and the color grey is associated with sadness, anger, boredom and melancholy (Kaya & Epps, 2004; Kaya & Crosby, 2006; Schaie, 1961; Terwogt and Hoeksma, 1995; Wexner, 1954). In other words, when white is examined in isolation, it is associated both with positive and negative emotions whilst the color grey is only associated with negative emotions, however, the literature examining the effect of the color white in the interior space suggest that this color creates stress, causes a lower productivity and efficiency, more errors, and lower levels of happiness in the users (Kruczek & Zentall, 1988; Kwallek et al., 1996). Grangaard (1995), compared two classrooms, one with white walls and one with light blue ones. The results of his study showed higher levels of blood pressure and more off-task behaviors in the white classroom. Dijkstra, Pieterse and Pruyn (2008), compared white, green and orange in hospital rooms and the results indicated more stress in white rooms. Furthermore, anger, depression and dysphoria were other emotions associated with the white rooms (Kwallek et al., 1997). Park (2007), analyzed color preference of children between the ages of 7 to 11 in healthcare settings and the results indicated that white was the least preferred color and was associated with negative emotions. The difference between the effect of white in this study and in the study done by Park maybe the age difference between the two studies and the developmental transition in emotional associations towards the color white that occurs during the preschool (ages between 3 and 5) and

elementary school years (ages of 7 to 11). In reference to the studies mentioned above, the finding of this study regarding the color white is in contrast with those mentioned in the literature. However, the findings regarding the classroom with high saturated grey as wall colors is in consistency with the literature (Dijkstra, Pieterse & Pruyn, 2008; Kaya & Crosby, 2006).

In the case of the most and least preferred classrooms in the achromatic color schemes, the results indicated that white was the most preferred classroom whilst high saturated grey was the least preferred classroom. The discussion made in the most and least preferred classrooms in chromatic color schemes, applies to this part as well. In that sense, congruent with the literature, white that was selected as the most preferred classroom was associated with happiness whereas high saturated grey that was selected as the least preferred classroom was associated with anger, a negative emotion (Pope, Butler & Qualter, 2012; Terwogt & Hoeksma, 1995).

Overall, as both the literature and findings of this study suggest, it is important to choose indoor colors in spaces for children with care and consideration. In order to maximize the development level, performance, happiness and hopefulness in children while reducing stress, anxiety, boredom and withdrawal best colors should be chosen. In that sense, this study has tried to fill the gap that exists in the literature by focusing on children, learning environments, interior space and emotions.

Chapter 4

Conclusion

The impact of high and low saturated colors, chosen from achromatic and chromatic color schemes, on emotions of children were explored with a concentration on the interior spaces. Additionally, preference was also looked at in this study in order to explore the correlations between preference and emotional responses.

As the literature suggests, color is a salient element in a child's life (Boyatzis & Varghese, 1994). Colors that surround the child convey different psychological messages and emotional reactions. In that sense, both color and emotions are central concepts in a child's life that are experienced either consciously or unconsciously. Moreover, due to the physiological and psychological responses that color causes, it can affect the quality of life, by giving it either a negative or positive attribute. Furthermore, color is one of the features of the physical environment that can be changed easily, as a result, by applying proper approaches in using color in the interior space, better environments that enhance wellbeing and reduce stress would be created. The

preschools have a great impact on an individual's development and accomplishments. Moreover, the quality of social and physical environment in preschools influences the development level of the child during the education process (Şahin & Dostoğlu, 2012). However, there are limited studies that explore the effect of physical elements such as color on children's emotions in preschool interior spaces. Most of the studies concerning children and emotions are inconsiderate of the interior space (Meerum Terwogt & Hoeksma, 1995; Boyatzis & Varghese, 1994; Zener, 2001) with only a few exceptions (Park, 2007; Umamaheshwari, Asokan & Kumaran, 2013). In addition, the last two mentioned studies are done in healthcare settings. Therefore, the general structure and the statistical results of this thesis have tried to fill the gap in the literature about the effects of color on children's emotion in interior spaces.

The literature suggest that saturation is the most important color attribute in evoking emotional responses and that at a constant hue, high saturated colors are preferred over low saturated ones. The statistical analysis done on classrooms with high and low saturated red as wall colors were in contrast with the literature. High saturated red was associated with anger and it was the least preferred classroom whereas the classroom with low saturated red as the wall color was associated with happiness. Therefore, it can be concluded that in the case of red, saturation works in the opposite way as what has been suggested in the literature. However, the importance of saturation is apparent in the color blue, as the literature suggests, high saturated blue was associated with happiness and it was selected as the most preferred classroom whereas the classroom with low

saturated blue did not evoke an emotion in children. Therefore, it can be concluded that the effect of saturation varies in different hues.

In the case of achromatic colors, high and low saturated grey and white were selected. Colors of grey and white are critical choices, because they are pervasive colors for most building types such as healthcare settings, offices and educational settings. A study done on 126 preschools in America demonstrated that 86 preschools (68 %) had used white as the wall color and 24 had used grey (19%) (Read, 1996). Due to the contrast between the effect of white in this study and the ones discussed in the literature no certain conclusion can be derived regarding the usage of white in preschool interior spaces. It can be only mentioned that this color should be applied carefully due to the many negative impacts that it can elicit in later years. Moreover, due to the association between high saturated grey and anger and the literature that supports the negative impacts of this color, it can be concluded that usage of dark colors for spaces that occupy children should be minimal.

It should be mentioned that the results obtained from this study are not definite and prescriptive because a variety of confounding factors can influence the effects of colors on emotions. However, it is hoped that this study would help design professionals understand color better. In that sense, an important finding of this study that can be put in effective use is the relationship between preference and emotional responses. Using preferred colors in the interior space would evoke positive emotions whereas using the colors that are not preferred would lead to negative emotional responses. Therefore, by

considering children's color preferences and applying them to interior spaces healthy environments that enhance growth and wellbeing may be created.

Future investigations, can take place using various ages, races and regions over a specific time frame. Additionally, a cross-cultural study with a larger sample may provide valuable information to determine cultural effects. In addition, interdisciplinary approaches such as color science to control the quality of a color or psychophysiology to measure heart rate, pulse, respiratory responses and etc. would provide more rigorous guidelines for architects, interior architects and environmental psychologists.

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Appendices



Appendix A

(Achromatic colors questionnaire in English)



This study is designed to gather data for a master thesis entitled “The effect of color on children’s emotion in preschools” prepared at Bilkent University, Department of Interior Architecture and Environmental Design. Please take a few minutes to supervise your child in order to answer the following questions.

The questionnaire is made up of four parts, in the first part please answer questions regarding age, gender and nationality of your child. In the second part please ask your child to look at each classroom and match it with one of the four schematic faces, expressive of happiness, sadness, anger and neutral. In the third part, please ask your child to match each individual color with one of the schematic faces. In the final part, please ask your child to choose the most preferred and the least preferred classroom among others.

Please take your time to support your child in order to answer the following questions. There are no time limits. Please answer the questions after sunset under artificial lighting a minimum of 300 Lux.

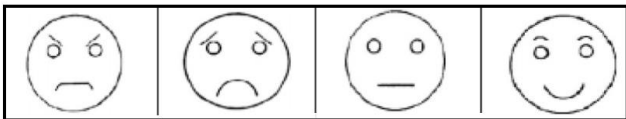
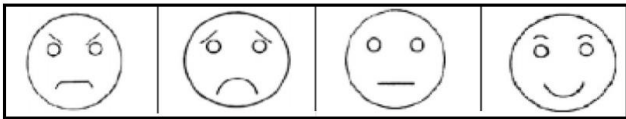
Responses to these questions will provide valuable scientific data to peruse this experiment, and it would be appreciated if you could return this questionnaire in a two days’ time.

Thank you for your participation in this study.

Part 1: Personal information

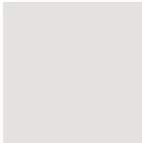

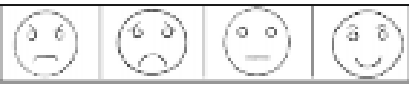
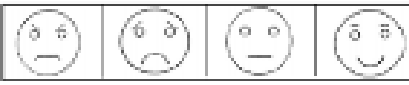
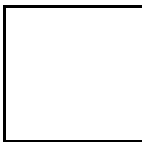

1	Gender	Male	Female
2	Age		
3	Nationality		

Part 2: Please ask your child to match each classroom with one of the schematic faces representing happiness, sadness, anger and neutral.





Part 3: Please ask your child to match each individual color with one of the schematic faces representing happiness, sadness, anger and neutral.

Part 4: Please ask your child to choose the most preferred and the least preferred classroom among the others.



1



2



3

1. What is the most preferred classroom among others?

Classroom number: 1 2 3

2. What is the least preferred classroom among others?

Classroom number: 1 2 3

Appendix B

(Chromatic colors questionnaire in English)



This study is designed to gather data for a master thesis entitled “The effect of color on children’s emotion in preschools” prepared at Bilkent University, Department of Interior Architecture and Environmental Design. Please take a few minutes to supervise your child in order to answer the following questions.

The questionnaire is made up of four parts, in the first part please answer questions regarding age, gender and nationality of your child. In the second part please ask your child to look at each classroom and match it with one of the four schematic faces, expressive of happiness, sadness, anger and neutral. In the third part, please ask your child to match each individual color with one of the schematic faces. In the final part, please ask your child to choose the most preferred and the least preferred classroom among others.

Please take your time to support your child in order to answer the following questions. There are no time limits. Please answer the questions after sunset under artificial lighting a minimum of 300 Lux.

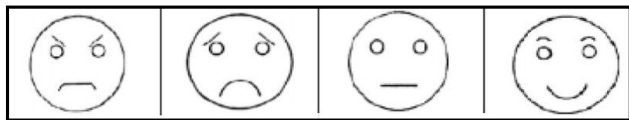
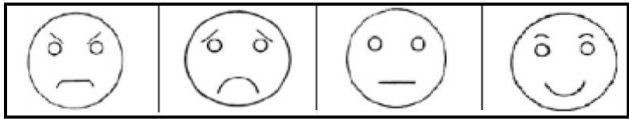
Responses to these questions will provide valuable scientific data to peruse this experiment, and it would be appreciated if you could return this questionnaire in a two days’ time.

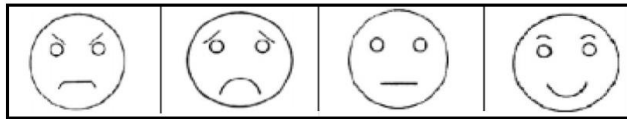
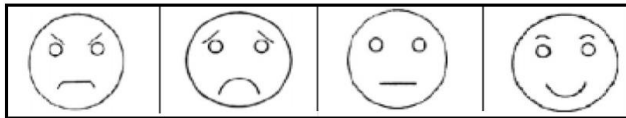
Thank you for your participation in this study.

Part 1: Personal information


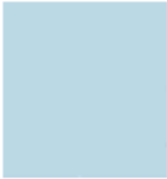


















1	Gender	Male	Female
2	Age		
3	Nationality		

Part 2: Please ask your child to match each classroom with one of the schematic faces representing happiness, sadness, anger and neutral.





Part 3: Please ask your child to match each individual color with one of the schematic faces representing happiness, sadness, anger and neutral.

Part 4: Please ask your child to choose the most preferred and the least preferred classroom among the others.



1



2



3



4

1. What is the most preferred classroom among others?

Classroom number: 1 2 3 4

2. What is the least preferred classroom among others?

Classroom number: 1 2 3 4

Appendix C

(Achromatic colors questionnaire in Turkish)



Bu anket Bilkent Üniversitesi İç Mimarlık ve Çevre Tasarımı Bölümü bünyesindeki ‘Anaokullarında rengin çocukların hisleri üzerindeki etkisi’ konulu bir yüksek lisans tezine veri toplamak amacı ile hazırlanmıştır. Lütfen birkaç dakikanızı ayırarak çocuğunuzun aşağıdaki soruları yanıtlamasına yardımcı olunuz.

Anketimiz dört bölümden oluşmaktadır. Birinci bölümde çocuğunuzun yaşı, cinsiyeti ve uyruğuyla ilgili sorular bulunmaktadır. İkinci bölümde çocuğunuzun farklı duyguları ifade eden dört şematik yüzle fotoğrafları; üçüncü bölümde renkleri eşleştirmesi beklenmektedir. Son bölümde ise, gösterilen fotoğraflar arasında en çok ve en az tercih ettiği sınıfı seçmeleri istenmektedir.

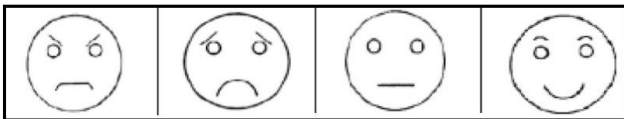
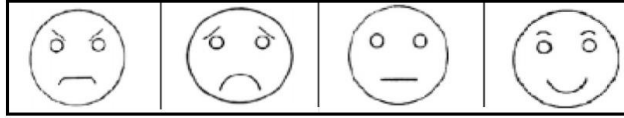
Verdiğiniz yanıtlardan bilimsel veriler elde edileceğinden anketi iki gün içerisinde tamamlayıp bizlere geri vermeniz bizim için önem taşımaktadır.

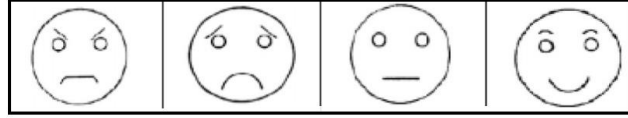
Bu çalışmaya katkılarınızdan dolayı çok teşekkür ederiz.

Bölüm 1: Kişisel Bilgiler

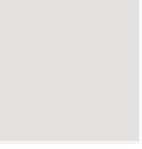



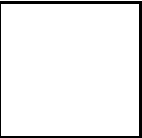

1	Cinsiyet	Erkek	Kız
2	Yaş		
3	Uyruk		

Bölüm 2: Lütfen çocuğunuzdan mutluluk, hüznün, öfke, yansızlık hislerini ifade eden dört şematik yüzle verilen fotoğrafları eşleştirmesini isteyiniz. Her fotoğrafı sadece tek bir şematik yüzle eşleyiniz.





Bölüm 3: Lütfen çocuğunuzdan mutluluk, hüznün, öfke, yansızlık hislerini ifade eden dört şematik yüzle verilen renkleri eşleştirmesini isteyiniz. Her rengin sadece tek bir şematik yüzle eşleyiniz.

Bölm 4: Lütfen çocuđunuzdan gösterilen fotođraflar arasında en çok ve en az tercih ettiđi sınıfı seçmelerini isteyiniz.



1



2



3

1. Çocuđunuzun bir ana sınıfı için en çok tercih ettiđi renk hangisidir?

Sınıf numarası: 1 2 3

2. Çocuđunuzun bir ana sınıfı için en az tercih ettiđi renk hangisidir?

Sınıf numarası: 1 2 3

Appendix D

(Chromatic colors questionnaire in Turkish)



Bu anket Bilkent Üniversitesi İç Mimarlık ve Çevre Tasarımı Bölümü bünyesindeki ‘Anaokullarında rengin çocukların hisleri üzerindeki etkisi’ konulu bir yüksek lisans tezine veri toplamak amacı ile hazırlanmıştır. Lütfen birkaç dakikanızı ayırarak çocuğunuzun aşağıdaki soruları yanıtlamasına yardımcı olunuz.

Anketimiz dört bölümden oluşmaktadır. Birinci bölümde çocuğunuzun yaşı, cinsiyeti ve uyruğuyla ilgili sorular bulunmaktadır. İkinci bölümde çocuğunuzun farklı duyguları ifade eden dört şematik yüzle fotoğrafları; üçüncü bölümde renkleri eşleştirmesi beklenmektedir. Son bölümde ise, gösterilen fotoğraflar arasında en çok ve en az tercih ettiği sınıfı seçmeleri istenmektedir.

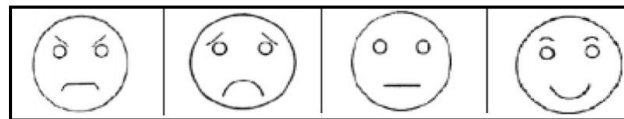
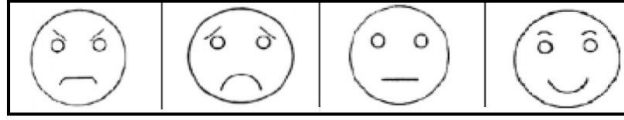
Verdiğiniz yanıtlardan bilimsel veriler elde edileceğinden anketi iki gün içerisinde tamamlayıp bizlere geri vermeniz bizim için önem taşımaktadır.

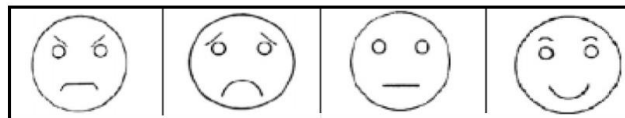
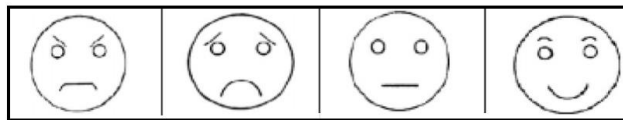
Bu çalışmaya katkılarınızdan dolayı çok teşekkür ederiz.

Bölüm 1: Kişisel Bilgiler

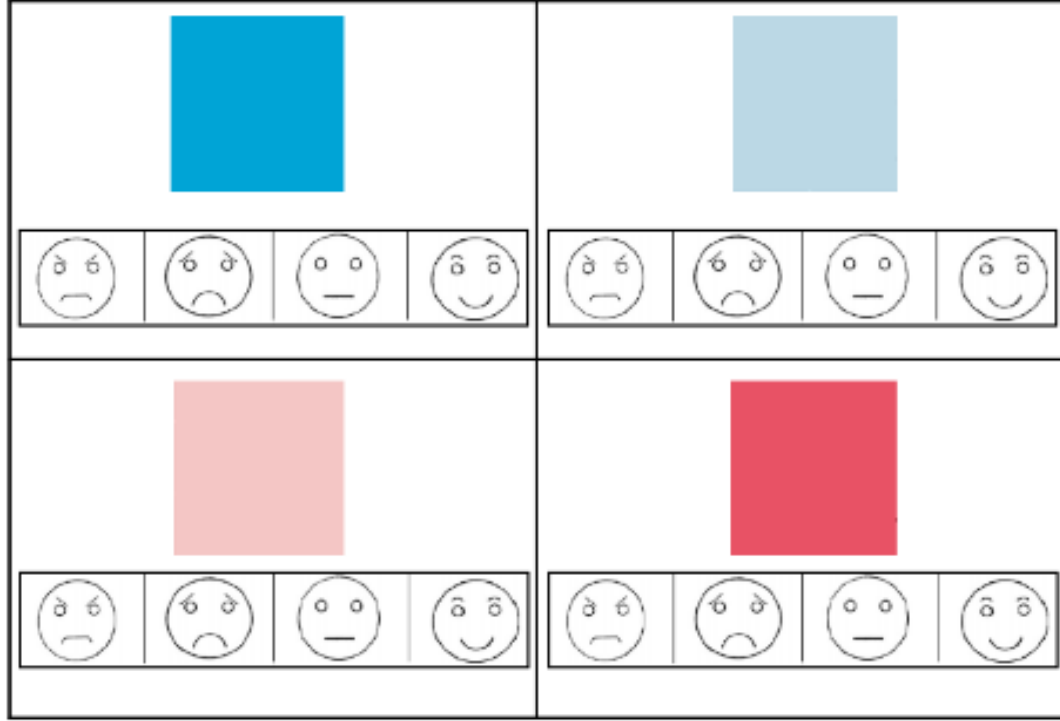
1	Cinsiyet	Erkek	Kız
2	Yaş		
3	Uyruk		

Bölüm 2: Lütfen çocuğunuzdan mutluluk, hüznün, öfke, yansızlık hislerini ifade eden dört şematik yüzle verilen fotoğrafları eşleştirmesini isteyiniz. Her fotoğrafı sadece tek bir şematik yüzle eşleyiniz.





Bölüm 3: Lütfen çocuğunuzdan mutluluk, hüznün, öfke, yansızlık hislerini ifade eden dört şematik yüzle verilen renkleri eşleştirmesini isteyiniz. Her rengin sadece tek bir şematik yüzle eşleyiniz.



Bölm 4: Lütfen çocuđunuzdan gösterilen fotođraflar arasında en çok ve en az tercih ettiđi sınıfı seçmelerini isteyiniz.



1



2



3



4

1. Çocuđunuzun bir ana sınıfı için en çok tercih ettiđi renk hangisidir?

Sınıf numarası: 1 2 3

2. Çocuđunuzun bir ana sınıfı için en az tercih ettiđi renk hangisidir?

Sınıf numarası: 1 2 3

Appendix E

(Statistics)



Table E.1. Frequencies of the effect of gender on emotional responses across chromatic colors

		Male	Female	Total
High saturated blue	Anger	3	1	4
	Sadness	1	4	5
	Neutral	0	1	1
	Happiness	16	14	30
Total	Count	20	20	40
Low saturated red	Anger	6 60%	4	10
	Sadness	3	5	8
	Neutral	0	2	2
	Happiness	11	9	20
Total	Count	20	20	40
High saturated red	Anger	9	7	16
	Sadness	4	1	5
	Neutral	2	3	5
	Happiness	5	9	14
Total	Count	20	20	40
High saturated red	Anger	3	4	7
	Sadness	5	9	14
	Neutral	5	5	10
	Happiness	7	2	9
Total	Count	20	20	40

Table E.2. Findings of the Chi-Square test on gender and emotional responses

	Value	Df	Asymp. Sig
High saturated blue	3.933	3	0.269
Low saturated red	3.100	3	0.376
High saturated red	3.393	3	0.335
Low saturated blue	4.063	3	0.255

Table E.3. Frequency of distribution of emotions across chromatic colors

		Observed N	Expected N	Residual
High saturated blue	Anger	4	10.0	-6.9
	Sadness	5	10.0	-5.0
	Neutral	1	10.0	-9.0
	Happy	30	10.0	20.0
High saturated red	Anger	16	10.0	6.0
	Sadness	5	10.0	-5.0
	Neutral	5	10.0	-5.0
	Happy	14	10.0	4.0
Low saturated blue	Anger	7	10.0	-3.0
	Sadness	14	10.0	4.0
	Neutral	10	10.0	.0
	Happy	9	10.0	-1.0
Low saturated red	Anger	10	10.0	0.0
	Sadness	8	10.0	-2.0
	Neutral	2	10.0	-8.0
	Happy	20	10.0	10.0

Table E.4. Findings of the effect of color on emotional responses

Test Statistics				
	High saturated blue	Low saturated red	High saturated red	Low saturated blue
Chi-Square	54.200 ^a	16.800 ^a	10.200 ^a	2.600 ^a
df	3	3	3	3
Asymp. Sig.	.000	.001	.017	.457
Exact Sig.	.000	.001	.017	.495
Point Probability	.000	.000	.001	.080

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.0.

Table E.5. Frequency of distribution of the most preferred classroom

	Observed N	Expected N	Residual
Low saturated blue	2	10.0	-8.0
High saturated red	5	10.0	-5.0
Low saturated red	4	10.0	-6.0
High saturated blue	29	10.0	19.0
Total	40		

Table E.5. Frequency of distribution of the least preferred classroom

	Observed N	Expected N	Residual
Low saturated blue	11	10.0	1.0
High saturated red	17	10.0	7.0
Low saturated red	9	10.0	-1.0
High saturated blue	3	10.0	-7.0
Total	40		

Table E.6. Findings of the most and least preferred classrooms

	Most preferred	Least Preferred
Chi-Square	48.600 ^a	10.000 ^a
df	3	3
Asymp. Sig.	.000	.019
Exact Sig. Point Probability	.000	.017

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.0.

Table E.7. Findings of the Wilcoxon Test in chromatic color schemes

	Minimum	Maximum	Percentiles			Friedman test	
			25 th	50 th Median	75 th	N	40
High saturated blue	1	4	3.25	4.00	4.00	Chi-square	21.670
Low saturated red	1	4	1.25	3.00	4.00		
High saturated red	1	4	1.00	1.00	4.00		
Low saturated blue	1	4	2.00	2.00	3.00	df.	3
Isolated low saturated blue	1	4	2.00	3.00	4.00		
Isolated high saturated red	1	4	2.00	4.00	4.00	Asymp. Sig	0.003
Isolated low saturated red	1	4	2.00	4.00	4.00		
Isolated high saturated blue	1	4	1.00	3.00	4.00		

1=anger 2=sad 3=neutral 4=happy

Table E.8. Findings of the Friedman Repeated Measures Analysis of Variance on Ranks in chromatic color schemes

COMPARISONS	Z	Asymp. Sig
Low saturated red vs. high saturated blue	-2.085	0.37
High saturated red vs. high saturated blue	-3.191	0.001
Low saturated blue vs. high saturated blue	-3.376	0.001
Isolated high saturated blue vs. high saturated blue	-2.671	0.08
High saturated red vs. low saturated red	-1.353	0.176
Low saturated red vs. low saturated blue	-0.988	0.323
Isolated low saturated red vs. low saturated red	-1.141	0.254
Low saturated blue vs. high saturated red	-0.132	0.895
Isolated high saturated red vs. high saturated red	-1.877	0.060
Isolated low saturated blue vs. low saturated blue	-1.745	0.081

Table E.9. Frequencies of the effect of gender on emotional responses across achromatic colors

		Male	Female	Total
High saturated grey	Anger	14	10	24
	Sadness	3	7	10
	Neutral	3	3	6
	Happiness	16	14	30
Total	Count	20	20	40
Low saturated grey	Anger	5	3	8
	Sadness	9	6	15
	Neutral	2	6	8
	Happiness	4	5	9
Total	Count	20	20	40
White	Anger	0	0	0
	Sadness	0	2	2
	Neutral	9	1	10
	Happiness	11	17	28
Total	Count	20	20	40

Table E.10. Findings of the Chi-Square test on gender and emotional responses

	Value	Df	Asymp. Sig
High saturated grey	2.267	2	0.269
Low saturated grey	3.211	3	0.360
White	9.686	2	0.008

Table E.11. Frequency of distribution of emotions across chromatic colors

		Observed N	Expected N	Residual
High saturated grey	Anger	24	10.0	14.0
	Sadness	10	10.0	0.0
	Neutral	6	10.0	-4.0
	Happy	0	10.0	-10.0
Low saturated grey	Anger	8	10.0	-2.0
	Sadness	15	10.0	5.0
	Neutral	8	10.0	-2.0
	Happy	9	10.0	-1.0
White	Anger	0	10.0	-10.0
	Sadness	2	10.0	-8.0
	Neutral	10	10.0	0.0
	Happy	28	10.0	18.0

Table E.12. Findings of the effect of color on emotional responses in achromatic colors

Test Statistics			
	High saturated grey	Low saturated grey	White
Chi-Square	13.400 ^a	3.400 ^b	26.600 ^a
df	2	3	2
Asymp. Sig.	.001	.334	.000
Exact Sig.	.001	.362	.000
Point Probability	.000	.036	.000

a. 0 cells (0.0%) have expected frequencies less than 5.
The minimum expected cell frequency is 13.3.

b. 0 cells (0.0%) have expected frequencies less than 5.
The minimum expected cell frequency is 10.0.

Table E.13. Frequency of distribution of the most preferred classroom

	Observed N	Expected N	Residual
White	35	13.3	21.7
Low saturated grey	3	13.3	-10.3
High saturated grey	2	13.3	-11.3
Total	40		

Table E.14. Frequency of distribution of the least preferred classroom

	Observed N	Expected N	Residual
Low saturated grey	7	20.0	-13.0
High saturated grey	33	20.0	13.0
Total	40		

Table E.15. Findings of the most and least preferred classrooms

Test Statistics

	Most preferred	Least Preferred
Chi-Square	52.850 ^a	16.900 ^b
df	2	1
Asymp. Sig.	.000	.000
Exact Sig.	.000	.000
Point Probability	.000	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 13.3.

b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

Table E.16. Findings of the Wilcoxon Test in chromatic color schemes

		Minimum	Maximum	Percentiles			Friedman test		
				25 th	50 th Median	75 th	M	N	20
High saturated grey	Male	1	3	1.00	1.00	2.00	M	Chi-square	43.139
	Female	1	3	1.00	1.00	2.00		Asym. Sig	0.000
Low saturated grey	Male	1	4	1.25	2.00	3.00	F	N	20
	Female	1	4	2.00	3.00	3.75		Chi-square	55.669
White	Male	3	4	3.00	4.00	4.00		Asym. Sig	0.000
	Female	2	4	4.00	4.00	4.00			

1=anger 2=sad 3=neutral 4=happy

Table E.17. Findings of the Friedman Repeated Measures Analysis of Variance on Ranks in chromatic color schemes

COMPARISONS	Z		Asymp. Sig
Low saturated grey vs. High saturated grey	Male	-2.555	0.111
	Female	-2.609	0.0324
White vs. High saturated grey	Male	-3.994	0.000
	Female	-3.974	0.000
Isolated high saturated grey vs. High saturated grey	Male	-2.693	0.042
	Female	-1.508	0.132
White vs. Low saturated grey	Male	-3.342	0.001
	Female	-3.100	0.002
Isolated low saturated grey vs. Low saturated grey	Male	-2.745	0.056
	Female	-1.833	0.067
Isolated white vs. White	Male	-2.610	0.054
	Female	-1.141	0.888