INFLUENCE OF COLOR-TEXTURE ASSOCIATIONS ON PREFERENCE

A Master's Thesis

by

ELA FASLLIJA

Department of

Interior Architecture and Environmental Design

İhsan Doğramacı Bilkent University

Ankara

July, 2017

Ngjyrave që s'reshtin kurrë së na mbushuri me shpresë

INFLUENCE OF COLOR-TEXTURE ASSOCIATIONS
ON PREFERENCE

The Graduate School of Economics and Social Sciences

of

İhsan Doğramacı Bilkent University

by

ELA FASLLIJA

In Partial Fulfillment of the Requirements for the Degree of

MASTER OF FINE ARTS

Department of

Interior Architecture and Environmental Design

İhsan Doğramacı Bilkent University

Ankara

July, 2017

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.

N. Olguntürk

Assoc. Prof. Dr. Nilgün Olguntürk

Supervisor

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

Asst. Prof. Dr. Çağrı İmamoğlu

Examining Committee Member

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.

Asst. Prof. Dr. Begüm Ulusoy

Examining Committee Member

Approval of the Graduate School of Economics and Social Sciences

Halime

Prof. Dr. Halime Demirkan

Director

ABSTRACT

INFLUENCE OF COLOR-TEXTURE ASSOCIATIONS ON PREFERENCE

Fasllija, Ela

M.F.A Department of Interior Architecture and Environmental Design

Supervisor: Assoc. Prof. Dr. Nilgün Olguntürk

July 2017

This study analyzes the possible existence of a relationship between color and texture in terms of preference. One hundred design-trained and 96 non-design trained respondents underwent an experiment carried out in a virtual and abstract environment. 12 color-texture mapped squares, (4 colors x 3 textures) were placed in a neutral grey colored background and shown to the respondents. They responded the question about their most preferred color-association. As a second part of the experiment, they answered also about their most preferred texture strength of the previously selected square. Results of the study deny the existence of a dependency between color and texture. Moreover, blue was the overall most preferred color in any context. Fine textures were preferred more compared to coarse ones. In addition, small changes were observed in terms of preference between the design trained and non-design trained respondents. However, gender was not a prominent factor affecting preferences in this study.

Keywords: Color, Color-Texture Associations, Preference, Texture

ÖZET

RENK-DOKU İLİŞKİLERİNİN TERCİHLER ÜZERİNDEKİ ETKİSİ

Fasllija, Ela

İç Mimarlık ve Çevre Tasarımı Yüksek Lisans Programı

Danışman: Doç. Dr. Nilgün Olguntürk

Temmuz 2017

Bu tez, renk ve doku tercihleri açısından bağımlılık mevcudiyetini incelemiştir. 100 tasarımla ilişkili, 96 tasarım eğitimi olmayan katılımcı sanal ve soyutlanmış ortamda gerçekleştirilen deneye tabi tutulmuştur. 12 adet eşlenmiş renk-doku kareleri (4 renk x 3 doku), nötr gri renkli arka plana yerleştirilmiş ve katılımcılara gösterilmiştir. Katılımcılar, en çok tercih ettikleri renk-doku ilişkileriyle alakalı soruları cevaplamışlardır. Deneyin ikinci aşaması olarak, seçtikleri dokunun en çok tercih ettikleri biçim düzeniyle alakalı soruları da yanıtlamışlardır. Çalışmanın sonuçları renk ve doku arasındaki bağımlılık mevcudiyetini reddetmiştir. Bununla birlikte, mavi tüm durumlarda en çok tercih edilen renk olmuştur. İnce dokular, kalın olanlara kıyasla daha çok tercih edilmiştir. Ayrıca, tercihler açısından tasarımla ilişkili ve ilişkili olmayan katılımcılar arasında küçük değişiklikler gözlenmiştir. Ancak cinsiyet, bu çalışmada tercihleri etkilemede öne çıkan bir faktör olmamıştır.

Anahtar kelimeler: Desen, Renk, Renk-Doku Ilişkileri, Tercih

ACKNOWLEDGMENTS

Firstly, I would like to express my gratitude to my advisor Assoc. Prof. Dr. Nilgün Olguntürk for her valuable support and encouragement throughout the study. Her academic and intellectual guidance through these two years were a crucial part for the fulfillment of this study. At the same time, I would like to thank instructor Dilek Güvenç for her guidance during the conduction of statistical analysis of the study.

Secondly, I would like to thank the members of the examining committee, Asst. Prof. Dr. Çağrı İmamoğlu and Asst. Prof. Dr. Begüm Ulusoy for their valuable evaluations, comments and recommendations during the defense of the thesis.

Moreover, I am thankful to my friends and officemates who were my companions during this process. I am indebted to Dilay Seda Ozgen for helping me find the necessary materials in order to conduct this study. A special thanks goes to my friends Ali Ranjbar and Elif Aksel for their support during the last phases of the thesis.

I am eternally grateful to my parents Astrit and Liljana Fasllija who always gave me the necessary support and encouragement needed to pursue my dreams. Thank you for always believing in me!

Moreover, this thesis wouldn't have been possible without the guidance my sister Edona Fasllija always gave me throughout the important steps of my educational life. I would also like to thank my niece Earta Xhelilaj for always reminding me the beauty and colorfulness of life.

Last but not least, I want to express my fond gratitude to my fiancé Besmir Kamberi for his persistent support, patience and trust through this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Preferences of individuals are related to different sensorial aspects such as visual, tactile, auditory and olfactory. To prefer means to like the most. Visual aesthetics has been considered as the primary factor affecting preference (Yi & Choi, 2008). People show specific preferences towards different aspects of their surroundings; some prefer some colors to other, or some specific shapes, patterns or textures rather than others (Chen, Tanaka, Matsuyoshi & Watanabe, 2015). At the same time responses to color preferences can be influenced by age, gender and background (Manav, 2006).

As one of the most appealing visual elements, color plays a crucial role on preference. Color, by behaving as an emotional messenger, can convey affective qualities of itself or of the environment/product (D'Andrade & Egan, 1974; Clarke & Costall, 2008). That's why it is one of the most popular experimental variables used in different researches related to design and psychology.

In our surroundings color is rarely seen as an isolated element. More specifically, in interior spaces color has a major impact on the quality of space, but apart from it, most of the materials used to create these spaces, have their own specific textures. ‘‘Non-uniformity of objects colors (texture) and their environment seems to be the rule rather than the exception’’ (Lucassen, Gevers & Gijsenij, 2010).

Color and texture are complementary of each other in design fields. Especially in textile industry color and texture relationships have been widely studied. Color affects the quality of the fabric (Luo, Tsang, Shen, Shao & Xin, 2014) but also this color is influenced by the texture of the fabric (Xin, Shen & Chuen, 2005; Kandi, Tehran & Rahmati, 2008). Texture can perceptually and instrumentally affect the color of the fabric (Kandi et al., 2008).

Luo et al. (2014) divides studies related to the effect of texture on color of the fabric in three categories as below: the influence of texture on color difference, the influence of texture on color attributes and the relationship between texture descriptors and colors. This study pertains to the last group tending to find any relationship between color and texture in terms of preference.

Psychological responses to color are an important matter of studies related to environmental design. The oldest study related to color-texture relationship conducted by Tinker (1938) states that the differences in surface texture, have little effect upon apparent warmth and affective value of colors. A more recent study indicate that surface texture can change the emotional responses to textile samples, depending on color (Enhart & Irtel, 2006). Also, addition of texture has a significant impact on the perceived unpleasantness of colors (Simmons & Russells, 2008).

The effect of texture on the visual color is more dependent on the type of the structure than the coarseness of the structure (Kandi et al., 2008).

Moreover, the advances in electronic technologies can provide realistic visualization of the desired color information by using scanned images or Cathode Ray Tube (CRT). Cathode Ray Tube is a high vacuum tube which is created by emitting electrons in order to produce a luminous image in a fluorescent screen. These methods have been widely used in the textile industry because they reduce the production process time (Xin et al., 2005). Additionally, Suk & Irtel (2010) found that media type (physical vs. CRT) has no effect on emotional responses to color. These studies supported the methodology used in the current study which is carried on in a Virtual Environment (VE).

1.1 Aim of the study

This study aims to find a relationship between two main design basics, color and texture, in terms of preference. It is also of interest to understand if there exist differences between the two samples groups having different backgrounds in terms of design training, in their preference choices. The gap in knowledge consisted of not having enough sources related to the association of these two variables in terms of preference. The majority of the studies analyzed the effect of texture on color difference or color attributes but none of them explored the existence of a relationship between them. This study is concerned not only about the texture type – color association but also about the texture strength (Coarseness level) - color one.

This research is made possible by using four primary colors obtained from the Natural Color System and three most popular textures used in the textile industry. By having an abstract context, this study can be of use to professionals in many fields such as textile industry, architecture, interior, product and graphic design. The findings of this research can help them use the most preferred color-texture mappings in their designs.

1.2 Thesis structure

This thesis is composed of six chapters. The first chapter explains the context in which this study takes place. It briefly explains previous works concerned about the effect of texture on both instrumental and perceptional color. It also talks about the color-texture relationship works in terms of the methodologies used. Additionally, 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 and color preferences. The first part of this chapter consists of definition of color, its attributes and the color order systems. Moreover, it mentions about human response to color and more specifically about color preferences. Being an important part of the current dissertation, previous studies on color preference are described in terms of age, gender, culture, context and design related background. Additionally, the last part of this chapter consists of cross preferences for different domains.

The third chapter is more concerned about the second variable of the study, texture. It goes through its definition and main characteristics. Afterwards, studies related to the effect of texture on color difference, color attributes and color judgments are described.

The methodology of the study is described in the fourth section. Firstly, aim of the study, research questions and hypotheses are explained. Furthermore, the experiment, including the sample groups, experimental sets and the experimental setting is explained in detail. Then, the procedure of the experiment is shown step by step.

Afterwards, the data gathered from the experiment is statistically analyzed in the fifth chapter and the findings are examined in relation to the relevant hypotheses and research questions. It also consists of a discussion based on of the findings of the study according to the related literature.

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

CHAPTER 2

COLOR

2.1 Definition of color

Color has different specialized meanings in different scientific domains such as chemistry, physics, psychology and design (Agoston, 1987). Scientifically, color stimulus is known to be created when light from a natural or artificial object is interrupted by a dust particle (Meervein, Rodeck & Mahnke, 2007). The psychologist Hurvich (1981) states that our perception of color derives from the interaction of our visual system with light rays. Simply, color is a characteristic of light that comes to the retina of the eyeball.

On the other hand, color is studied also about its physiological aspect, mostly concerning associations of particular amounts of color stimulus to specific responses (Burhnam, 1963). These studies are usually engaged with the color responses respondents have to different colors in terms of influence, attention, preference, memory etc. Moreover, color perception is a visual attribute that is described by color names (Kuehni, 1983). At the same time, ‘‘Color is a salient element of the design of all materials and surfaces from light and paint to art’’ (Dalke, Little, Niemman, Camgöz, Steadman, Hill & Scott, 2005, p.343). Its role is as aesthetic as functional. The last definition has been embraced in this study.

2.1.1 Color attributes

Isolated perceived colors have been found to have simply three attributes: hue, saturation (chroma) and brightness (Evans, 1974) (Figure 1). Simply, hue is the pigment of the color itself and can be easily distinguished from each other (as red, blue, green, purple etc.). Four hues from almost 200 that human eye can perceive, are not perceived as mixtures and are called unitary hues (Evans, 1974). They are unitary red (R), unitary yellow (Y), unitary green (G) and unitary blue (B). All the other perceived colors are mixtures of the unique colors mentioned above. At the same time colors that possess a hue are called chromatic colors, and the ones who do not are called achromatic (Agoston, 1987). White, black and greys belong to the latter group.

Saturation or also known as chroma is another attribute of perceived color in which the relative amount of the hue component in the color is the perceptional measure (Agoston, 1987). Simply, saturation is the strength of the hue and can distinguish vivid colors from pale ones. Also saturation is denoted as the purity of a color.

The third attribute concerning color is brightness, which is defined as the illumination in which an object is viewed (Evans, 1974). Brightness, also known as lightness or value, makes the distinction of a dark color from a light one. It is also described as the amount of black that exists in a color (Melara, Marks & Potts, 1993).

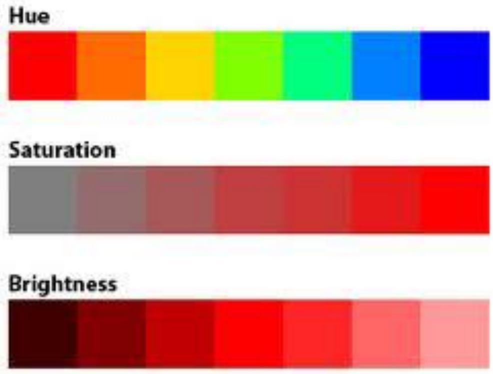


Figure 1. A visual explanation of hue, saturation and brightness (http://www.snap2objects.com/2009/03/color-theory-101/)

2.2 Color systems

Color systems are produced in order to specify and distinguish colors from each other. These systems sometimes are based on subtractive mixture, additive mixture and perceptual evaluation (Kuehni, 2000; Wyszecki, 1986). The systems most commonly used in design fields are RGB, CIELAB, Munsell, and Natural Color System. All these systems use the abovementioned attributes of color (hue, saturation, brightness) to order color in a systematic way according to their principles.

2.2.1 RGB Color system

The RGB color system is an additive mixture model and uses three primary color lights as red, green and blue. As mentioned, these are the hues that are pure and aren't obtained as a mixture of other hues. These primary colors are mixed with each other to form secondary colors yellow (red +green), cyan (blue +green) and magenta (red+ blue). As seen below in Figure 2, also these secondary colors are mixed in equal proportions within each other to form the tertiary colors such as orange, yellow-green, cyan-green, cyan- blue, blue- magenta and red magenta. The mixture of all these mentioned color lights forms white (Feisner, 2006).

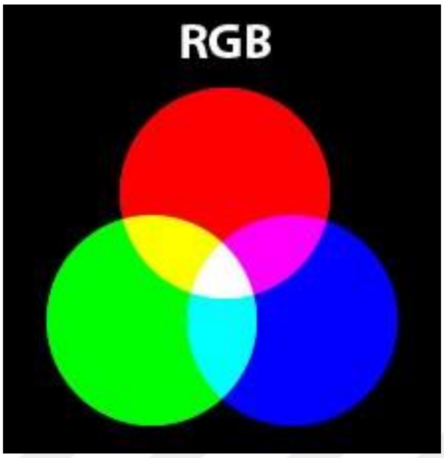


Figure 2. RGB additive color mix
(http://www.snap2objects.com/2009/03/color-theory-101/)

Hues in the RGB Color Circle are arranged from the top 0˚ (red), continuing by 30˚ clockwise for each color as seen in Figure 3.

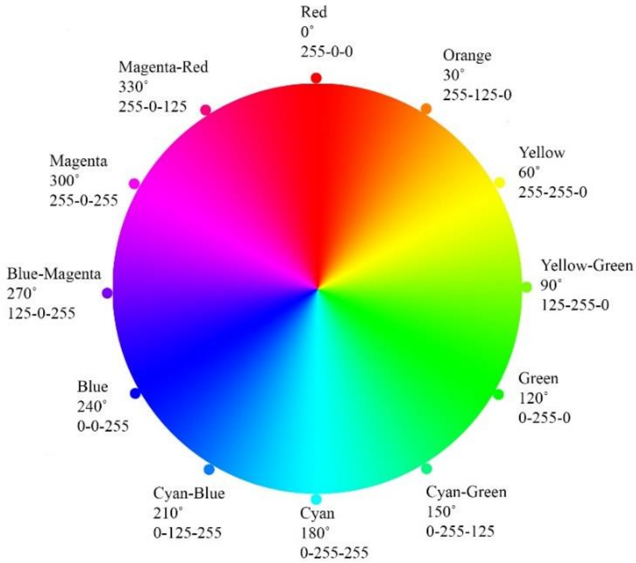


Figure 3. RGB color wheel
(http://www.colormatters.com/color-and-design/color-systems-rgb-and-c)

2.2.2 CIELAB color system

CIELAB is a recent system derived from the CIE color space and is based on spectrophotometric measurements of color samples illuminated by specific types of lighting and uses the responses of a standard observer (Ferhman & Ferhman, 2000, p.209). CIELAB uses color attributes as three dimensions (x- hue, y-saturation, and z-brightness). In this system relative amounts of primary colors (red, green, blue) are mixed to describe and indicate any color (Figure 4). It supports a uniform color system to differentiate industrial color differences in scientific studies (Agoston, 1987). Color samples of this system are described in terms of coordinates (Mahnke & Mahnke, 1987).

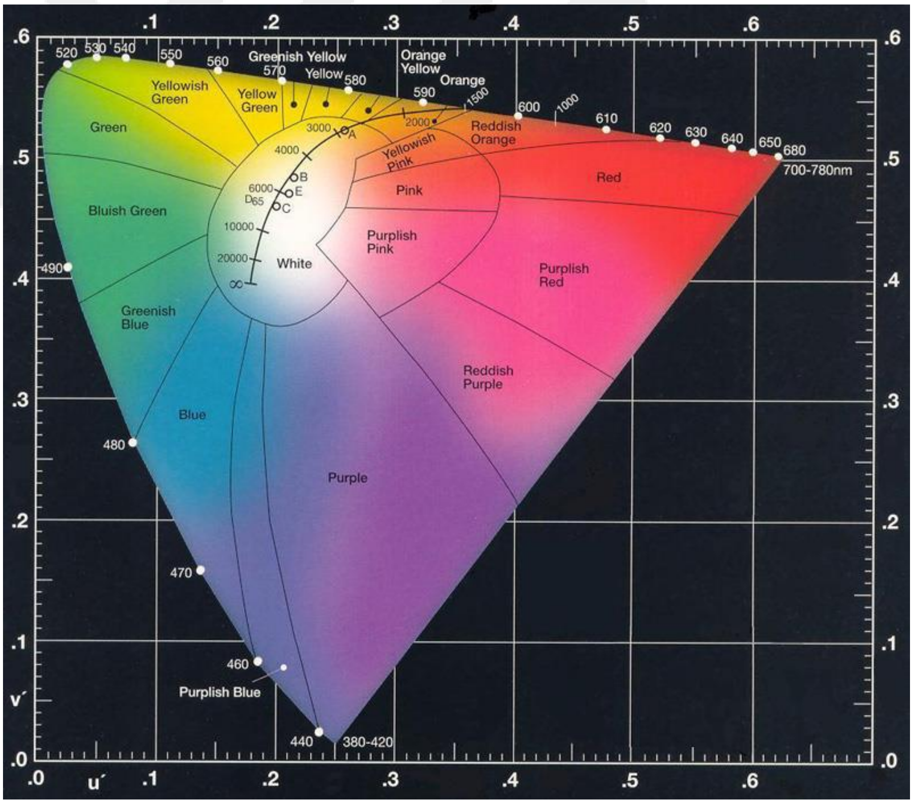


Figure 4. The CIE chromaticity diagram

(http://hyperphysics.phy-astr.gsu.edu/hbase/vision/cie1976.html#c1)

2.2.3 Munsell Color System

Munsell Color System developed by A.H. Munsell in 1905, is a widely internationally accepted system and is used in various research fields. It explains surface colors in terms of three attributes such as hue, chroma (saturation) and value (brightness) (Agoston, 1987). This system consists of five major hues such as red (R), green (G), yellow (Y), purple (P) and blue (B); five intermediate hues such as yellow-red (YR), green-yellow (GY), blue-green (BG), purple-blue (PB), and red-purple (RP) (Hunt, 1987) (Figure 5&6).

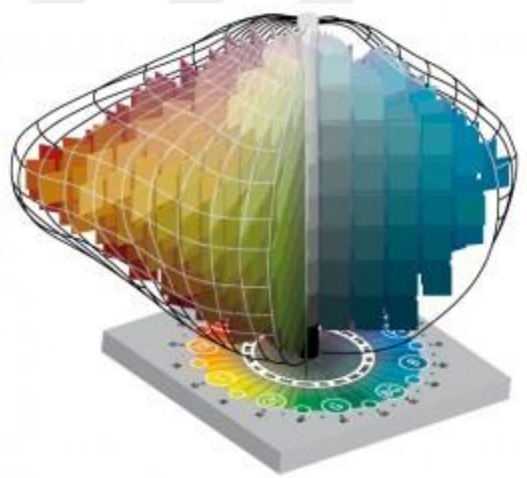


Figure 5. Munsell Color Circle

Figure 6. Munsell Color solid

(http://munsell.com/)

Each hue mentioned above is subdivided further into four sections and denoted by its initial such as: 2.5R, 5R, 7.5R, 10R (Mahnke & Mahnke, 1987). Chroma is indicated by numbers ranging from 2 (the least saturated) to 14 (the most saturated) (Beach, Wise & Wise, 1988). The Value (V) (brightness) level is described on a scale from 1 to 10 and describes the brightness of comprehended color as the luminance effect; 1 is the value of black, 10 the one of white and in between values belong to grey (Agoston, 1987).

2.2.4 Natural Color System (NCS)

NCS, produced by the Swedish physicist Tryggue Johansson enables the observers with normal vision to evaluate surface colors without color measurement instruments. It is the most used system in psychological studies related to color perception, since it does not involve having any particular color knowledge in order to use it (Agoston, 1987). This system is based on the experiences of the observers when coping with color stimuli, making it widely used by architects and designers (Kuehni & Schwarz, 2008).

This system uses the four primaries such as red, yellow, green and blue since they are not a result of any mixture of colors (Hunt, 1987). These colors are arranged in a circle with 9 subdivisions between each, obtaining in this way 40 hues in total. As seen from the Figure 7, hues obtained from the combination of the primaries are named as Yellow-Red (YR), Red-Blue (RB), Blue-Green (BG) and Green-Yellow (GY) (Figure 7). If the hue has 10% unitary yellow and 90% unitary red it is denoted as Y90R.

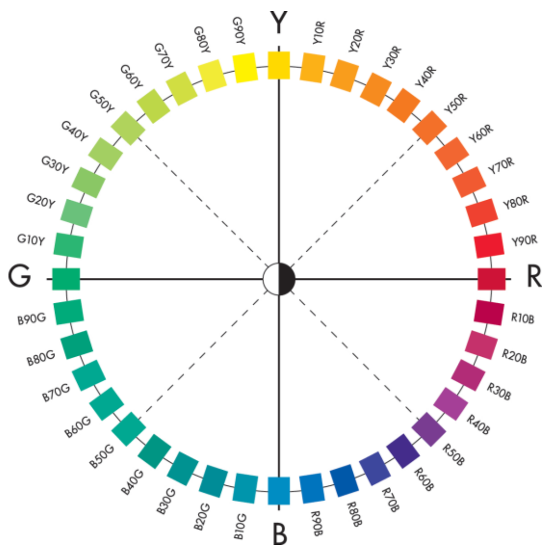


Figure 7. NCS Color circle
(http://www.ncscolour.com/en/natural-colour-system/logic-behind-the-system/)

Furthermore, each hue is explained in color triangles regarding the pure hue in relation with black and white. If the relative amounts of blackness (S) is 10% and 50% hue (C), its NCS notation is S1050-Y90R (Figure 8). The color triangles explain values of blackness, whiteness and chromaticness. In the NCS Atlas there are 1750 color samples (Swedish Standards Institution, 1996).

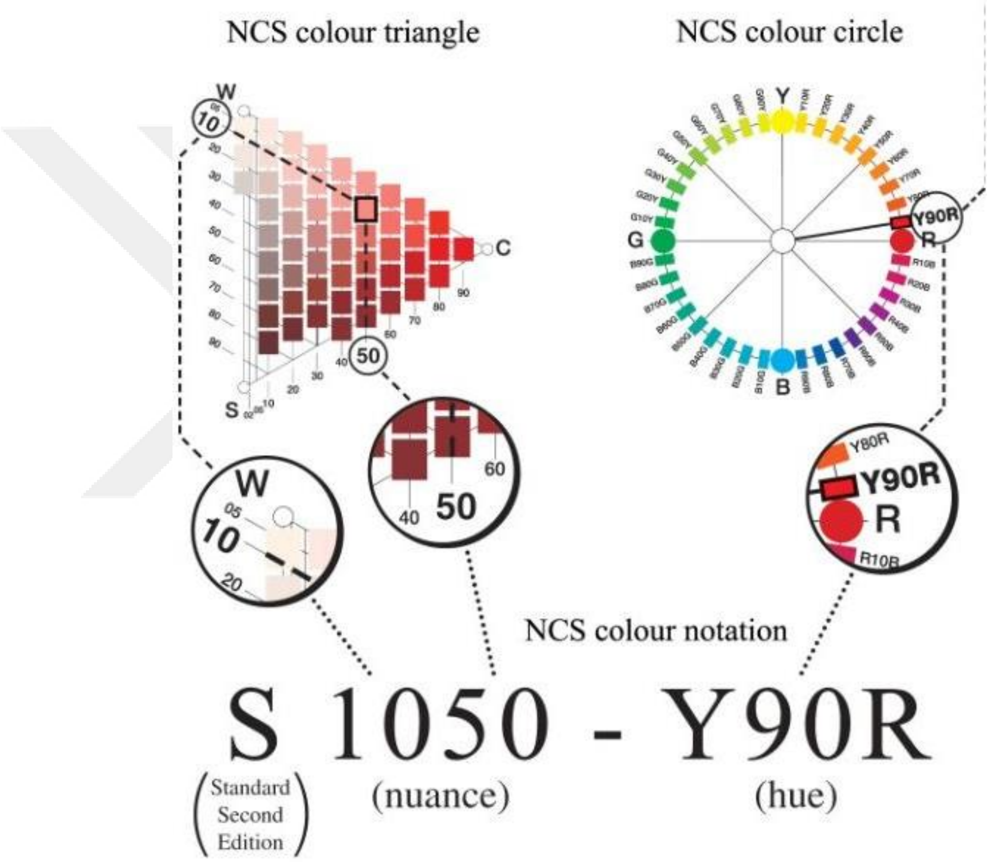


Figure 8. NCS hue triangle of Y90R

(http://thelandofcolor.com/color-theory-podcast/)

2.3 Human responses to color

While being used in design areas, color as a stimulus, has an important influence on the psychological and physiological responses of humans. Its affective impact on the viewer (user) has been of wide interest in various disciplines such as: color image, color preference, color semantics, color emotion etc. (Ou, Luo, Sun, Hu & Chen, 2011).

Psychological and physiological responses of humans happen as a result of the perception of the stimulus by the respondent. When a wavelength of light leans on an object, the surface absorbs everything apart from that one color wave reflected from it. This is the color that enters in our eyes and is absorbed by one of its cones (red, blue or green) (Morton, 1995). The nerves located in the eye transmit this information to our nervous system and consequently we give responses according to the interpretation our brain has done. Different variables such as culture, background color, lighting and context can affect people's perception about color, their responses and preferences (Chen et al., 2015).

2.3.1 Color preferences in terms of color attributes

Preferences have a salient impact on our judgements and decisions, such as which furniture to buy and which kind of clothing to wear (Palmer, Schloss & Sammartino 2013). In a big domain of things, we tend to prefer something more than the rest. Color, as an important visual element in our everyday life has been widely studied in terms of preference. Learning how visual preferences are structured gives insights into the role of visual cues which shape an individual's decisions. This is a very important point for marketing and design fields (Chen et. al., 2015).

Changes in color's attributes, (hue, saturation and brightness) influence color preferences. Studies have found that at a constant saturation and brightness short-wave length colors are preferred to long-wave length ones (Guilford, 1934; Guilford & Smith, 1959; Sivik, 1974).

More specifically, Guilford (1934) conducted a research for the affective value of 40 colors (18 hues equal in saturation and brightness, 11 hues varying in brightness and low in saturation, and 11 hues in high saturation) chosen by the Munsell Color System. The sample group consisting of 5 men and 5 women ranked the colors according to a pleasantness scale. The researcher found that when the hue is kept constant, lighter and more saturated colors are preferred more than darker and less saturated ones. In another study in collaboration with Smith, Guilford (1959) used 316 color stimuli from the same color system. Also, they increased the number of respondents to 40, 20 men and 20 women. This study contributed to literature by finding that at a constant saturation and brightness level, green-blue colors range is preferred more than yellow-reddish one.

Sivik (1974) asked a stratified sample of Swedish adults to give responses about 71 color spaces chosen from the NCS Atlas according to different semantic scales in terms of four factors: excitement, evaluation, potency and temperature. The study (Sivik, 1974) supports the assumptions that brighter and more saturated colors are preferred more, and blue was found to be the most preferred hue apart from saturation and brightness level.

A more recent study conducted by Camgöz, Yener & Güvenc (2002) resulted in the same line as the studied above. The importance of this study stands because until then colors were exposed on a neutral background and for the first time in the mentioned study, stimuli were presented on other colors, but the findings were still consistent with previous studies. Brighter and more saturated colors were preferred more and blue was the most preferred color above all. They also stated that all the three attributes of color stimulus influence color preference.

In another study, respondents experienced realistic full scale red and blue interior spaces. After physiological and affective measures were taken, it was found that saturation compared to hue and brightness, had the biggest influence on people' color perception and responses (Mikellides, 1990). This study is important because it gives some insights about human responses to colors in interior spaces.

In terms of color attributes, it can be concluded that bright, high saturated and short wavelength colors are preferred more than the other ones. Blue is the overall preferred color (Eysenck, 1941; Valdez & Mahrebian, 1994; Dittmar, 2001; Bakker et al., 2015; Sivik, 1974; Camgoz et al, 2002).

2.3.2 Color preference factors

There are some factors which may affect color preference of individuals. Color preferences are mainly influenced by age, gender, culture, context and design training (Chen et al, 2015).

2.3.2.1 Color preference by age

Different studies have found differences in color preferences of two or more sample groups differing in age. Ou et al. (2011) analyzed if individual responses in terms of color preference would change with the increase of age. The study consisted of 40 respondents, respectively 20 young and 20 old ones. They underwent an experiment by showing colors in isolation and combined, and consequently answered in terms of 4 word pairs: like-dislike, warm-cool, heavy-light and harmonious-disharmonious. Results showed that for single colors, all color samples were evaluated as less active, less liked and cooler by older respondents rather than the young ones.

Another research by Manav (2007) supported that age is a determining factor in selection of achromatic black for color preferences. In her research with 50 respondents divided in three groups according to their age ranges: 18-32 years old, 33-47 years old and 48-62 years old, it was concluded that all the respondents belonging to the last group preferred black.

Dittmar (2001) carried out a study with 842 adults aging from 19 to 90 years old. They were divided in two groups according to their age and were asked about their least and most preferred color that they had chosen by name out of four given colors (blue, green, red, yellow). He concluded that color preference is a variable changing throughout a human's life span. He also found that with the increasing of age, the tendency to prefer blue decreases and an inclination towards green and red starts to appear.

Bakker et al. (2015) conducted an important study in terms of color preferences. It is important because of the large number of the sample set and the wide information obtained. In the questionnaire handled to 1095 Dutch people, they asked about their color preferences about different topics (general, clothing, interior spaces, and mood) in relation to personal characteristics such as age, education, gender etc. This study supports the existence of a significant relation between color preference and age.

2.3.2.2 Color preference by gender

Gender issues are of wide interest in color studies. Researchers have found differences in color preference according to gender (Eysenck, 1941; Funk & Ndubisi, 2006; Manav, 2007; Beniani &Yamamoto, 2014; Bakker et al., 2015)

Funk & Ndubisi (2006) in their research about how color can simulate and increase appeal power of product found some preference differences between male and female Lithuanian respondents. The findings obtained from 196 consumers who were randomly selected and responded to the questionnaire, show that female respondents chose white, blue and green as their favorite color much more frequently, whereas men preferred red more often than women.

Another study tested 208 observers whose majority were British and aged 20–26 years old. They picked their preferred color from a series of pairs of small colored rectangles in a neutral CRT display. In terms of gender differences it was found that female observers preferred red-range colors more than male ones (Hurlbert and Ling, 2007).

Manav‘s (2007) study about color preferences including 30 males and 20 females, found a relation between gender and responses for the achromatic black. Female respondents had positive responses towards black color samples, whereas men did not.

Bakker et al.’s (2015) study concluded that in general blue is the overall preferred color, when 25% of males and 13% of females preferred it. Secondly,18 % of females and 16% had not a particular color preference. In the clothing context, black was found to be in the first place mostly chosen by women, whereas male respondents chose mostly blue as a color suitable for clothing.

Conflicting with the studies above, there are also some studies which in fact did not find any gender differences in color preferences (Ou, Luo, Woodcock & Wright, 2004; Camgoz et al., 2002). It is an aim of this study to investigate gender differences in the color-texture association preferences.

2.3.2.3 Color preference by culture

Cross-cultural studies have shown that culture and the meanings given to specific colors also affect color preference (Gunnerod, 1991; Saito, 1996; Shoyama, Tochihara & Kim, 2003; Beniani & Yamamoto, 2014 etc).

Saito (1996) in a study containing three surveys showed cross-cultural differences and similarities in color preference among Asian groups. In the first survey respondents from four large cities in Japan were asked to rank the three most liked and the three least liked color chips from 65 of them. The second survey applied the same method to respondents from Seoul, Korea and Tokyo, Japan focusing more on the preference of white. The last survey consisted of respondents form Taipei and Tokyo and it also focused on the preference of white. Findings demonstrated that, there exists a general inclination of Asian people towards the preference of the white color. Specifically for this study, Japanese respondents significantly ranked white as their first, second and third most preferred choice.

Even in between Asian cultures there exist differences. Gunnerod (1991) in his study related about marketing flowers stated that Japanese people prefer white, while Hong Kong originated respondents prefer red.

Shoyama et al. (2003) carried out a comparative study between Japanese and Korean women in terms of elderly clothing color preference. Simulated images of 75 color elderly clothes were shown to the sample group. They concluded that Japanese women consumers prefer black and light greyish orange for clothing, while Korean women preferred light grey and dark blue.

Baniani & Yamamoto (2014) on their comparative study on correlation between personal background and interior color preference, found differences in the color varieties used by respondents while coloring the given space images. Foreigners living in Japan (originating from all continents) and Iranians used more colors while painting the given spaces than Japanese respondents.

In another study, where 582 undergraduate students were asked about their color preferences, it was found that African Americans prefer colors in the range of red-purple-black, whereas white race respondents prefer blues and greens (Silver et al., 1988)

The above mentioned results were also supported by Weigersma and Elst (1988) in whose study blue was the most overall preferred color by Dutch respondents, apart from the ones from Senegal who preferred red and black.

2.3.2.4 Color preference by context

Some of color preference studies are concerned about the preference of an overall favorite color, while some studies aim is to find a favorite color for a specific context. Context plays a crucial role in color preference (Bakker et al., 2015). For example colors located in the yellowish range are rarely mentioned as preferred colors, but in advertisements yellow is one of the most used colors because of its eye-catching and radiating quality (Lee & Barnes, 1990).

Gage (1995) and Bakker et al. (2015) found that black is the overall preferred color for clothing. Even though gender and educational derived differences were found in Bakker's study; in the clothing context, females prefer black while males prefer more blue or dark blue. It is originated by the fact that people are viewed as more elegant and attractive while dressed in black and red (Roberts, Owen & Havlicek, 2010). Furthermore respondents having a university educational level chose blue as the most preferred clothing color, while other respondents who had a higher or lower vocational education level chose black as their most preferred color (Bakker et al., 2015). Moreover, Schloss, Strauss & Palmer (2012) asked 48 respondents about their preference towards 37 colors in different clothing contexts: dress shirts/blouses, ties/scarves, and T-shirts. They concluded that there exist differences in color preferences according to clothing type.

Color plays a prominent role in physical environments because of its effects on user's psychology. Because of the spaciousness it evokes, white is the most preferred color for physical environments especially for workplaces (Kwallek, Lewis, Lin-Hsiao & Woodson, 1996). A total 675 respondents participated in the study which used nine office colors: red, green, white, orange, yellow, blue, beige, grey and purple with two saturation and two value levels, and were evaluated according to proofreading performance, mood states, and color preference. Respondents revealed that they were more likely to work in white and beige environments (Kwallek et al., 1996).

Bakker et al., (2015) asked in a questionnaire about the respondents' most preferred color for the physical environment. 41% of the respondents chose white as the most suitable color especially for office spaces.

In another study concerned about influences of red and blue colors on perceived well-being and productivity of employers during regular meetings, the 52 respondents' responses who completed the distributed questionnaires demonstrated that low saturated colors of light blue, light aqua green are found to be preferred in offices. (Bakker, van der Voordt, Vink & Boon, 2013)

Manav (2007) color preferences research for the case of residences stated that the existence of a strong dependency and use of green in residences. When asked about the color they would associate within a particular space, the frequency distributions of the 50 respondents show that pink is more preferred in the sleeping and children's room; light blue in the living room; light yellow in the dining areas and corridors and white in wet cores.

Color preferences change also according to the mood of the respondent. It was found that respondents prefer white for 'being quiet and focused', red for 'being energetic' and no color preference for being creative (Bakker et al., 2015).

2.3.2.5 Color preference by design training background

Having a background in design related fields which give a specific knowledge on color and color harmony can affect color perception, preference and usage. Beniani and Yamamoto research (2014) asked respondents to color the given space images (an interior and exterior one) with 24 given colors. In the demographic questionnaire they handled first, they also asked about the major of the respondents and if their parents had art related backgrounds.

The finding of this study showed that respondents who had a major in art and design fields used more number of colors in their paintings compared to the ones who had not. Additionally, students who had parents with a design related background, made use of more colors than the remaining part of the sample group. This leads to an assumption that individuals who have an art or design tie in their life are more sensitive to the use of color as a visual element.

The current study tends to find any difference in color preferences of two different sample groups having different design related backgrounds. The first sample group consists of people studying a major in art, design and architecture. They are named as Design Trained (DT) respondents, whereas the second group consists of individuals studying other majors rather than the ones mentioned above. They belong to the Non Design Trained (NDT) sample group.

2.3.3 Cross preferences

Accumulated evidence suggests that individual preferences for different domains are not independent but on the contrary they are correlated with each other. People who show a specific preference in a particular domain also tend to prefer certain information in other domains. These associated preferences lead to intertwined or cross preferences between different domains. They can be determined by different factors such as individual taste or personality traits (Chen et al, 2015).

Eysenck (1941) while studying aesthetic preferences for different domains (color, painting, polygons, lines of poetry and odors) noted some correlated preferences between these domains. He suggests a factor named ‘good taste’ has the main impact on these correlations.

Later, Palmer and Griscom (2010) found that preferences for different domains (color, shape, volumetric location and music) were correlated with individuals’ own harmony judgements. In their study, ninety respondents were asked about their preference towards 127 visual stimuli in terms of aesthetic preference and later for harmony. Before they responded about their visual preference they were also presented to the musical selections.

Chen et al. conducted a study in 2015 which is related to cross preferences of color and shapes. They concluded that color and shape preferences were partly but systematically correlated. Individuals who preferred simple shapes, had a tendency to prefer light and warm colors; while the ones who preferred complex shapes tended to prefer dark and cold colors.

It was assumed that the current study would find any relationship of this kind between color and texture. It was expected that people who prefer a specific color will at the same time prefer a specific texture type or texture strength.

CHAPTER 3

TEXTURE

3.1 Definition of texture

‘‘Texture includes the visual surface appearance and the feel of material’’ (Koester, 1993, p.1). It stimulates both our visual and our tactile perceptions. ‘‘The sensation of touching, holding and squeezing textures is also known as hand’’ (Koester, 1993, p.1). The word itself comes from the Latin word ‘textere’ which means to weave (Larsen &Weeks, 1975, p.6). All fabrics not only the woven ones have texture and use it to make a material more desirable. Our presumption that texture is the roughness or the granularity of a material is too narrow and partially wrong. Sleek satins and frosty taffetas have textures too. ‘‘Fabric texture is the bas-relief of highlight and shadow on the ‘ups and downs’ of the construction’’ (Larsen &Weeks, 1975, p.8). The main texture descriptors are: the weave (texture type), its density (texture strength) and its fiber content (Larsen &Weeks, 1975, p.8).

3.1.2 Texture characteristics

There are different adjective pairs describing the overlapping of the visual and tactile sensation such as: crisp-limb, firm-flexible, opaque-transparent, rough- smooth, shiny-dull, stretchy-stable etc. (Koester, 1993).

Fiber is the smallest component of the fabric but it strongly influences the texture of the material. For example, wool gives soft textures while linen gives crisp ones (Figure 9 &10). These fibers are joined in different lengths and methods to form a yarn.

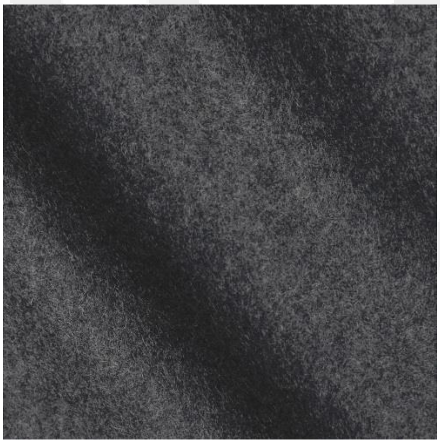


Figure 9a. Wool fabric's texture

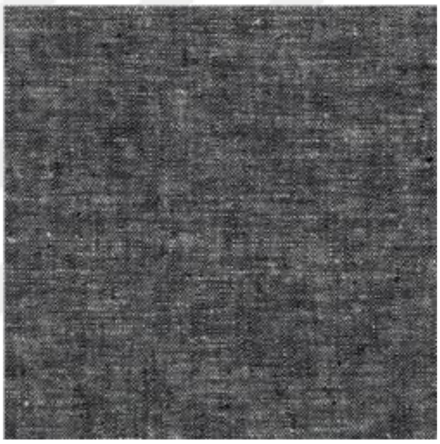


Figure 9b. Linen fabric's texture

(https://www.fabric.com/)

Spinning of the yarn is an important factor determining both the weave and the density of the texture. This is also called as fabric construction, which is the result of yarn, the order of interlacing and the density. At the same time spinning (the amount of yarn) determines the texture strength of a fabric, whether it will be a fine or a coarse texture. (Larsen & Weeks, 1975). The weave of the fabric determines important aspects of the fabric such as its weight, flexibility, firmness and stability (Koester, 1993).

3.1.2.1 Opacity and transparency of textures

Other important characteristics of texture are the opacity and transparency of the fabric and the amount of these characteristics. Fabrics can be opaque, which slightly admit light, or transparent in which you can see through. The range between opaque-transparent is immense, though making possible innumerable textures. There exist also fibers which sparkle in light such as metallic or translucent monofilaments (Koester, 1993) (Figure 10).

Figure 10. Metallic filaments
(http://www.thesewingdirectory.co.uk/fabric-glossary/)

3.1.2.2 Relief of textures

For the visual aspect, relief is known as highlight and shadow. That's why the amount and the direction of the light which illuminates the texture are of great importance. For the tactile aspect, the relief of texture is the broken or the uneven surface sensed by touching the fabric. In some fabrics relief can be only visual, because of the two different yarns (light-dark) that are perceived as highlight and shadow (Larsen & Weeks, 1975).

The effect of the relief of textures on the psychology of individuals dates long ago in time. These rhythmic textures and patterns, presented in the physical environment behave as a stimuli for humankind. During modern architecture, the variety of natural textures found in sound and foliage seemed to be absent because of the massive use of concrete (Larsen & Weeks, 1975). Lately, because of the awareness of sustainable materials and design solutions, natural textures have become an important part of our lived spaces.

In interior spaces, paint, plastic and glass by offering smoothness consequently lack in relief. That’s why among the readily available materials fabric is the one that mimics nature by its broken color and its shades and shadows. Fabric’s relief (softness and textured surface) influences psychological responses of users. As an example, light and airy casements fabrics provide privacy regardless the usage of outdoor spaces or sunlight (Larsen & Weeks, 1975).

3.2 Color and texture

Color and texture are tightly tied up with each other in design fields. While buying a fabric, they are the main aesthetic values a consumer gives attention to. Color is usually introduced in interiors by the use of materials. Fabrics within their wide range in colors and textures have become a changeable and feasible design component.

Color is usually judged according to its amount, or the juxtaposition it has to other colors. On the other hand, for fabrics, color can be judged also in relation to the combination of color and texture (Larsen & Weeks, 1975).

3.2.1 Color-Texture related studies

A lot of various studies had on focus the investigation of the fabric's texture impact on its color. Color affects the quality of the fabric and on the other hand the color itself is influenced by the texture of the fabric (Xin et al., 2005). Texture structures are known to have an effect on both instrumental and perceived colors (Luo, Tsang, Shen, Shao & Xin,2014). The instrumental color of a fabric is the color measured by a device called spectrophotometer, which assumes the surfaces of the fabric are flat when measured (Hunter & Harold,1987). Studies related to color and texture are mainly divided in three main categories: the effect of texture on color difference; the effect of texture on color attributes; the effect of texture on color judgements (Luo et al, 2014). The current study aims to belong to the last stated group.

3.2.1.1 The effect of texture on color difference

The first ones investigating how addition of texture to a color affects its perception were Kuehni and Marcus (1979). Their study concerned about visual scaling of small color differences included six colors. The object-color samples were evaluated according to their subjective estimation and ranking. In this study, they concluded that the minimum value to perceive a difference between different texture types was one CIELAB unit.

Furthermore, Xin, Lam & Luo (2003) studied the effect of texture and the texture pattern amount of 15 woven textiles on the visual color difference evaluation. The findings of the study supported the assumption that fabric samples have a significant impact on the color difference evaluation. The study conducted in Cathode Ray Tube

(CRT) monitor also contributed to the literature by finding that when texture strength is increased 10 times, color difference evaluation decreases by 0.25 CIELAB unit.

Moreover, another study conducted by Han, Cui & Luo (2003) explored the effect of the texture pattern on the visual color difference evaluation. 15 different textures mapped within 3 colors: red, green and blue were shown in a CRT display. In total, 30 color difference image pairs were produced, two for each texture. The color differences between textured and non-textured color samples demonstrated that color texture mapped pairs show a reduction of 35-43% of visual color difference. They also found that the increasing of texture strength, decreases visual color difference result.

Furthermore, in a research by Kandi & Tehran (2008) eight different polyester textures were dyed by seven colors: red, orange, brown, yellow, green, blue and purple in five different concentrations of these colors. In the end 280 samples were achieved for the experiment (8 x 7 x 5) and investigated in terms of color difference formulae. Twenty three observers assessed the color differences of the displayed pairs by using the grayscale method. The findings indicated that texture structures had a significant effect on the color difference formulae.

Han et.al (2003) simulated fine and coarse textures in CRT to investigate color difference for automobile coating. They found an insignificant impact of texture on color difference in this particular context. This was inconsistent with the previous studies. These results may be shaped because of the context given to the study.

3.2.1.2 The effect of texture on color attributes

Addition of texture to a color sample, consequently affects its color attributes. Luo et al. (2014) explored the influence of texture surface of fabrics on its instrumental color. This study used eighty four knitted cotton yarn dyed fabrics. They were dyed in four colors: green, grey, red, blue and had 21 different texture structures. The findings of this study could be used to remove the effect which texture has on the instrumental color of a fabric measured by spectrophotometer. They could achieve a reduction of 79%, 55%, 71% and 57% on the effect textures have on the color difference of the four colors used in this study.

Shao, Xin, Zhang & Zhou (2006) explored the influence of texture structures of knitted fabrics on visual and instrumental color. It was found that textures have a significant impact on the hue, chroma and lightness values of the color of the fabric.

An important study conducted by Montag and Berns (2000) resulted that textures increase the lightness tolerance thresholds. The term tolerance used in this study is the ‘‘perceptibility of color differences in comparison to a standard color difference set’’ (Montag & Berns, 2000, p.1). The experiment consisted of simulated thread wound textures in a card on CRT. The investigation was finalized by approving that texture affect lightness tolerance, and lightness tolerances affect lightness thresholds. Another important finding of this study was stating that texture’s impact on the increasing of lightness tolerance thresholds is two times higher compared to the regular stimuli.

Huertas, Rivas, Yebra and Perez (2004) studied a similar topic which investigated the influence of texture on color attributes’ tolerances. They used simulated textures random dot- textures on single color samples and found that this type of texture influences the tolerances of lightness, chroma and hue. Textures have a bigger impact on the lightness tolerance rather than hue and chroma ones.

The effect of surface texture on its color has been investigated also in terms of luminance and chromaticity values. Luminance is the intensity of light a surface emits for surface unit. (Luo, Tsang, Shao & Xin, 2013). In this study 268 knitted fabrics in 67 texture types and dyed in 4 color spaces are used and evaluated in terms of color difference. It was found that texture of the fabric influences its luminance rather than its chromaticity (Luo et al., 2013).

3.2.1.3 The effect of texture on color judgement

Texture has an impact on color and its attributes. Color's hue, saturation and brightness have a major impact on color perception and color judgements. The earliest study exploring the effect of texture on value of colors and their apparent warmth (preference) was conducted by Tinker in 1938. It used only paper and a cloth as two different textures and in fact, he didn't find any significant effect of texture on the two tested variables. Reasons behind these results may be the lack of available methods provided at that time.

Recent studies found that surface texture changes the emotional effect of colored textile samples (Lucassen, Gevers & Gijsenij, 2010). Ten respondents were asked about their emotional responses towards simulated color chips in terms of four scales: warm-cool, masculine-feminine, hard-soft and heavy light. In the first phase of the experiment, they had to rank only solid colors according to the scales before mentioned. After, grayscale textures produced by using Perlin Noise were displayed in the monitor and ranked similarly in a horizontal way. Perlin noise is a primitive structure used in pseudo-random appearance of texture generations. All the visual details in Perlin noise images are the in same size meaning that it represents a single texture. The textures produced for this study are achromatic, differing only in lightness. By parametrizing Perlin noise we can obtain random sample of textures by only randomly sampling the Perlin parameter space. As the last part of the experiment, color and texture were mapped with each other and the respondents ranked their emotional responses once again. As a result, the study concluded that when texture is added to uniform color samples, color emotions change. More specifically, the hard- soft scale of emotional responses is totally determined by texture (Lucassen et al., 2010).

In the same line with this study, it was found that adding texture can significantly influence the perceived unpleasantness of colors according to texture type (Simmons & Russell, 2008). Even though this study is concerned only about one type of emotion, it gives clues about the importance of adding texture to color samples.

CHAPTER 4

METHODOLOGY

4.1 Aim of the study

This study purports to find the existence of a relation between two design elements: color and texture in terms of preference. Its aim is to explore color texture mapping associations according to the visual preference of two different samples in a Virtual Environment and abstract context.

4.1.1 Research questions

This study aims to find answers to the following questions:

1. Is there a dependency between color and texture in terms of preference?
2. Are there some specific texture types preferred more with some specific colors?
3. Are there some specific texture strengths preferred more with some specific colors?

4. Are there any differences in color-texture association preference between design and non-design trained respondents?
5. Are there any differences in the preferences of color texture associations between males and females in the non-design trained sample set?

4.1.2 Hypotheses

1. There is a dependency between color and texture in terms of preference.
2. One texture type is preferred more than the others apart from color.
3. Blue is the most preferred color apart from texture.
4. There exists a dependency between color and texture strength.
5. One texture strength is preferred more than the other apart from color and texture type.

4.2 The experiment

4.2.1 Sample group

There were two sample groups participating in the study divided according to their design-related background. The first group consisted of 100 design trained respondents where 82 of them were female and 18 were male. Most of the respondents (71%) of the first sample were sophomore students from the Interior Architecture and Environmental Design Department of Bilkent University. The remaining part were from Architecture, Graphic Design, Landscape Architecture and Communication and Design Departments in different grades (See Appendix A). Their ages ranged from 19 to 32 with a mean average of 22.57 (See Appendix A).

On the other hand, the second group consisting of 96 non design trained respondents had a more normal distribution in terms of gender such as 44 males to 52 females (Table 1). The respondents studied in different departments of Bilkent University and their mean age was 21.8 (See Appendix A).

None of the respondents in either sample groups were color blind according to Ishihara Color Blindness Test and they had no other vision or color deficiencies preventing them to participate in the study.

Table 1. Distribution of respondents by background and gender

	Male	Female	Total
Design-trained	18	82	100
Non design-trained	44	52	96
Total	62	134	196

4.2.2 Experimental sets

4.2.2.1 Texture sets

Nurus design office and Tepe Home Mobilya donated some of their upholstery textile catalogues to the Material Laboratory of Bilkent University on behalf of this study. Since in between textures, the saturation and brightness values differed for the same color, it was impossible to use these textile samples as physical experimental sets for the study (See Figure 11 & 12).

Fig.11 Nurus design office samples

Fig.12 Tepe home mobilya samples

Some studies (Kandi et al., 2008; Xin et al., 2005) have used an alternative but yet innovative way to have realistic-like textile samples by scanning and then displaying them in a Virtual Environment. At the same time this method would eliminate the tactile sensation which could influence the preference results of the respondents in the current study. Firat Color studio in Ankara scanned the neutral beige samples from the textiles above, in grayscale mode by the help of Canon image FORMULA DR-F120 Desktop scanner having a 2400dpi. The three scanned textile samples were 100% polyester and each had one of the three textures mostly used in the textile industry: plain, basket, and broken twill (Xin et al, 2005). The images were modified in Adobe Photoshop CS6 (RGB mode) with brightness and contrast values in order to achieve the same light grey color (R: 214, G: 214, B: 214) (Figure 13).

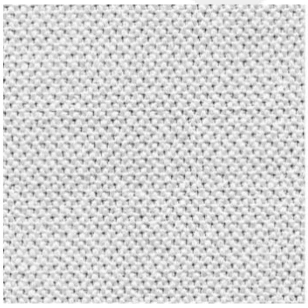


Fig.13a Plain texture

Fig.13b Basket Texture

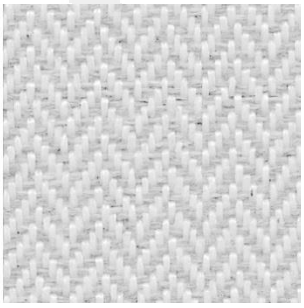


Fig.13c Broken twill

This study is concerned also about texture strength and two of the textures namely plain and basket having also two texture strength levels: fine and coarse. The following images show coarse levels of two of the textures (Figure 15).

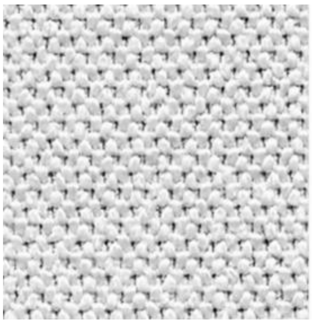


Fig. 14a Plain Coarse

Fig.14b Basket Coarse

4.2.2.2 Color mapped sets

Because of its basic and abstract context, this study used the four unique hues (Yellow, Red, Blue, Green) obtained from the Natural Color System Catalogue. NCS is suitable for everyone with normal color vision to make color evaluations without using color-measuring instruments (Agoston, 1987, p. 133). This system is used to directly determine the perceived color of a specific surface. This color measurement is an absolute measurement according to color perception. It describes the formal basic elements of color language and it provides the ability to identify characteristic similarities and relations between colors (Hard and Sivik, 2001).

In this study the four psychological primaries were used: yellow, red, green and blue. In the NCS, colors are defined by the relative amounts of the basic colors that are perceived presented by percentages (Hunt, 1987). The saturation and brightness values used are the ones who mostly resemble the ones of physical samples. The used NCS specifications are S2050-Y, S2050-R, S2050-G, and S2050-B. . For instance, the S2050-Y color the yellow value is 100%, whiteness value (W) is 30%, and blackness (S) is 20% and the C (chromatic component) 50%. In the hue triangle, by the relative amounts of S, W, and C, the perceived color can be represented (see Fig 15, 16, 17, 18).

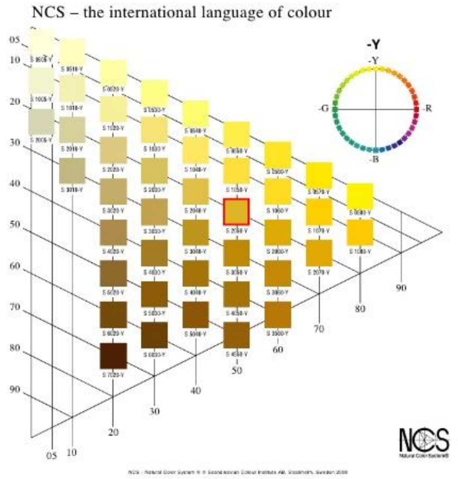


Figure 15. Yellow (2050-Y)

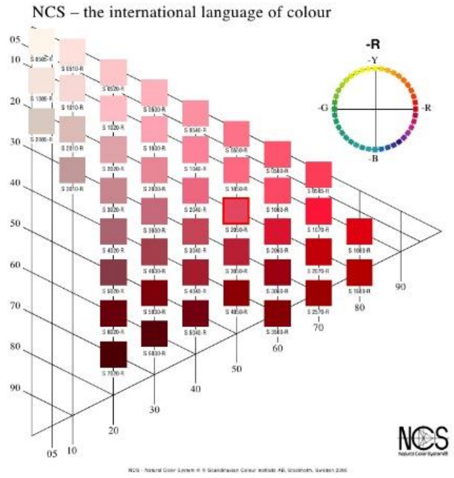


Figure 16. Red (2050-R)

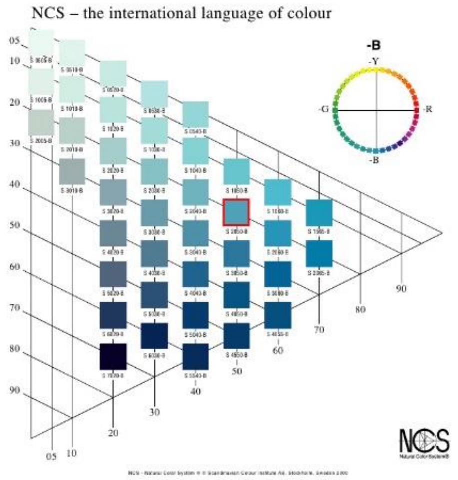


Figure 17. Blue (2050-B)

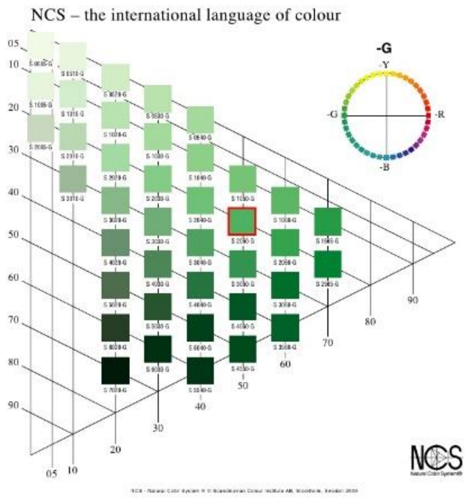


Figure 18. Green (2050-G)

(http://www.ncscolour.co.uk/information/ncs_system.html)

By installing the NCS color swatches in the Adobe Photoshop Software, the chosen color specifications were picked by Color Picker Tool and then were mapped with the texture patches prepared previously. The achieved images (4 colors x 3 textures =12) having dimensions of 5x5 cm were placed in a neutral grey background (R: 192, G: 192, B: 192) (See Figure 19). The same was applied for the coarse texture samples of the 2nd phase of the experiment (Figure 20).

In order to reduce order effect, the squares' location changed randomly for every respondent according to a sequence obtained by random.org.

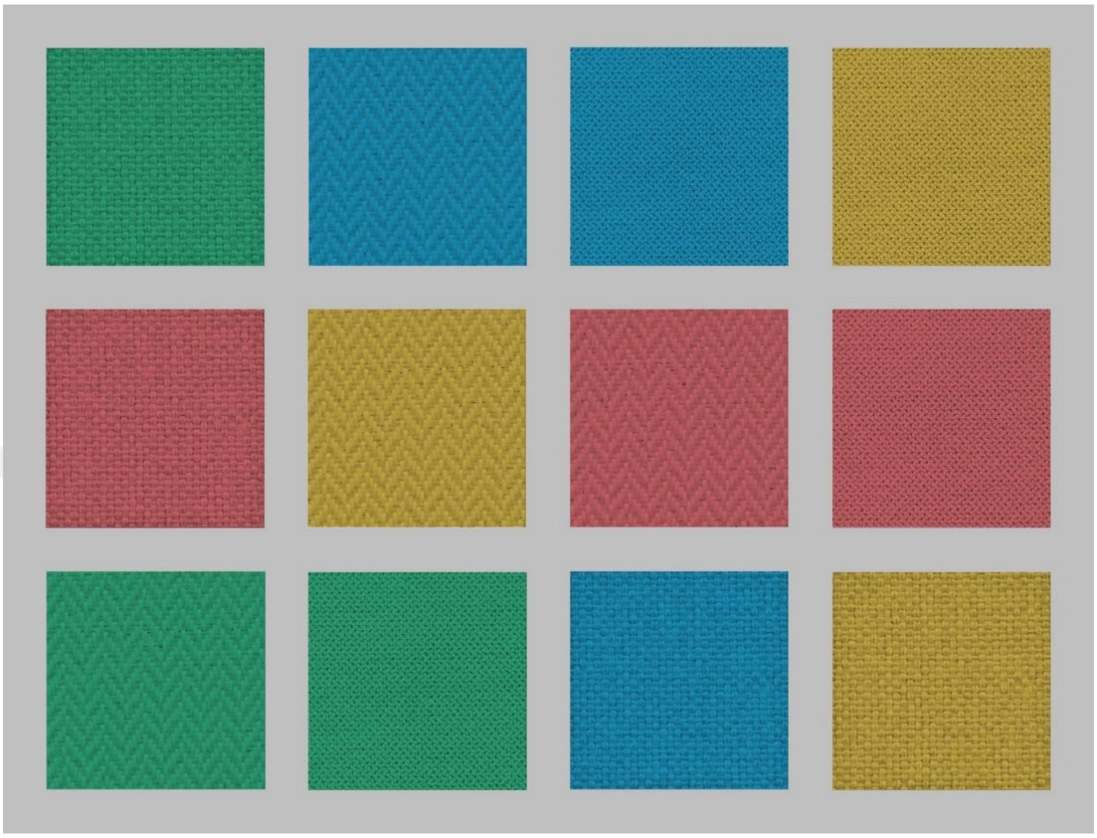


Figure 19. Texture-color mapped images

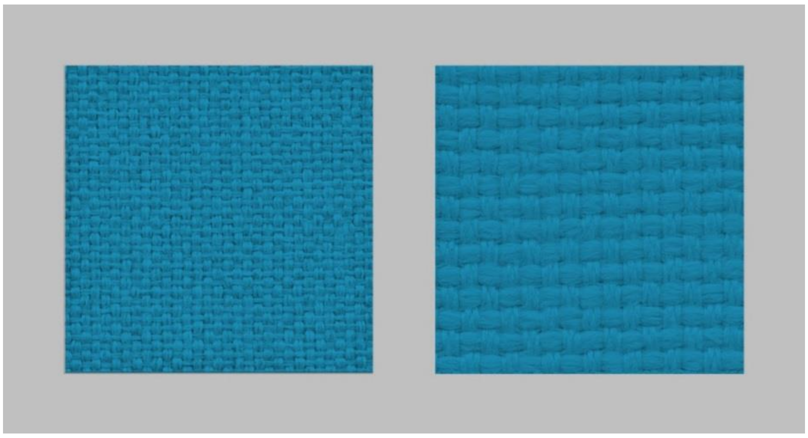


Figure 20. Fine-coarse basket texture mapped with blue

4.2.3 Settings of the experiment

Design trained respondents carried out their experiment in the building science laboratory of the Department of Interior Architecture and Environmental Design, at Bilkent University (Figure 21). It is a 17.138 m^2 space having white painted walls and ceiling. This room was suitable for the experiment because of its lack of windows and the facility to have controlled lighting. The environmental setup had cove lighting which is suitable for experiments carried out in front of computer screens in order to prevent glare. Standard Philips TL 54 fluorescent, having 6200 color temperature (CT) and 72 color rendering index (CRI) were used to provide lighting in the room. The illuminance level measured by Minolta Illuminance meter in the room was measured and fixed as 300 lx

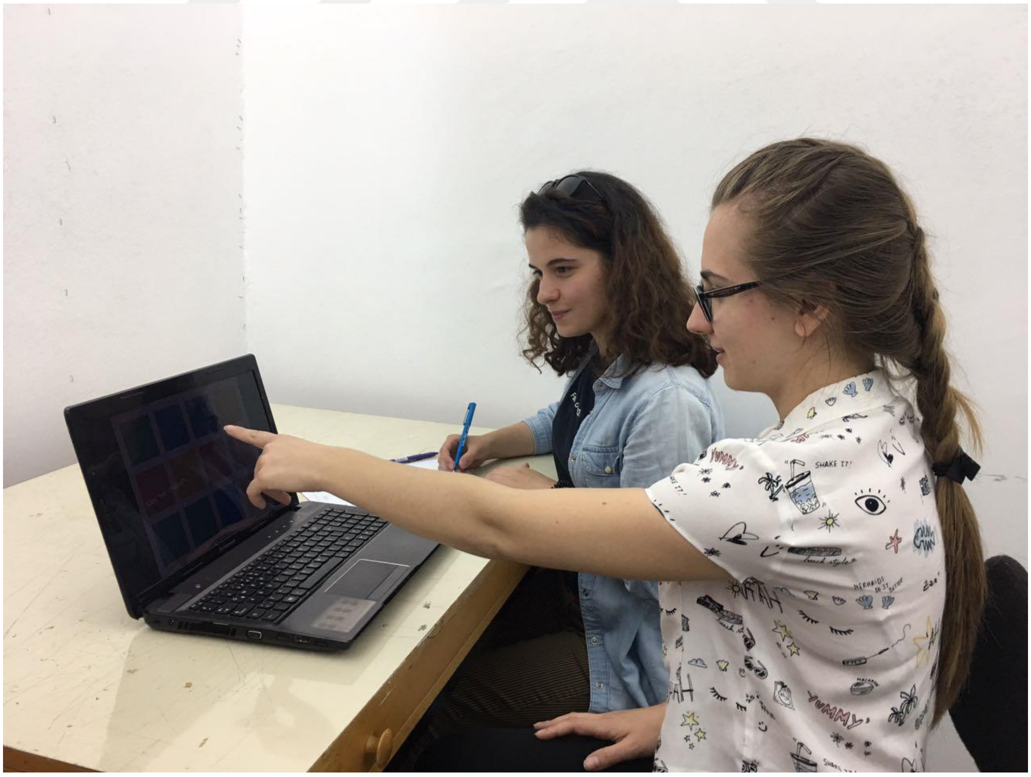


Figure 21. Experiment at lab in the FC building with design-trained respondents

On the other hand, non-design trained respondents completed the experiment in one of the windowless booths (NO: 8) in the Multimedia Room at Bilkent University Library. These spaces are rooms used mostly for group study and at the same time supply an isolated area in which there is not any obvious interaction between the inside and outside.

This space satisfied the same conditions in terms of lighting as the laboratory in the FC building stated above. At the same time it was one of the most accessible places to find respondents who had no design related background (Figure 22).

Figure 22. Experiment in the Library Booth

4.2.4 Procedure

The experiment consisted of showing the respondents a 1366 x 768 pixels, 32 bit color depth and 60 Hz refresh rate calibrated built- in (laptop) display. (See Appendix B). Twelve color-texture mapped squares were shown in a neutral grey background (R: 192, G: 192, B: 192). The respondents were sit 50 cm far from the front of the monitor placed in the experimental setups mentioned above (see 4.2.3). Firstly they answered some questions about their demographic information (See Appendix B). Respondents with vision deficiencies used the necessary equipment (glasses or lenses) to correct them.

The respondents were asked to carefully observe all the squares in the image, and then to choose the square they prefer the most without considering it in any context. The question was asked in Turkish ‘‘Bu kareleri inceledikten sonra, en çok tercih ettiğiniz kare hangisi?’’. The English version of the question was: “After observing all the mapped squares in the image, which one do you prefer the most?’’ If the selected square had a plain or basket texture, the experiment continued with a second phase. The preferred square was shown in the same color and texture but only the texture strength changed. The respondent had to choose between fine or coarse textures of the previously chosen color-texture association. After the researcher marked down the answers, the experiment was over. Respondents also answered the questions about whether they have conservative or changing color preferences (See Appendix B).

CHAPTER 5

RESULTS

The preferences of two sample groups, consisting of 100 and 96 respondents respectively, were used for the data analysis. The data gathered from the experiment explained in the previous section (see Section 4.2) was analyzed in the SPSS (Statistical Package for the Social Sciences 20.0) software. Firstly, the demographic information of the respondents was analyzed and frequency tables were produced (See Appendix B). In order to understand the existence of a dependency between the two main variables, color and texture, for the two sample groups, Chi square test for Independence was run. Since this study consists of count data (frequency distributions) non parametric tests were used. To analyze if the distribution of color and texture is equal between their pertaining categories Chi square goodness of fit tests were ran. One Sample Binomial tests were used to analyze colors in between themselves by comparing them two by two. The same was applied to textures. Furthermore, Binomial tests were also used to compare texture strength preferences.

5.1 Cross tabulations for color-texture mapped images

5.1.1 Design trained sample set

Color-texture mapped squares' preference frequencies of the first sample are shown in the cross tabulation below. Texture types are the horizontal variables (rows) and colors the vertical ones (columns). The preference percentages in terms of color and texture are also shown in this table (Table 2).

Table 2. Color texture cross, DT

			Color				
			Yellow	Red	Green	Blue	Total
Texture	Plain	Count	5	8	6	10	29
		% within Text.	17,2%	27,6%	20,7%	34,5%	100%
		% within Color	25%	33,3%	33,3%	26,3%	29%
	Basket	Count	7	13	9	16	45
		% within Text.	15,6%	28,9%	20%	35,6%	100%
		% within Color	35,0%	54,2%	50,0%	42,1%	45%
	Broken Twill	Count	8	3	3	12	26
		% withinText.	30,8%	11,5%	11,5%	46,2%	100%
		% within Color	40%	12,5%	16,7%	31,6%	26,0%
Total		Count	20	24	18	38	100
		% within Text.	20%	24%	18%	38,0%	100%
		% within Color	100%	100%	100%	100%	100%

By observing this table, it can be inferred that in this sample set, texture preference is slightly more important than the color one. 45% of the respondents chose the same basket texture apart from color, and 38% of them chose blue as the most preferred color apart from texture type. The reason behind this may be that the sample group has a design based background allowing them to be more aware of detail and pattern.

5.1.2 Non-Design trained sample set

The same cross tabulation is done also for the second sample consisting of 96 respondents not having a design related background (Table 3).

Table 3. Color texture cross tabulation, NDT

			Color				
			Yellow	Red	Green	Blue	Total
Texture	Plain	Count	3	8	10	17	38
		% within Text.	7,9%	21,1%	26,3%	44,7%	100%
		% within Color	27,3%	34,8%	40%	45,9%	39,6%
	Basket	Count	4	8	6	14	32
		% within Text.	12,5%	25%	18,8%	43,8%	100%
		% within Color	36,4%	34,8%	24%	37,8%	33,3%
	Broken Twill	Count	4	7	9	6	26
		% within Text.	15,4%	26,9%	34,6%	23,1%	100%
		% within Color	36,4%	30,4%	36%	16,2%	27,1%
Total		Count	11	23	25	37	96
		% within Text.	11,5%	24%	26,0%	38,5%	100%
		% within Color	100%	100%	100%	100%	100%

In the second sample it seems that there is not a difference between color and texture preference. The most preferred color (blue) has nearly the same percentage 38.5% as the most preferred texture (plain) 39.6%.

5.2 Color - texture dependency

In order to understand if there exists dependence between our two main variables, a Chi Square Test for Independence was run for both sample sets. As a result it was found that color and texture are independent of each other in terms of preference for the two sets. For design trained sample the results showed $\chi^2 = 5.788$, df =6, p=0.447, p>0.05; for non-design trained sample $\chi^2 = 4.560$, df=6, p=0.589, p>0.05 (see

Appendix A). These findings reject the first hypothesis of this study stating the existence of a dependency between the variables.

Also One Sample Binomial Tests are ran in order to understand if a specific color is preferred within a specific texture for all colors one by one. But there was not found a significant association between a specific color and texture (see Appendix A).

5.3 Preference of texture apart from colors

The second hypothesis of the study states that different textures would have different preference rankings and one texture would be preferred more than the others. A Chi Square Goodness of Fit test was conducted for both sample sets to explore the abovementioned assumptions.

In the first sample set, texture types are not preferred within equal probabilities (χ^2= 6.260, df=2, p=0.044, p<0.05; see Appendix A). The Binomial One Sample test between texture types show that basket texture is preferred more than the broken twill one (see Appendix A). The frequency percentage charts show that basket is the most preferred texture type apart from color (Figure 23).

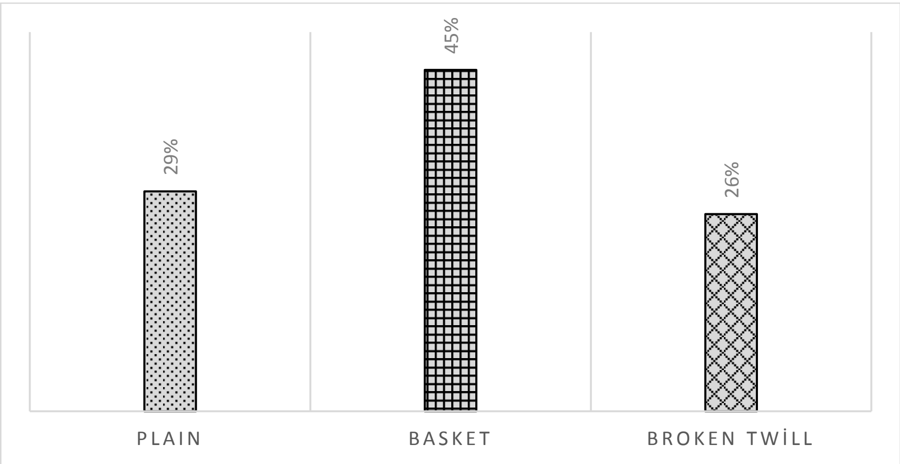


Figure 23.   Texture preference distribution, DT

On the other hand, for the second set (Non Design Trained) there is nearly an equal distribution of texture preferences (Figure 24). The Chi Square Goodness of fit test results in maintaining the null hypothesis stating that texture categories are equally preferred by respondents apart from color. (χ^2=2.250, df=2, p=0.325, p>0.005; see Appendix A)

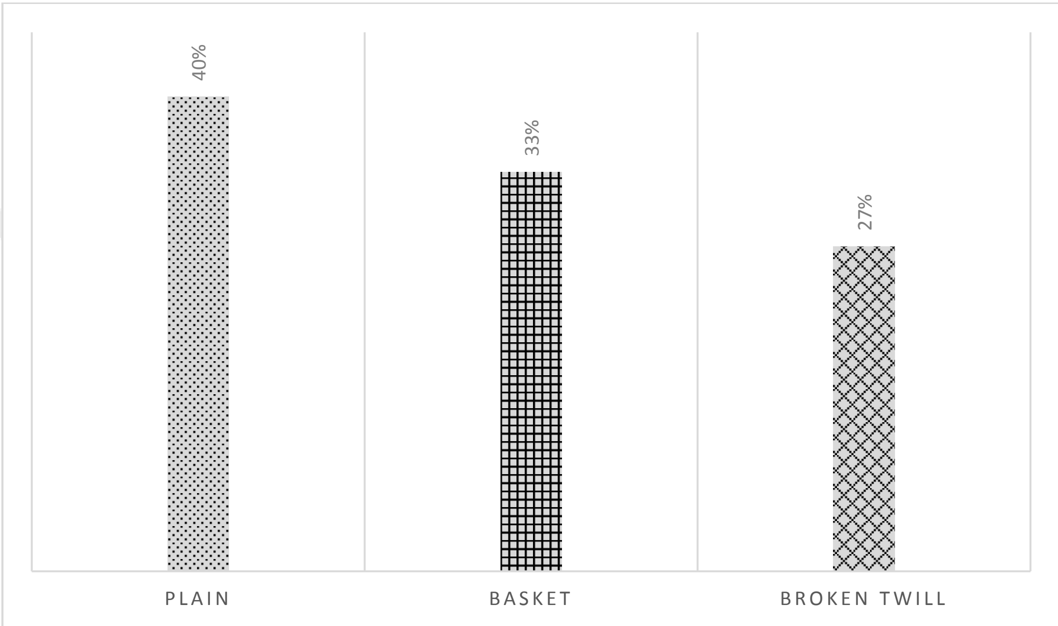


Figure 24. Texture preference distribution, NDT

5.3.1 Texture preference distribution between genders

The results obtained by Chi square Goodness of Fit show that in the male sample set test (χ^2= 3.333, df=2, p=0.189, p>0.005; see Appendix A) and female one (χ^2= 0.269 df=2, p=0.874, p>0.005; see Appendix A) texture categories are preferred with equal possibilities.

5.4 Preference of color apart from texture

Previous studies (Eysenck, 1941; Valdez & Mahrebian, 1994; Dittmar, 2001; Bakker et al., 2015; Sivik, 1974; Camgoz et al, 2002) suggest that generally blue is the most preferred in any context. A Goodness of Fit Chi Square test was conducted to understand whether color categories (yellow, red, green, blue) are equally preferred by the respondents. In the design trained sample set different colors have different preference percentages (χ^2= 9.760, df=3, p=0.021, p<0.05; see Appendix A). The Binomial One Sample tests found that blue is more preferred than yellow and green (See Appendix A). Moreover as a frequency distribution, 38% of the respondents preferred the blue color in the three texture types (Figure 25).

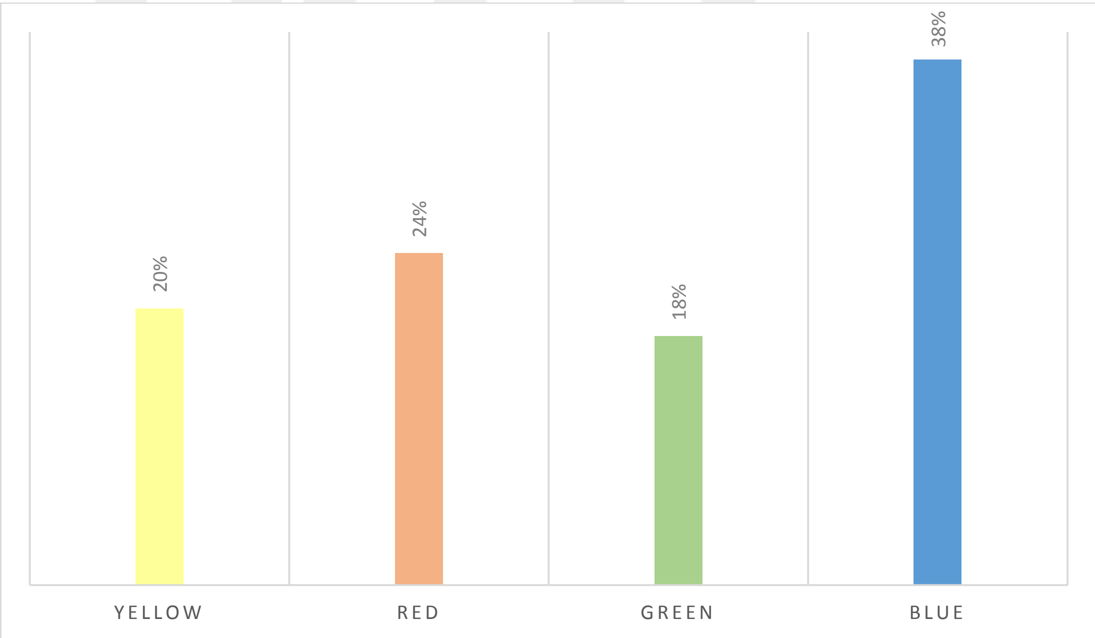


Figure 25. Color preference distribution, DT

The same interpretation is valid for the second sample set in which colors do not have an equal distribution between categories in terms of preference.(χ^2=14.167, df=3, p=0.003, p<0.005; see Appendix A) Like the first sample set blue (39.6%) is the most preferred color of the respondents (Figure 26).

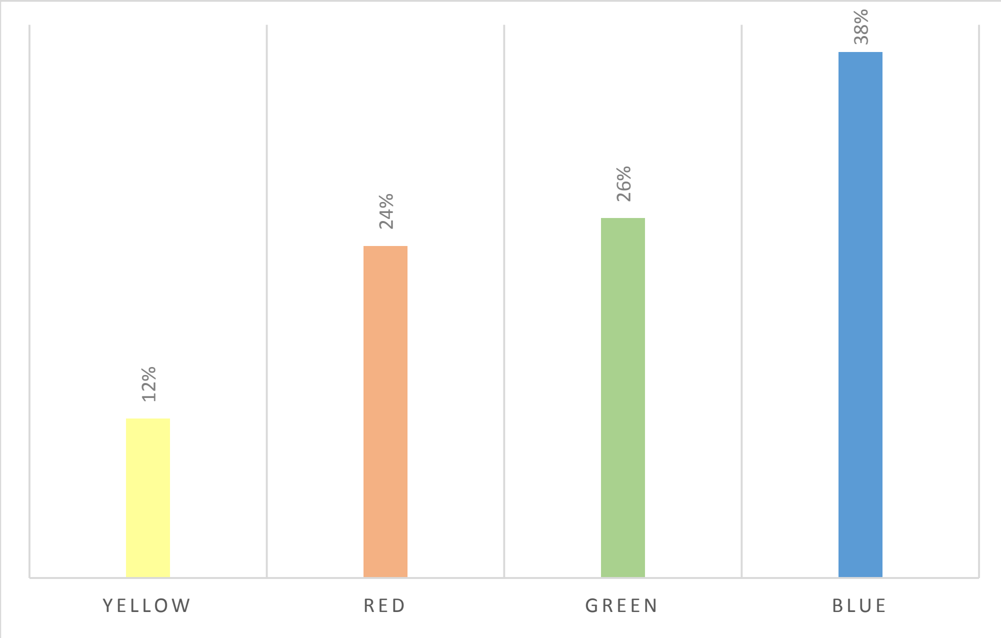


Figure 26. Color preference distribution, NDT

5.4.1 Color preference distribution between genders

In the male sample set of the non-design trained respondents color preference distribution is not the same among the categories. (χ^2= 8.909, df =3, p=0.031, p<0.005; see Appendix A) 43% of the respondents preferred blue among the other colors (Figure 27).

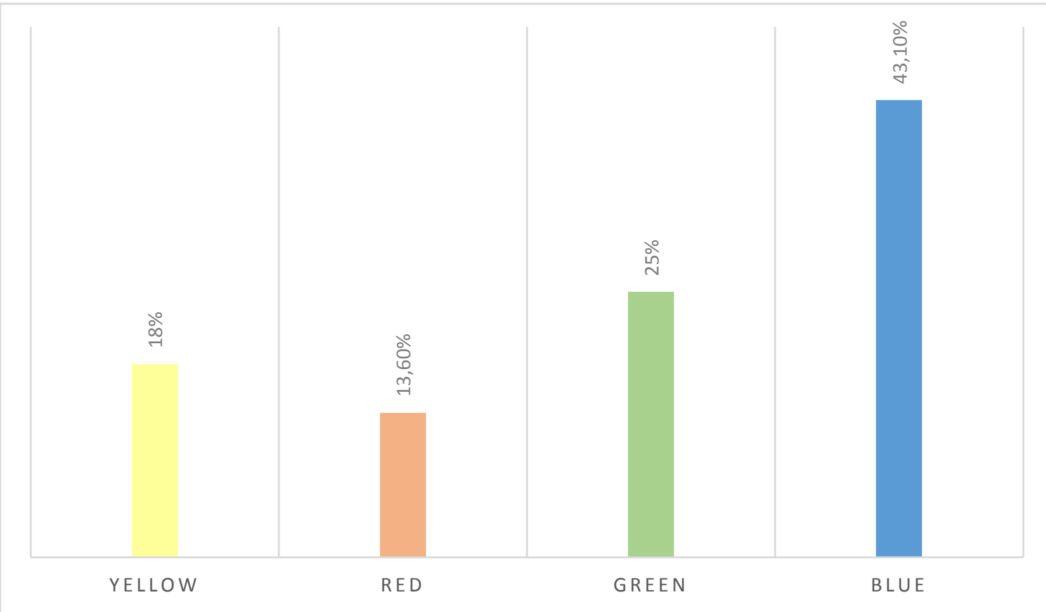


Figure 27. Color preferences for, NDT

Even the female set color categories has different preference frequency distributions. (χ^2= 10,923, df =3, p=0.012, p<0.005; see Appendix A). Only 5% of non-design-trained female respondents preferred the yellow color (Figure 28). Another Chi Square Goodness of Fit test between red, green and blue showed that color preferences between this colors occur with equal probabilities (χ^2= 0.531, df 23, p=0.767; p>0.05)

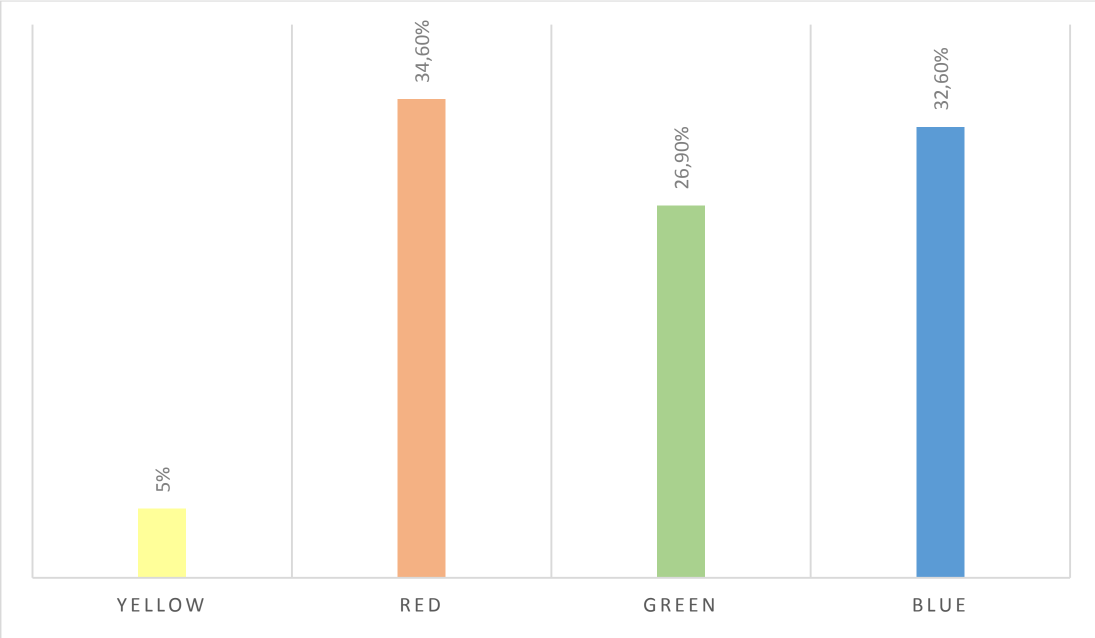


Figure 28. Color preferences for females , NDT

5.5 Color- texture strength dependency

It is of interest to this study to explore the existence of an association between a texture strength (fine or coarse) with a specific color. A crosstab was achieved from the choices respondents made in the second phase of the experiment (see 4.2.4). In the first set (DT) 74 of 100 respondents chose the textures which had two texture strengths. The preference choices are as shown in Table 4.

Table 4. Texture strength-Color preference cross tabulation for DT

			Color				Total
			Yellow	Red	Green	Blue	
Strength	Fine	Count	8	11	11	20	50
		% within Text.	16%	22%	22%	40%	100%
		% within Color	66,7%	52,4%	73,3%	76,9%	29%
	Coarse	Count	4	10	4	6	24
		% within Text.	16,7%	41,7%	16,7%	25%	100%
		% within Color	33,3%	47,6%	26,7%	23,1%	32,4%
Total		Count	12	21	15	26	74
		% within Text.	16,2%	28,4%	20,3%	35,1%	100%
		% within Color	100%	100%	100%	100%	100%

The results showed that there is no significant association between color and texture strength in terms of preference in the design trained sample set (χ^2= 3.481 df =3, p=0.323, p>0.005; see Appendix A). The same test was conducted for the second set (NDT) and the same conclusion was reached (χ^2= 0.641 df =3, p=0.887, p>0.05; see Appendix B). Only 60 of 96 respondents chose the plain and basket textures having two different texture strengths. This caused half of the cells in the crosstab to be less than 5 which is a constraint for the reliability of the Chi Square test (See table 5).

Table 5. Texture strength-Color preference cross tabulation for NDT

			Color				Total
			Yellow	Red	Green	Blue	
Strength	Fine	Count	6	13	12	16	47
		% within Text.	12,8%	27,7%	25,5%	34%	100%
		% within Color	85,7%	81,3%	75%	76,2%	78,3%
	Coarse	Count	1	3	4	5	13
		% within Text.	7,7%	23,1%	30,8%	38,5%	100%
		% within Color	14,3%	18,8%	25%	23,8%	21,7%
Total		Count	7	16	15	21	60
		% within Text.	11,7%	26,7%	26,7%	35,0%	100%
		% within Color	100%	100%	100%	100%	100%

5.6 Texture strength preference

In order to understand if there is a more preferred texture strength apart from texture type and color, a One Sample Binomial test was ran. For the DT set a (p value of 0.004; p<0.005) which is smaller than our significance level shows than a texture strength is preferred more than the other one. Fine textures are preferred more than coarse ones (Figure 29).

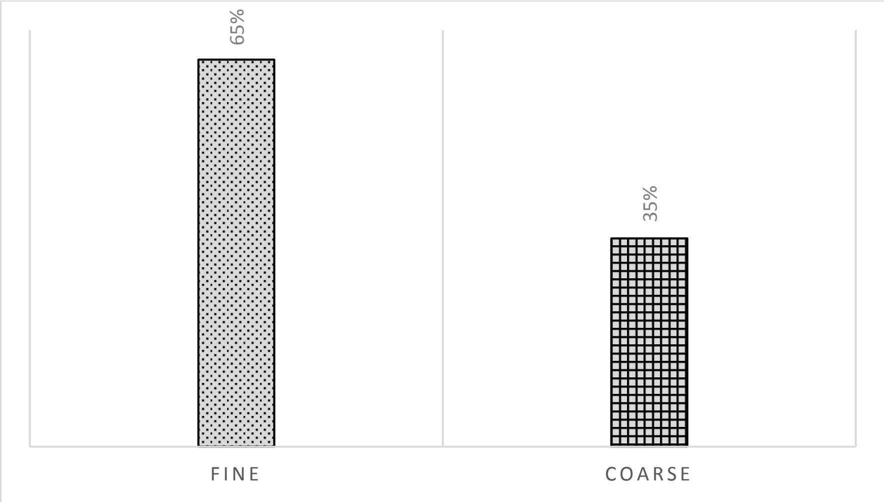


Figure 29. Texture strength preference percentages, DT

The same test was ran for the NDT respondents and the results show that fine texture strength is preferred more than the coarse one apart from texture type and color (p=0.000, p<0.05) (Figure 30).

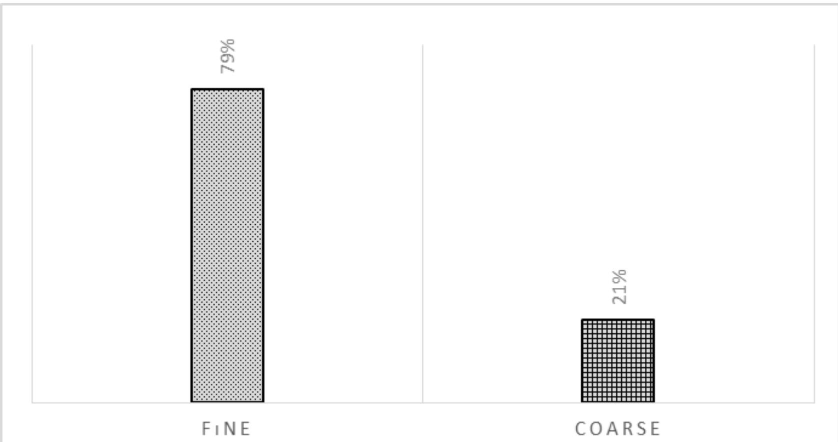


Figure 30. Texture strength preference percentages, NDT

5.6.1 Texture strength preference distributions between genders

88 % of the male respondents from the second set preferred fine textures more than coarse ones. Binomial test results ($p=0.000$, $p<0.05$) support the hypothesis that the fine texture strength is preferred more than others.

Female respondents (75%) also mostly chose fine textures above coarse ones. This non equality is tested by One Sample Binomial test for frequency distributions ($p=0.000$, $p<0.05$).

5.6.2 Texture strength preference for texture type

In the DT sample set, results from Binomial test show that plain textures are preferred equally in different texture strengths ($p=0.63$, $p>0.05$) . In the NDT group plain fine textures are preferred more ($p=0.000$, $p<0.05$) (Figure 31a). For basket textures, in both sets fine strengths are preferred more (DT $p=0.037$, $p<0.05$; NDT $p=0.017$, $p>0.05$) (Figure 31b).

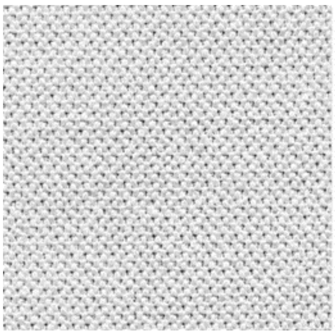


Figure 31a. Fine plain texture

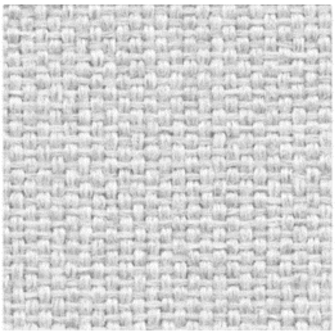


Figure 31b. Fine basket texture

5.6.3 Texture strength preference for color

Some extra tests are performed to understand if a texture strength is preferred more within a specific color. For yellow in both sets there is an equal distribution of texture strengths preferences (DT $p=0.388$ $p>0.05$; NDT-0.07 $p>0.05$).

Red fine textures are preferred more than coarse ones in the NDT respondent group. ($p=0.21$ $p<0.05$) (Figure 32). Design trained respondents prefer both red texture strengths in the same proportions ($p=1.000$, $p>0.05$)

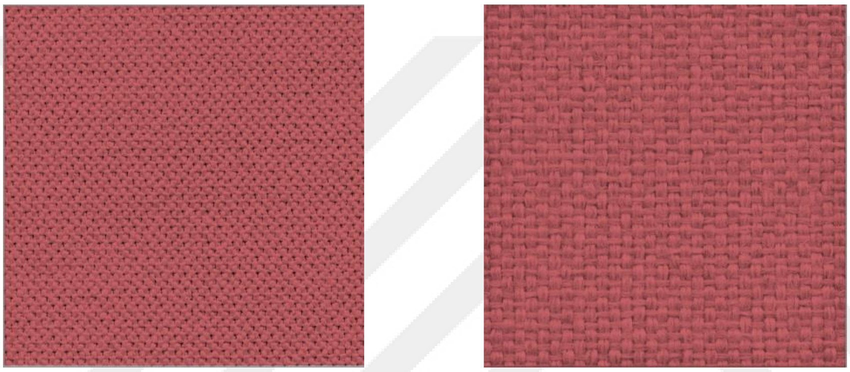


Figure 32. Red fine textures

For green color, in both sample groups there is no a significant difference in texture strength preferences. (DT $p=0.118$, $p>0.05$; NDT $p=0.77$, $p>0.05$)

Finally all the respondents of the study preferred fine blue textures more over coarse textures (DT $p=0.011$, $p<0.05$; NDT $p=0.027$, $p<0.05$) (Figure 33).

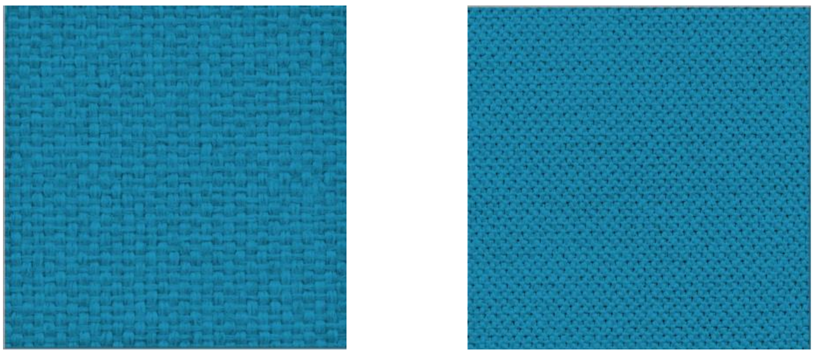


Figure 33. Blue fine textures

5.7 Discussion

This study purported to find any relationship between two important elements of basic design: color and texture. Its main concern was to investigate the existence of any color-texture associations in term of preference. Because of having an abstract and basic context, the study used as its main variables four primary colors chosen from the NCS catalogue and the three most used textures in the textile industry, plain, basket and broken twill. In that sense, 12 color-texture mapped associations were achieved. It was hypothesized that there would exist a dependency between the two variables in terms of preference. Based on what the literature suggests, it was expected that people who showed a specific preference in a domain also would a certain thing in another domain (Chen et al., 2016). Additionally, color studies mostly refer to blue as the overall most preferred color (Eysenck, 1941; Valdez & Mahrebian, 1994; Dittmar, 2001; Bakker et al., 2015; Sivik, 1974; Camgoz et al, 2002). One of the interests of the study was to understand if the same thing happens also in the texture domain. In a clearer way, it was expected that a texture would be preferred more than the remaining ones. Usually in color studies, color is studied within its attributes but in the current study, color's dimensions apart from hue remain constant. The changing variable is texture strength instead. For two textures, two different texture strengths are used and analyzed in terms of preference. Specifically, plain and basket had both fine and coarse texture levels. Also, they were mapped with the chosen colors: yellow, red, blue and green. After, it was tried to find any existing associations between color and texture strength. Because previous studies proved that texture strength has a significant impact on mainly lightness values of color (Montag & Berns, 2000), moreover lightness also influences color preferences (Guilford &Smith, 1959), it was deducted that a specific texture strength would be preferred more than the other one.

An important part of the study consisted in finding preference differences between genders. A lot of studies prove the existence of gender differences especially when the respondent of interest is color (Eysenck, 1941; Manav, 2007; Beniani &Yamamoto, 2014; Bakker et al., 2015; Funk & Ndubisi, 2006). Since this study since is related to preference which is a subjective value, it was expected to observe differences between male and female respondents. Even though the sample group wasn't too large, tests were run to analyze the above hypothesis. Small differences in particular topics were observed between male and female respondents opposing to studies which didn't find any significant differences between genders (Ou et al., 2004; Camgoz, 2002).

Another crucial factor influencing color related studies is the background of the respondents. The ones having a background linked with art, architecture and design have a tendency to be more sensitive to color and detail (Beniani & Yamamoto, 2014). The responses of 100 respondents who have a design related background were compared with the 96 responses given by respondents having no bonds with color related fields.

The first hypothesis of the study stating the existence of a dependency between color and texture was rejected. Even though accumulated evidence shows that individual preferences for different domains are not independent, in the case of this study, we intersected the domains (color x texture) within each other. The methodology of the study didn't consist on showing color and textures separately but on the contrary we mapped them with each other. That's why the preference choice was a result of both the combination of texture and color. It is known that especially in the case of fabrics, the combination of color-texture affects consumer's preferences (Larsen & Weeks, 1975). If only color chips were shown first, and then non-colored textures second, maybe a cross preference between the two domains would exist. But, even though this method wouldn't be enough accurate to understand the color-texture associations, because of the influence they have on each other. We examined respondents only according to their age, gender and background but many other factors can affect individual preferences. Another factor that may be affecting the above stated result may be the number of the respondents since the analysis test (Chi Square test for Independence) used requires a large number of respondents.

This study also assumed that a texture would be preferred more than the other ones and this was verified in the sample group with respondents having a design related background. Results show that basket texture has the highest preference frequency among the three. The same cannot be stated for the second sample group because the Chi Square Goodness of Fit test resulted in having an equal texture preference distribution among texture types. This can originate because DT people are more sensitive to detail as literature suggests (Beniani & Yamamoto, 2014) and apart from choosing color, they also paid attention to texture choice more than the NDT respondents. The study didn't find any gender difference in terms of texture preference.

Findings of this study sustain other researches stating that blue is the overall most favorite color (Eysenck, 1941; Manav, 2007; Beniani &Yamamoto, 2014; Bakker et al., 2015; Funk & Ndubisi, 2006). Chi Square tests show an unequal distribution of responses in color preferences. In both sample groups, blue has the highest preference percentage. Furthermore in between genders, blue is the most preferred color for males, but on the other part for female respondents it can be concluded that yellow is the least preferred color as literature suggests (Guilford &Smith, 1959; Camgoz et al., 2002).The reasons behind this may be that females preferences are changing and males' ones are conservative.

Moreover, it was not found any dependency between color and texture strength in both sets. But the hypothesis assuming that a texture strength would be preferred more than the other was verified. Fine textures were more preferred than coarse ones. This is valid for both sample sets and for both genders. If shown in a particular context, the current findings may change.

Other tests were run in order to analyze if a particular texture strength is preferred more within a particular texture type. In NDT sample group it was found that plain fine textures are preferred more whereas in the DT set basket fine textures are preferred more. These results have such an inclination because the majority of respondents in DT chose basket texture and the NDT chose the plain one. The large number of responses gave more accurate statistical results.

Furthermore, the texture strength preference for each color was investigated. Since blue had the largest frequency distribution, it was the only color having an association between the blue hue and fine textures for all the respondents. The small number of number of respondents choosing the other colors couldn't give any statistical results according to this issue.

Lastly, this research tried to fill the gap and give a new insight on color-texture association preferences. Even though, this study couldn't find any dependency relationships between the two variables, it could be considered a beginning on this topic. As we discussed above preferences will always remain subjective and biased on many other topics, but it is of great interest to find what majority of the population prefers in terms of color-texture combinations. The latter ones are present in nearly every part of our surroundings affecting our psychological and physiological responses (Gaines & Curry, 2011).

CHAPTER 6

CONCLUSION

The relationships between two or more design elements are always of big interest in design related fields. Several studies have been carried out in order to find perfect combinations of hues, saturations and brightness so that to achieve color harmony. Researches having color as their main variable usually tend to explore and to break down to its attributes. Because of the high impact it has on user's psychological responses, color can be considered as the main aesthetic value of an object or a space.

A less popular element of design is texture. Texture not only affects our visual sense but it also stimulates our tactile one. Present in natural materials or in man-made ones, texture has an impact on our preferences. We don't perceive colors in the same way when they are mapped with textures.

Since color is rarely seen as a uniform plain element, the current research used both color and texture as equally important weighted variables in it. Color combinations are widely studied, that's why it was of interest of the researchers to understand color-texture combinations. Even though conducted in a basic environment and with basic experimental sets, the findings gave an insight that these two elements are tied with each other.

Notwithstanding, the analyses of the study couldn't approve the existence of a dependency between color and texture type variables. A relationship between color and texture strength didn't exist either. Furthermore, the results showed that blue is the overall most preferred color both by design trained and non-design trained respondents. For men, blue was the most favorite color, whereas for women yellow was the least favorite one. DT respondents chose basket texture as their most preferred one. Moreover, fine textures are clearly more preferred than coarse ones in all the respondents' responses. DT respondents associate the basket texture more with the fine strength level, while NDT ones prefer plain fine textures more. Lastly, all the respondents agreed on the fact that the blue color is most preferred when associated with fine textures rather than coarse ones.

The study had its own limitations. Using physical textile samples would have been more accurate and realistic in terms of texture effect. Even though the study was concerned only on the visual effect of the texture, its tactile sensation cannot be easily neglected. For this study, it was impossible to find physical samples in the desired textures and colors. That's why conducting it in a Virtual Environment was a lot more feasible in terms of cost and time (Xin et al., 2005). Also designers now are used to work in Virtual Environments and don't have difficulties in imagining a simulated work into a realistic one. Supporting this statement, Suk & Irtel (2010) found that media type (physical vs. simulated) has no effect on emotional responses to color.

It should be accentuated that the results of this study are not definite and prescriptive because a variety of confounding factors that affect individual preferences. However, this study hopes to be helpful to design professionals in gaining an insight about color-texture combinations of DT and NDT individuals. At the same time manufacturers can also make use of this study by understanding which the most preferred color-texture matches are.

Further studies could investigate color-texture association preferences in a physical environment. Additionally, more colors and textures and maybe the combination of two colors with two textures could be investigated under the concept of color-texture harmony. Colors chosen can be the most used ones in upholstery fabrics such as brown, beige etc. More fabric types can be used. More texture strength levels can be used. This would give a more realistic context to the study.

Later studies can also give new insights on the procedure of the experiment. Another method would have been to show the color-texture mapped images one by one and ask the user's preference rating. This would give mean data and more statistical tests could be conducted. But preference differs from liking. Preference is a greater liking for one alternative over another or others. Ranking the images from the most preferred to the least preferred one could be another way to understand the relationships we are interested in. That would give median values, but on the other hand when using lot of variables (more colors & textures), data could become too complicated to be understood.

At the same time, in order to have 'universal' preference results a big number of people should participate to the experiment. Additionally, since texture is present not only in fabrics but also in other architectural materials, their usage in other studies should be taken in consideration. People can have difference combination preferences for curtains or for carpets. Investigation of preferences on all these topics would provide greater information to architects in order to design spaces towards which users have positive responses. Design is not an exact field of study; nevertheless architects tend to have some ‘universal standards’ in terms of design harmony, in order to produce quality spaces for their clients.

BIBLIOGRAPHY

Agoston, G. A. (1987). *Color theory and its application in art and design*. Berlin: Springer-Verlag.

Bakker, I., Van der Voordt, T. J., De Boon, J., & Vink, P. (2013). Red or blue meeting rooms: does it matter? *Facilities*, *31*(1/2), 68-83. doi:10.1108/02632771311292527

Bakker, I., Van der Voordt, T., Vink, P., De Boon, J., & Bazley, C. (2015). Color preferences for different topics in connection to personal characteristics. *Color Research & Application*, *40*(1), 62-71. doi:10.1002/col.21845

Baniani, M., & Yamamoto, S. (2014). A comparative study on correlation between personal background and interior color preference. *Color Research & Application*, *40*(4), 416-424. doi:10.1002/col.21906

Beach, L. R., Wise, B. K., & Wise, J. A. (1988). *The human factors of color in environmental design: A critical review*. NASA Grant No. NCC22-404, Technical Report, NASA Ames Research Center, Moffett Field, CA.

Burnham, R. W. (1963). Color, a guide to basic facts and concepts. Dalke, H., Little, J., Niemann, E., Camgöz, N., Steadman, G., Hill, S., & Stott, L. Color and lighting in hospital design. *Optics & Laser Technology*, *38*, 343- 365. doi:10.1016/j.optlastec.2005.06.040

Camgöz, N., Yener, C., & Güvenç, D. (2001). Effects of hue, saturation, and brightness on preference. *Color Research and Application, 27*(3), 199-207. DOI: 10.1002/col.10051

Chen, N., Tanaka, K., Matsuyoshi, D., & Watanabe, K. (2015). Cross preferences for colors and shapes. *Color Research & Application*, *41*(2), 188-195. doi:10.1002/col.21958

Clarke, T., & Costall, A. (2008). The emotional connotations of color: A qualitative investigation. *Color Research & Application*, *33*(5), 406-410. doi:10.1002/col.20435

D'andrade, R., & Egan, M. (1974). The colors of emotion. *American Ethnologist, 1*(1), 49-63. doi:10.1525/ae.1974.1.1.02a00030

Dittmar, M. (2001). Changing color preferences with ageing: A comparative study on younger and older native Germans aged 19–90 years. *Gerontology, 47*, 219– 226. doi:10.1159/000052802

Erhart, L. Irtel, H. (2006). Der Einfluss von Oberfla¨cheneigenschaften auf die emotionale *Wirkung von Farbe*. FarbInfo, Dresden

Evans, R. M. (1948). *An introduction to color*. New York:Wiley.

Eysenck, H. J. (1941). A critical and experimental study of color preferences. *The American Journal of Psychology, 54,* 385-394. Retrieved from: http://www.jstor.org/stable/1417683?seq=1#page_scan_tab_contents

Fehrman, K. R., & Fehrman, C. (2000). *Colour: The Secret Influence*. New Jersey: Prentice-Hall.

Feisner, A. (2006). *Color: How to use color in art and design* (2nd ed.). London: Laurence King Publishing.

Funk, D., & Oly Ndubisi, N. (2006). Colour and product choice: a study of gender roles. *Management Research News*, *29*(1/2), 41-52. doi:10.1108/01409170610645439

Gage, J. (1995). *Color and culture*. Cambridge: Cambridge University Press; p 188–189.

Gorji Kandi, S., Amani Tehran, M., & Rahmati, M. (2008). Colour dependency of textile samples on the surface texture. *Coloration Technology*, *124*(6), 348-354. doi:10.1111/j.1478-4408.2008.00162.x

Griscom, W. S., & Palmer, S. E. (2010). Individual Differences in Preference for Harmony. *Journal of Vision*, *10*(7), 411-411. doi:10.1167/10.7.411

Guilford, J. P. (1934). The affective value of color as function of hue, tint and chroma. *Journal of Experimental Psychology*, *17*, 342-370. Retrieved from http://psycnet.apa.org/journals/xge/17/3/342/

Guilford, J. P. & Smith, P. (1959). A system of color preferences. *American Journal of Psychology*, *62* (4), 487-502. Retrieved from http://www.jstor.org/stable/1419491?seq=1#page_scan_tab_contents

Gunnerod PK.(1991). Marketing cut flowers in Japan and Hong Kong. *International Trade Forum* ; 27:28–29.

Han, B., Cui, G.H., Luo, M.R.(2003). Texture effect on evaluation of colour difference. In proceeding of AIC03–8th Congress of the International Colour Association, p 176–180. Hansuebsai A, editor. Bangkok, Thailand. Available online. http://www.aic-color.org/congr_archivos/aic2003proc.pdf.

Harris, P. (1989). *Children and emotion*. Oxford: Blackwell.

Huertas, R., Melgosa, M., & Hita, E. (2006). Influence of random-dot textures on perception of suprathreshold color differences. *Journal of the Optical Society of America A*, *23*(9), 2067. doi:10.1364/josaa.23.002067

Hunt, R. W. (1977). The Specification of Colour Appearance. I. Concepts and Terms. *Color Research & Application*, *2*(2), 55-68. doi:10.1002/col.5080020202

Hurlbert, A. C., & Ling, Y. (2007). Biological components of sex differences in color preference. *Current Biology*, *17*(16), R623-R625. doi:10.1016/j.cub.2007.06.022

Hurvich, L. M. (1981). *Color vision*. Sunderland, MA: Sinauer assoc.

Kandi, S. G., & Tehran, M. A. (2009). Investigating the effect of texture on the performance of color difference formulae. *Color Research & Application*, NA-NA. doi:10.1002/col.20555

Koester, A. (1993). *Analyzing the Color, Design and Texture of Fabric*. Oregon State University Extension Service.

Kuehni, R. G. (1983). *Color, essence and logic.* New York: Van Nostrand Reinhold.

Kuehni, R. G. (2000). A comparison of five color order systems. *Color Research & Application*, *25*(2), 123-131. dıi: 10.1002/(SICI)15206378(200004)25:2<123: :AID-COL7>3.0.CO;2-E

Kuehni, R.G. , Marcus, R.T. (1979). An experiment in visual scaling of small colour differences. *Color Reseach & Application;* 4:83–91.

Kuehni, R., & Schwarz, A. (2008). *Color ordered a survey of color order systems fromantiquity to the present*. New York; Oxford: Oxford University Press.

Kwallek, N., Lewis, C. M., Lin-Hsiao, J. W. D., & Woodson, H. (1996). Effects of nine monochromatic office interior colors on clerical tasks and worker mood. *Color*

Research and Application, 21(6), 448-458. DOI: 10.1002/(SICI)1520 6378(199612)21:6<448::AID-COL7>3.0.CO;2-W

Larsen, J. L., & Weeks, J. G. (1975). *Fabrics for interiors: a guide for architects, designers, and consumers*. New York: Van Nostrand Reinhold.

Lee S, Barnes JH. (1990). Using color preferences in magazine advertising. *Journal of Advertising Research*; 29:25–30.

Lucassen, M. P., Gevers, T., & Gijsenij, A. (2010). Texture affects color emotion. *Color Research & Application, 36*(6), 426-436. doi:10.1002/col.20647

Luo, L., Tsang, K. M., Shen, H., Shao, S., & Xin, J. H. (2014). An investigation of how the texture surface of a fabric influences its instrumental color. *Color Research & Application, 40*(5), 472-482. doi:10.1002/col.21923

Luo, L., Tsang, K.M., Shao, S.J., Xin, J.H. (2013). *How the surface texture of afabric affects its colour*. In Proceedings of AIC Colour 2013—12th Congress of the International Colour Association, Newcastle, UK.1329–1332. Available online. http://www.aic-color.org/congr_archivos/aic2013abstr.pdf

Mahnke, F., & Mahnke, R. (1987). *Color and Light in Man-Made Environments*. New York: Van Nostrand Reinhold Co.

Manav, B. (2007). Color-emotion associations and color preferences: A case study for residences. *Color Research & Application*, *32*(2), 144-150. doi:10.1002/col.20294

Meervein, G., Rodeck, B., & Mahnke, F. H. (2007). *Colour: communication in architectural space*. Switzerland: Birkhauser Verlag.

Melara, R. D., Marks, L. E., & Potts, B. C. (1993). Primacy of dimensions in color perception. *Journal of Experimental Psychology: Human Perception and Performance*, *19*(5), 1082-1104. doi:10.1037//0096-1523.19.5.1082

Mikellides, B. (1990). Color and physiological arousal. *Journal of Architectural and Planning Research*, *7*(1), 13 - 20. Retrieved from http://www.jstor.org/stable/43028942?seq=1#page_scan_tab_contents

Montag, E. D., & Berns, R. S. (2000). Lightness dependencies and the effect of texture on suprathreshold lightness tolerances. *Color Research & Application*, *25*(4), 241-249. doi:10.1002/1520-6378(200008)25:43.0.co;2-e

Morton, J. (1995). *Color Matters.* Retrieved from http://www.colormatters.com.

Ou, L., Luo, M. R., Woodcock, A., & Wright, A. (2004). A study of colour emotion and colour preference. Part I: Colour emotions for single colours. *Color Research & Application*, *29*(3), 232-240. doi:10.1002/col.20010

Ou, L., Luo, M. R., Sun, P., Hu, N., & Chen, H. (2011). Age effects on colour emotion, preference, and harmony. *Color Research & Application*, *37*(2), 92-105. doi:10.1002/col.20672

Palmer, S. E., Schloss, K. B., & Sammartino, J. (2013). Visual Aesthetics and Human Preference. *Annual Review of Psychology*, *64*(1), 77-107. doi:10.1146/annurev-psych-120710-100504

Roberts, S. C., Owen, R. C., & Havlicek, J. (2010). Distinguishing between Perceiver and Wearer Effects in Clothing Color-Associated Attributions. *Evolutionary Psychology*, *8*(3), 147470491000800. doi:10.1177/147470491000800304

Saito, M. (1996). Comparative studies on color preference in Japan and other Asian regions, with special emphasis on the preference for white. *Color Research & Application*, *21*(1), 35-49. doi:10.1002/(sici)1520-6378(199602)21:13.3.co;2-5

Schloss, K. B., Strauss, E. D., & Palmer, S. E. (2012). Object color preferences. *Color Research & Application*, n/a-n/a. doi:10.1002/col.21756

Shao, S.J., Xin, J.H., Zhang, Y.G., Zhou, L.M.(2006). The effect of texture structure on instrumental color difference evaluation and visual assessment. *AATCC Review*; 6:42–43.

Shoyama, S., Tochihara, Y., & Kim, J. (2003). Japanese and Korean ideas about clothing colors for elderly people: Intercountry and intergenerational differences. *Color Research & Application*, *28*(2), 139-150. doi:10.1002/col.10132

Silver, N. C., Mc Culley, W. L., Chambliss, L. N., Charles, C. M., Smith, A. A., Waddell, W. M., & Winfield, E. B. (1988). Sex and Racial Differences in Color and Number Preferences. *Perceptual and Motor Skills*, *66*(1), 295-299. doi:10.2466/pms.1988.66.1.295

Simmons DR, Russell CL. (2008). Visual texture affects the perceived unpleasantness of colours. *Perception37 ECVP Abstract Supplement* doi:146

Sivik, L. (1974). Color meaning and perceptual color dimensions: A study of color samples. *Goteborg Psychological Reports*, *4*(1), 1-21. DOI: 10.1002/1520-6378(200102)26:1<4:: AID-COL3>3.0.CO;2-T

Suk, H., & Irtel, H. (2010). Emotional response to color across media. *Color Research & Application*, *35*(1), 64-77. doi:10.1002/col.20554

Tinker, M. A. (1938). Effect of Stimulus-Texture upon Apparent Warmth and Affective Value of Colors. *The American Journal of Psychology*, *51*(3), 532. doi:10.2307/1416154

Valdez, P., & Mehribian, A. (1994). Effect of color on emotions. *Journal of Experimental Psychology: General*, *123*(4), 394-409. Doi.org/10.1037/0096-3445.123.4.394

Wiegersma, S., & Van Der Elst, G. (1988). “Blue Phenomenon”: Spontaneity or Preference? *Perceptual and Motor Skills*, *66*(1), 308-310. doi:10.2466/pms.1988.66.1.308

Wyszecki, G., & Stiles, W. S. (1982). *Colour science: Concepts and methods, quantitative data and formula*. New York: John Wiley & Sons.

Xin, J.H., Chuen, L.C., Luo, M.R. (2003). Investigation of texture effect on CRT colour difference evaluation. In Proceedings of AIC03–8th Congress of the International Colour Association, p 60–64. In: Hansuebsai A, editor. Bangkok, Thailand. Available online. http://www.aic-color.org/congr_archivos/aic2003proc.pdf

Xin, J. H., Shen, H., & Chuen Lam, C. (2005). Investigation of texture effect on visual colour difference evaluation. *Color Research & Application*, *30*(5), 341-347. doi:10.1002/col.20138

Yi, E., & Choi, J. (2008). Intergenerational differences of color sensation and preference for naturally dyed fabrics. *Fibers and Polymers*, *9*(5), 646-652. doi:10.1007/s12221-008-0101-6

.

APPENDICES

APPENDIX A

Design trained sample’s demographic information

Table 6. Age frequency table

Statistics

Age

N	Valid	100
	Missing	0
Mean		22,57
Mode		23
Minimum		19
Maximum		32

Table 7. Department frequency table

Department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	IAED	71	71,0	71,0	71,0
	GRA	12	12,0	12,0	83,0
	ARCH	7	7,0	7,0	90,0
	LAUD	5	5,0	5,0	95,0
	COMD	5	5,0	5,0	100,0
	Total	100	100,0	100,0	

Table 8. Grade frequency table

Grade

	Frequency	Percent	Valid Percent	Cumulative Percent
1	5	5,0	5,0	5,0
2	50	50,0	50,0	55,0
3	12	12,0	12,0	67,0
4	10	10,0	10,0	77,0
5	10	10,0	10,0	87,0
6	12	12,0	12,0	99,0
8	1	1,0	1,0	100,0
Total	100	100,0	100,0	

Non-design trained sample's demographic information

Table. 9 Age frequency table

Statistics

Age

N	Valid	96
	Missing	0
Mean		21,80
Mode		21
Minimum		18
Maximum		30

Table 10. Gender frequency table

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	44	45,8	45,8	45,8
	Female	52	54,2	54,2	100,0
	Total	96	100,0	100,0	

Table 11. Department frequency table

Department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	THM	2	2,1	2,1	2,1
	MATH	2	2,1	2,1	4,2
	HART	2	2,1	2,1	6,3
	GEN	2	2,1	2,1	8,3
	AMER	5	5,2	5,2	13,5
	BA	2	2,1	2,1	15,6
	ME	10	10,4	10,4	26,0
	EE	3	3,1	3,1	29,2
	PHYS	2	2,1	2,1	31,3
	PSY	5	5,2	5,2	36,5
	IR	10	10,4	10,4	46,9
	IE	14	14,6	14,6	61,5
	LAW	9	9,4	9,4	70,8
	CS	17	17,7	17,7	88,5
	ECON	11	11,5	11,5	100,0
	Total	96	100,0	100,0	

Table 12. Grade frequency table

Grade

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	24	25,0	25,0	25,0
	2	22	22,9	22,9	47,9
	3	14	14,6	14,6	62,5
	4	20	20,8	20,8	83,3
	5	6	6,3	6,3	89,6
	6	5	5,2	5,2	94,8
	7	2	2,1	2,1	96,9
	8	3	3,1	3,1	100,0
	Total	96	100,0	100,0	

Table 13. Color preference frequency table, DT

Colorpreference

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Conservative	47	47,0	47,0	47,0
	Changing	51	51,0	51,0	98,0
	Not important	2	2,0	2,0	100,0
	Total	100	100,0	100,0	

Table 14. Color preference frequency table, NDT

Colorpreference

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Conservative	43	44,8	44,8	44,8
	Changing	39	40,6	40,6	85,4
	Not important	14	14,6	14,6	100,0
	Total	96	100,0	100,0	

Table 15.Color-texture chi square for dependency, DT

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,788[a]	6	,447
Likelihood Ratio	6,039	6	,419
Linear-by-Linear Association	,001	1	,980
N of Valid Cases	100		

a. 1 cells (8,3%) have expected count less than 5. The minimum expected count is 4,68.

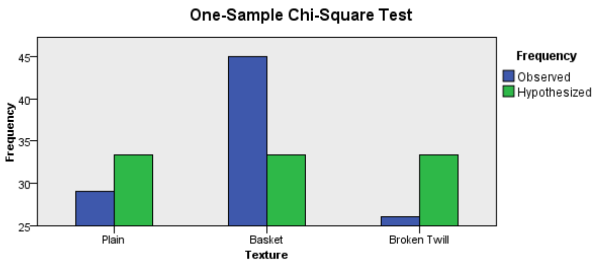
Table 16. Color-texture chi square for dependency, NDT

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,650[a]	6	,589
Likelihood Ratio	4,916	6	,555
Linear-by-Linear Association	2,486	1	,115
N of Valid Cases	96		

a. 3 cells (25,0%) have expected count less than 5. The minimum expected count is 2,98.

Figure 34. Texture preferences apart from color, DT



Total N	100
Test Statistic	6,260
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	,044

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 33,333.

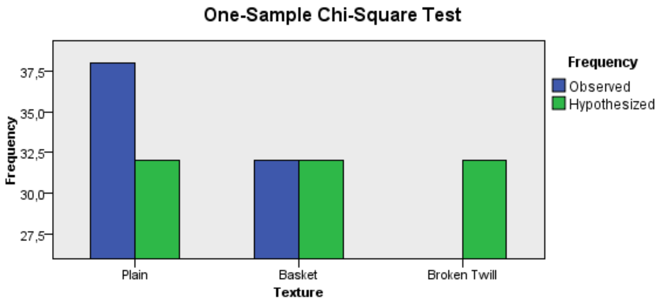
Table 17. Basket-broken twill Binomial test

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texture Basket and Broken Twill occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,033	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

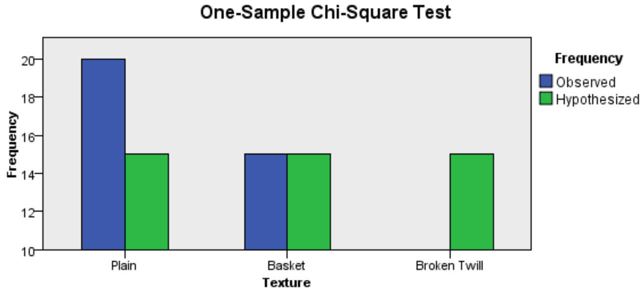
Figure 35. Texture preferences apart from color, NDT



Total N	96
Test Statistic	2,250
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	,325

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 32.

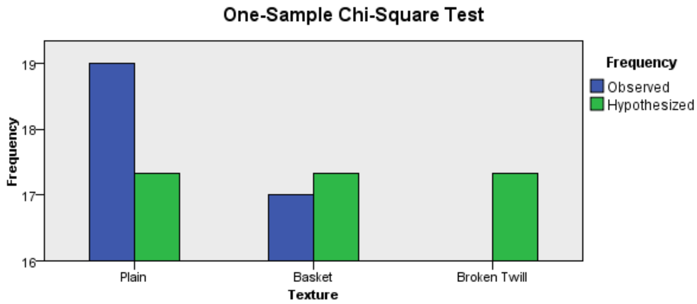
Figure 36. Texture preferences apart from color, males NDT



Total N	45
Test Statistic	3,333
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	,189

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 15.

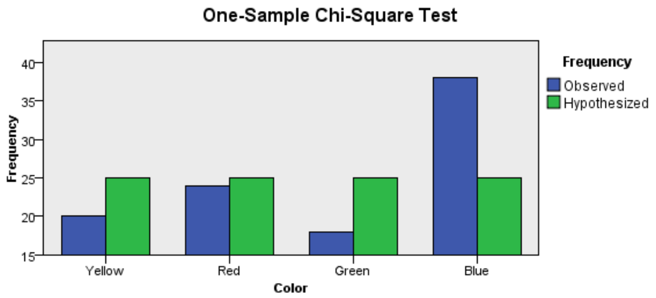
Figure 37. Texture preferences apart from color, females NDT



Total N	52
Test Statistic	,269
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	,874

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 17,333.

Figure 38. Preference of color apart from texture , DT



Total N	100
Test Statistic	9,760
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	,021

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 25.

Table 18. Green-Blue binomial test, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Color = Green and Blue occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,011	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

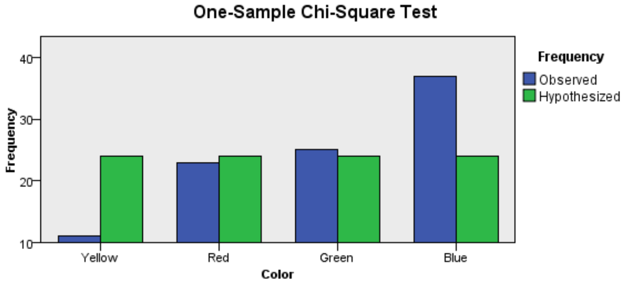
Table 19. Yellow- Blue binomial test, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Color = Yellow and Blue occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,026	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Figure 39. Preference of color apart from texture, NDT



Total N	96
Test Statistic	14,167
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	,003

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 24.

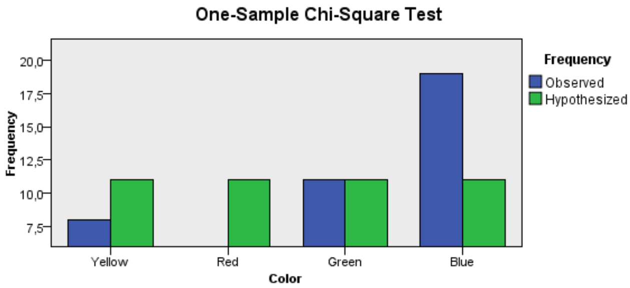
Table 20. Yellow-Blue binomial test, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Color = Yellow and Blue occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Figure 40. Preference of color apart from texture in , males NDT



Total N	44
Test Statistic	8,909
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	,031

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 11.

Table 21. Red- Blue binomial test, males NDT

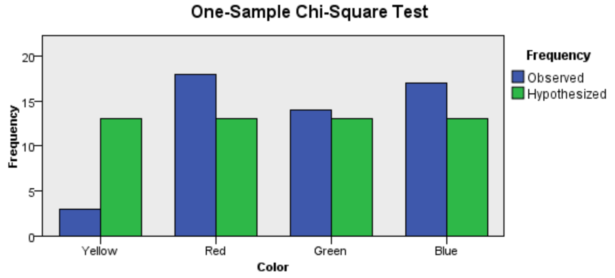
Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Color = Red and Blue occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,015[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

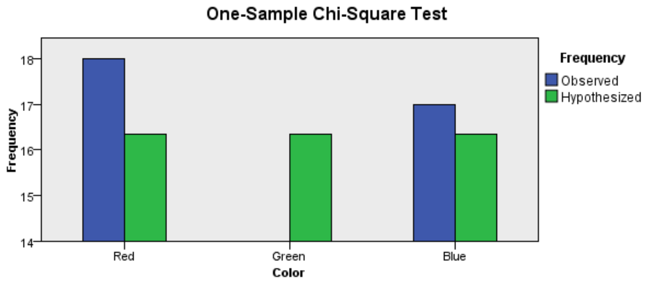
Figure 41. Preference of color apart from texture , females NDT



Total N	52
Test Statistic	10,923
Degrees of Freedom	3
Asymptotic Sig. (2-sided test)	,012

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 13.

Figure 42. Preference of color (red, green, blue) apart from texture, females NDT



Total N	49
Test Statistic	,531
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	,767

1. There are 0 cells (0%) with expected values less than 5. The minimum expected value is 16,333.

Table 22.Color-texture strength dependency, DT

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3,481[a]	3	,323
Likelihood Ratio	3,424	3	,331
Linear-by-Linear Association	1,702	1	,192
N of Valid Cases	74		

a. 2 cells (25,0%) have expected count less than 5. The minimum expected count is 3,89.

Table 23. Color-texture strength dependency, NDT

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	,641[a]	3	,887
Likelihood Ratio	,684	3	,877
Linear-by-Linear Association	,481	1	,488
N of Valid Cases	61		

a. 4 cells (50,0%) have expected count less than 5. The minimum expected count is 1,70.

Table 24. Texture strength preference, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Strength = Fine and Coarse occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,004	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 25. Texture strength preference, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Strength = Fine and Coarse occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 26. Texture strength preference, males NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 27.Texture strength preference, females NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,005	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 28. Texture strength preference for plain textures, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,063	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 29. Texture strength preferences for basket textures, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,037	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 30.Texture strength preference for plain textures, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 31.Texture strength preference for basket textures, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,017[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Exact significance is displayed for this test.

Table 32. Texture strength preference for yellow color, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,388[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Exact significance is displayed for this test.

Table 33. Texture strength preference for red color, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	1,000[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Exact significance is displayed for this test.

Table 34.Texture strength preference for green color, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,118[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

Table 35.Texture strength preference for blue color, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,011	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 36. Texture strength preference for yellow color, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,070[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

Table 37. Texture strength preference for red color, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5	One-Sample Binomial Test	,021[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

Table 38. Texture strength preference for green color, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,077[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Exact significance is displayed for this test.

Table 39.Texture strength preference for blue color, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Texturestrength = Fine and Coarse occur with probabilities 0,5 and 0,5.	One-Sample Binomial Test	,027[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Exact significance is displayed for this test.

Table 40. Preference of blue within a specific texture, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,479	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 41.Preference of green within a specific texture, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,223	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 42. Preference of red within a specific texture, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,044	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 43.Preference of yellow within a specific texture, DT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,705	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 44. Preference of blue within a specific texture, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,073	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 45. Preference of green within a specific texture, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,595	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 46. Preference of red within a specific texture, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,957	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 47. Preference of yellow within a specific texture, NDT

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The categories of Texture occur with equal probabilities.	One-Sample Chi-Square Test	,913	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

APPENDIX B

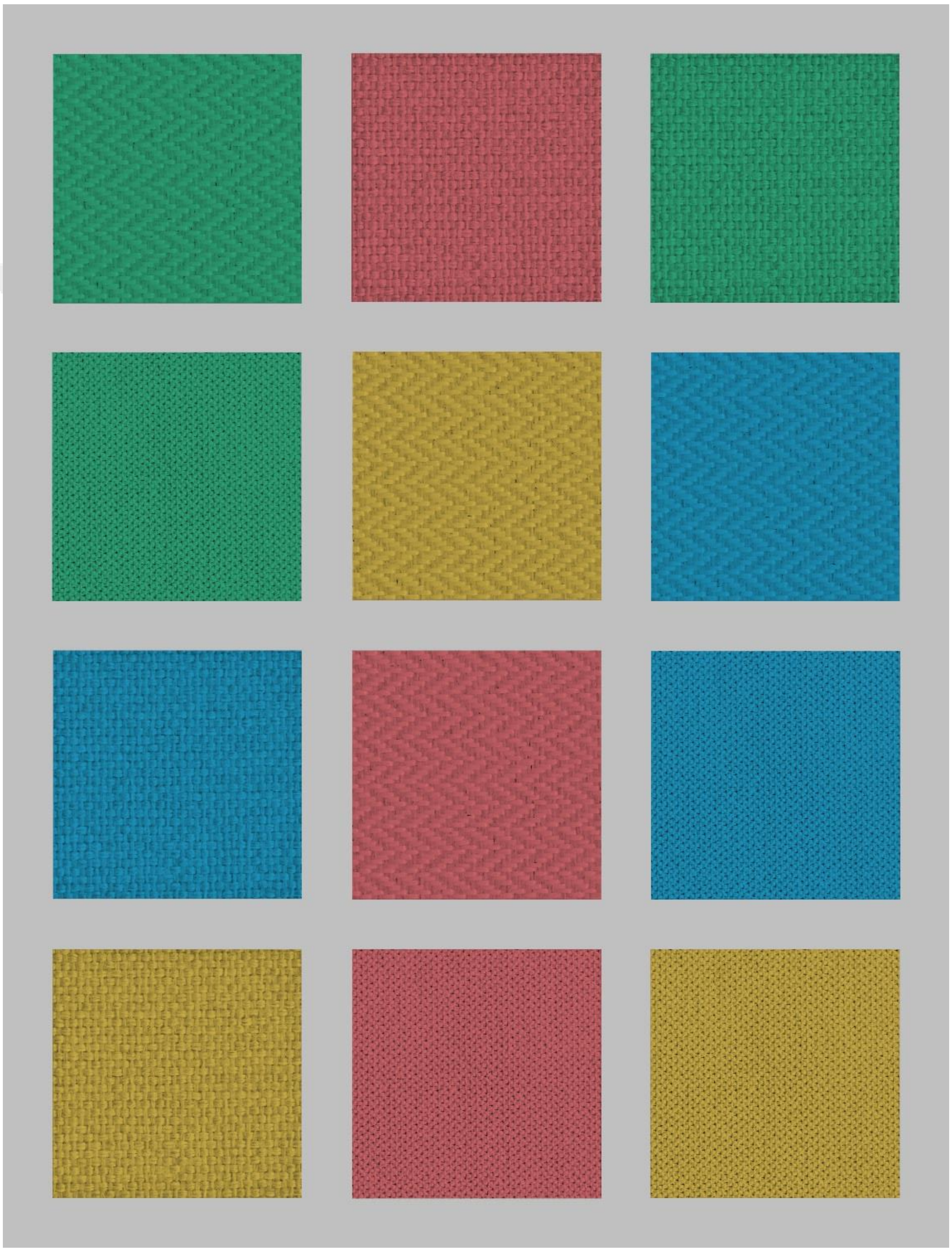
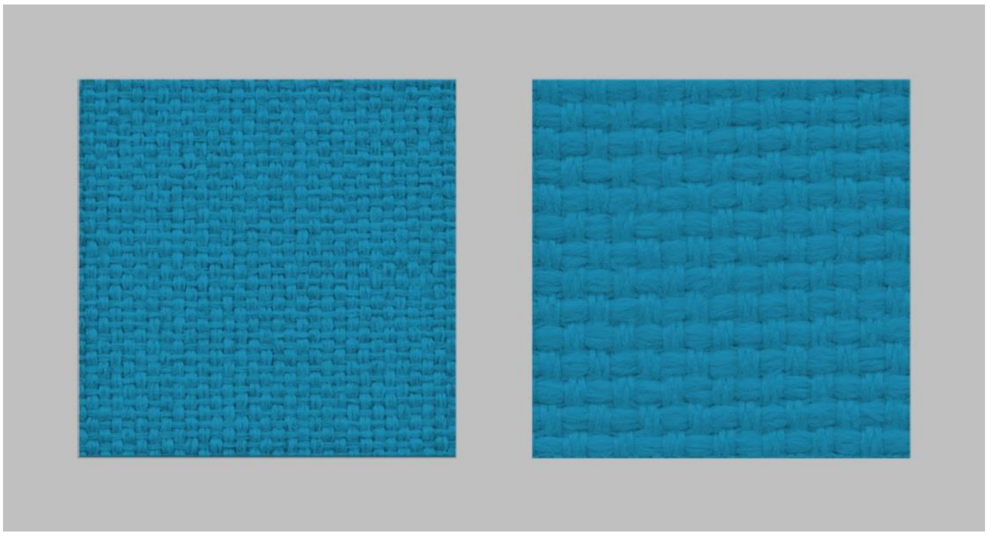
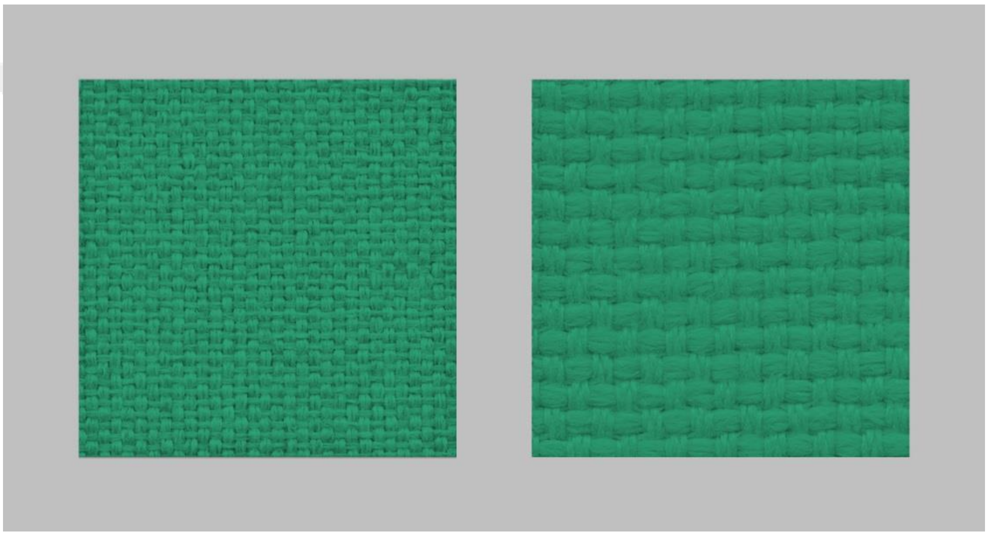
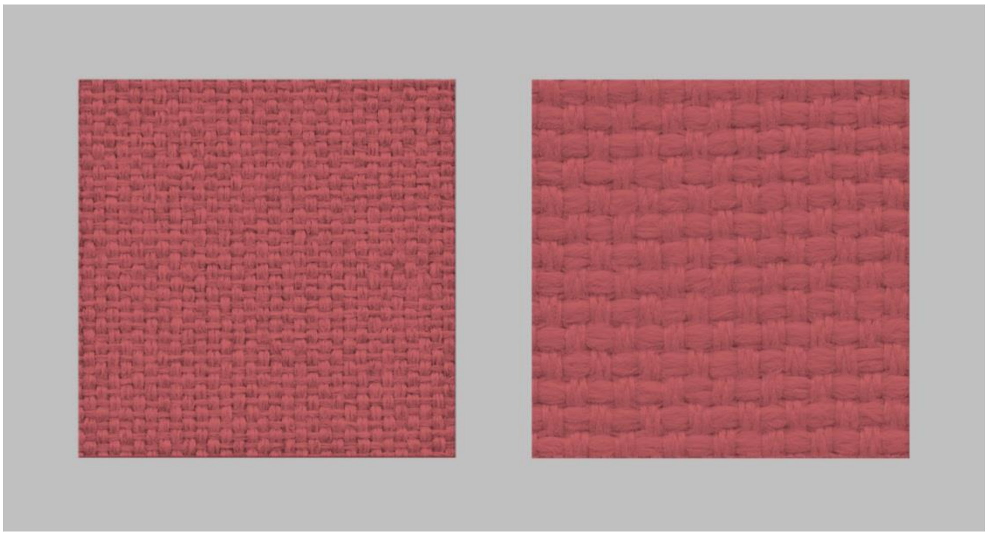


Figure 43.A randomized sequence shown to one of the respondents







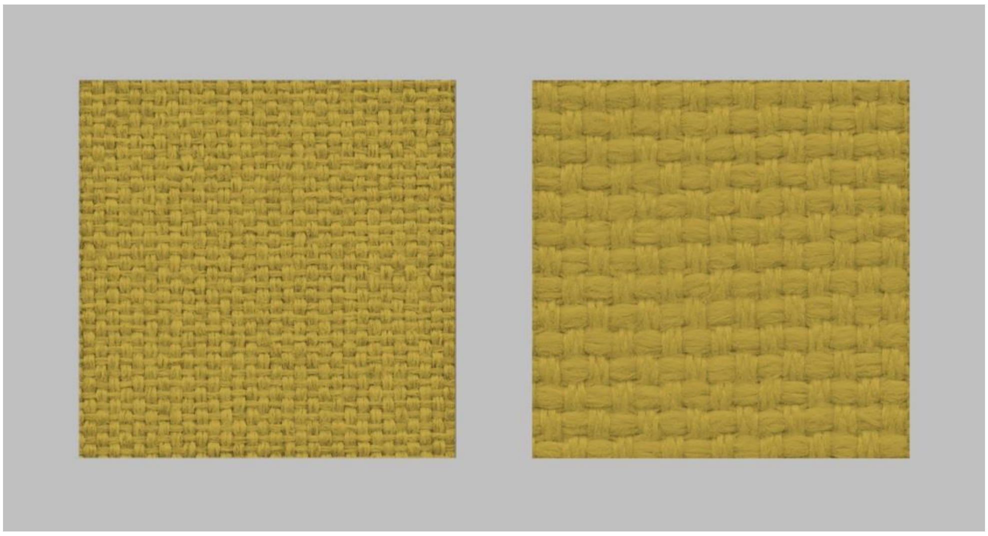
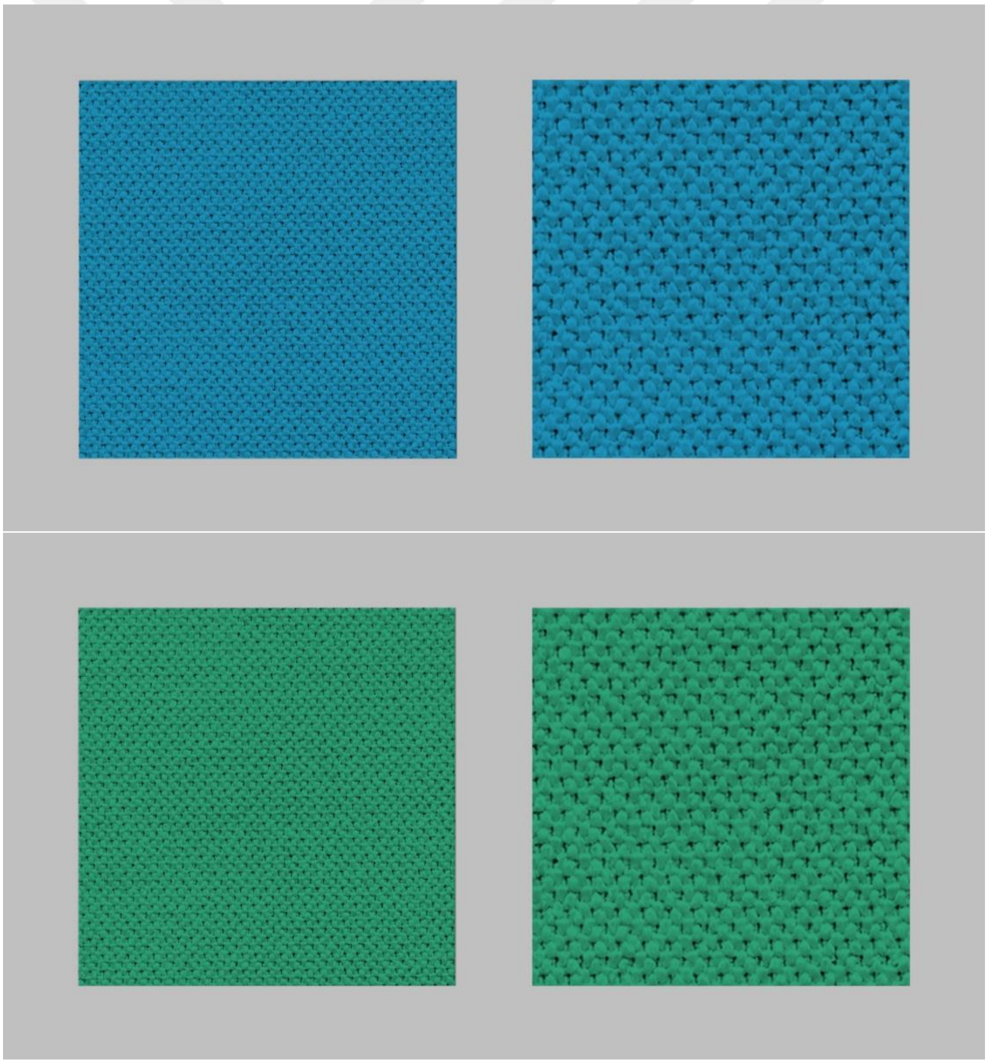


Figure 44. Fine coarse pairs of basket textures in blue, green, red and yellow



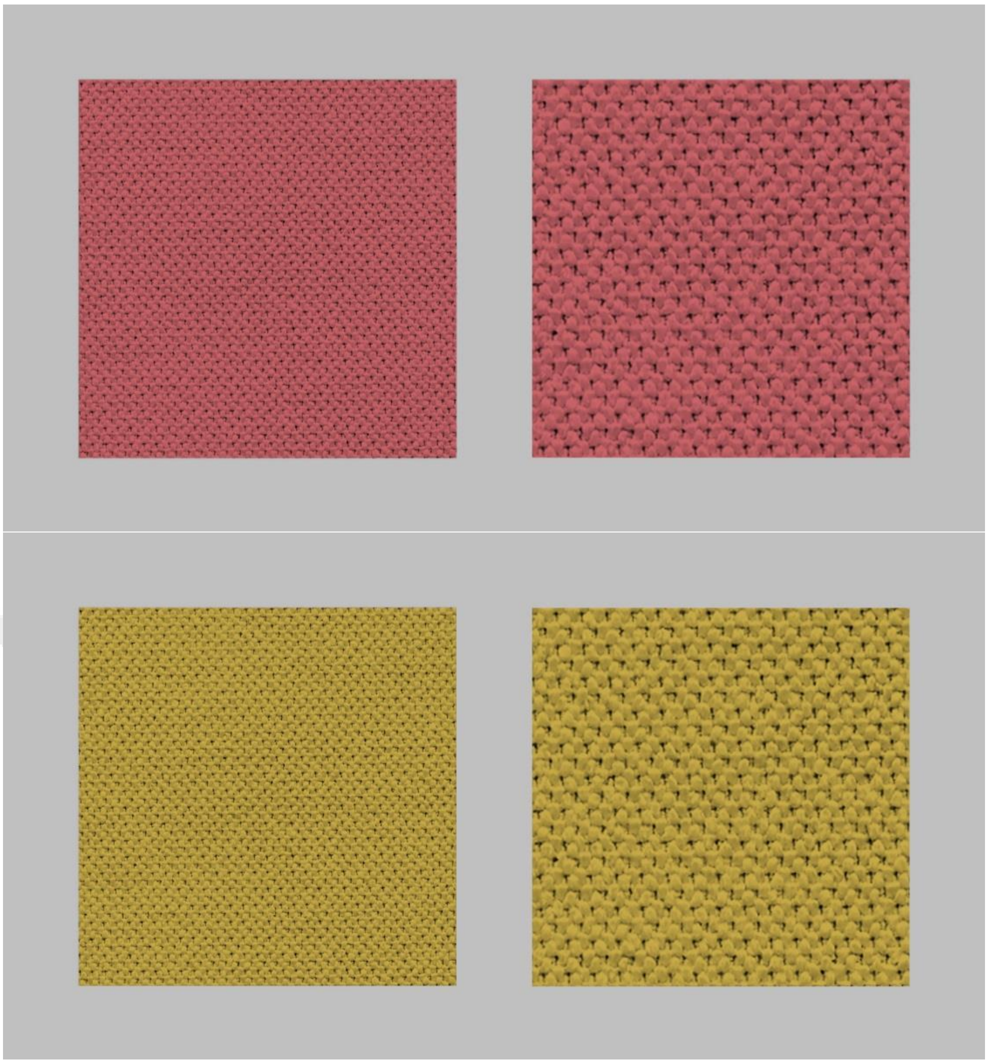


Figure 45. Fine-coarse pairs of plain texture in blue, green, red and yellow

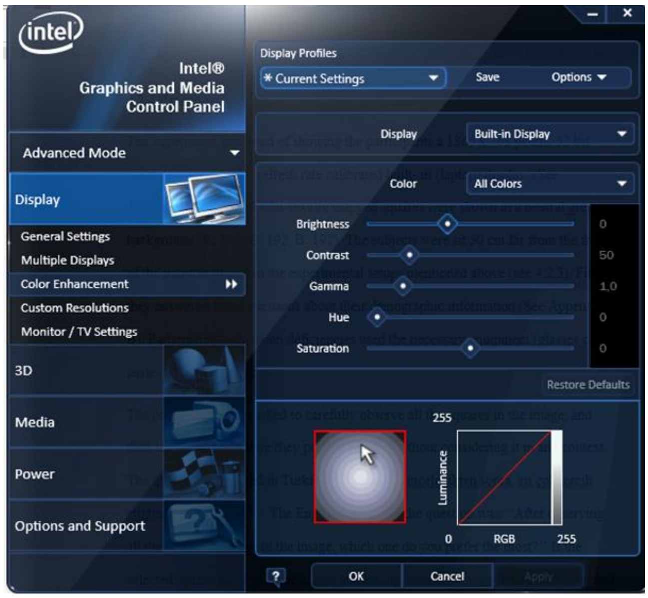


Figure 46. Screen specifications

QUESTIONNAIRE

1. Name, Surname :

2. Age:

3. Gender: F M

4. The department you are attending to:
The grade you are in:

5. Do you have any eye or vision deficiencies? If yes, please explain.

6. Do you use any correction equipment (contact lenses, eyeglasses, etc.) for any eye or vision deficiency you have? Are you wearing this equipment at the moment?

7. Have you had any courses or training related to color?
If yes, indicate its type, duration and place.

8. In my color preferences, I am:

a. Conservative (I have colors that I always like and use).
b. Changing (My color preferences are changeable/ I follow color trends).
c. Color preferences are not important to me/ I do not care.
d. I let others to decide for me.

9. Ishihara Color Test:

Yes No

Preferred chip:
Texture strength: Fine Coarse

ANKET

1. Adınız, Soyadınız:

2. Yaşınız:

3. Cinsiyetiniz: K E

4. Öğrencisi olduğunuz bölüm:

Devam etmekte olduğunuz sınıf:

5. Herhangi bir göz bozukluğunuz var mı? Varsa açıklayınız lütfen.

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

7. Üniversite eğitiminiz süresince dolaylı da olsa renk ile ilgili bir eğitim ya da ders aldınız
mı? Aldınızsa eğitimin türünü, süresini ve yerini belirtiniz.

8. Renk tercihlerimde:
a. Tutucuyum (hep sevdiğim ve kullandığım bazı renkler vardır).
b. Değişkenim (renk kullanımı tercihlerim değişir/ modayı takip ederim).
c. Renk tercihleri benim için önemli değildir/ İlgilenmem.
d. Renk tercihlerini başkalarına bırakırım.

9. Ishihara Renk Testi :

Evet Hayir

Tercih edildiği çip:
Doku düzeni : Ince Kalin