COLOR PREFERENCES IN TERMS OF VALUE AND CHROMA IN UNIVERSITY STUDENTS' DORMITORY ROOMS

A Master's Thesis

by
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Ankara

June 2022

To my granddads

Turgut and Hüseyin (R.I.P.)

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

by

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In Partial Fulfillment of the Requirements for the Degree of
MASTER OF FINE ARTS

DEPARTMENT OF
INTERIOR ARCHITECTURE AND ENVIRONMENTAL DESIGN
İHSAN DOĞRAMACI BILKENT UNIVERSITY
ANKARA

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By Serra Koz

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.

Nilgün Olguntürk

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

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

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Approval of the Graduate School of Economics and Social Sciences

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ABSTRACT

COLOR PREFERENCES IN TERMS OF VALUE AND CHROMA IN UNIVERSITY STUDENTS' DORMITORY ROOMS

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June 2022

Environments are considered as interior and exterior, both of which color is a vital part. The existing preferences studies mainly focus on hue and not enough on value and chroma which of three is the perceptual variables of color. Value has shown to be a more prominent factor in affecting color preferences than hue. The main goal of this research is to explore the relation of chroma and value to the preferences of university students. In this regard, university students expressed their preferences for 12 different surfaces taking place in the interiors of a dormitory room. Each surface was analyzed separately and the results showed that university students prefer high value in their color selections for dormitory rooms, except for two surfaces. The relationship between chroma and preferences have shown significant correlation except for the cabinet. Chroma and value were found to have a weak negative correlation. In the final part of the study, the role of gender was analyzed, considering the fact that dormitories are designed based on gender. The results indicated that gender and color preferences have a significant relationship regarding specific surfaces, differing among genders. Two surfaces were found to have statistically significant relations to males, namely, the walls, the floor and two surface showed significance for females, that are, the floor and the cabinet. All in all, the results indicate a common propensity for high value and low chroma with chromatic colors as well as a minor role of gender, effective in color preferences studies.

Keywords: Chroma, Color, Dormitory Rooms, Preferences, Value

ÖZET

ÜNİVERSİTE YURTLARINDA ÖĞRENCİLERİN AÇIKLIK VE DOYGUNLUK AÇISINDAN RENK TERCİHLERİ

Koz, Serra
İç Mimarlık ve Çevre Tasarımı Bölümü Yüksek Lisans Programı
Danışman: Doç. Dr. Nilgün Olguntürk

Haziran 2022

Mekanlar iç ve dış alanlar olarak ikiye ayrılır ve renk bu ortamların vazgeçilmez bir parçasıdır. Rengin üç algısal değişkeni vardır: Renk, doygunluk ve açıklık. Literatürde renk tercihi çalışmaları doygunluk ve açıklıktan çok renk üzerine gerçekleştirilmiştir ve bu üç değişken rengin algısal değişkenlerdir. Açıklık renk tercihlerini renkten daha fazla etkileyen faktör olarak öne çıkmaktadır. Bu araştırmanın temel amacı ise üniversite öğrencilerinin renk tercihleri ile açıklık ve doygunluk arasındaki ilişkiyi incelemektir. Bu kapsamda üniversite öğrencileri, bir yurt odasının 12 farklı yüzeyi için tercihlerini belirlemiştir. Her yüzeyin tek tek incelenmesi üzerine üniversite öğrencilerinin, yurt odalarında, iki yüzey haricinde, açıklık değeri yüksek tercihler yaptığı ortaya çıkmıştır. Doygunluk ve renk tercihleri arasındaki ilişkinin, dolap yüzeyi dışında, önemli bir ilişkiye sahip olduğu görülmüştür. Açıklık ve doygunluk arasında ise zayıf bir negatif ilişki bulunmuştur. Yurt odalarının cinsiyet temel alınarak tasarlanması sebebiyle, çalışmanın son aşamasında renk tercihlerinin cinsiyete bağlı olup olmadığı araştırılmıştır. Sonuçlar, cinsiyet ve tercihlerin, kadın ve erkek olmak üzere iki cinsiyet için yalnızca belirli yüzeylerde kayda değer bir ilişkiye sahip olduğunu göstermektedir. Erkeklerde duvar ve zemin olmak üzere iki yüzey için tercih

edilen renkler, cinsiyet ile istatistiksel olarak anlamlı bir ilişki gösterirken kadınların renk tercihlerinde zemin ve dolap cinsiyet ile anlamlı bir ilişkisi olduğu görülmüştür. Bu çalışma ile elde edilen veriler bütün olarak incelendiğinde, kromatik renkler ile yüksek açıklık ve düşük doygunluk değerlerinin tercih edildiği ve cinsiyetin renk tercihlerinde küçük bir rolü olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Açıklık, Doygunluk, Renk, Tercihler, Yurt Odaları

ACKNOWLEDGEMENTS

I would like to begin by thanking my advisor Assoc. Prof. Dr. Nilgün Olguntürk for her valuable support and encouragement throughout this study. It has been a privilege to work with her.

Secondly, I would like to thank all the members of the examining board, Asst. Prof. Dr. Çağrı İmamoğlu and Assoc. Prof. Dr. İpek Memikoğlu, for their valuable evaluations, comments, and recommendations expressed during the thesis defense.

I also sincerely thank İlker Kalender for his support and sharing his vast knowledge with me for the statistical part of this thesis.

Many thanks to Kemal Batuhan Abut for his valuable contribution to this thesis by the design of the highly detailed website specified in the methodology part.

Lastly, I would like to express my gratitude to Deniz Karaytuğ for her endless encouragement and the final proofreading.

I would like to state my appreciation to my beloved family, Lokman, Hanife, Beyza and Fatih, for their endless support, their invaluable tolerance, and the never-ending patience they have shown me throughout my thesis process. It was very hard for me to overcome all obstacles but I held on to my belief that I have to do my best for them, especially during hard times. I lost a grandparent of mine in the middle of my working process on this thesis. I am sure my grandfather watches over me from the sky now and is proud of me. Rest in peace.

Last but not least, I want to express my endless gratitude to Burak Ballı, who encouraged me a lot not only in this thesis process but in every part of my life. I am a very lucky person to have met you and cannot wait to spend rest of my life with you with huge smiles on our faces.

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CHAPTER I

INTRODUCTION

People spend most of their time in interior spaces, environments of which color is an integral part. Environmental psychologists focus on the effect of color and agree that it plays a significant role on lives of individuals. Color may have an effect on individuals' cognitive performance (Al-Ayash et al., 2016; Mehta & Zhu, 2009; Yildirim et al., 2007), productivity and moods (Kwallek, 1996; Kwallek et al., 2007), performance (Ainsworth et al., 1993), emotions and behaviors (Elliot & Maier, 2007; Ou, Lou, et al., 2004; Ou, Luo, et al., 2004a, 2004b) in different places. It is the most feasible and easy to alter architectural element. To illustrate, adding proportions of color around a room with the help of small pieces of fabric or choosing to painting a whole wall would affect and alter the aura of that interior space. However, the usage of color has no certain rules so as to which colors should be used and where; hence designers do their best to create and contribute to what they consider the optimal aura of a place, deciding either instantly or based on some rules regarding the users of that place, i.e., the contexts and contents.

Spaces to which people are exposed on daily bases can be divided into two categories, as natural environments and built ones. The latter, which can be called human-made spaces, can be described as offices, residential areas, entertainment buildings, etc., whereas natural spaces would be parks, forests, and so on. Every environment has different impact on people, since their contexts are different from each other. For example, residential spaces are where people mainly desire to relax, when office environments are expected to encourage productivity of users as they work.

It should be noted that university education is an important period in an individual's life, possibly enabling them to start one step ahead in their future professional life. Beginning from their freshman year, university students are specifically exposed to various spaces in the built environment, some of which are classrooms, social gathering areas, and dormitories. "Many students prefer accommodation at the dormitories, especially the ones who reside out of their university town, considering the advantages of dormitories" (Jouhari et al., 2014, p. 21). Architects and interior designers should work on the architectural elements of the built environment with respect to the needs, the thoughts, and the preferences of potential users, which, hereupon, will refer to university students, regarding the context of this thesis. Classes and social gathering areas are widely studied in terms of architectural points of view; when, in contrast, dormitories have not been studied thoroughly enough. This said lack of interest in dormitories within architectural context disregards the potential effects on well-being, and the academic achievements of students, in many ways. Hence, the design of dormitories should be particularly studied on so as to increase university students' quality of life.

In the light of the above, this study examines the effect of color on dormitories with regards to its potential role in university students' mindsets and preferences; looking to improve their quality of life, using, as stated before, the most feasible architectural property of the built environment, color.

1.1. Aim of the Study

This study aims to investigate whether there is a relationship between the color preferences of university students and the nature of the said relationship; examining the two attributes of color, value and chroma, in the chosen environment, that is the dormitory rooms. In the literature, color studies mainly focus on either different or single hues; disregarding the fact that there are two other attributes of color, value and chroma, and their potential importance. There is a lack of information in the literature, as only a small number of studies focus on value and chroma, hence a consensus on the two is yet to be reached. All in all, there is a gap in the literature due to the lack of past research on dormitories.

Research shows that scholars frequently use two color systems, the Natural Color System and the Munsell Color System; whereas the most systematic and inclusive one known is CIELAB, on which there is also a lack in the literature due to no researchers having used it. They seem to have mainly preferred to use other color systems and then convert the necessary codes into CIELAB. Unless a new and more methodical system than CIELAB is found, this study can be used in the upcoming future by professionals and researchers from various fields –architects, interior architects, product designers, colorists, etc.– in a highly scientific way.

1.2. Structure of Thesis

This thesis is composed of seven chapters. The first chapter introduces the context of study. It establishes that there is indeed a lack of research on dormitories, as well as the potential impact of dormitories on the life of a university student. It presents general information about the study and why this study is crucial for the literature. Finally, it refers to the importance of using CIELAB and it shows the structure of thesis.

The second chapter discusses what color means, as it goes into different definitions of color. Subsequently, it introduces the perceptual variables of color: hue, value, and chroma. It also discusses color systems, color models and color theories in detail and explains why CIELAB is selected as the system to be used in the thesis.

The third part is a discussion on color preference studies. It gives general information about the present studies before elaborating on some of them, which were done in different built environments, and displays their results. The chapter continues with color preference studies that were conducted regarding the perceptual variables of color and discussion on the lack of them in the existing literature.

The fourth chapter establishes the methodology of the thesis. The aim of the study with the finalized research questions and the hypotheses are established in the beginning. The sample group, the instruments, the setting, and the procedure of the experiment are explained in detail.

The fifth chapter sets and displays the results of the experiment. It consists of the statistical analysis of the data followed by a discussion on the subject which is in the sixth chapter

In the seventh chapter, the conclusion and limitations of the study are explained. Future implications are noted for designers, architects, and anyone who could be interested in the upcoming color preference studies.

CHAPTER II

COLOR

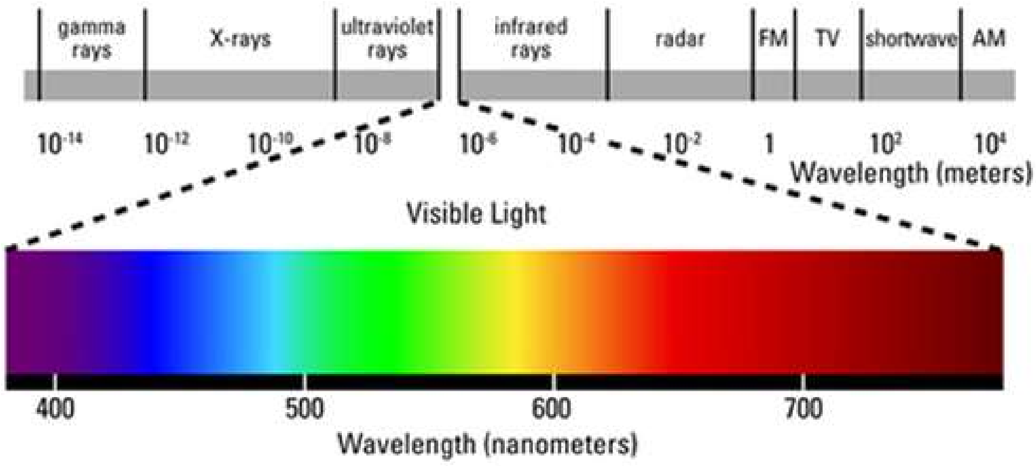
2.1. The Concept of Color

Color is a phenomenon that has fascinated humankind from the beginning of time. Artists, scientists, physicians, chemists, designers, musicians, writers, and many more were affected and inspired by the ways it exists in nature. R. M. Evans, one of the pioneers of color, stated that color has various meaning (Agoston, 1979). To exemplify, color might be used to define properties of materials, such as “red table”, “blue sky”, “green leaves”, etc., it may refer to a property of light, such as “red traffic light”. In short, the various concepts of color are widely used in many aspects of the daily life.

Color scientists define color as a characteristic of light that is called *stimulus* (Agoston, 1979). Light is a form of energy. The colors red, blue, yellow, etc. are what correspond to specific wavelengths in the electromagnetic spectrum. The human eye can see only a certain amount of light from the electromagnetic spectrum, which falls in the range from 380 nanometers to 780 nanometers (Agoston, 1979) as it is shown in Figure 1.

Figure 1

The electromagnetic spectrum with visible light region

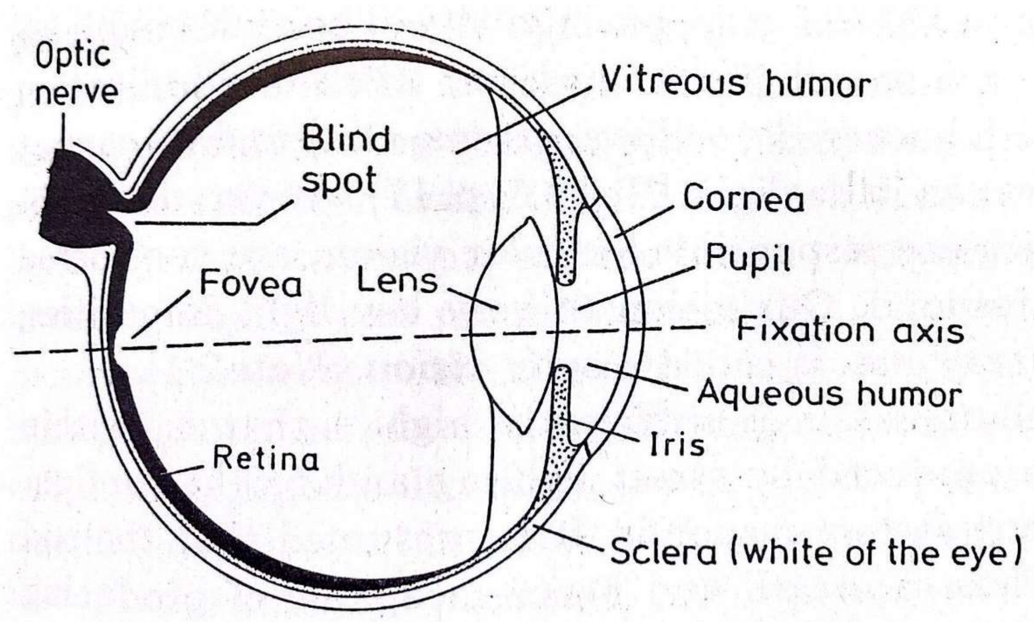


Note. From "Study and Analysis of Atomic Spectra" by Nayak et al., 2020, *International Journal of Scientific and Research Publications (IJSRP)*, *10*(11), p.946. CC BY-NC.

Biologically, people perceive color *stimuli*, through their eyes. Light enters and passes through the eye by the *pupil* and *lens,* before transversing in the back of the eye, *vitreous humor* (Agoston, 1979) as it is exemplified in Figure 2. As it falls on the *retina*, optic nerves send a signal to the brain, which causes the perception of color (Padgram & Saunders, 1975).

Figure 2

Semantic diagram of the horizontal cross section of the right eye



Note. From *Color Theory and Its Application in Art and Design* (p.7), by G. Agoston, 1976, Springer-Verlag Berlin Heidelber.

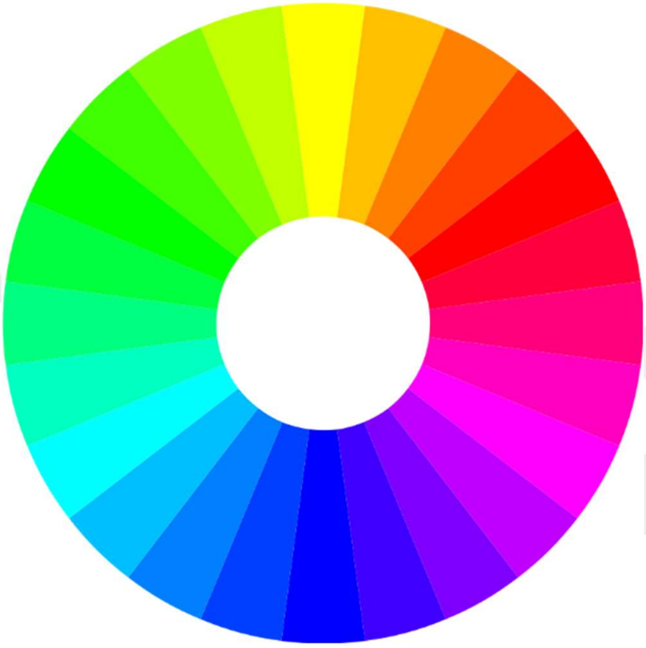
Specifically, color has three perceptual variables: hue, value (lightness), and chroma (saturation) (Alexander & Shan Sky, 1976). More information on these variables is provided in the following subsections.

2.1.1. Hue

Put in simple terms, hue can be defined as the color name like red or green. In other words, when we talk about a red apple, we simply perceive a red hue. The example of 24 different hues is in Figure 3. Color is classified into two as cool and warm colors. Warm colors – red, orange, yellow – are the colors that near to 780 nanometers and cool colors – green, blue, purple – are the colors that near to 380 nanometers (Bailey & Davoli, 2006). Also, warm colors correspond to long wavelengths colors and cool colors correspond short wavelengths.

Figure 3

24 hues

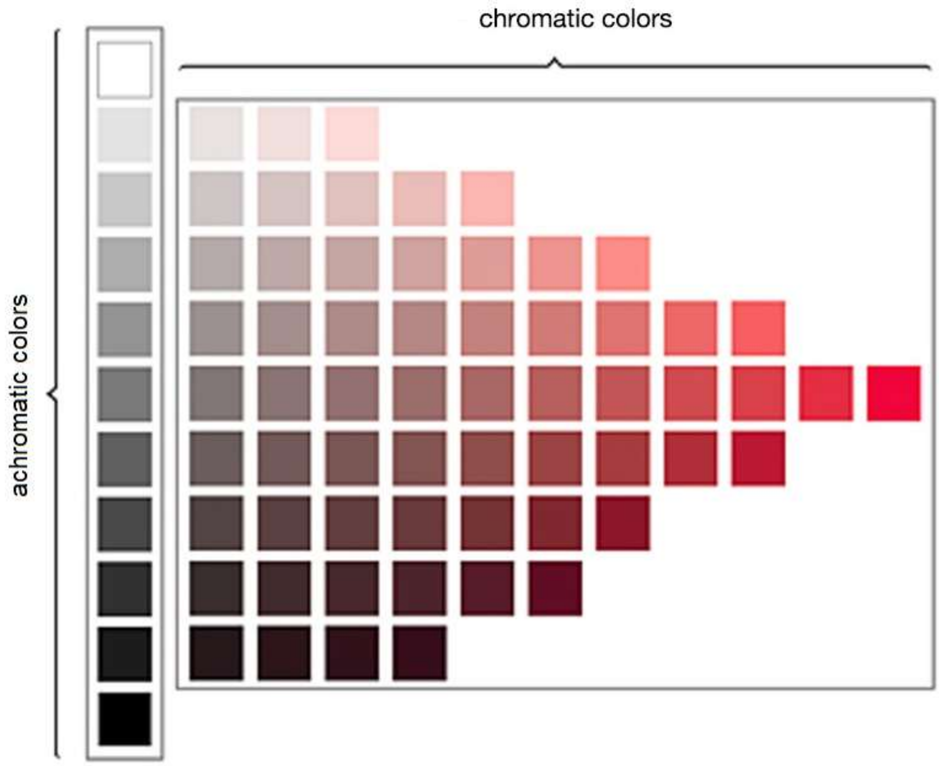


Note. From Hue. In *Wikipedia*, 2022 (https://en.wikipedia.org/wiki/Hue). Copyright 2022 by Nemeth, L.

Newton explored the color spectrum and introduced basic hues that are red, orange, yellow, green, blue, and purple – colors of the rainbow – as a result of his experiment (Agoston, 1979). Perceived colors are divided into two categories: achromatic colors and chromatic colors. Elementally, achromatic colors are ones that lack hue, such as white, grey, and black, as shown in column of Figure 4; whereas chromatic colors have hue, such as red, orange, yellow, green, blue, and purple. Red hue is portrayed as an example in Figure 4.

Figure 4

Achromatic and chromatic color scheme



Note. From "Chromatic and Achromatic Colors". In *Mau Art & Design Glossary*, 2022 (https://art-design-glossary.musabi.ac.jp/chromatic-and-achromatic-color). Copyright 2022 by Musashino Art University.

2.1.2. Chroma

Chroma can be defined as the purity of color or the strength of hue. The words chroma and saturation are used interchangeably. It is what separates colors that are vivid from ones that are dull. Adding achromatic color (greys) to a pure hue decreases the level of chroma. For instance, the level of chroma is what sets red and pink apart, i.e., pink has lower saturation than red (Agoston, 1979). The purest color has the highest level of chroma.

Color studies mainly focus on hue, of either a single color or combinations of colors (Bonnardel et al., 2018; Read & Upington, 2009; Torres et al., 2020;

Zhang et al., 2019). However, the importance of the two other perceptual variables of color, value and chroma, are still being discussed upon. Yi and Kang claim that “people perform activities in a comprehensive environment composed of a variety of colors, and scenes with single or certain pure colors are very rare” (2020, p. 513) and suggest that hue was found to have a weak connection with color preferences, unlike chroma, which was found to have a rather significant impact (Yi & Kang, 2020).

2.1.3. Value

Value is the attribute of perceived color used to detect how close a color is to black or white. Lightness can also be used instead of value, as it commonly is. Dark colors have low value, whereas light colors have high value (Agoston, 1979). For instance, in additive color mixtures, value of a color can be attained by different methods. One of such methods is adding a color to white, which results in the tints of the color or, conversely, adding black to a color, which results in the shades of the color. Tints and shades of colors are used to attain different ones, whereas adding grey results in the tones of said colors.

Color studies considering value are very limited in the literature. Some studies suggest light, in other words, high valued colors to be preferred most with high chroma (Jiang et al., 2020; Zhang et al., 2019). Thus, it is obligatory to look into the three perceptual variables of colors both separately and together in order to reach a common sense.

2.2. Color Systems

Human beings perceive colors with their eyes, as stated in Chapter 2.1. Although, colors themselves bears the need of a way of universal communication in the industry. For example, describing an object as blue might be a different process for different people since their environment, age, cultural background, geographical location, and other factors might affect the definition of blue in their minds. This is the reason why color systems and its models were invented, so as to specify colors. Before analyzing the color systems, we should look at the details of color theories since colors systems are based on the theories.

2.2.1. Color Theories

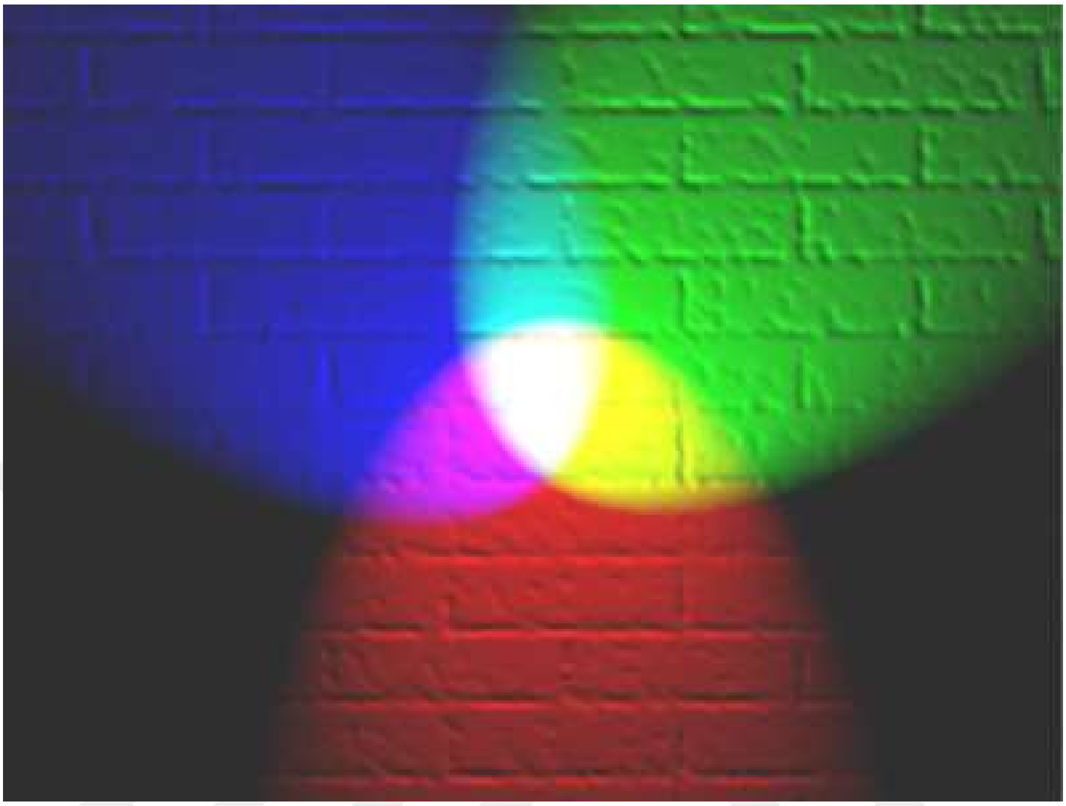
Although color has been a part of human life since the beginning of it, the scientific research on color dates back to the 17th century, thanks to the interest of Isaac Newton. He stated that even the colors white and black can be achieved by the proper mixture of light (Balaraman, 1962). Thereafter, color mixture curves emerged with Maxwell, König, and Abney in 1900s, followed by some American color scientists, among which two leading names were Thomas Young and Helmholtz. Maxwell contributed to the literature in the 20th century by the help of Isaac Newton's studies, which were conducted almost 100 years ago (Schanda, 2007). Munsell and Ostwald tried to find a way to teach color and so they developed different color systems to identify and specify colors (Agoston, 1979). Itten, Kardinsky, Birren, Munsell, Albers also designed different color models to teach color to their students. Today we are still widely utilizing those systems since they are easy to understand

and explain the basic concepts of color sufficiently, despite some lack of information they hold. Before introducing the color systems, it is obligatory to analyze the color theories such as *Trichromatic Theory, Opponent Process*.

Fovea, a part of the human eye, as shown in Figure 1, contains three different cone cells which enable the human perception of colors. These cone cells have specific sensitivities to detect specific wavelengths; as in normal human vision, red receptor perceives the color red, green receptor perceives the color green, and blue receptor perceives the color blue. The initials of the cone cells -red, green and blue, three primary colors of the additive color mixture- constitute the Trichromacy Theory abbreviation, RGB which was found by Thomas Young and Hermann von Helmholtz. For example, white color stimulates all the receptors and brain respond the color white as white. Yellow stimulates red and green receptor and brain respond as yellow color as it is labelled in Figure 5. As a result, in order to form the color yellow, we need to put green and red light together, which is called the additive color model (Balaraman, 1962). Since these colors are achieved by light, current usage areas of the RGB Color Space are televisions, projection machines, digital cameras, any electronic device using LED displays, etc.

Figure 5

RGB color mixture

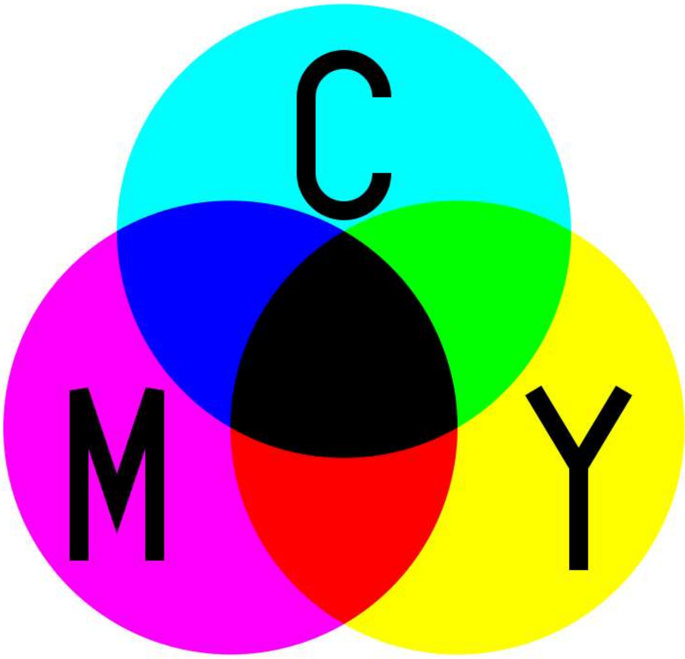


Note. From *Additive Color Mixing*. In Wikipedia, 2007 (https://en.wikipedia.org/wiki/RGBcolormodel)

Another color theory called the *Opponent Process Theory*, put forward by Ewald Hering, claims that there are three primary colors: cyan, magenta, and yellow (abbr. CMY). The theory is also called the *Subtractive Color Model* and is portrayed as shown in Figure 6 It is generally used in printing and producing dyes. Each of the CMY colors absorbs different RGB colors –cyan absorbs red, magenta absorbs green, and yellow absorbs blue– and for this reason, the Opponent Process Theory is against the Trichromatic Theory. The two theories are perceived in different areas of the brain. Furthermore, the model not enabling shade addition led to adding a key black part to the charts, changing the abbreviation to CMYK (Dill et al., 2012).

Figure 6

CMYK color mixture



Note. From *Subtractive Color*. In Wikipedia, 2006 (https://en.wikipedia.org/wiki/Subtractive_color)

In the early 20th, many developments were made on the model in order to teach color theories and applications. Some of the color systems used today are clarified in the following subsections.

2.2.2. Various Color Systems

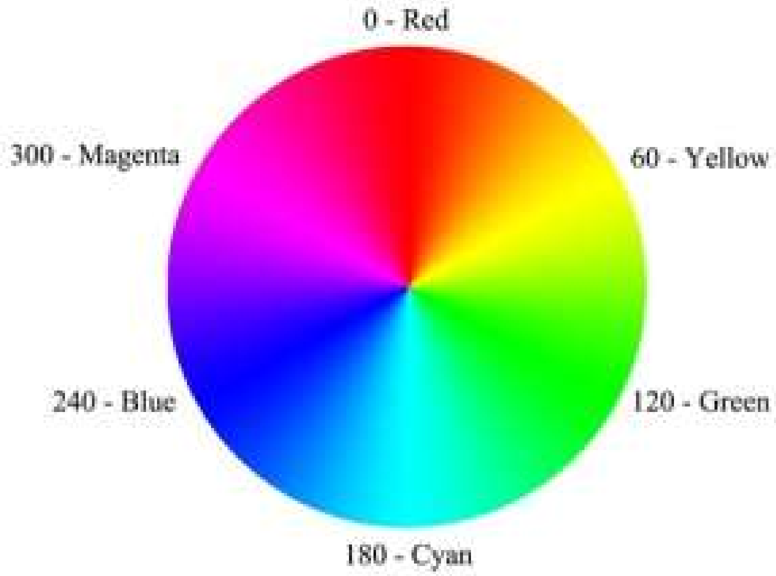
Color system and model designs are generally based on different theories, such as the Trichromatic Theory and the Opponent Process Theory; however, there are several newly proposed theories, as well. Some of these new systems are RGB, CMYK, Munsell, HSV, NCS, RAL, Pantone, and CIELAB. This section provides information on the most commonly used color models in the industry.

2.2.2.1. RGB Model

The RGB color model is based on the Trichromatic Color Theory. Three primary colors of light -red, green, and blue- are used as the primary colors. This model is also called the additive color mixtures. It consists of different degrees which correspond to different colors. For instance, 0° represents red, 60° represents yellow, 120° represents green, 180° represents cyan, 240° represents blue, and 300° represents magenta (Dill et al., 2012) as shown in the Figure 7.

Figure 7

RGB color wheel



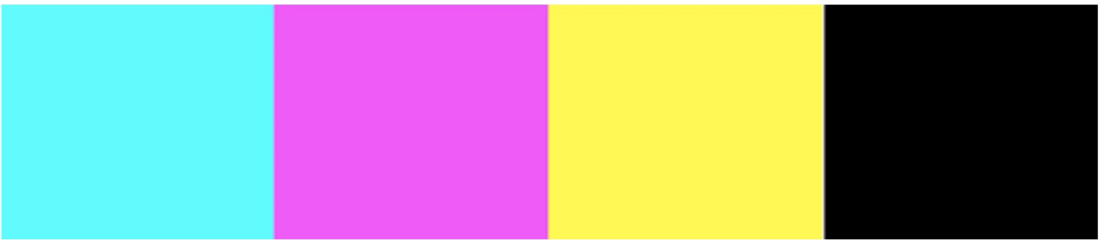
Note. From "Changing trends of color of different laryngeal regions in laryngopharyngeal reflux disease" by Du et al., 2019, *Ear, Nose and Throat Journal*, *99*(4), p.3.

2.2.2.2. CMYK Model

The CMYK model is based on the Opponent Process Theory. It is mainly used for printing colors. Each color has a printing proportion that varies between 0% to 100%. The colors used in the CMYK model is labeled as in Figure 8 (Dill et al., 2012, p.265). Since the model is used for printing, light colors are obtained with help of the white paper and dark colors are obtained by adding to other colors different portions of black.

Figure 8

CMYK colors

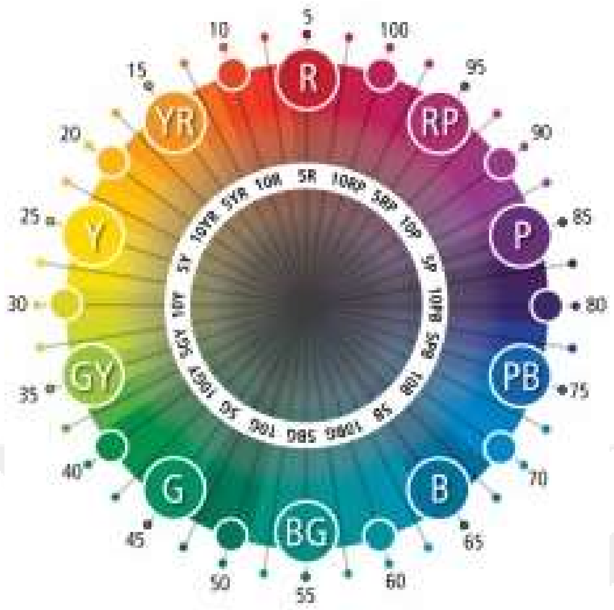


2.2.2.3. Munsell Color System

Albert H. Munsell developed his color system in 1905 and the system is used in different research fields. Munsell published The Atlas of the Munsell Color System that contains real color ships with different codes. The system consists of five hues -red, purple, blue, green, yellow- and their combinations, e.g., red-purple, purple-blue, blue-green, green-yellow, yellow-red, etc. as shown in Figure 9. The system is based on the perceived equidistance of colors. It has three different axes; the vertical axis shows different chroma levels and the horizontal axis shows different values. The value levels range between zero and ten, where ten corresponds to pure white and zero to absolute black. Additionally, chroma varies from color to color. Not all the colors have the same chroma levels; for instance, has the lowest chroma, whereas yellow has the highest (Agoston, 1979; Dill et al., 2012). as shown in Figure 10.

Figure 9

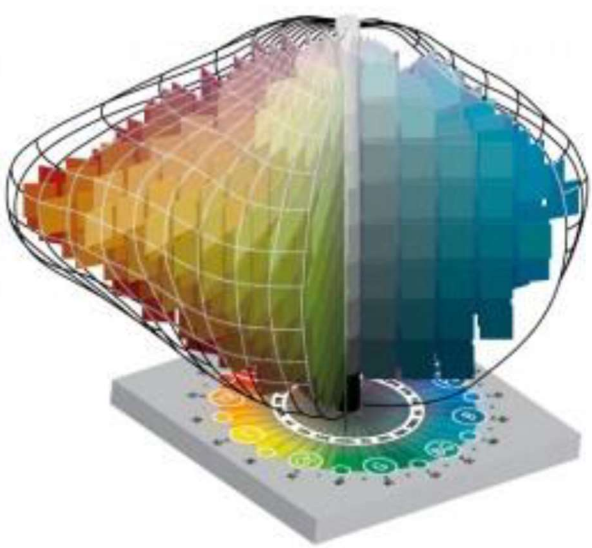
Munsell hue designation circle



Note. From *Munsell Hue Designation Circle*, by Munsell. 2022 (https://munsell.com/about-munsell-color/how-color-notation-works/munsell-hue/). Copyright 2022 by Munsell.

Figure 10

Munsell color solid



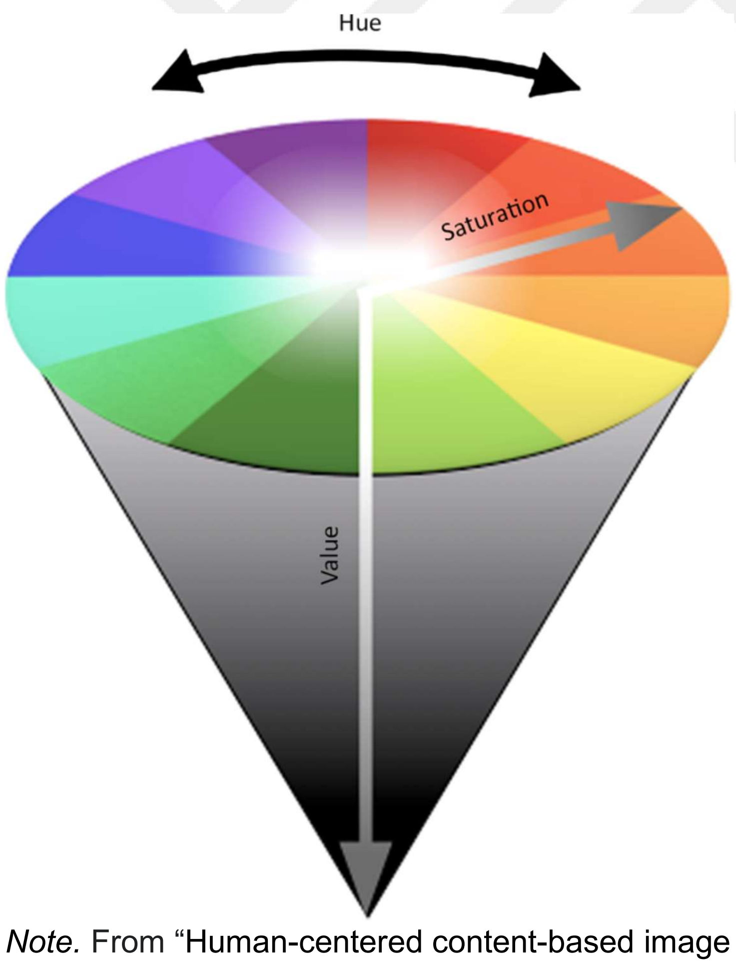
Note. From *Munsell Color Solid*, by Munsell. 2022 (https://munsell.com/about-munsell-color/how-color-notation-works/munsell-color-space-and-solid/). Copyright 2022 by Munsell.

2.2.2.4. HSB and HSV

RGB and CMYK models are born from the insufficiency of using perceived colors. The HSB (Hue, Saturation and Brightness) or as it is sometimes called, the HSV (Hue, Saturation and Value) models are attempts to find a relationship between digital color matching and perceived colors. Different hues are selected from the horizontal axis and lightness, from the vertical axis of a three-dimensional cone (Figure 11). Vertical axis shows different value (brightness) levels. The center of the model represents the achromatic (hueless) colors (Dill et al., 2012).

Figure 11

Three-dimensional cone representation of hue, saturation and value



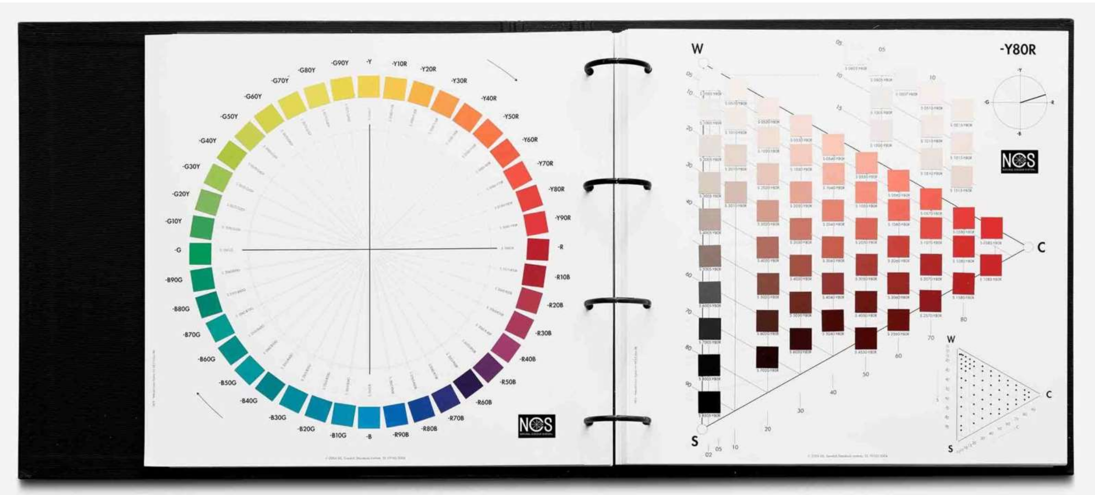
Note. From "Human-centered content-based image retrieval", by Van den Broek et al., 2008, *Human Vision and Electronic Imaging XIII, 6806*(February), p. 24.

2.2.2.5. NCS

Natural Color System (NCS) is based on the human perception with normal color vision. The current version of NSC was developed by the Swedish Color Center. Architects, designers, and industrial designers mostly use the NSC colors. The primary colors of this system are red, yellow, green, and blue, along with black and white. To use NCS colors, the hues should be determined first, which are denoted as Y, R, G, B or their combinations, YR, RB, BG, GY. Then, the chromaticness of the colors should be decided upon, which is denoted by C (chromatic component) and afterward, the white (W) and black (S) should be defined. Swedish Color Centre Foundation stated that people who have no experience with any color model can easily use NCS. They also published the Color Atlas, which involves more than 1400 color chips (Agoston, 1979). A page from Color Atlas is shown in Figure 12.

Figure 12

Natural color system atlas



Note. From *NCS – Natural Color System*, by nc. 2022 (https://ncscolour.com/ncs/). Copyright 2022 by NCS

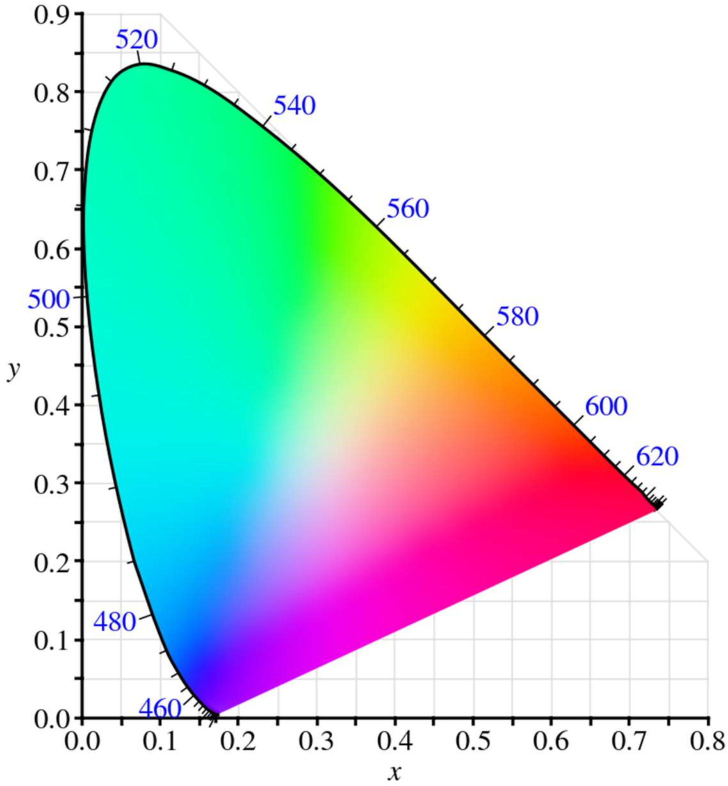
2.2.2.6. CIELAB

The lack in the literature raised the need of an international system and thus The International Commission on Illumination (*Commission Internationale d'Eclairage,* abbreviated as CIE) invented a system that basically consists of color measurements, i.e., *colorimetry* (Schanda, 2007). This section essentially concentrates on the CIE colorimetry; its history, understanding, and usage in the industry.

John Guild worked on the description of the algebraic and geometric methods that would then be used to specify colors. different wavelengths correspond to different colors, as is seen how short wavelengths correspond to blue, medium wavelengths correspond to green, and long wavelengths correspond to red; he noted that the three independent variables are needed to specify for obtaining color codes. Guild dealt with color specification and, in the process, came up with various apparatus to measure colors via RGB. He published the results he obtained on color mixture curves, at the viewing condition of a 2° fovea. His publication was accepted in the CIE meeting that took place in the United States in 1928. Wright found a variation in the coefficient among observers for perception. The perceived difference among the colors by the human eye was investigated. In 1929, based on the theory and works of König and Abney, trichromatic coefficient for spectral color distribution was derived and noted that white color is at the center. CIE adopted the derivation of standard observers for colorimetry, for the three primaries (the primary colors) with respect to three coordinates (x, y, z) in 1931, based on Guild and Wright’s investigations, as shown in Figure 13.

Figure 13

The CIE 1931 color space chromaticity diagram



Note. From The CIE 1931 color space chromaticity diagram. In *Wikipedia*, 2022 (https://en.wikipedia.org/wiki/CIE_1931_color_space).

Along with the fact that two investigations used RGB models, the CIE published a formulation for converting color codes in RGB. The rationale for the formulation of CIE XYZ to RGB was to utilize different primary colors. (Schanda, 2007). The shape of the chromaticity diagram was not consistent, which made the viewpoint crucial. The 1931 Colorimetry diagram was based on 2°, which had a very narrow angle, although it could be suitable within a range of 1 to 4°. Nonetheless, a larger viewpoint was still needed and so based on the works of Stiles, Burch, and Speranskaya, CIE proposed the 1964 standard observer with 10° fovea (Agoston, 1979; Schanda, 2007). Afterward, CIE recommended two uniform spaces for color specifications in

1976, called CIELAB and CIELUV. Both systems were developed based on the 1931 colorimetric diagram. The difference between CIELAB and CIELUV is fundamentally the color selections. That is, in CIELAB, single color equations are formulated, whereas CIELUV correlates differences and angles of hue, value, and chroma (Schanda, 2007).

CIELAB is based on the human vision and contains more colors in its gamut. It is mathematically well-balanced and its color matching is well studied. “CIELAB is based on spectrophotometric measurements of color samples illuminated by specific types of lighting and uses the responses of a standard observer” (Fehrman & Fehrman, 2015). In other words, it is based on the uniform color system that many people can utilize for color matching and color differentiation purposes (Agoston, 1979).

On CIELAB, the positive a* axis consists of red stimuli whereas negative a* axis is green and similarly, positive b* axis is yellow stimuli, whereas negative b* axis are blue stimuli. L* is defined as luminance or lightness. The hue angle in CIELAB can vary between 0° and 90° when a* and b* are positive; 90° and 180° when b* is positive and a*, negative; 180° and 270° when a* and b* are negative; 270° and 360° when b* is negative and a*, positive. The level of L* corresponds to lightness or value as it ranges from 100 to 0. The other perceptual attribute of color which is chroma (saturation) is the distance between central axis and either a* or b*. In order to visualize the CIELAB system please see the Figure 14 and Figure 15 (“A Guide to Understanding Color,” 2016, p.12).

Figure 14

CIELAB Color Chart 1

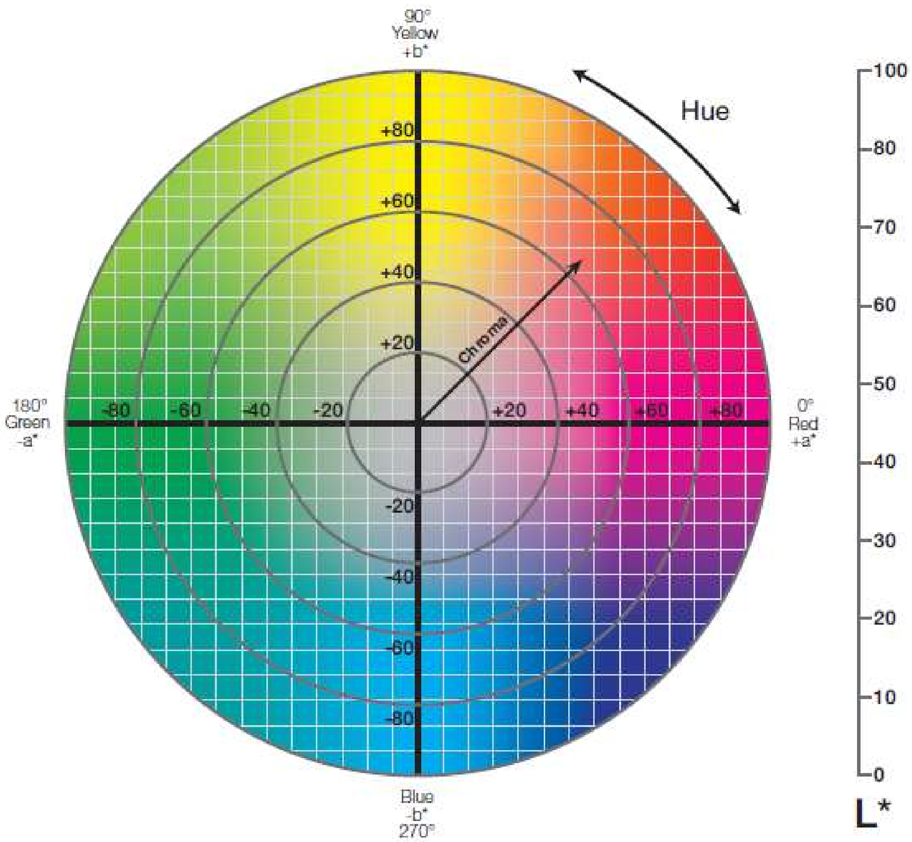
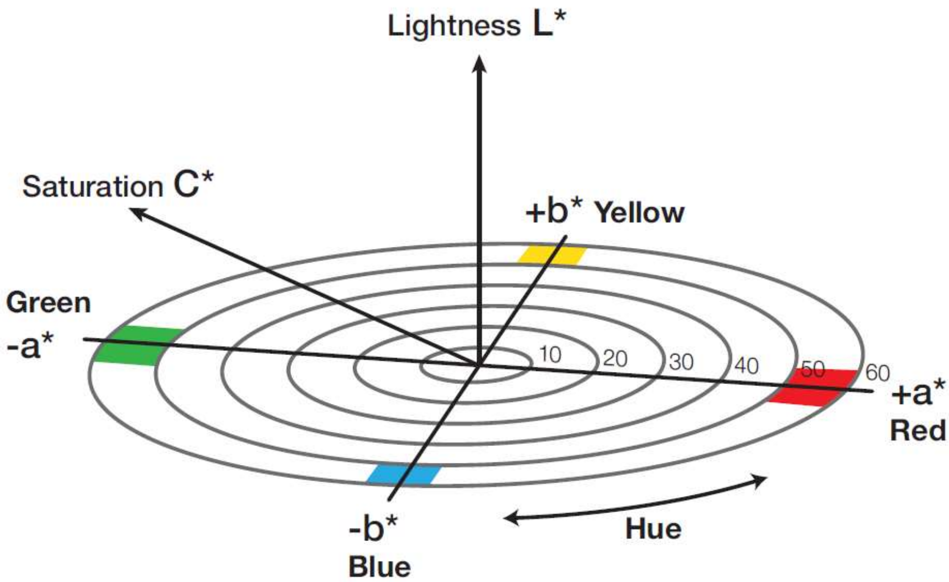


Figure 15

CIELAB Color Chart 2



2.2.2.7. Other Color Systems

There are several more systems, such as Pantone and RAL. Pantone takes printing as its baseline and thus it is derived from the Opponent Process Theory. Pantone colors do not consist of different colors; instead, each color has its own, single unit. Pantone is globally used for printing materials (Pantone et al., 2014). The other system mentioned is the RAL Design System, which is mainly used by architects. The color arrangement in RAL Design System has a basis consisting of hue, value, and chroma, as well. The provided colors in RAL Design Systems are juxtaposed with CIELAB Colors.

CHAPTER III

COLOR PREFERENCES

3.1. Color Preference Studies throughout History

Color is an undeniably major part of human life, considering how all surroundings have color to the human eye. Color preferences have been a matter of fascination among researchers for a long time. Therefore, throughout the years, they have tried to find a proper answer to the question of which colors are preferred by people and when. Studies on color preferences began in the late 1800s and continued through late 1900s (Chandler, 1934). Nevertheless, the notion of color preference studies relied not on color preferences in a systematic manner, but rather on the observed universal tendencies of people (Hurlbert & Ling, 2017). In 1893 Jastrow's experiment, asked individuals to choose a single color from a twelve-piece set of colored papers and the order of preferences was observed to be blue, red, light blue, blue-violet, red-violet, light-red, violet, from the most preferred to the least (cited in Chandler, 1934; and Dorcus, 1926). As Eysenck (1941) translated the first empirical approach to the color preferences problems was in Cohn's article in 1894 where Eysenck studies focus on formulating a universal order of color preferences by collecting data from 21.060 participants, of which the results were blue, red, green, violet, orange, yellow, from the most preferred to the least. According to Cohn's interpretation of the study, there was no order in color preferences as they were based merely on the taste of individuals. However, this notion was disagreed upon by some researchers; resulting in the emergence of a new claim; that color preferences are observed in an order of blue and red or green and yellow consecutively (Walton et al., 1933). Notwithstanding, Chandler (1934) also observed an order in preferences that was blue, red, light blue, blue-violet, red-violet, light red, violet, "no choice", green, yellow, and stated that orange and the shades of it were the least favorable colors.

Later on, new color preference studies suggested focusing on the preferences of individuals regarding how they were affected by different factors such as gender, cultural and social background, geographical region, lifestyle, age, personal characteristics, educational levels, and experience of using color (Eysenck, 1941). Furthermore, it was stated that the said variables, especially gender, age, and cultural and social backgrounds are not the only ones to have impact on color preferences and that there are other influential factors: the perceptual variables of color itself. The said variables of color –hue, value, and chroma– and their relation to color preferences and variables had not been indicated clearly yet (Arnheim, 1957). Furthermore, Lind (1993) claimed that both biological and social factors are effective on the preferences, regarding the perceptual color attributes.

In the 20th century, there is substantiated data of color preference studies on the most and least preferred colors. According to these, the most preferred colors are green and blue, when the least preferred colors are yellow and yellow-green (Guilford & Smith, 1959). However, the measures used in such studies are questionable due to a lack of control and calibration in the experiments. i.e., the experiments were conducted in uncontrolled environments, which causes loss of control over illumination, and held unreliable control of the used methods (Hurlbert & Ling, 2017). Despite the unreliability of past experiments, the recent studies show high preferences of the color blue and low preferences of the color green-yellow (Hurlbert & Ling, 2017; Palmer & Schloss, 2010). No matter the popular misconception, research on color preferences has yet to reach a clear consensus.

Color preferences is a very wide topic that has been covered throughout the history. Selection of colors the most and least liked or the matter of individuals' favorite colors come with some disadvantages when considering different environments. Context plays a prominent role in color preferences since people tend to evaluate their surroundings and try to find the most appropriate colors for that specific context. Some studies particularly asked for the preferred color within specific contexts such as clothing (Choo & Kim, 2003; Gage, 1995; Roberts et al., 2010; Vrij & Akehurst, 1997), food (Beauchamp & Cowart, 1987; Garber et al., 2000; Lakshmi, 2014), advertisement (Bakker et al., 2013; Hsiao, 1995; Schindler, 1986), furniture and textiles (Holmes & Buchanan, 1984; Jiang et al., 2020), and in built environment. Chapter 3.3. has the detailed information about color preferences in built environments.

3.2. Factors Affecting Color Preferences

In recent years, color preference studies have mainly studied color preferences in terms of different factors, such as the age, the gender, the educational background, the culture and geographical regions, the intellectual development, the marital status and background, the lifestyle, the personality, etc. of individuals (Bakker et al., 2013). Some of these factors effective in preferences are mentioned in the following subsections.

3.2.1. Gender

Throughout the history of scholarly work on color preferences, gender has been a controversial matter of discussion. Although color preferences remark blue as the most preferred hue, gender is commonly noted to be a deciding factor. Because Jastrow’s experiment was the first one to be conducted in color preferences history, it focused on colors directly and not on the potential effects of other factors. Nonetheless, it seems clear that there is a significant difference between the preferences of the two genders that are male and female, considering how it was observed that women voted for red more than men, whereas the number of blue preferred by women (n=1810) appeared to be almost as half as the number of blue preferred made by men (n=2746) (cited in Hurlbert & Ling, 2017). It is irrational to accept the notion as it is, since the experiment had a lack of information and system. Among some experiments that have attempted to cover the gender factor, there is Dorcus (1926), who suggested that women preferred red more than men, having sampled different age groups. This idea was supported by McManus et al. (1981), who stated that women preferred red and yellow more, compared to men, although noted the most preferred color was still blue. Nonetheless, Eysenck (1941) agreed that there is a difference between the said two genders, especially regarding orange and yellow hues; noting that women also rated higher than men when it came to the pleasantness of the colors (Helson & Lansford, 1970). In a more controlled experiment, the females in India aged between 10 to 19 showed higher selection rates of red than those of males (Sinha et al., 1970), when in another one conducted in Japan, females commonly preferred “pale pink” (Saito, 1996). A different experiment showed that children aged between 6 and 18 prefer blue and green the most; when among all ages, more saturated colors of any hue are preferred more than less saturated ones (Child et al., 1968). In contrast to these studies, some researchers argued that there is no difference between the said two genders (Camgöz et al., 2002; Granger, 1955; Ou, Luo, et al., 2004a). Consequently, it shall be noted that the role of gender in color preferences has not been agreed upon by scholars at the time. In recent years, the situation has remained the same as some researchers accept that there is a significant difference between two genders, whereas others object.

Dormitories are generally designed taking gender as a basis. The colors used in dormitories have different functions, e.g., gender coding (red for girls, blue for boys, etc.) (Jouhari et al., 2014). It is commonly claimed that gender has an impact on color preferences of spaces. In the literature, some research came to the conclusion that there is no difference in the outcomes of color preferences dependent on gender (Camgöz et al., 2002; Eysenck, 1941; Granger, 1955; Jadva et al., 2010; Ou, Luo, et al., 2004a; Torres et al., 2020); whereas others claimed to have observed gender as an influential factor on preferences (Gyu Park, 2013; Hurlbert & Ling, 2017; McManus et al., 1981; Ou, Lou, et al., 2004; Ou, Luo, et al., 2004b; P. Porter & Garth, 1934; Read & Upington, 2009; Van der Voordt et al., 2017; Walton et al., 1933; Yildirim et al., 2007; Zhang et al., 2019).

With all these in mind, the fact remains that the number of research focusing on the effects of chroma and value, together withs gender roles is very little. Zhang et al. (2019) mentioned that females tend to like light colors more than males do, when Jiang et al. (2020) came to the conclusion that males preferred different chromaticness than females did. Samimi and Sadraei (2021) claimed that there is no significant difference between the two genders with respect to individuals' preferences of hue, value, and chroma, within a group aged 5 to 6.

3.2.2. Age

Although some studies claim that age difference does not have any significant effect on color preferences across the life span of an individual (Dorcus, 1926; Wijk et al., 1999), age showed to be another determining factor of color preferences. Preference rates of blue are inversely correlated with age, whereas preference rates of red are higher among older people (Wijk et al., 1999). Dittmar's experiment (2001) was a milestone of color preferences studies with regards to the age factor, with 842 adults having participated, within the age range from 19 to 90. The participants were asked their most and least preferred colors. In this sense, Dittmar agreed with Wijk, whose analysis suggested that the preference rates of blue decreased, as those of red and green increased with age. He also concluded that color preferences vary during the lifespan of an adult individual. Manav observed in his research different age groups, from 18 to 32, from 33 to 47, and from 48 to 62, by which he concluded each group to have different preference level of black (2007). Ou et al. (2011) experimented on two main age groups, namely, young and old individuals, who were asked to match colors with word pairs and the results showed a difference among the preferences of the two groups. Additionally, preferences of orange and dark colors seemed to have increased with increasing age of subjects (Zhang et al., 2019).

3.2.3. Culture

Culture is a factor effective in people's preferences of color (Gyu Park, 2013; Lin et al., 2001; Madden et al., 2000; Manav, 2007; Ou et al., 2012; Saito, 1996; Xin et al., 2004). Saito (1996) experimented on Asian people with an attempt to find similarities and differences in the color preferences across different cultures. The latter is assumed to be the first cross-cultural color preferences study. He concluded that Asian participants have a tendency to prefer white colors more than people of other cultures do, which might be due to white being the symbol of the pure, the harmonious, the beautiful, the gentle, the natural, and the clean in Asian culture.

Study of Lin et al. (2001) examined British and Taiwanese participants, whose languages, English and Mandarin, respectively, are completely different from each other. 40 subjects from each group participated in the study. As a result, the relationship between language and color was found to be significant. Xin et al. (2004) worked on subjects from Hong Kong, Japan, and Thailand, investigating their keenness on different perceptual variables of color, lightness and chroma. The study concluded that the taste and the feelings people expressed varies depending on their culture. It shall be noted that these studies have mainly focused on different areas of color, not the preferences of it.

There are a few articles in the literature focusing on cultural background as a factor of color preferences. For instance, the study of Madden et al. (2000) focused on color preferences across different countries from East Asia, Europe, North America, and South America and the results showed variance within each country. Additionally, there is a significant difference between the preferences of British and Indian subjects (Bonnardel et al., 2018). Elder Korean and Japanese people were observed in terms of their color preferences for clothing (Shoyama et al., 2003). The difference between the two cultures was said to be of significance, and it was suggested that this difference may stem from various factors; e.g., the subjects' traditions, their cultural backgrounds, morals of their countries, and their racial consciousness. Another cross-cultural study investigated Japanese students living in Japan, foreign students living in Japan, and Iranian students living in Iran regarding the two residential interior environments (Baniani & Yamamoto, 2014). It was found that Japanese students preferred to use less color compared to foreign students and Iranian students. It is thus concluded that cultural background plays a prominent role in color preferences.

3.3. Color Preferences in Built Environments

Although many of them strongly accept that color preferences may vary within different contexts, some recent studies on color preferences have dealt with specific architectural spaces, such as cafes/restaurants (Yildirim et al., 2007), hotels (Yar Bilal, 2016), shopping malls (Kaya & Crosby, 2006; Yi & Kang, 2020), adolescents' rooms (Jiang et al., 2020), classrooms (Read et al., 1999; Yildirim et al., 2015), nursing homes (Torres et al., 2020), different parts of interiors (Van der Voordt et al., 2017), living rooms (Manav, 2007; Yildirim et al., 2011), and playgrounds (Mousavi Samimi & Sadraei Tabatabaei, 2021); yet none has mentioned dormitory rooms, specifically. It appears that yellow wall colors are said to cause lower levels of positive effects than purple do, which gives the conclusion that customers prefer short wavelengths in restaurants (Yildirim et al., 2007). Achromatic colors are suggested in educational spaces; however, the impact of color on students is significant. For example, Yildirim (2015) used three different hues, cream, blue, and pink –warm, cool and neutral colors– when making observations and concluded their effect on students to be substantial, regardless it is used only for walls. In addition, elder people touched upon the importance and their preference of using warm colors over cool ones, especially yellow hue, for activity rooms and cool colors over warm ones, especially green hue, for sleeping areas (Torres et al., 2020). Nevertheless, it is clear that white is the most preferred color, followed by “no color choice” in different parts of interior environments (Bakker et al., 2013). On another note, since preschool children spend too much time at playgrounds, a study observed indoor and outdoor playground areas of different socioeconomic classes and analyzed children’s preferences accordingly. According to Mousavi Samimi et al. (2021), cool colors for outdoor and warm colors for indoor playgrounds are preferred by children, with high levels of chroma. As it is seen from the examples, not only color preferences for different interior spaces can be conflicting, but also none of the studies focus on color preferences among dormitories.

Dormitories serve the public but in their design processes, the way that they are private spaces, as well should also be considered. Put simply, dormitories are semi-public spaces that serve the needs of students and influence students’ learning process, their performance, and their well-being while doing so. A dormitory mainly composes of a sleeping area for its users individually and a social area for all users. The social gathering areas are designed as public spaces and one can differ from another with respect to their range of usage purposes, e.g., whether they involve a study room, a TV room, a seating area, etc. Designers of dormitories may concentrate mainly on the activities that shall take place in the area and not enough on the preferences of the individuals who would use the said area. These public spaces do not require being designed for individuals specifically; nevertheless, designers must provide different types of dormitories depending on their potential usage, such as the number of people who are going to live in it. The architectural layout in their design is very similar to that of hotels but the rationales behind the two's design processes are completely different from each other. Hotels are places for short-term accommodation and thus their main focus areas are sophistication, aesthetics, relaxation, service quality, and, sometimes, luxury (Kim et al., 2020); whereas the focus of dormitories is on the needs of students who would use them for at least four years under normal circumstances. Sleeping quarters of the dormitories are designed to comprise of an area for sleeping, studying, and miscellaneous needs that would be fulfilled with bathrooms and kitchens or kitchenettes. They serve the students themselves in various contexts and for activities, yet designers provide only the basics for them. Consequentially, students may be affected in either positive or negative ways. All in all, it should be kept in mind that the sleeping areas of the dormitories are private spaces and they have significant impact on the well-being of students.

3.4. Perceptual Attributes of Color in Color Preferences

Color has three perceptual attributes that are hue, value, and chroma. Many color preference studies conducted in the past have focused on hue, rather than value and chroma. It is shown that there is a universal pattern in color preferences, seeing as how the hue preferences clearly depend on value and chroma (Hurlbert & Ling, 2017). It is agreed that blue is the most preferred color and yellow is the least preferred one (Eysenck, 1941; Zhang et al.,

2019) and that people tend to choose more saturated colors (Hurlbert & Ling, 2017). Interestingly, Palmer and Schloss (2010) have obtained almost the same results, yet also noted that higher saturation is preferred no matter what the hue is. Moreover, color preferences with respect to value and chroma mainly studied different age groups and showed that varying preferences among the participant groups. Ou et al. (2011) stated that preferences on different chroma levels are analyzed among adults and elders, which again bears the uncertainty on the preferences of different participant groups, such as undergraduate students. The role of value and chroma in preferences is prominent (Camgöz et al., 2002; Eysenck, 1941; Guilford, 1934; Jiang et al., 2020; Zhang et al., 2019) but a very limited number of sources mention about preferences of the two, especially in the context of interior spaces. Table 1 was prepared in order to summarize the past scholarly work done on value and chroma for built environments. According to Table 1, participants preferred mostly high chroma and high value for interior environments like interior rooms, adolescent room and playgrounds. It should be kept in mind that the participant group was either children or adolescents. Also, Gyu Park (2013) suggested that some hues go best with specific chroma and value levels.

Table 1

Literature review about chroma and value by Serra Koz

Author(s) & Year	Analysis from the Source	Participants / Context	Result	
			Value	Chroma
Mousavi Samimi and Sadraei Tabatabaei. 2021	Preferred saturation of cool and warm colors is same but values are slightly different.	Preschool children / Playgrounds	Preference of high value	Preference of high chroma for almost all colors
Jiang et al. 2020	Children preferred low blackness and high chromaticness.	Adolescents / Furniture color preference	Preference of high value	Preference of high chroma
Gyu Park, J. 2013	Lightness has positive correlation with yellow hue. Children prefer high chroma with hue blue.	Children / Interior rooms	Preference of high value for yellow hue	Preference of high chroma for blue hue

CHAPTER IV

METHODOLOGY

4.1. Aim of the study

This study focuses on the gap in the literature and analyzes color preferences of university students who live in dormitories, in terms of value and chroma. The relationship between color preferences and said color attributes are analyzed by using the methodology further elaborated in the following subsections.

4.1.1. Research Questions

The aim of the study is to find and answer to the following research questions:

Research Question 1: Do university students prefer high value (lightness) over low value for their dormitory rooms?

Research Question 2: Do university students prefer high chroma (saturation) over low chroma for their dormitory rooms?

Research Question 3: Is there any significant relationship between high chroma and high value in terms of university students' color preferences?

Research Question 4: Is there any significant relationship between genders and color preferences in dormitories?

4.1.2. Hypotheses

Hypothesis 1: University students prefer high value (lightness) in their dormitory rooms.

Hypothesis 2: University students prefer high chroma (saturation) in their dormitory rooms.

Hypothesis 3: There is a significant relationship between chroma and value in terms of university students' preferences.

Hypothesis 4a: There is a significant difference male between color preferences in their dormitory rooms.

Hypothesis 4b: There is a significant difference female between color preferences in their dormitory rooms.

4.2. The experiment

The experiment was approved by the İ. D. Bilkent University Ethics Committee (see Appendix A). This section provides detailed information on the participants, setting, and procedures.

4.2.1. Participants

The participants were university students who have accommodated for at least one semester in one of the dormitories of İ. D. Bilkent University. The most participated students were the ones who accommodated one semester (n=60), followed by the ones who accommodated three semesters (n=39) and two semesters (n=26) in dormitory (For more see Table 24, Appendix E). Snowball sampling was used. 200 university students participated in the experiment, although the answer of one participant was decided to be ineligible, as well as seven students who turned out to be color blind according to Ishihara Color Blindness Test (Ishihara, 1972) thus their answers were eliminated. Three plates of Ishiara Color Blindness Test (Figure 34, Figure 35, Figure 36, Appendix D). were used which are plate number eight, eleven and twelve. These plates identify both person with red-green deficiencies and person with total color blind. Hereby, the answers of 192 participants were accepted as convenient to be used in the experiment. 74 males and 118 females participated this experiment (Table 21, Appendix E). Age range of participants was 18 to 32 and the most participated ages are 19 and 20 (n=48) (Table 23, Appendix E). Participants were from different departments such as interior architecture and environmental design, architecture, economy, mathematics, philosophy, computer engineering, law, molecular biology and genetics, chemistry, industrial engineering, graphic design, mechanical engineering, American culture and literature, political science and public administration, electrical and electronics engineering, information systems and management, international relations, management, psychology, urban design and landscape architecture, physics, translation and interpretation, communication and design, English language and literature, archeology, Turkish literature (Table 22, Appendix E). The most participated department was interior architecture and environmental design (n=25) followed by computer engineering (n=21). Participants were from different classes and freshman students were the most participated (n=61) followed by sophomore (n=32) and junior students (n=32) (Table 25, Appendix E).

4.2.2. Setting

The Covid-19 outbreak and the consequentially declared pandemic caused the rise of difficulties for conducting the experiment in a physical environment. Thus, the setting of the experiment was designed to be online, with the help of a website that was prepared, https://serrakoz.lyri.cyou/. Although the online setting enabled the experiment to be conducted on a larger scale than a laboratory experiment, which would have more limits by nature, it is noted that small scale experiments conducted in laboratories could provide more accuracy due to a possibly stronger color management, i.e., because all colors would look the same to all participants. Nevertheless, despite the slight color inaccuracy caused by the varying electronic devices participants used, the number of participants was large enough to assure sufficient consistency of colors among different devices.

4.2.3. Procedure

The instruments were prepared in Turkish since all participants were native Turkish speakers. The said instruments are the consent form (Appendix B), demographic data collection sheet (Appendix C), Ishihara's test for color-blindness (Appendix D), two-dimensional line images of dormitory rooms (Figure 18), and the selected 66 color chips from CIELAB 1931 2°

fovea color gamut (Figure 19). It shall also be noted the two-dimensional line image of a dormitory room based on an actual photograph of the interiors belonging to İ. D. Bilkent University 78th dormitories, taken from the official website of dormitories (Figure 17) and plan is illustrated in not-to-scale form (Figure16). The room is typical dormitory room for four students with two bunk beds. It has four wardrobes for each student, a study area. The dormitory room has a mini refrigerator in dormitory room covered by a wood material. Four seating units are provided for study area and shelves located above the study area's table. The room has a window but because of the point of view of photograph the window cannot seen. The bunk bed frames, wardrobes, door, study area shelves and tables made out of wood. Floor material is marble. Ceiling and walls were painted on satin plaster. A chair used for study area has two different surfaces which are plastic material for backside and fabric for the seating area. The room has one artificial lighting on top. This photograph of the dormitory room interiors was converted into a two-dimensional line image, with the corresponding .svg format (Figure 18). By this means, participants were able to select and fill the empty spaces of surfaces falling between any two lines, with a click. Moreover, some color chips were set, which would be selected to fill the spaces. The color chips were decided upon considering the same levels of L*, a*, and b*. The chosen L* level falls in the range of 80 and 20, with a distance of 20 units; a* is range between 40 and -40, with the distance of 20 units; b* is range between 40 and -40, with the distance of 20 units. The distance is mathematically equal for all selected chips; although some codes are not existent in the CIELAB gamut, as shown in the Figure 19. In addition, the colors black (0, 0, 0) and white (100, 0, 0) were included in the list.

Figure 16

Plan of the dormitory room drawn by Serra Koz

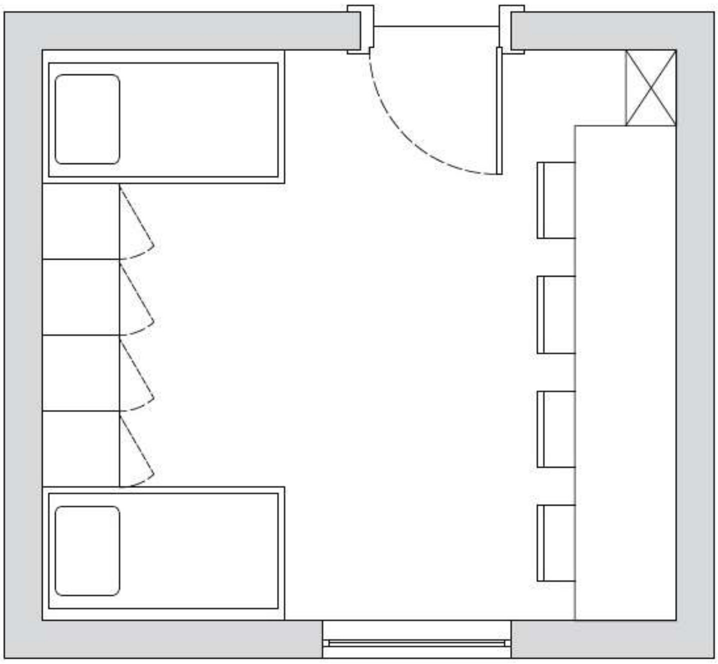


Figure 17

Original photograph of the dormitory room

Figure 18

Two-dimensional line image adapted by Serra Koz

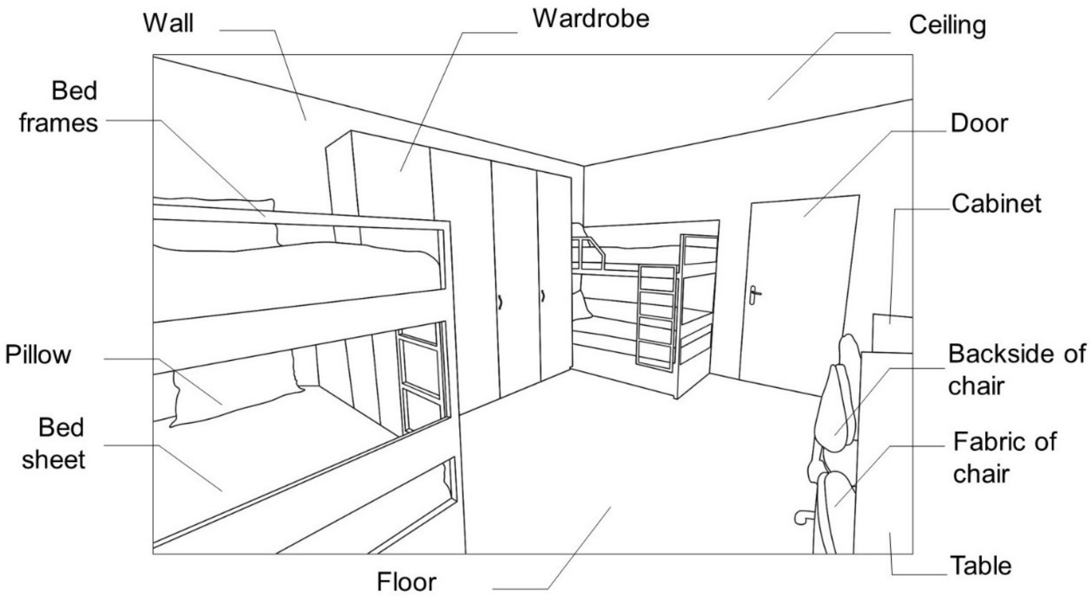


Figure 19

66 color chips from CIELAB color gamut adapted by Serra Koz

	a=40				a=20				a=0				a=-20				a=-40			
	L	a	b		L	a	b		L	a	b		L	a	b		L	a	b	
L=80	80	40	-20		80	20	-20		80	0	-20		80	-20	-20					
					80	20	0		80	0	0		80	-20	0		80	-40	0	
					80	20	20		80	0	20		80	-20	20		80	-40	20	
									80	0	40		80	-20	40		80	-40	40	
L=60	60	40	-40		60	20	-40		60	0	-40									
	60	40	-20		60	20	-20		60	0	-20		60	-20	-20					
	60	40	0		60	20	0		60	0	0						60	-40	0	
	60	40	20		60	20	20		60	0	20						60	-40	20	
	60	40	40		60	20	40		60	0	40		60	-20	40		60	-40	40	
L=40	40	40	-40		40	20	-40		40	0	-40									
	40	40	-20		40	20	-20		40	0	-20									
	40	40	0		40	20	0		40	0	0		40	-20	0					
	40	40	20		40	20	20		40	0	20		40	-20	20					
	40	40	40		40	20	40		40	0	40		40	-20	40		40	-40	40	
L=20	20	40	-40		20	20	-40													
	20	40	-20		20	20	-20													
	20	40	0		20	20	0		20	0	0									
	20	40	20		20	20	20		20	0	20									
									0	0	0									
									100	0	0									

Initially, participants were asked to fill out a consent form and the demographic data collection sheet. The absence of a color vision deficiency was approved by Ishihara's test for color-blindness and any participants with eyesight problems were detected. Afterward, two-dimensional line images were used to collect the necessary data. In this part of the experiment, participants were asked to indicate their color preferences by choosing from the given color chips for different surfaces of a dormitory room; such as the walls, the floor, the ceiling, the bed frames, the bed sheets, the door, etc. The resulting scenarios of students' color preferences are exemplified in Figure 20 and Figure 21. Finally, they answered two questions on which colors and surfaces they selected first.

Figure 20

Example of preferred colors of dormitory room filled by an undergraduate student 1

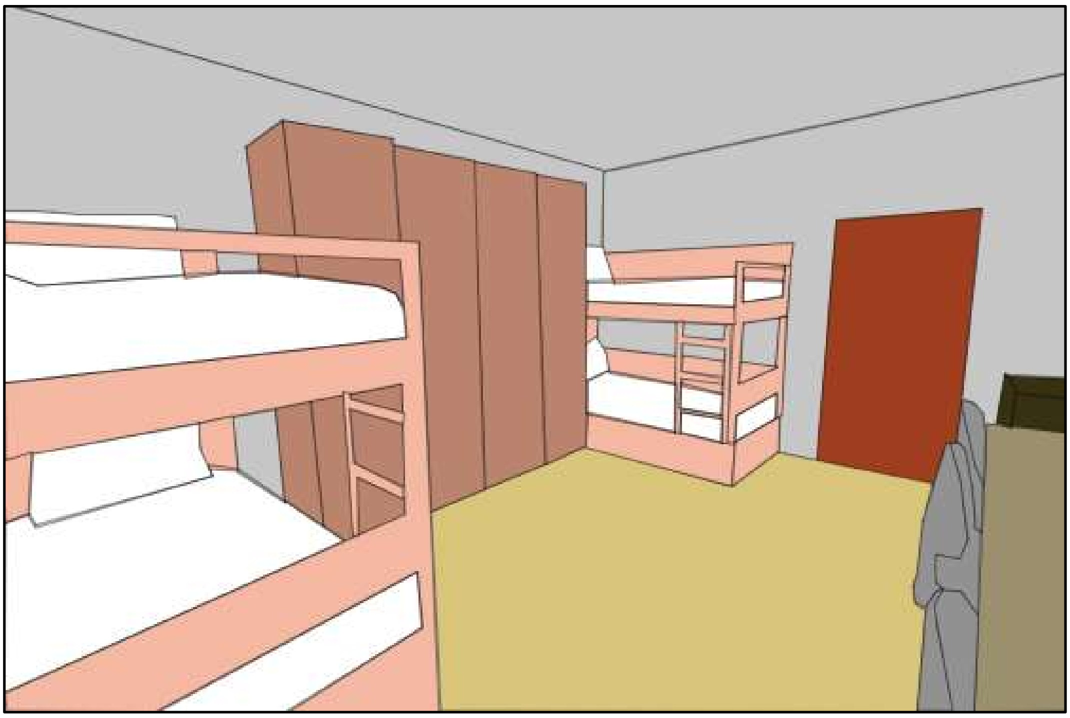
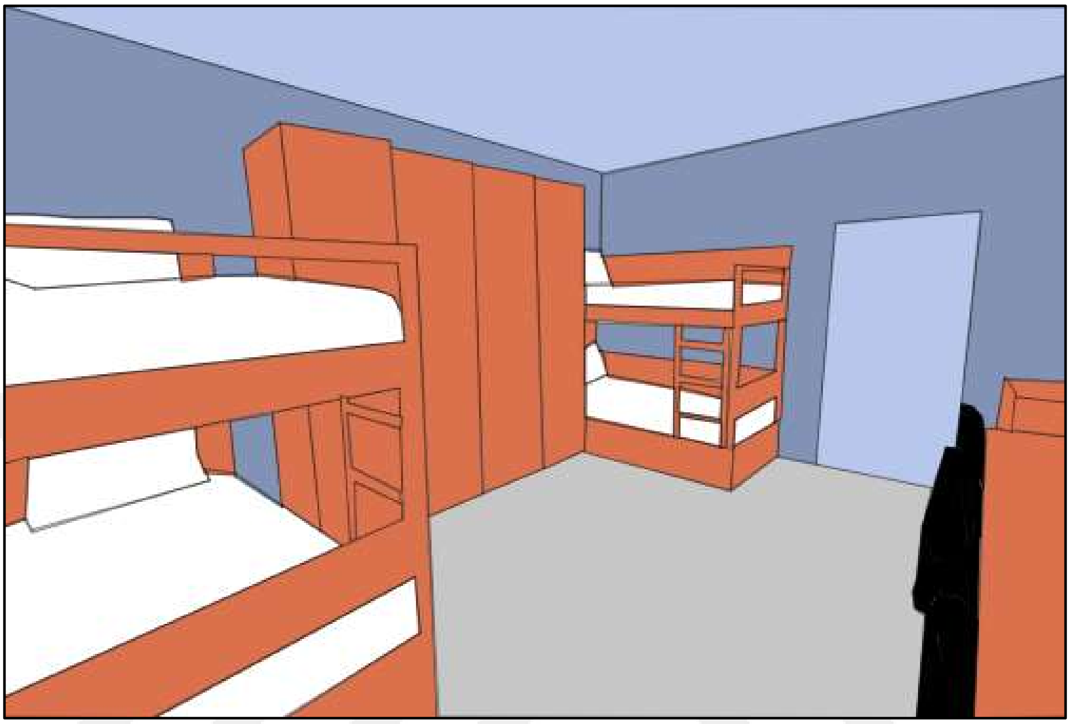


Figure 21

Example of preferred colors of dormitory room filled by an undergraduate student 2



CHAPTER V

RESULTS AND ANALYSIS

The main object of this study is to examine color preferences of university students in terms of value and chroma in dormitory rooms. For this purpose, statistical analysis was conducted with IBM SPSS Statistics 16 (Statistical Package for the Social Sciences). Demographic data tables were produced (see Appendix F). Inferential statistic tests (Chi-Square for Independence) were run. The results were classified and are shown under two titles, the first being color preferences descriptive statistics, which is followed by inferential statistics.

5.1. Descriptive Statistics of Color Preferences

As mentioned in Chapter 4, university students selected their preferences for dormitory rooms regarding 12 different surfaces; the ceiling, the walls, the floor, the door, the wardrobe, the table, the cabinet, the backside of chair, the fabric of chair, the bed frame, the pillow, and the bed sheet. Some cases are not shown under the results due to technical problems and then number of valid cases are presented below in Table 2.

Table 2

Valid and missing data for 12 different surfaces

	Ceiling	Wall	Door	Floor	Wardrobe	Table	Cabinet	Backside of chair	Fabric of chair	Bed frame	Pillow	Bed sheet
Valid	191	192	192	192	190	191	190	190	189	187	185	180
Missing	1	0	0	0	2	1	2	2	3	5	7	12

Descriptive statistics were used for each surface separately. Colors are denoted by three different variables (L*, a*, b*). Crosstabulation tables and graphs were produced and the obtained results are as explained in the following subtitles.

5.1.1. Ceiling Colors

The color preferences of university students for the ceiling and the corresponding frequency table are shown in Table 3 with crosstabulation. The columns are divided into two, starting from the level of L* and subdivided into the a* levels, which are 40, 20, 0, -20, and -40. Levels of b* are represented in the rows as 40, 20, 0, -20, -40. Some colors in the given color gamut were not preferred by students (see Figure 19 for all color chips) despite having been provided. According to Table 3, the most preferred color for the ceiling was white, which was coded as 100, 0, 0 (n=95); meaning that L* (Lightness) is 100, when a* and b* are 0 among 191 cases. The second most preferred color for the ceiling was light grey, coded as 80, 0, 0 (n=24), which is very close to the most preferred color, white. Students showed to have a tendency to prefer either white or whitish colors for the ceiling. That said, 30 colors were preferred among the given 66, as shown in Table 3. Some colors were preferred only once, by one student. These colors are black (coded as 0, 0, 0), dark purple, red, green (coded as 20, 20, -40; 20, 40, 20; 40, 40, 20; 60, -40, 0; 60, -40, 40, respectively), blue and its desaturated tones (60, 0, -40 and 60, 0, -20), yellow and its desaturated tones (60, 0, 20 and 60, 0, 40), light purple and tones of purple (60, 20, -20 and 60, 20, 0), a saturated color close to orange and pink (60, 40, 40), and light pink (80, 40, -20). Nonetheless, it should be kept in mind that some colors are not preferred by any university student as the ceiling color and other missing colors can be out of the limits of CIELAB.

Table 3

Crosstabulation of ceiling color preferences in terms of L, a*, b**

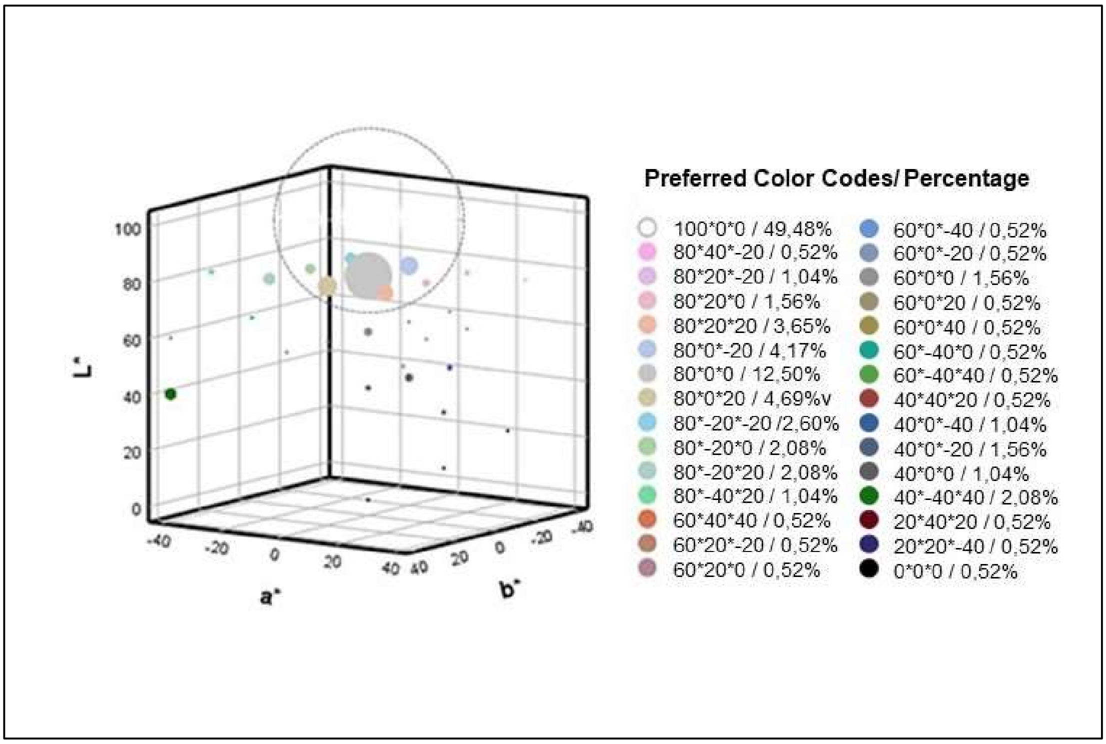
L*			b*				
			-40	-20	0	20	40
0	a*	0			1		
20	a*	20	1			0	
		40	0			1	
40	a*	-40	0	0	0	0	4
		0	2	3	2	0	0
		40	0	0	0	1	0
60	a*	-40	0	0	1	0	1
		0	1	1	3	1	1
		20	0	1	1	0	0
		40	0	0	0	0	1
80	a*	-40		0	0	2	
		-20		5	4	4	
		0		8	24	9	
		20		2	3	7	
		40		1	0	0	
100	a*	0			95		

Color Codes	
100*0*0	60*0*-40
80*40*-20	60*0*-20
80*20*-20	60*0*0
80*20*0	60*0*20
80*20*20	60*0*40
80*0*-20	60*-40*0
80*0*0	60*-40*40
80*0*20	40*40*20
80*-20*-20	40*0*-40
80*-20*0	40*0*-20
80*-20*20	40*0*0
80*-40*20	40*-40*40
60*40*40	20*40*20
60*20*-20	20*20*-40
60*20*0	0*0*0

The preference rates of university students showed an increase at the level of 100 in terms of L*, followed by 80 (n=69), 40, and 60 (40 and 60 having been selected in an equal number, n=12), 20 (n=2), being the least at 0 (n=1) (see Table 3). From the combination of a* and b*, 0*0 was selected the most with a very wide margin (n=125), disregarding the L* levels. When the results are compared considering the L* levels, the most preferred lightness for a* and b* was 100 (n=95), followed by 80 (n=24); yet there was no preference in L* level that was equal to 20. The least preferred codes of a* and b* were when a* ranged from 40 (n=4) to -40 (n=8) and b* ranged from 40 (n=7) and -40 (n=4). As it is presented in Figure 22, the preferred colors accumulate in the area where a* and b* are zero. The preference percentages, symbolized by the changing marking sizes.

Figure 22

Scatter-plot of ceiling color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.2. Wall Colors

The color preferences of university students for the walls and the corresponding frequency table are shown in Table 4 by crosstabulation. As is seen from Table 4, the most preferred color is light grey, coded as 80, 0, 0 (n=34), which means that L* is 80 when both a* and b* are 0. The latter is followed by the color white, coded as 100, 0, 0 (n=28), as the second most preferred color, which has a very small difference from the most preferred one. The least preferred colors are the ones that were selected only once by the students from the given color gamut. These colors were dark grey or shades of grey (20, 0, 0), shades of purple (20, 40, -20), dark-bluish grey (40, 0, -20), light purple (40, 40, -40), green (60, -40, 40), blue (60, 0, -40), desaturated yellow or a tone of yellow (60, 0, 40), light desaturated purple and blue (60, 20, -40 and 60, 20, -20), desaturated light and dark pink (60, 20, 20 and 60, 40, 0), tint of purple (60, 40, -20), and light saturated greenish-blue and green (80, -40, 0 and 80, -40, 20). The preference rates of university students increase at the level of 80 (n=118) in terms of L*, followed by 60 (n=28), 100 (n=28), 40 (n=13), 0 (n=3) and is the least at 20 (n=2). From the combination of a* and b*, 0, 0 is selected the most with a wide margin (n=75), disregarding the L* levels. The least preferred codes among the selected colors of a* and b* were where range of a* is -40 (n=8) and range of b* is -40 (n=6). Additionally, as it is mentioned in Chapter 2.2.2.6., the 90°-180° hue angle (where a* is positive and b* is negative) and the 180°-270° hue angle (where a* is negative b* is positive) were preferred at least once where other hue angles had some non-preferred colors, even though the colors existed in gamut.

Table 4

Crosstabulation of wall color preferences in terms of L, a*, b**

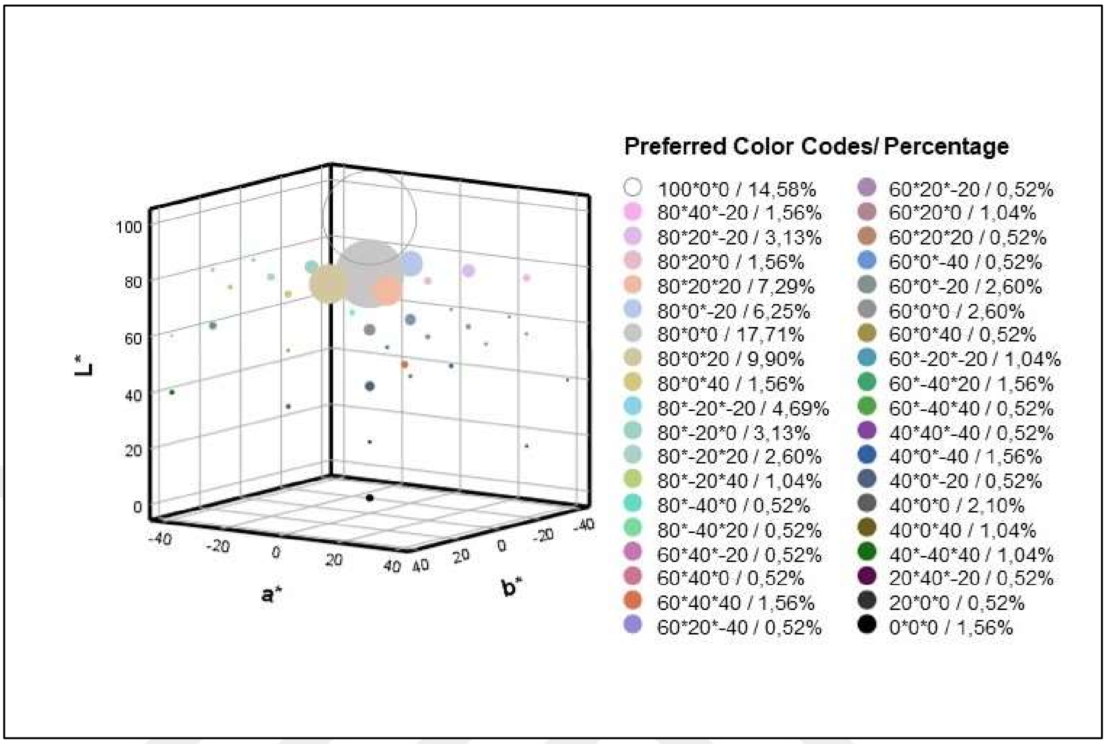
L*			b* -40	b* -20	b* 0	b* 20	b* 40
0	a*	0			3		
20	a*	0		0	1		
		40		1	0		
40	a*	-40	0	0	0		2
		0	3	1	4		2
		40	1	0	0		0
60	a*	-40	0	0	0	3	1
		-20	0	2	0	0	0
		0	1	5	5	0	1
		20	1	1	2	1	0
		40	0	1	1	0	3
80	a*	-40		0	1	1	0
		-20		9	6	5	2
		0		12	34	19	3
		20		6	3	14	0
		40		3	0	0	0
100	a*	0			28		

Color Codes	
100*0*0	60*20*-20
80*40*-20	60*20*0
80*20*-20	60*20*20
80*20*0	60*0*-40
80*20*20	60*0*-20
80*0*-20	60*0*0
80*0*0	60*0*40
80*0*20	60*-20*-20
80*0*40	60*-40*20
80*-20*-20	60*-40*40
80*-20*0	40*40*-40
80*-20*20	40*0*-40
80*-20*40	40*0*-20
80*-40*0	40*0*0
80*-40*20	40*0*40
60*40*-20	40*-40*40
60*40*0	20*40*-20
60*40*40	20*0*0
60*20*-40	0*0*0

In Figure 23, 38 preferred colors among the given 66 are visualized. The preferred colors accumulate in the area where L* is 80. Also, four codes seem to be leading. The most preferred one is tint of grey, coded as 80, 0, 0 (n=34), which was selected by 17.71% of the subjects and the second one is white, coded 100, 0, 0 (n=28), which was selected by a proportion of 14.58%. Following white, tint of blue, coded as 80, 0, -20 (n=12), was preferred by 6,25% of the subjects and tint of yellow, coded as 80, 0, 20 (n=19), was preferred by a proportion of 9.90%.

Figure 23

Scatter-plot of wall color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.3. Door Colors

The color preferences of university students for the door and the corresponding frequency table are shown in Table 5. Having been selected by 18 students, the most preferred color is white (100, 0, 0), followed by light blue (80, 0, 20), which was selected by 16 students. The least preferred colors for the door are dark browns (20, 0, 20 and 20, 20, 0), dark tones of purple (20, 20, -20), dark and light greens (40, -20, 0; 40, -20, 40; 80, -40, 40 and 80, -20, 0), greyish purple (40, 20, 0), tones of blue (60, 0, -20), light purple and pink (60, 20, 0 and 60, 40, 20), and light desaturated greenish blue (80, -40, 0). The least preferred colors were the ones selected only once by students. The most preferred color of university students, in terms of lightness, appears to be 80 (n=55), 40 (n=49), 60 (n=33), 20 (n=31), 100 (n=18), and 0 (n=6) consequentially. Among the combinations of a* and b*, 0, 0 (n=61) was selected the most, which corresponds to no hue. The code pairs of 20, 20 (n=32) and 0, 20 (n=22) for a* and b* follow the said 0, 0. The codes corresponding to the least preferred colors among the selections of a* and b* are where a* is in the range of -40 (n=4) and -20 (n=6) with b* in the range of -40 (n=6), which stimulate green and blue hues due to negative a* and b*. In addition, the hue angle 0°-90° (where a* and b* are positive) was preferred at least once by university students, whereas other hue angles have some missing data despite having been offered.

Table 5

Crosstabulation of door color preferences in terms of L, a*, b**

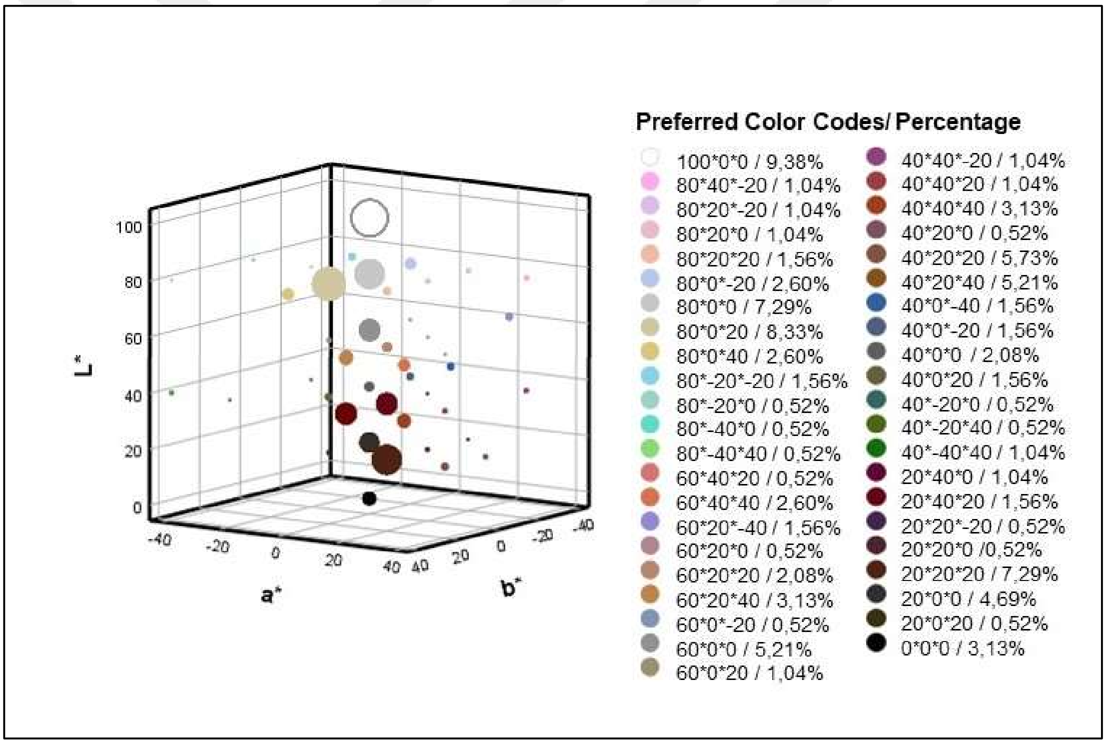
			b*				
L*			-40	-20	0	20	40
0	a*	0			6		
20	a*	0		0	9	1	
		20		1	1	14	
		40		0	2	3	
40	a*	-40	0	0	0	0	2
		-20	0	0	1	0	1
		0	3	3	4	3	0
		20	0	0	1	11	10
		40	0	2	0	2	6
60	a*	0	0	1	10	2	0
		20	3	0	1	4	6
		40	0	0	0	1	5
80	a*	-40		0	1	0	1
		-20		3	1	0	0
		0		5	14	16	5
		20		2	2	3	0
		40		2	0	0	0
100	a*	0			18		

Color Codes	
100*0*0	40*40*-20
80*40*-20	40*40*20
80*20*-20	40*40*40
80*20*0	40*20*0
80*20*20	40*20*20
80*0*-20	40*20*40
80*0*0	40*0*-40
80*0*20	40*0*-20
80*0*40	40*0*0
80*-20*-20	40*0*20
80*-20*0	40*-20*0
80*-40*0	40*-20*40
80*-40*40	40*-40*40
60*40*20	20*40*0
60*40*40	20*40*20
60*20*-40	20*20*-20
60*20*0	20*20*0
60*20*20	20*20*20
60*20*40	20*0*0
60*0*-20	20*0*20
60*0*0	0*0*0
60*0*20	

In Figure 24, 43 preferred colors among the given 66 are visualized. The preferred colors accumulate around the area where a* and b* are zero, the most, followed by the area where a* and b* are positive with the hue angle 0°-90°. Positive a* and b* selections indicate high preference of red and yellow stimuli, respectively. These two-colors mostly form different tones of orange stimuli, as mentioned in Chapter 2. 2. 2. 6; whereas when we consider the L* levels, we see darker color preferences.

Figure 24

Scatter-plot of door color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.4. Floor Colors

The color preferences of university students for the floor and the corresponding frequency table are shown in Table 6 by crosstabulation.

Table 6 indicates that the most preferred color is tint of grey (80, 0, 0), having been selected by 37 students. The least preferred colors are dark greyish yellow (40, 0, 20), dark purples (40, 20, 0 and 40, 40, -20), shades of brownish red (40, 40, 20), blue (60, 0, -40), yellow-grey (60, 0, 40), tint of purple (60, 20, -20), pink (60, 40, 20), and light greens (80, -40, 20; 80, -40, 40 and 80, -20, 20). The least preferred colors are the ones that were selected only once by the students. The most preferred color of university students, in terms of lightness, appears to be 80 with a wide margin (n=96), followed by 60 (n=38), 40 (n=23), 20 (n=15), and 100 (n=15), with 0 (n=5) being the least preferred. Among the combinations of a* and b*, 0, 0 (n=77) was selected the most, which corresponds to the color grey. The colors in which a* and b* are zero can be compared in terms of their respective L* levels. For instance, the most preferred code pairs of a* and b*, where they are equal to zero, belong to different L* levels, which are 80 (n=37), followed by 100 (n=15), 60 (n=10), and the least preferred one being 0, 20 and 40 (n=5). The least preferred codes among selected colors with regards to the combinations of a* and b* stand where a* is -40 (n=2) with b*, is -40 (n=1) and where a* is zero with b*, -40 (n=1). Furthermore, the hue angle 0°-90° (where a* and b* are positive) was preferred at least once by students.

Table 6

Crosstabulation of floor color preferences in terms of L, a*, b**

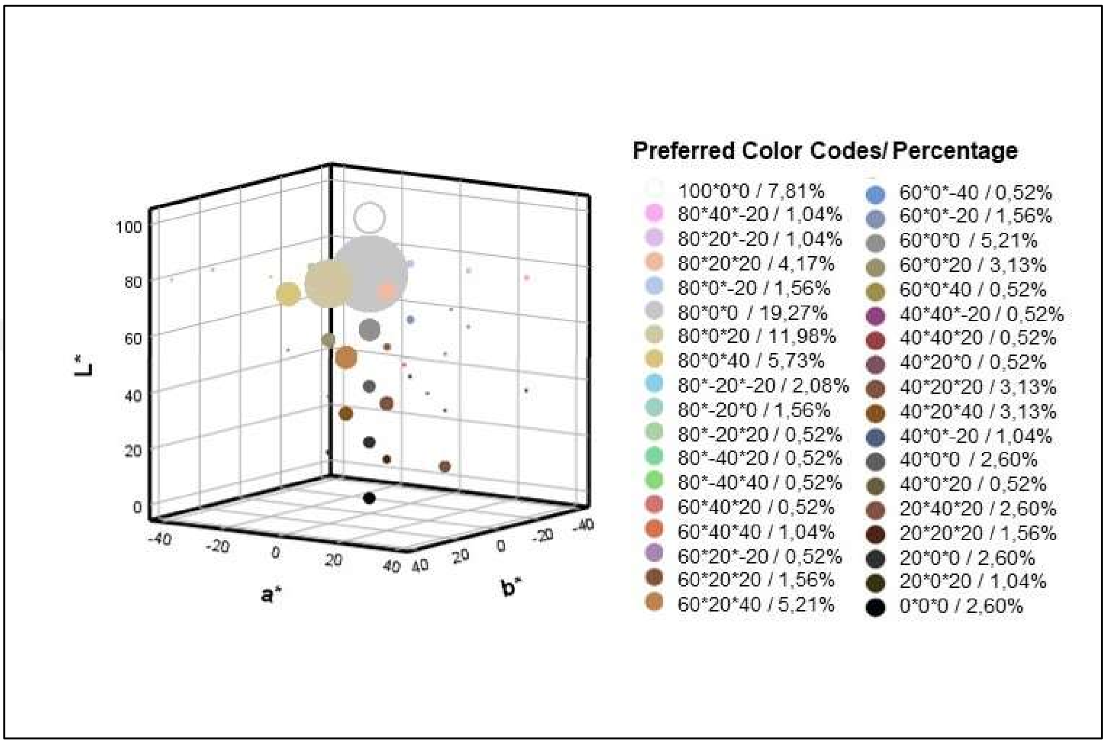
			b*				
L*			-40	-20	0	20	40
0	a*	0			5		
20	a*	0			5	2	
		20			0	3	
		40			0	5	
40	a*	0		2	5	1	0
		20		0	1	6	6
		40		1	0	1	0
60	a*	0	1	3	10	6	1
		20	0	1	0	3	10
		40	0	0	0	1	2
80	a*	-40		0	0	1	1
		-20		4	3	1	0
		0		3	37	23	11
		20		2	0	8	0
		40		2	0	0	0
100	a*	0			15		

Color Codes	
100*0*0	60*0*-40
80*40*-20	60*0*-20
80*20*-20	60*0*0
80*20*20	60*0*20
80*0*-20	60*0*40
80*0*0	40*40*-20
80*0*20	40*40*20
80*0*40	40*20*0
80*-20*-20	40*20*20
80*-20*0	40*20*40
80*-20*20	40*0*-20
80*-40*20	40*0*0
80*-40*40	40*0*20
60*40*20	20*40*20
60*40*40	20*20*20
60*20*-20	20*0*0
60*20*20	20*0*20
60*20*40	0*0*0

In the Figure 25, 36 preferred colors among the given 66 are visualized. The most preferred colors accumulate around the area where a* and b* are zero (grey colors), followed by where b* is 20 (which stimulates yellow hue) and a* is either 0 or 20 (which stimulate red hue). Additionally, low lightness appears to be preferred by students, although the percentage of it is low, seeing as how the size of markers are smaller in the below graph. Moreover, the empty areas of the graph correspond to the non-preferred colors. That is, the emptiness on the top left of the graph (where a* and b* are negative, which stimulates blue and green hues) and its top right corners (where a* is positive, which stimulates red hues, where b* is negative, which stimulates blue, and where b* is positive, which stimulates yellow) indicate that almost no color was preferred from those parts.

Figure 25

Scatter-plot of floor color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.5. Wardrobe Colors

The color preferences of university students for the wardrobe and the corresponding frequency table are shown in Table 7 by crosstabulation. It is seen in Table 7 that the most preferred color is light yellowish grey, coded as 80, 0, 20 (n=15). The least preferred colors are different tones, shades, and tints of purple (20, 20, -20; 40, 20, -20; 40, 40, -40; 40, 40, -20; 60, 20, -40 and 60, 40, -40), brownish orange (40, 40, 40), green and bluish green (60, -40, 40; 60, -20, 40 and 60, -20, -20), tones of pink (60, 20, 0; 60, 40, 20 and 80, -20, 20), and light green (80, -20, 20). The most preferred colors in terms of lightness are 80 (n=65), 60 (n=44), 40 (n=43), 20 (n=21) and 100 (n=12), with the least being 0 (n=7). Among the combinations of a* and b*, 0, 0 (n=44) seems to be the most preferred one, followed by 20, 20 (n=29); although it covers almost half of the most preferred colors. The colors where a* and b* are zero can be compared in terms of their respective L* levels. For instance, the most preferred code pairs of a* and b*, where they are zero, belong to the L* level 100 (n=12), followed by 80 (n=9), 0 and 20 (n=7), and 60 (n=6), with the least preferred one being 40 (n=5). The combination of a* and b* being equal to zero corresponds to grey colors. Thus, the order of grey preferences from the most preferred to the least is white, light grey, black and dark grey, mid-grey, and dark-mid grey.

Table 7

Crosstabulation of wardrobe color preferences in terms of L, a*, b**

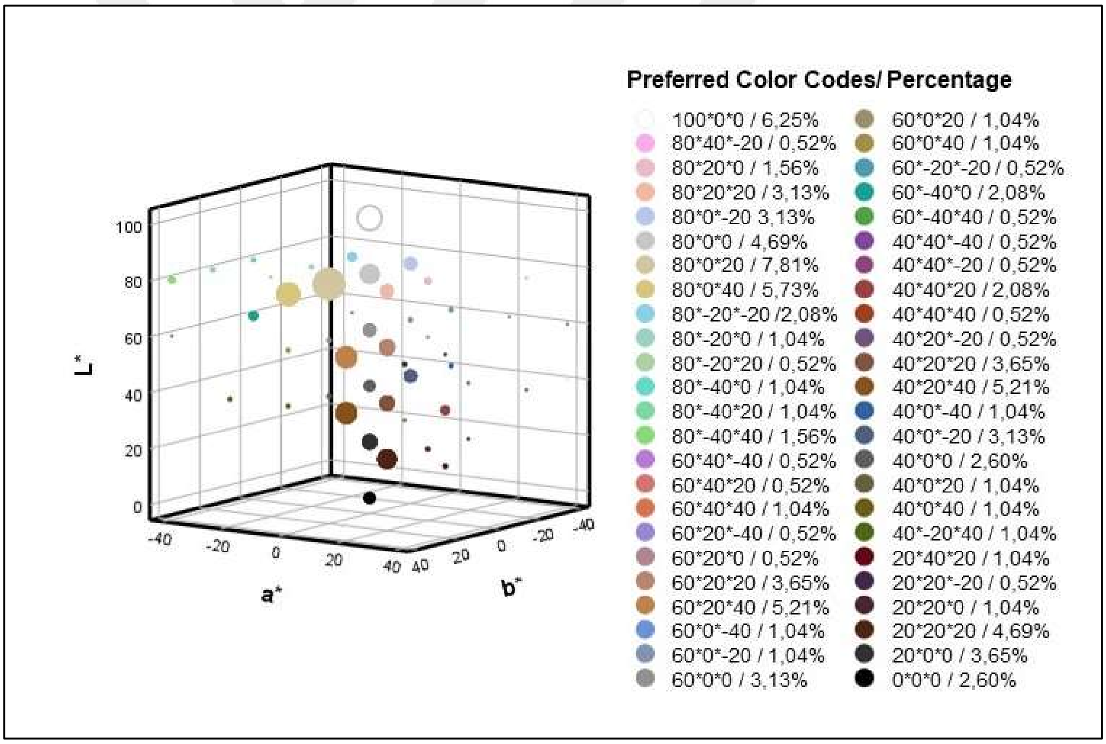
			b*				
L*			-40	-20	0	20	40
0	a*	0			7		
20	a*	0		0	7	0	
		20		1	2	9	
		40		0	0	2	
40	a*	-20	0	0	0	0	2
		0	2	6	5	2	2
		20	0	1	0	7	10
		40	1	1	0	4	1
60	a*	-40	0	0	4	0	1
		-20	0	1	0	0	1
		0	2	2	6	2	2
		20	1	0	1	7	10
		40	1	0	0	1	2
80	a*	-40		0	2	2	3
		-20		4	2	1	0
		0		6	9	15	11
		20		0	3	6	0
		40		1	0	0	0
100	a*	0			12		

Color Codes	
100*0*0	60*0*20
80*40*-20	60*0*40
80*20*0	60*-20*-20
80*20*20	60*-40*0
80*0*-20	60*-40*40
80*0*0	40*40*-40
80*0*20	40*40*-20
80*0*40	40*40*20
80*-20*-20	40*40*40
80*-20*0	40*20*-20
80*-20*20	40*20*20
80*-40*0	40*20*40
80*-40*20	40*0*-40
80*-40*40	40*0*-20
60*40*-40	40*0*0
60*40*20	40*0*20
60*40*40	40*0*40
60*20*-40	40*-20*40
60*20*0	20*40*20
60*20*20	20*20*-20
60*20*40	20*20*0
60*0*-40	20*20*20
60*0*-20	20*0*0
60*0*0	0*0*0

In the Figure 26, 48 preferred colors among 66 given colors are visualized. The preferred colors are overweighted in different areas where a* and b* are positive and L* level of 80, 60, 40. Even though some colors preferred at least once by university students, the colors size is so small in the two area one of them is where a* are negative and the other one is the edge of the a* of 40 and different codes of b* such as 20, 0, -20 and -40. On the other hand, since most of the marker's sizes seem almost equal, the difference between colors is not too much.

Figure 26

Scatter-plot of wardrobe color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.6. Table Colors

The color preferences of university students for the table and the corresponding frequency table are shown in Table 8 with crosstabulation.

According to Table 8, the most preferred color is light yellowish grey, coded as 80, 0, 20 (n=27) and the least preferred colors are dark brown (20, 0, 20), dark purples (20, 20, -20 and 40, 20, 0), green yellow and its tint (40, -40, 40 and 80, -20, 40), different tones, shades, and tints of blue (40, 0, -40; 60, 0, -40 and 60, 20, -40), dark blue green (60, -20, -20), desaturated yellow grey (60, 0, 40), bluish purple (60, 20, -40), light purple (60, 20, -20), green blue (80, -40, 20), and pinks (60, 40, 0 and 80, 40, -20). The frequency of the most preferred lightness level is at its highest on 80 (n=77), 40 (n=37), 60 (n=32), 100 (n=23), and 20 (n=19), with the least being 0 (n=7). Among the combinations of a* and b*, the most preferred one is 0, 0 (n=52); meaning, that different tones of grey are preferred the most, followed by 0, 20 (n=32), which corresponds to different tones of yellow-grey, although it takes up almost half of the most preferred colors. The colors where a* and b* are zero can be compared in terms of their corresponding L* levels. For instance, the most preferred code pairs of a* and b*, where they are zero, belong to L* levels of 100 (n=23), corresponding to white; followed by 80 (n=12), corresponding to light grey; 40, corresponding to mid-dark grey; 60, corresponding to mid-grey (n=5); and 20, corresponding to dark grey (n=4); with the least preferred one being 0 (n=3), corresponding to black. Furthermore, students mostly preferred colors within a range where a* is zero (n=112; whereas the least preferred colors were within a range where b* is -20 (n=4), which stimulates blue hue.

Table 8

Crosstabulation of table color preferences in terms of L, a*, b**

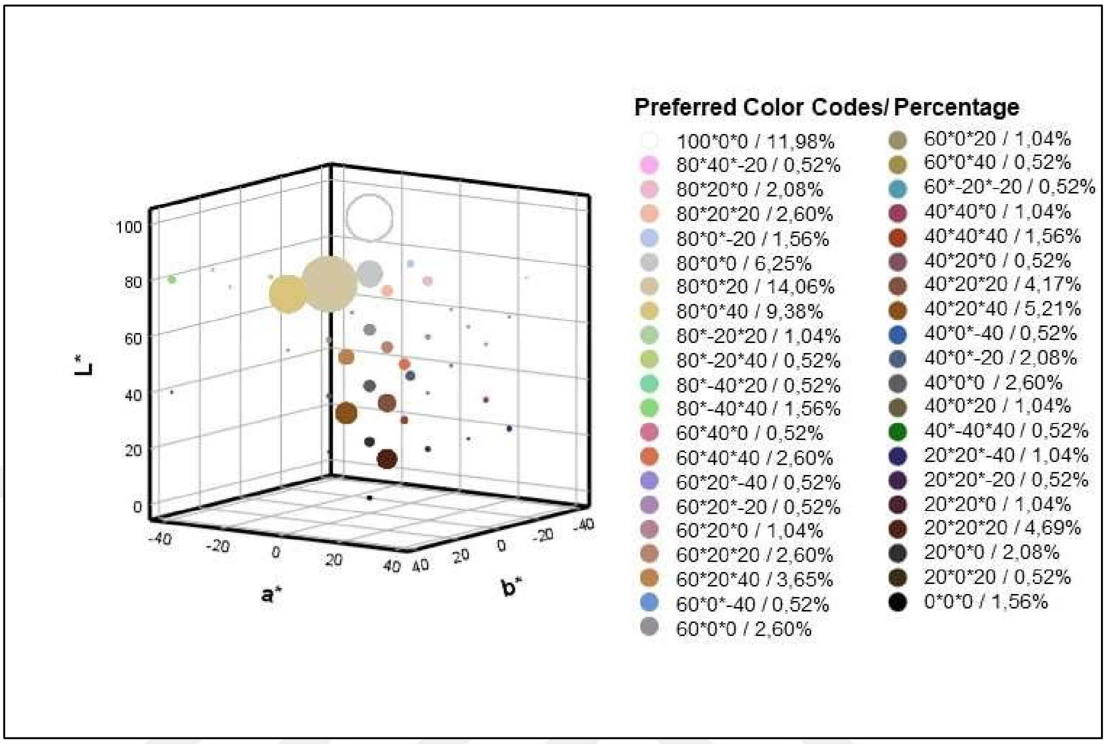
			b*				
L*			-40	-20	0	20	40
0	a*	0			3		
20	a*	0	0	0	4	1	
		20	2	1	2	9	
40	a*	-40	0	0	0	0	1
		0	1	4	5	2	0
		20	0	0	1	8	10
		40	0	0	2	0	3
60	a*	-20	0	1	0	0	0
		0	1	0	5	2	1
		20	1	1	2	5	7
		40	0	0	1	0	5
80	a*	-40		0	0	1	3
		-20		0	0	2	1
		0		3	12	27	18
		20		0	4	5	0
		40		1	0	0	0
100	a*	0			23		

Color Codes	
100*0*0	60*0*20
80*40*-20	60*0*40
80*20*0	60*-20*-20
80*20*20	40*40*0
80*0*-20	40*40*40
80*0*0	40*20*0
80*0*20	40*20*20
80*0*40	40*20*40
80*-20*20	40*0*-40
80*-20*40	40*0*-20
80*-40*20	40*0*0
80*-40*40	40*0*20
60*40*0	40*-40*40
60*40*40	20*20*-40
60*20*-40	20*20*-20
60*20*-20	20*20*0
60*20*0	20*20*20
60*20*20	20*0*0
60*20*40	20*0*20
60*0*-40	0*0*0
60*0*0	

In Figure 27, 41 preferred colors among the given 66 are visualized. The preferred colors accumulate in the areas where a* is 0, 20, which stimulates red and -20, which stimulates green; with b* is both 20 and 40, which stimulate yellow hues. It is noted that the preference rates depend on levels of L*. Nonetheless, as it is seen from the graph, university students show a tendency to prefer high levels for the table, in terms of lightness. Besides the latter, the percentage of a dark brown color, coded as 20, 20, 20, was preferred by 4.59% of the students. Moreover, all colors in a range where a* is 0, 20 and b* is 40, corresponding to red and yellow hues, respectively, were preferred at least once by university students for the table surface.

Figure 27

Scatter-plot of table color preferences in terms of L, a*, b*



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.7. Cabinet Colors

The color preferences of university students for the cabinet and the corresponding frequency table are shown below in Table 9 with crosstabulation. As it is seen in Table 9, the most preferred color is light yellow 80, 0, 40 (n=16); whereas the least preferred colors are a shade of blue grey (40, 0, -20), dark purple (40, 40, 0), greens (60, -40, 40 and 60, -20, 40), desaturated dark yellow (60, 0, 40), tints of purple (60, 40, -40 and 80, 20, -20), and light green (80, -40, 20). Lightness levels from the most preferred to least is 80 (n=68), 60 (n=47), 40 (n=41), 20 (n=22), 100 (n=8), 0 (n=4). Among the combinations of a* and b*, 0, 0 (n=34) was most preferred, meaning that hueless colors are preferred more than the chromatic ones.

Moreover, the second and third most preferred colors take place in the area where b* is fixed at 20 but a* varies between 20 (n=25) and 0 (n=23); thus, it is seen that the difference of preference rates between the two codes of a* are minor. Among the combinations of a* and b*, the most preferred range was where a* is zero with a wide margin (n=88), followed by where a* is 20 (n=64), which stimulates red hue. This information indicates that students have a tendency to prefer colors from the a* range more than the b* range. Nevertheless, it shall be noted for clarification that within the range of b* that is 0 and 20 (n=56), 40 (n=54), almost all colors were preferred with equal frequencies; whereas negative b* values, which stimulate blue hues, were preferred almost the least.

Table 9

Crosstabulation of cabinet color preferences in terms of L, a*, b**

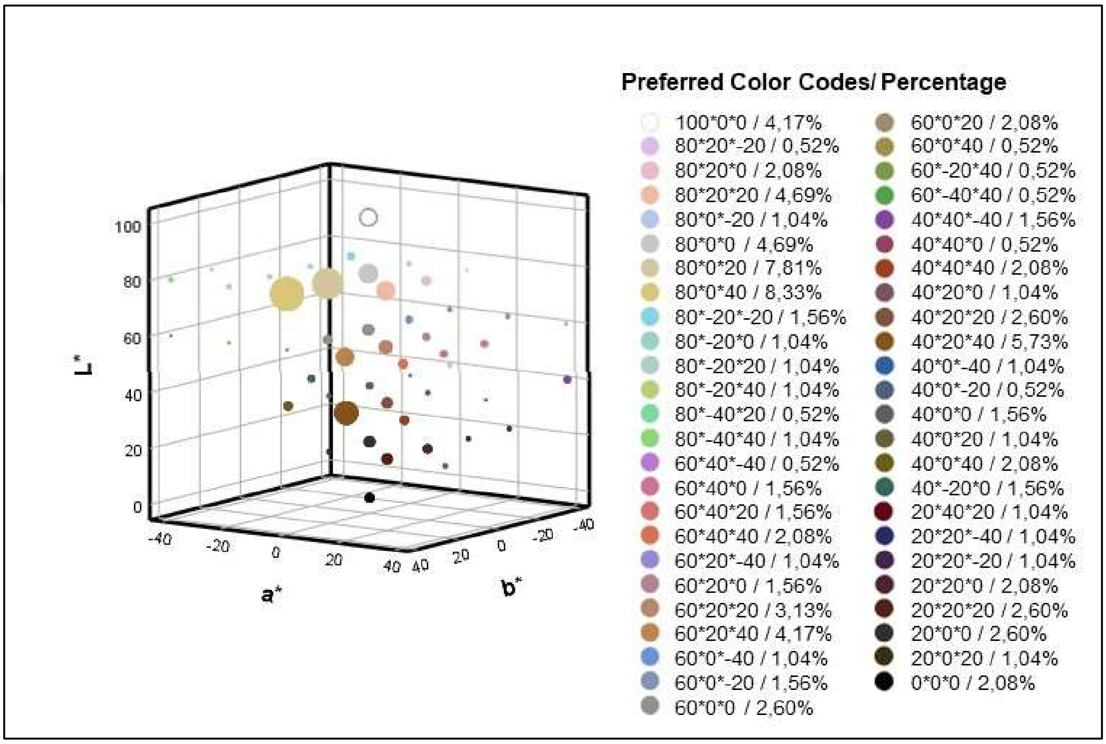
			b*				
L*			-40	-20	0	20	40
0	a*	0			4		
20	a*	0	0	0	5	2	
		20	2	2	4	5	
		40	0	0	0	2	
40	a*	-20	0	0	3	0	0
		0	2	1	3	2	4
		20	0	0	2	5	11
		40	3	0	1	0	4
60	a*	-40	0	0	0	0	1
		-20	0	0	0	0	1
		0	2	3	5	4	1
		20	2	0	3	6	8
		40	1	0	3	3	4
80	a*	-40		0	0	1	2
		-20		3	2	2	2
		0		2	9	15	16
		20		1	4	9	0
100	a*	0			8		

Color Codes	
100*0*0	60*0*20
80*20*-20	60*0*40
80*20*0	60*-20*40
80*20*20	60*-40*40
80*0*-20	40*40*-40
80*0*0	40*40*0
80*0*20	40*40*40
80*0*40	40*20*0
80*-20*-20	40*20*20
80*-20*0	40*20*40
80*-20*20	40*0*-40
80*-20*40	40*0*-20
80*-40*20	40*0*0
80*-40*40	40*0*20
60*40*-40	40*0*40
60*40*0	40*-20*0
60*40*20	20*40*20
60*40*40	20*20*-40
60*20*-40	20*20*-20
60*20*0	20*20*0
60*20*20	20*20*20
60*20*40	20*0*0
60*0*-40	20*0*20
60*0*-20	0*0*0
60*0*0	

In the Figure 28, 49 preferred colors among the given 66 are visualized. The preferred colors accumulate in the areas where a* and b* are positive and zero with a large frequency, which means that red and yellow hues are preferred more than blue and green hues.

Figure 28

Scatter-plot of cabinet color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.8. Backside of Chair Colors

The color preferences of university students for the backside of chair and the corresponding frequency table are shown below in Table 10 with crosstabulation. Table 10 shows that the most preferred color is black, coded as 0, 0, 0 (n=41) and the least preferred colors are dark purples (20, 40, -20 and 20, 40, 20), green (40, -40, 40), shades of greyish yellow (40, 0, 20 and 40, 0, 40), brown (40, 20, 40), reddish purple (40, 40, 0), tints of purples (40, 40, -40; 40, 40, -20; 60, 20, -40; 60, 40, -40; 80, 20, -20), green (60, -40, 0), and different tints and tones of pink (60, 40, 0; 60, 20, 20; 80, 20, 0). The order of lightness from the most preferred to the least is 60 (n=43), 0 (n=41), 40 and 80 (n=35), 20 (n=31), 100 (n=5). Although black is most preferred with a L* level of 100, the L* level equal to 60 has highest preference rate. Among the combinations of a* and b*, the most preferred code pair is 0, 0 (n=72), which means the most preferred color is grey.

Table 10

Crosstabulation of backside of chair color preferences in terms of L, a*, b**

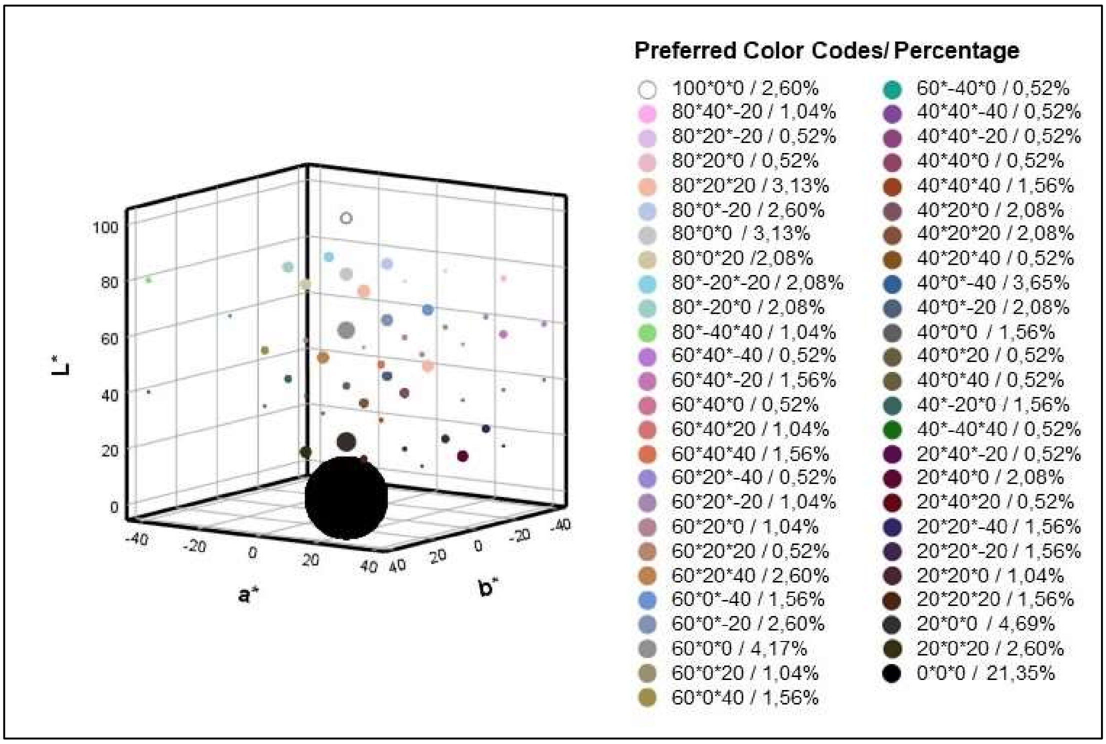
			b*				
L*			-40	-20	0	20	40
0	a*	0			41		
20	a*	0	0	0	9	5	
		20	3	3	2	3	
		40	0	1	4	1	
40	a*	-40	0	0	0	0	1
		-20	0	0	3	0	0
		0	7	4	3	1	1
		20	0	0	4	4	1
		40	1	1	1	0	3
60	a*	-40	0	0	1	0	0
		0	3	5	8	2	3
		20	1	2	2	1	5
		40	1	3	1	2	3
80	a*	-40		0	0	0	2
		-20		4	4	0	0
		0		5	6	4	0
		20		1	1	6	0
		40		2	0	0	0
100	a*	0			5		

Color Codes	
100*0*0	60*-40*0
80*40*-20	40*40*-40
80*20*-20	40*40*-20
80*20*0	40*40*0
80*20*20	40*40*40
80*0*-20	40*20*0
80*0*0	40*20*20
80*0*20	40*20*40
80*-20*-20	40*0*-40
80*-20*0	40*0*-20
80*-40*40	40*0*0
60*40*-40	40*0*20
60*40*-20	40*0*40
60*40*0	40*-20*0
60*40*20	40*-40*40
60*40*40	20*40*-20
60*20*-40	20*40*0
60*20*-20	20*40*20
60*20*0	20*20*-40
60*20*20	20*20*-20
60*20*40	20*20*0
60*0*-40	20*20*20
60*0*-20	20*0*0
60*0*0	20*0*20
60*0*20	0*0*0
60*0*40	

In Figure 29, 51 preferred colors among the given 66 are visualized. The preferred colors accumulate in areas where a* is positive and zero (which stimulate red hue and hueless colors, respectively), regardless of the b* values. The colors are specifically seen in the area where a* and b* are equal to 0 with an L* level of 0, i.e., the said preference has higher percentage compared to others in which a* and b* are positive. Furthermore, the size of the markings indicate that university students have a tendency for colors with low lightness for the plastic. In addition, the non-selected colors take place in the areas either where a* is -40 or where it is -20 (which stimulate green hue), despite being provided in the color gamut. All in all, the preferred colors are those which stimulate red, yellow hues, or in other words, hue angles of zero to 180°.

Figure 29

Scatter-plot of backside of chair color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.9. Fabric of Chair Colors

The color preferences of university students for the fabric of chair and the corresponding frequency table are shown below in Table 11 with crosstabulation. As it is seen in Table 11, the most preferred color is black, coded as 0, 0, 0 (n=20); whereas the least preferred colors are tones of green (60, -40, 40; 40, -40, 40, and 40, -20, 20), tones and shades of yellow (40, 0, 20; 40, 0, 40; 60, 20, 40 and 60, 0, 40), and tones and tints of pink (60, 20, 20; 60, 40, -40; 60, 40, -20 and 80, -20, 20). The order of lightness levels from the most preferred to the least is 80 (n=53), 40 (n=47), 60 (n=39), 20 (n=23), 0 (n=20), and 100 (n=7). Although the color coded as 0, 0, 0 is the most preferred one, the given order of lightness preferences shows that other colors with an L* range of 80, 40, 60 are selected more than the code 0, 0, 0, which corresponds to black. When the combinations of a* and b* are considered, 0, 0 (n=51) is the most preferred one, meaning that achromatic colors were selected more than chromatic colors. The least preferred colors take place in a range where a* is -40 (n=2), with only two colors having been selected by two students; with the codes 40, -40, 40 and 60, -40, 40, corresponding to green hue.

Table 11

Crosstabulation of fabric of chair color preferences in terms of L, a*, b**

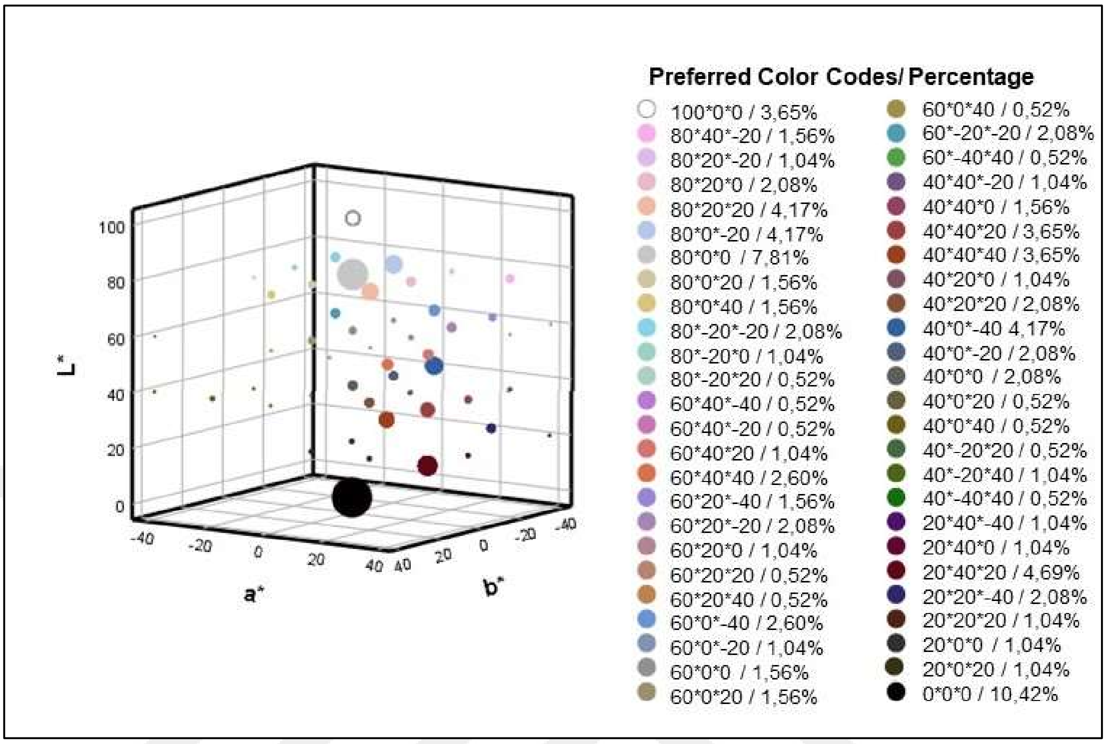
			b*				
L*			-40	-20	0	20	40
0	a*	0			20		
20	a*	0	0		2	2	
		20	4		0	2	
		40	2		2	9	
40	a*	-40	0	0	0	0	1
		-20	0	0	0	1	2
		0	8	4	4	1	1
		20	0	0	2	4	0
		40	0	2	3	7	7
60	a*	-40	0	0	0	0	1
		-20	0	4	0	0	0
		0	5	2	3	3	1
		20	3	4	2	1	1
		40	1	1	0	2	5
80	a*	-20		4	2	1	0
		0		8	15	3	3
		20		2	4	8	0
		40		3	0	0	0
100	a*	0			7		

Color Codes	
100*0*0	60*0*40
80*40*-20	60*-20*-20
80*20*-20	60*-40*40
80*20*0	40*40*-20
80*20*20	40*40*0
80*0*-20	40*40*20
80*0*0	40*40*40
80*0*20	40*20*0
80*0*40	40*20*20
80*-20*-20	40*0*-40
80*-20*0	40*0*-20
80*-20*20	40*0*0
60*40*-40	40*0*20
60*40*-20	40*0*40
60*40*20	40*-20*20
60*40*40	40*-20*40
60*20*-40	40*-40*40
60*20*-20	20*40*-40
60*20*0	20*40*0
60*20*20	20*40*20
60*20*40	20*20*-40
60*0*-40	20*20*20
60*0*-20	20*0*0
60*0*0	20*0*20
60*0*20	0*0*0

In Figure 30, 50 preferred colors among the given 66 are visualized. The preferred colors accumulate in the areas where a* and b* are both positive and where a* is positive with negative b*; which means that red, yellow, and blue hues are preferred more than others. Nonetheless, the highest rate of preference belongs to the color coded as 0, 0, 0, as is inferred from Figure 30 and the corresponding marker size surpassing remaining colors. Furthermore, seeing as how almost each color in the color gamut was selected at least once by the subjects, it appears that too many colors were preferred for the fabric of chair.

Figure 30

Scatter-plot of fabric of chair color preferences in terms of L, a*, b*



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.10. Bed Frame Colors

The color preferences of university students for the bed frame and the corresponding frequency table are shown below in Table 12 with crosstabulation. Table 12 shows that the most preferred color is light yellowish grey, coded as 80, 0, 20 (n=19), with the second most preferred color being light blue purple, coded as 60, 20, 40 (n=16). The least preferred colors were the ones selected only once by the students, which are green (40, -40, 40 and 40, -20, 40), dark blue grey (40, 0, -40), dark yellow grey (40, 0, 40), shade of reddish purple (40, 40, 20), tints and tones of purple (40, 20, 0; 40, 40, -40; 60, 20, -2, and 60, 40, -40), tints and tones blue (60, 0, -40; 80, -20, -20; 80, -20, 0, and 60, -20, -20), and light and orangish pink (60, 40, 0; 60, 40, 0). The order of lightness levels from the most preferred to the least is 80 (n=58), 60 (n=48), 40 (n=40), 20 (n=21), 0 (n=12), 100 (n=8). Among pairs of a* and b*, the most preferred one is 0, 0 (n=37), which corresponds to tones the color. The least preferred colors, having been selected by 3 students, are within a range where a* is -40 (n=3), b* is 40, and L* is either 40 or 80. The colors with the a* and b* range 0, 0 have the highest preference rates. That said, the area where a* and b* are positive, especially where they are equal to 20 (n=31) corresponds to the second most preferred colors' range. This range involves the area with red and yellow, the colors of which the combination gives orange. In other words, it is concluded that, for the bed frame, the most preferred colors are within the grey scale, followed by orange hue.

Table 12

Crosstabulation of bed frame preferences in terms of L, a*, b**

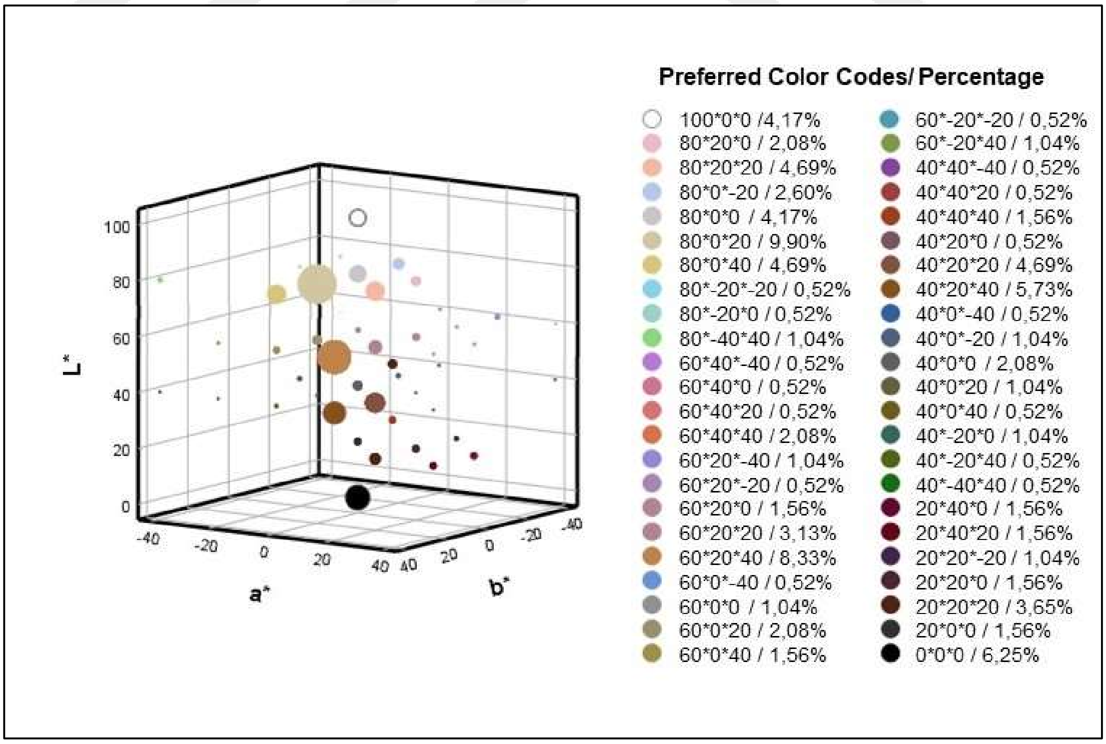
			b*				
L*			-40	-20	0	20	40
0	a*	0			12		
20	a*	0		0	3	0	
		20		2	3	7	
		40		0	3	3	
40	a*	-40	0	0	0	0	1
		-20	0	0	2	0	1
		0	1	2	4	2	1
		20	0	0	1	9	11
		40	1	0	0	1	3
60	a*	-20	0	1	0	0	2
		0	1	0	2	4	3
		20	2	1	3	6	16
		40	1	0	1	1	4
80	a*	-40		0	0	0	2
		-20		1	1	0	0
		0		5	8	19	9
		20		0	4	9	0
100	a*	0			8		

Color Codes	
100*0*0	60*-20*-20
80*20*0	60*-20*40
80*20*20	40*40*-40
80*0*-20	40*40*20
80*0*0	40*40*40
80*0*20	40*20*0
80*0*40	40*20*20
80*-20*-20	40*20*40
80*-20*0	40*0*-40
80*-40*40	40*0*-20
60*40*-40	40*0*0
60*40*0	40*0*20
60*40*20	40*0*40
60*40*40	40*-20*0
60*20*-40	40*-20*40
60*20*-20	40*-40*40
60*20*0	20*40*0
60*20*20	20*40*20
60*20*40	20*20*-20
60*0*-40	20*20*0
60*0*0	20*20*20
60*0*20	20*0*0
60*0*40	0*0*0

In Figure 31, 46 preferred colors among the given 66 are presented. The preferred colors accumulate in the areas where a* equals 20 or 0 and b* equals 0, 20, or 40. Students seem to have preferred colors in the areas where a* and b* are equal to zero and where they are equal to 20. For the negative a* and b* values, there is a low preference percentage, compared to the other hue angles. The codes corresponding to colors that are close to the edge of the given gamut, such as a* equaling -40 or b* equaling -40, were preferred by university students with very little frequency. These ranges correspond to the colors red and yellow. Thus, it is seen that students have a tendency to prefer red and yellow hues with different lightness levels, especially those of 80 and 60, more than green and blue hues.

Figure 31

Scatter-plot of bed frame color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.11. Pillow Colors

The color preferences of university students for the pillow and the corresponding frequency table are shown below in Table 13 with crosstabulation. As is seen from Table 13, the most preferred color is white, coded as 100, 0, 0 (n=63); whereas the second most preferred color is light grey, coded as 80, 0, 0 (n=10). Being the most preferred color, white was selected more than twice as light grey was, which is hence the second most preferred color for the pillow. 21 colors were preferred only once by students and so there are 21 different least preferred colors. The order of lightness levels from the most preferred to the least is 100 (n=63), 80 (n=47), 60 (n=30), 40 (n=27), 20 (n=15), and 0 (n=3). When the pairs of a* and b* are considered, 0, 0 (n=87) stands as the most preferred one, meaning that achromatic colors are preferred more for the pillow than the colorful ones. In this case, 0,0 is the most preferred pair by a wide margin; as the other combinations of a* and b* were preferred with very low frequency. For instance, the color in which a* and b* are equal to 20 was preferred 7 times, when the one in which a* and b* are equal to 40 was preferred 8 times by university students. Students have a tendency to prefer within the range of a* and b* are zero. In this sense, it is seen that students tend to prefer achromatic colors with different lightness levels, followed by light red and yellow colors.

Table 13

Crosstabulation of pillow preferences in terms of L, a*, b**

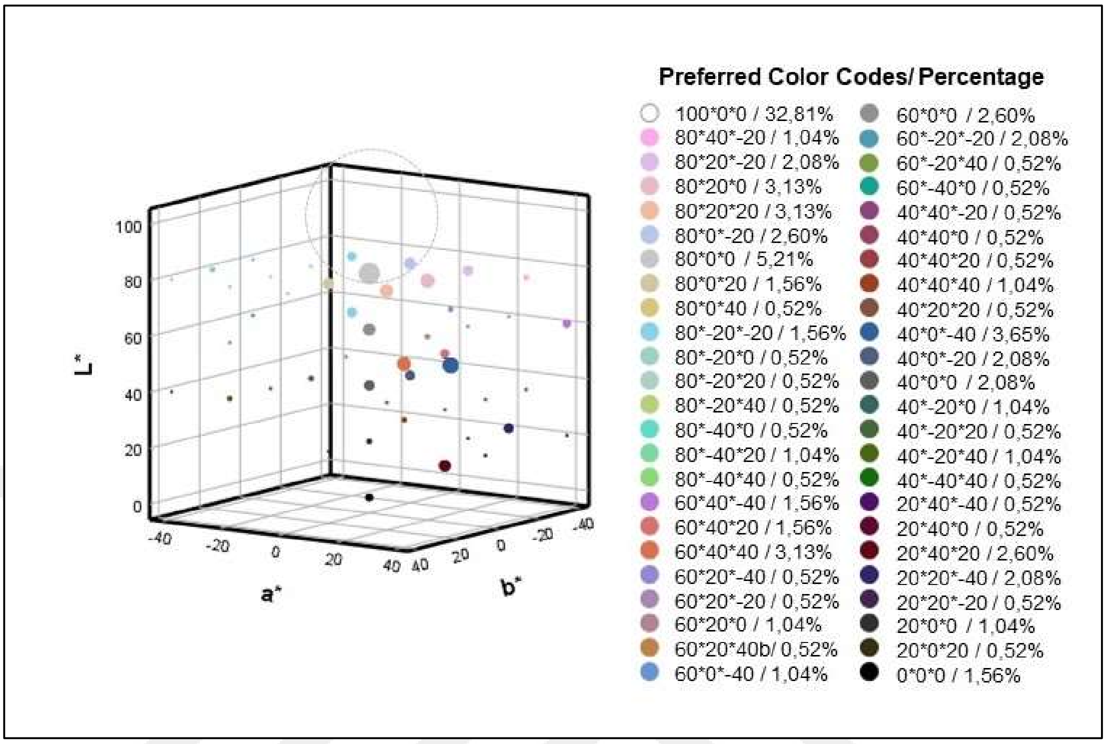
			b*				
L*			-40	-20	0	20	40
0	a*	0			3		
20	a*	0	0	0	2	1	
		20	4	1	0	0	
		40	1	0	1	5	
40	a*	-40	0	0	0	0	1
		-20	0	0	2	1	2
		0	7	4	4	0	0
		20	0	0	0	1	0
		40	0	1	1	1	2
60	a*	-40	0	0	1	0	0
		-20	0	4	0	0	1
		0	2	0	5	0	0
		20	1	1	2	0	1
		40	3	0	0	3	6
80	a*	-40		0	1	2	1
		-20		3	1	1	1
		0		5	10	3	1
		20		4	6	6	0
		40		2	0	0	0
100	a*	0			63		

Color Codes	
100*0*0	60*0*0
80*40*-20	60*-20*-20
80*20*-20	60*-20*40
80*20*0	60*-40*0
80*20*20	40*40*-20
80*0*-20	40*40*0
80*0*0	40*40*20
80*0*20	40*40*40
80*0*40	40*20*20
80*-20*-20	40*0*-40
80*-20*0	40*0*-20
80*-20*20	40*0*0
80*-20*40	40*-20*0
80*-40*0	40*-20*20
80*-40*20	40*-20*40
80*-40*40	40*-40*40
60*40*-40	20*40*-40
60*40*20	20*40*0
60*40*40	20*40*20
60*20*-40	20*20*-40
60*20*-20	20*20*-20
60*20*0	20*0*0
60*20*40	20*0*20
60*0*-40	0*0*0

In the Figure 32, 48 preferred colors among 66 given colors are visualized. The preferred colors belong to the range where a* and b* are zero and L* level of 100 (white) and 80 (light grey). As it is seen from the sizes of markers, the preference rates of other colors are very limited. A few of the colors seem prominent, such as blue, coded as 40, 0, -40 (3,65%); orangish pink, coded as 60, 40, 40 (3,13%); light pink, coded as 80, 20, 0 (3,13%); light orangish pink, coded as 80, 20, 20 (3,13%), etc. Thus, achromatic colors appear to be preferred for the pillow more than chromatic colors.

Figure 32

Scatter-plot of pillow color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.12. Bed Sheet Colors

The color preferences of university students for the bed sheet and the corresponding frequency table are shown below in Table 14 with crosstabulation. As is seen from Table 14, the most preferred color is white, coded as 100, 0, 0 (n=57). 22 different colors were selected once by the students and thus are the least preferred colors for the bed sheet. The order of lightness levels from the most preferred to the least is 80 (n=59), 100 (n=57), 60 (n=29), 40 (n=20), 20 (n=12), and 0 (n=3). While white is the most preferred color, L* equaling 100 is the second most preferred lightness level. That is, even though L* at 80 is the most preferred lightness level, the latter involves more than one color, whereas at the lightness level of L* equaling

100, there is only one color, which is white. When the pairs of a* and b* are considered, 0, 0 (n=81) is the most preferred one, meaning that tints and shades of grey were selected the most. The lowest preference rates are within range of a* and b* pairs where a* is -40 and b* is either zero (n=4) or 20 (n=3). The negative a* value corresponds green hue, whereas the positive b* values correspond to yellow hues. Hereby, it is seen that the colors yellow and green are the least preferred ones, especially compared to the colors red and blue.

Table 14

Crosstabulation of bed sheet preferences in terms of L, a*, b**

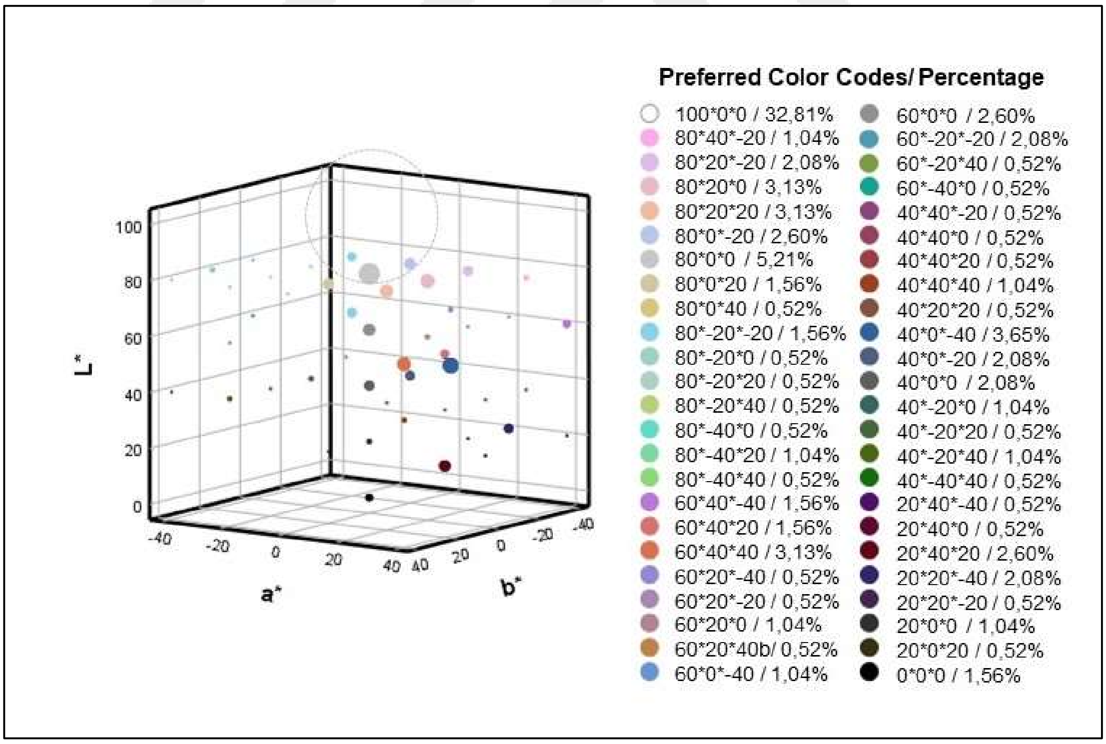
			b*				
L*			-40	-20	0	20	40
0	a*	0			3		
20	a*	0	0	0	1	1	
		20	2	0	2	0	
		40	1	1	0	4	
40	a*	-20	0	0	1	0	1
		0	3	3	3	0	1
		20	0	1	0	0	1
		40	0	0	1	4	1
60	a*	-40	0	0	3	1	0
		-20	0	1	0	0	1
		0	4	4	5	0	1
		20	1	1	2	1	0
		40	0	1	1	0	2
80	a*	-40		0	1	2	0
		-20		4	0	4	1
		0		6	12	4	3
		20		4	6	8	0
		40		4	0	0	0
100	a*	0			57		

Color Codes	
100*0*0	60*0*40
80*40*-20	60*-20*-20
80*20*-20	60*-20*40
80*20*0	60*-40*0
80*20*20	60*-40*20
80*0*-20	40*40*0
80*0*0	40*40*20
80*0*20	40*40*40
80*0*40	40*20*-20
80*-20*-20	40*20*40
80*-20*20	40*0*-40
80*-20*40	40*0*-20
80*-40*0	40*0*0
80*-40*20	40*0*40
60*40*-20	40*-20*0
60*40*0	40*-20*40
60*40*40	20*40*-40
60*20*-40	20*40*-20
60*20*-20	20*40*20
60*20*0	20*20*-40
60*20*20	20*20*0
60*0*-40	20*0*0
60*0*-20	20*0*20
60*0*0	0*0*0

In Figure 33, 48 preferred colors among the given 66 are visualized. The preferred colors accumulate in the areas where a* and b* are equal to zero. As it is seen from the graph below, white is preferred by a large percentage (32,81%). Only some colors are show dominance in a sense of preference rates over others. Some of these colors are light grey, coded as 80, 0, 0 (5,21%); dark blue coded as 40, 0, -40 (3,65%); orangish pink coded as 60, 40, 40 (3,13%); light pink coded as 80, 20, 0 (2,08%). Inferring from this and seeing as how a* and b* equaling zero corresponds to no hue among the provided colors, it is seen that university students prefer almost hueless or, in other words, achromatic colors for the pillows.

Figure 33

Scatter-plot of bed sheet color preferences in terms of L, a*, b**



Note. The size of markers represents percentages and colors of markers with exact colors of provided codes.

5.1.13. Analysis of 12 Surface Colors

Detailed analysis of the obtained descriptive statistics was conducted for each of the previous sections separately. Nevertheless, the overall analysis should be conducted with regards to a comparison of the provided 12 surfaces together, so as to understand the nature of the relationship of different surfaces altogether. In this light, Table 15 and Table 16 are generated; i.e., in order to analyze the relations between different surfaces.

Table 15 shows the most preferred colors for the 12 different surfaces. Five colors seem to dominate as the most preferred ones. The most preferred color is white, coded as 100, 0, 0, for four different surfaces: ceiling, door, pillow, and bed sheet. The next most preferred color, light yellow grey, coded as 80, 0, 20, was selected for the wardrobe, the table, and the bed frame. Light grey, coded as 80, 0, 0, was selected for the walls and the floor and, lastly, light yellow, coded as 80, 0, 40, was selected for the cabinet only. These colors have a common property, that is, high lightness levels. University students seem to prefer colors of high lightness for dormitory room surfaces, except from the backside and the fabric of chair. It shall be noted that the fabric and the backside of chair were adjacent surfaces in the given two-dimensional diagram when it is concluded that the most preferred color for them has the lowest lightness level, i.e., it is the color black (0, 0, 0). When the most preferred colors are compared, it is seen that the color white has the highest preference frequency for the ceiling (n=95), followed by the pillow (n=63) and the bed sheet (n=57). Even though light greyish yellow, coded as 80, 0, 20, is the most preferred color for the wardrobe; it shows the lowest preference frequency, that of 15, among the most preferred colors. Eventually, the colors show almost an equal distribution for the wardrobe. This situation also occurs in the cases of the door (n=55), the cabinet (n=68), and the bed frame (n=58). Another strong common point among the most preferred colors appears to be the codes of a*, which is equal to zero for all the provided surfaces. Negative and positive a* values stimulate different colors, such as red and green. That said, it seems that university students mostly prefer colors other than red and green for any surface. In addition, it appears that none of the most preferred colors show negative b* values for the provided surfaces, which correspond to the color blue. In other words, university students seem to not have not prefer blue for their dormitory rooms. Overall, achromatic colors are mostly preferred more than chromatic colors for dormitory room surfaces, followed by light yellow.

Table 15

Most preferred colors for 12 different surfaces

	L*	a*	b*	Frequency	Color
Ceiling	100	0	0	95	
Wall	80	0	0	34	
Door	100	0	0	18	
Floor	80	0	0	37	
Wardrobe	80	0	20	15	
Table	80	0	20	27	
Cabinet	80	0	40	16	
Backside of chair	0	0	0	41	
Fabric of chair	0	0	0	20	
Bed frame	80	0	20	19	
Pillow	100	0	0	63	
Bed sheet	100	0	0	57	

As it is shown in Table 16, the cumulative percentage up to the point where the L* level is 80 equals 50,3% for the ceiling, which means that almost half of the subjects prefer L* levels of 0, 20, 40, 60, and 80, when the other half prefers only 100. The wall is another surface that shows to have importance in terms of lightness levels, seeing as how the cumulative percentage equals 24,0% up to the L* level of 60 and eventually jumps to 85,4% at the L* level of 80. The difference between the two codes is very large, which helps concluding that students prefer an L* level of 80 for the wall. Additionally, cumulative percentage of the floor up to where the L* level is 60 equals 42,2% and where the L* level is 80, it equals 92,2%, which means that students have a tendency to prefer colors with an L* range of 80. The small difference between the two cumulative percentages means that students are nearly indifferent toward colors with varying L* levels. This situation also occurs in some other cases, such as those of the surfaces the ceiling, the wall, the cabinet, the backside of chair, the fabric of chair, and the bed frame as shown in Table 16. The obtained differences between 0 and 20 in terms of the cumulative percentages for the ceiling and the wall equal 1,0%, which means that very few of the subjects have selected colors with the levels 0 and 20. That said, the obtained difference between the L* levels 80 and 100 in terms of the cumulative percentages is very little for the cabinet, the backside of chair, the fabric of chair, and the bed frame. In summary, the cumulative percentage difference is 4,2% for the cabinet, 2,6% for the backside of chair, 3,7% for the fabric of chair and 4,3% for the bed frame. It is thus seen that, for the said four surfaces, the L* levels between 80 and 100 are less preferred than the L* levels of 0, 20, 40, and 60. Although 80 and

100 are preferred less for these four surfaces, it is seen that high lightness levels are preferred more in general for all surfaces, except for the backside of chair. The cumulative percentage of the backside of chair is the highest (21,6%) among other surfaces where L* equals 0.

Table 16

L levels of 12 surfaces' frequencies and its cumulative percent*

		L*					
		0	20	40	60	80	100
Ceiling	Frequency	1	2	12	12	69	95
	Cumulative Percent	0,5	1,6	7,9	14,1	**50,3**	**100,0**
Wall	Frequency	3	2	13	28	118	28
	Cumulative Percent	1,6	2,6	9,4	**24,0**	**85,4**	100,0
Door	Frequency	6	31	49	33	55	18
	Cumulative Percent	3,1	19,3	44,8	62,0	90,6	100,0
Floor	Frequency	5	15	23	38	96	15
	Cumulative Percent	2,6	10,4	22,4	**42,2**	**92,2**	100,0
Wardrobe	Frequency	5	21	44	43	65	12
	Cumulative Percent	2,6	13,7	36,8	59,5	93,7	100,0
Table	Frequency	3	19	37	32	77	23
	Cumulative Percent	1,6	11,5	30,9	47,6	88,0	100,0
Cabinet	Frequency	4	22	41	47	68	8
	Cumulative Percent	2,1	13,7	35,3	60,0	95,8	100,0
Backside of chair	Frequency	41	31	35	43	35	5
	Cumulative Percent	21,6	37,9	56,3	78,9	97,4	100,0
Fabric of chair	Frequency	20	23	47	39	53	7
	Cumulative Percent	10,6	22,8	47,6	68,3	96,3	100,0
Bed frame	Frequency	12	21	40	48	58	8
	Cumulative Percent	6,4	17,6	39,0	64,7	95,7	100,0
Pillow	Frequency	3	15	27	30	47	63
	Cumulative Percent	1,6	9,7	24,3	40,5	65,9	100,0
Bed sheet	Frequency	3	12	20	29	59	57
	Cumulative Percent	1,7	8,3	19,4	35,6	68,3	100,0

Considering how L* denotes lightness (value), regarding the perceptual variables of color, these results also show that university students prefer high value for certain interior surfaces in their dormitory rooms, yet context plays a prominent role on their preferences. Thus, the first hypothesis which is university students prefer high value (lightness) in their dormitory room, is generally accepted according to the results.

Negative and positive a* stimulate red and green, respectively but as it is seen from Table 15, university students showed higher preference rates where a* and b* are zero. Nevertheless, positive b* seems to have a prominent role in color preferences, with either 20 or 40 having been preferred by university students, for certain surfaces. Because positive b* values correspond to the color yellow in CIELAB, it can be said that there is a tendency to select yellowish colors more than others for dormitory rooms. The difference between a* and b* indicate the chroma (saturation) level in CIELAB. Students seem to prefer colors with low chroma levels for the surfaces of dormitory rooms, except for the cabinet. Low chroma preference with respect to the results obtained for eleven of the given surfaces but accepted for the cabinet, seeing as how the highest chroma level provided in the research was selected for it. Consequently, the second hypothesis is rejected.

5.2. Inferential Statistics

In order to understand the relationship between chroma and value and color preferences, inferential statistics was used, in addition to the above explained descriptive statistics. Chi-square test for independence was run by IBM SPSS for each surface. However, two codes were eliminated from the calculations for all surfaces; that is, the codes with L* levels 0 and 100 were left off due to the system limiting their choices by design. This is because the CIELAB gamut provides only 0, 0 as a* and b* when the L* level is 100 or 0. Thus, the results below are driven considering the L* levels of 20, 40, 60, and 80 only.

The results obtained from Pearson's Chi-Square test are considered to analyze the third hypothesis. The said results indicate that there is no significant relationship between the a* and b* values and the preferences of university students for the surfaces of the cabinet (χ^2 (16) =23.009, p>0.05). Moreover, it shows that there is a significant difference between the a* and b* values and the preferences of students for almost all surfaces provided, except for the cabinet. This implies an equal distribution of the data among the given levels of L* for the cabinet but not for the ceiling, the wall, the door, the floor, the wardrobe, the table, the backside of chair, the fabric of chair, the bed frame, the pillow, and the bed sheet. The summarized and labeled results can be seen in Table 17 (see Table 26, Appendix E for more detailed version).

Table 17

Pearson Chi-Square test for chroma

	Value	df	Asymptotic Significance (2-sided)
Ceiling	54,892	16	0,000
Wall	51,396	16	0,000
Door	67,997	16	0,000
Floor	65,194	16	0,000
Wardrobe	51,798	16	0,000
Table	28,50	16	0,027
Cabinet	23,009	16	**0,114**
Backside of chair	38,494	16	0,001
Fabric of chair	58,409	16	0,000
Bed frame	27,720	16	0,034
Pillow	42,174	16	0,000
Bed sheet	27,724	16	0,034

The correlation between the two variables was analyzed for each surface separately and the results are attached to Appendix E starting from Table 27 to Table 38. The analysis shows that L* and a* have a negative correlation, except for the ceiling and the backside of chair; that the L* and b* have a negative correlation among the surfaces of the ceiling, the door, the floor, the wardrobe, and the fabric of chair; whereas it shows a positive correlation among other surfaces. To elaborate, the ceiling, the wall, the backside of chair, and the fabric of chair have a very weak and perhaps negligible association between their respective L* and a* values and the door, the floor, the wardrobe, the table, the cabinet, the bed frame, the pillow, and the bed sheet show a weak association. In addition, the correlation between L* and b* seem to be very weak among all the 12 surfaces provided. There are some important points that should be noted. L* and a* have a relationship with a significance level of 0.01 (2-tailed) among the surfaces of the door (Pearson's r= -0.316, p>0.01), the floor (Pearson's r= -0.366, p>0.01), the wardrobe (Pearson's r= -0.324, p>0.01), the bed frame (Pearson's r= -0.233, p>0.01), the pillow (Pearson's r= -0.279, p>0.01), and the bed sheet (Pearson's r= -0.296, p>0.01) and one with a significance level of 0.05 (2-tailed) for the surface of the fabric of chair (Pearson's r=-0.165, p>0.05). For the door levels of L* and b*, 0.01 (2-tailed) is significant for correlation (Pearson's r= -0.147, p>0.01).

Table 18

Pearson correlation in terms of L*, a* & b* for 12 surfaces

	L* & a*		L* & b*	
	Value	Type of Association	Value	Type of Association
Ceiling	0,039	positive very weak	-0,052	negative very weak
Wall	-0,036	negative very weak	0,050	positive very weak
Door	-0,316	negative weak	-0,147	negative very weak
Floor	-0,366	negative weak	-0,110	negative very weak
Wardrobe	-0,324	negative weak	-0,004	negative very weak
Table	-0,386	negative weak	0,019	positive very weak
Cabinet	-0,314	negative weak	0,117	positive very weak
Backside of chair	0,003	positive very weak	0,040	positive very weak
Fabric of chair	-0,165	negative very weak	-0,034	negative very weak
Bed Frame	-0,233	negative weak	0,087	positive very weak
Pillow	-0,279	negative weak	0,090	positive very weak
Bed Sheet	-0,296	negative weak	0,044	positive very weak

Overall, chroma and value were found to have a weak or very weak relationship. Their correlation is mostly negative, indicating that as high lightness levels are preferred more for the dormitory rooms by the university students, their preference rates of high a* and b* values decrease (Table 18). Thus, the third hypothesis is accepted according to the results.

Gender is another characteristic that is effective in color preferences. Chi-Square test was run in order to analyze the relationship between gender and the perceptual variables of color. Crosstabulation tables were generated so as to observe the relation of gender to the L* and a* values of the preferred colors for each surface and to the L* and b* values the preferred colors for each surface, separately. The resulting tables are attached to Appendix E (from Table 39 to Table 62) so as to interpret the difference between the preferences of two genders. 74 males and 118 females have contributed to this research (Table 21, Appendix E); however, an equal number of participants were selected randomly so as to analyze the relationship between color preferences and gender. Thus, 74 males and 74 females were investigated. In general, there is an equal distribution among the color preferences of the two genders, although some of them for the given surfaces show difference. The distribution shows no difference among males for the wall and the floor, when for females, it shows no difference for the floor and the cabinet. The association is not statistically significant between males and the levels of L* and a* for the wall ($\chi^2(20) = 22.688$, $p>0.05$), as well as the levels of L* and b* for the floor ($\chi^2(20) = 27.289$, $p>0.05$) and not statistically significant among females for the floor and the levels of L* and a* ($\chi^2(20) = 29.661$, $p>0.05$), and the levels of L* and a* for cabinet ($\chi^2(20) =$ 29.29,773, $p>0.05$), as summarized in Table 19. Hence, it is concluded that gender is an effective factor in color preferences but not for all the interior surfaces of dormitory rooms. In the end, it shows that there is a significant difference between the color preferences of two genders for almost all surfaces except for the wall, the floor, and the cabinet which means the fourth hypotheses are accepted.

Table 19

Pearson Chi-Square test in terms of gender, L*, a*, b* for 12 surfaces

Surface	Gender	L* vs a*	L* vs b*
		Asym. Sig. (2-sided)	Asym. Sig. (2-sided)
Ceiling	Male	0,000	0,000
	Female	0,000	0,000
Wall	Male	**0,304**	0,000
	Female	0,000	0,008
Door	Male	0,004	0,000
	Female	0,009	0,012
Floor	Male	0,001	**0,127**
	Female	**0,076**	0,008
Wardrobe	Male	0,049	0,042
	Female	0,022	0,012
Table	Male	0,001	0,003
	Female	0,000	0,003
Cabinet	Male	0,049	0,029
	Female	0,016	**0,074**
Backside of chair	Male	0,006	0,000
	Female	0,003	0,007
Fabric of chair	Male	0,000	0,000
	Female	0,000	0,000
Bed frame	Male	0,004	0,000
	Female	0,009	0,000
Pillow	Male	0,000	0,000
	Female	0,000	0,000
Bed sheet	Male	0,002	0,000
	Female	0,002	0,000

CHAPTER VI

DISCUSSION

This study aims to find a relationship between the two perceptual variables of color, value and chroma, and the color preferences of university students. The relation of the gender factor to the color preferences was also examined. The results obtained from the study are discussed in the previous chapter in detail. Regarding the information provided in Chapter III, it appears that some results are contradictory with the existing literature, whereas some agree with it. This chapter discussed the results with similar and dissimilar studies that were previously completed. Four research questions and five hypotheses were formed based on the existing literature. From the analysis conducted in the previous chapter, the below table was constituted to summarize the results, findings and decisions of this study (Table 20.)

Table 20

Findings and decisions

Hypotheses	Findings	Decision
H. 1.: University students prefer high value (lightness) in their dormitory rooms.	University students prefer high lightness (value) in their dormitory room.	Accept hypothesis 1.
H. 2.: University students prefer high chroma (saturation) in their dormitory rooms.	University students prefer low chroma (saturation) in their dormitory room.	Reject hypothesis 2.
H. 3.: There is a significant relationship between chroma and value in terms of university students' preferences.	The relationship between chroma and value found to have negative very weak.	Accept hypothesis 3.
H. 4a.: There is a significant difference male between color preferences in their dormitory rooms.	There is a significant difference male between color preferences in their dormitory rooms except the surface of the floor and the wall.	Accept hypothesis 4. a.
H. 4b.: There is a significant difference female between color preferences in their dormitory rooms.	There is a significant difference female between color preferences in their dormitory rooms except the surface of the floor and the cabinet.	Accept hypothesis 4. b.

It was hypothesized that university students prefer colors with low chroma and high value for their dormitory rooms. Ou et al. (2004a) suggest that preferences depend on the perceptual variables. Some existing studies focus on value and chroma, such Chen et al. (2015), Gyu Park (2013), Jiang et al. (2020), Mousavi Samimi and Sadraei Tabatabaei (2021), Ou et al. (2011), Ou, Luo, et al. (2004a), Schloss and Palmer (2011), and Zhang et al. (2019). Mousaci Samimi and Sadraei Tabatabaei (2021) suggest that preschool children prefer high value levels for almost all colors. In addition, Jiang et al. (2020) claims that high value and high chroma levels are common features of adolescent color preferences. Although Zhang's experiment (2019) was designed to analyze the role of different cultures, it showed that saturation has an effect on color preferences, seeing as how Himba participants have preferred saturated colors. Ou et al. (2011) states that different age groups prefer different chroma and value levels; e.g., older people prefer colors with high value and high chroma, adults prefer colors with low chroma, etc. Ou et al. (2004) also suggests a general inclination for color preferences with high value levels but the study does not provide any information on the relation of chroma. Palmer and Schloss (2010) note the importance of different value levels but they do not touch upon the role of chroma, as well. It should be kept in mind that context plays a prominent role in color preference studies, as Chen et al. (2015) mentions. Context plays an important role in this experiment as well, considering how the twelve provided surfaces might have different contexts for the participants; that is, it is possible that students think about the feasibility regarding the application of colors. For instance, changing the color of a bed sheet or a pillow would seem easier than changing the color of a whole wall or the ceiling. Moreover, undergraduate students may associate surfaces with specific colors; e.g., if a student has adopted a sense of purpose for the table as only to serve as a place for studying, their preferred color would be one that is proper for the said action. In this study, the preference rates of high lightness levels are significantly different from those of low lightness for almost all surfaces. The only low lightness preference belongs to the backside of chair and the fabric of chair. Furthermore, preferences of the chroma level, which indicates the difference between a* and b* in CIELAB, frequently seems to be low among university students. The results show that there is no statistically significant relationship between a* and b*, which correspond to saturation or chroma, respectively, only for cabinet surface (χ^2 (16) =23.009, p =0.114, p>0.114); whereas the rest of the provided surfaces show a significant difference between the chroma levels and preference rates. University students have mostly preferred colors with low chroma levels for their dormitory room surfaces. Thus, there is no consistency between this study and the experiments of Mousaci Samimi and Sadraei Tabatabaei (2021), Jiang et al. (2020), Zhang (2019)'s, and Ou et al. (2004a) regarding their claim of a common preference of high chroma (saturation) levels but it is agreed that colors with high value (lightness) levels are preferred.

The literature lacks in terms of information on the relationship between value and chroma. Only a few studies focus on both variables. One is by Gyu Park (2013), as he mentions a single hue of yellow and concludes that high value is preferred and that the preferences of the color blue color have a relation to high chroma levels. The other study was conducted by Ou et al. (2012), which observes different age groups and their preferences of different chroma and value levels; claiming that as individuals get older, they prefer higher value and chroma levels, when, for adults, the situation is vice versa. Since this study investigated not only single colors but huge combinations of color gamut it is concluded that relation of chroma and value found to have a negative weak relation.

The final part of this study investigates the role of gender in color preferences. As stated before, some studies conclude that there is no difference dependent on gender in color preferences (Camgöz et al., 2002; Eysenck, 1941; Granger, 1955; Jadva et al., 2010; Mousavi Samimi & Sadraei Tabatabaei, 2021; Ou, Luo, et al., 2004a; Torres et al., 2020); whereas others claim to have observed an effect of gender on color preferences (Gyu Park, 2013; Hurlbert & Ling, 2017; McManus et al., 1981; Ou, Lou, et al., 2004; Ou, Luo, et al., 2004b; Porter & Garth, 1934; Read & Upington, 2009; Van der Voordt et al., 2017; Walton et al., 1933; Yildirim et al., 2007; Zhang et al., 2019). The studies mentioned do not touch upon the perceptual variables of color but instead, focus mainly on the hues in the experiments. Zhang et al. (2019) mentions that females seem to have more tendency toward high value levels compared to males. Furthermore, Jiang et al. (2020) notes that males prefer different value levels but fails to mention which color is the most preferred one. Overall, color preferences show an equal distribution among both genders, for almost all provided surfaces. Nonetheless, some surfaces of the dormitory room do not present equal distribution of color preferences among males, such as the wall, the floor; whereas the floor and the cabinet do not do so among females. The root cause of these small differences may be the varying contexts and not gender. Hence, more studies should be conducted so as to investigate the role of gender with respect to context; which seems to be an important research area due to the potential usage of color for discrimination, despite the nature of spaces being genderless.

CHAPTER VII

CONCLUSION

This study observes the color preferences of university students for their dormitory rooms. To participate in the study, students must have accommodated in the dormitories for at least one semester, in order to having been familiar with place. This study examines 12 different surfaces of an existing dormitory room and analyzes the relationships between the said 12 surfaces with the given 66 colors. The reason 66 color stimuli were used from the CIELAB gamut is to be able to cover more colors in the study and thus making it more comprehensive. The colors for the gamut were selected with equal mathematical distances, such as levels of L* being 100, 80, 60, 40, 20, 0 and of a* and b* being 40, 20, 0, -20, -40. Such codes indicate different value and chroma levels.

It is concluded that high lightness and low saturation are preferred for almost all surfaces of the dormitory room. A weak negative correlation was also found between the preferred levels of lightness and saturation but further research might be necessary in order to analyze the said correlation regarding different interior spaces. 200 participants completed the necessary test but only 192 of the obtained data showed to be valid for statistical usage. 118 of the participants were female and 74 of them were male. As a final part of the thesis, the difference between the color preferences of two genders was investigated, resulting in the indication of a difference among the two genders for almost all surfaces but noting that some specific surfaces showed no significant relation to gender, such as the wall, the floor, and the cabinet.

This study is of importance to the literature, mainly due to past color preferences studies having been conducted regarding only some specific surfaces of an interior space. In such studies, participants were asked to select their preferred color accordingly to a given schema. Thus, participants may have had the tendency to select not their actual preference but the colors that were compatible with the readily provided colors around its respective surface. This study enabled its participants to select each surface one-by-one, as they desired and to change their previously chosen colors in case of a change in their preferences during the process. Hence, this study on color preferences is a crucial one for the literature. This aside, it was noted that CIELAB is not commonly used in color preferences studies and that other systems take the lead in general, mostly because they are relatively more user friendly. However, CIELAB is known to be the most scientific system and thus was chosen for this study. In addition, it appears that dormitories are highly disregarded in the literature. Notwithstanding, dormitories are very special places not only in terms of being designed with a basis of gender, specifically, but also being residential environments that are designed as public spaces at the same time.

Designers, architects, interior designers, colorists, and similar professions can make use of this study in their color selection processes. Furthermore, designers who work with university students and dormitories should specifically focus on color studies; that is, especially for the sake of the students' well-being, their academic success, their motivation, and so on. Their perceptions of the environment they are exposed to on a daily basis is of high significance to their ability of feeling free and comfortable, as it should be kept in mind that they are the future of our world.

This study has some limitations due to the used methodology. It should be noted that age differences are claimed to cause an important variance on color preferences in terms of the hue, value, and chroma levels; however, because this study investigates only undergraduate students, the age factor is missing. In addition to age, new studies must be conducted in order to understand the effects of other demographic data. Class, past color education, student departments, and the level of familiarity to the place regarding how long the subjects have been accommodating in it are some additional factors that shall be investigated further.

Moving on, the adjacency of given surfaces should also be considered as a possible factor in the preferences. For instance, the high preference rate of black for the backside of chair may have led the adjacent surface, the fabric of chair, to also be preferred as black, seeing as how it is a common color combination. Moreover, students might consider combinations of colors important, such as the assumption of when the pillow is white, so must be the bed sheet. Consequentially, providing some specific colors for certain surfaces as a clue for the participants might alter the results since they could try to combine said certain colors with their own preferred colors.

This study was conducted without considering the color-texture association, meaning that white marble and white fabric may be seen as different from each other, although the selected colors are technically the same in the experiment. That said, student might also be inclined to believe certain colors must be selected for certain surfaces due to the common products provided in the industry, such as the common understanding on how wood has to be brown or another dark color. Thus, adding texture to the provided environment might give different results for color preference studies.

The provided two-dimensional image shows only a part of the chosen dormitory type. There are several typologies for dormitories that are inspired by hotel rooms. Studying different typologies is strongly suggested for both dormitories and different environments in order to have a deeper understanding of how color preferences are associated to different typologies.

Even though students were provided the choice of selecting the first surface to color, most students stated to have started from the ceiling since it was the first surface given to them by default. This might have affected the order of color preferences. In other words, students may have a tendency to prefer colors according to their first selected place, causing them to try and find proper color combinations for their preferences. In this sense, the selection order of surfaces should be investigated deeply so as to understand whether the first surface selection has a significant effect on color preferences when more than one color is preferred by participants. It is suggested that a new study is conducted for this purpose, with a design that allows each participant to receive a random and thus different order of colors and surfaces to select from.

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APPENDICES

Appendix A. *Approval of Ethics Committee*

Bilkent Üniversitesi
Akademik İşler Rektör Yardımcılığı

Tarih	: 29 Kasım 2021
Gönderilen	: Nilgün Olguntürk
Gönderen	: H. Altay Güvenir İnsan Araştırmaları Etik Kurulu Başkanı
Konu	: *"Color ..."* çalışması etik kurul onayı

Üniversitemiz İnsan Araştırmaları Etik Kurulu, 29 Kasım 2021 tarihli görüşme sonucu, *"Color Preferences of University Students in terms of Value and Chroma at Dormitories"* isimli çalışmanız kapsamında yapmayı önerdiğiniz etkinlik için etik onay vermiş bulunmaktadır. Onay, ekte verilmiş olan çalışma önerisi, çalışma yürütücüleri ve bilgilendirme formu için geçerlidir.

Bu onay, yapmayı önerdiğiniz çalışmanın genel bilim etiği açısından bir değerlendirmedir. Çalışmanızda, kurulumuzun değerlendirmesi dışında kalabilen özel etik ve yasal sınırlamalara uymakla ayrıca yükümlüsünüz.

Kovid-19 salgını nedeniyle konulmuş olan kısıtlamaların yürürlükte olduğu süre içinde, tüm komite toplantıları elektronik ortamda yapılmaktadır; aşağıda isimleri bulunan Bilkent Üniversitesi Etik Kurulu Üyeleri adına bu yazıyı imzalama yetkisi kurul başkanındadır.

Etik Kurul Üyeleri:

Ünvan / İsim	**Bölüm / Uzmanlık**	
Prof.Dr. H. Altay Güvenir	Bilgisayar Mühendisliği	Başkan
Prof.Dr. Erdal Onar	Hukuk	Üye
Prof.Dr. Haldun Özaktaş	Elektrik ve Elektronik Müh.	Üye
Doç.Dr. Işık Yuluğ	Moleküler Biyoloji ve Genetik	Üye
Dr. Öğr. Üyesi Burcu Ayşen Ürgen	Psikoloji	Üye
Doç.Dr. Çiğdem Gündüz Demir	Bilgisayar Mühendisliği	Yedek Üye
Dr. Öğr. Üyesi A.Barış Özbilen	Hukuk	Yedek Üye

Kurul karar/toplantı No: 2021_11_29_01

Bilkent Üniversitesi, 06800 Bilkent, Ankara • Telefon: (312) 290 12 13 • (312) 290 12 14 • Faks: (312) 266 41 52

Appendix B. *Consent Form (in Turkish)*

ONAY FORMU

Üniversite Öğrencilerinin Yurt Odalarındaki Açıklık ve Doymuşluk Açısından Renk Tercihleri

Yüksek Lisans Araştırma Çalışması

AMAÇ

Bu araştırmanın amacı, üniversite öğrencilerinin yurt odalarındaki renk tercihlerini açıklık ve doymuşluk açısından incelemektir. Katılımcı olarak, bu araştırmanın yalnızca üç aşamasından sorumluyum: Demografik veri toplama, Ishihara'nın renk körlüğü testi ve yurt odasının iki boyutlu çizgisel görselinin renk tercihleri üzerine seçimi.

KATILIM

Katılımım tamamen isteğe bağlıdır ve istediğim zaman çekilme hakkına sahip olduğumu biliyorum. Bu nedenle, bu araştırmaya katılmaktan rahatsızlık duymuyorum. Bir katılımcı olarak, katılmazsam veya katılımdan çekilirsem akademik değerlendirmemin etkilenmeyeceğinin farkındayım. Ayrıca bu araştırmayla ilgili herhangi bir sorum olursa, araştırmacıyla, araştırmacının danışmanıyla veya Bilkent Üniversitesi Yerel Etik Kurulu'yla iletişime geçebilirim.

PROSEDÜR

Bu araştırmanın katılımcısı olarak, yaşım, cinsiyetim, bölümüm, sınıfım ve yurtta kaldığım süre ile ilgili bilgileri içeren demografik bilgiler bölümümle ilgili soruları cevaplayacağım. Ishihara'nın renk körlüğü testine de cevap vermem gerekecek. Son bölümde ise tercihlerime göre bir yurt odasının iki boyutlu çizgisel görüntüsünün renk seçimi içindir.

FAYDALAR VE RİSKLER

Bu araştırmanın bana doğrudan bir faydası olmayacak. Ancak bulgular mimarlar, iç mimarlar, renk uzmanları vb. tarafından gelecekteki yurt odalarının tasarımına katkı sağlama potansiyeline sahiptir. Bu araştırmaya katılmak, teorileri test etmek için gerekli verileri toplamak adına faydalı olacaktır. Renk alanındaki mevcut sınırlı bilgiye ve araştırmalara katkıda bulunacaktır. Bu araştırmanın bana herhangi bir zarar vermeyeceğini, araştırmaya katılmanın beklenilen herhangi bir risk olmadığını anlıyorum.

TAZMİNAT

Bu araştırmaya katıldığım için bana ücret verilmeyecek. Bu araştırma çalışmasına katılmak için para ödenmeyecektir.

GİZLİLİK

Bu çalışmada elde edilen her türlü bilgi sadece bilimsel amaçlarla yayınlanacaktır. Bir katılımcı olarak, verilerimle ilgili her türlü bilginin gizli kalacağının farkındayım. Yalnızca araştırmacı ve araştırma sorumlusu bilgilerime erişebilecek ve çalışma için elde edilen tüm bilgilerim şifre korumalı bir bilgisayarda veya kilitli dolaplarda güvenli bir şekilde saklanacaktır.

☐ *Bu formu okuduğumu ve anladığımı kabul ediyorum. Araştırma ile ilgili tüm soruları sordum ve ne yapmam gerektiğini anladım. Bu araştırmaya gönüllü olarak katılmak kabul ediyorum.*

☐ *18 yaşın üzerindeyim ve üniversite yurtlarında en az bir yarıyıl kaldım.*

Katılımcının Adı: ______________________

Katılımcının E-postası:______________________

Katılımınız için teşekkür ederim.

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Appendix C. Demographic Data Collection Sheet (in Turkish)

İsim-Soyisim:

Yaş:

Cinsiyet: ☐ Kadın ☐ Erkek

Bölüm:

Uyruk:

Sınıf: ☐ Hazırlık ☐ 1. Sınıf ☐ 2. Sınıf ☐ 3. Sınıf ☐ 4. Sınıf ☐ Mezun ☐ Diğer

Yurtta kaldığınız dönemler: (Birden fazla seçenek seçebilirsiniz.)

☐ 2020-2021 Güz Dönemi

☐ 2019-2020 Bahar Dönemi

☐ 2019-2020 Güz Dönemi

☐ 2018-2019 Bahar Dönemi

☐ 2018-2019 Güz Dönemi

☐ 2017-2018 Bahar Dönemi

☐ 2017-2018 Güz Dönemi

☐ 2016-2017 Bahar Dönemi

☐ 2016-2017 Güz Dönemi

☐ 2015-2016 Bahar Dönemi

☐ 2015-2016 Güz Dönemi

☐ 2014-2015 Bahar Dönemi

☐ 2014-2015 Güz Dönemi

☐ Diğer

Herhangi bir göz veya görme bozukluğunuz için herhangi bir düzeltme ekipmanınız (kontak lens gibi) var mı?

☐ Evet ☐ Hayır

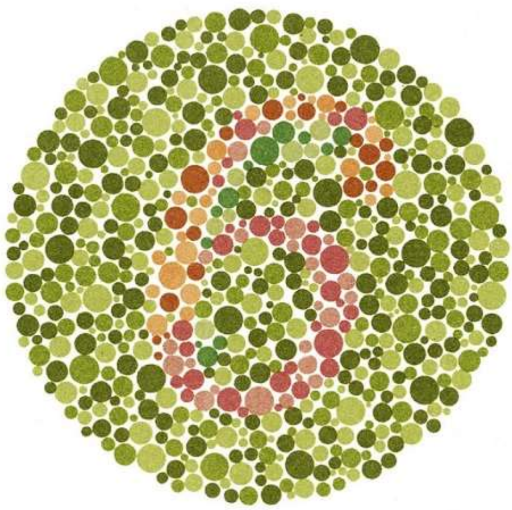
Eğer evet ise, lütfen deney sırasında kullanınız.

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

Appendix D. *Ishihara's Test for Color-Blindness Plates*

Figure 34

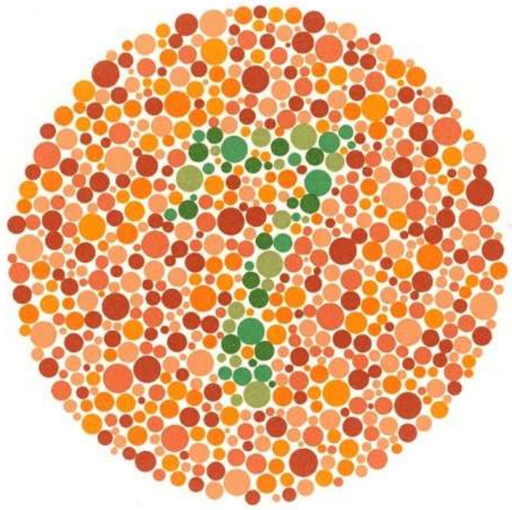
Ishihara's Test for Color-Blindness Plate Number 8.



Note: Correct Answer is 6. Planet Number 8. Reprinted from *Test for Color-Blindness* (p. 17) by Ishihara, 1972. Copyright 1972 by Kanehara Shuppan Co. LTD.

Figure 35

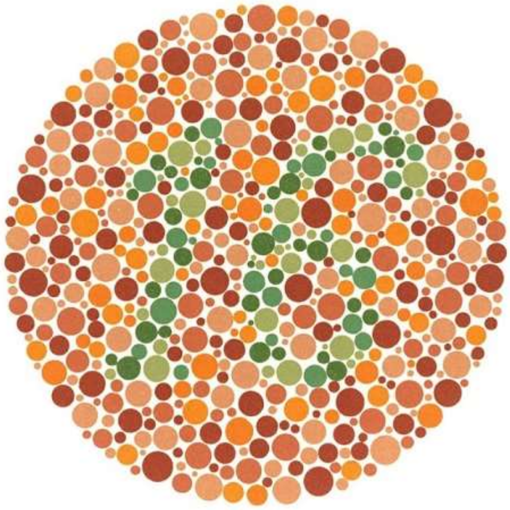
Ishihara's Test for Color-Blindness Plate Number 11



Note: Correct Answer is 7. Planet Number 11. Reprinted from *Test for Color-Blindness* (p. 22) by Ishihara, 1972. Copyright 1972 by Kanehara Shuppan Co. LTD.

Figure 36

Ishihara's Test for Color-Blindness Plate Number 12



Note: Correct Answer is 16. Planet Number 12. Reprinted from *Test for Color-Blindness* (p. 23) by Ishihara, 1972. Copyright 1972 by Kanehara Shuppan Co. LTD.

Appendix E. *Statistical Data*

Table 21

Gender of Participants

Gender		
		Frequency
Valid	Male	74
	Female	118
	Total	192

Table 22

Departments of Participants

Department		
		Frequency
Valid	Interior Architecture and Environmental Design	25
	Architecture	7
	Economy	5
	Mathematics	2
	Philosophy	2
	Computer Engineering	21
	Law	15
	Molecular Biology and Genetics	7
	Chemistry	3
	Industrial Engineering	18
	Graphic Design	2
	Mechanical Engineering	8
	American Culture and Literature	3
	Political Science and Public Administration	7
	Electrical and Electronics Engineering	9
	Information Systems and Management	3
	International Relations	13
	Management	13
	Psychology	14
	Urban Design and Landscape Architecture	1
	Physics	2
	Translation and Interpretation	4
	Communication and Design	3
	English Language and Literature	2
	Archaeology	1
	Turkish Literature	2
	Total	192

Table 23

Age of Participants

Age		
		Frequency
Valid	18	22
	19	48
	20	48
	21	29
	22	14
	23	13
	24	1
	25	2
	26	6
	27	1
	28	1
	29	2
	30	2
	31	1
	32	2
	Total	192

Table 24

Sum of the Semesters that Accommodate at Dormitories

Sum of the Semesters that Accommodate at Dormitories		
		Frequency
Valid	1	60
	2	26
	3	39
	4	8
	5	19
	6	7
	7	13
	8	4
	9	5
	10	6
	13	2
	14	2
	15	1
	Total	192

Table 25

Class of Participants

Class		
		Frequency
Valid	Prep Class	26
	Freshman	61
	Sophomore	32
	Junior	32
	Senior	16
	Graduate	5
	Other	20
	Total	192

Table 26

Chi-Square tests for chroma

CeilingL ~= 0 & CeilingL ~= 100 (FILTER)		Value	df	Asymptotic Significance (2-sided)
Selected	Pearson Chi-Square	54,892[a]	16	0,000
	Likelihood Ratio	40,959	16	0,001
	Linear-by-Linear Association	2,885	1	0,089
	N of Valid Cases	95		
WallL ~= 0 & WallL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	51,396[a]	16	0,000
	Likelihood Ratio	52,095	16	0,000
	Linear-by-Linear Association	1,773	1	0,183
	N of Valid Cases	161		
DoorL~= 0 & DoorL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	67,997[a]	16	0,000
	Likelihood Ratio	70,100	16	0,000
	Linear-by-Linear Association	10,078	1	0,002
	N of Valid Cases	168		
FloorL~= 0 & FloorL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	65,194[a]	16	0,000
	Likelihood Ratio	70,883	16	0,000
	Linear-by-Linear Association	12,695	1	0,000
	N of Valid Cases	172		

Table 26. *Chi-Square tests (Cont'd)*

WardropeL~= 0 & WardropeL ~= 100 (FILTER)		Value	df	Asymptotic Significance (2-sided)
Selected	Pearson Chi-Square	51,798[a]	16	0,000
	Likelihood Ratio	53,942	16	0,000
	Linear-by-Linear Association	3,500	1	0,061
	N of Valid Cases	173		
TableL~= 0 & TableL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	28,509[a]	16	0,027
	Likelihood Ratio	32,589	16	0,008
	Linear-by-Linear Association	0,208	1	0,648
	N of Valid Cases	165		
CabinetL~= 0 & CabinetL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	23,009[a]	16	0,114
	Likelihood Ratio	22,615	16	0,124
	Linear-by-Linear Association	0,024	1	0,876
	N of Valid Cases	178		
BacksL~= 0 & BacksL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	38,494[a]	16	0,001
	Likelihood Ratio	38,068	16	0,001
	Linear-by-Linear Association	0,563	1	0,453
	N of Valid Cases	144		
FabricL~= 0 & FabricL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	58,409[a]	16	0,000
	Likelihood Ratio	54,300	16	0,000
	Linear-by-Linear Association	7,949	1	0,005
	N of Valid Cases	162		

Table 26. *Chi-Square tests (Cont'd)*

BedfL~= 0 & BedfL ~= 100 (FILTER)		Value	df	Asymptotic Significance (2-sided)
Selected	Pearson Chi-Square	27,720[a]	16	0,034
	Likelihood Ratio	30,489	16	0,016
	Linear-by-Linear Association	0,771	1	0,380
	N of Valid Cases	167		
PillowL~= 0 & PillowL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	42,174[a]	16	0,000
	Likelihood Ratio	47,983	16	0,000
	Linear-by-Linear Association	0,284	1	0,594
	N of Valid Cases	119		
SheetL~= 0 & SheetL ~= 100 (FILTER)				
Selected	Pearson Chi-Square	27,724[a]	16	0,034
	Likelihood Ratio	33,944	16	0,006
	Linear-by-Linear Association	0,001	1	0,979
	N of Valid Cases	120		

Table 27

Correlation of ceiling

		L*	a*	b*
L*	Pearson Correlation	1	0,039	-0,052
	Sig. (2-tailed)		0,590	0,473
	N	191	191	191
a*	Pearson Correlation	0,039	1	-,178*
	Sig. (2-tailed)	0,590		0,014
	N	191	191	191
b*	Pearson Correlation	-0,052	-,178*	1
	Sig. (2-tailed)	0,473	0,014	
	N	191	191	191

*. Correlation is significant at the 0.05 level (2-tailed).

Table 28

Correlation of wall

		L*	a*	b*
L*	Pearson Correlation	1	-0,036	0,050
	Sig. (2-tailed)		0,617	0,493
	N	192	192	192
a*	Pearson Correlation	-0,036	1	-0,104
	Sig. (2-tailed)	0,617		0,151
	N	192	192	192
b*	Pearson Correlation	0,050	-0,104	1
	Sig. (2-tailed)	0,493	0,151	
	N	192	192	192

Table 29

Correlation of door

		L*	a*	b*
L*	Pearson Correlation	1	-,316**	-,147*
	Sig. (2-tailed)		0,000	0,042
	N	192	192	192
a*	Pearson Correlation	-,316**	1	,278**
	Sig. (2-tailed)	0,000		0,000
	N	192	192	192
b*	Pearson Correlation	-,147*	,278**	1
	Sig. (2-tailed)	0,042	0,000	
	N	192	192	192

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 30

Correlation of floor

		L*	a*	b*
L*	Pearson Correlation	1	-,366**	-0,110
	Sig. (2-tailed)		0,000	0,129
	N	192	192	192
a*	Pearson Correlation	-,366**	1	,292**
	Sig. (2-tailed)	0,000		0,000
	N	192	192	192
b*	Pearson Correlation	-0,110	,292**	1
	Sig. (2-tailed)	0,129	0,000	
	N	192	192	192

**. Correlation is significant at the 0.01 level (2-tailed).

Table 31

Correlation of wardrobe

		L*	a*	b*
L*	Pearson Correlation	1	-,324**	-0,004
	Sig. (2-tailed)		0,000	0,952
	N	190	190	190
a*	Pearson Correlation	-,324**	1	,156*
	Sig. (2-tailed)	0,000		0,032
	N	190	190	190
b*	Pearson Correlation	-0,004	,156*	1
	Sig. (2-tailed)	0,952	0,032	
	N	190	190	190

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 32

Correlation of table

		L*	a*	b*
L*	Pearson Correlation	1	-,386**	0,019
	Sig. (2-tailed)		0,000	0,790
	N	191	191	191
a*	Pearson Correlation	-,386**	1	0,089
	Sig. (2-tailed)	0,000		0,222
	N	191	191	191
b*	Pearson Correlation	0,019	0,089	1
	Sig. (2-tailed)	0,790	0,222	
	N	191	191	191

**. Correlation is significant at the 0.01 level (2-tailed).

Table 33

Correlation of cabinet

		L*	a*	b*
L*	Pearson Correlation	1	-,314**	0,117
	Sig. (2-tailed)		0,000	0,109
	N	190	190	190
a*	Pearson Correlation	-,314**	1	0,009
	Sig. (2-tailed)	0,000		0,898
	N	190	190	190
b*	Pearson Correlation	0,117	0,009	1
	Sig. (2-tailed)	0,109	0,898	
	N	190	190	190

**. Correlation is significant at the 0.01 level (2-tailed).

Table 34

Correlation of backside of chair

		L*	a*	b*
L*	Pearson Correlation	1	0,003	0,040
	Sig. (2-tailed)		0,971	0,582
	N	190	190	190
a*	Pearson Correlation	0,003	1	0,064
	Sig. (2-tailed)	0,971		0,383
	N	190	190	190
b*	Pearson Correlation	0,040	0,064	1
	Sig. (2-tailed)	0,582	0,383	
	N	190	190	190

Table 35

Correlation of fabric of chair

		L*	a*	b*
L*	Pearson Correlation	1	-,165*	-0,034
	Sig. (2-tailed)		0,024	0,643
	N	189	189	189
a*	Pearson Correlation	-,165*	1	,219**
	Sig. (2-tailed)	0,024		0,002
	N	189	189	189
b*	Pearson Correlation	-0,034	,219**	1
	Sig. (2-tailed)	0,643	0,002	
	N	189	189	189

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 36

Correlation of bed frame

		L*	a*	b*
L*	Pearson Correlation	1	-,233**	0,087
	Sig. (2-tailed)		0,001	0,238
	N	187	187	187
a*	Pearson Correlation	-,233**	1	0,122
	Sig. (2-tailed)	0,001		0,097
	N	187	187	187
b*	Pearson Correlation	0,087	0,122	1
	Sig. (2-tailed)	0,238	0,097	
	N	187	187	187

**. Correlation is significant at the 0.01 level (2-tailed).

Table 37

Correlation of pillow

		L*	a*	b*
L*	Pearson Correlation	1	-,279**	0,090
	Sig. (2-tailed)		0,000	0,224
	N	185	185	185
a*	Pearson Correlation	-,279**	1	0,043
	Sig. (2-tailed)	0,000		0,558
	N	185	185	185
b*	Pearson Correlation	0,090	0,043	1
	Sig. (2-tailed)	0,224	0,558	
	N	185	185	185

**. Correlation is significant at the 0.01 level (2-tailed).

Table 38

Correlation of bed sheet

		L*	a*	b*
L*	Pearson Correlation	1	-,296**	0,044
	Sig. (2-tailed)		0,000	0,560
	N	180	180	180
a*	Pearson Correlation	-,296**	1	-0,002
	Sig. (2-tailed)	0,000		0,983
	N	180	180	180
b*	Pearson Correlation	0,044	-0,002	1
	Sig. (2-tailed)	0,560	0,983	
	N	180	180	180

**. Correlation is significant at the 0.01 level (2-tailed).

Table 39

Crosstabulation of gender, L, a* for ceiling*

			L*					
Gender			20	40	60	80	100	Total
Male	a*	-40	0	4	2	2	0	8
		-20	0	0	0	5	0	5
		0	0	4	2	19	33	58
		20	0	0	0	2	0	2
		40	1	0	0	0	0	1
	Total		1	8	4	28	33	74
Female	a*	-20	0	0	0	7	0	7
		0	0	2	2	15	40	59
		20	1	0	1	5	0	7
		40	0	0	0	1	0	1
	Total		1	2	3	28	40	74

Table 40

Crosstabulation of gender, L, b* for ceiling*

Gender			L* 20	40	60	80	100	Total
Male	b*	-40	0	1	1	0	0	2
		-20	0	1	0	7	0	8
		0	0	2	1	14	33	50
		20	1	0	0	7	0	8
		40	0	4	2	0	0	6
	Total		1	8	4	28	33	74
Female	b*	-40	1	1	0	0	0	2
		-20	0	1	1	6	0	8
		0	0	0	1	12	40	53
		20	0	0	1	10	0	11
	Total		1	2	3	28	40	74

Table 41

Crosstabulation of gender, L, a* for wall*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	2	2	0	0	4
		-20	0	0	0	2	8	0	10
		0	2	1	10	4	26	8	51
		20	0	0	0	0	5	0	5
		40	0	0	1	1	2	0	4
	Total		2	1	13	9	41	8	74
Female	a*	-40		0		1	2	0	11
		-20		0		0	11	0	42
		0		0		5	24	13	15
		20		0		5	10	0	3
		40		1		1	1	0	6
	Total			1		12	48	13	74

Table 42

Crosstabulation of gender, L, b* for wall*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	0	4	0	0	0	4
		-20	0	0	1	4	13	0	18
		0	2	1	4	2	12	8	29
		20	0	0	0	1	13	0	14
		40	0	0	4	2	3	0	9
	Total		2	1	13	9	41	8	74
Female	b*	-40		0		1	0	0	1
		-20		1		3	11	0	15
		0		0		5	18	13	36
		20		0		2	17	0	19
		40		0		1	2	0	3
	Total			1		12	48	13	74

Table 43

Crosstabulation of gender, L, a* for door*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	2	0	2	0	4
		-20	0	0	2	0	0	0	2
		0	2	6	5	2	19	7	41
		20	0	6	7	2	1	0	16
		40	0	1	5	4	1	0	11
	Total		2	13	21	8	23	7	74
Female	a*	-20	0	0	0	0	3	0	3
		0	1	3	5	6	11	10	36
		20	0	5	11	7	5	0	28
		40	0	1	4	2	0	0	7
	Total		4	9	20	15	19	10	74

Table 44

Crosstabulation of gender, L, b* for door*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	0	2	1	0	0	3
		-20	0	0	1	0	6	0	7
		0	2	6	2	2	4	7	23
		20	0	7	5	2	8	0	22
		40	0	0	11	3	5	0	19
	Total		2	13	21	8	23	7	74
Female	b*	-40	0	0	1	1	0	0	2
		-20	0	0	3	1	3	0	7
		0	1	4	3	5	8	10	31
		20	0	5	8	2	7	0	22
		40	0	0	5	6	1	0	12
	Total		1	9	20	15	19	10	74

Table 45

Crosstabulation of gender, L, a* for floor*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	0	0	1	0	1
		-20	0	0	0	0	7	0	7
		0	4	5	3	7	25	3	47
		20	0	0	6	5	2	0	13
		40	0	3	0	2	1	0	6
	Total		4	8	9	14	36	3	74
Female	a*	-40	0	0	0	0	1	0	1
		-20	0	0	0	0	1	0	1
		0	1	0	3	8	32	7	51
		20	0	3	3	6	5	0	17
		40	0	1	2	0	1	0	4
	Total		1	4	8	14	40	7	74

Table 46

Crosstabulation of gender, L, b* for floor*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	0	0	1	0	0	1
		-20	0	0	1	1	6	0	8
		0	4	3	2	3	15	3	30
		20	0	5	3	4	7	0	19
		40	0	0	3	5	8	0	16
	Total		4	8	9	14	36	3	74
Female	b*	-20	0	0	1	3	4	0	8
		0	1	0	3	3	14	7	28
		20	0	4	3	4	21	0	32
		40	0	0	1	4	1	0	6
	Total		1	4	8	14	40	7	74

Table 47

Crosstabulation of gender, L, a* for wardrobe*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	0	3	2	0	5
		-20	0	0	0	0	2	0	2
		0	2	4	4	8	18	5	41
		20	0	4	7	6	1	0	18
		40	0	0	3	3	1	0	7
	Total		2	8	14	20	24	5	73
Female	a*	-40	0	0	0	1	4	0	5
		-20	0	0	0	1	3	0	4
		0	2	3	6	4	15	5	35
		20	0	6	5	9	4	0	24
		40	0	1	4	1	0	0	6
	Total		2	10	15	16	26	5	74

Table 48

Crosstabulation of gender, L, b* for wardrobe*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	0	1	2	0	0	3
		-20	0	0	1	0	3	0	4
		0	2	4	1	5	7	5	24
		20	0	4	6	5	5	0	20
		40	0	0	5	8	9	0	22
	Total		2	8	14	20	24	5	73
Female	b*	-40	0	0	1	2	0	0	3
		-20	0	0	5	2	6	0	13
		0	2	4	1	4	6	5	22
		20	0	6	6	3	10	0	25
		40	0	0	2	5	4	0	11
	Total		2	10	15	16	26	5	74

Table 49
Crosstabulation of gender, L, a* for table*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	1	0	2	0	3
		-20	0	0	0	1	0	0	1
		0	2	3	4	4	27	5	45
		20	0	5	9	6	1	0	21
		40	0	0	1	3	0	0	4
	Total		2	8	15	14	30	5	74
Female	a*	-40	0	0	0	0	1	0	1
		0	1	1	4	0	21	13	40
		20	0	7	4	9	6	0	26
		40	0	0	4	2	0	0	6
	Total		1	8	12	11	28	13	73

Table 50

Crosstabulation of gender, L, b* for table*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	1	1	0	0	0	2
		-20	0	0	1	1	1	0	3
		0	2	2	1	3	3	5	16
		20	0	5	5	4	11	0	25
		40	0	0	7	6	15	0	28
	Total		2	8	15	14	30	5	74
Female	b*	-40	0	1	0	1	0	0	2
		-20	0	0	1	1	0	0	2
		0	1	2	5	2	10	13	33
		20	0	5	3	2	13	0	23
		40	0	0	3	5	5	0	13
	Total		1	8	12	11	28	13	73

Table 51

Crosstabulation of gender, L, a* for cabinet*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	0	0	2	0	2
		-20	0	0	0	0	3	0	3
		0	1	5	5	5	21	3	40
		20	0	5	9	6	3	0	23
		40	0	0	2	3	0	0	5
	Total		1	10	16	14	29	3	73
Female	a*	-40	0	0	0	1	0	0	1
		-20	0	0	3	1	2	0	5
		0	3	1	5	4	14	3	30
		20	0	5	5	10	4	0	24
		40	0	2	4	7	0	0	13
	Total		3	8	17	22	20	3	73

Table 52

Crosstabulation of gender, L, b* for cabinet*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	2	1	0	0	0	3
		-20	0	0	1	0	2	0	3
		0	1	3	2	2	4	3	15
		20	0	5	4	6	10	0	25
		40	0	0	8	6	13	0	27
	Total		1	10	16	14	29	3	73
Female	b*	-40	0	0	2	4	0	0	6
		-20	0	2	0	1	1	0	4
		0	3	3	5	6	6	3	26
		20	0	3	3	5	8	0	19
		40	0	0	7	6	5	0	18
	Total		3	8	17	22	20	3	73

Table 53

Crosstabulation of gender, L, a* for backside of chair*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	1	0	2		3
		-20	0	0	1	0	2		3
		0	22	3	8	10	5		48
		20	0	3	3	2	1		9
		40	0	3	1	3	2		9
	Total		22	9	14	15	12		72
Female	a*	-20	0	0	0	0	4	0	4
		0	9	7	4	8	7	3	38
		20	0	7	4	5	5	0	21
		40	0	3	2	6	0	0	11
	Total		9	17	10	19	16	3	74

Table 54

Crosstabulation of gender, L, b* for backside of chair*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	0	4	4	0		8
		-20	0	1	2	2	5		10
		0	22	6	4	2	3		37
		20	0	2	2	3	2		9
		40	0	0	2	4	2		8
	Total		22	9	14	15	12		72
Female	b*	-40	0	2	1	0	0	0	3
		-20	0	3	2	5	6	0	16
		0	9	7	4	6	5	3	34
		20	0	5	2	2	5	0	14
		40	0	0	1	6	0	0	7
	Total		9	17	10	19	16	3	74

Table 55

Crosstabulation of gender, L, a* for fabric of chair*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-20	0	0	2	1	3	0	6
		0	12	1	6	6	9	5	39
		20	0	3	0	1	1	0	5
		40	0	9	9	4	0	0	22
	Total		12	13	17	12	13	5	72
Female	a*	-40	0	0	0	1	0	0	1
		-20	0	0	1	2	2	0	5
		0	4	1	6	4	16	2	33
		20	0	3	1	8	8	0	20
		40	0	4	5	3	2	0	14
	Total		4	8	13	18	28	2	73

Table 56

Crosstabulation of gender, L, b* for fabric of chair*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	3	3	2	0	0	8
		-20	0	0	1	2	4	0	7
		0	12	3	3	2	7	5	32
		20	0	7	5	1	2	0	15
		40	0	0	5	5	0	0	10
	Total		12	13	17	12	13	5	72
Female	b*	-40	0	3	2	5	0	0	10
		-20	0	0	4	8	10	0	22
		0	4	1	0	1	11	2	19
		20	0	4	3	3	6	0	16
		40	0	0	4	1	1	0	6
	Total		4	8	13	18	28	2	73

Table 57

Crosstabulation of gender, L, a* for bed frame*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	1	0	2	0	3
		-20	0	0	1	2	0	0	3
		0	3	1	3	5	17	3	32
		20	0	4	6	7	5	0	22
		40	0	3	3	5	0	0	11
	Total		3	8	14	19	24	3	71
Female	a*	-20	0	0	2	1	2	0	4
		0	5	1	4	2	12	4	28
		20	0	6	8	17	4	0	35
		40	0	2	1	2	0	0	5
	Total		5	9	15	22	17	4	72

Table 58

Crosstabulation of gender, L, b* for bed frame*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-20	0	0	2	1	2	0	5
		0	3	3	1	0	2	3	12
		20	0	5	2	6	13	0	26
		40	0	0	9	12	7	0	28
	Total		3	8	14	19	24	3	71
Female	b*	-40	0	0	2	3	0	0	5
		-20	0	2	0	0	1	0	3
		0	5	4	5	3	8	4	29
		20	0	3	6	5	6	0	20
		40	0	0	2	11	2	0	15
	Total		5	9	15	22	17	4	72

Table 59

Crosstabulation of gender, L, a* for pillow*

Gender			L* 0	20	40	60	80	100	Total
Male	a*	-40	0	0	0	0	2	0	2
		-20	0	0	1	3	1	0	5
		0	2	3	11	2	6	27	51
		20	0	2	0	0	2	0	4
		40	0	1	2	2	1	0	6
	Total		2	6	14	7	12	27	68
Female	a*	-40		0	0	0	1	0	1
		-20		0	1	2	3	0	6
		0		0	4	2	9	24	39
		20		1	1	4	8	0	14
		40		4	2	6	1	0	13
	Total			5	8	14	22	24	73

Table 60

Crosstabulation of gender, L, b* for pillow*

			L*						
Gender			0	20	40	60	80	100	Total
Male	b*	-40	0	2	6	1	0	0	9
		-20	0	0	2	2	5	0	9
		0	2	3	3	2	3	27	40
		20	0	1	1	0	3	0	5
		40	0	0	2	2	1	0	5
	Total		2	6	14	7	12	27	68
Female	b*	-40		1	1	3	0	0	5
		-20		1	3	3	6	0	13
		0		0	2	2	9	24	37
		20		3	1	1	5	0	10
		40		0	1	5	2	0	8
	Total			5	8	14	22	24	73

Table 61

Crosstabulation of gender, L, a* for bed sheet*

			L*						
Gender			0	20	40	60	80	100	Total
Male	a*	-40	0	0	0	1	1	0	2
		-20	0	0	1	0	5	0	6
		0	2	2	6	5	8	24	47
		20	0	2	0	1	4	0	7
		40	0	2	3	1	0	0	6
	Total		2	6	10	8	18	24	68
Female	a*	-40	0	0	0	2	1	0	3
		-20	0	0	0	2	2	0	4
		0	1	0	3	6	11	24	45
		20	0	1	1	3	6	0	11
		40	0	3	2	1	3	0	9
	Total		1	4	6	14	23	24	72

Table 62

Crosstabulation of gender, L, b* for bed sheet*

Gender			L* 0	20	40	60	80	100	Total
Male	b*	-40	0	0	3	2	0	0	5
		-20	0	0	2	1	8	0	11
		0	2	3	1	3	5	24	38
		20	0	3	2	1	5	0	11
		40	0	0	2	1	0	0	3
	Total		2	6	10	8	18	24	68
Female	b*	-40	0	1	0	3	0	0	4
		-20	0	1	1	5	3	0	10
		0	1	0	3	3	8	24	39
		20	0	2	1	1	9	0	13
		40	0	0	1	2	3	0	69
	Total		1	4	6	14	23	24	72

Table 63

Chi-Square tests L, a* and gender for ceiling*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	109,952[a]	16	0,000
	Likelihood Ratio	44,141	16	0,000
	Linear-by-Linear A.	6,470	1	0,011
	N of Valid Cases	74		
Female	Pearson Chi-Square	35,106[b]	12	0,000
	Likelihood Ratio	35,523	12	0,000
	Linear-by-Linear A.	1,968	1	0,161
	N of Valid Cases	74		

a. 22 cells (88,0%) have expected count less than 5. The minimum expected count is ,01.
b. 18 cells (90,0%) have expected count less than 5. The minimum expected count is ,01.

Table 64

Chi-Square tests L, b* and gender for ceiling*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	79,966[b]	16	0,000
	Likelihood Ratio	69,033	16	0,000
	Linear-by-Linear A.	5,225	1	0,022
	N of Valid Cases	74		
Female	Pearson Chi-Square	90,865[c]	12	0,000
	Likelihood Ratio	58,576	12	0,000
	Linear-by-Linear A.	8,702	1	0,003
	N of Valid Cases	74		

b. 22 cells (88,0%) have expected count less than 5. The minimum expected count is ,03.
c. 17 cells (85,0%) have expected count less than 5. The minimum expected count is ,03.

Table 65

Chi-Square tests L, a* and gender for wall*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	22,688[b]	20	0,304
	Likelihood Ratio	27,896	20	0,112
	Linear-by-Linear A.	0,510	1	0,475
	N of Valid Cases	74		
Female	Pearson Chi-Square	42,579[c]	12	0,000
	Likelihood Ratio	30,899	12	0,002
	Linear-by-Linear A.	5,125	1	0,024
	N of Valid Cases	74		

b. 25 cells (83,3%) have expected count less than 5. The minimum expected count is ,05.
c. 15 cells (75,0%) have expected count less than 5. The minimum expected count is ,04.

Table 66

Chi-Square tests L, b* and gender for wall*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	52,599[b]	20	0,000
	Likelihood Ratio	51,873	20	0,000
	Linear-by-Linear A.	0,161	1	0,688
	N of Valid Cases	74		
Female	Pearson Chi-Square	26,975[c]	12	0,008
	Likelihood Ratio	29,361	12	0,003
	Linear-by-Linear A.	0,778	1	0,378
	N of Valid Cases	74		

b. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,05.
c. 15 cells (75,0%) have expected count less than 5. The minimum expected count is ,01.

Table 67

Chi-Square tests L, a* and gender for door*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	40,797[b]	20	0,004
	Likelihood Ratio	44,363	20	0,001
	Linear-by-Linear A.	3,765	1	0,052
	N of Valid Cases	74		
Female	Pearson Chi-Square	30,836[c]	15	0,009
	Likelihood Ratio	35,622	15	0,002
	Linear-by-Linear A.	13,738	1	0,000
	N of Valid Cases	74		

b. 27 cells (90,0%) have expected count less than 5. The minimum expected count is ,05.
c. 18 cells (75,0%) have expected count less than 5. The minimum expected count is ,04.

Table 68

Chi-Square tests L, b* and gender for door*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	51,938[b]	20	0,000
	Likelihood Ratio	56,208	20	0,000
	Linear-by-Linear A.	1,158	1	0,282
	N of Valid Cases	74		
Female	Pearson Chi-Square	36,893[c]	20	0,012
	Likelihood Ratio	43,133	20	0,002
	Linear-by-Linear A.	2,218	1	0,136
	N of Valid Cases	74		

b. 24 cells (80,0%) have expected count less than 5. The minimum expected count is ,08.
c. 25 cells (83,3%) have expected count less than 5. The minimum expected count is ,03.

Table 69

Chi-Square tests L, a* and gender for floor*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	44,114[b]	20	0,001
	Likelihood Ratio	42,775	20	0,002
	Linear-by-Linear A.	7,624	1	0,006
	N of Valid Cases	74		
Female	Pearson Chi-Square	29,661[c]	20	0,076
	Likelihood Ratio	30,392	20	0,064
	Linear-by-Linear A.	15,053	1	0,000
	N of Valid Cases	74		

b. 25 cells (83,3%) have expected count less than 5. The minimum expected count is ,04.
c. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,01.

Table 70

Chi-Square tests L, b* and gender for floor*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	27,289[b]	20	0,127
	Likelihood Ratio	29,994	20	0,070
	Linear-by-Linear A.	0,115	1	0,734
	N of Valid Cases	74		
Female	Pearson Chi-Square	31,503[c]	15	0,008
	Likelihood Ratio	32,945	15	0,005
	Linear-by-Linear A.	1,870	1	0,172
	N of Valid Cases	74		

b. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,04.
c. 20 cells (83,3%) have expected count less than 5. The minimum expected count is ,08.

Table 71

Chi-Square tests L, a* and gender for wardrobe*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	31,486[b]	20	0,049
	Likelihood Ratio	36,850	20	0,012
	Linear-by-Linear A.	5,868	1	0,015
	N of Valid Cases	73		
Female	Pearson Chi-Square	34,686[c]	20	0,022
	Likelihood Ratio	38,891	20	0,007
	Linear-by-Linear A.	11,196	1	0,001
	N of Valid Cases	74		

b. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,05.
c. 25 cells (83,3%) have expected count less than 5. The minimum expected count is ,11.

Table 72

Chi-Square tests L, b* and gender for wardrobe*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	32,149[b]	20	0,042
	Likelihood Ratio	38,290	20	0,008
	Linear-by-Linear A.	0,002	1	0,966
	N of Valid Cases	73		
Female	Pearson Chi-Square	37,030[c]	20	0,012
	Likelihood Ratio	41,006	20	0,004
	Linear-by-Linear A.	0,009	1	0,924
	N of Valid Cases	74		

b. 24 cells (80,0%) have expected count less than 5. The minimum expected count is ,08.
c. 26 cells (76,7%) have expected count less than 5. The minimum expected count is ,08.

Table 73

Chi-Square tests L, a* and gender for table*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	45,519[b]	20	0,001
	Likelihood Ratio	49,629	20	0,000
	Linear-by-Linear A.	7,662	1	0,006
	N of Valid Cases	74		
Female	Pearson Chi-Square	52,434[c]	15	0,000
	Likelihood Ratio	60,316	15	0,000
	Linear-by-Linear A.	17,561	1	0,000
	N of Valid Cases	73		

b. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,03.
c. 19 cells (79,2%) have expected count less than 5. The minimum expected count is ,01.

Table 74

Chi-Square tests L, b* and gender for table*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	41,432[b]	20	0,003
	Likelihood Ratio	40,863	20	0,004
	Linear-by-Linear A.	1,932	1	0,165
	N of Valid Cases	74		
Female	Pearson Chi-Square	41,227[c]	20	0,003
	Likelihood Ratio	45,524	20	0,001
	Linear-by-Linear A.	0,198	1	0,656
	N of Valid Cases	73		

b. 24 cells (80,0%) have expected count less than 5. The minimum expected count is ,05.
c. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,03.

Table 75

Chi-Square tests L, a* and gender for cabinet*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	31,497[b]	20	0,049
	Likelihood Ratio	36,253	20	0,014
	Linear-by-Linear A.	9,951	1	0,002
	N of Valid Cases	73		
Female	Pearson Chi-Square	35,904[c]	20	0,016
	Likelihood Ratio	42,449	20	0,002
	Linear-by-Linear A.	3,173	1	0,075
	N of Valid Cases	73		

b. 24 cells (80,0%) have expected count less than 5. The minimum expected count is ,03.
c. 24 cells (80,0%) have expected count less than 5. The minimum expected count is ,04.

Table 76

Chi-Square tests L, b* and gender for cabinet*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	33,591[b]	20	0,029
	Likelihood Ratio	34,063	20	0,026
	Linear-by-Linear A.	2,986	1	0,084
	N of Valid Cases	73		
Female	Pearson Chi-Square	29,773[c]	20	0,074
	Likelihood Ratio	32,728	20	0,036
	Linear-by-Linear A.	0,781	1	0,377
	N of Valid Cases	71		

b. 24 cells (80,0%) have expected count less than 5. The minimum expected count is ,04.
c. 24 cells (80,0%) have expected count less than 5. The minimum expected count is ,16.

Table 77

Chi-Square tests L, a* and gender for backside of chair*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	33,892[b]	16	0,006
	Likelihood Ratio	37,064	16	0,002
	Linear-by-Linear A.	0,002	1	0,964
	N of Valid Cases	72		
Female	Pearson Chi-Square	34,057[c]	15	0,003
	Likelihood Ratio	37,163	15	0,001
	Linear-by-Linear A.	0,502	1	0,479
	N of Valid Cases	74		

b. 20 cells (80,0%) have expected count less than 5. The minimum expected count is ,38.
c. 19 cells (79,2%) have expected count less than 5. The minimum expected count is ,16.

Table 78

Chi-Square tests L, b* and gender for backside of chair*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	50,939[b]	16	0,000
	Likelihood Ratio	59,486	16	0,000
	Linear-by-Linear A.	0,018	1	0,894
	N of Valid Cases	72		
Female	Pearson Chi-Square	38,805[c]	20	0,007
	Likelihood Ratio	42,662	20	0,002
	Linear-by-Linear A.	0,330	1	0,565
	N of Valid Cases	74		

b. 21 cells (84,0%) have expected count less than 5. The minimum expected count is 1,00.
c. 25 cells (83,3%) have expected count less than 5. The minimum expected count is ,34.

Table 79

Chi-Square tests L, a* and gender for fabric of chair*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	61,534[b]	20	0,000
	Likelihood Ratio	68,197	20	0,000
	Linear-by-Linear A.	0,033	1	0,856
	N of Valid Cases	72		
Female	Pearson Chi-Square	28,891[c]	20	0,000
	Likelihood Ratio	31,746	20	0,000
	Linear-by-Linear A.	2,879	1	0,008
	N of Valid Cases	73		

b. 25 cells (83,3%) have expected count less than 5. The minimum expected count is ,49.
c. 25 cells (66,7%) have expected count less than 5. The minimum expected count is ,03.

Table 80

Chi-Square tests L, b* and gender for fabric of chair*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	45,235[b]	15	0,000
	Likelihood Ratio	55,835	15	0,000
	Linear-by-Linear A.	4,103	1	0,043
	N of Valid Cases	72		
Female	Pearson Chi-Square	52,196[c]	20	0,000
	Likelihood Ratio	54,111	20	0,000
	Linear-by-Linear A.	,046	1	0,829
	N of Valid Cases	73		

b. 18 cells (75,0%) have expected count less than 5. The minimum expected count is ,35.
c. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,16.

Table 81

Chi-Square tests L, a* and gender for bed frame*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	40,797[b]	20	0,004
	Likelihood Ratio	44,363	20	0,001
	Linear-by-Linear A.	3,765	1	0,052
	N of Valid Cases	74		
Female	Pearson Chi-Square	30,836[c]	15	0,009
	Likelihood Ratio	35,622	15	0,002
	Linear-by-Linear A.	13,738	1	0,000
	N of Valid Cases	74		

b. 25 cells (83,3%) have expected count less than 5. The minimum expected count is ,13.
c. 18 cells (75,0%) have expected count less than 5. The minimum expected count is ,04.

Table 82

Chi-Square tests L, b* and gender for bed frame*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	52,519[b]	15	0,000
	Likelihood Ratio	50,341	15	0,000
	Linear-by-Linear A.	0,499	1	0,480
	N of Valid Cases	71		
Female	Pearson Chi-Square	43,832[c]	20	0,000
	Likelihood Ratio	46,825	20	0,000
	Linear-by-Linear A.	1,142	1	0,285
	N of Valid Cases	72		

b. 18 cells (75,0%) have expected count less than 5. The minimum expected count is ,21.
c. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,17.

Table 83

Chi-Square tests L, a* and gender for pillow*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	49,424[b]	20	0,000
	Likelihood Ratio	43,147	20	0,002
	Linear-by-Linear A.	2,513	1	0,113
	N of Valid Cases	68		
Female	Pearson Chi-Square	54,680[c]	16	0,000
	Likelihood Ratio	61,804	16	0,000
	Linear-by-Linear A.	16,886	1	0,000
	N of Valid Cases	73		

b. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,06.
c. 22 cells (80,0%) have expected count less than 5. The minimum expected count is ,07.

Table 84

Chi-Square tests L, b* and gender for pillow*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	61,180[b]	20	0,000
	Likelihood Ratio	65,776	20	0,000
	Linear-by-Linear A.	2,738	1	0,098
	N of Valid Cases	68		
Female	Pearson Chi-Square	54,499[c]	16	0,000
	Likelihood Ratio	65,753	16	0,000
	Linear-by-Linear A.	0,072	1	0,788
	N of Valid Cases	73		

b. 27 cells (90,0%) have expected count less than 5. The minimum expected count is ,15.
c. 24 cells (88,0%) have expected count less than 5. The minimum expected count is ,34.

Table 85

Chi-Square tests L, a* and gender for bed sheet*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	43,966[b]	20	0,002
	Likelihood Ratio	47,005	20	0,001
	Linear-by-Linear A.	6,618	1	0,010
	N of Valid Cases	68		
Female	Pearson Chi-Square	43,321[c]	20	0,002
	Likelihood Ratio	45,750	20	0,001
	Linear-by-Linear A.	7,129	1	0,008
	N of Valid Cases	72		

b. 26 cells (86,7%) have expected count less than 5. The minimum expected count is ,06.
c. 27 cells (90,0%) have expected count less than 5. The minimum expected count is ,04.

Table 85

Chi-Square tests L, b* and gender for bed sheet*

Gender		Value	df	Asymptotic Significance (2-sided)
Male	Pearson Chi-Square	63,157[b]	20	0,000
	Likelihood Ratio	67,243	20	0,000
	Linear-by-Linear A.	0,195	1	0,658
	N of Valid Cases	68		
Female	Pearson Chi-Square	54,479[c]	20	0,000
	Likelihood Ratio	61,451	20	0,000
	Linear-by-Linear A.	1,309	1	,491
	N of Valid Cases	72		

b. 27 cells (90,0%) have expected count less than 5. The minimum expected count is ,09.
c. 22 cells (90,0%) have expected count less than 5. The minimum expected count is ,06.