COLOR NAMING

A THESIS
SUBMITTED TO THE DEPARTMENT OF
INTERIOR ARCHITECTURE AND ENVIRONMENTAL DESIGN
AND THE INSTITUTE OF FINE ARTS
OF BİLKENT UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF Ph. D. IN ART, DESIGN AND ARCHITECTURE

By
Ebru Şahin
May, 1998

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May, 1998

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality as a thesis for the degree of Ph.D. in Art, Design and Architecture.

Assoc. Prof. Dr. Cengiz Yener (Supervisor)

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality as a thesis for the degree of Ph.D. in Art, Design and Architecture.

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I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality as a thesis for the degree of Ph.D. in Art, Design and Architecture.

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ABSTRACT

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Ebru Şahin

Ph.D. In Art, Design and Architecture

Supervisor: Assoc. Prof. Dr. Cengiz Yener

May, 1998

In this study, visual aspects of color and neurophysiological processes involved in the phenomenon, language of color and color models were explained in addition to the discussion of different ideas, orientations and previous works behind the subject of matter. Available color terms in Turkish language have been identified and the most frequently known or used non-basic color terms have been attained. An experimental research has been conducted to investigate the resemblance of the basic, and mostly used non-basic color terms, in the minds of the native speakers of Turkish language. Using Munsell Color System, color ranges, reflecting the color naming and color perception of Turkish Society, have been constructed for each color term investigated in the experimental research.

Key Words: Color, Color Naming, Color Perception, Color Terms

ÖZET

RENKLERİN ADLANDIRILMASI

Ebru Şahin

Güzel Sanatlar, Tasarım ve Mimarlık Fakültesi

Doktora

Tez Yöneticisi : Doç. Dr. Cengiz Yener

Mayıs, 1998

Bu tezde, renk konusu ile ilgili değişik fikirlerin, eğilimlerin ve önceden yapılmış çalışmaların anlatımının yanısıra, renk olayının nörofizyolojik işleyişi ve görsel özellikleri, renk dili ve renk dizgeleri tartışılmıştır. Türkçede kullanılan renk adları ve bu adlar arasında en çok bilinen, ya da kullanılmakta olan ikincil renk adları tesbit edilmiştir. Sözü geçen , temel ve ikincil renk adlarının, ana dili Türkçe olan kişilerin belleklerindeki yansımalarını saptamak üzere uygulamalı bir araştırma yapılmıştır. Araştırma sonucunda, Munsell Renk Dizgesi kullanılarak, incelenen tüm isimler için, Türk toplumunun, renkleri adlandırmasını ve algılamasını örnekleyen renk bölgeleri oluşturulmuştur.

Anahtar Sözcükler : Renk, Renklerin Adlandırılması, Renk Algısı, Renk Terimleri

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1. INTRODUCTION

Our understanding and gathering knowledge of the world, emotionally or intellectually, depend on the experiences that we live through the various senses. Vision is the most effective sense that ties human beings to the environment that they live. Consequently, seeing is a great part of human existence and in a broad sense most of our visual sense is founded on color vision. Sensation of color and its importance in experiencing and perceiving our daily environment is undeniable and it can be argued that color contributes to the beauty or ugliness of the visual world.

Color can help to simplify, assist and satisfy some basic human needs. It can identify and define objects. It acts as a qualifying tool conveying necessary information about the entities for survival, enjoyment, etc. It can be used to define space, create ambiance, mark territory. Color is a probable tool in emphasizing or hiding figures, shapes, objects and etc. Most important, the use, preference, and arrangement of color enables us to express our personal taste and subjective feelings.

The explanation of color phenomena involves several branches of science (chemistry, physics, psychophysics, psychology, etc.). On the other hand, others (e.g., botany, zoology, geology, archeology, anthropology) use color as evidence, reference, and identification of related facts. Since color is part of many sciences it can be introduced in various ways. The physicist's approach to color is different from the psychologist's or the artist's.

Psychology is the science that deals with the mind, with mental and emotional processes referring to behavior. Thoughts, feelings, and any other activity a person experiences is included in behavior. These experiences can be conscious, subconscious, and unconscious processes. Conscious experiences are the ones that we are aware of what we are thinking and feeling. Subconscious processes refer to mental activities occurring without conscious perception. The unconscious is the sum of all thoughts, memories, impulses, desires, and feelings of which we are not conscious, but which influence our emotions and behavior. Experiencing color can be involved in any of the three processes of human behavior. Human reaction to color or color in the environment can be considered as a psychological activity, but it can also result in a physiological reaction (Mahnke 6).

Various approaches to color have created many color languages. Correct use of color is a valuable tool as it permits people working on different aspects of color to understand each other and to collaborate successfully. Let us consider a physicist. According to him color is resulted from the concept of 'wavelength'. This means that the terminology that he uses is the language of physics that is used to describe the sensory stimuli perceived as color. For the physicist, red, for example, means a light wave that has a wavelength of 630-780 nanometers. However for another field of profession, definition of red may or may not be associated with a physical event.

One of the amazing part of color perception is that the input, causing human beings to see a color, is not always experienced as an external stimuli. When we are to picture a ripe tomato, probably the first color comes in our mind is red. But the stimuli this time is not a light wave between 630-780 nanometers. In other words no stimuli exists cause us to see the tomato as being red. This means that color is not always in the environment, but also in the mind. Thus the language of a psychologist, trying to describe this phenomena, is somewhat different than a physicist.

Mahnke argues that, " All of the color stimuli that we receive from the external world are connected with our internal world: our psyche" (7). Thus it is convincing to believe that color perception does not depend just on the external world, but may also originate through the ability of men's imagination using his inner world.

Although mechanism of seeing is the keystone, it is not the only factor in color perception. Sensations and feelings are also included in the activity which activates our thoughts and emotions. Mahnke exemplifies this fact as follows:

> For example, if I say *green grass* , obviously *grass* is associated with the color *green* or vice versa. From the standpoint of physicist, this green of the grass is nothing than the pigment chlorophyll, which in its molecular structure is so devised as to absorb all the wavelengths of sunlight, with the exception of green, which it reflects. However, in the perception of green, whether real or imagined, do most of the people think chlorophyll? I doubted it. They might think about a walk in a green meadow, or a certain event in their life which is triggered by the association with green. A whole range of

> thoughts and emotions may be set in motion that interact automatically, so that at the end, the green may have nothing more to do with it. But it was the impulse *green* that triggered the whole process. (7)

Color language is somehow mysterious. Some color words are believed to carry meanings, moods, and associations. For years artists, architects and interior designers have attributed moods, feelings to color configurations. Helson (qtd. in Rohles et al. 511) lists such properties of color as texture, liveness, volume, gloss, hardness and warmth. The most common interpretation on color, especially for the hue representations, is a color's being warm or cool. Laboratory tests in Europe and the United states (Rohles et al. 511-527, Flynn and Spencer 167-179) have shown that the psychological interpretation of color and temperature has been far from being evident and unable to support "hue-heat hypothesis" which possesses that light frequencies toward the red end of the visible spectrum contribute to a feeling of warmth and frequencies toward the blue end of the visible spectrum contribute to cool feelings. Although this is the fact, most people know and will continue to think of yellows oranges, and reds as at the warm end of the spectrum, and blues and greens at the cool.

Each individual in the society has different thoughts, emotions, experiences, view points etc. Because of this reason picturing the world is different for any individual. Same is valid in color perception, and the image of color in mind shows variations depending on the factors listed above. If we examine the letter below, written by Stevenson from Samoa on Oct. 8, 1892, to Sidney Colvin, it is easier to understand the difficulty in the communication of color. Stevenson says:

> Perhaps in the same way it might amuse you to send us any pattern of wall paper that might strike you as cheap, pretty, and suitable for a room in a hot and extremely bright climate. ... The room I have particularly in mind is a sort of bed and sitting room, pretty large, lit on three sides, and the color in favor of its proprietor at present is a topazy yellow. But then what color to reveal it? For a little work-room of my own at the back, I should rather like to see some patterns of unglossy-well, I'll be hanged if I can describe this red- it is not Turkish and it is not Roman and it is not Indian, but it seems to partake of the two last, and yet it can be either of them because it ought to be able to go with vermilion. ... anyway, with what brains you have left choose me and send some-many-patterns of this exact shade (Munsel, A Color Notation 13).

The cited letter above is a clear way that emphasizes the difficulty in the description and communication of color between two individuals. As could be understood from the request of Stevenson, he finds himself unable to describe the color he wants. The reason is simply because color terms convey different ideas to different persons.

Two observers may agree that one color is blue and other is green. On the other hand, the same condition may not be valid for a third color "between" the first two. For this intermediary color, one observer may call it bluish green, while the other may insist on that it is greenish blue. The disagreement between two observers reflects uncertainty about naming. However when the task is to arrange blue-green chips in a row according to relative degree of blueness or greenness, observers may do the task without disagreement. Although people understand what they see, disagreement on the word representing the perceived color is natural.

In all languages there are color words adopted to reflect the image of the light wave belonging to certain wavelength. Most of the time speakers of languages refer to general words rather than making fine descriptions in color naming. However this approach can be misleading as the term can be applied to a huge color percepts grouped under a general term. For example, the word that corresponds to blue can be misleading as blue is general. Blue, names a range of colors rather than an individual shade and it may create disappointment in indicating any particular blue, as the word include every member of blue class.

Names for individual shades of color are agreed to differ from the general name of the class. Although the term "blue" can be used for every blue, people are aware of specific names that exist for particular blues. Everyone knows or agrees that, words such as blue are general and are not the names of the individual members of their corresponding classes. The reason of not using the specific names might be the uncertainty of how to apply them, or for some reason people may not have interest in offering them.

Application of different names for different wavelengths means that people are aware of the differences between those wavelengths. People, most of the time, use the same color name unless they visualize and compare different colors. For example lights of 530 and 550 nm are both called green, but the difference between them is easy to be visualized if they are shown side by side.

The color names in the following list, all referring to varieties of red are not synonyms. They identify more than one range of color. Without color samples it is difficult to explain and visualize what the each name means (Sloane, 19):

vermilion
madder red
Chinese red
Indian red
English red
carnelian
red earth
Japanese red
Egyptian red
Turkish red
persimmon
crimson
Spanish red
Pompeiian red
Roman red
flame red
poppy
Naples red
Morocco red
Indian red
scarlet
lacquer red
Mars red
Venetian red

Like the terms mentioned above, there are also color terms in Turkish referring to varieties of red. Some of them are:

Kızıl
Kiremit Rengi
Al
Doru
Bayrak Kırmızısı
Fes Rengi
Kan Kırmızısı
Kiraz Rengi
Domates Kırmızısı
Alev Kırmızısı
Elma Kırmızısı
Gelincik Kırmızısı
Ateş Kırmızısı
Gül Kırmızısı

Unique color names for the discriminable wavelengths are highly culture dependent. Cornsweet argue that "... natives of the jungle have many names for wavelengths in what we call the green region of the spectrum" (68). This does not mean that, they can perform better than any other culture in discriminating among those wavelengths, when the wavelengths are presented side by side. Like these natives, painters, weavers, chemists, etc., all use different color names to refer to and to remember different combinations of wavelengths that are important to them. One amazing example for this specification is that, in Turkish language, there are many names used in the classification of horses, considering their fur color. "Kır", "doru", "yağız", "alaca", "kula", etc. can be counted to be the examples of this type. (Davaz 1991).

The human mind is weak in remembering specific shades. The moment we look away from a color, we forget the exact coloration. To communicate color verbally, it is also necessary to establish and use standard terms. In naming colors, close attention was paid to ensure that the terms used can easily be visualized. Many talented artists, designers, and colorists are suggested to have better color memory than most; however, recalling the exact nuances of a hue without a sample as a guide is really a difficult job.

A proper study of color terminology requires consideration of linguistics, and culture and environment, as well as the psychophysiology of vision. Because hue, a psycholinguistical dimension, is a direct product of light. It is a natural physical dimension. Besides, color terminology has been found to vary cross-culturally (Bornstein, The Influence of 774). Thus, color naming is related with the physics of the real world and the acquisition of knowledge about that world.

Brief introduction above outlines the problem definition of this study. I believe, since people began to identify and describe elements surrounding them, they also began to create new and more refined color names concerning these elements. The use and expressing of color make descriptions more practical and helpful in daily life. Like people all over the world, Turkish people, started unconsciously to use the surface colors of some elements as they are real color names.

As well as in the United States (Inter-Society Color Council) and in the United Kingdom (British Standards Institution), certain organizations also in Japan (Color Science Association of Japan), Germany (Deutscher Verband Farbe), and Sweden (Swedish Color Center Foundation) published color scales, orders to communicate color among the society. In Turkey we also sometimes, refer to these publications even if some names, presented with a chip of color, seem incorrectly represented, or meaningless or irrelevant to us. Cultural environment and cultural background are the reason for this unfamiliarity with the color terminology. Although it is possible to establish basic color lexicons (see section 4.2 for detailed information) universally (Berlin and Kay 1-5), non-basic color terminology is not universal and not applicable to every culture. Also, the image or perception of the certain colors may not be universal, while color names may be. Because of this reason, the intention of this study is to investigate the color perception of Turkish society and the lexicon carrying these color percepts, including some mostly used non-basic color names as well as the basic ones.

1.1 METHODOLOGY AND DESIGN of RESEARCH

The general format of the document, as indicated in the Table of Contents, is divided into several chapters, each of which focused on an important and related aspect of color naming. To understand the underlying concepts in color perception, it is important to know about the visual aspects of color and the neurophysiological processes involved in the phenomenon; this is the subject of Chapter 2, the Color Perception. Throughout history, different approaches to color perception have emerged, most of the time concerning the differences in behavior. Different orientations discussed the subject. To be aware of the continuing debate over color naming, it is also essential to summarize the different orientations and previous works in color naming. Chapter 3, Color Naming from Different View Points, discusses the different ideas behind the subject in detail. Chapter 4 deals with Language of Color and Chapter 5 briefly summarizes the Color Models developed to ease the communication of color in society. The final Chapter 6 covers the development, implementation, and analyses of an original experimental research conducted to investigate color perception and color lexicon of Turkish people.

Thus, this dissertation is partly an archival research study and partly an original experimental research, both concerned with the color perception and color naming.

1.2 THE LITERATURE SEARCH

Most of the material reviewed for this study were various research studies done over the last thirty years in order to determine the various attributes of color naming. They have focused more on the investigation of basic color terms than the non-basic ones. These studies were found in professional journals such as: Psychological Bulletin , Perceptual and Motor Skills , American Anthropologist , Color Research and Application , Language , and Psychological Research . Information was also gathered from a number of books and articles written on color perception, color naming by such better known authors as Paul Kay, Brent Berlin, Frank Mahnke, Marc Bornstein, Lars Sivik, Larry Hardin and others. E-mail communication with Maffi, Lammens, etc. also provided necessary clues in reaching the sources of information.

In my investigation I found that color covers four enormous investigative fields: physics, physiology, psychology and social anthropology. There are also many other fields, using color as a subject to be investigated. Thus, color, its properties, and concepts are included in broad spectrum of the sciences and arts.

2. COLOR PERCEPTION

2.1 THE PHENOMENON OF COLOR

Radio waves, x-rays and visible light waves are among several forms of electromagnetic energy ranging from cosmic rays at the highest level to electric power transmission at the lowest. Difference in these forms of energy is related with the various wavelengths at which they travel. Visible spectrum is the result of specific waves of energy within a limited range. Although infrared and ultraviolet light are included in the light portion of the electromagnetic spectrum, they are invisible and not included in the visible spectrum. Psychophysically, color is the visual appearance of electromagnetic radiant energy having a spectral composition ranging in wavelength from about 380 to about 780 nanometers (Figure 2.1). Physical quality of light is the determining factor for the color sensation, however the process depends on the physiological procedures followed in the retina and in the brain.

Three psychological dimensions (hue, brightness, and saturation) cause simultaneous variations in man's color perception. The most important representative of color perception is hue, which divides the color world into qualitative regular patterns. Hue is established by the dominant wavelength which determines place of color in the spectral order, and brightness (luminance-lightness or darkness of the color) is the result of the quantity of electromagnetic energy. The perception of color is determined by wavelengths which hit the retina within the eyes. The optic nerve sends the stimuli to the brain; the brain assigns a name to this stimuli as color (Eiseman & Herbert 933).

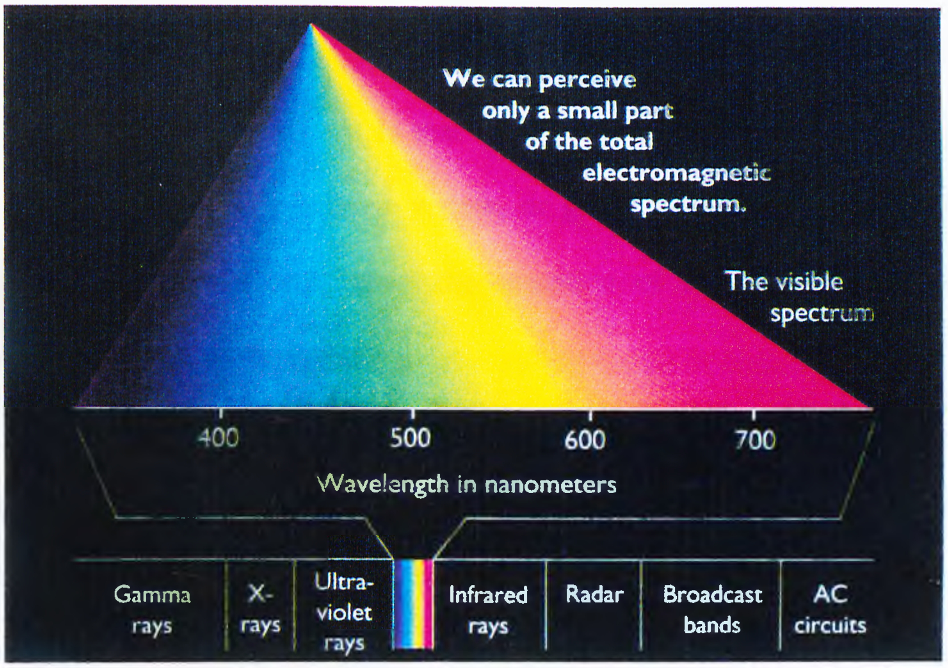


Figure 2.1 Electromagnetic Spectrum (Baron 87).

Color can be regarded as a continuum since any two colors are separated by a range of intermediary colors. Although 7,295,000 visible differences, in other words intermediary colors, are estimated to be present in the physical color solid, the identification of these differences in the color continuum is limited by human perception. As people vary in ability to discriminate nuances within the color continuum, just noticeable differences are relative to the observers. Finally, this partitioning of the color continuum is carried with language where people originate names for the little portion that the eye can discern (Bornstein, <u>The Influence of</u> 774).

2.2 VISUAL QUALITIES OF COLOR

In spite of this physical, biological, and psychological dimension, visible color is often specified in terms of only three sensory "attributes": hue, value (brightness), and chroma (saturation).

Hue is the name of a color. It is that quality by which we distinguish one color family from another, as red from yellow, or green from blue or purple. Science assigns this quality (which causes the sensation of color) to difference in the wavelengths hitting on the retina.

Value is the lightness of a color. It is that quality by which we distinguish a light color from a dark one. The lighter values of color, made by adding white to a pure color are called tints of the color. On the other hand, there are also tones of a specific color which are the darker values of color made by adding black to a pure color. Darkening a pure color by adding its complement results in the perception of a new color which is a shade of the modified color.

Chroma is the strength of a color. It is that quality of color by which we distinguish a strong color from a weak one; how much or how little gray it contains. A hue in its purest form is at maximum chroma.

Every color sensation carries these three distinct qualities. It is possible to modify the perceived color by altering its value or chroma. One quality may be changed without disturbing the other. A color can be weakened or strengthened in chroma without changing its value or hue. Thus, in planning a color system, value and chroma are as important as the choice of hue.

2.3 COLOR VISION

2.3.1 THE NEUROPHYSIOLOGICAL BASES OF COLOR PERCEPTION

Visual photopigments, found in the outer segment of the photoreceptors (the rods and the cones) are necessary in the absorption of the light that influence the eye. When light is absorbed, a change in the shape of the photopigment occurs. This is the only direct effect that light has on the eye. All of the following events are chemical reactions occurring beyond this retinal level (Wooten and Miller 59).

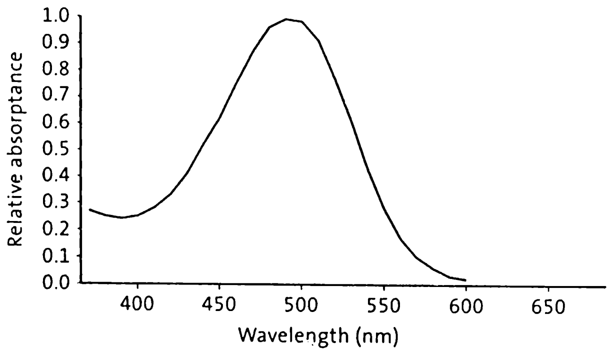


Figure 2.2 Relative spectral absorption of human rhodopsin (Wooten and Miller 60).

When the lighting conditions are dim, the rods function and the rhodopsin is the substance that interacts with light. This phenomenon is known as the scotopic vision. It is sometimes called night vision as well. One of the most fundamental aspects of scotopic vision is that chromatic colors are not seen, instead, only the shades of gray are experienced. The reason for this complete color blindness is inherent in a fundamental property of any given photopigment. Wooten and Miller explain the fact as:

> ... the event of quantal fundamental absorption contains no information concerning which spectral (wavelength) region the quantum came from. The photopigment can only signal that a quantum has been absorbed. It can not signal the wavelength associated with the absorbed quantum. This concept is referred to as the *Law of Univariance* and applies to all known visual photopigments (60).

Human color vision is possible with more than one photopigment with different spectral absorption curves. But how many? Although the number is known as three, it is better to describe the stages succeeded in the process.

The assumptions about discovering how differences in the wavelengths of light reaching the eye are transformed into response differences, began with Thomas Young, in 1803. He pointed out that:

> The number of photopigments could not be a large number because then spatial vision (acuity) would be poor. Each small region of the retina is devoted primarily to spatial resolution. Hence two small points of light can be discriminated as distinct even if placed quite close together. This would not be possible if each small retinal region contained a large number of receptors (each with a slightly different photopigment) devoted to the analysis of wavelength (qtd. in Wooten and Miller 64).

Young guessed that the number is three. With the help of complex techniques and modern methods of investigation, Young's hypothesis is reliable today and it is known that the human retina contains three different photopigments, which are the components of color vision. These photopigments are found in the outer segments of cone cells and each cone has only one pigment. These pigments are like rhodopsin, but differ only in the relative spectral absorption process. The relative spectral absorption curves of these three photopigments are presented in Figure 2.3. As could be seen from the figure, the β photopigment is most sensitive at about 540 nm whereas the γ pigment is most sensitive at about 570 nm. The third one, α, is shifted to the short-wave region with peak sensitivity at about 420 nm (Wooten and Miller 64).

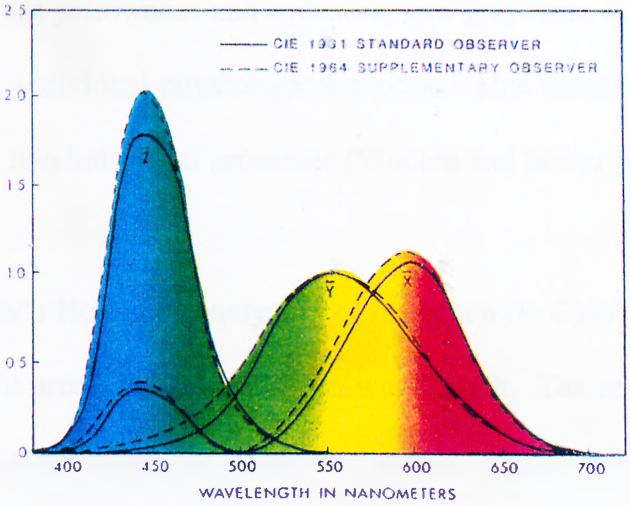


Figure 2.3 The relative spectral absorption curves of the three photopigments (IES 5-9).

Ewald Hering, great nineteenth century physiologist, studied on Young's claim (later called Young-Helmholtz Theory) in order to improve it to be a satisfying model of perception. In the light of the theory of photoreceptors' being effective in the sensation of blue, green and yellow (420 nm, 540 nm, and 570 nm respectively), Hering formulated his own conceptions, which came to be called the *opponent-process theory*. His idea was based on the subjective appearance of the spectrum and stated that there are four primary central hue sensations: blueness, yellowness, greenness, and redness. Later, he emphasized certain relations between these central hues. According to Hering, blueness for example, can be perceptually mixed with greenness or redness. For that reason, although each hue are unique in character, it is possible to perceive green-blues, red-blues, yellow-greens, and yellow-reds. On the other hand what he mentioned was that, blueness and yellowness can not be perceptually mixed as there is no light that appears blue-yellow. Similarly, he established this theory for the perceived greens and reds, and claimed that while greenness may be perceptually mixed with yellowness, or blueness, it can not have the same process with redness. Depending on these suggestions, Hering hypothesized that yellowness and blueness, and greenness and redness are opposite appearances of individual physiological process. Hue sensation is a result of light's effect on these two individual processes (Wooten and Miller 68).

Figure 2.4 show's Hering's conception of red-green (R-G) and the yellow-blue (Y-B) opponent processes depending on wavelength. The relative strengths of these states directly determines the perceived hue. Hering's model has two response output systems represented by curves. The point at which curve crosses the horizontal axis defines a unique hue. At about 580 nm, a normal observer experiences "pure" yellow as the response has neither green nor red in it. Similarly, a "pure" green will be experienced at approximately 510 nm as the Yellow-Blue function is at zero, and a "pure" blue at approximately 475 nm where Red-Green function is zero. When the figure is examined, a "pure" red is impossible to be experienced with a single wavelength due to the fact that both red and yellow outputs occur from 600 nm to 700 nm, and both red and blue outputs occur from 400 nm to 470 nm. Jameson and D'Andrade provide an explanation for achieving this special red as; "... the yellow component of a 650 nm light must be canceled by the blue component of a 450 nm light so that only a red response occurs" (302).

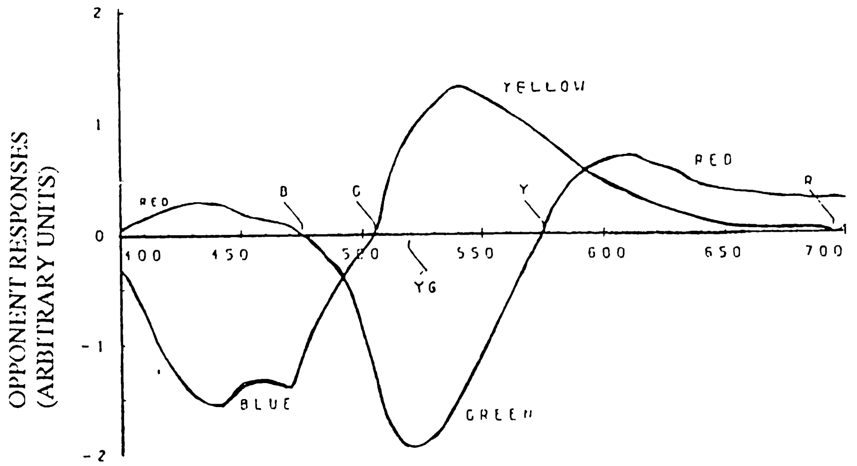


Figure 2.4 Response patterns of opponent cells (Kay and McDaniel 619).

When Figure 2.4 is examined, light of 520 nm is shown to produce a yellow response in the YB system. At the same time, a green response in the RG system, which is of greater magnitude than the yellow response, is also produced. The result is that, light of 520 nm is seen as principally green with a 'veil' of yellow, i.e., as yellowish green. The appearance of the entire visible spectrum can be accounted in this manner, by evaluating at each wavelength the states and relative strengths of the two opponent response functions.

Appearance of light at different wavelengths makes us perceive color. The names for these wavelengths, representing the chromatic color aspect of light, are identified by such terms as "violet," "red," "yellow" etc. Another major dimension of light is the achromatic aspect and is represented by the terms "black", "white" and all shades of "gray". All of the achromatic qualities are simply perceptual mixtures of black and white.

Wooten and Miller express Hering's explanation for the activation of black and white process as:

> According to Hering, the white process is driven by receptor activity, feeding directly to the white channel. The black process is however, organized quite differently. It is not activated directly by receptor activity. Rather it is responsive to receptor activity from neighboring retinal regions. In a functional sense, black is a contrast color, i.e., the percept of black corresponding to a given region of visual space arises from light stimulating an adjacent area of visual space (70).

Only the Black and White receptors function when Red-Green and Blue-Yellow channels are activated equally. When this is the case, the resulting colors vary from pure black, through the shades of gray, to pure white and these achromatic response is referred as the dimension of *lightness.*

As black and white cells are in non-opponent character, each cell behaves individually, either excited or not, relative to the light of every wavelength. They may be perceived in the same part of the visual field at the same time, unlike the opponent pairs red-green and yellow-blue. Located in a separate channel, this brightness and darkness sensitive cells inform us regarding the whiteness or blackness of a stimulus (Kay and McDaniel 627). The functions of the non-opponent cells, are graphed in Figure 2.5. As both curves have positive values, black and white can be perceived together at the same time, and the resulting value is gray.

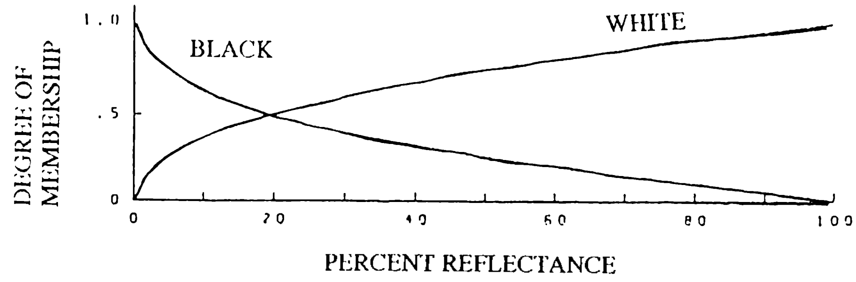


Figure 2.5 Functions of black and white cells (Kay and McDaniel 619).

It is nearly impossible for a stimulus to activate a single chromatic receptor in reality. Most stimuli cause an activation in one or both chromatic channels as well as the black and white channels. The simultaneous activation to varying degrees of chromatic and achromatic channels provides the basis for the perceptual dimension of *saturation.* Thus colors are the perceptions resulting from the activation of both chromatic (red or green and blue or yellow) and achromatic (black and/or white) aspects of light (Wooten and Miller 70).

Hering's opponent-color theory hypotheses two things. First, there are neurophysiologically opponent-process mechanisms in the visual system that produce the experience of the primary colors. Second, the opponent pairs red/green, and yellow/blue with non-opponent one black/white are all that is needed to derive any other color (besides the primary ones) that can be experienced.

Researches conducted after 1960s are concerned with providing necessary data to support Hering's opponent color theory. Cells with opponent response characteristics, which were hypothesized by Hering in 1894 for the first time, have been identified by R. De Valois and his co-workers in an Old Word monkey, a 'macaque', with a visual system similar to man. These scholars discovered four types of opponent cells which are excited by "red", "yellow", "green", and "blue" stimuli and two non-opponent cells responsible for the sensation of the black, white and shades of gray (De Valois et al. 966-977).

The work of De Valois and his colleagues in 1966 indicates that, the phenomenal appearance of light of any given wavelength is consequently the result of (1) the response state (R or G, Y or B) of each opponent system, and (2) the relative strengths of the responses in each state (966-977).

De Valois, Abramov, and Mead have stated that, the ability of individuals to differentiate hue is highly related with the capacities of four chromatic cell types processing together (415-433). Besides their arguments, Bornstein goes one step further and suggests that the existence, activity, and specificity of the neural system provides a direct biological foundation for hue categorization. According to Bornstein, "... the wavelength regions in the spectrum which tend to be confused nominally represent regions where the visual system falters in discrimination, whereas the wavelength regions which tend to be distinguished nominally correspond to regions where the visual system differentiates acutely" (The Influence of 786).

Referring to Bornstein's paper The Influence of Visual Perception on Culture, it is both convincing and logical to discuss that hue categorization is related to wavelength discrimination. In this relationship, visual discrimination capacity, which is given biologically, can be seen to establish tendencies of linguistic categorization.

2.3.2 BIOLOGICAL UNIFORMITY AND BIOLOGICAL DIVERSITY

Variability in basic color lexicons is, most of the time, due to biological diversity of peripheral visual process. Color vision in man begins with the operation of three types of cells (cones) in the eye: one sensitive in the blue, a second in the green, and a third in the yellow-red portion of the spectrum. Color vision deficiencies, permanent or temporary, may be produced by the failing or genetic missing of one or more of these cell types. Besides, the selective adaptation of cell type or the selective screening of stimulation from cones can also cause deficiencies in color vision. Thus, it is true to claim that, the color vision of different peoples may sometimes differ.

Beginning with Rivers at the turn of the century, many field studies were organized to investigate genetic red or green color blindness. Reported results consistently favor non-Europeans and it was established that Negroids and Mongoloids suffer less frequent occurrence of genetic red and green color blindness than Europeans (Bornstein, The Influence of 787).

However, deficiency in blue and yellow color vision has been found to occur among Negroids and Mongoloids. A review of cross-cultural studies of blue-yellow color deficiency or color weakness by Bornstein (Color Vision 276-278) explains that, rate of occurrence and the degree of blue-yellow irregularity tended to correlate closely with the occurrence and the degree of eye (and skin) pigmentation of the people tested.

In Color Vision and Color Naming, Bornstein mentioned that, optical pigmentation, which is yellow in color, absorbs incident short-wavelength radiation and therefore filters "blue" light from sensitive photoreceptor cells in the eye. Lesser sensitivity to short-wavelength (blue) light is related with high pigmentation in the eye. Like other biological pigments, visual pigmentation may be dietary (as is macular pigment-appendix 1a) or genetic (as are intraocular pigments- appendix 1b) in origin and they are biologically adaptive (276-277).

Yellow pigments are protective for the eye and assist acuity in the perception. They protect visual cells in the eye from harmful rays by selectively absorbing near ultraviolet and short-wavelength visible light. Moreover, in Color Vision and Color Naming, Bornstein argues that, such absorption reduces the amount of out-of-focus blue light and increases visual acuity (787).

Judd and Wyszecki have pointed out that blood pigment also acts as an effective optical filter and the related hemoglobin absorption in the eye is significant between 410-430 nanometers (278). Just like the atmospheric transmission of ultraviolet components of sunlight, hemoglobin density is known to increase with altitude. Thus, hemoglobin pigment also causes the same type of color vision deficiency seen as a consequence of eye pigmentation.

Such limited color vision exhibits itself in altered color naming behavior. In the case of attenuation of short-wavelengths, lexical identities such as green with blue, blue with black, and green and blue with black can be expected. Pickford (qtd. in Bornstein, Color Vision) who has conducted extensive studies with blue-weak subjects, described their color naming behavior in detail:

> With the yellow -blue blind and even with the yellow-blue weak either or both, blue and yellow are diminished in saturation compared with the normal. Dark gray tends to invade blue and light gray or white tends to invade yellow. The intermediate colors, violet and blue-green tend to join hands across the blue, while orange and yellow-green may tend to join across yellow. Thus there may be difficulty in accepting distinctions made by the normal person about any of the four intermediate colors: blue-green, violet, orange and yellow-green. The yellow-blue weak person will often be able to report having had disputes or differences of opinion about why a blue-green should not be called 'green', why brick red should be distinguished from orange and so on. He may say that he often confuses yellow with white and he may call orange beads 'yellow' and yellow ones 'white' (278).

A survey of color-naming systems, from approximately 150 societies around the world, showed that, societies closer to the equator, more frequently, identify short wavelength color names (blue and green) with one another and sometimes with black. Figure 2.6 displays the geographical distribution of semantic color identities all around the world. The density of yellow intraocular filtration is considered to be the reason in this failure of color naming systems. Such filtration that helps visual acuity, selectively attenuates the amount of short wavelength visible radiation reaching the photoreceptors. Consequently, the absence of existing color term "blue" is a result of a process that decreases the distinctive sensation of "blueness" (Bornstein, Color Naming 257-258).

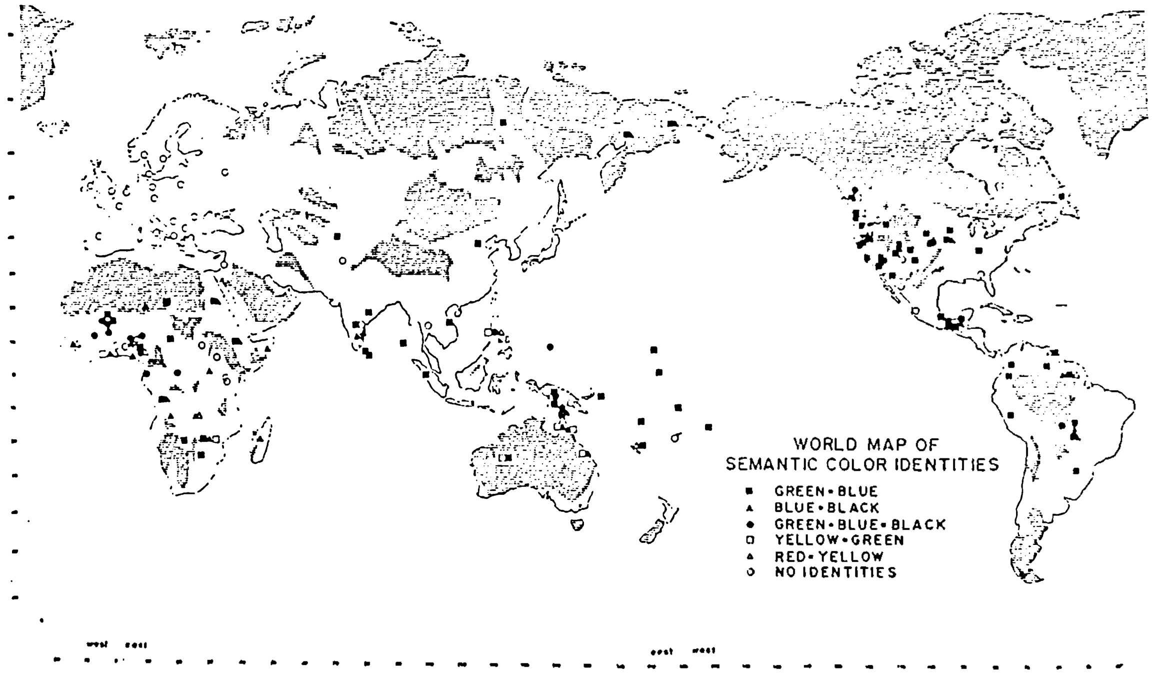


Figure 2.6 The geographical distribution of semantic color identities (Bornstein, The Influence of 790).

If density of pigmentation is considered to be a determinant in visual limitation and visual lexical identification, it must not be surprising to have diversities in the color naming systems around the world.

3. COLOR NAMING FROM DIFFERENT VIEW POINTS

3.1 INFERRED PRELIMINARIES OF DIFFERENCES IN BEHAVIOR

Psychological outcomes were presented as the consequences of four classes of preliminary variables: ecological influences, genetic transmission, cultural transmission, and acculturation influences. These four classes of variables are considered to be the explanation of behavioral differences that can be distinguished in literature (Figure 3.1)

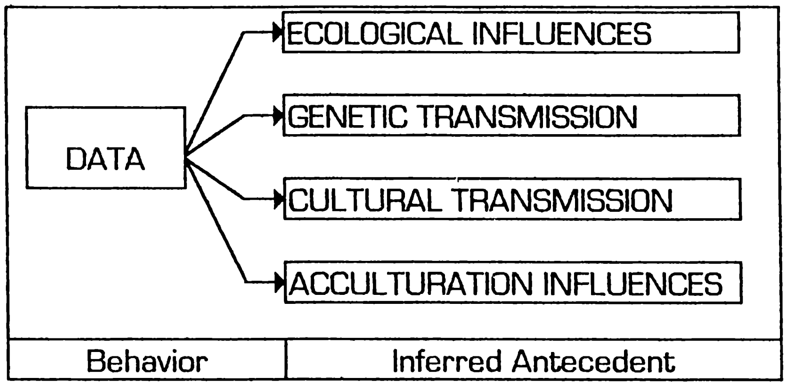


Figure 3.1 Four classes of preliminary variables in certain behavioral differences (adapted from Berry et al. 252)

Ecological influences are the consequences achieved from the interaction of human organisms and the physical environment. There are ecological necessities for all populations. These are known as ecological context and can be described as the set of relationships that provide a range of life possibilities for a population. Many variables are included in the context. Some of the basic ones include the process of adaptation of human population to natural environment, and factors such as hunting, gathering, agriculture forming the economic activity. Socialization practices and economic considerations, relationships between natural and man-made environments are the basic cases introducing ecological interactions and influences (Berry et al. 2).

The basis of genetic transmission depends on the biological transmission of specific characteristics with the help of genetic mechanisms. Certain features of populations continue over time across generations through genetic transmission. This type of variable is important in understanding the complex pattern of interaction between the human organisms as a biological entity and environmental factors (Berry et al. 192).

When cultural transmission is the concern as a variable in changing behavior, the mechanisms of teaching and learning gain importance. There is a cultural group's preservation and, then, transmission of the preserved features among the generations through the mentioned mechanisms. There are three types of cultural transmission: vertical, horizontal and oblique. In vertical transmission parents transmit cultural values, skills, beliefs, motives (and so forth) to their children. In this case it is difficult to distinguish between cultural and biological transmission, since biological and cultural parents are the same. In the case of horizontal cultural transmission, there is a procedure happening from birth to adulthood. Besides the parents, the interaction of child with the environment, and his relationship to different people (his schoolmates, neighbors, etc.) plays an important role in the development. And in the case of an oblique transmission, one learns from other adults and institutions (for example in formal schooling), either in his own culture or from other cultures.

In an oblique transmission, if the process takes place entirely within one's own culture, then the terms enculturation and socialization are the appropriate ones (Berry et al. 17-18). On the other hand, acculturation influences are the other outcomes from oblique cultural transmission. "Acculturation refers to cultural and psychological change caused by contact with other peoples belonging to different cultures and exhibiting different behavior at the end of learning process."(Berry et al. 19)

The result of both enculturation and socialization, is the development of behavioral similarities within cultures and behavioral differences between cultures. Thus, they are the reasons of similarities and differences also at the individual level resulting from the cultural mechanisms.

3.2 GENERAL ORIENTATIONS IN SHAPING THE BEHAVIOR

Three general orientations in cross-culturally research have been emerged from these four categories that shape the behavior. They are called absolutism, relativism, and universalism. Table 3.1 (after the brief description of each orientation) outlines a number of features of the three orientations under three headings: general orientation, theoretical perspectives, and methodological perspectives.

3.2.1 ABSOLUTISM

An ordinary observer naively believes that the world is exactly as he sees it. He has an uncritical perception. Thus, he is not aware of indirect reference systems affecting his visual perception. He has no doubt that his vision is direct, immediate and unmediated. This attitude is called absolutism (or phenomenal absolutism) which is accepted as an important aspect of human observing. Objective orientation and naive realism are other terms to represent the idea (Segall et al. 5).

In absolutism, the observer assumes that perception does not differ among individuals. He thinks that all other members of his species see, understand, and interpret the conditions as he does. Rather than differences in perception, he accepts intention to be the reason in case of unexpected response.

The term ‘perception’ has been used to express several processes. According to some individuals, the term represents an action; such as perceiving in the sense of seeing, hearing, or detecting or discriminating some aspect of the environment. The meaning of perception is more literal in this sense. On the other hand, others have applied the term almost symbolic to indicate a world view, a perspective on life, or some other very general cognitive product.

Segall and his colleagues state that; “Even when the term ‘perception’ is meant in its literal sense, it may cover differing aspects of behavior. Traditionally, ‘perception’ has been used for a whole class of processes, at one extreme bordering on sensation and, at the other, on concept-formation”(24). When psychologists talk of perception, they tend more often to refer to processes that are more nearly sensory; whereas when anthropologists employ the term, they more often refer to processes close to cognition.

The perceptual mechanisms may be innate, or may be learned. Whatever the case in these occurrences, visual perception is influenced by learning and adaptation. Thus, the distinction between sensation and perception is the result of these learned meanings and integration constituting perception. Direct process of perception includes learned organizations, description, and interpretations. As people have no awareness of the learned associations in lifelike situations, they interpret the process phenomenally absolute (Segall et al. 6-7).

Anthropologists noticed that, absolutism plays an important role in man's tendency to perceive and value other cultures, and they have found that human being tries to evaluate, generalize, apply and value all perceptions unconsciously based upon on his own. "Ethnocentrism" is the term used to describe this naive attitude. Segall et al. define ethnocentrism as "... the view of things in which one's own group and its customers are unconsciously used as the standard for all judgments, as the center of everything, with all other peoples and customs scaled and rated accordingly." (9-10)

To understand such ethnocentrism, it is important to know the process of enculturation. Processes, that involve conflict and cooperation, punishment and reward, control of behavior, and like force all individuals to adopt their behavior to that of other members of his society. This could be named as the socialization process. Individuals experience enculturation as the result of such process where there is the introduction of specific culture.

There are many ways that people can learn. Frequent repetition of behavioral standards and models of society is one of them. However, observation is the most effective and refined way of learning among humans. Through these ways, members learn to accommodate themselves to the society, especially to the culture that shapes and limits the content of their performances.

Segall et al. state that "... a significant feature of the enculturative experience is that, the individual typically remains, throughout his lifetime unaware of how his own habits, which to him appear 'only natural', in fact result from a learning process in which he never had an opportunity to attempt alternative responses" (10). Every human being goes through a process of enculturation that shapes his entire lifestyle.

Language is one of the distinct feature that represent this unconscious transmission. When the child is aware and in need of language, all the necessary knowledge of the world is transferred to him through information on what others observed and learned. Even in his direct learning, in contact with physical objects, expectations as a result of culture are strongly important in shaping the final form of knowledge. Because of that reason, most of the time, the member of a society is not aware of his culture and of its role in shaping his behavior, although he is completely encultured.

The absolutists seem little concerned with the problems of ethnocentrism or of seeing people "in their own terms." Rather, they consider psychological phenomena to be basically the same across cultures. Berry et al. mention that,

> ... the essential character of, for example, "intelligence", "honesty," or depression is assumed to be the same everywhere, and the possibility is ignored that the researchers' knowledge is rooted in their own cultural conceptions of these phenomena. Where differences do occur they are

> quantitative differences on the assumed underlying common construct; different people are just "less intelligent," "less honest," or "more depressed" (257-258).

Methodologically, comparisons of different cultures are possible and using of the same instruments for any culture does not create problems or suspicion. Absolutist view accepts that, psychologically people everywhere are pretty much alike.

3.2.2 RELATIVISM

In relativism (or we may call cultural relativism), attempts to describe behavior of people are not dependent on the investigator's own culture. Cultural relativist idea tries to see each culture in terms of its own evaluative system. In these studies the researcher tries to remain aware of the fact that his judgments are based upon his own experience. The aim is to view objectively any other culture.

Although it accepts a basic biological similarity of individuals, relativism does not at all conclude that this similarities cause common human nature. It emphasizes that culture and biology are independent and assumes that any individual can learn any language and culture. Relativism also claims that efforts to describe the learned specifics from the biological point of view highly underestimate the cultural contribution (Segall et al. 17).

For all mankind, the basic process of perception is the same; only the contents differ and these contents are highly affected by culture. When we introduce culture to the behavior, perception is a result of learning in spite of the phenomenally absolute character.

Perception is an aspect of human behavior. In particular, each individual's experiences determine his reaction to a given stimulus. Like personal experiences, each culture is not unique. Thus, it is natural that certain classes of experiences are more likely to occur in some cultures than in others which result in cultural behavioral differences, including differences in perceptual tendencies.

Murphy (qtd. in Segall et al.) states that:

> We do not really see with our eyes or hear with our ears. If we all saw with our eyes, we should see pretty much alike; we should differ only so far as retinal structure, eyeball structure, etc., differ. We differ much more widely than this because we see not only with our eyes but with our midbrain, our visual and associative centers, and with our systems of initial behavior, to which almost all visual perceiving leads. (21)

As people have different past learning situations and reinforcements in visual perception, it is sensible to accept the claim by Murphy.

Herskovits identified the relativist position in 1948 for the first time in anthropology, however the ideas advanced by Boas in 1911 were accepted as the base of the orientation. Relativism tries to understand people without imposing any value judgments of any kind. As ethnocentrism is neglected, relativism avoid describing, categorizing and understanding differences, contrasts from an external cultural point of view.

Relativists are not interested in the existence of similarities across cultures. In contrast, they try to explain cultural differences and their influence in the development of individuals. Comparative studies are avoided in relativism. All judgments depend on the followed procedures (tests and so on), which are designed and developed, for the specific culture to be investigated (Berry et al. 256).

3.2.3 UNIVERSALISM

The universalist approach accepts basic psychological processes to be common in human life everywhere, but claims that these processes are influenced by culture and expressed in different ways.

Investigations, researches of this orientation use comparisons. Application of existing theories and tests are possible, with necessary modifications, considering the local cultural knowledge of the case being investigated.

Berry et al. explains the theoretical base as "Theoretically, interpretations of similarities and differences are made starting from the belief that basic psychological processes are panhuman and that cultural factors influence their development (direction and extend) and deployment (for what purposes and how, they are used)." (258).

	Absolutist	Universalists	Relativists
1. General orientation			
a) Factors underlying behavior:	Biological	Biological and cultural	Cultural
b) Role of culture in behavior variation:	Limited	Substantial	Substantial
2. Theoretical perspectives			
a) Similarities due to:	Species-wide basic processes	Species-wide basic processes	Generally
b) Differences due mainly to:	Non-cultural factors	Culture-organism interactions	Cultural influences
c) Emics and etics:	Imposed etic	Derived etic	Emic
d) Context-free definition of concepts:	Directly available	Difficult to achieve	Usually impossible
3. Methodological perspectives			
a) Context-free measurement of concepts:	Usually possible	Often impossible	Impossible
b) Assessment procedures:	Standard instruments	Adapted	Local instruments
c) Comparisons:	Straightforward, frequent, evaluative	Controlled, frequent, non-evaluative	Usually avoided, non-evaluative

Table 3.1 Properties of the three orientations: absolutism, relativism, universalism (Berry et al. 257).

3.3 PREVIOUS WORKS IN COLOR NAMING WITH THE RELATED VIEW POINTS

Newton's qualitative description of his own experiments, "the celebrated phenomenon of colors", could be suggested to be an example of absolutism; that is, as scientist, Newton first saw and then labeled the spectrum as he saw it. This view argues that language terms are only effective and necessary in labeling the primary perceptions (Bornstein, The Influence of 776).

Such a naive realism has been challenged by an alternative view, that of cultural relativism. Relativists argue that perceptions are influenced directly by the linguistic, specifically the semantic and cultural environment.

These two philosophical viewpoints, with their distinctive theories of the acquisition of knowledge about the physical world, support two essential views on color categorization. In The Influence of Visual Perception on Culture, Bornstein explains this idea as follows:

> The absolutist position favors visual determinism i.e., a philosophical position which dictates that knowledge about and language describing color will be responsive to actual visual processing, and the relativist position favors a more pragmatic and utilitarian position i.e., one which claims color terminology and even color perception reflect local environmental and cultural dispositions. (777)

These two views correspond to two ideas about the origin, development, and differences in color nomenclature. One, the comparative evolutionary idea, considers the variation in basic color naming systems to have resulted from developmental phenomena of one of two kinds. First phenomenon is related with biological foundations in man. It is supposed that the linguistic categorization of colors showed variation because, the visual mechanism has biologically developed somehow within lifetime. If this is not the case, second phenomenon, social and/or technological development, is responsible from these variations. By contrast a second idea, which refers to cultural relativism, suggests a logical patterning of cultural variation in color semantics (Bornstein, The Influence of 777).

Absolutism assumes that color vocabulary was thought to result from visual processing. It accepts the influence of perceptual and cognitive forces on language development. Alternatively, relativism states that language influences and directs both thought and perceptual processes. Learned color words control and direct the actual ways in which color phenomena are perceived and recognized.

3.3.1 EVOLUTIONARY IDEA

The earliest work that deals with the evolution of color vocabulary is that of William Gladstone in 1858. He realized that the color words blue and brown had never been used in the poetry of Homer. This consciousness made him claim that, the Greeks of Homeric times perceived color different than the man of his time. He concluded that the Greeks of the heroic age has partially developed color vision system and originated the argument that differences of perception are best reflected by language (Bornstein, The Influence of 778).

In 1880 Gladstone's theory was modified by Geiger who first detected a universal sequence in the acquisition of basic color terms. Geiger tried to prove that man's color vision could not be as fine as it is now. Another hypothesis he studied and tried to formulate was about the order of the color words in language. He argued that, man has become aware of colors in the order in which they appear in the spectrum starting with the longest wavelengths. In other words he believed that yellow was awakened before that green, as the wavelength of yellow is bigger than the latter. While suggesting that, he was also conscious and noted that, the neutral colors began to be realized and used earlier than the colorful ones. Berlin and Kay mention that Geiger's views were among the first to include the notion that a stage development of semantic organization paralleled biological development (Berlin and Kay 135).

After black and red, the third stage adds yellow as the next color to be perceived. Geiger thought that the reason of this specific order of color names is related with close contact of man with nature. According to him these color names were the appreciation of the sensations affected by the night, the dawn, and the sun. He was also of the opinion that yellow included other colors at this stage and the color white was included in red.

Geiger suggested that white appears in the fourth stage and green appears at the fifth stage of color evolution. One of the last colors to be salient is blue. Thus, many blue colors were noted as green and black until the perceptibility of blue was clear (Berlin and Kay 136).

In Berlin and Kay , it was suggested that, by 1880 the scholarly world was aware of certain facts relating to the differences in color nomenclature of different languages. Conclusions, drawn by Berlin and Kay from these studies, argue that fewer color terms were salient in the earlier stages of European languages and the languages of the contemporary primitives than today's. In addition to that, strict sequence, indicating the development of the color terminology, was not constructed yet in 1880's (138).

Magnus (1880), an eye doctor, was the first who attempted an empirical investigation. He collected information from foreign residents in a number of countries, using a questionnaire as well as chips of different colors. From the results that he had obtained from his questionnaires, Magnus concluded his study with a summary of ten basic points:

> 1. All primitive peoples investigated possess a color-sense which in general agrees with that of the civilized nations in its limits.
> 2. Color perception and color identification do not coincide. Because of the lack of the latter, one may not conclude lack of the former.
> 3. Color perception and color identification are peculiarly disproportionate as concerns very many primitive peoples in that a well developed perception is accompanied by a greatly stunted color terminology.
> 4. If an inadequate color terminology is present, strikingly often it shows a regular form.
> 5. Linguistic expressions for long wave colors are always much more sharply defined than those for short wave colors.

> 6. The linguistic expression for red is the most clearly developed, then follows that for yellow, then that for green and finally that for blue.
>
> 7. Confusion of linguistic expression [for colors] with each other occurs mostly in a manner that linguistically unites neighboring colors of the spectrum, i.e., red with orange or yellow, yellow with green, green with blue, blue with violet. An irregular mixing such that e.g. red and blue are connected linguistically could be demonstrated only very rarely in our investigation [more likely, never]. In any case, the general condition is that of linguistic unification [only] of spectrally neighboring colors.
>
> 8. The most usual mixing is that of green with blue. This finding is also confirmed by many other researchers.
>
> 9. Color terminology can be so little developed that the long wave colors are all put under the linguistic expression for red and the short wave colors under that for dark [that is, BLACK].
>
> 10. Even in more highly developed color terminology it often occurs that the colors of shorter wavelength are united with the linguistic concept of dark or indefinite. Blue and violet (and even green) are designated as black or gray (Berlin and Kay 145).

Basically, Magnus concluded from the results of his field tests that vocabulary and vision may vary independently. By the turn of the century, the Geiger-Magnus semantic evolutionary theory was established. It explained intercultural differences on a question of language within an evolutionary scheme (Bornstein, The Influence of 779).

In 1901 Rivers inquired about local color naming and tested the color vision of Australasian natives. His conclusion favored the semantic developmental theory established by Geiger and Magnus. Rivers argued that color vision of the subjects he examined was characterized by a certain insensitiveness to blue and green as compared to Europeans. He found a frequent confusion between green and blue and between saturated blue and dark or dull colors, which resulted in a least advanced development of language in the blue range, when compared to the red one. Rivers, at the beginning of the twentieth century, was the first to introduce the opinion of a parallel mental and social development (Bornstein, The Influence of 779).

River's findings were important as they tried to figure out the reasons of the absence of color terms in primitive languages. The data also supported Gladstone's and Geiger's claims that the absence had some definite cause, probably of a physiological nature.

P.W. Robertson is basically an evolutionist, who stresses biological and ethnolinguistic co-development. Robertson found that red and green were the first colors to be perceived. Yellow was perceived next, and blue came last (Bornstein, The Influence of 781). Robertson is the only evolutionist who stressed that yellow is perceived after green. All the others had an agreement on the identification of yellow before green.

Berlin and Kay in 1969, emphasized once again the sequential order in the development of color nomenclature in all languages. They explained the fixed sequence with seven stages (will be mentioned in chapter 4) depending on their investigation. They have concluded that there exist eleven basic perceptual color categories for humans and added that, these eleven or fewer basic color terms are notable in any language (Berlin and Kay 17-20).

More direct evidence on the role of possible physiological factors in the linguistic categorization of colors was reported by Marc Bornstein (Color Vision , 257-285). He related the wavelength of the focal colors found by Berlin and Kay to the spectral sensitivity of four types of cells found in the brain of Macaque monkeys. These cells were found to be sensitive for wavelengths corresponding to red, yellow, green, and blue respectively. Besides this attempt he also tried to explain the role of eye pigmentation in the formation of color lexicon of different cultures.

In a further study (Bornstein, Kessen, & Weiskopf 201-202), the technique of stimulus habitation was used with 4-month-old babies, using red, yellow, green, and blue stimuli. It was found that the infants showed a stronger reaction to the new stimulus when the latter type of color is changed. This indicated that the categories and boundaries between categories for babies are much the same as those for adults long before the beginning of speech. Bornstein and his associates argued that, primary role of perception in the primacy of color identification was once proved with this study.

Besides these studies with human subjects, Von Frisch in 1950, DeValois and his friends in 1965 (qtd. In Bornstein, The Influence of 783-784), and Wright and Cumbing with their work Color Naming Functions for the Pigeon (7-17) in 1971 investigated color response patterns and hue categorization of some animals (bee, monkey, and pigeon respectively). In a more recent study, Matsuzawa investigated the color naming and classification in a chimpanzee, using various color chips from the Munsell Color System (283-291). Depending on his findings, Matsuzawa suggested that, not only the perception of colors, but also the use of color names have characteristics in common between the human and the chimpanzee. At the end of each experiment it was concluded that each animal species respond to the change in color and adapt their behavior according to the tested colors. These data employed evidence, favoring the evolutionists, the notion that hue categories of the color spectrum exist among species who have no language in itself.

3.3.2 RELATIVIST IDEA

The starting point for relativist researchers is basically a linguistic one. Relativist researchers do not base their research on the recognition and naming of color chips. They take a linguistic theory, proposed by Jost Trier, as starting point, which is commonly known as "Lexical/semantic field" or "wordfield theory". Lyons, in his work Semantics, explains this theory as;

> Lexemes and other units that are semantically related, whether paradigmatically or syntagmatically, within a given language system can be said to belong to, or to be members of, the same (semantic) field. A lexical field is therefore a paradigmatically and syntagmatically structured subset of the vocabulary (or lexicon) (268).

Lyons states that, it is often possible to identify lexical fields across languages. Field of color, of kinship, of furniture, of food are some of the examples of the theory. Although they are easily noticeable in language, Lyons mentions that these fields are not isomorphic across languages (Language 155).

According to Lyons, as well as many other relativists, colors are not real; they are the product of the lexical and grammatical structure of particular languages. Lyons in his article Color in Language argues that the perception of color, and perception in general is species specific. In other words, the way the world appears to members of one species, more particularly to human beings, is specific to that species. Language is similarly species specific. Universalists say that languages are grammatically and lexically isomorphic; relativists say that they are not. Lyons defend that, although there are few, most of the languages are not isomorphic. According to Lyons, this is more clear when the vocabulary, especially the color vocabulary of different languages are compared (Lyons, Color in Language 199).

Lyons (Color in Language) considers few examples to confirm his idea that, one to one correspondence of color terms with another is not always possible in specific languages:

> ... there was no word meaning brown or gray in Latin, literary Welsh has no words with the same meaning as the English words green, blue, gray, or brown, but one word (glas) that covers part of green, another that covers the remainder of green, the whole of blue and part of gray... Russians has no single word meaning blue, the words goluboi and sinii (usually translated as light blue and dark blue, respectively) denote what are in Russian distinct

> colors, not different shades of the same color...Hanunoo (a Malayo-Polynesian language of the Philippines) has just four basic color terms, which can be translated (in some contexts at least) as 'black', 'white,' 'red,' and 'green' (200).

The researchers of relative idea assume that there is a relationship between concepts (semantic field such as food, or kinship, and so on) and the words indicating these semantic contents (structured units of lexemes). To these researchers, the color range between 380 and 720 nm corresponds to a semantic field in the language system of humans. They are neither interested in finding the first chip, that a member of a particular language choose first, out of a large number, nor the color words that a member attribute to the hue of a chip. However they try to figure out "How is the semantic field represented in a particular language?" or "What relations hold between these terms or members of a field?" (Wyler 19).

For the relativists, the emphasis is not only on the investigation of primary or basic colors. Names of shades and tones of hues are as essential as terms of primary colors, because they are thought to represent a part of a structured field. Moreover, the total set of color terms are important as they express, reflect the characteristic features of a specific culture. Consequently terms like 'lily-white' or 'lemon yellow' or 'azure' are of greatest importance in the context of wordfields. Wyler has an emphasis on the question "How does a speech community segment and consequently verbalize the color continuum?", as he believes it illustrates "the mental process of transforming objects of nature into human language in an exemplary manner" (20).

For many years, studies tried to introduce new evidence regarding the role of language as a factor in human color memory. Subjects' reflecting accounts in the experiments of Lucy and Shweder (588-600) indicate that language is one type of "standard" used in memory and it is a useful supplement to other standards, such as permanently stored objects and images. Also it is discussed by Lucy and Shweder that this standard is not personal.

Linguists, anthropologists, and philosophers support the role of cultural relativism in the acquisition of knowledge. Benjamin Lee Whorf is among the most important members of this society. He is also well known with the "Whorfian hypothesis" in linguistics, which accepts the effect of language on perception.

Whorf hypothesized that (qtd. in Kay and Kempton 66);

> 1. Structural differences between language systems will, in general, be paralleled by nonlinguistic cognitive differences, of an unspecified sort, in the native speakers of the two languages.
> 2. The structure of anyone's native language strongly influences or fully determines the world view he will acquire as he learns the language.

To exemplify his hypothesis on perception, Whorf pointed out that (qtd. in Bornstein, The Influence of 776):

> The Inuit has a separate word for each of three kinds of snow. Although other peoples may invent phrases, e.g., 'good-skiing snow,' to represent perceptual experience, the easy accessibility of simple and separate names

> for the different kinds of snow facilitates the Inuit's recognition of and perhaps discrimination among different types.

Whorf used the more universal example of color naming, and he suggested that the Iakuti, who possess a single term for blue and green, may see the two colors more similar than English speakers who have separate words (Bornstein, The Influence of 777).

Benjamin Lee Whorf played an important role in color research tradition, especially when the concern is effect of language on color. From Whorf's perspective, the relationship between biological universals (what he referred to as "lower- psyche facts") and language and culture was not one of contrast but rather one of "appropriation" (Lucy and Shweder 601).

According to Whorf the world presents itself in a "kaleidoscopic flux of impressions." He suggests that the word is perceived categorically, and there are references in every perception. Whorf explains his view as;

> ... principle of relativity; which holds that all observers of the universe are not led by the same physical evidence to the same *picture* of the universe unless their linguistic backgrounds are similar, or can in some way be calibrated. ...The categories and types we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary *the world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds-* and this means largely by the linguistic system in our minds.

> We cut up nature' *organize it into concepts* , and ascribe significance as we do, largely because we are parties to an agreement to organize it in this way an agreement that holds throughout our speech community and is codified in the patterns of our *language* (212-213).

Whorf was mainly interested in the relationship between how people perceive the world and the world as it presents itself. Throughout his studies he suggested that: "(a) there is no such thing as a single copy of the way the world actually is; and (b) the relationship between a representation (e.g., a "picture") and the thing represented (e.g., the "universe") is not one of the similarity" (Lucy and Shweder, 602). To those principles quoted above, Whorf adds a third that the way of grouping things into categories shows itself particularly in speech in a society and in culture.

Linguistic background and the way of categorizing or organizing nature into concepts are the primary considerations of Whorf in the passage quoted above.
He does not see these two variables independent from each other. Yet, he believes in that, language and its category system are two inseparable parts of a whole. Whorf states that :

> ... language first of all is a classification and arrangement of the stream of sensory experience which results in a certain world-order ... and ... every language is a vast pattern system, different from others, *in which* we are culturally ordained the forms and categories by which the personality not only communicates, but also analyses nature, notices or neglects types of relationships and phenomena...(Whorf 55).

Two possible conclusions about the relationship among language, thought, and external stimuli in the color domain can be drawn from the Whorfian Hypothesis. First, people do not need an array of color scale in order to recognize a color. Second, the concept of "focality", referred to in many evolutionist researches, is not such an important feature in perception and identification of color and "focality" has nearly no influence over language. For example, most color categories (e.g., blonde, sky, blue, lavender, etc.) have no reference to focal areas at all; focality is not a necessary condition for forming a color category (Lucy and Shweder 604).

In the first years of research on language and thought, color was studied as a continuum. The main interest of the researches was the ways of expressing the concept and division of color in language. After the perceptual irregularities in the color spectrum and variations in naming were realized, main concern shifted to the investigation and demonstration of the influence of cultural factors in language. Some of the investigations holding and supporting the relativist idea, besides Whorf, in color phenomena are presented below.

The reflection of language in color naming was also defended by Ray, who concluded from his own studies with Amerindians that, each culture has divided the visible spectrum into units physically arbitrary. Ray rejected the famous confusion between blue and green and attributed it to refinement in classification. As a modern anthropologist, Ray refused the notion that linguistic organization should correlate with mental or cultural complexity as he sees all cultures complex. Rather, he insisted that, color term absence, confusion, or elision are highly related with functional use of the terms. (Ray 251-259).

McNeill, who is an anti-evolutionist, argued that color words enter the dictionary to adapt cultural necessity and to reflect local natural resources. He also criticized Berlin and Kay and objected to their findings claiming that they ignored the functional meaning of colors in culture (McNeill 21-33).

Like McNeill did, Sahlins in 1976 emphasized the subjective meaning of colors. He rejected the evolutionists' approach as reduce the culture to nature with their claims. He emphasized the social meaning that colors carry, in particular when they are used in symbols and rituals. In Sahlins' view this social meaning has a logic of its own that cannot be explained with reference to biological features. According to Sahlins culture makes use of nature rather than nature should determine culture (1-22).

In 1979, Lucy and Shweder have designed experiments to test color language and behavior, and have related their findings to Whorf's views of language. They demonstrated that color perception and memory are not natural but involve higher social-psychological functions. Lucy and Shweder found that, subjects coded colors in for recall by associating them with names of colors as well as with names of familiar objects. Some examples are "pea soup green but a little lighter" or "the color of my bedroom." They stated that, subjects, in order to match the stimulus color, generally mediated their color perception by culturally provided cognitive and verbal codes (Ratner 370-371).

To conclude, the relativists share the idea that "... color is not "out there" in the light but in our perceptual interpretation of light, it is time to recognize that the comunicatively relevant encoding of visual experience do not lie "in there" in the biology but out in socially anchored linguistic systems" (Lucy 341).

4. LANGUAGE OF COLOR

4.1 COLOR TERMINOLOGY AS A SYSTEMATIC CULTURE PATTERN

The aspect of culture that color theory attempts to explain is the part that is stored in the minds of its members. Roberts has expressed that "It is possible to regard all culture as information and to view any single culture as an 'information economy' in which information is received or created, stored, retrieved, transmitted, utilized, and even lost... In any culture, information is stored in the minds of its members and, to a greater or lesser extent, in artifacts" (qtd. in Romney et al. 314).

In a similar way, D'Andrade has developed the notion of culture as a shared and learned "information pool." D'Andrade states that ;

> It is not physical objects which are products of culture... Behavior environments, consisting of complex messages and signals, rights and duties, and roles and institutions, are a culturally constituted reality which is a product of our socially transmitted information pool... In saying that an object-either a physical object like a desk, or a more abstract object like a talk or theorem-is a product of culture, I mean that the cultural pool contains the information which defines what the object is, tells how to construct the object, and prescribes how the object is to be used. Without culture, we could not have or use such things. (180)

Clearly, it is difficult to study all of culture. Thus, to some extent, systems are developed to divide the total information pool constituting culture into smaller segments. One segment of culture that provides a reasonable focus is concluded from the idea of 'systematic culture pattern' (Romney et al. 314). Systematic culture patterns are characterized as reasonable subsystems of knowledge. They can be accepted as limited units that tend to make understanding of one aspect of culture.

In systematic culture patterns there are related semantic fields which provide a way of classification. Semantic fields, which can be defined as an organized set of words, are necessary tools of describing and talking about the elements in a culture pattern. The words in a semantic field reflect the way in which a given language classifies the relevant concepts of the culture pattern. One of the most important examples of semantic fields includes the color terminology.

4.1.1 COLOR AND LANGUAGE

Language is the most active, remarkable, and effective tool invented by human beings. It holds a specific logic which offers a way of organizing, cataloging and describing the facts and phenomena that human beings experience. Objects are expressed with words holding their reflected meanings. Same is also valid for colors. Thus, both colors and language, and also language of colors hold symbolic meanings.

Every culture has a special way of describing color. Color terms specifically indicate color hues. However, sometimes the meaning of a color term may not carry the exact nuances it describes. Colors may not be indicated definitely and other phenomena are included in the expressions. In this case, common language and experience is the fact that directs the individual understand what the speaker is describing. In other words, so as to understand these indefinite color expressions, it is essential to have a good knowledge of culture that uses certain concepts and comparisons to understand what the word really means.

In our culture, we use expressions like olive green, lemon yellow, blood red, etc., to describe shades which would be difficult to describe in a different way. These expressions are indirect constructions of color words resulted from the people's concern with accurate color designations.

Language is a significant factor in human existence and color perception inevitably supports its importance. Depending on the researches, Lloyd indicates that, not only do color terms develop on the basis of one's color impressions, but conversely color perception to a certain extent is determined by the color vocabulary. (86)

4.1.2 NAMING OF COLOR IMPRESSIONS

It is important to learn the meaning of words. Children must be guided and thought to use terms correctly when indicating impressions. For example, they must learn to use the term 'red' to express shades of red, while they must be aware of the term 'blue' to apply it for the shades of blue. Obviously, they must know how to use and decide on the necessary words in distinguishing the differences between the colors. After knowing the basic shades, they may proceed through learning different terms for fine distinctions.

The following conclusions can be drawn from the statements above:

1. Some knowledge of color names are necessary for people in order to arrange objects according to color names.
2. Different hues indicated by the same name are usually arranged in one group. The colors are brought under the same concept and grouped accordingly (Heider, The Nature of 320).
3. Different colors, known by different names, as a rule, are not arranged in the same group. The color names make possible the conception of different categories and a classification based upon those categories (Heider, The Nature of 322).

From the conclusions mentioned above, it is apparent that color terms have practical values. Color terms provide ways to view objects in their specific color aspect as distinguished from their actual "object" character. Lloyd states that "In analyzing color perception, we have to observe both the aspects of color: its concrete and its abstract form. The perception of color is the experience of the color as concretely exemplified, as well as its conceptual, abstract use."(89)

When color vocabulary of any language is analyzed, it can be seen that there are many ways of using colors. The idea of color is not involved only in the development of a child learning speech, but at some stage in the development of the people speaking that language as well as in the development of any language.

It seems that every culture has a different pattern of language development and that the patterns result in different concepts. It is not faithful to argue that all peoples of different languages and cultures must use the same words just because a group have words for red, yellow, green, and blue. Others may have developed categories, different from ours, based totally on different principles. Their color vocabulary, just as ours, may be rooted in their culture and in their pattern of existence (Lloyd 90).

Best examples of different use of color, depending on culture and lifestyle, is the investigation of Danian Languages (languages of Highland New Guinea). People of this language have only two color words: one for black (including green and dark shades), and one for white (including red, yellow). However this does not mean that they can not differentiate red from yellow. Their culture, partitions the color solid into two with the use of two terms which are satisfactory in expressing their color perception (Heider, Probabilities 448-466 and Berlin and Kay 24-25).

It is important to understand, find out for what particular reason specific color terms developed. There was not a single and uniform development for color terms in all cultures. There are certain color names developed in an early stage, while others only included afterwards, through the development of culture and language.

What are the reasons for the development of a color name, and consequently for the abstraction of the colors and the formation of color concepts? Lloyd supposed that, "... words arise just in proportion to the necessity which exists for conveying their meaning." (91) Every color name in a language is a result of some special need to indicate a particular color. Throughout history, one very important reason for using color names is the need for labeling of paints and dyes. The necessity to differentiate and recall the color of desired paint and dyes cause people attach certain color names to the samples. Paints and dyes are the practical, actual information tools in which the colors are viewed independent of the object. Paints and dyes are thus practical abstraction of color which, with the help of language, express their own names apart from any object (Lloyd 91).

4.2 COLOR TERMS

Other than music and body language, color is the only kind of expression that does not require words. However, words help us to enrich, modify, execute, and above all communicate the language of color.

As it is not possible to express every color sensation with a single lexicon, different categories of color expressions exist in any language. Most languages of the world, in fact, have a lexical system of color categorization which differentiates basic from non-basic color terms. In these languages, the color terminology is divided into these two levels with respect to etymology, frequency, and usage.

First level of color terminology include words known as the "basic" ones which are considered to be more general and more easily named in any kind of identification task. Basic color terms, represented in English by black, white, red, yellow, green, and blue, are to be the most frequently occurring color words in language and literature. Stated by Zipf (qtd. in Bornstein, Color Vision 258), in English, Latin, and Chinese the length of a word, measured in phonemes or syllables, is negatively correlated with the frequency of its usage.

Second level terms, the "non-basic" ones on the other hand, are transitional between the basic ones (sometimes expressed as a combination of them, e.g., blue-green). Some of the "non-basic" color terms may make specific qualifications on the basic terms using the dimensions of brightness and saturation (e.g., light, pale, dark, etc.), or may exist on their own having an object referent or derived characteristics (e.g., indigo, apricot, etc.)

4.2.1 BASIC COLOR TERMS

Definition of basic color terms differ among professions depending on their field of study. Investigators, more psychologically oriented, have often studied criteria which differentiate basic from non-basic color categories on the basis of psycobiological considerations, including psychological (codability; memorial and developmental qualities), psychophysical (uniqueness and nameability), biological (brain function), as well as basic linguistic (frequency, usage, and etymology) principles. (Bornstein, The Influence of 775)

On the other hand, ethnolinguists have chosen rules which differentiate basic from non-basic color names only on the basis of linguistic considerations. Thus, if we examine the basic color terms from the ethnolinguists' point of view, quoting from Berlin and Kay, a "basic color term" is identified with the criteria below (6);

1. It is monolexemic; that is, its meaning is not predictable from the meaning of its parts (unlike reddish-blue).
2. Its signification is not included in that of any other color term (unlike crimson and vermilion, both of which are kinds of red).
3. Its application must not be restricted to a narrow class of objects (unlike blond and roan).
4. It must be psychologically salient for informants. Indices of psychological salience include, among others, (1) a tendency to occur at the beginning of elicited lists of color terms, (2) stability of reference across informants and across occasions of use, and (3) occurrence in the ideolects of all informants (unlike mauve).

The above criteria are enough in nearly all cases to determine the basic color terms in a given language. However, Berlin and Kay, in their book "Basic Color Terms", have supplemented the following criteria for the use of investigator in case of some doubtful cases arise (6):

5. The doubtful form should have the same potential of use as the previously established basic terms. For example, in English, allowing the suffix -ish, for example reddish, and greenish are English words, but chartreuse -ish is not.
6. Color terms that are also the name of an object characteristically having that color are suspect, for example gold, silver, and ash.
7. Recent foreign loan words may be suspect.
8. In cases where lexemic status is difficult to assess, morphological complexity is given some weight as a second criterion (elimination of the term blue-green)

In the World Color Survey a general definition of basic color terms has been added by Kay, Berlin and Merrifield in 1979, as "the smallest subset of color terms such that any color can be named by one of them." (qtd. in Maffi and Hardin 349)

Berlin and Kay performed a study of color terms in 1969 in order to investigate the evolution of basic color terms. They suggested that, there are sequential and chronological order for the color names in all languages. They explained seven stages in the evolution of basic color terms and their consequences are quoted below, including the color processing of each stage.

> Stage I in the evolution of lexical color categories is represented by just two terms: *black* plus most dark hues, and *white* plus most light hues.
>
> At Stage II a third category emerges which we call RED. Red includes all reds, oranges, most yellows, browns, pinks, and purples (including violets). White and Black continue to segment the middle range hues.
>
> At Stage III the reduction in scope of White and Black continues and a new category emerges. This may be either green or yellow. Green normally includes English yellow-green, greens, blue-greens, blues, and blue-purples, it may however, include only greens plus yellow-greens and tans or light browns. The addition of the green category at Stage III is designated as Stage III a. If the yellow category is added at Stage III, the extension is always into light greens and light browns and tans. This development is designated as Stage III b.

> At Stage IV Yellow or Green whichever did not emerge at the previous stage, now emerges. The green term now includes most blues, irrespective of the variant of Stage III through which the language has passed. Red continues to encompass the areas of English red, some yellow -reds, purple, and purple-reds. Presumably, Black and White continue to be deprived of hue reference, becoming increasingly restricted to neutral values.
>
> At Stage V the focus of blue emerges from the Green area. Green now becomes green. At this stage Black and White are fully reduced to black and white, that is, to neutral values. The red area is probably also reduced, losing purples and violets.
>
> Stage VI, the last at which a single focus appears, introduces brown. At Stage VI both Red and Yellow become even more restricted in scope although it is not until Stage VII that they become red and yellow.
>
> At Stage VII the remaining basic categories , purple, pink, orange, and gray are quickly added to the lexicon. " (16-20)

Interpreting the data obtained from 98 different languages, Berlin and Kay listed their results to three main conclusions. First, eleven basic color categories exist universally for humans and these categories assist as the psychophysical referents of the eleven or fewer basic color terms in any language. Second there are two possible fixed partial orders in the introduction of basic color terms as a result of perception. These two possible orders are:

$$\left.\begin{matrix}\text{white}\\ \text{black}\end{matrix}\right| \to \text{red} \to \text{green} \to \text{yellow} \to \text{blue} \to \text{brown} \left|\begin{matrix}\text{purple}\\ \text{pink}\\ \text{orange}\\ \text{gray}\end{matrix}\right.$$

and

$$\left.\begin{matrix}\text{white}\\ \text{black}\end{matrix}\right| \to \text{red} \to \text{yellow} \to \text{green} \to \text{blue} \to \text{brown} \left|\begin{matrix}\text{purple}\\ \text{pink}\\ \text{orange}\\ \text{gray}\end{matrix}\right.$$

Third, the number of color terms are highly related with the degree of complexity of cultures and technology. Berlin and Kay suggest that color lexicons with few terms are seen in association with relatively simple cultures and simple technologies, while color lexicons with many terms occur in association with complex cultures and complex technologies (to the extend that complexity of culture and technology can be assessed objectively) (Berlin and Kay 104).

Berlin and Kay, in their Basic Color Terms, have presented much evidence suggesting color terms can be ordered in an evolutionary sequence. Depending on Berlin and Kay's claim and many other investigations, the opponent-process theory has been considered and hypothesized to play an important role in this evolutionary process (Kay et al. 14). However Jameson and D'Andrade support an opposite hypothesis and they argue that the evolution of color terms is based on a process where terms introduced into a language tend to be maximally distant in perceptual color space from already existing terms (316).

Jameson and D'Andrade assume that the names that are used to define a color percept, at any stage in the development, are the ones that give more information about the color. If there are only two terms of color in a language, these terms are adapted to give information about the percepts that are really representing two extremes of the system. Thus the most informative system is the one that places referents of the terms at the maximum distance from each other. A dark/cool versus light/warm division of the color space accomplishes exactly this. Jameson and D'Andrade suggest that the following term, after the light/warm versus dark/cool division has been made, is red as it is the most distant region of color space from the regions specified by these two terms (312). Considering the work of Boynton and Olson in 1987 (107-123), which computed the distances between centroids in the OSA color space, it is natural to expect either yellow or blue to be the next division, followed by green, purple, pink, orange, brown, and gray. When the concept of 'distant regions', rather than neurologically based fundamentals, is accepted to be the determinant factor of Berlin and Kay's eleven basic colors, the conclusion is that, basic colors are divided well not because they are universally named but because they are well separated in color space.

Jameson and D'Andrade relate the developmental order of color names to the irregular shape of the color space. They argue that the irregularities of the perceptual color space provide an informational advantage to making the division so that focal points of the categories are really different from each other. They also add that, these irregularities also make certain regions of the color space perceived easily than others (Jameson and D'Andrade 313).

After the study of Berlin and Kay, various investigations were done about the same subject in many different countries with different languages. Collier, G. and his colleagues repeated the study by Berlin and Kay, controlling for saturation in the color stimulus material in 1976 and found further evidence to support the basic color category universals (880-894). Later, Erica Friedl in 1979, examined recent changes in the color terminology of people in Iran (51-68). In 1977, Witkowski and Brown argued that specific physiological perception mechanisms account for some of the regularities associated with the lexical encoding of basic color terms described by Berlin and Kay. They have focused upon these regularities and explained them through reference to certain general principles of naming behavior in their paper An Explanation of Color Nomenclature Universals (50-57). Witkowski and Brown, also (Lexical Encoding 13-27) investigated the color terminology systems depending on the lexical encoding sequence and language change.

With the possible exception for Russian, all of the studies suggested that, there is no language investigated so far has more than eleven basic color terms. Russian *goluboy* 'light blue' (white+blue) is a potential word to be a twelfth basic color term. Kay and McDaniel (641) claim that 'light blue' is a basic term for some Russian speakers and may achieve basic term status for all speakers of Russian in the future. They also argue that similarly it is possible that several non basic color terms in English, used to name intersections of fundamental response categories, will become basic in the future. Aqua/turquoise (green+blue), maroon/burgundy (black+red), and chartreuse/lime (yellow+green) are given to be examples to this hypothesis.

One amazing point in basic color terms is that, no basic color exist between green and its nearest chromatic neighbors, blue and yellow. There is no suggestion that a new basic color term representing a blue-green or yellow green is needed or possible to develop. GRUE could describe an early cognitive stage for the two linked primary basic colors green and blue. A single term for the yellow-green region is similarly possible (and chartreuse is already being used in English). It is suggested by Boynton that, orange between red and yellow, and purple between red and blue exist just because these transitional colors provide a bridge between the mentioned basic colors. A single category including red and yellow, or red and blue is not enough as their separation is too great. Thus orange and purple have emerged as they include necessary bridges to close the gap between these primaries (Boynton 144).

It must be noted here that some of the basic color terms (such as red and green) are also derived names. The derivation of basic color term 'red' is from blood, and 'green' refers to the activity of growing plants (Sloane 4-5). The process that characterizes derived category formation still continues today. In all languages there are color names borrowed from objects, flowers, etc. If we think about the naming process for red and green, there is no apparent reason to believe that the process will not continue, extending basic color term lexicons beyond the present eleven terms.

4.2.2 NON-BASIC COLOR TERMS

Non-basic terms can be stated as synonyms of basic terms as in the case of vermilion's being an example of red. Non-basic terms are of more recent origin and have not been used with the necessary definiteness for a sufficient length of time when compared to basic ones.

Since societies became more sophisticated, just eleven names for color became inadequate to satisfy human identification. More significant color terms were required for fine descriptions. Thus, modifiers were used to describe a specific color or to indicate a related tone: deep red, blue-green, lemon yellow, light blue, burnt orange, and so forth. A gradual change is indicated by adding "ish" or "y" to the end of a word: grayish white, smoky grape.

Like some of the basics , the largest group of non-basic color names consists of terms derived from the names of objects, such as olive and rose. When an object name is used as a color name, the definition of the color name is a simile. If the color expressed by "burgundy" is considered, the correct definition arises as a color that of Burgundy wine. Colors are usually named after objects regarded as good examples of that color (Sloane 5).

Color names drawn from object names are reminders of where to look for a sample of the color. The refinement is a result of social and most of the time personal understanding. The language of the perceived color differences refers to each individual's own subjective world of color perception. Thus, although words such as honey, brick red, lemon yellow, turquoise and others are commonly used, the visualization of them may differ between different individuals.

The names of non-basic colors are primarily taken from the environment to describe the impressions; such as (Eiseman and Herbert 11):

Natural phenomena: Sunshine, Sky Blue, Green Haze, Desert Dust, Snow White

Flowers, vegetation, and woods: Golden Poppy, Iris Orchid, Lilac, Spearmint, Mahogany

Minerals, gemstones, and metals: Amethyst, Aquamarine, Emerald, Lapis, Slate, Opal, Silver Lining, Medal Bronze, Lead Gray

Animals, birds, and fish: White Swan, Nutria, Dove, Flamingo, Shrimp, Oyster Gray

Geography: Indian Red, Malaga, Capri Blue, Inca Gold, Bordeaux

Foods, dyes, and spices: Caramel Cream, Apricot, Raspberry, Apple Green, Mango, Paprika, Chili, Indigo, Scarlet, Ocher

Other color terms can also be derived by the designers, writers, painters, manufacturers, etc., to depict, represent and classify different aspects.

Color names borrowed from object names do not always indicate the color of the named object. Saffron is not the color of the saffron flower. The word refers to the yellow-orange of the dried stigmas of the flower. Madder, a color name used for paints, is not related to the yellow flowers of the madder plant. The indirect reference instead is to the red dye manufactured from the plant's root (Sloane 7).

Rivers (qtd. in Segall et al. 42) mentioned same type of approach outlined above in using color names. He exemplified that, the Mabuiag people of New Guinea had a great tendency to invent names for special colors and expressed his astonishment saying that: "... why one native coined a name for a bright blue by comparing it to the color of water, muddied from washing mangrove roots."

Human beings can learn to use a word, in an accustomed manner, without knowing its derivation. Some of the examples for this generalization, expressed by Sloane are the color term 'Magenta' and 'Umber'. English color name magenta (purplish red) is borrowed from the battle of Magenta in 1859 between Austrians and French. Actually Magenta is neither an object that can be seen, nor an article to be represented by its surface color. It is only a name of town. Likewise umber is used for designating dark brown in English, which is also a district in central Italy (5).

Besides these object or phenomena derived non-basic color categories, there are two-term non-basic color terms which are also known as composite categories or "macrocolors". These color terms are derived from the various combinations of the four basic hues (red, yellow, green, blue) and black and white. When these categories were examined it was visualized that blue-green, red and yellow, and yellow-green are found in color systems, but not the combinations blue-yellow, and red-green. Besides the opponent-process theory of Hering, discussing this situation, an other explanation comes from Witkowski and Brown related to the fact. The reason explained by Witkowski and Brown (An explanation 54) is connected to the order of wavelengths of the perceived colors. They suggest that this ordering is important in human color perception and categorization. According to Witkowski and Brown, only basic colors adjacent to each other in wavelength order can be combined in composite classes. Referring to this claim, a composite category combining yellow and blue which are not adjacent in wavelength order, and another composite color category, red and green are not possible and are not available in the lexicon. On the other hand, blue-green, the yellow-green, and a red-yellow class are present in color systems as they are all composed of colors adjacent in wavelength order. Thus wavelength order is important in color categorization as are the more general principles of conjunctive and disjunctive categorization.

It is possible for a human being to live his life without using any other color names beyond the primaries. Besides, there are hundreds and even thousands of color names present in languages that are used for intermediary colors. Composite or derived categories have more complex perceptual bases than the basic categories in identification process. Most of the time, the name of color draws our attention to the attributes of that color rather than just visualizing it. Identification of non-basic color names is highly subjective, and the visualization of the mentioned color is relative to the mental functioning of the viewers. Thus, it is never absolutely possible to be certain that two people imagine a color exactly the same way. The varying shades of "coffee with milk" for example, will depend on how much milk is added to the cafe.

Basic color terms, for example, black, green, orange etc., are "simplex" lexemes. That is, they are uncomplicated and easily used lexemes. "Complex" lexemes constitute another category in color naming. "Complex" lexemes are derived through word-formation processes of modification and adjustment. Non-basic color terms are simplex and complex lexemes. Scarlet, blond, indigo, and eggshell are simplex lexemes, and yellowish, light green, wine red, and tea rose are complex lexemes (Casson 232).

From linguistic point of view, simplex color words are also divided into two groups: semantically transparent or synchronically analyzable, and semantically opaque or synchronically unanalyzable. Simplex non-basic terms all have hue senses. No brightness terms such as light and dark are used in the description. They all have non-color physical object referents, creating sense of color, from five object domains: plants, animals, minerals, foods, and artifacts. The meaning of transparent terms such as salmon, ivory, pearl, coral are generally obvious to English speakers. Although the meaning of opaque terms such as buff (light brown), teal (bluish color), crimson, and vermilion are not generally known by English speakers, they were once the names of animals or of animal parts or products (Casson 232-233).

Violet a transparent term entered English with both its plant sense and its flower sense. Crimson, scarlet, and vermilion are examples of early opaque terms. Crimson which is an opaque term derived ultimately from Arabic *girmiz* "kermes." An insect or worm producing a red dye. Indigo, which is an opaque term is the name of an Indian plant and the blue powder product of the plant that was used as a dyestuff. (Casson 234-235)

During the early twentieth century, proposals for simplifying and standardizing names of colors were put forth by Albert H. Munsel, Wilhelm Ostwald, and other color theorists. The systems (which will be explained in the next chapter) generally eliminate color names drawn from the names of objects. These theorists concluded that describing the difference between any two colors and exact understanding is only possible by recognizing and using three dimensions of color.

4.3 COLOR CATEGORIZATION FROM A DIFFERENT POINT OF VIEW: FUZZY SETS

Although numerical values are used to describe physical phenomena in our environment, categorical representations are preferred in expressing perceptual dimensions. This case is more evident in color vision. Quantitative variations in the wavelength are the determinants of color perception. However, these quantitative data is expressed, labeled, and described with color categories that represent qualitative differences in perception. Thus, the physical and the psychological representation of the electromagnetic waves between 400 and 700 nanometer are two different coding and classification processes although the source of information is one.

Berlin and Kay (1969), and Kay and McDaniel (1978) have related color classification of different languages with Hering's opponent-process color theory. Berlin and Kay's evolutionary sequence of color space was reconceptualized by Kay and McDaniel, and presented as "fuzzy set theory" to model the color category organization.

Wooten and Miller explain the function of a fuzzy set as follows: "Fuzzy sets allow for degrees of membership in which there is a continuum from highly representative members to rather poor members." (84)

Fuzzy set theory can be accepted as a modified type of standard set theory. The basic difference between a standard set theory and fuzzy set theory results from the definition of membership that each theory considers. In standard set theory, an element is simply and strictly a member or not a member of a given set, however degrees of membership are possible in fuzzy set theory (Kay and McDaniel 621).

Kay and McDaniel explain briefly the operation of membership in a fuzzy set as: "A fuzzy set A is defined by a characteristic function f_A which assigns, to every individual x in the domain under consideration, a number $f_A(x)$ between 0 and 1 inclusively, which is the degree of membership of x in A "(622).

Zimmer handles the operation outlined above for the phenomenon of color, which consists of all visible lights in the range of approximately 400 nm to 700 nm. He states that "... the fuzzy set of a specific color (e.g., red) is not characterized by a step function as in normal set theory but by a continuous membership function." (214). As could be seen from Figure 4.1 the degree of membership for the color 'red' is about zero in the 500 nm area and increases to a value of 1.0 for longer wavelengths.

Color words are sometimes used to indicate degree, resemblance and approximation of a color to the ideal example of the referred color. Expressions like: a good red, the best example of red, sort of red, slightly red, an off red modify or qualify the degree to which something is a member of a particular color category. A 'good red' expresses a greater degree of similarity to the idea of 'red' than the term 'slightly red'. In all of the mentioned indications of red, a color is defined (1) by reference to some basic color category, and (2) by the use of a word which indicates how much the color actually named deviates from the norm for this basic category (Kay and McDaniel 622).

Color terms like yellowish green, blue-green, light blue or dark brown also indicate degree of approximation to a standard. In addition to that, these terms indicate the direction of variation from the standard as well. It is obvious that a yellowish-green is not a good example of green as it has some degree of yellow in it. Same is valid for blue-greens as they are neither perfect blues nor perfect greens. While some color terms indicate only variation in hue from a standard (e.g., blue-green, yellowish green, etc.), other terms express the attributes of brightness and/or saturation (e.g., light blue, dark brown, etc.). Light blues are blues which are to some degree lighter or whiter than the standard blue. In like manner, dark browns are black to a greater degree than browns.

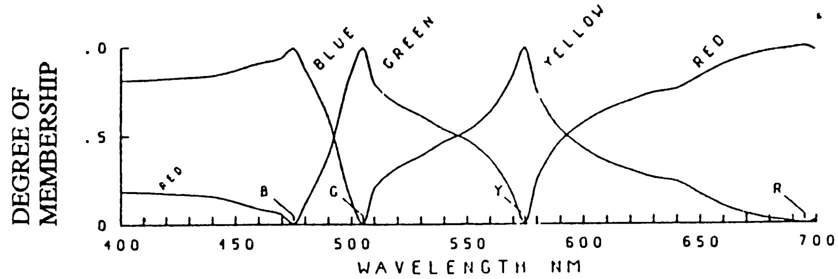


Figure 4.1 Membership functions for the color categories (Kay and McDaniel 625)

Sorts of color expressions exemplified above are possible in all languages. They help members of a society recognize and talk about degrees of color category membership. Kay and McDaniel consider color categories as fuzzy sets since they believed color categorization is experienced as a matter of degree and membership. All possible color percepts constitute the members of the fuzzy set corresponding to each basic color category. A value between zero and one is given in order to specify the degree of membership of the percept in a particular category (Figure 4.1).

Kay and McDaniel interpret individual color categories as fuzzy sets. They divide basic color categories into three types. The first type of fuzzy sets includes the six color categories, which are also known as the primary color percepts in Hering's theory: black, white, red, yellow, green, blue.

The second type, known as "the composites", is a color category achieved from the fuzzy unions of the six fundamentals. A category formed by such a union is composed of all the colors that have any degree of positive membership in any of the fundamental response categories from which it is formed. The composite category found most often is GRUE, equivalent to the fuzzy union $f_{\text{green OR blue}}$ as seen in figure 4.2.

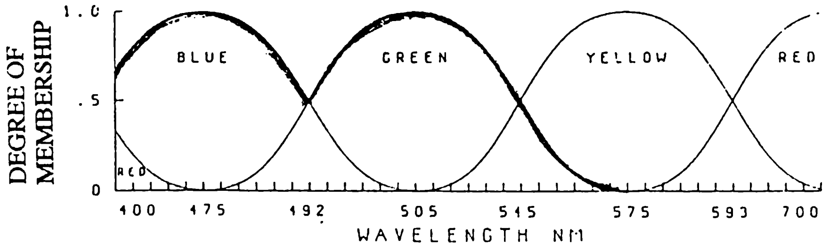
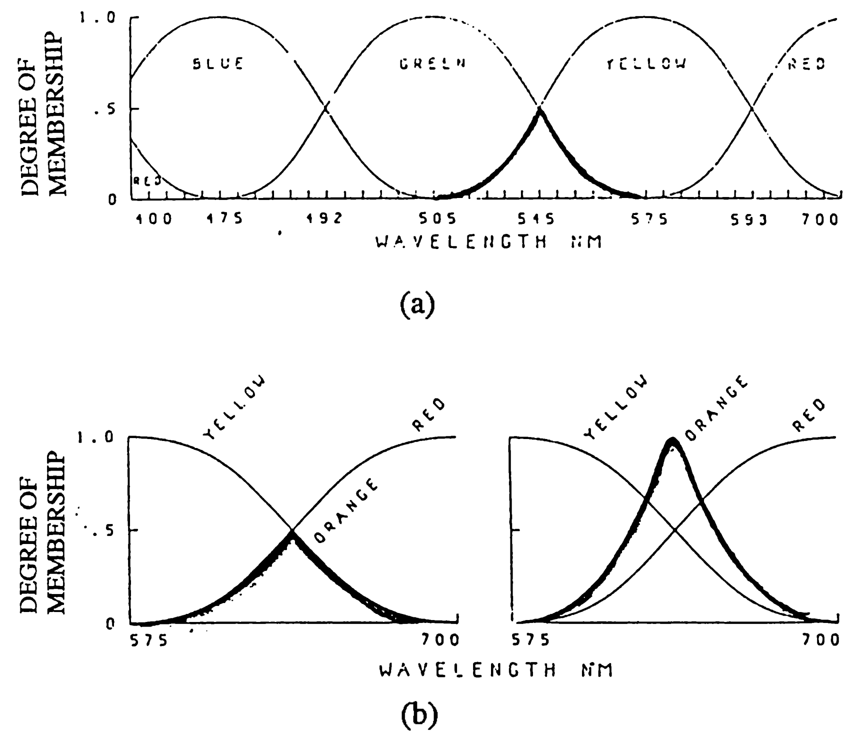


Figure 4.2 The fuzzy union of $f_{\text{green OR blue}}$ (Kay and McDaniel 630)

The colors included in the third type are called "derived" categories and are defined in terms of the fuzzy intersections of the fundamentals. This type of colors are seen as mixtures of fundamentals, for example orange is seen as a mixture of red and yellow. The definition of orange is given as: 'red AND yellow= orange' in fuzzy set theory. (Kay et al., 22 and Wooten and Miller 84).

The actual membership values which these categories have are not precisely the values that the simple fuzzy intersection yield. If the simple fuzzy intersection model of orange, in Figure 4.3 a, is considered, two claims can be investigated that are contradicted by both casual and experimental observations. First one is that there are no really good examples of orange as the membership function of orange can only exceed up to 0.5. Second one is that although there are good examples of orange in comparison to the basic color terms, it is not possible to obtain a good orange as there is no hue sensation with a higher degree of membership in orange than in either red or yellow (Kay and McDaniel 633). Thus, Kay and McDaniel modified the fuzzy intersection function in favor of a model, which allows some colors to have a membership function whose maximum is unity. Figure 4.3 b shows the new function of fuzzy intersection for orange, comparing it with the simple fuzzy intersection function, where the degree of membership for this color reaches up to unity.



(a)

(b)

Figure 4.3 a. Simple fuzzy intersection of $f_{\text{red AND yellow}}$

b. Comparison of the simple and modified fuzzy intersection function of orange ($f_{\text{red AND yellow}}$). (Kay and McDaniel 632)

Beyond Stage V of the evolutionary sequence suggested by Berlin and Kay, the development of basic color term vocabularies follows a different pattern. Basic color term lexicons developed by addition of terms that refer to regions of the color space where the fundamental neural response categories overlap. These later, ‘derived’ categories are brown, orange, pink, purple, and gray.

Neural Response Categories	**Semantic Categories Based on Identity**
f_{black}	f_{black} = black
f_{white}	f_{white} = white
f_{red}	f_{red} = red
f_{yellow}	f_{yellow} = yellow
f_{green}	f_{green} = green
f_{blue}	f_{blue} = blue
	Semantic Categories Based on Fuzzy Union
$f_{\text{black OR green OR blue}}$	$f_{\text{black OR green OR blue}}$ = dark- cool
$f_{\text{white OR red OR yellow}}$	$f_{\text{white OR red OR yellow}}$ = light- warm
$f_{\text{red OR yellow}}$	$f_{\text{red OR yellow}}$ = warm
$f_{\text{green OR blue}}$	$f_{\text{green OR blue}}$ = cool
	Semantic Categories Based on Fuzzy Intersection
$f_{\text{black + yellow}}$	$f_{\text{black + yellow}}$ = brown
$f_{\text{red + blue}}$	$f_{\text{red + blue}}$ = purple
$f_{\text{red + white}}$	$f_{\text{red + white}}$ = pink
$f_{\text{red + yellow}}$	$f_{\text{red + yellow}}$ = orange
$f_{\text{white + black}}$	$f_{\text{white + black}}$ = gray

Table 4.1 Summary listing of color categories showing the three types of fuzzy set operations and related fundamental response categories (Kay and McDaniel 637)

Kay and McDaniel argue that, all basic color categories are formed from the human visual system's six fundamental response categories by one of three fuzzy logical operations: identity, fuzzy union, or fuzzy intersection operations. White, black, red, yellow, green and blue are the primary basic color categories formed from the identity operation of the six fundamental response functions. Fuzzy unions of fundamental response categories are the basis of the four composite basic color categories light-warm, dark-cool, warm, and cool. Finally the derived categories; brown, pink, purple, orange and gray are obtained from the fuzzy intersections of fundamental response categories (637). Table 4.1 is a summary listing of these categories, showing the three types of fuzzy set operations that relate them to the fundamental neural response categories.

4.4 COLOR IN TURKISH LANGUAGE

In this section, the vocabulary of color in Turkish language will be discussed briefly. It is really difficult to say how many color terms exist in Turkish language. Apart from the list presented in appendix 2.1, there are still color words recently introduced into language, e.g., "milka moru", "benetton yeşili". Dialect variations, the specialized sub-vocabularies of artists, interior designers, textile designers, paint manufacturers, and so on add to the color vocabulary list of Turkish language day by day. Besides the color words included in appendix 2.1, hundreds of others may enter to the list, many of which would be unfamiliar to most native speakers of Turkish language.

The number of words, which are definitely counted as color terms, are small. These are in general use and assumed to be known and understood by most of the native speakers of Turkish language. They are the basic color terms in Turkish: **kırmızı, sarı, yeşil, mavi, kahverengi, mor, pembe**, and **turuncu. Black, white** and **gray** can also be added to the list of basic color terms. Besides these basic color terms, there are a large number of color terms, such as **lacivert, gül kurusu, bordo, yavruağzı**, which are grouped under the category non-basic color terms. The names of non-basic colors are primarily taken from the natural environment, foods, minerals and metals, and from the natural phenomena in Turkish. Basic color terms are more general and non-basic ones are more specific.

Basic color terms are used most of the time to answer to the question 'What color is X?' when there is no need to be more specific. In Turkish, and in all other languages, basic color terms are learned earlier by children as they are much more frequent in everyday language.

Non-basic color terms can often be defined in terms of basic color words. For example **leylak** might be defined as (a particular kind of purple) pale purple, **kızıl** as 'a brilliant red (tinged with orange)', and so on. Most of the color words appear in Turkish language are the surface color of some objects. The term can be used as either " 'x' -rengi" or having a color name attached after the referred object. Examples of these word include: "bal rengi", "zeytin yeşili", "buz beyazı", "kül rengi", "çilek kırmızısı" and so many others.

Turkish language has several words that may be used to qualify or modulate basic color terms (although this is not their single or primary use). These words include **koyu, açık, uçuk, parlak, canlı, soluk, mat, donuk, pastel, acı, kirli, cart, sıcak, soğuk** (Davaz 3-61, and see appendix 2.1). Definition of non-basic color terms, in terms of basic color words are possible with the use of these qualifiers- e.g., the definition of **kanarya sarısı** as 'canlı sarı' or **fildişi** as 'kirli beyaz'. These color terms create new phrases in order to increase specificity. They are essentially used instead of non-basic color terms in Turkish language.

In Turkish there are color words used to emphasize or strengthen the color. For example when we heard a word "**kapkara**" we understand that it is the strongest black that may exist in the environment. Similarly, "**sapsarı**" defies a color that has the most "sarı" content in it. Contrarily, we sometimes refer to expressions like "**beyazca**", "**yeşilimsi**" or "**siyahımtırak**" when the vocalized term has a little content of the hardly visualized color. These terms are mostly used when we are not so sure to use the color word during naming process. For example "**yeşilimsi**" is used when the "yeşil" content in the perceived color is not as strong as the one in pure "yeşil" (Davaz 9).

There are color expressions in Turkish like the ones mentioned in the 4.3 section of the dissertation. These expressions are generally used to indicate degree, resemblance and approximation of a color to the ideal example of the referred color. Some of the expressions in Turkish, using red for example, are: tam kırmızı, kırmızının göbeği, kırmızı gibi, kırmızıya yakın, bir cins kırmızı, etc.

5. COLOR SYSTEMS

While some researchers claim that there are eleven basic colors, others pronounce the number to be several millions. That millions of different colors are possible to be notified only if two identical surfaces are first presented adjacent to each other and then one of them slightly varied until a just noticeable difference can be seen.

In order to distinguish the differences between all of the possible color nuances, the colors or the stimuli must not be far from each other. Sivik mentions that, the two color surfaces, which when juxtaposed are seen as clearly dissimilar, immediately appear identical when they are moved apart even a few centimeters. He also adds that, rather large color differences are necessary to see surfaces as dissimilar, if the color samples are hold even farther from each other. If the procedure mentioned above is accepted, it is possible to drop the number of perceptually distinct colors to thousands or less (Sivik 163).

It is a complex assignment to determine the number of colors. The number is stated to be many. However, the necessary task is not to guess the number, but know how to describe these differences in color world. The easiest way is to attach a name for each specific color percept. The color terms and their corresponding color categories that people use in all cultures, in their everyday speech, can be considered as the first color reference systems.

Words are incomplete expressions for color. What one calls blue, another may think it as purple-blue, or blue-green. The perception and identification of ideal green varies with almost every person considered. Thus color scales are needed to explain the visual judgment of color, and such scales must not be left to personal thought or assessing. They should be standardized by scientific methods.

A "color model" or "color space" or "color order system" or "color atlas" is a way to organize the set of possible human color percepts in a systematic way. Wyszecki and Stiles state that, "A color system is a rational method or a plan of ordering and specifying all object colors or all within a limited domain by means of a set of material standards selected and displayed so as to represent adequately the whole set of object colors under consideration." (506)

Invention of a color system depends on the concept of setting out colors in a logical sequence and explaining relationships between them. Newton, who tried to separate and catalogue the spectrum of white light, in 1704, was known to be the inventor of the color systems. The impurities in the available pigments and dyes unabled Newton to standardize his findings and unabled him to translate them into terms of surface colors. Because of the same reason, 19th century color atlases, developed by naturalists, also avoided the use of the spectral colors. They based their standards of hue and value on a range of natural objects. (Gage 184)

Color specification for scientists has now become completely mathematical, as they try to quantify the stimuli. However, there are some other examples of color specifications try to qualify the data instead of quantifying it. In 1940’s, an English pioneer of nonrepresentational painting, Winifred Nicholson, arrange a spectrum of hues and values entirely related to natural objects and phenomena (Figure 5.1). Her scale underlines the fact that, surface colors possess several characteristics, such as texture, apart from the hue, value, and saturation, which have usually been held to define the parameters of color as perceived (Gage 184-185).

clay	mud	dust	earth	shadow	slate	lead
terra-cotta	dun	putty	khaki	mist	pewter	prune
brick	fawn	beige	faded oak leaf	sea gray	steel	mulberry
roan	bistre	hay	sage	air force blue	blue gray	vieux rose
rust	ochre	straw	willow	fell blue	knife blue	musk rose
coral	sand	amber	crab apple	turquoise	royal	wine
ruby	flame	topaz	emerald	azure	sapphire	amethyst
RED	**ORANGE**	**YELLOW**	**GREEN**	**BLUE**	**INDIGO**	**VIOLET**
sugar pink	alabaster	sulfur	duck’s egg	baby ribbon blue	ice blue	pale lilac
scarlet	apricot	lemon	pea green	sky	French blue	lavender
vermilion	fire	canary	grass green	forget-me not	hyacinth	heliotrope
tomato	fox	brass	cabbage	larkspur	ultramarine	purple
dragon’s blood	copper	daffodil	forest green	lapis-lazuli	electric blue	maroon
mahogany	tobacco	mustard	laurel	horizon	midnight	damson
RAVEN	BLACK COFFEE	TIGER SKIN	BLACK VELVET	ZENITH	PITCH	CHOCOLATE

Figure 5.1 Color scale by Winifred Nicholson (Gage 185)

Color systems are intended to help colorists, manufacturers and users of different kinds of colored products to communicate about in color in the sense of color percepts. As they usually have actual samples that can be seen, they are easy to understand. Most of them (such as Munsell, NCS, etc.) are easy to use since side by side comparisons are possible without any instrument. The systems can be used as;

- an educational illustration of color phenomena;
- a general reference in the choice and communication about color;
- a practical tool in visual color identification;
- an aid in the choice of colors with a specified luminous factor;
- a basis for the choice of colors in product ranges, etc.

Color systems vary in number depending on their consideration and techniques of representing the color stimuli. In most of these color systems, although they differ in progress, the stimuli are considered either as radiation or as a surface color.

Those, that accept the stimuli as a radiation, are based primarily on the principles of additive mixtures of color stimuli. The best known example of this system is *CIE (x, y, Y) chromacity diagram*, which is based on physical measurement of spectral reflectance, usually using three primary color filters and some kind of photometer (IES 5-4).

In the other group of color-order system mentioned above, uniformly constructed color chips are selected to represent scales of constant hue, value, and chroma. This system is sometimes called color appearance system. Examples include the *Munsell Color System*, *NCS* and *Ostwald Color System.*

Among various systems, the CIE and Munsell are the most referred ones. While the CIE is used as a reference system for all color systems, Munsell Color System is the one most often cited in literature and in investigations because of its ease in use. In addition to these two systems, the color system developed by Ostwald; which is most familiar to artists and designers, and ISCC-NBS system; published by The National Bureau of Standards of ISCC, which is aimed for all the public, and The Natural Color System (NCS) developed referring to the opponent process theory of Hering (described in chap. 2) will be discussed in detail below. It is possible for the users to convert these systems into each other.

5.1 MUNSELL COLOR SYSTEM

The Munsell system was created by an American artist, Albert Munsell. One of the reasons why he took an interest in color systematic was to "find a systematic color scheme for painters, so as to determine mentally on some sequence before laying the palette" (Sivik 166).

Munsell introduced his system in 1905 proclaiming that "Color anarchy is replaced by systematic color description" (Munsell 24). With his system, Munsell aimed to eliminate notations as lemon yellow, sky blue, etc.

In this system, surface colors are identified by three qualities: Munsell Hue, Munsell Value, and Munsell Chroma. Each chip is identified by a 3-part code. For example , the notation 2.5 YR 5/10 describes the chip with the Munsel hue 2.5 YR, Munsell value 5/, and Munsell chroma /10.

Hue is the name of a color. It is the distinctive quality of coloring in an object or on a surface. Hue is used to communicate the differences in the spectrum. In other words it is necessary for the differentiation of red, yellow, green, blue, and purple from each other.

There are 10 hue ranges in the hue circle of Munsell system which appear in the order (clockwise) red (R), yellow red (YR), yellow (Y), green yellow (GY), green (G), blue green (BG), blue (B), purple blue (PB), purple (P), red purple (RP). The hue scale is subdivided by a scale consisting of 100 equally spaced Hue radii. The end hue radius of one range corresponds to the beginning hue radius of the next range. For each Hue range there is a major hue, which is located at the middle of each Hue range, represented with the number 5. Munsell color chips are provided not only for hues at radii 5 in each of the ten Hue ranges but also for hues at intermediate radii 2,5, 7,5, and 10 (Figure 5.2).

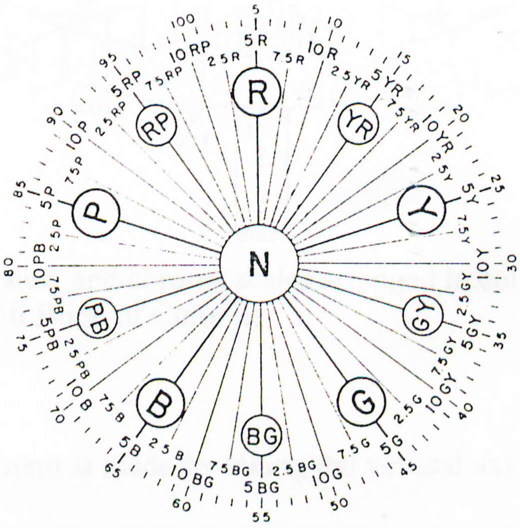


Figure 5.2 Related hue symbols arranged on 100 hue circuit (Munsell Book of Color 1).

Value is the brightness of color. It is that quality by which we distinguish a light color from a dark one. The value scale contains ten steps from black to white; 0 to 10. Munsell color samples are offered at Values 2,3, ..., 9 for all hues. Value 8.5 exists only for the yellow hues (Figure 5.3 and 5.4).

Chroma is the strength of a color. In other words chroma, also named saturation, intensity or strength, describes the purity of a color or the extent of its departure from gray. Two colors may be the same hue and value, but still they may appear different in chroma. From chroma 2 up to the maximum produceable one, chroma circles display uniform steps for each of the 40 Hues(Figure 5.3 and 5.4).

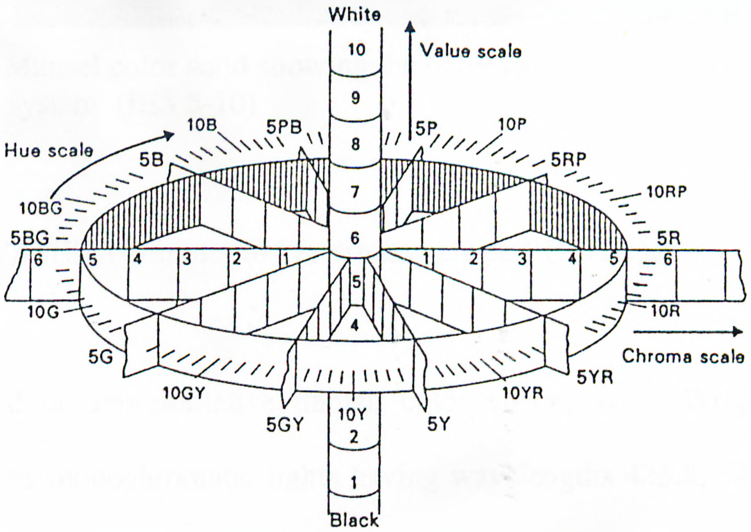


Figure 5.3 Hue, value, and chroma scales arranged in color space
(Munsell Book of Color 2)

Munsell Color System is made by taking the vertical axis of the sphere which carries a scale of value. The hue scale is positioned in equal visual steps around the vertical axis. The branches carrying the scale for chroma are at right angles to the vertical value scale. The branches of chroma are equidistantly spaced around the vertical value axis according to the Hue. Color space of the Munsell Color System is quite irregular. (Figure 5.3 and 5.4).

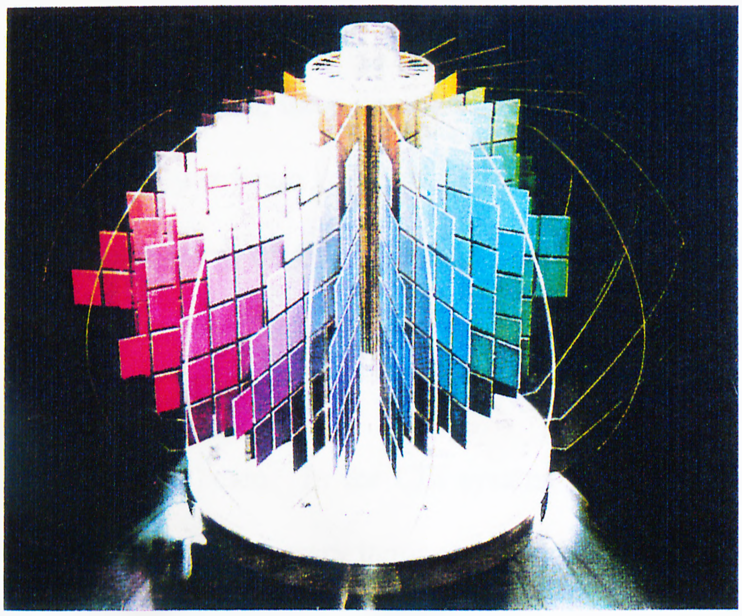


Figure 5.4 Munsel color solid showing the color pages and their arrangment in the system (IES 5-10)

5.2 CIE SYSTEM (Commission Internationale de l'Eclairage)

Concentrated on representative human color vision, W.D. Wright and J. Guild obtained three monochromatic lights having wavelengths 435.8, 546.1, and 700 nm needed to match the colors of the spectrum. Their data were adopted in 1931 by the CIE to characterize the visual response of a typical normal viewer. CIE method, or called the CIE *1931 standard observer,* is an internationally accepted method for color specification depending on the data obtained by these two scientists. This system defines all metameric pairs (two indistinguishable lights having different spectral power distribution) by giving the amounts of three imaginary primary colors (red, green, blue) required by a standard observer to match the color being specified (IES 5-4).

It is possible to obtain the spectrum colors at any wavelength within range 400-700 nanometers. Relative amounts of the three primary colors are used to match any spectrum color. In CIE system, three items are needed to satisfy fully our perception of any color supplied by a beam of light. First one is the hue. It is the 'color' presented on the outer curve of CIE triangle. The second is the 'saturation' (also designated chroma or purity). Saturation is the extent to which the color is pure or has white or black mixed in with it. The last item needed is the brightness or *luminous intensity* of the beam. In the CIE system, *x, y* and Y values are used in order to express these three necessary items explained above. Any color on the CIE diagram is described by the x, and y values given on the axes, and Y represents the luminous emmittance of the light beam (Nassau 9).

To describe a certain beam of medium strength, pink appearing light, we could say: "orange hue of 620 nm, 25 percent saturation, medium brightness", or we could give the x=0.4, y=0.3, and Y values (Nassau 12).

The chromaticities of the imaginary primaries occupy the corners of the triangular CIE diagram, and the chromaticity of any color that results from their mixture is represented by one point plotted within the triangle or on one of its three sides. White, produced by an equal mixture of the primaries is represented by its chromaticity at the center E (Figure 5.5).

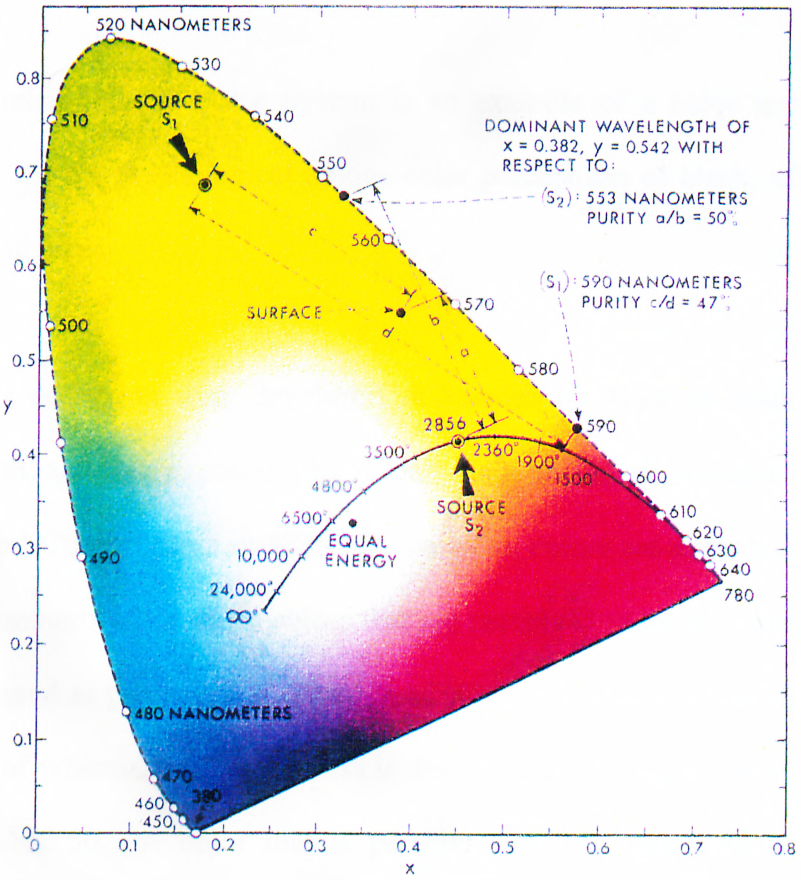


Figure 5.5 1931 CIE chromaticity diagram showing method of obtaining dominant wavelength and purity for different samples (IES 5-9)

Most saturated colors are found at the circumference of the triangle. Going inwards, closer to the E point, they become lighter and less saturated. Any two colors at the tips of any segment, that passes through the center, are opposed or complementary.

Colors that have purple hues, or hues of red associated with the purple line, are called nonspectral colors; all other chromatic colors are called spectral colors (Agoston 53).

5.3 THE SWEDISH NATURAL COLOR SYSTEM (NCS)

The Swedish Natural Color System is an example of a color appearance system based on the six psychological unique color perceptions of black, white, red, green, yellow and blue.

The ideas of Hering were developed in Sweden by Tryggve Johansson and Sven Hesselgren, and, more recently, by Anders Hard and his co-workers so as to produce the Natural Color System or NCS. In the NCS, colors are described in terms of the relative amounts of the basic colors that are perceived to be present. These amounts are expressed as percentages. Thus , a medium gray that is perceived to have equal amounts of whiteness and blackness is described as having a whiteness of 50 and a blackness of 50. A color that is perceived to be a pure red with no trace of yellowness or blueness or whiteness or blackness is described as having a redness of 100 (Hunt 86).

Colors are represented in equilateral triangular arrays. In these arrays, white is represented by the point W at the top, black by the point S at the bottom, and the specific hue of any color by the point C at the right hand corner of the triangle. Thus colors having only combinations of one specific hue of any color, blackness and whiteness are illustrated in each array of the system.

The specific hue of any color is determined by its perceived contents of red and yellow, or yellow and green, or green and blue, or blue and red. The triangular arrays are positioned in the system according to the relative amounts of the basic colors that are perceived. Figure 5.6 shows an example of a triangular array and the arrangement of hues in the NCS.

The sum of whiteness, blackness and chromaticness (hue contents) of a color is always 100. If a color had 30% whiteness, 20% blackness, 25 % redness, and 25% blueness, its hue would be determined by the ratio of its two hue contents, that is 25 to 25, which is the same as 50 to 50, so that it would be on the R50B triangle. Its position in this triangle would be 20% of the maximum possible distance from the line WC, and 50% of the maximum possible from the line WS as shown by the darkened point in figure 5.6. NCS whiteness is omitted in the designation as the sum of the variables is always 100.

The specification of the color with s=20, c(sum of the hue content)= 50, with a hue ratio of 50 red and 50 blue is denoted as 20 50 - R50B. The numbers are always given in the order of blackness, chromaticness, and hue. The NCS hue is indicated by the initial letter of one unique hue followed by the percentage of a second hue (Figure 5.6).

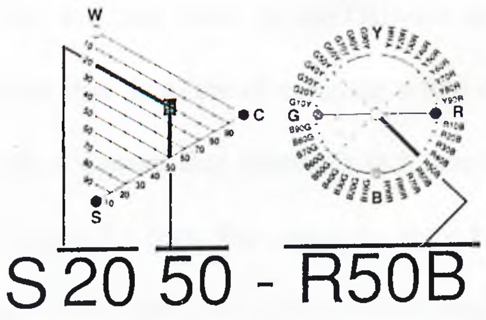


Figure 5.6 Example of the relationship between the NCS-notation of a color sample and the location of the color in the NCS-color triangle and NCS-color circle (Color Atlas 96)

5.4 OSTWALD COLOR SYSTEM

As a chemist and an amateur painter Wilhelm Ostwald produced his color harmony manual in order to assist the knowledge and study of color harmony and color coordination in design.

Developing his color system in 1916, Ostwald paid attention to surface colors. Hue, whiteness and blackness was used to describe color. The "Ostwald Color Solid' consists of two identical cones that have a common circular base and a central axis oriented vertically (Figure 5.7 (a)). There are 24 triangles radiating from the central axis. Each of the triangles represents a set of 28 colors of one hue. The vertical axis in the color system is composed of eight equal steps of his gray series extending from black up to white (Agoston 123).

Intersecting two diagonal paths, originated from white-black axis, are used in the two letter notation (Figure 5.7 (b)). In each two letter notation , the first letter is that on the rising diagonal path. Ostwald color specification consists of the Ostwald hue number and the two letter notation. The letters in the two letter notation refer to the percentages of pure white and pure black in the Ostwald neutral grays. The diagonal that rises from the vertical line is a line of constant white content and is called as an *isotint line*. Similarly the diagonal that descends is a line of constant black content, called an *isotone line* (Figure 5.7 (c)). For example, for a blue color denoted as 14ic, the *'I' value* is 14% and *'c'* is 44%. The full color content at the specified color is determined by subtracting from 100 the sum of the white and black components., thus the full color content for 14ic blue is 42%. Table 5.1 gives the percentage values of pure white and pure black necessary in the examination of colors in Ostwald system.

In addition to isotint and isotone sets of colors, there are two other sets of interest in the Ostwald Color Solid. One called the isochrome or more commonly, the *shadow series*, consists of colors represented by points falling along a straight vertical line (Figure 5.7 (c)). There are six shadow series for each Ostwald hue. In each shadow series the ratio of the amount of full color to that of white, called *Ostwald Purity*, is the same. The colors in shadow series decrease in lightness from the top point to the bottom one (Agoston 126).

Neutral gray	a (w)	c	e	g	i	l	n	p (Bk.)
Pure white	89.0	56.0	35.0	22.0	14.0	8.9	5.6	3.5
Pure black	11.0	44.0	65.0	78.0	86.0	91.1	94.4	96.5

Table 5.1 Percentages of pure white and pure black in the Ostwald neutral grays (Agoston 125)

The remaining set, called an isovalent circle, consists of a circle of colors of all 24 hues that have the same percentage composition of white, black and full color. An isovalent circle is designated by a two letter color notation, for example, *ic*. The isovalent circle of colors of maximum purity *pa* lies along the equator of the Ostwald color solid. At the apex of each hue triangle, the letter C refers to the color of maximum purity of the particular hue (Figure 5.7 (c)). (Agoston 127).

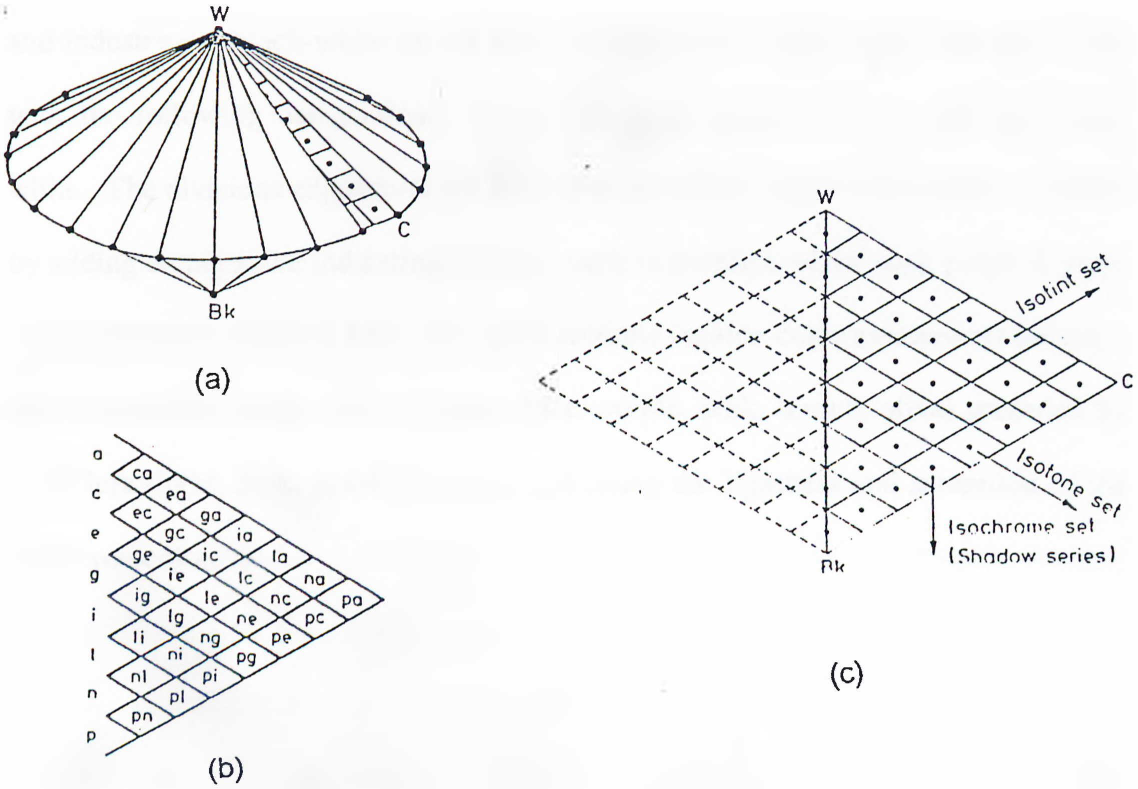


Figure 5.7 (a) Ostwald color solid (double cone)
(b) Ostwald's two letter notation
(c) Vertical cross section of the Ostwald color solid (Agoston 124)

5.5 ISCC-NBS COLOR SYSTEM

The National Bureau of Standards, which has an interest especially in industrial color standards, sponsored a study of color names in 1932. It was aimed to ease of exchange of information about color among industrial, scientific, and social groups. Inter-Society Color Council (ISCC) organized a method of cataloging and naming colors, and The National Bureau of Standards published the ISCC-NBS system in 1939. The system was revised into its present form a decade later. The system intended to create an understanding of color by the whole public (Sloane 21).

It was aimed to assign a name to each possible color expression used in art, science and industry. A black-white axis is used, and this axis is partitioned into gray scale with the following designations: black, dark gray, medium gray, light gray, and white. The divisions adjacent to the gray scale are given similar designations formed by adding an adjective indicating the hue, such as purplish white, dark purplish gray, or purplish black (Figure 5.8). All other sections include color expressions having a hue name (red, orange, yellow, green, blue, purple, pink, brown, olive) preceded by modifiers (light, dark, grayish, strong) indicating the lightness and saturation of the perceived color.

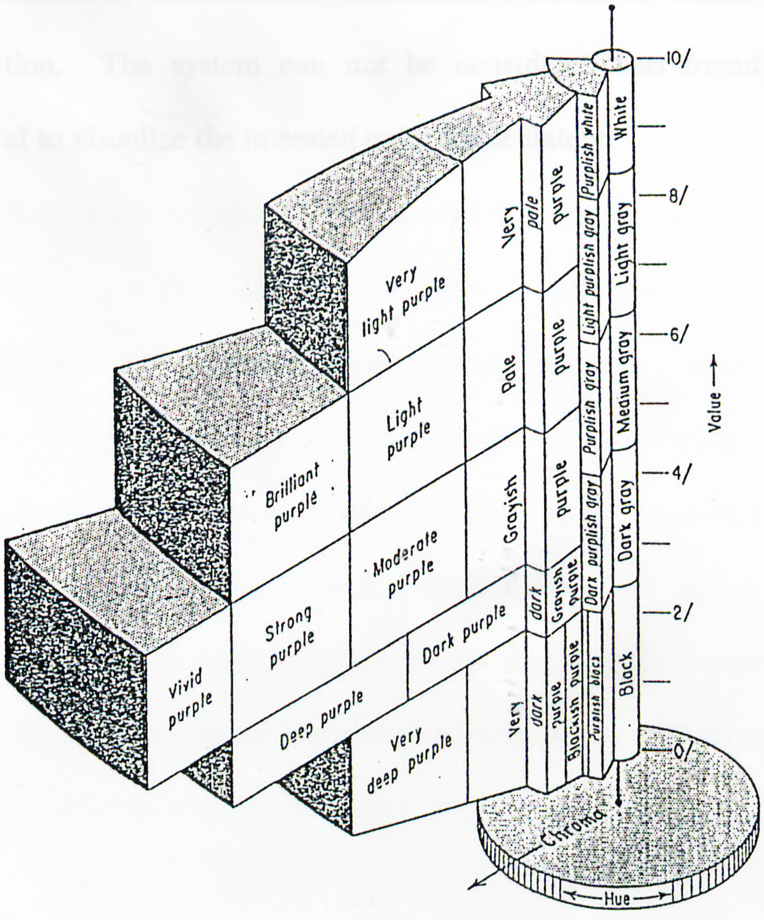


Figure 5.8 Illustration of the three dimensional nature of the ISCC-NBS system (Judd and Wyszecki 389)

The system identifies 267 major classes of color each of which has a name. Hue modifying terms, such as vivid, brilliant, light, moderate, etc., were used with the color names to make finer adjustments. Like modern systems for simplifying color naming, non-basic names derived from object names were eliminated, with the exception of olive in this case. The intention is to replace color names derived from object names (such as salmon) by compounds, such as grayish yellowish pink (Sloane 22).

It is difficult, even to respondents familiar with yellow, gray, and pink, to imagine the intended color upon hearing grayish yellowish pink. The ISCC carefully took this into account by recommending that a sample of the color be exhibited in case of identification. The system can not be considered user-friendly as it is really impractical to visualize the intended color immediately.

6. EXPERIMENTAL RESEARCH ON COLOR NAMING

6.1 INTRODUCTION

The second half of the thesis concerns an experimental research that investigates the color naming, color perception of Turkish People and the related color lexicon. It is also aimed briefly to focus on whether there are differences between the subjects depending on the variation in age, gender, city of living, and using color in their work.

Organization of color, naming of colors and the like can be considered as subjective evaluations. They are specific to individuals. Attitudes to colors are formed to a greater part by early childhood learning processes and thus culturally imposed. But this is not the only dimension in color naming. People learn to use necessary terms in order to have more specific descriptions. Colors serve us as informative cues about the surrounding environment, therefore, to some extent also have become common symbols for different concepts and phenomena. In naming the color that we see, it must also be carried in mind that some neurophysiological facts are considered to be main determinants in color term salience.

For each color term, the effect of age, gender, color use, and city of living, on color naming were examined statistically. Relationships between these variables and color naming were investigated (see appendix 3.3) for each color term. No significant effect of 'gender' and 'work' were identified in the naming of color impressions. It can be claimed that these two variables do not influence the color naming processes for Turkish people. On the other hand, the findings for the variable 'city' and 'age' are not adequate to support the statement that there are significant effects of these two variables on color perception and color naming. For example, it is not possible to claim that, either 'city' or 'age' is a dominant factor in the naming process for all color terms, as nearly half of the color terms did not show significant values supporting this idea. Because of this reason, instead of making general statements, I have decided to discuss each color term separately. The available information and discussion of the findings, related with the investigated variables are given in the appendix 3.3.

6.2 EXPERIMENTAL RESEARCH

6.2.1 OBJECTIVES

The major objective of the project is to find the range of color chips for each basic and non-basic color for Turkish Society. Besides it was also aimed to determine answers to the following questions:

1. What are the color names involved in Turkish Language?,
2. How do Turkish People perceive the basic colors? ,
3. Which non-basic color names are known mostly by the society?,
4. Do people differ so much or show close responses in selecting the color chip when a specific color name is assigned.

5. How is the response pattern in selecting a non-basic color name when compared to the basic color names?.

6.2.2 PHASES of EXPERIMENTAL RESEARCH

Three research phases were developed in order to find answers to the questions mentioned in the objectives section of the case study.

Phase 1: It was aimed to gather all the color names that I can find in Turkish Language. Dictionaries, catalogues from painting, dyeing, textile, carpet industries, theses from language departments, literature on the subject were scanned in order to form the necessary list carrying the color names in Turkish Language. The complete list of color names found are presented in Appendix 2.1.

Phase 2: An elimination procedure was applied to the list constructed in Phase 1 of the research. The procedure was as follows:

Step 1: Elimination of Color Names Having Adjectives

e.g., Açık Mavi
Uçuk Yeşil
Koyu Sarı
Soğuk Siyah
Pastel Kırmızı
Soluk Mavi etc.

All the adjectives, qualifiers, modifiers attached to the color terms were eliminated as darkness, brightness, lightness, being pale, or such, are totally subjective perceptions. Also in a color system there may exist more than one bright, or light value of a color. Thus, all the colors behind or after a certain color chip can be considered as lighter or brighter, or such than the color assigned. These color terms were removed away to construct a color list carrying terms without these attachments.

Step 2: Elimination of Color Names having Foreign Origin

e.g.,
Okr Kırmızısı (Fr)
Siyena Sarısı (It)
Ombra (It)
Grena (Fr)
Titian (Eng.)
Madder (Eng.) etc.

As could be seen above, some color names having foreign origin are totally unfamiliar to us. These color names are not used by the native speakers of Turkish language in daily conversation.

Step 3: Elimination of Professional, Specific Culture based Terms

e.g.,
Titanyum Beyazı
Piskopos Erguvanı
Bengal Pembesi
Çin Yeşili
Rembrant Kırmızısı
Aliminyum Bronzu etc.

Color terms eliminated in the third step require certain professional or culture based knowledge. For example, a painter possibly may know the color "rembrant kırmızısı" as the paint is manufactured and sold in the market with this name. Similarly "titanyum beyazı" is not something strange to someone related with metals. However, these color terms are naturally strange to the remaining part of the society, as they really require specific interest.

A second list was constructed after the three mentioned steps above (Appendix 2.2). After the construction of the second list, a survey was conducted among the randomly selected subjects in order to reduce the number of color names into the ones that are known by the 80% and up of the subjects tested. This process was necessary in obtaining the list that will be used in the third phase of the experimental research, which will be used in determining the color perception and naming of Turkish Society. Most of the color names (except some special ones e.g. "gece mavisi" in the second list were presented without indicating the actual color. For example "buz mavisi" was assigned as "buz rengi" in order to notify what color is imagined for ice, as there are also color terms used as "buz pembesi", "buz yeşili", or "buz beyazı". Same condition can also be exemplified by the term "zeytin rengi" as the color in mind may be black as well as it might be green. Same procedure was also necessary in order to identify whether people really know the assigned color name. When the color term is assigned as "kehribar sarısı" there is the risk of getting a response from any of the yellow color chips as the color 'yellow' was mentioned in assigning the color term. Thus the color was presented as "kehribar rengi" in order to prevent a guess instead of the exact coloration. The final list to be used in the major research phase was constructed after the procedures mentioned above (The colors included in the final list is shown in the questionnaire presented in Appendix 2.3).

Phase 3: Using a final list of 32 color names (8 basic, 24 non basic color terms), and the Munsell Color System, responses of subjects from different cities of Turkey were collected. Besides Ankara, data were collected in five other cities (Kayseri, Diyarbakır, Isparta, Edirne and Trabzon) from different regions of Turkey. The common property of these cities is that they do not accept migration, contrarily give migration to other cities (Ranking of cities according to the rate of migration. DPT, 1990). These cities are selected to see how native cultures evaluate the color terms. Investigation of possible variances between different cultures (from different cities) are possible with this procedure which may guide to further studies.

6.2.3 METHODOLOGY

Administration

A total of 132 subjects took part in the second phase of the research. From the distributed list (Appendix 2.2), they eliminated the color names which they are not familiar or have difficulty in identifying, visualizing, or remembering the exact color that the color name imposes.

After this elimination, the remaining color names (Appendix 2.3) were listed in order to execute the main part of the research study. A total of 322 subjects, from different cities of Turkey, were investigated. Besides the randomly selected subjects most of them were selected from companies, universities, institutions, and high schools offering a color related profession after graduation (Appendix 2.4).

Subjects were tested in spaces illuminated by natural daylight from north. A particular room was assigned for all subjects, to provide same lighting conditions and to avoid settings that could not be duplicated again. The lighting source (natural daylight) was uniform through the entire testing time.

Each subject was tested individually over a period of 10 to 20 minutes depending on their response speed. Before the test began, subjects were asked to choose the color chip among the chips laid down on the horizontal surface that matches most with the given color term. First the 8 basic, then the 24 non-basic color terms were assigned to the subjects. Subjects were instructed to pass over any color which they find it difficult to match with the color assigned by the color term. They were also instructed that this is not a test in order to evaluate their personal abilities. However their personal data is important for us, for the evaluation of the society in general.

Each subject selected the matched color chip of the Munsell System after they are given the color terms one by one. The responses were collected by me on the questionnaire sheet. Data were written down using the original coding system of Munsell.

Instruments

The stimuli were the regular color chips of the Munsell Book of Color, Glossy Finish Collection. The number of 40 pages of the original system was reduced to 10 pages as 4 page of the same hue were grouped and presented on a single page. Grouping of the four page into a single one, abled the observers to see the preceding and the following pages together. All the color pages were placed on a horizontal surface large enough so that the subject had the chance to view all the stimuli together during the test (Figure 6.1).

The color terms were the ones from the final list constructed in the second Phase of the research. First the response for the basic color terms were collected. This also made subjects to experience and examine the stimuli before beginning the test for the non-basic color terms. With the investigation of the first 8 basic colors, subjects got familiar with the pages that carry certain colors and this provided a clue for them where to look for the remaining non-basic colors.

Figure 6.1 Presentation of the stimuli used in the experimental research

In the questionnaire, the occupation, age, gender, and the city that the subject is living for the last ten years were also asked. A copy of the questionnaire is given as appendix 2.3.

6.2.4 DATA ANALYSIS

SPSS software is used in the analysis of the collected data. Graphs are generated to display the cumulation, distribution of responses collected for each assigned color term. Color pages and color chips of every single color term was investigated by chi-square tests in order to find if the responses of subjects were conscious or not (Appendix 3.1). Pearson correlation value was used to measure the relationship between any two color pairs (Appendix 3.2). Finally chi-square tests were applied to the collected data to investigate significance of the differences depending on gender, age, city, and use of color in work field (Appendix 3.3).

Four different pages of the ten hue ranges are coded into variables in order to enter the data in SPSS. Codes “1”, “2”, “3”, and “4” are assigned for the color pages 2.5, 5, 7.5 and 10 of each hue respectively. Selected color chips are entered into the computer by eliminating the “/” symbol between the lightness and saturation indicating values. After analyzing the data, actual notation system was rebuilt in the generation of graphs using labeling options that the software provides.

Four independent variables included in the study are explained below with their variable names and necessary value labels :

1. Variable name: Gender

Value labels: 1 “male”

2 “female”

2. Variable name: Work

Value labels: 1 “subjects that use or refer to color in their work field

2 “subjects that do not use or refer to color in their work field

3. Variable name: Age

Value labels: 1 “subjects between 14 -19 years old”

2 “subjects between 20-25 years old”

3 “subjects between 26-35 years old”

4 “subjects older than 35 years”

4. Variable name: City

Value labels: 1 “Ankara” 2 “Istanbul”

3 “Kayseri” 4 “Trabzon”

5 “Edirne” 6 “Diyarbakır”

7 “Isparta”

6.3 RESULTS AND DISCUSSION OF THE FINDINGS

Both descriptive and graphical analyses are being presented in order to permit the reader view the situation tried to be explained by words. On the other hand, some results depending on the statistical analyses are also given with necessary descriptions in the appendix 3.3. Frequency distribution of necessary dependents and independent variables were investigated to explain the significant differences observed.

6.3.1 ANALYSIS OF BASIC COLOR TERMS

Mor *(Purple)*:

As being one of the basic color terms there is no subject unable to identify the color represented by the term "mor". The distribution of the responses vary in 11 color pages, but main cumulation is in the 2.5 P and 5 P pages of the Munsell Color Book (Figure 6.2 b). Although 22 different color chips were selected by the subjects, only 5 of them were salient (Figure 6.2 c). These color chips constituting the range for "mor" are (Figure 6.2 a):

Color Page	Chips:		
2.5 P	4/12	3/10	2/10
5 P	4/12	3/10	

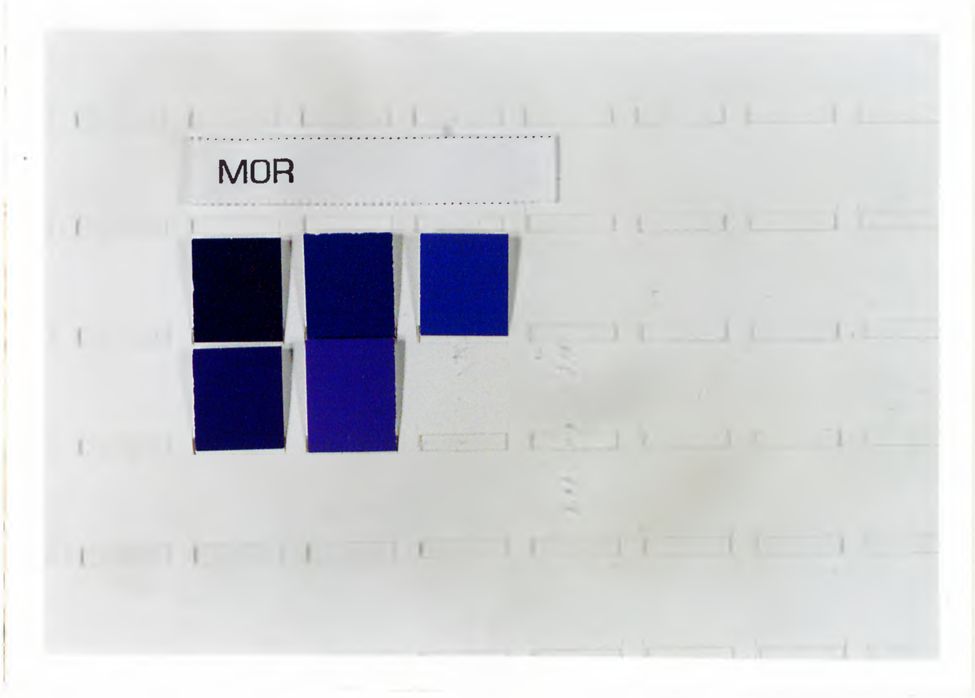


Figure 6.2 a. Presentation of color chips constituting the range for "mor".

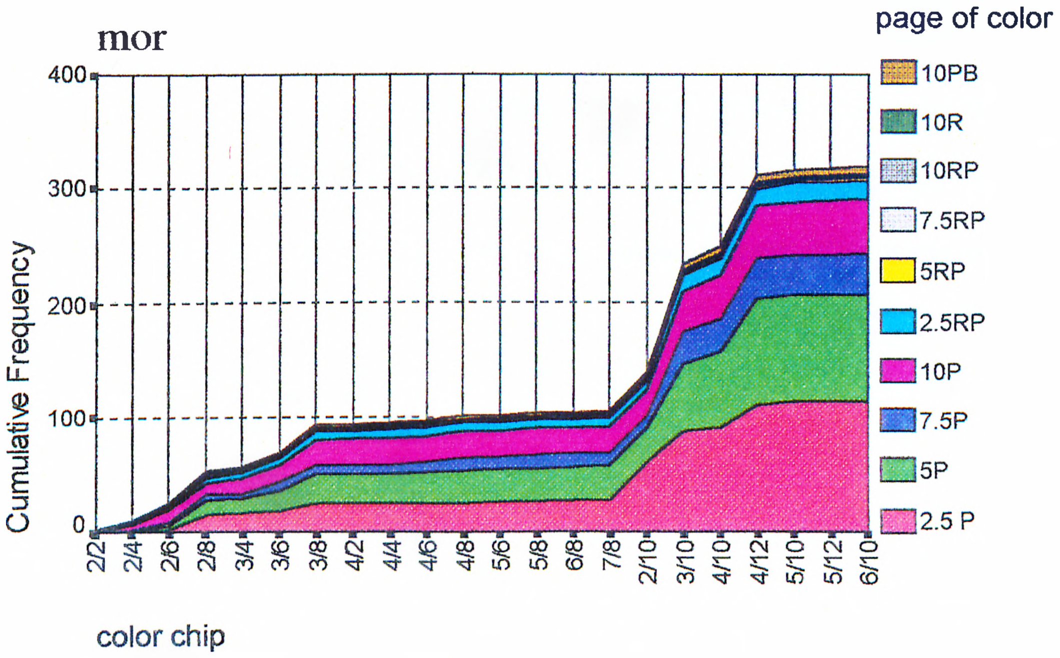


Figure 6.2 b. Cumulative frequency distribution of responses for "mor" using stacked area chart

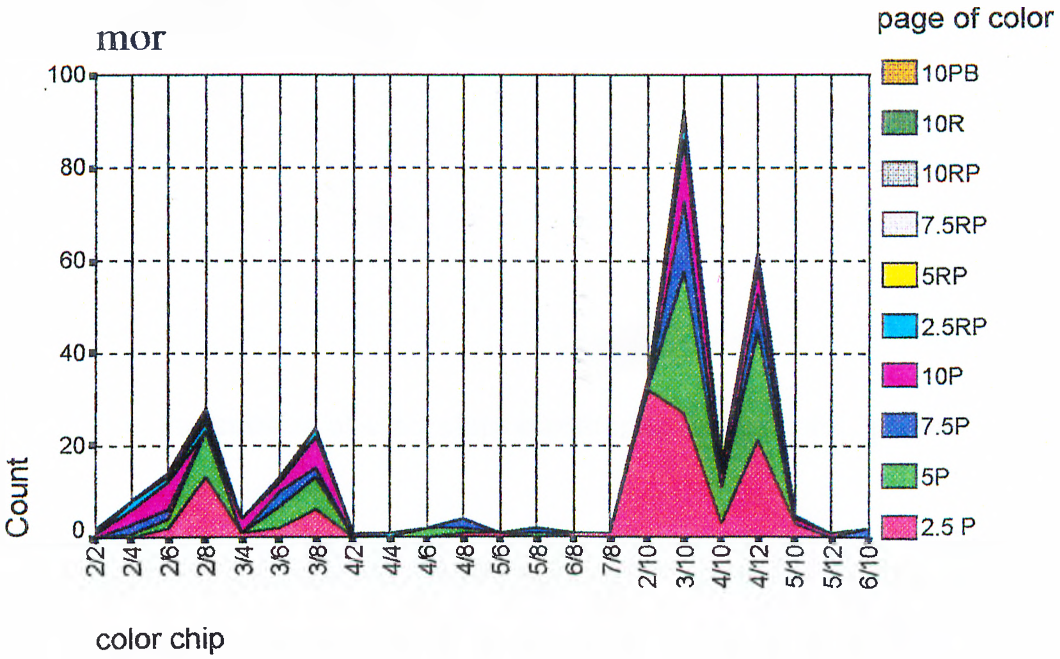


Figure 6.2 c. Stacked area chart showing the cumulative number of responses for "mor"

Pembe *(Pink):*

All of the subjects easily chose a color chip when the term "pembe" was assigned. A total of 10 color pages were noted during the study and 20 different chips were pointed to represent "pembe" (Figure 6.3 c). 2.5, 5, and 7.5 RP pages of the stimuli were mostly used (Figure 6.3 b). The color chips selected from these pages are (Figure 6.3 a):

Color Page:	Chips:		
2.5 RP	8/6	6/12	
5 RP	8/6	7/10	6/12
7.5 RP	8/6	5/14	

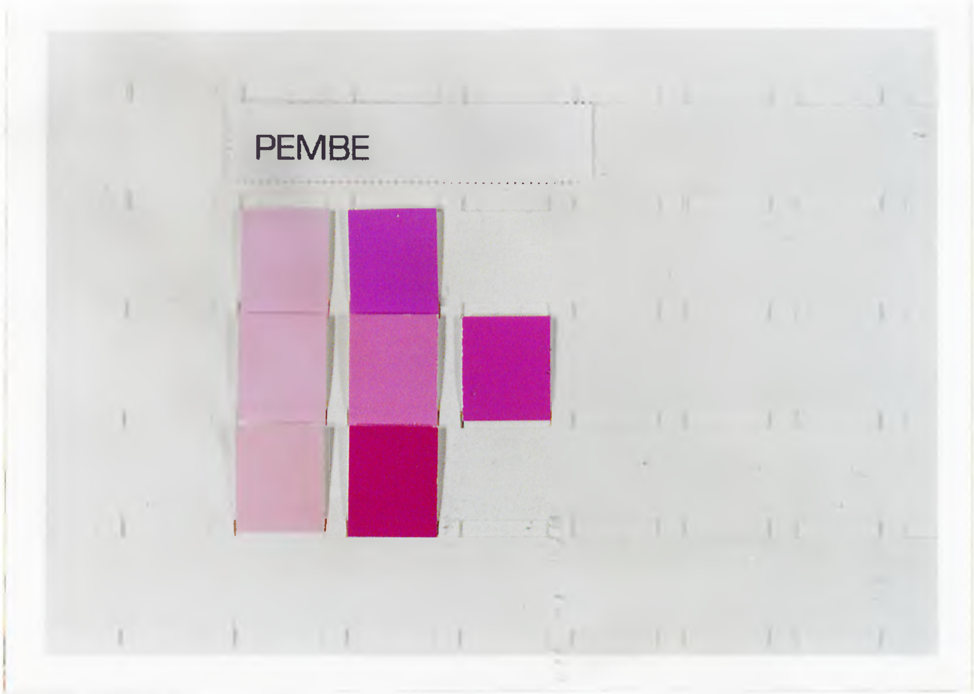


Figure 6.3 a. Presentation of color chips constituting the range for "pembe".

As could be seen from the correlation coefficients (Appendix 3.2) a relationship close to moderate has been analyzed between the color pages of "pembe"- "çingene pembesi", and "pembe"- "gül kurusu" which means color pages show similarities during the identification process.

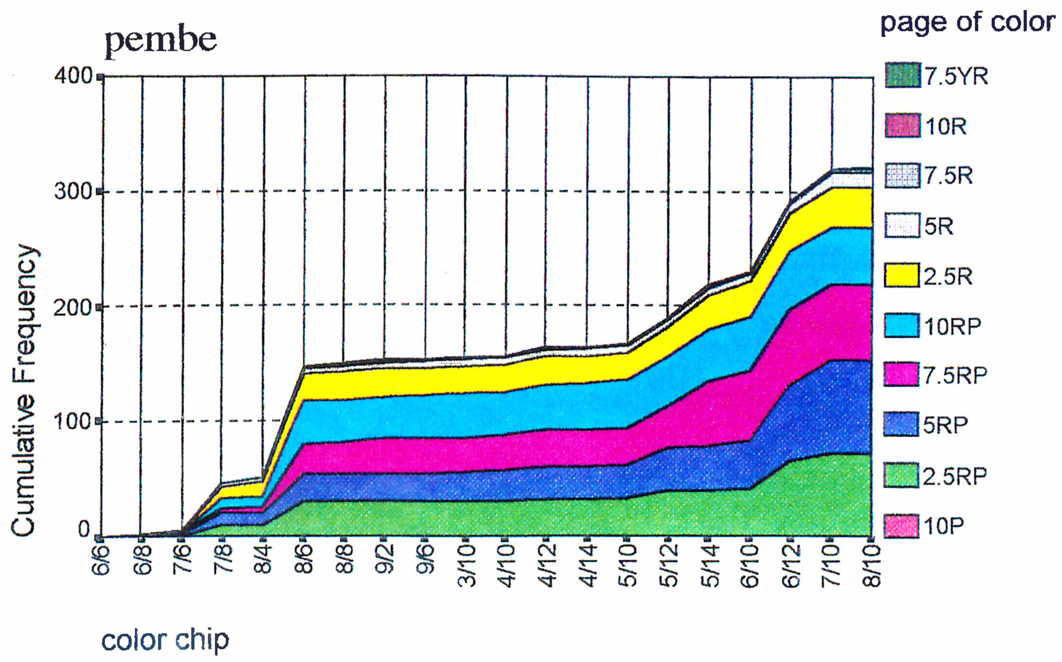


Figure 6.3 b. Cumulative frequency distribution of responses for "pembe" using stacked area chart

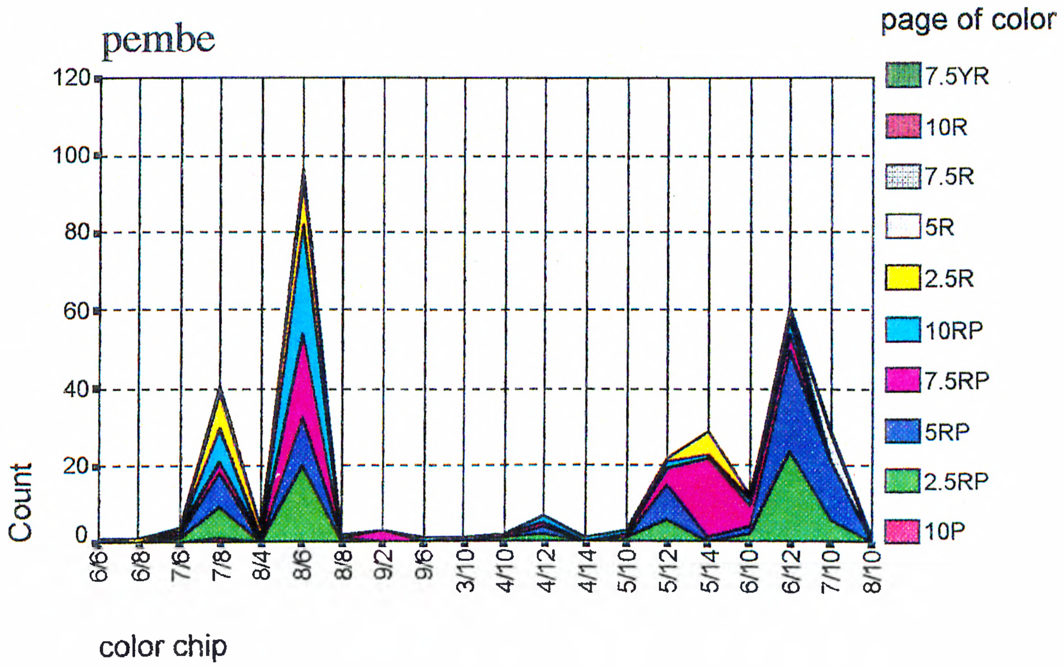


Figure 6.3 c. Stacked area chart showing the cumulative number of responses for "pembe"

Kırmızı *(Red):*

As could be seen clearly from Figure 6.4 b, most of the subjects chose a color chip from the 7.5 R page of the Munsell Color Book. However, when Figure 6.4c is examined carefully, page 5 R is also important as 4/14 chip of this page is highly dominant in the range what we call “kırmızı”. Kırmızı is one of the colors that shows notable consensus in the selection of the representative chip. The color chips constituting the range for “kırmızı” are as follows (Figure 6.4 a):

Color Page:	Chips:		
5 R	4/14		
7.5 R	4/14	4/16	5/16

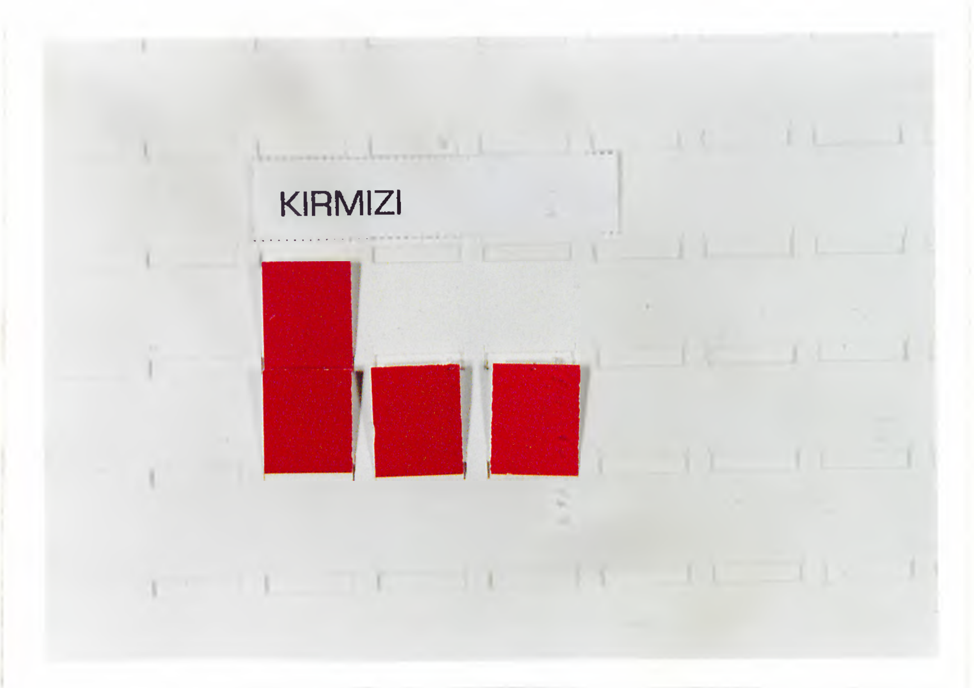


Figure 6.4 a. Presentation of color chips constituting the range for “kırmızı”.

Color pages for “kırmızı” show similarities with pages for “vişne çürüğü” and this analysis is also indicated in Appendix 3.2 at the end of the dissertation.

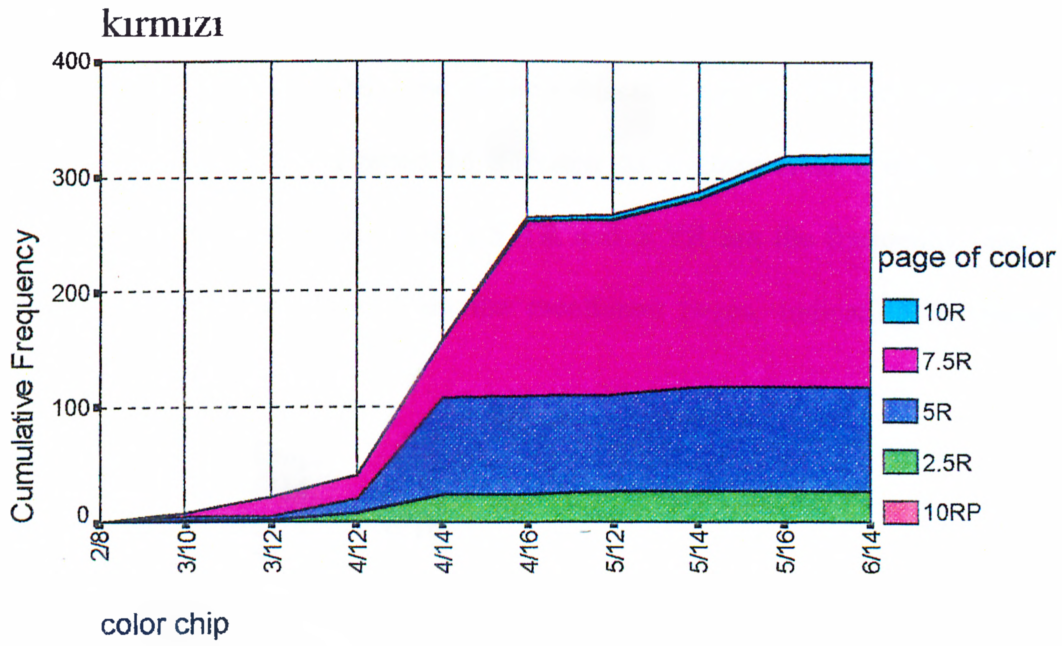


Figure 6.4 b. Cumulative frequency distribution of responses for "kırmızı" using stacked area chart

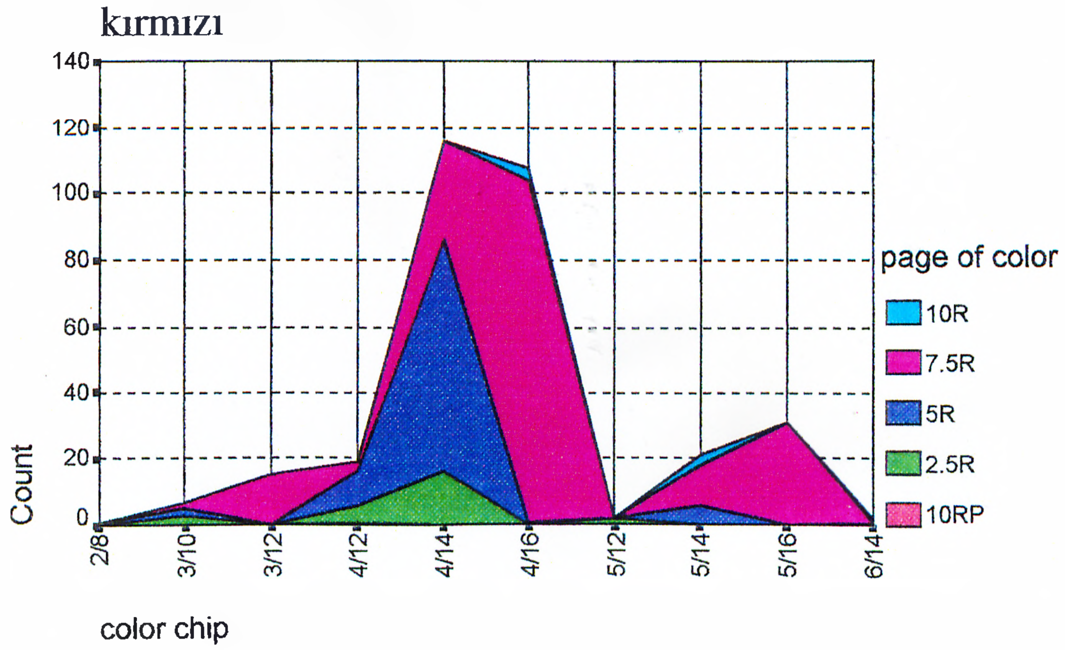


Figure 6.4 c. Stacked area chart showing the cumulative number of responses for "kırmızı"

Turuncu *(Orange)*:

"Turuncu" is also a basic color term like "kırmızı", that holds close responses in the formation of the range. Only one of the subjects could not identify what the color term represents. Subjects noted 16 different color chips from a total of 11 color pages (Figure 6.5c). Pages 10 R, 2.5 YR and 5 YR are the frequently cited ones (Figure 6.5 b). The chips, from the mentioned pages, indicating the range for "turuncu" are (Figure 6.5a):

Color Page:	Chips:	
10 R	6/14	
2.5 YR	6/14	6/16
5 YR	7/14	

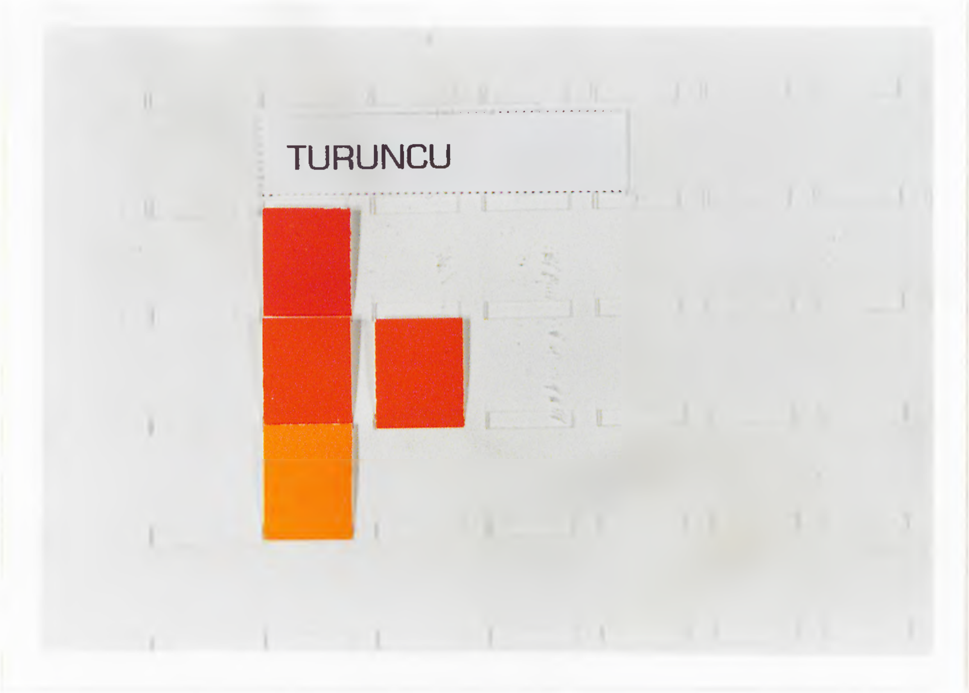


Figure 6.5 a. Presentation of color chips constituting the range for "turuncu".

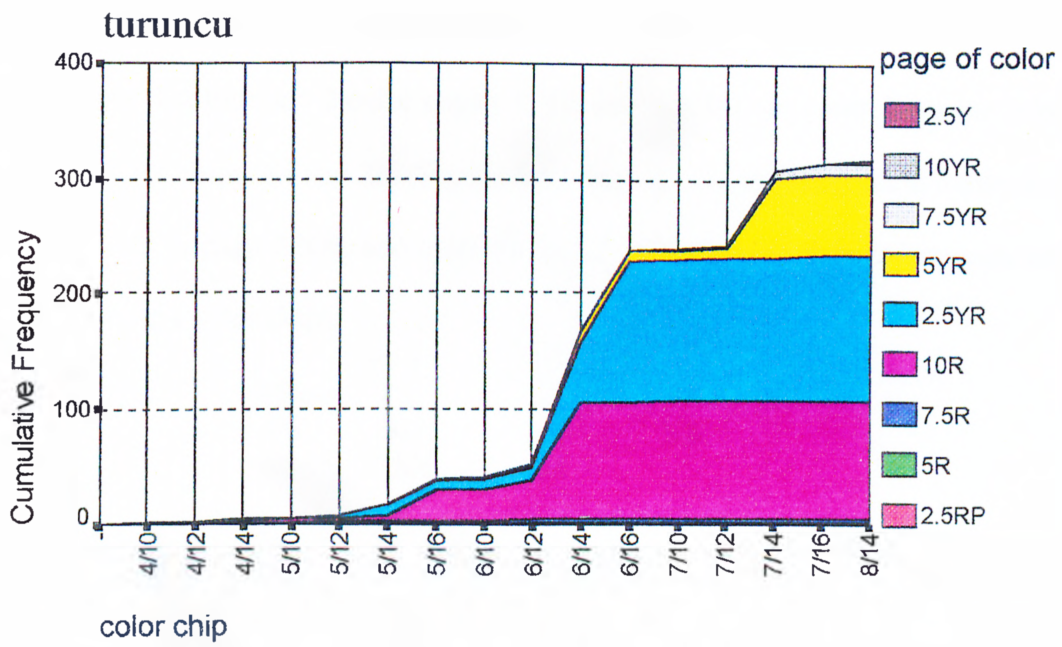


Figure 6.5 b. Cumulative frequency distribution of responses for "turuncu" using stacked area chart

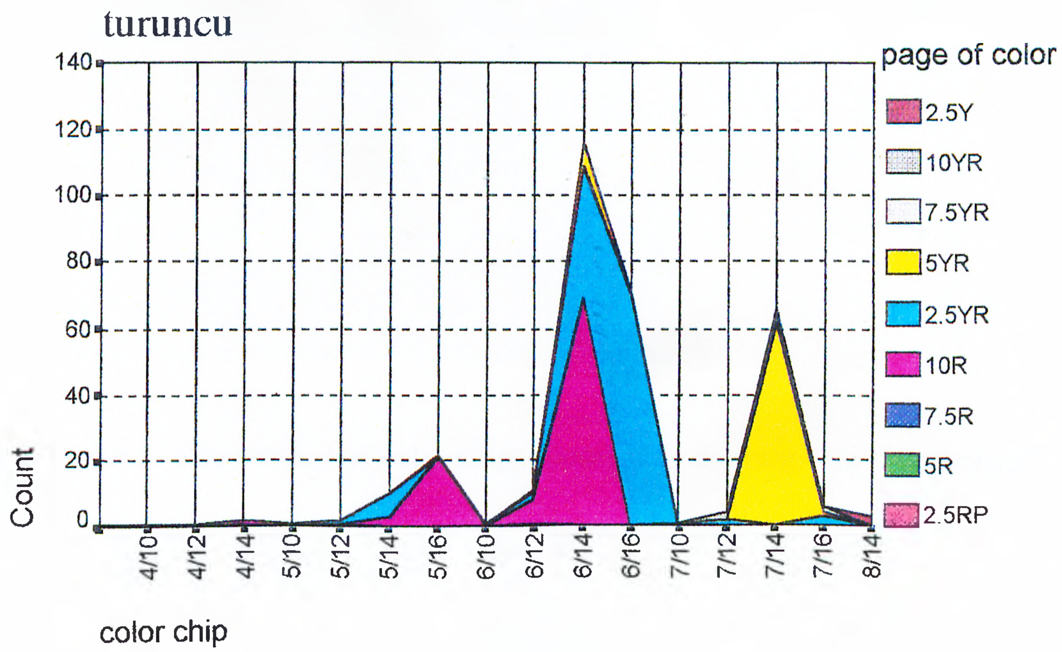


Figure 6.5 c. Stacked area chart showing the cumulative number of responses for "turuncu"

Kahverengi *(Brown):*

“Kahverengi” is a good example where the response pattern of the subjects show very close distribution. 2 color pages; 5 YR and 7.5 YR are controlling the selection having color chips 3/4 and 3/6 (Figure 6.6 b and c). On the other hand color chips of 4/6 and 4/8 in page 5 YR, and chip 4/8 in 7.5 YR show notable frequencies among the remaining color chips.

Color Page:	Chips:			
5 YR	4/6	4/8	3/4	3/6
7.5 YR	4/8	3/4	3/6	

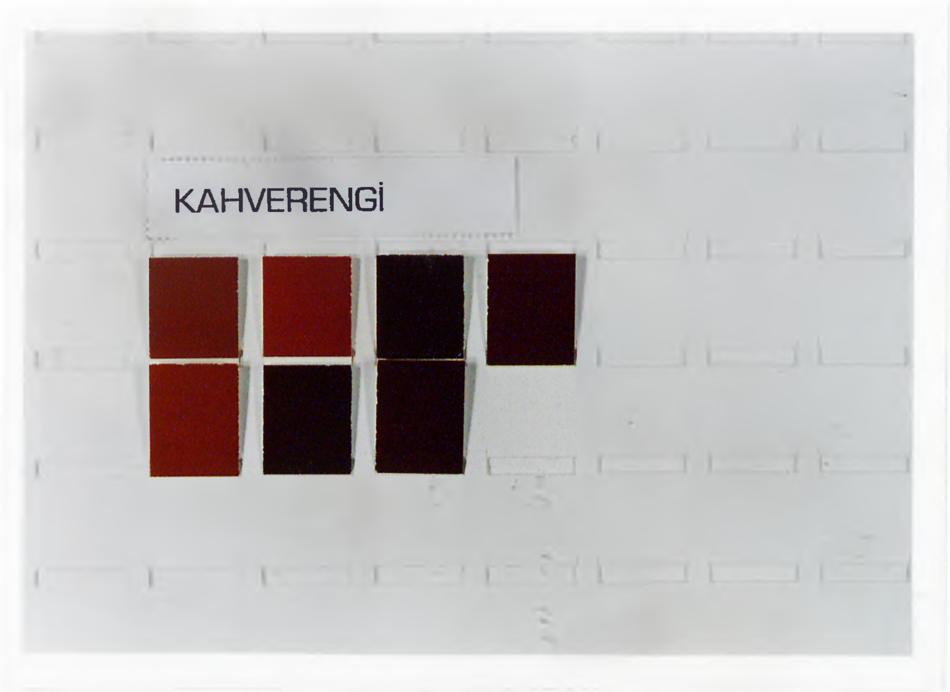


Figure 6.6 a. Presentation of color chips constituting the range for “kahverengi”.

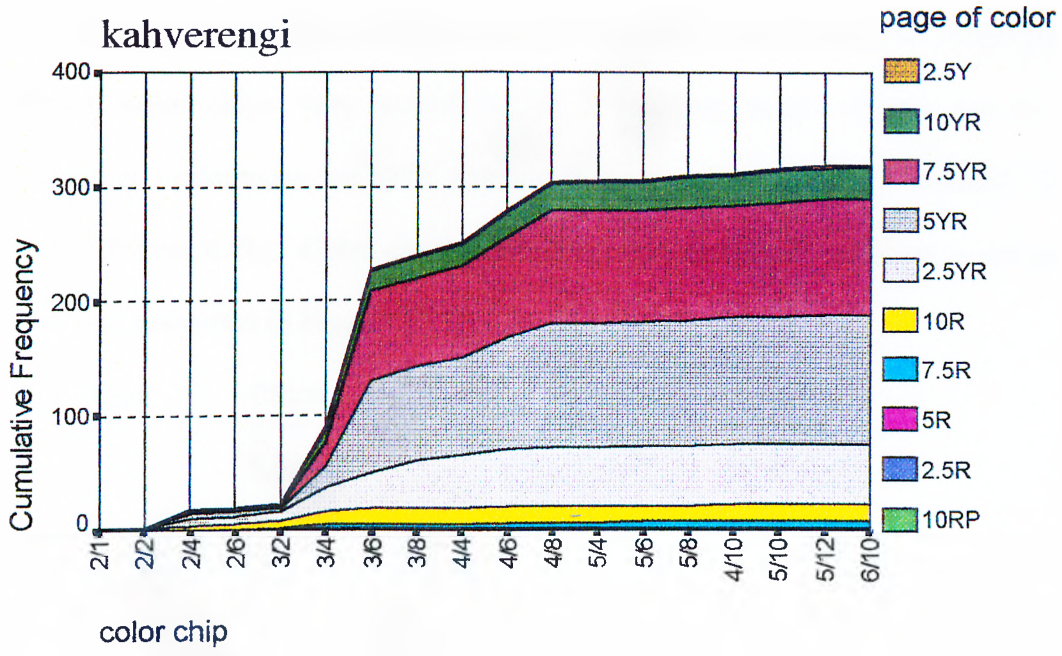


Figure 6.6 b. Cumulative frequency distribution of responses for "kahverengi" using stacked area chart

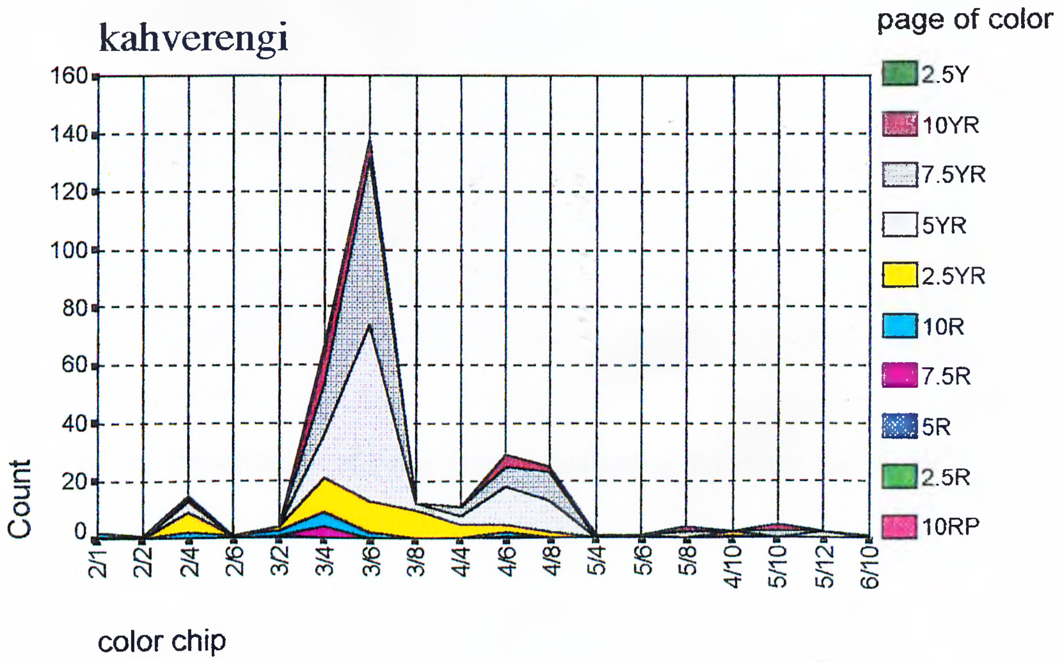


Figure 6.6 c. Stacked area chart showing the cumulative number of responses for "kahverengi"

Sarı *(Yellow)*:

The selection of the chips for color term "sarı" shows close responses. Although 13 different color chips were picked out of 7 different pages (Figure 6.6 b), the dominating preferences are only from pages 2.5 and 5 Y of the Munsell Color System (Figure 6.7b). Color chips that the subjects frequently referred to are given below and presented in Figure 6.7 a:

Color Page:	Chips:
2.5 Y	8/16
5 Y	8.5/14

Figure 6.7 a. Presentation of color chips constituting the range for "sarı".

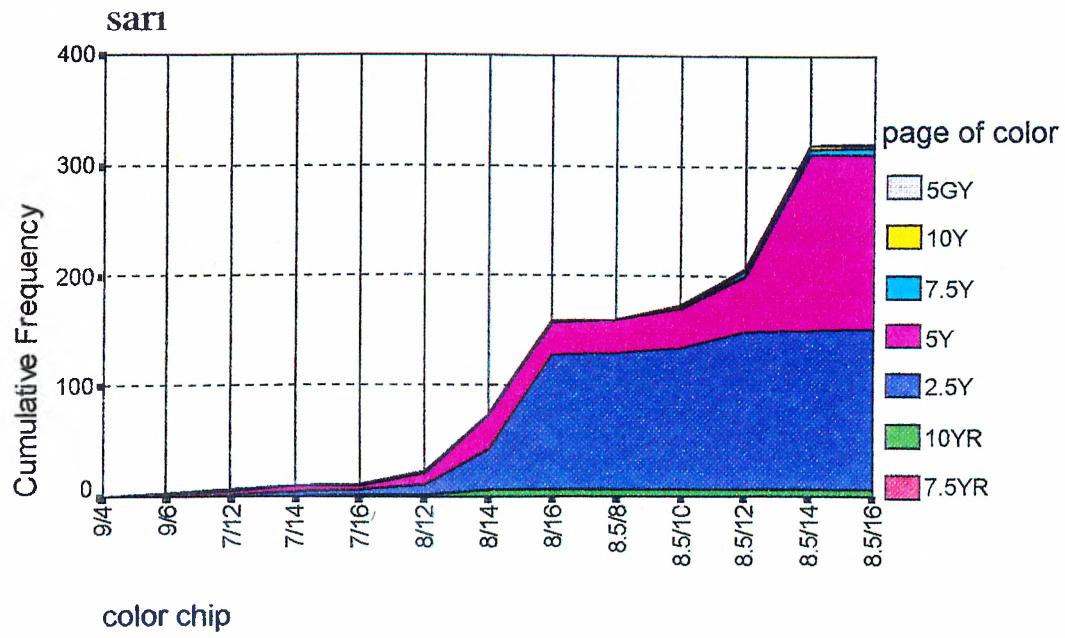


Figure 6.7 b. Cumulative frequency distribution of responses for “sarı” using stacked area chart

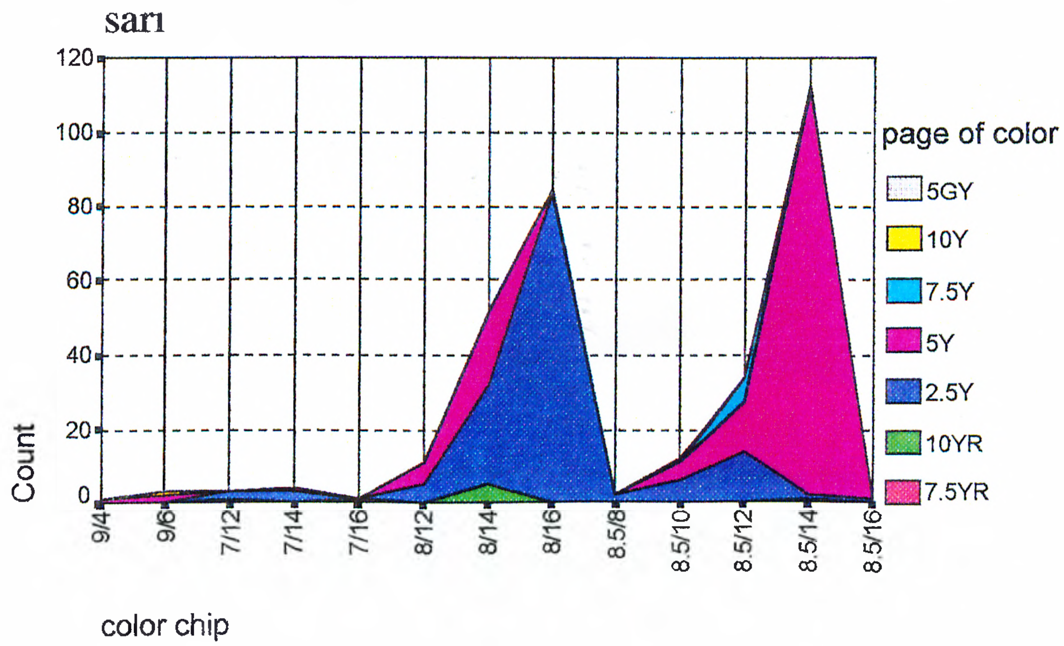


Figure 6.7 c. Stacked area chart showing the cumulative number of responses for “sarı”

Yeşil *(Green):*

Being a basic color term "yeşil" has a representation in every subject's mind and these representations vary in number. Distributed over a total of 12 color pages, 23 different color chips are selected to be the best representatives of "yeşil" (Figure 6.8c). Three color pages are salient among the selected ones (Figure 6.8 b). Mostly cited color chips are (Figure 6.8 a):

Color Page:	Chips:
7.5 GY	6/12
10 GY	5/12
2.5 G	5/12

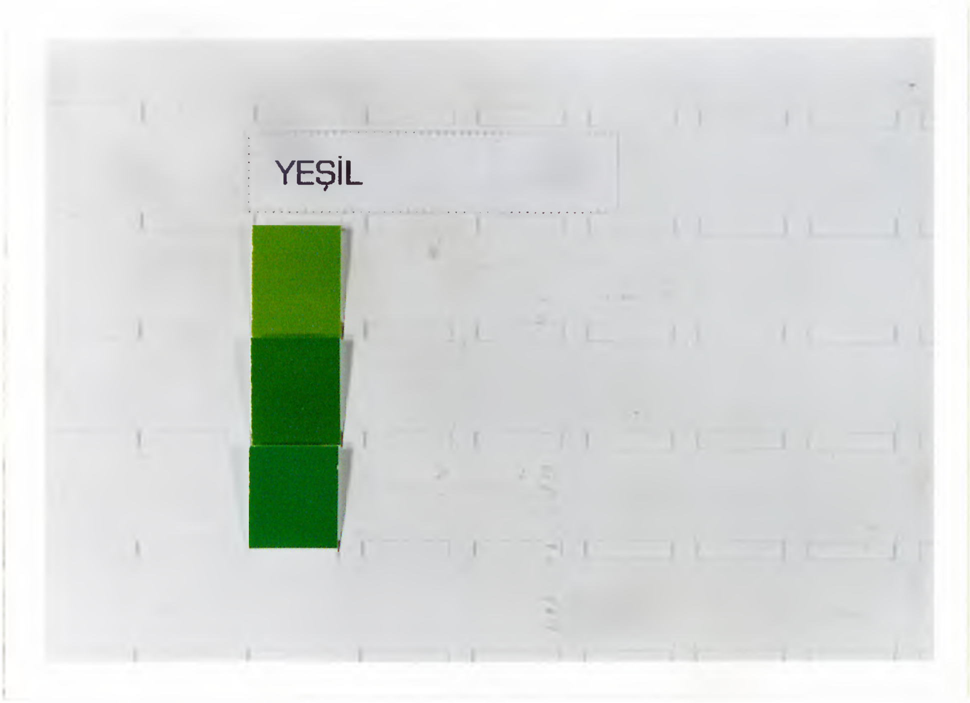


Figure 6.8 a. Presentation of color chips constituting the range for "yeşil".

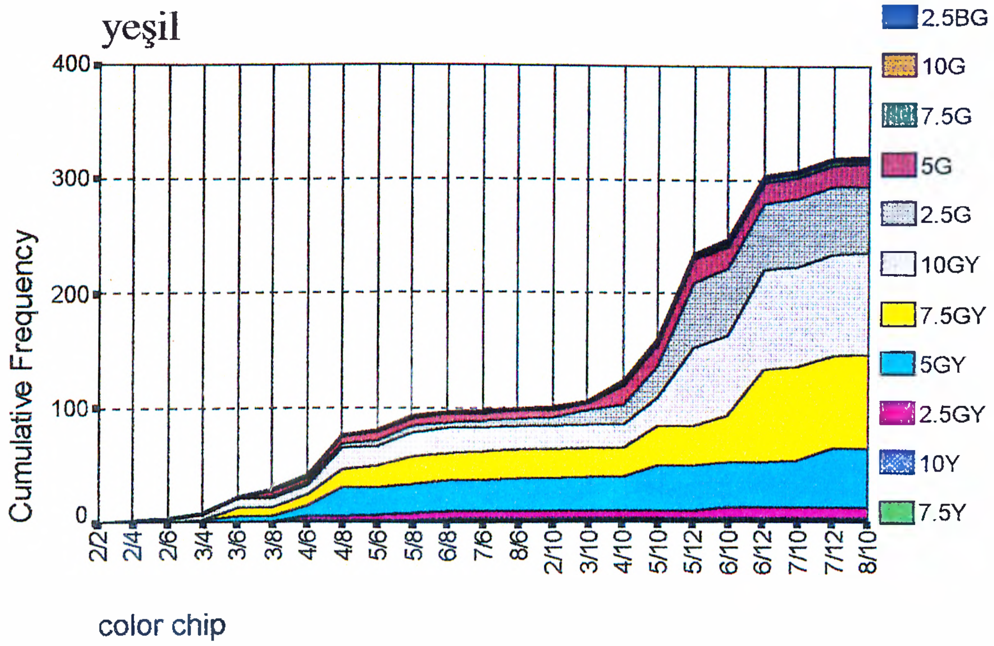


Figure 6.8 b. Cumulative frequency distribution of responses for "yeşil" using stacked area chart

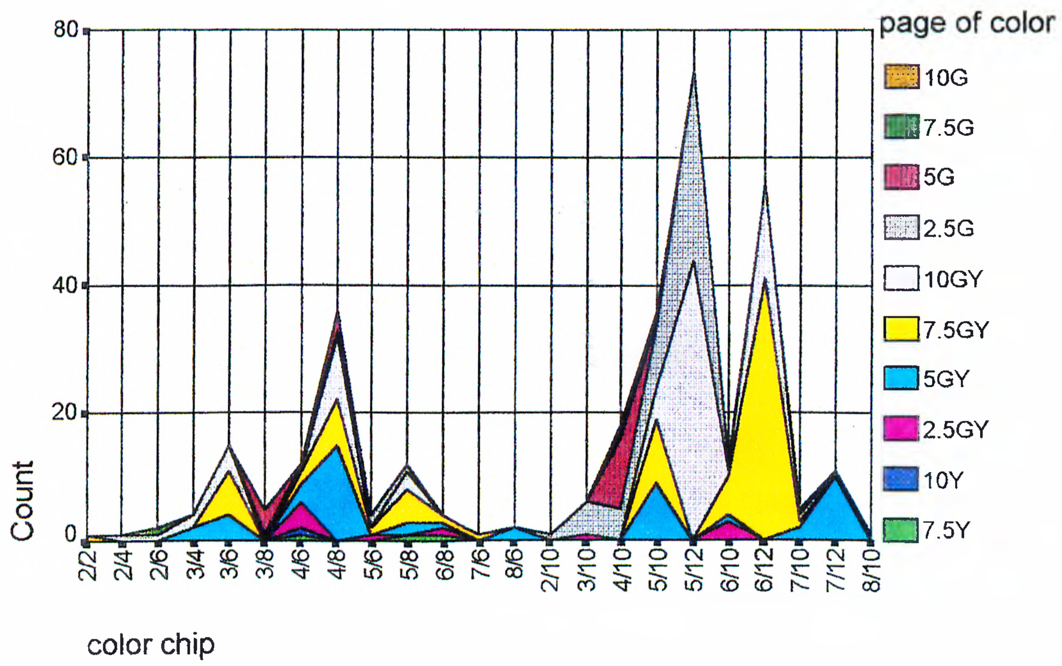


Figure 6.8 c. Stacked area chart showing the cumulative number of responses for "yeşil"

Mavi *(Blue)*:

As could be visualized from the chart presented in Figure 6.9 b, the responses collected for “mavi” are grouped under the pages 10 B, 2.5 PB and 5 PB of Munsell Color System. Subjects picked up 22 different color chips during the tests. For color pages 10 B and 2.5 PB, color chip 5/12, and for page 5 PB chip 4/12 are more salient than the rest of the stimuli (Figure 6.9 a).

Color Page:	Chips:
10 B	5/12
2.5 PB	5/12
5 PB	4/12

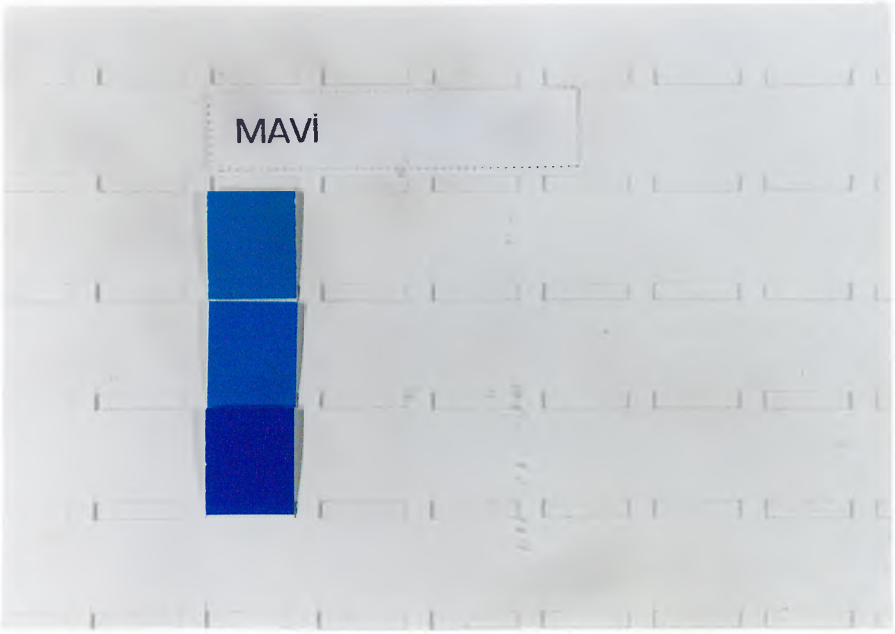


Figure 6.9 a. Presentation of color chips constituting the range for “mavi”.

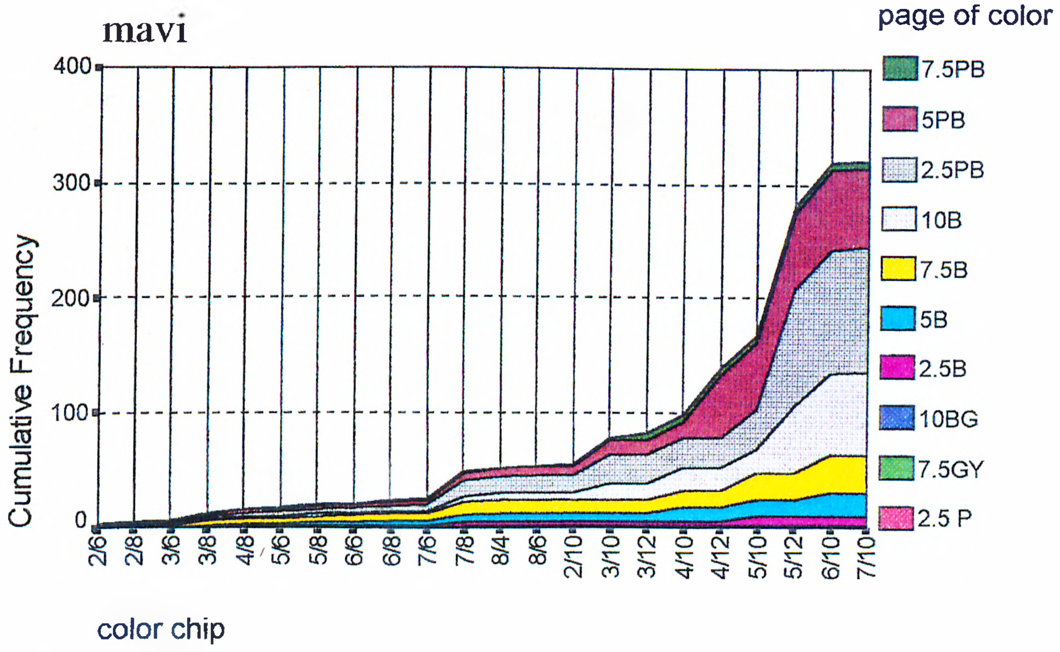


Figure 6.9 b. Cumulative frequency distribution of responses for "mavi" using stacked area chart

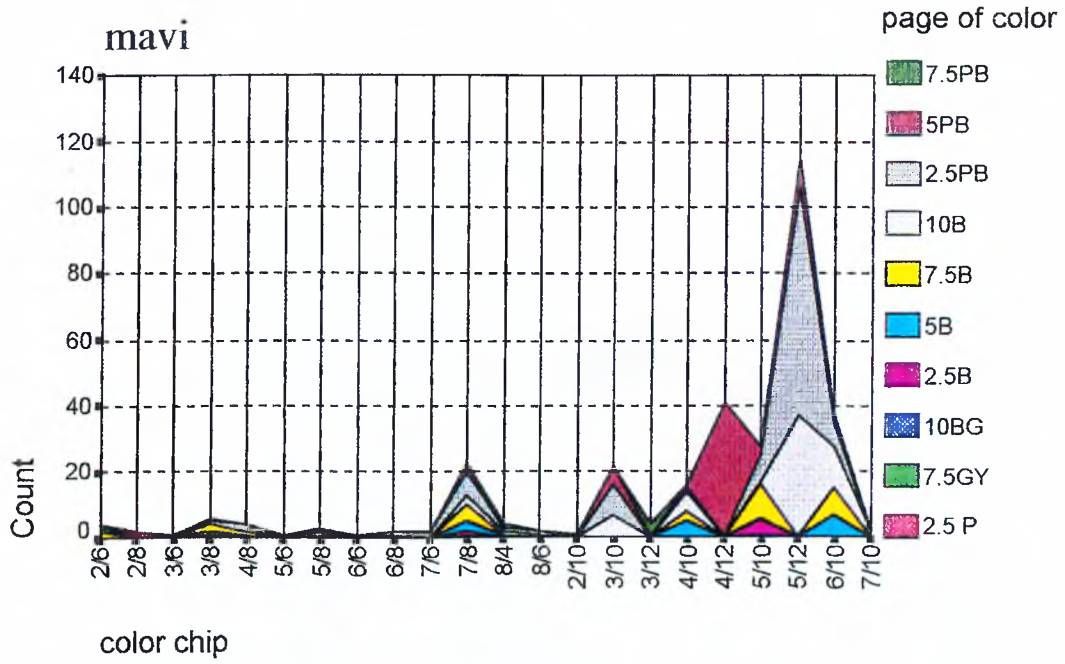


Figure 6.9 c. Stacked area chart showing the cumulative number of responses for "mavi"

6.3.2 ANALYSIS OF NON-BASIC COLOR TERMS

Patlıcan Moru *(Eggplant purple):*

"Patlıcan Moru", which is a type of purple, shows a different distribution pattern when compared to the basic color term "mor". 2.2 % of the subjects said they do not know the color that the term defines. 5 color pages (Figure 6.10 b) were identified that carry the necessary chips representing the color term, while the number of pages are only two in the representation of "mor" . Among 22 different color chips (Figure 6.10c), most referred ones representing the color range for "patlıcan moru" are (Figure 6.10 a):

Color Page:	Chips:	
2.5 P	2/6	2/10
5 P	2/4	2/8
7.5 P	2/4	2/6
10 P	2/4	2/6
10 PB	2/10	

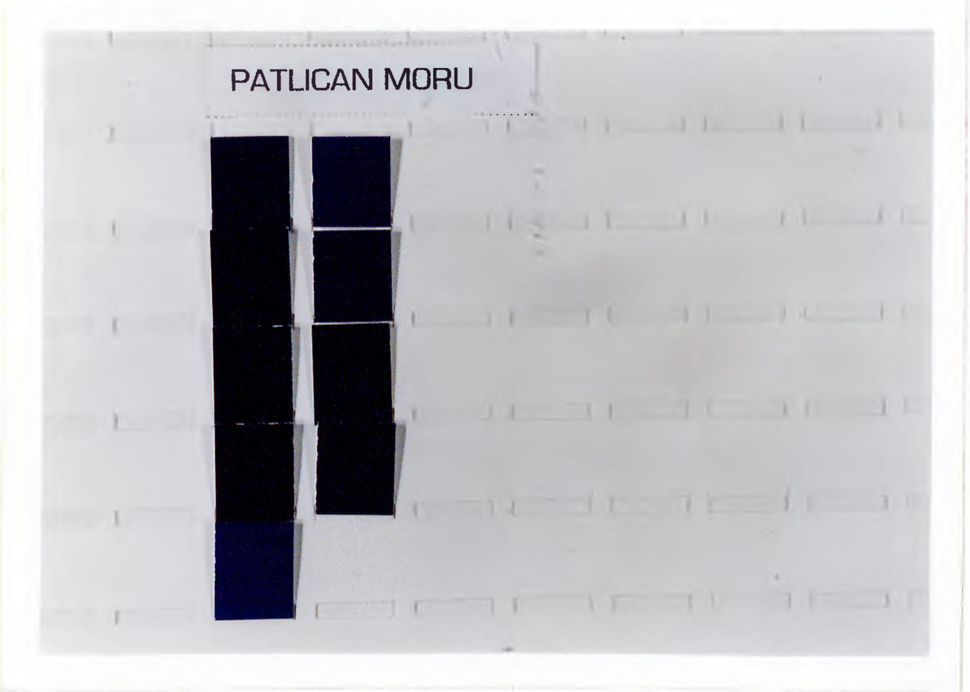


Figure 6.10 a. Presentation of color chips constituting the range for "patlıcan moru".

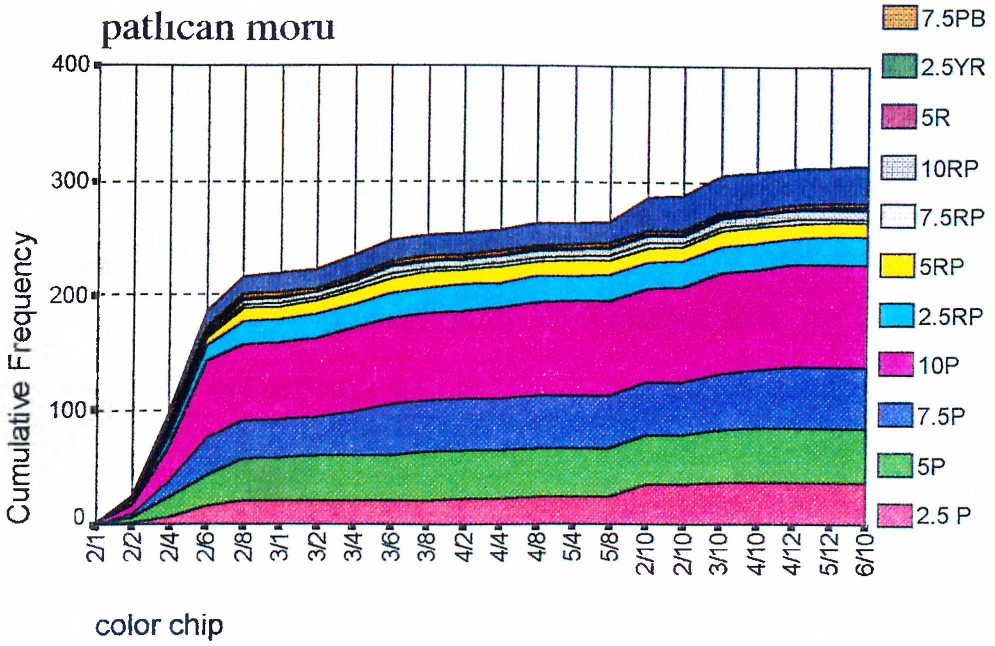


Figure 6.10 b. Cumulative frequency distribution of responses for "patlıcan moru" using stacked area chart

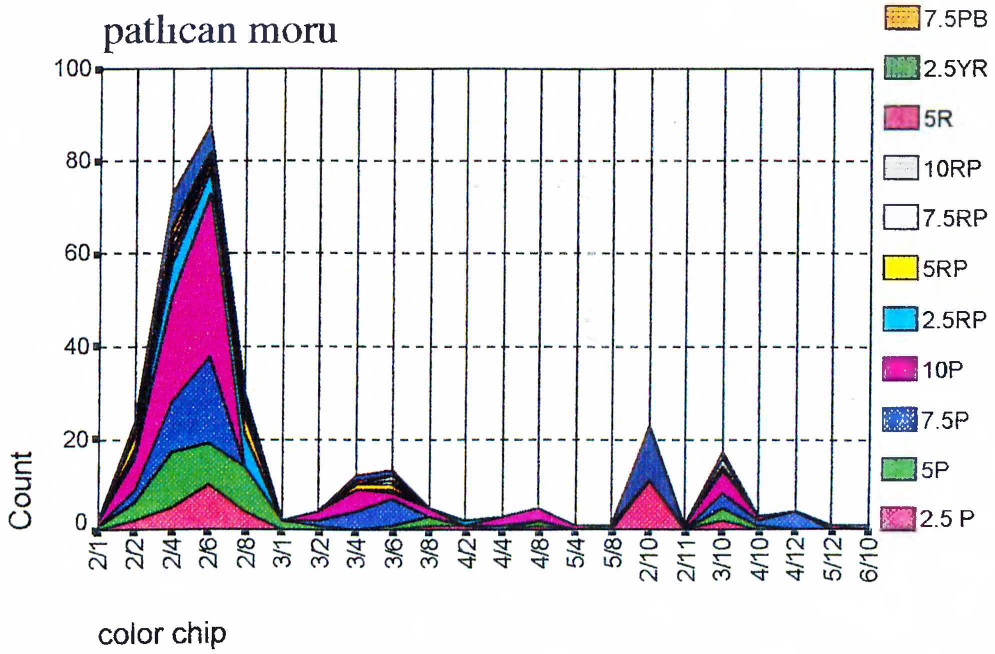


Figure 6.10 c. Stacked area chart showing the cumulative number of responses for "patlıcan moru"

Leylak *(Lilac):*

Although responses for "leylak" are distributed over a large number of color pages (Figure 6.11 b) and 37.6 % of the subjects state that they do not know what the color name represents, it is one of the non-basic color terms that holds close color chips forming the color range. Only 5 color chips are salient among the whole stimuli. Dominant chips, which can also easily be identified from the Figure 6.11 c are presented below and in Figure 6.11 a:

Color Pages	Chips:		
2.5 P	7/8	6/8	
5 P	7/8	6/8	5/10

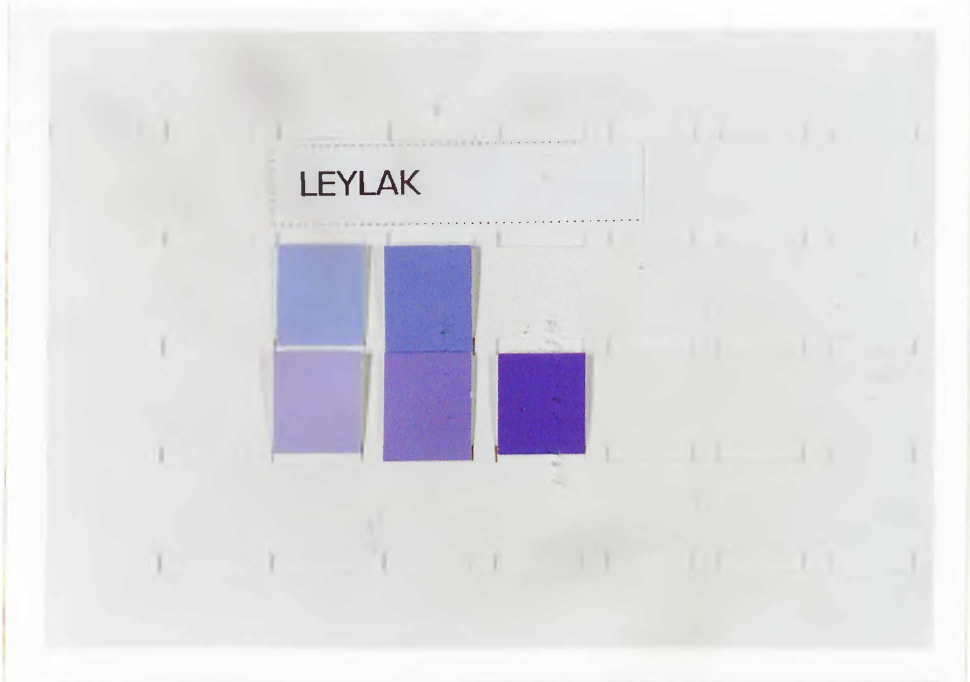


Figure 6.11 a. Presentation of color chips constituting the range for "leylak".

The selection of color pages for "patlıcan moru " and "leylak" show similar responses and moderate correlation have been identified between the color pages of these non-basic color terms (see Appendix 3.2).

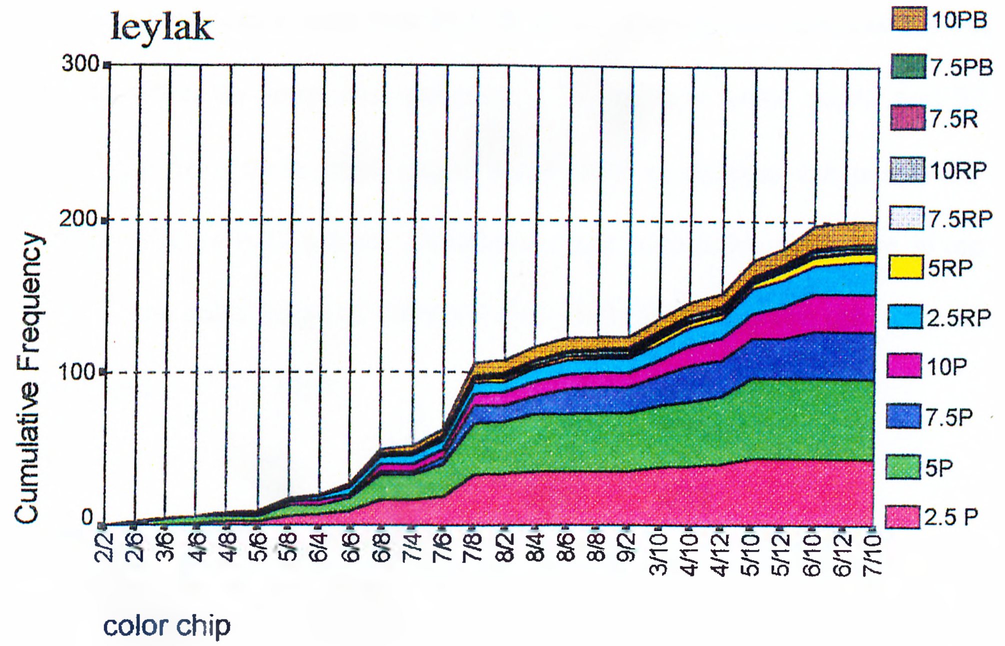


Figure 6.11 b. Cumulative frequency distribution of responses for "leylak" using stacked area chart

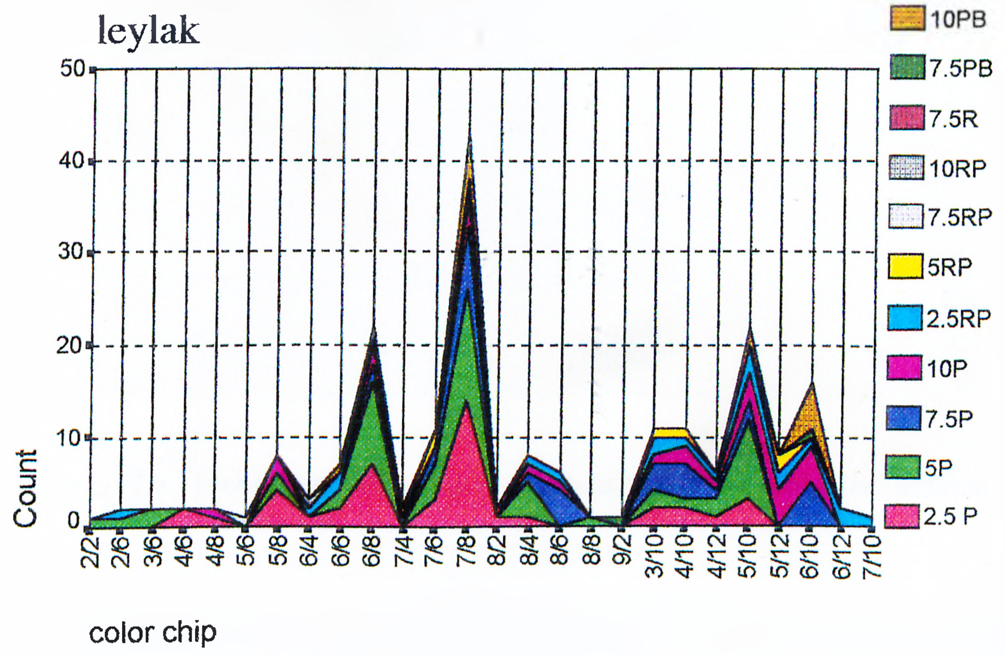


Figure 6.11 c. Stacked area chart showing the cumulative number of responses for "leylak"

Eflatun *(Violet):*

It is a non-basic color term that 21.1 % of the investigated subjects did not give any response when the term was assigned. 10 different color pages and 27 different color chips from these color pages were cited to express the perceived color for "eflatun" (Figure 6.12 a,b,c). Dominant chips with color pages are given below to figure out the color range of "eflatun" that Turkish Society use the name for:

Color Page:	Chips:			
2.5 P	7/8	6/8	5/10	4/12
5 P	7/8	6/8	5/10	
7.5 P	7/8	6/10	5/10	4/12

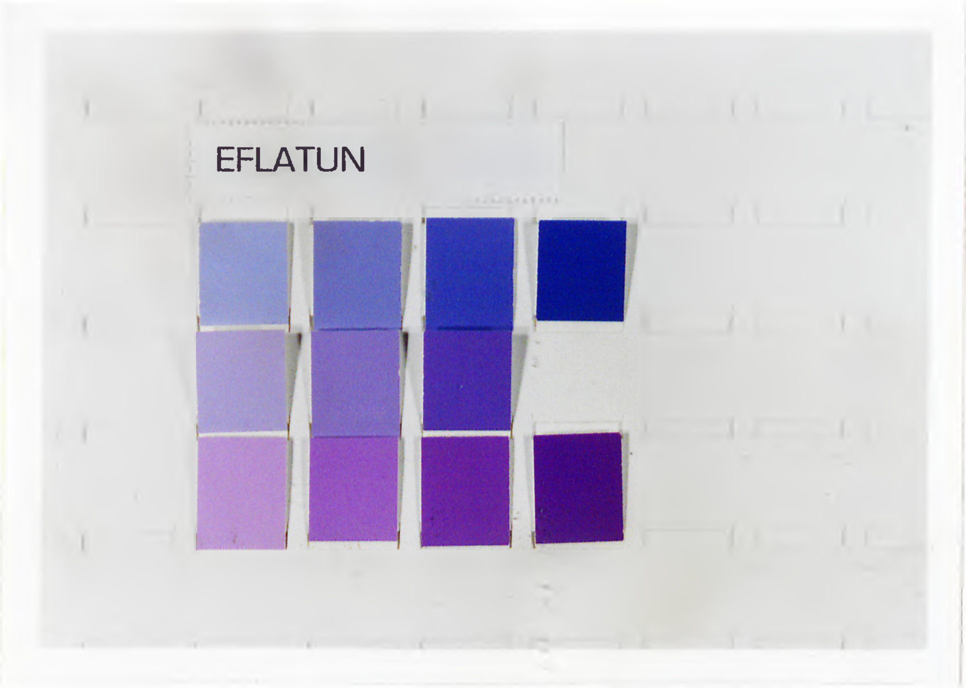


Figure 6.12 a. Presentation of color chips constituting the range for "eflatun".

Pearson correlation coefficient given in Appendix 3.2 shows a moderate relationship between the color pages selected for "leylak" and "eflatun".

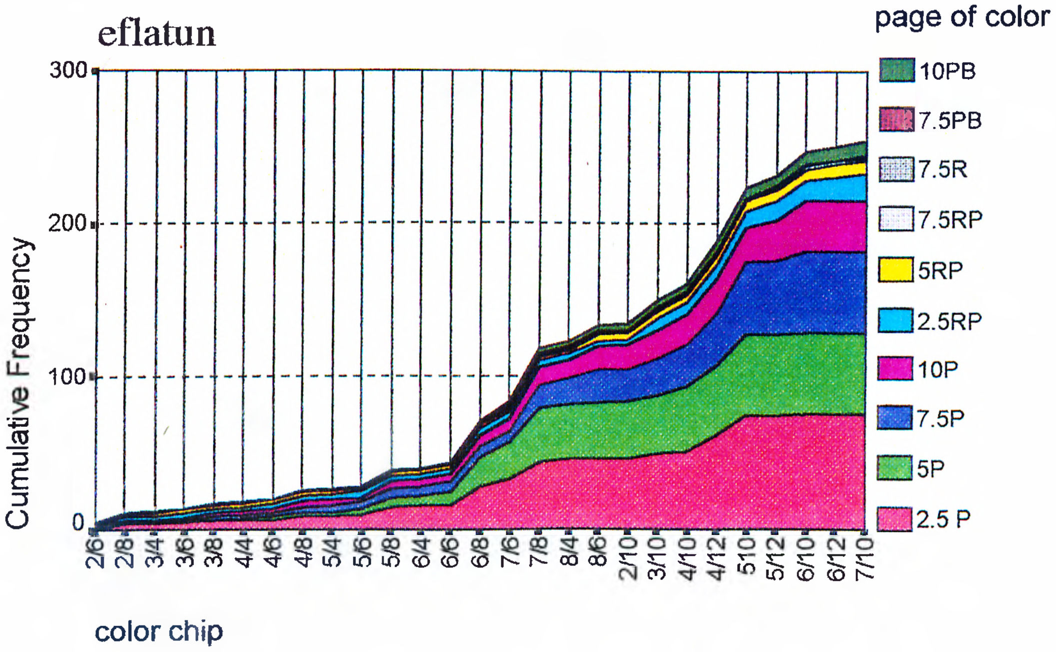


Figure 6.12 b. Cumulative frequency distribution of responses for "eflatun" using stacked area chart

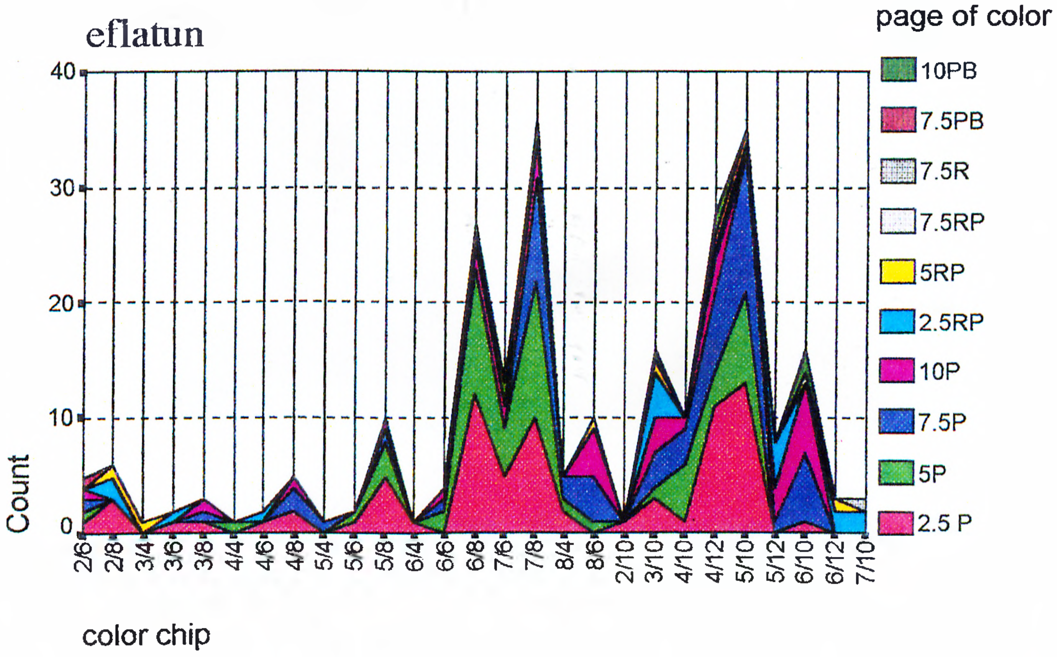


Figure 6.12 c. Stacked area chart showing the cumulative number of responses for "eflatun"

Çingene Pembesi *(Gypsy Pink):*

Besides a value of 3.1 %, nearly all of the subjects identified and stated that they know this non-basic color term. Preferences are from a narrow group of color pages. Only 8 color pages were used by the subjects and 17 different color chips were selected from these pages (Figure 6.13 b and c). Color range, has the color chips from the following color pages (Figure 6.13 a):

Color Pages:	Chips:	
2.5 RP	6/12	4/12
5 RP	5/12	4/12
7.5 RP	5/14	
10 RP	5/14	4/14

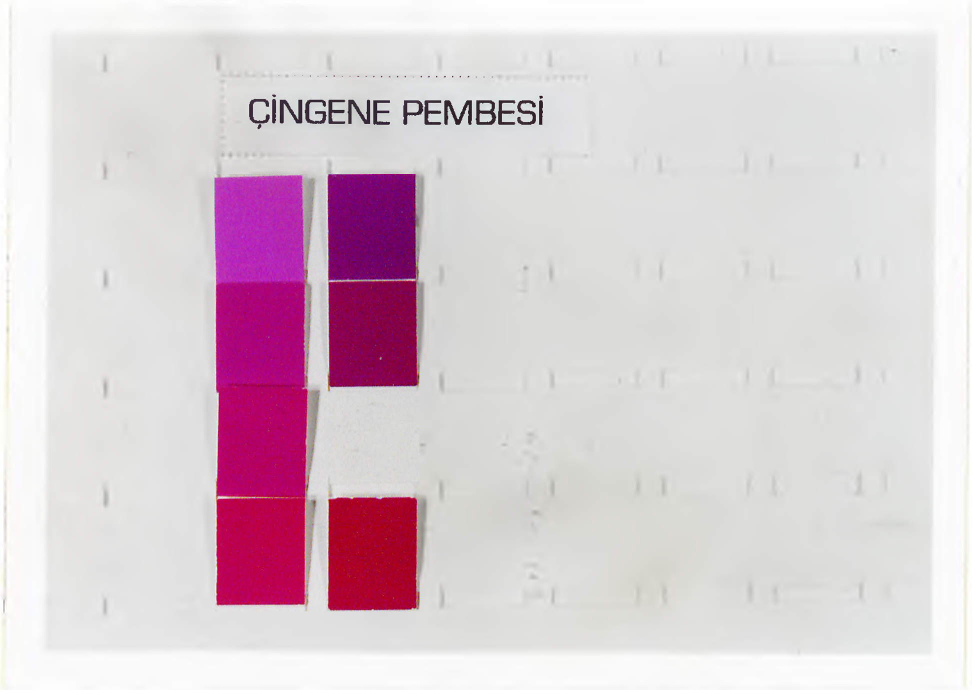


Figure 6.13 a. Presentation of color chips constituting the range for "çingene pembesi".

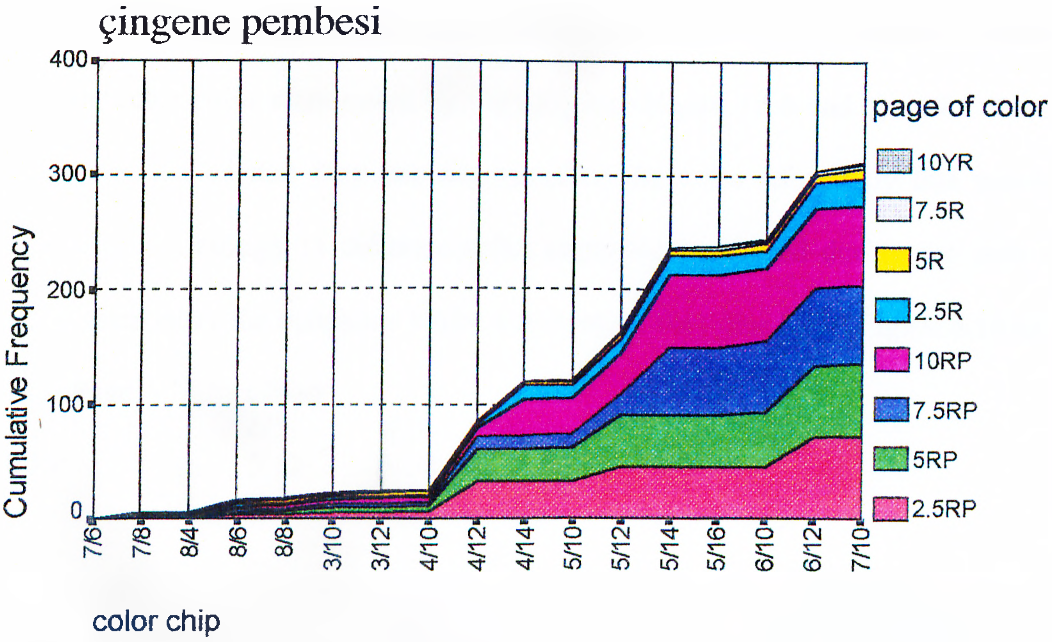


Figure 6.13 b. Cumulative frequency distribution of responses for "çingene pembesi" using stacked area chart

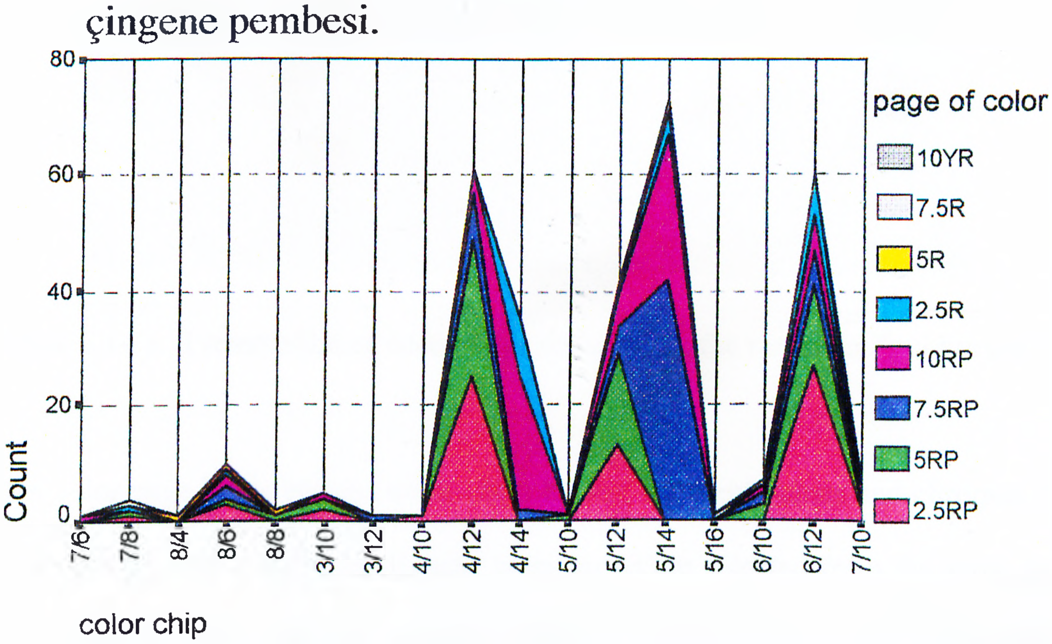


Figure 6.13 c. Stacked area chart showing the cumulative number of responses for "çingene pembesi"

Gül Kurusu *(Rose):*

The selection of a color chip to represent ”gül kurusu” varies in great number; 32 different color chips were noted by the subjects (Figure 14 b and c). 17.1 % of the respondents stated that they can not visualize the color carried by this non-basic color term. Although 11 different color pages were referred during the tests only two of them carry the necessary chips representing the color term (Figure 6.14 a).

Color Page:	Chips:		
7.5 RP	4/12	3/10	
10 RP	5/12	3/10	2/8

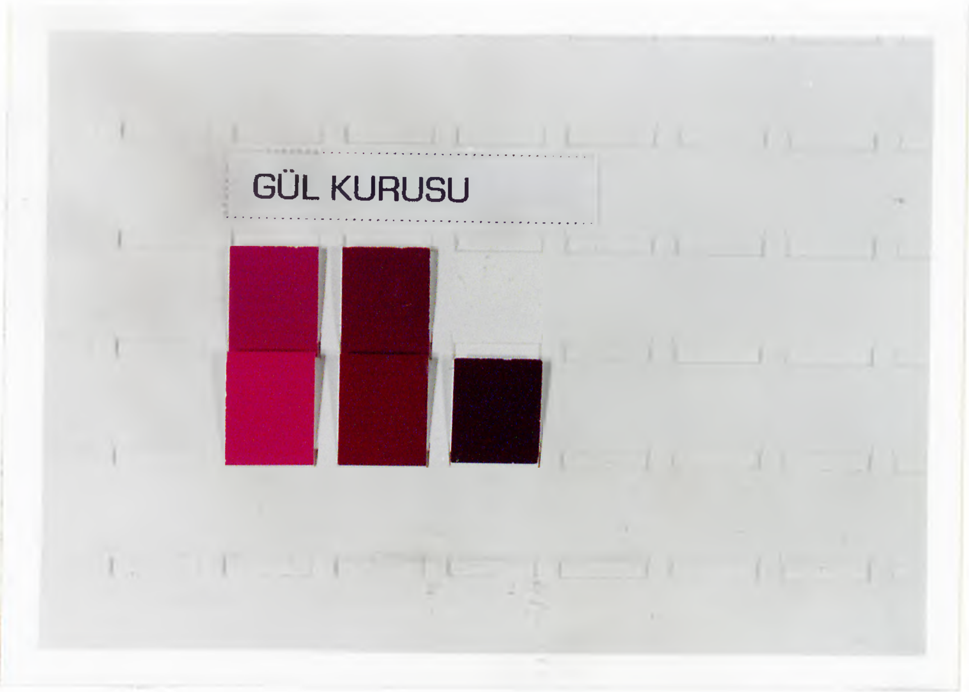


Figure 6.14 a. Presentation of color chips constituting the range for “gül kurusu”.

As a color page holds various color chips having different values and chromas, it is not surprising to see that two or more color terms are selected from the same page. “Gül Kurusu” and “Çingene pembesi” are two different color terms, but have a moderate degree of relationship with each other when their color pages are considered (see Pearson correlation coefficient, presented in Appendix 3.2).

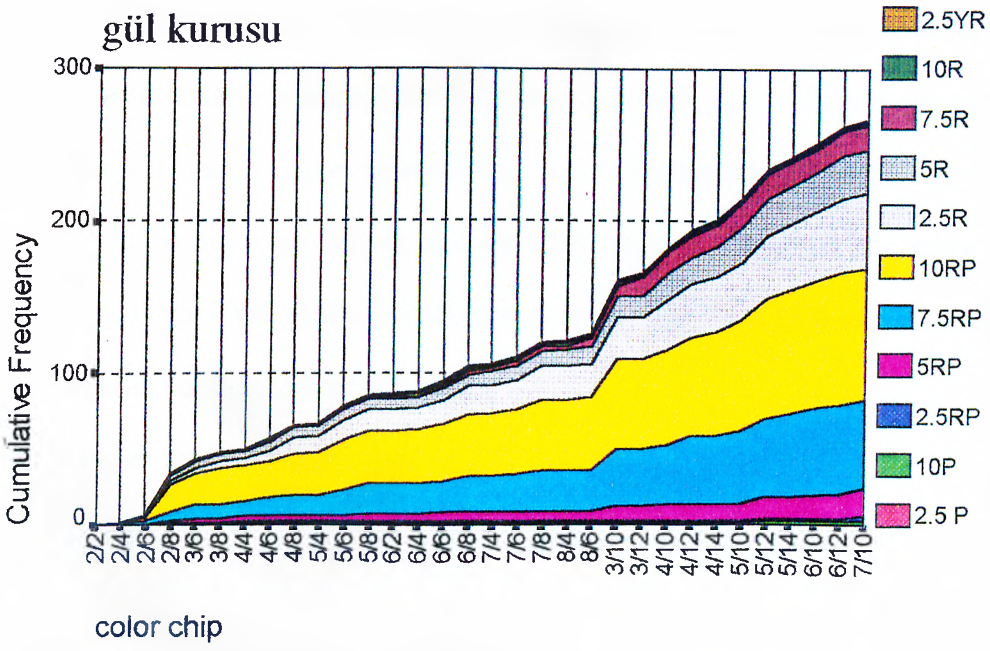


Figure 6.14 b Cumulative frequency distribution of responses for "gül kurusu" using stacked area chart

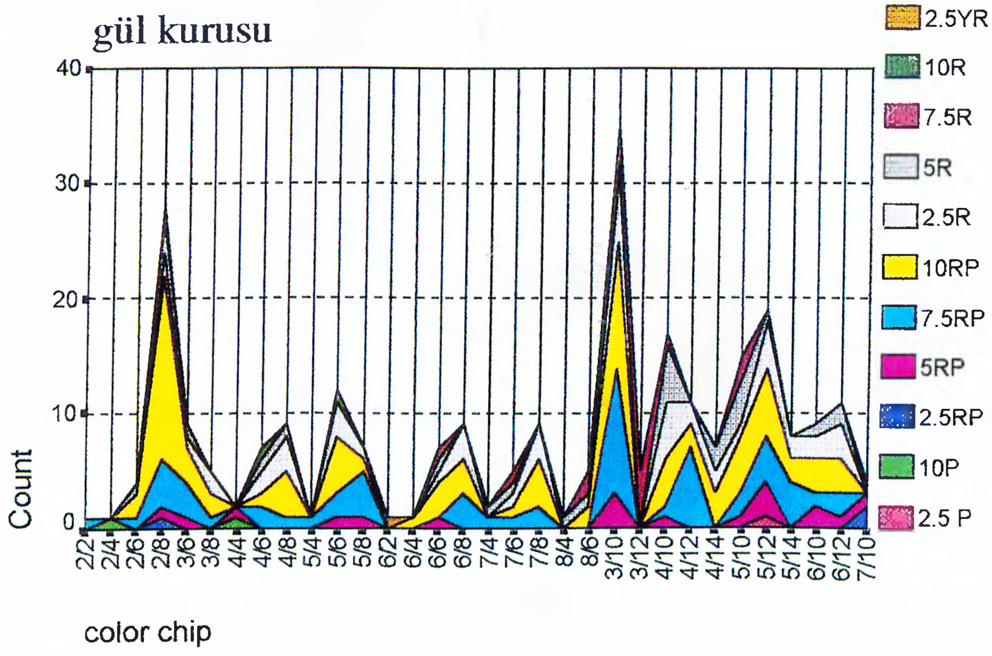


Figure 6.14 c. Stacked area chart showing the cumulative number of responses for "gül kurusu"

Yavruağzı *(Salmon):*

It was investigated that 24.8 % of the subjects could not show any color chip that they find suitable to represent the color term. Although 23 different color chips from 14 different pages were selected by the investigated subjects, only the ones mentioned below were salient and they are used to construct the color range of "yavruağzı" for Turkish People (Figure 6.15 a). Figure 6.15 b and c summarize all the responses collected for "yavruağzı".

Color Page:	Chips:	
7.5 R	7/10	
10 R	8/6	7/10
2.5 YR	8/6	

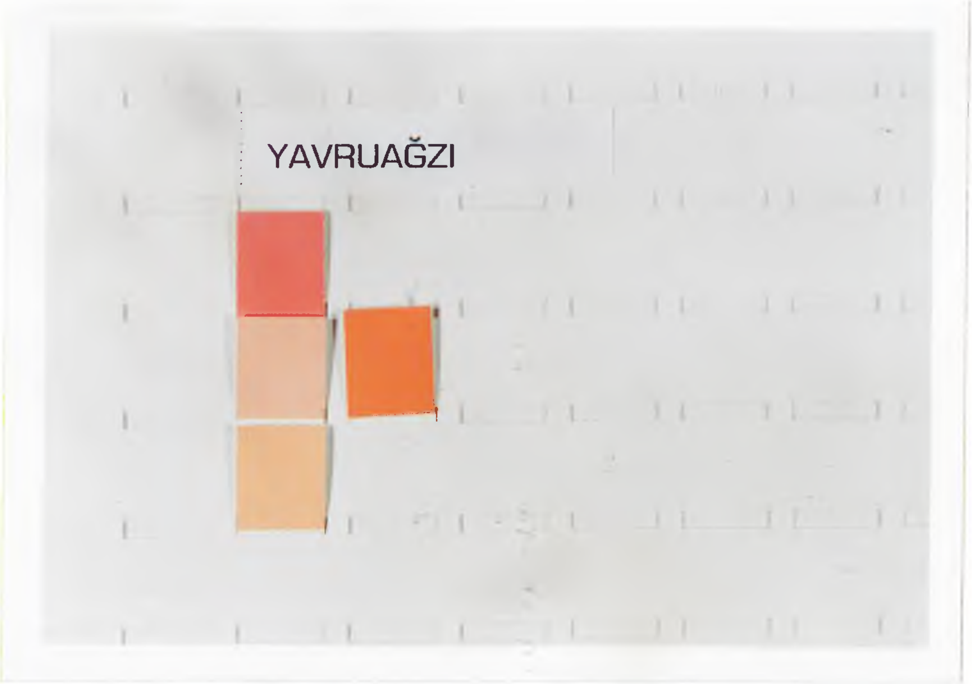


Figure 6.15 a. Presentation of color chips constituting the range for "yavruağzı".

Among the indicated ones above, color chips 8/6 are lighter color samples when compared to the darker ones such as 7/10. Although main concentration for this non-basic color term is on chips 8/6, color chips 7/10, which are darker are also salient among all other preferences. Thus perception of this color term is either from a darker or from a lighter stimuli.

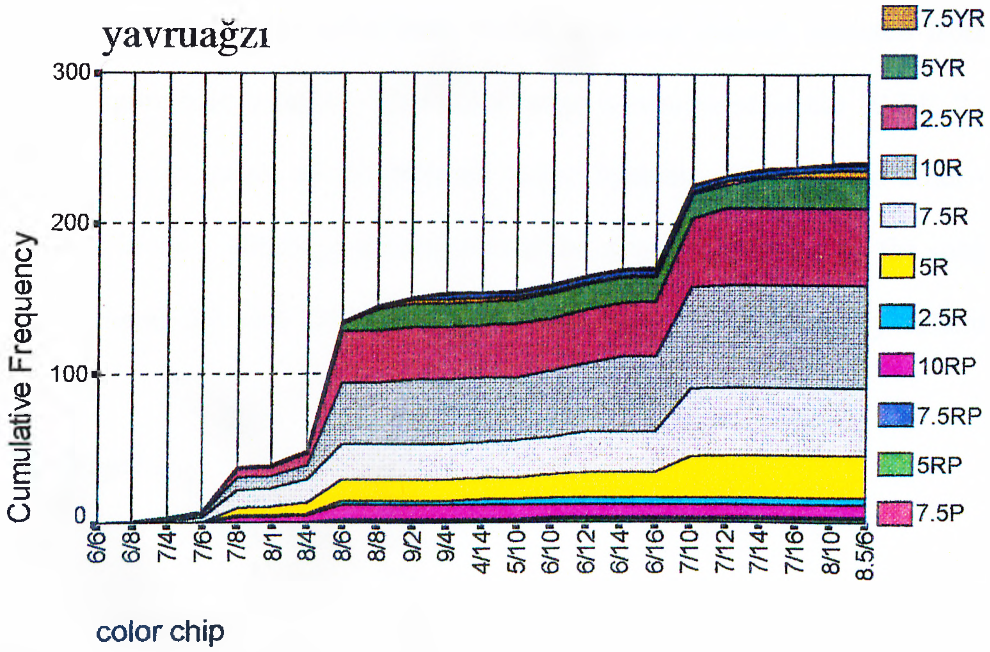


Figure 6.15 b. Cumulative frequency distribution of responses for "yavruağzı" using stacked area chart

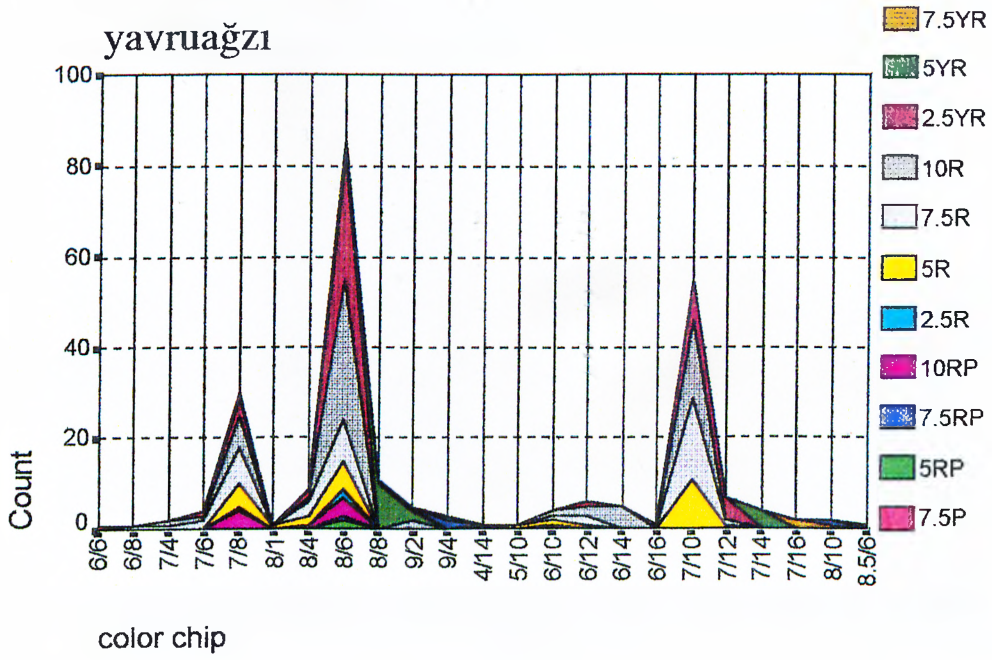


Figure 6.15 c. Stacked area chart showing the cumulative number of responses for "yavruağzı"

<u>Bordo</u> ***(Bordeaux red):***

"Bordo" is a non-basic color term which is almost equally selected from 4 color pages (Figure 6.16 b and c). The color range is composed of the 10 RP, 2.5 R, 5 R, and 10 R color pages of the Munsell Color System. Most agreed color chips are indicated below. Although 20 different color chips are selected by the subjects only two of them; 2/8 and 3/10 of certain color pages are remarkably salient (Figure 6.16a).

Color Page:	Chips:	
10 RP	3/10	2/8
2.5 R	3/10	2/8
5 R	3/10	2/8
7.5 R	3/12	2/8

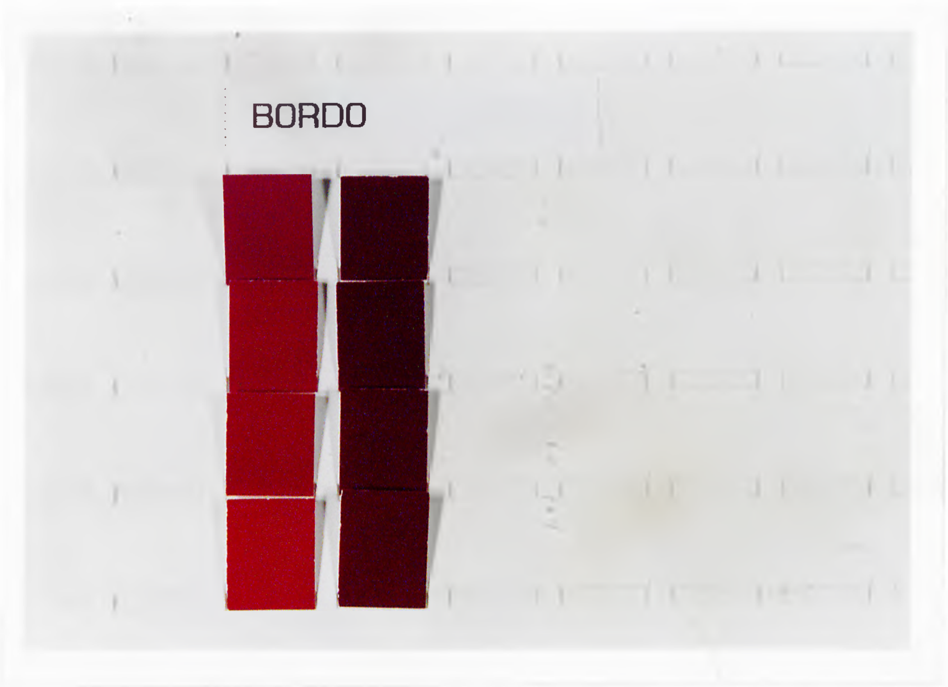


Figure 6.16 a. Presentation of color chips constituting the range for "bordo".

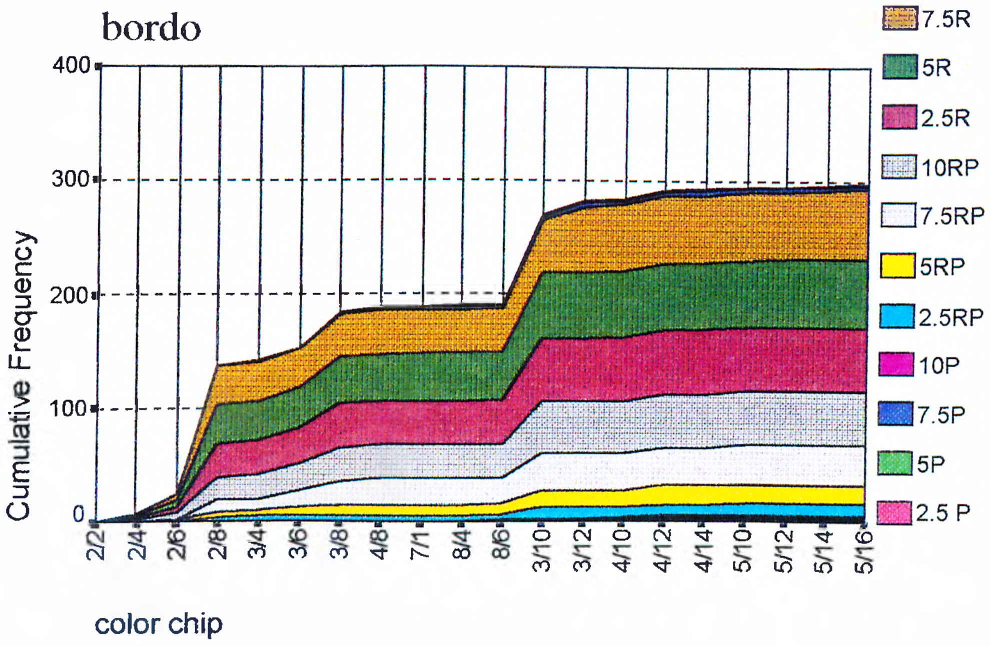


Figure 6.16 b. Cumulative frequency distribution of responses for "bordo" using stacked area chart

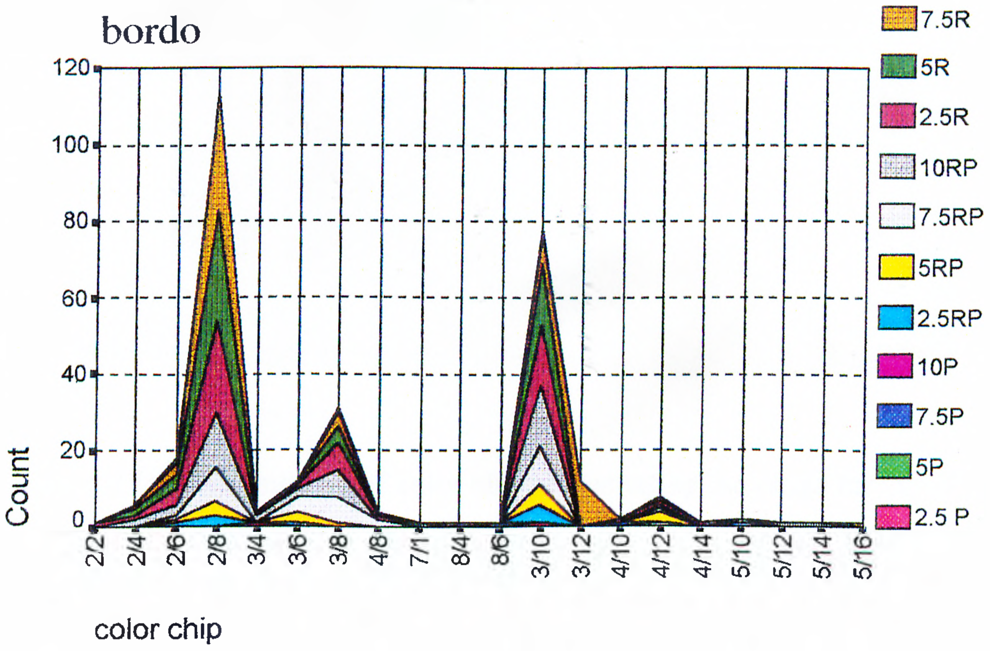


Figure 6.16 c. Stacked area chart showing the cumulative number of responses for "bordo"

Kızıl *(Scarlet):*

"Kızıl" is a non-basic color term that carries different color percepts. 22.7 % of the subjects could not identify the color that the term implies. Figure 6.17 b and c summarize the obtained results for "kızıl". 26 different color chips were specified to exemplify the value for "kızıl". Repeatedly agreed color chips are indicated below with their color pages (Figure 6.17a):

Color Page:	Chips:				
7.5 R	5/16	4/16	3/10	3/12	2/8
5 R	3/8	3/10	2/8		
10 R	4/12	3/10			

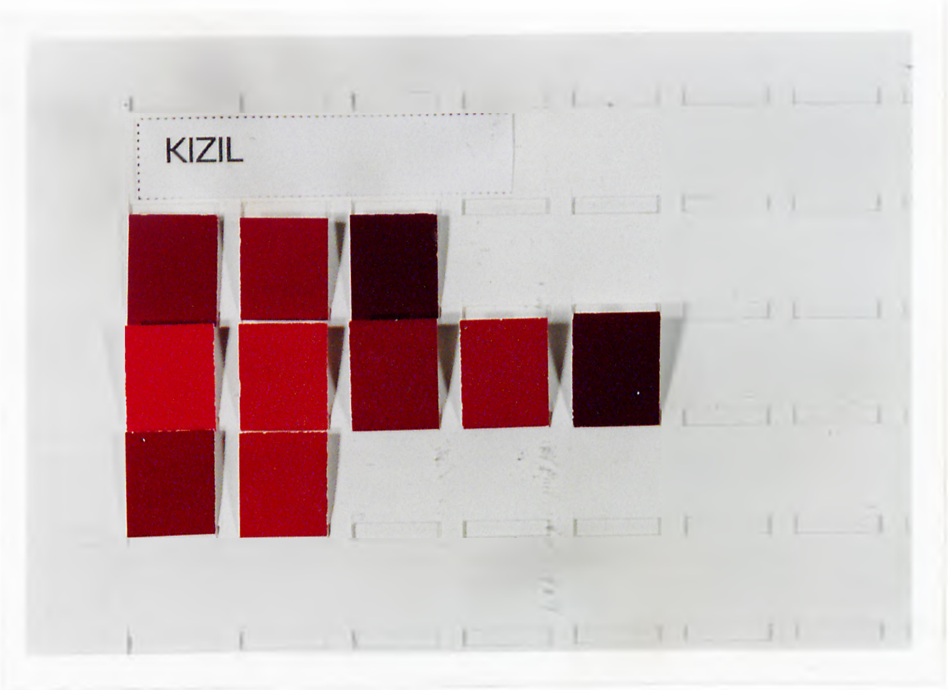


Figure 6.17 a. Presentation of color chips constituting the range for "kızıl".

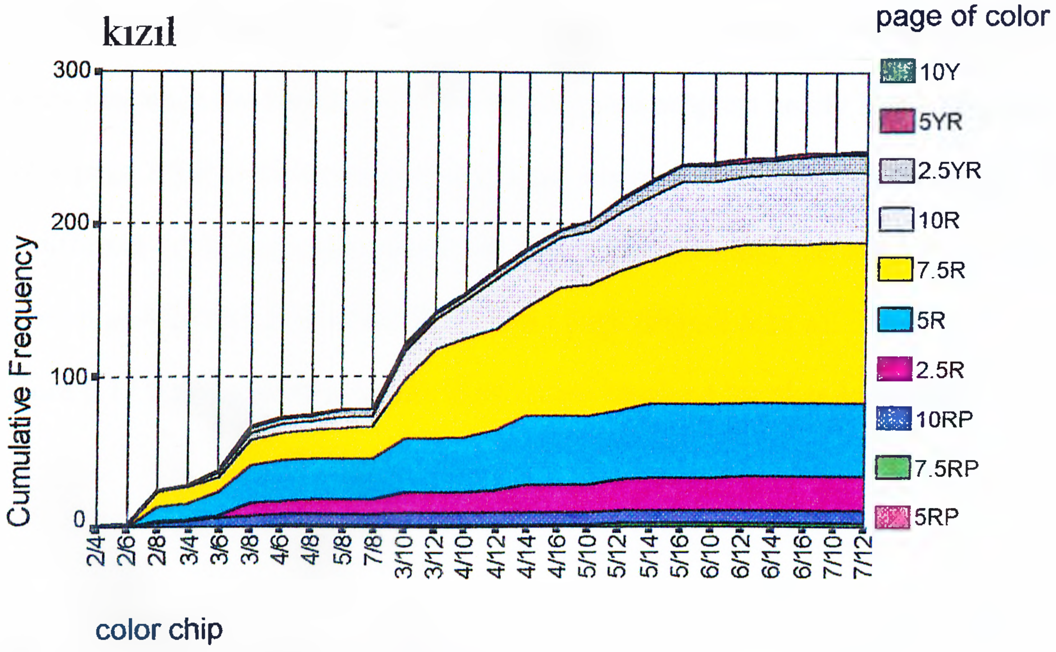


Figure 6.17b. Cumulative frequency distribution of responses for "kızıl" using stacked area chart

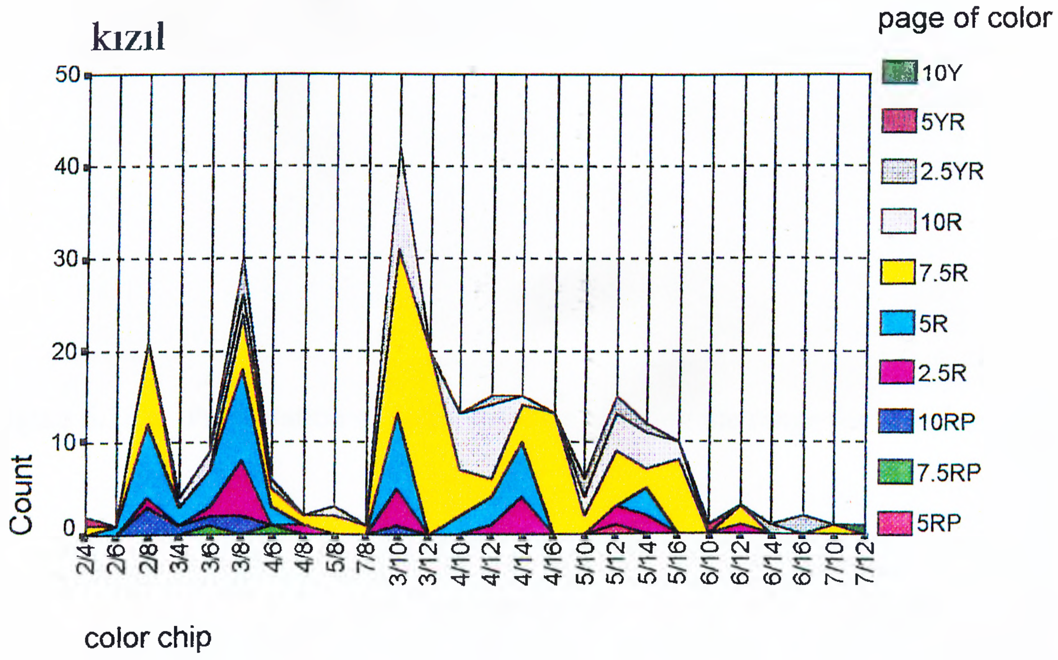


Figure 6.17 c. Stacked area chart showing the cumulative number of responses for "kızıl"

Kan Kırmızısı *(Blood red):*

It can be clearly seen from Figure 6.18 b that, "kan kırmızısı" is one of the color names that units the responses of the investigated subjects nearly into a single page. Color page 7.5 R is the dominant color page among the selected other 7 pages. Only 14 different color chips were preferred during the tests and the salient ones are the color chips 4/16 and 3/12 of the 7.5 R color page (Figure 6.18 a).

Figure 6.17 b and c show response distribution obtained for "kan kırmızısı".

Figure 6.18 a. Presentation of color chips constituting the range for "kan kırmızısı".

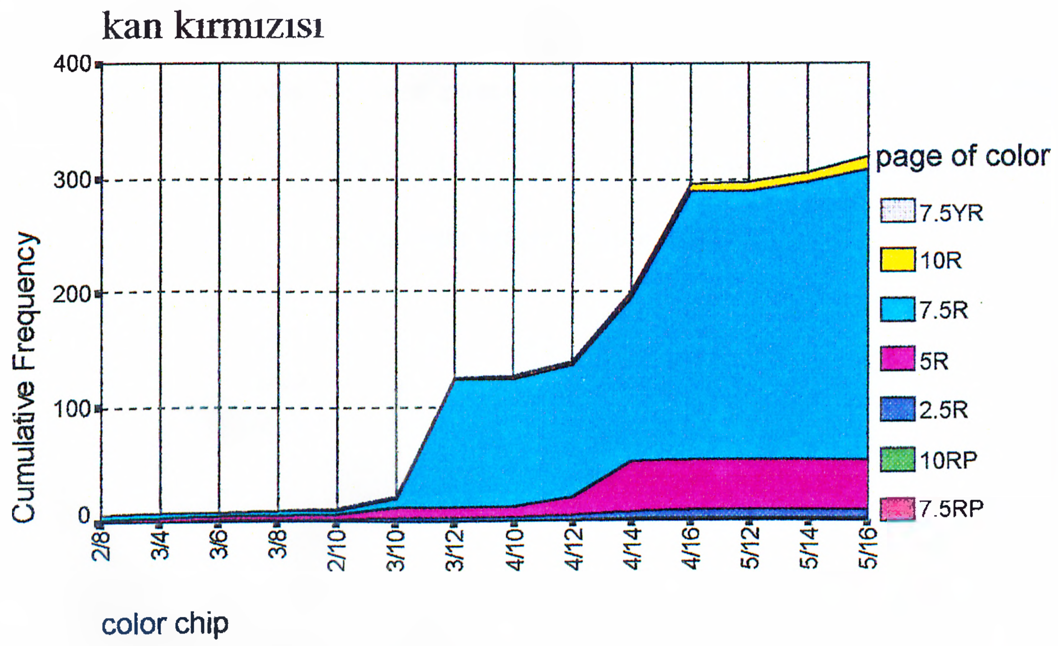


Figure 6.18 b. Cumulative frequency distribution of responses for "kan kırmızısı" using stacked area chart

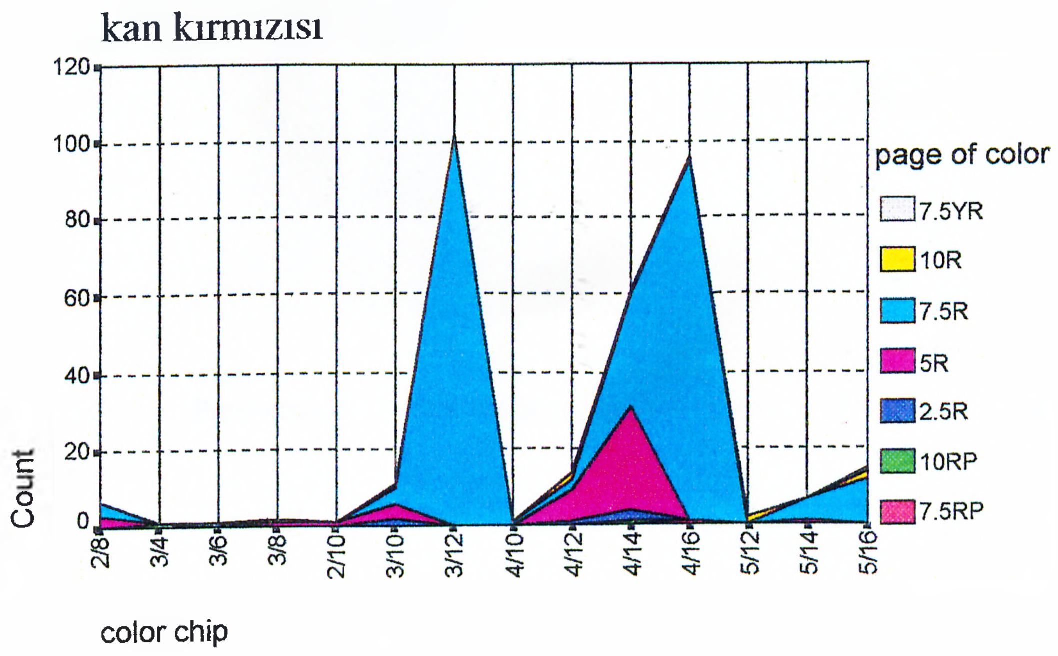


Figure 6.18 c. Stacked area chart showing the cumulative number of responses for "kan kırmızısı"

Vişne Çürüğü *(Cherry):*

11.2 % of the tested subjects could not give any response to the assigned color term. During the investigation 8 color pages were used in the selection of 20 different color chips (Figure 19 b and c). Color range for this non-basic color term is given below with color pages and the color chips (Figure 6.20 a):

Color Page:	Chips:		
2.5 R	3/8	3/10	2/8
5 R	3/10	2/8	
7.5 R	3/10	2/8	

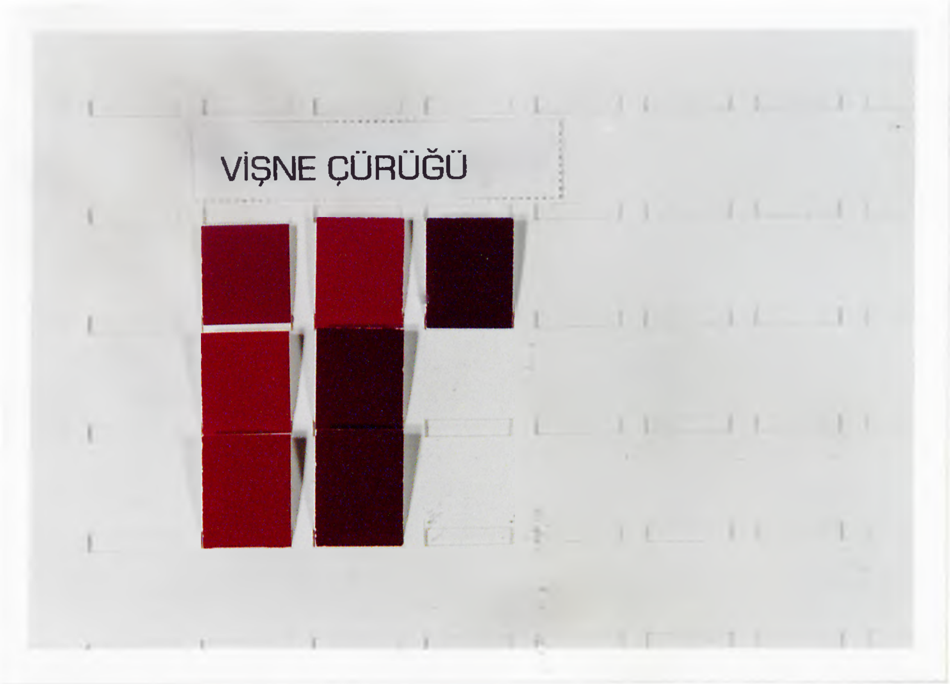


Figure 6.19 a. Presentation of color chips constituting the range for “vişne çürüğü”.

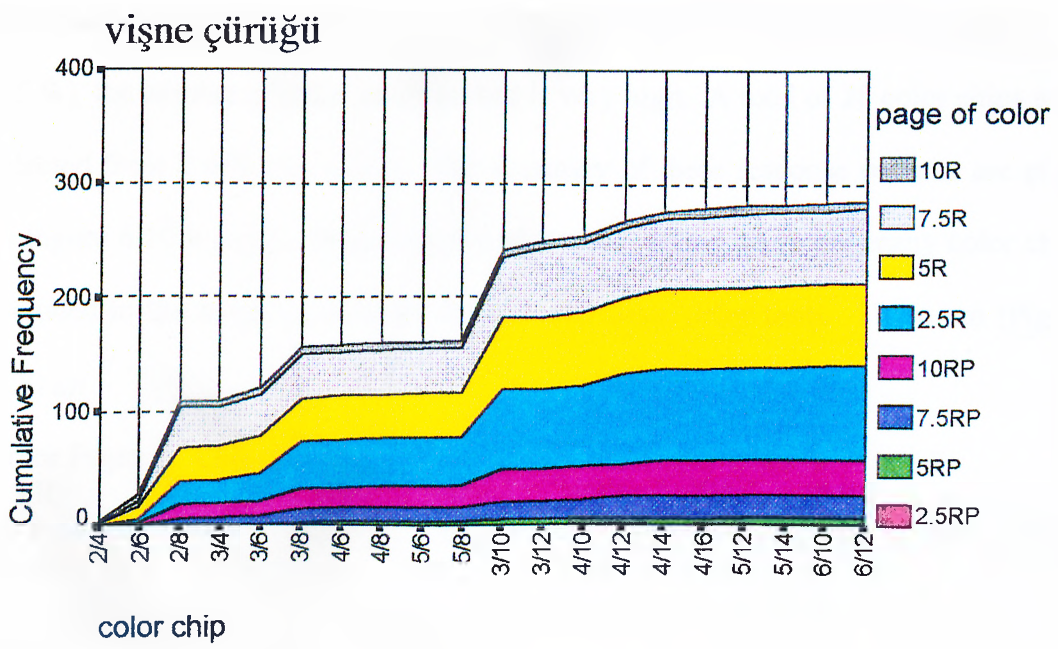


Figure 6.19 b. Cumulative frequency distribution of responses for "vişne çürüğü" using stacked area chart

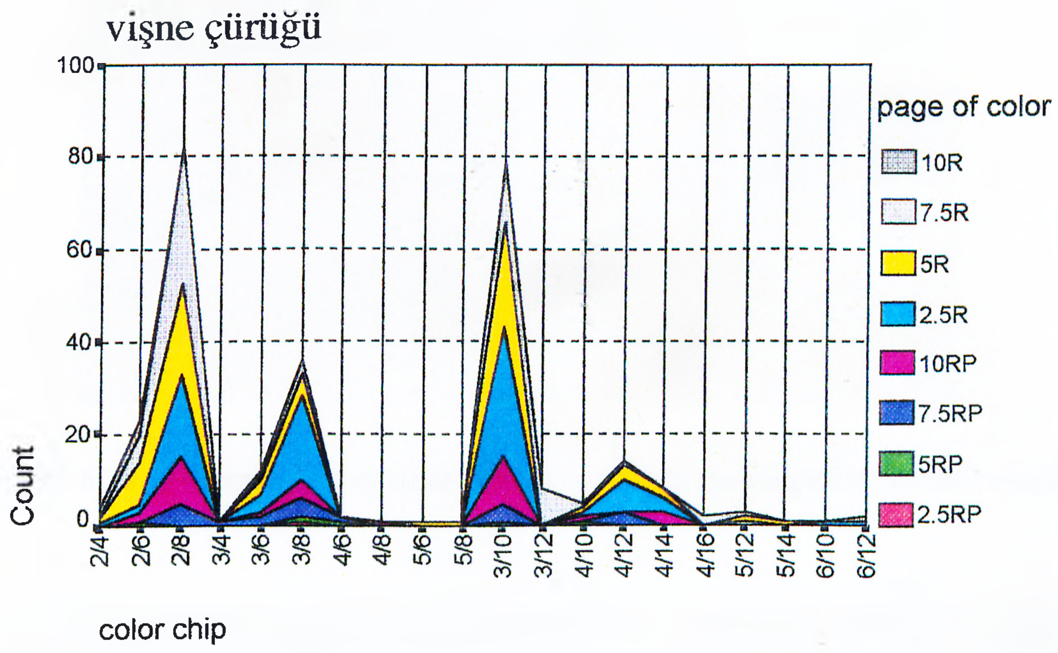


Figure 6.19 c. Stacked area chart showing the cumulative number of responses for "vişne çürüğü"

Kiremit Rengi *(Tile red):*

Although most of the subjects agreed on that they know the color name (except 2.5 %), the number of color chips picked is very high. A total of 28 color chips were selected from 8 different pages. The summary of these response patterns are given in Figure 6.20 b and c. When compared to other terms, there are many color chips included in the range constructed for this non-basic color term. These are (Figure 6.20 a):

Color Page:	Chips:							
7.5 R	5/12	4/8	4/10	4/12	3/8	3/10		
10 R	5/8	5/10	5/14	4/8	4/10	4/12	3/8	3/10
2.5 YR	4/10							

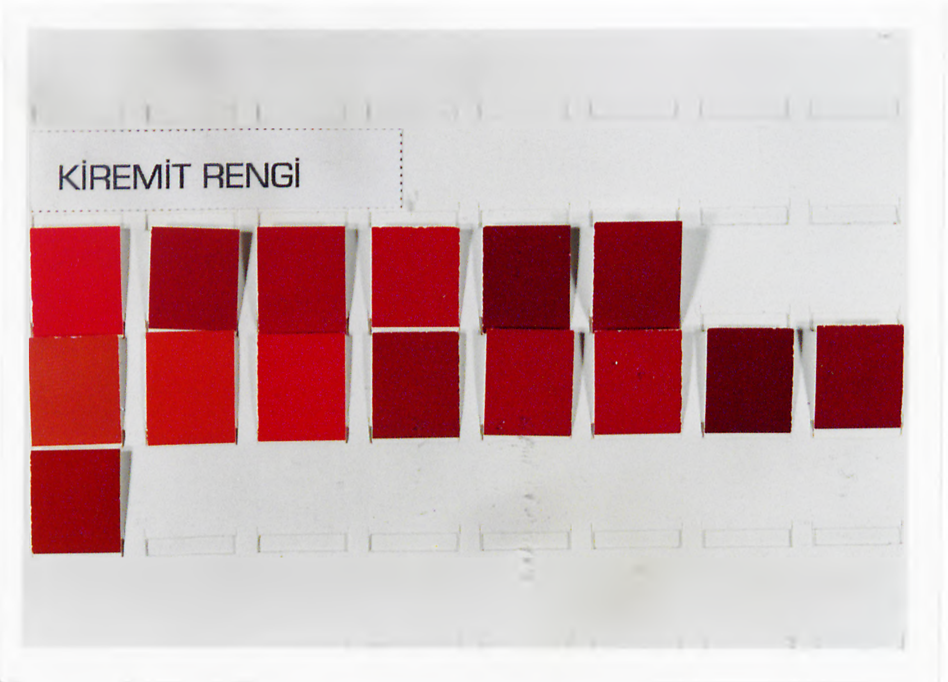


Figure 6.20 a. Presentation of color chips constituting the range for “kiremit rengi”.

In addition to the situation explained above Pearson correlation coefficient suggests a positive, but week relationship between the color pages of “kiremit rengi” and “kızıl” (Appendix 3.2).

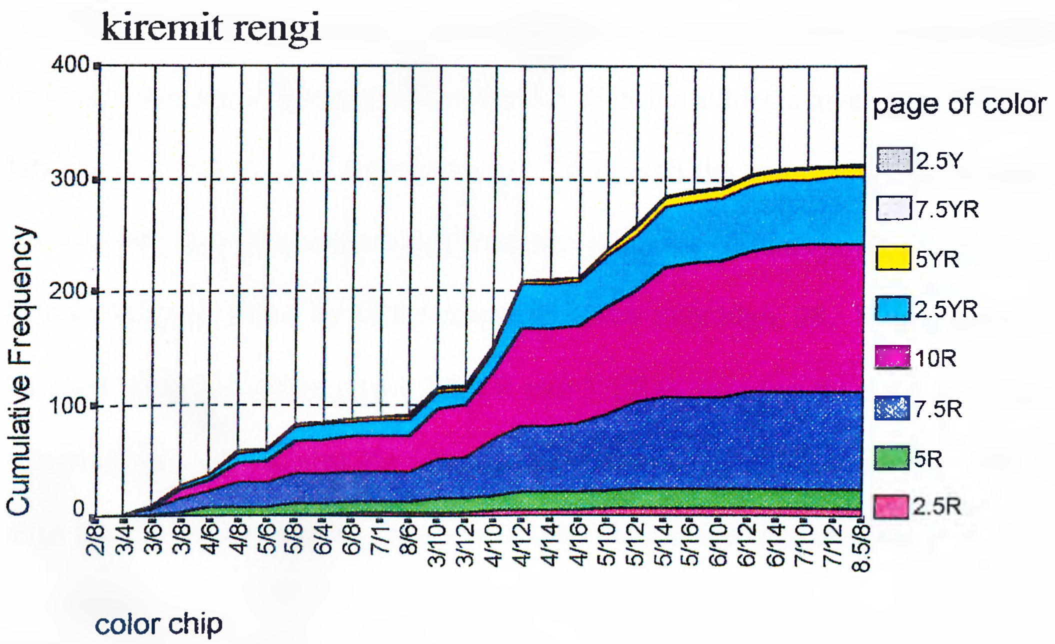


Figure 6.20 b. Cumulative frequency distribution of responses for "kiremit rengi" using stacked area chart

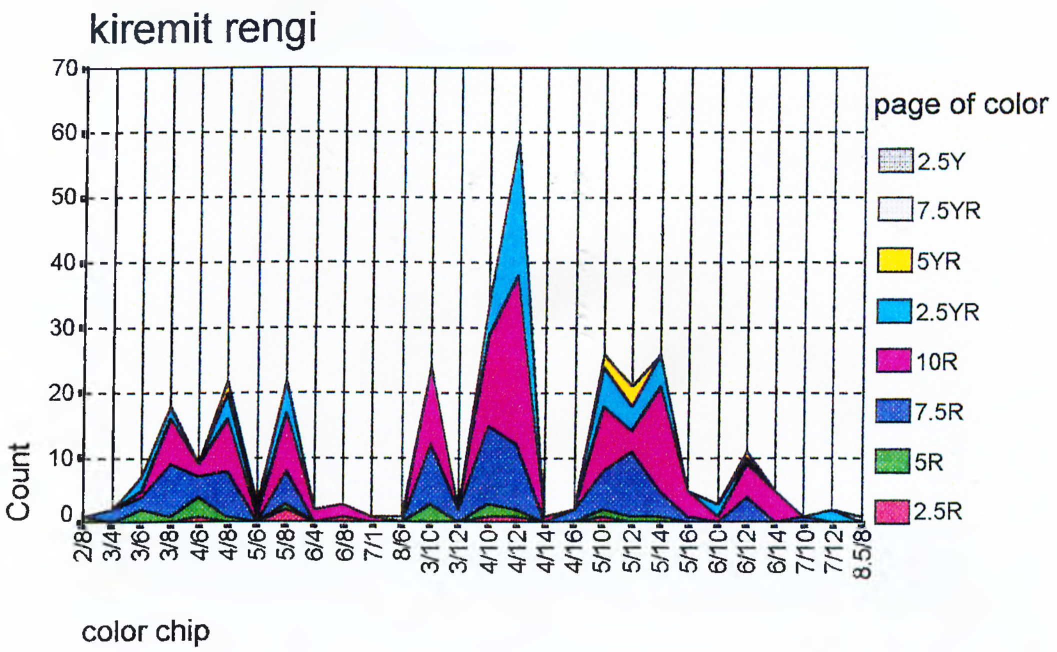


Figure 6.20 c. Stacked area chart showing the cumulative number of responses for "kiremit rengi"

Kavuniçi *(Mellon Yellow):*

The response pattern is nearly similar to the one obtained from the investigation of the basic color term "turuncu", however 5.6 % of the subjects investigated stated that they can not show a chip for "kavuniçi". Although the color range generalized for this term has very close color chips from the value and chroma point of view, sum of the color chips selected by all the respondents are very high, 28. When compared to "turuncu" chip 7/12 from pages 2.5 YR and 5 YR is added to the range. All figures following the text explains the obtained data and its distribution briefly. The color range has the following color pages with their color chips (Figure 6.21 a):

Color Page:	Chips:		
10 R	6/14		
2.5 YR	7/12	6/14	6/16
5 YR	7/12	7/14	

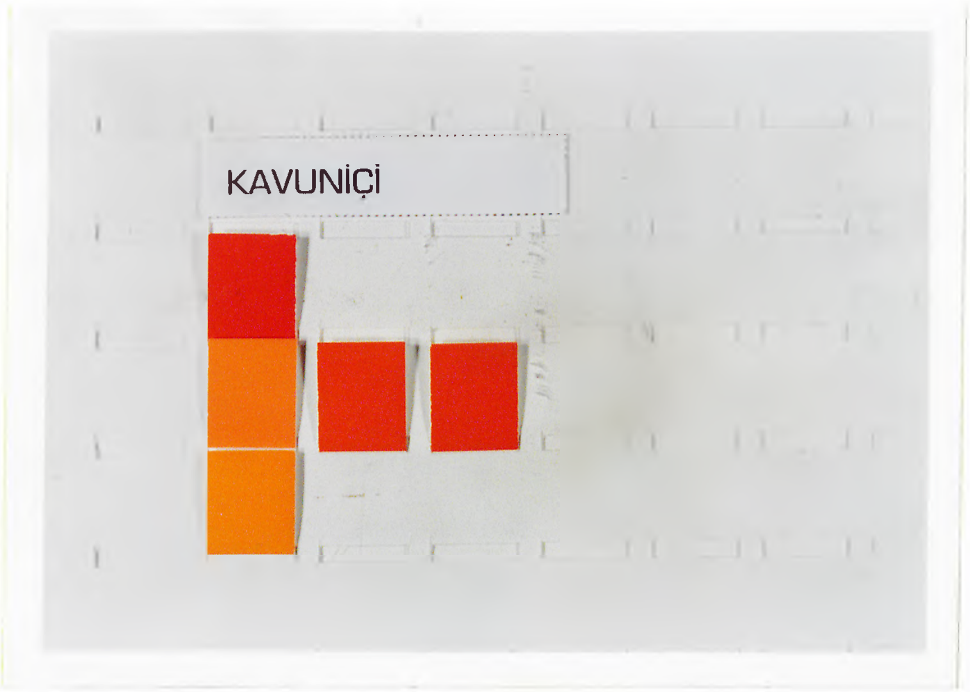


Figure 6.21 a. Presentation of color chips constituting the range for "kavuniçi".

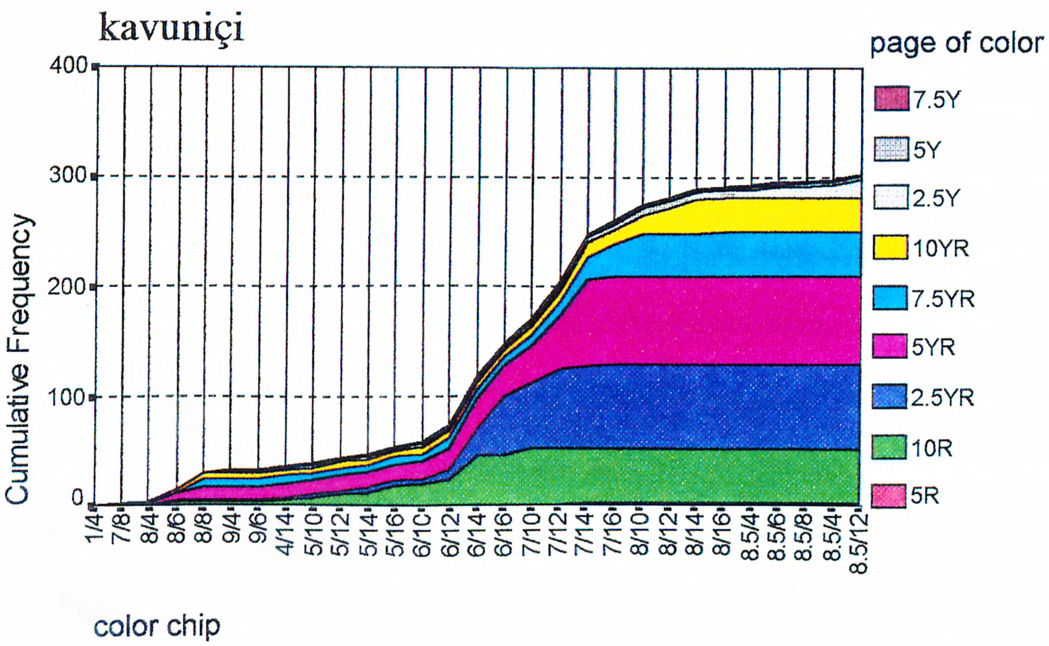


Figure 6.21 b. Cumulative frequency distribution of responses for "kavuniçi" using stacked area chart

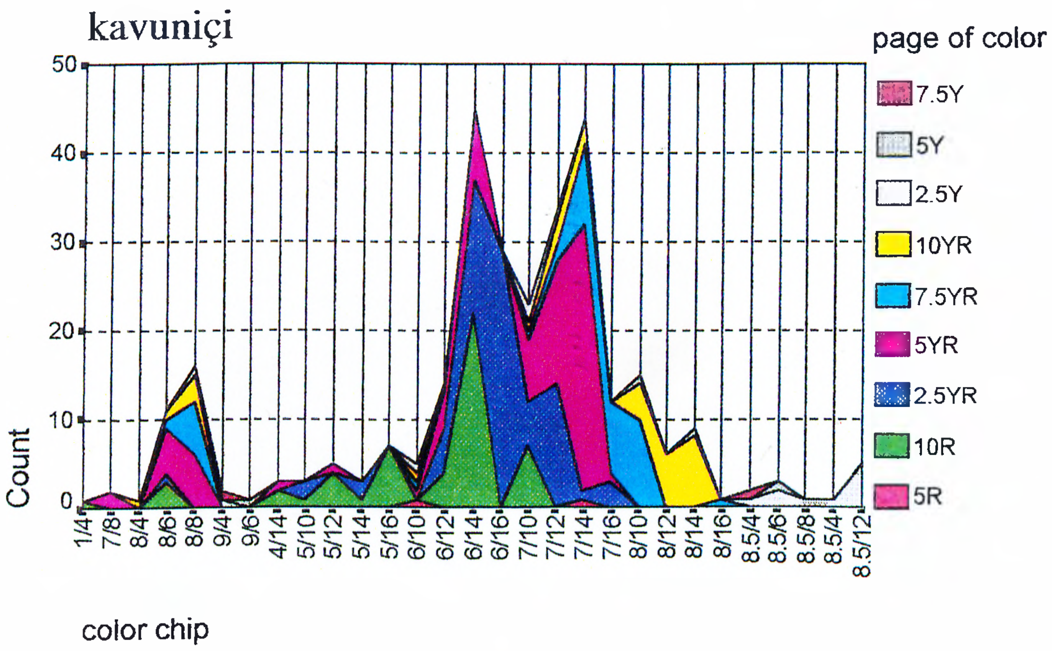


Figure 6.21 c. Stacked area chart showing the cumulative number of responses for "kavuniçi"

Ela *(Hazel):*

Known especially as an eye color, it is one of the most problematic color names that carries difficulties in constructing a color image in the minds of investigated subjects. Nearly half of the subjects (48.1 %) could not identify the color represented by this term. Most of the subjects stated that they know the color but they can not map it on the color scale. Besides this information, a total of 38 color chips, that is a huge number, out of 21 pages were selected (Figure 6.22 b and c). It is difficult to construct a color range, but the most frequently occurring color chips with holding pages are (Figure 6.22 a):

Color Page:	Chips:				
10 YR	6/6	6/8	6/10	5/6	4/8
2.5 Y	5/6	4/4	4/6		
5 Y	6/8	5/4	5/6	5/8	

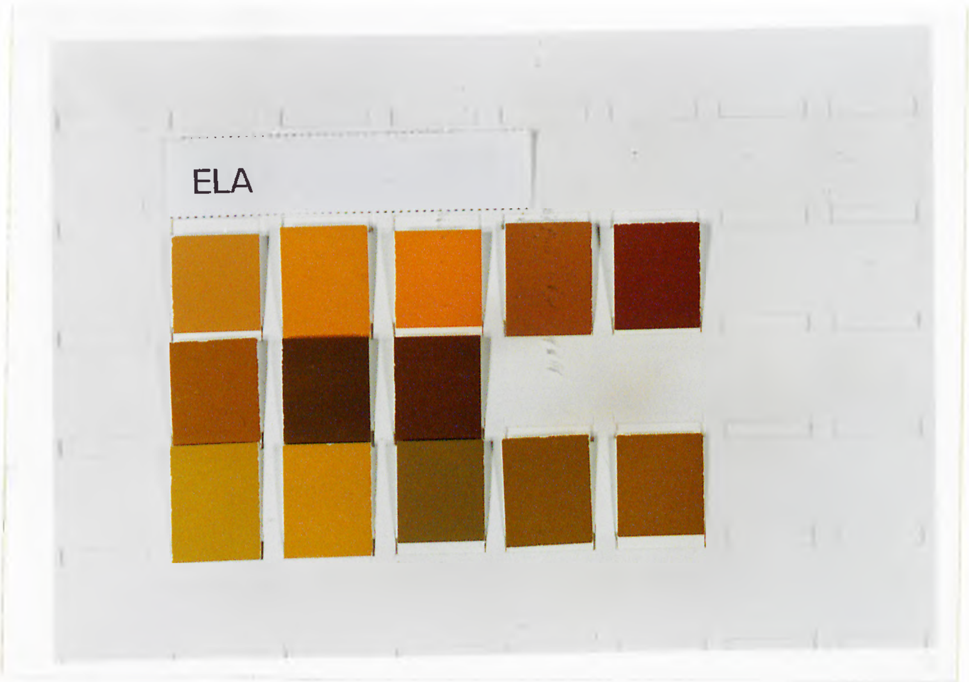


Figure 6.22 a. Presentation of color chips constituting the range for “ela”.

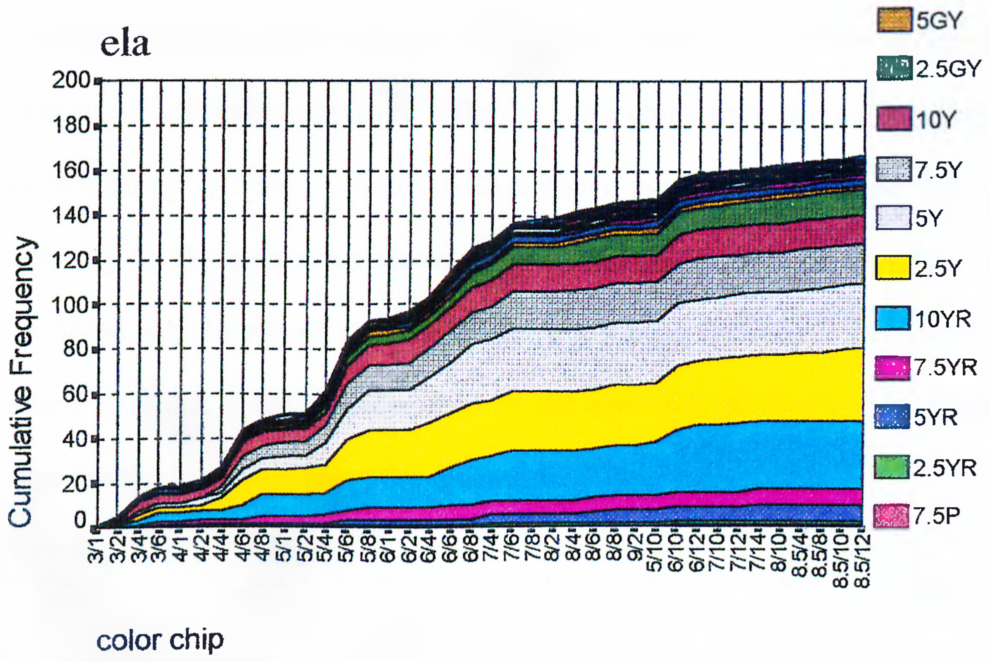


Figure 6.22 b. Cumulative frequency distribution of responses for "ela" using stacked area chart

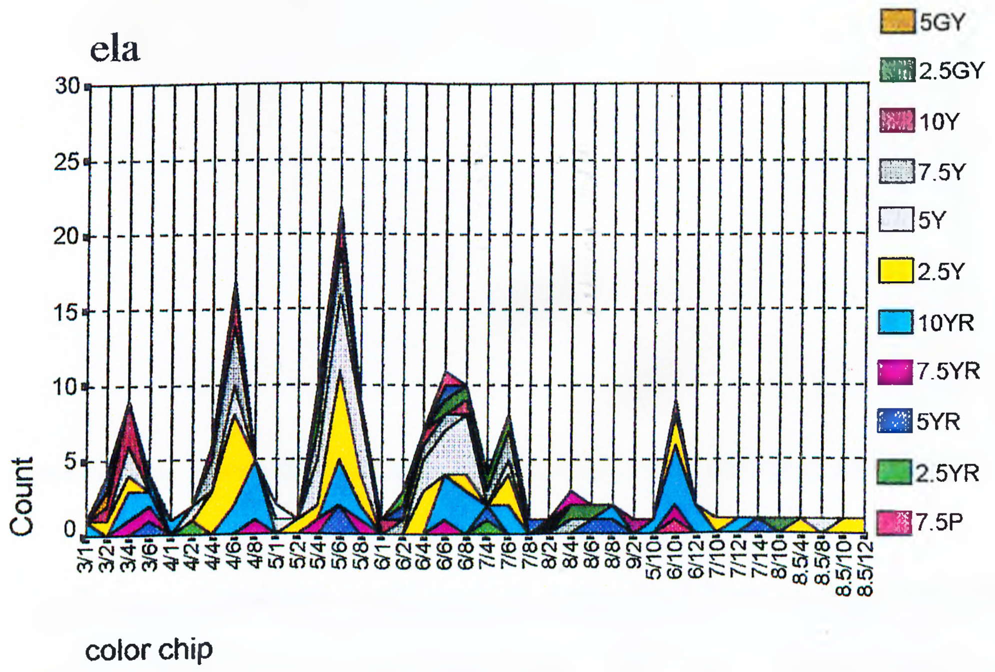


Figure 6.22 c. Stacked area chart showing the cumulative number of responses for "ela"

Bej *(Beige):*

As could be seen from Figure 6.23 b, many color pages were referred by the subjects. In addition to that, 26 different color chips were picked up to be the best representatives of "bej". Figure 6.23 b and c present the obtained data of "bej". Referring to the area chart showing the count number of color chips, it can be concluded that nearly all color chips having values between 9 and 7, and having chroma 1, 2 and 4 are considered to be the examples of "bej". The general color range has the following identities (Figure 6.23 a):

Color Page:	Chips					
10 YR	9/1	9/2	9/4	8/1	8/2	8/4
2.5 Y	9/2	9/4	8.5/2	8/4	7/4	

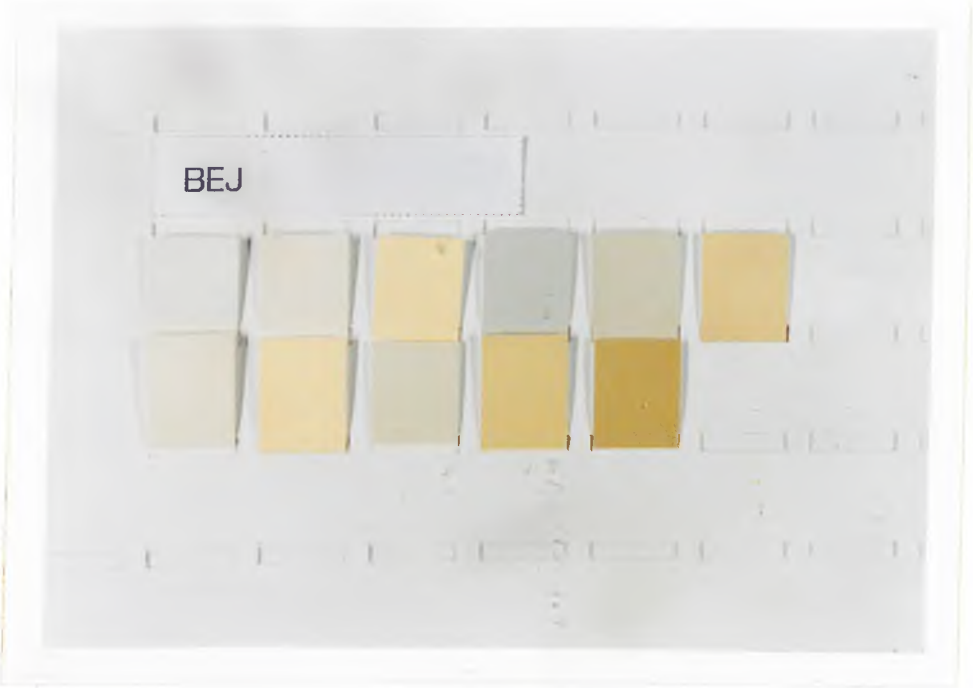


Figure 6.23 a. Presentation of color chips constituting the range for "bej".

If the Pearson Correlation coefficients in Appendix 3.2 are examined it can be seen that color pages "bej" and "krem", and "bej" and "fildişi" have moderate relationship. This suggestion can be viewed from the related graphs showing the color pages of each different color term.

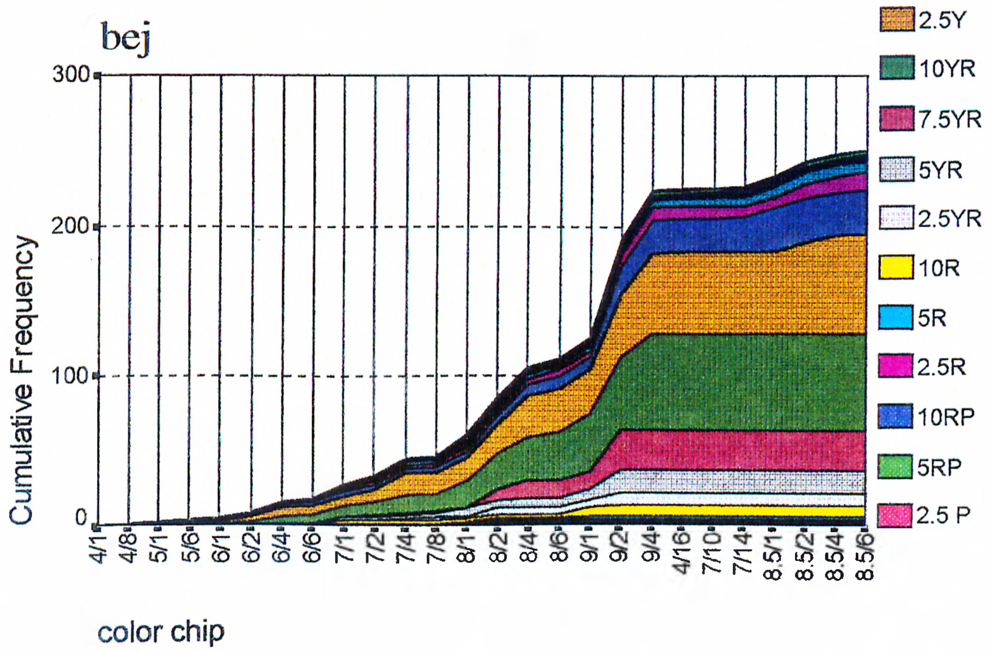


Figure 6.23 b. Cumulative frequency distribution of responses for "bej" using stacked area chart

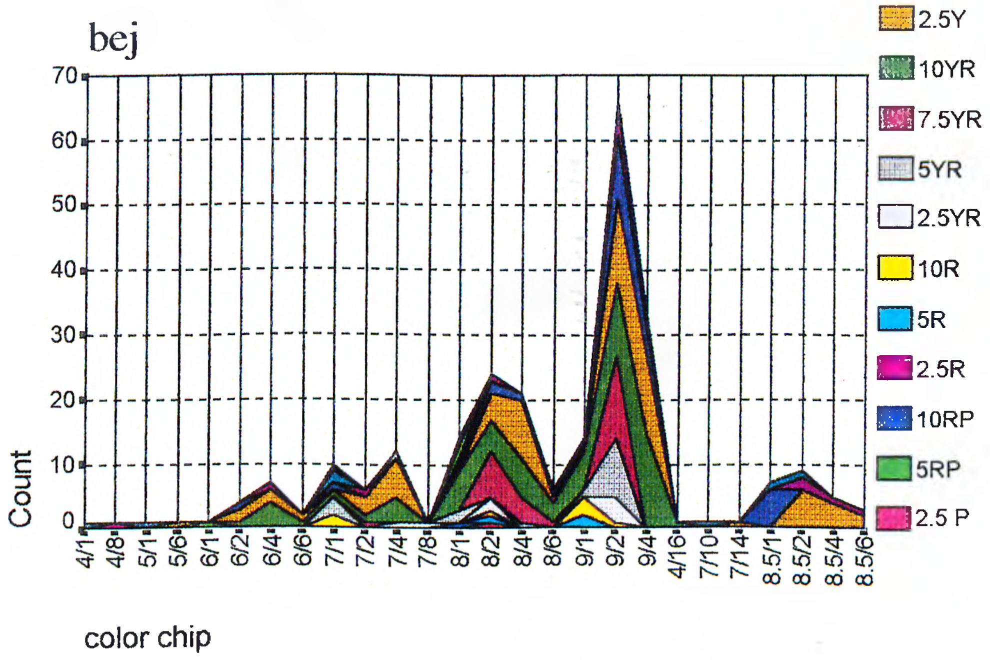


Figure 6.23 c. Stacked area chart showing the cumulative number of responses for "bej"

Kanarya Sarısı *(Canary Yellow):*

When the color pages and the color chips selected for the range of "kanarya sarısı" are examined (Figure 6.24 b and c), it can be stated that responses are similar to the ones for "sarı". Only 2.8 % of the subjects could not identify the color that the term carries. Particularly selected chips and their color pages are given below (Figure 6.24 a):

Color Page:	Chips:	
2.5 Y	8/16	
5 Y	8.5/12	8.5/14

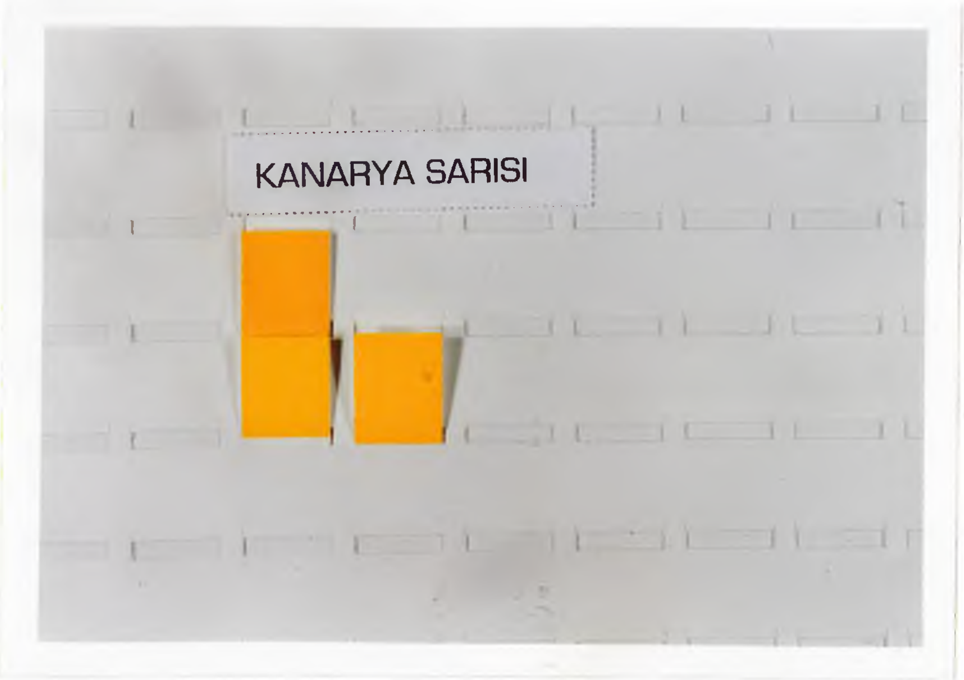


Figure 6.24 a. Presentation of color chips constituting the range for "kanarya sarısı".

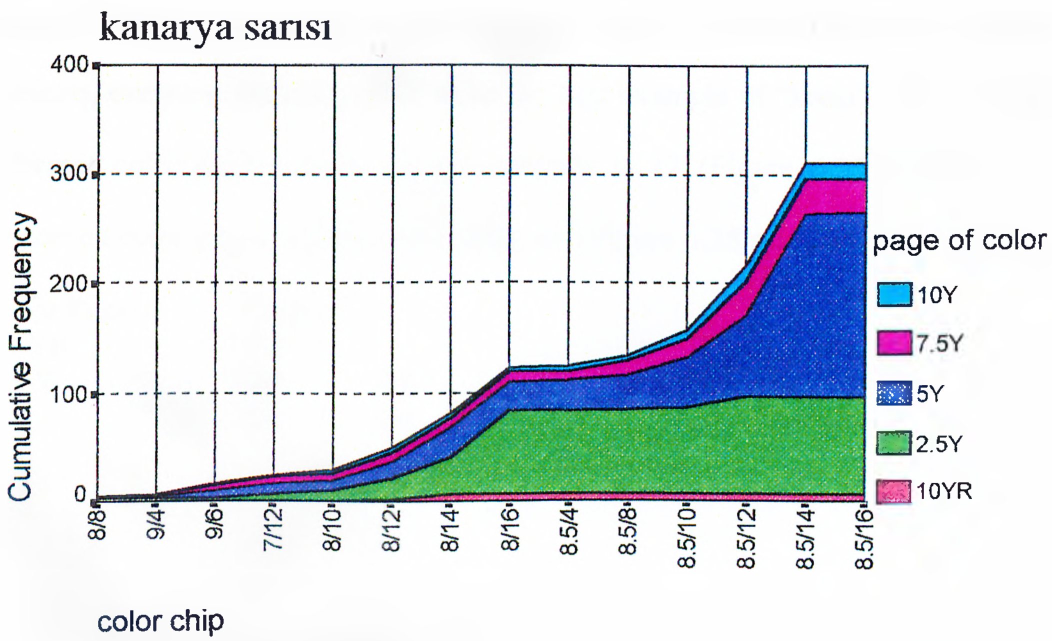


Figure 6.24 b. Cumulative frequency distribution of responses for "kanarya sarısı" using stacked area chart

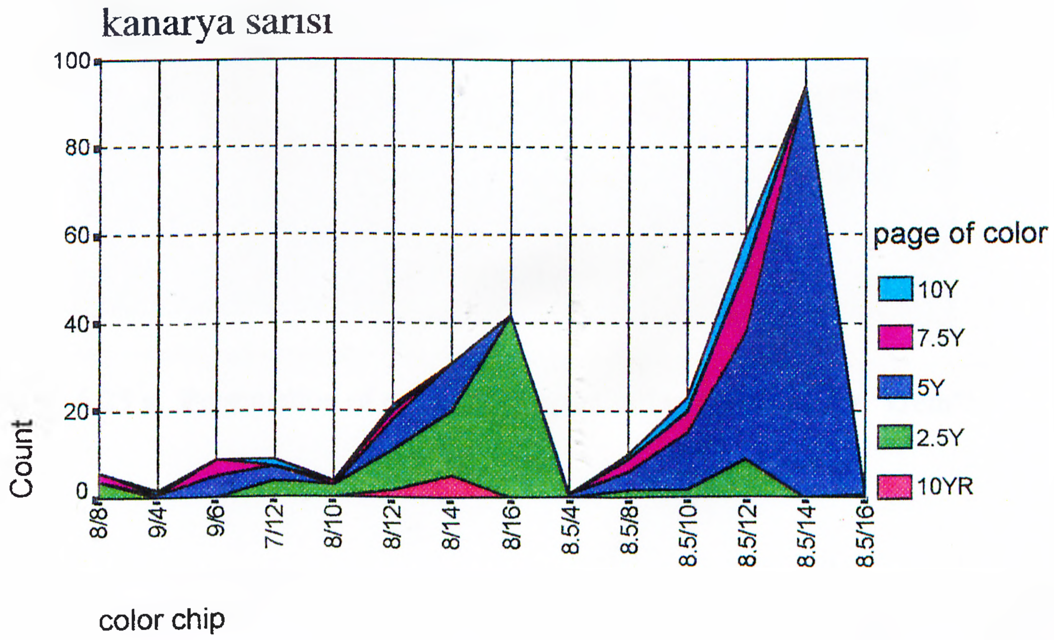


Figure 6.24 c. Stacked area chart showing the cumulative number of responses for "kanarya sarısı"

Krem *(Cream):*

From a total of 17 selected pages, only 3 of them are salient. Except 0.9 % of the subjects, everyone picked a color to be the best example of “krem”. The number of different color chips chosen by the subjects is 17 (Figure 6.25 b and c). The important color pages and the color chips are (Figure 6.25 a):

Color Page:	Chips:	
10 YR	9/4	
2.5 Y	9/2	9/4
5 Y	9/2	9/4

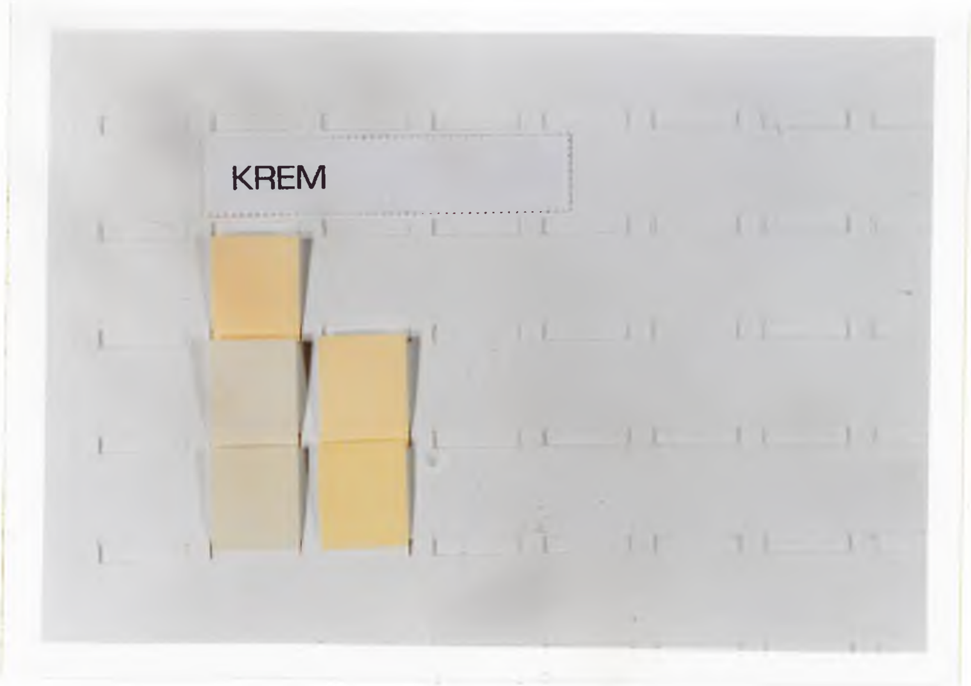


Figure 6.25 a. Presentation of color chips constituting the range for “krem”.

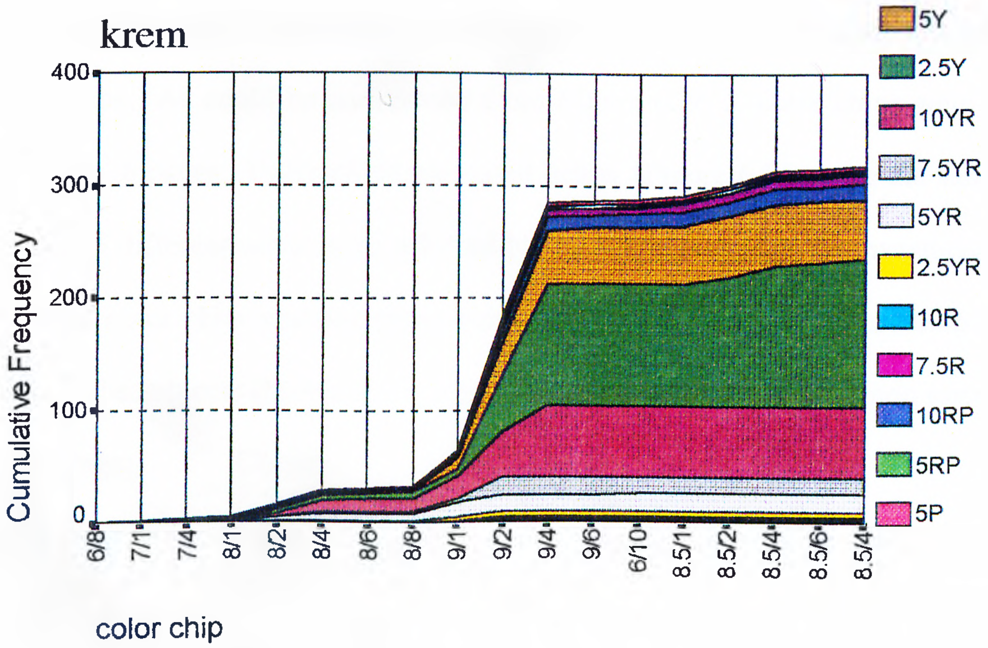


Figure 6.25 b. Cumulative frequency distribution of responses for “krem” using stacked area chart

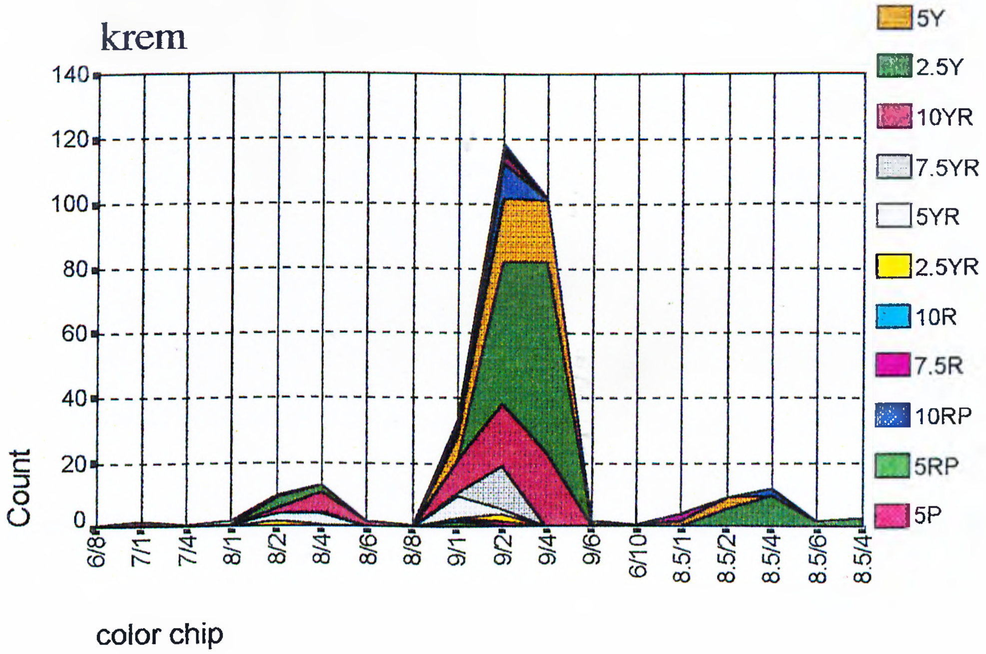


Figure 6.25 c. Stacked area chart showing the cumulative number of responses for “krem”

Limon Sarısı *(Lemon Yellow):*

It is one of the color terms that a great amount of agreement is achieved on certain color chips. As could be understood from Figure 6.26 b, color chips were selected from only 6 pages. Color chips presented below (Figure 6.26 a) are the salient ones among 15 different color chips selected by the subjects during the investigation. All the other color chips and the pages holding them are shown in Figure 6.26 b and c. 94 % of the subjects chose a color chip to be the best example of "limon sarısı".

Color Page:	Chips:		
5 Y	8.5/10	8.5/12	8.5 /14
7.5 Y	8.5/12		

Figure 6.26 a. Presentation of color chips constituting the range for "limon sarısı".

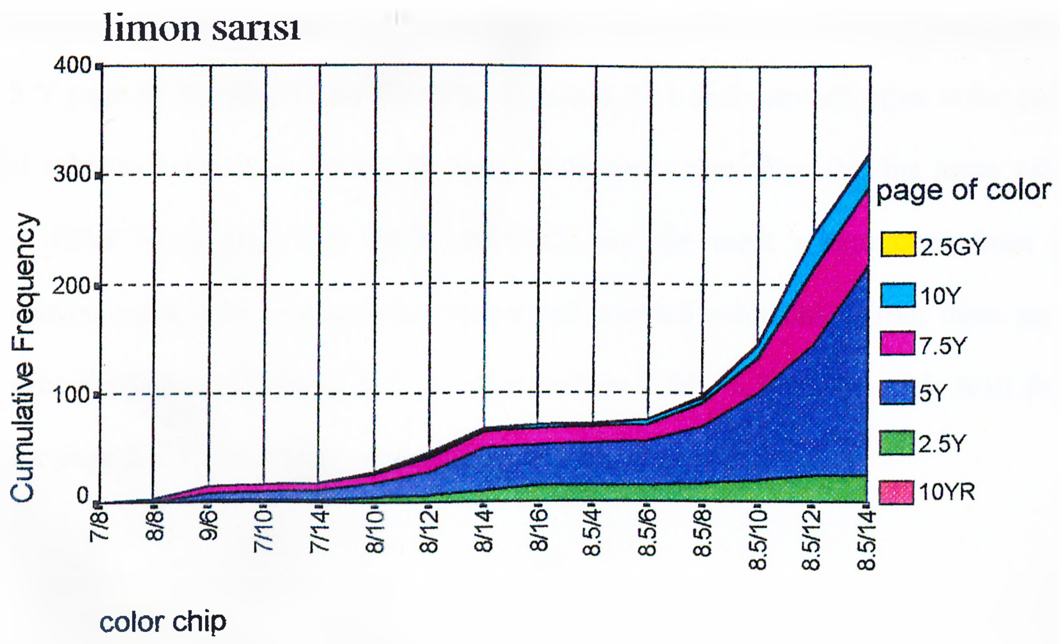


Figure 6.26 b. Cumulative frequency distribution of responses for "limon sarısı" using stacked area chart

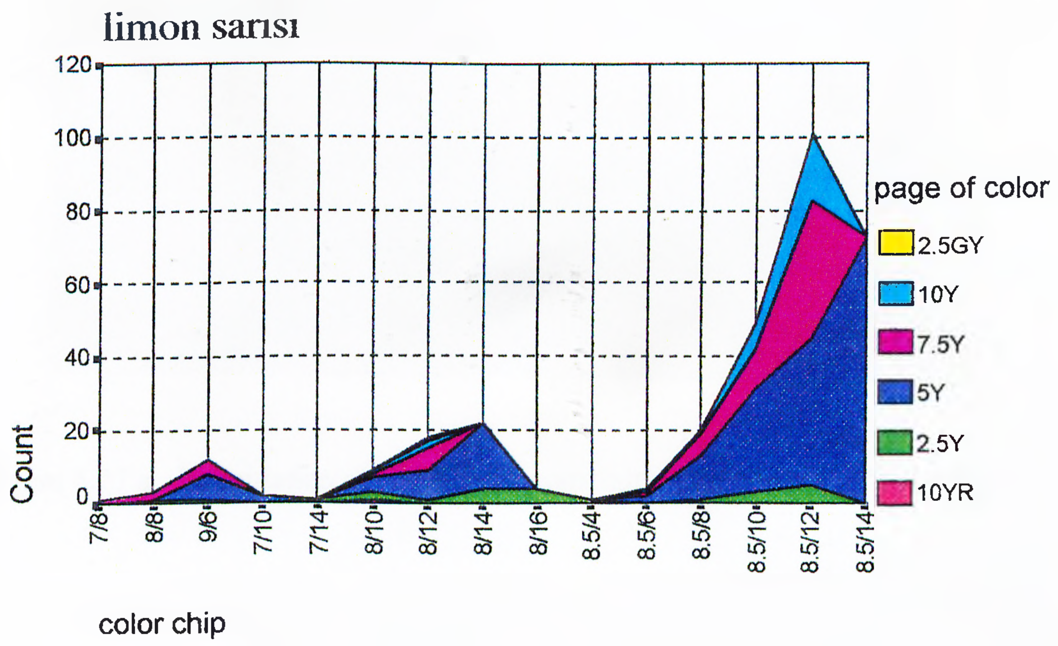


Figure 6.26 c. Stacked area chart showing the cumulative number of responses for "limon sarısı"

Bal Rengi *(Honey Yellow):*

"Bal Rengi" is a non-basic color term which holds great amount of responses in the 2.5 Y page of Munsell Color System. Figure 6.27 b indicates all other color pages that subjects referred to during the tests. Adjacent color chips (having same value, and differ in chroma) 7/8, 7/10, and 7/12, are the most salient ones from the dominant color page. Other color pages and selected color chips from these pages can be viewed from Figure 6.27 c. Color chips 8.5/6, 8.5/8, 8/10 and 6/10 from color page 2.5 Y can also be added to the range.

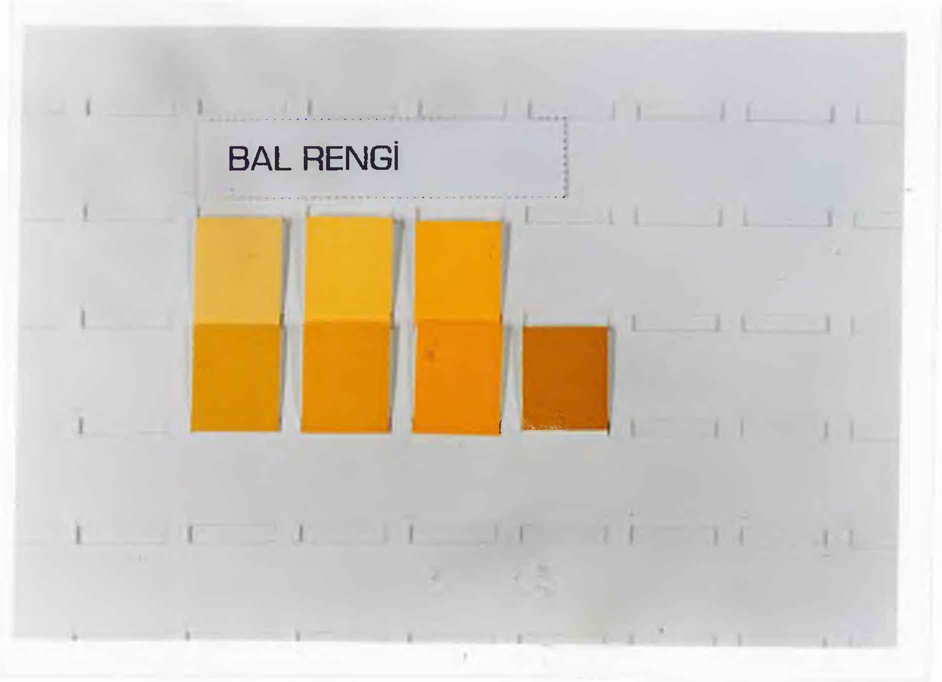


Figure 6.27 a. Presentation of color chips constituting the range for "bal rengi".

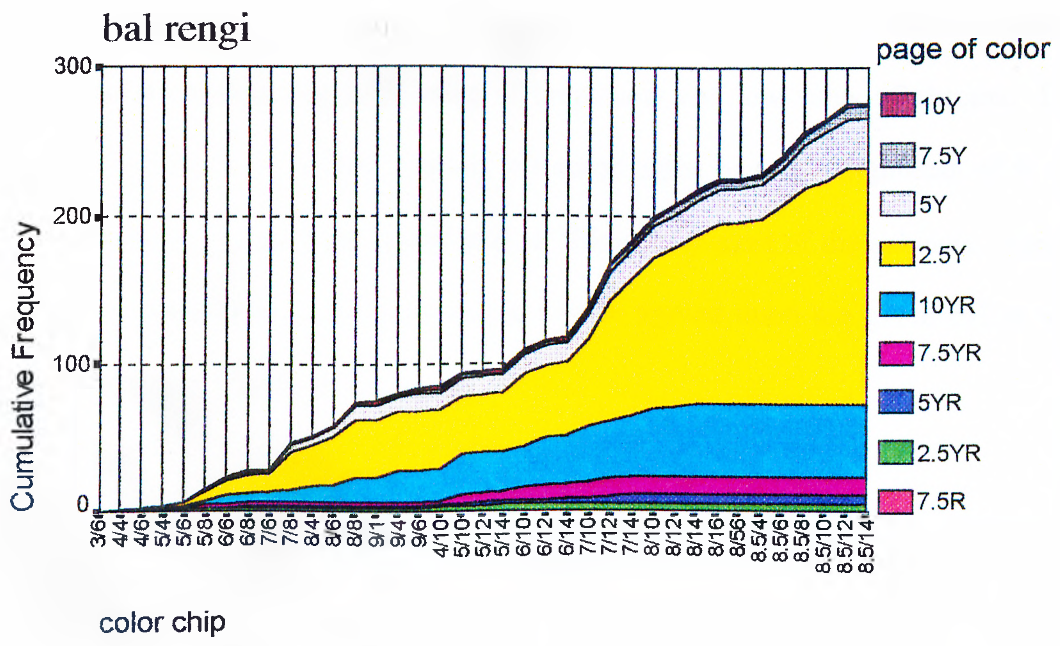


Figure 6.27 b Cumulative frequency distribution of responses for “bal rengi” using stacked area chart

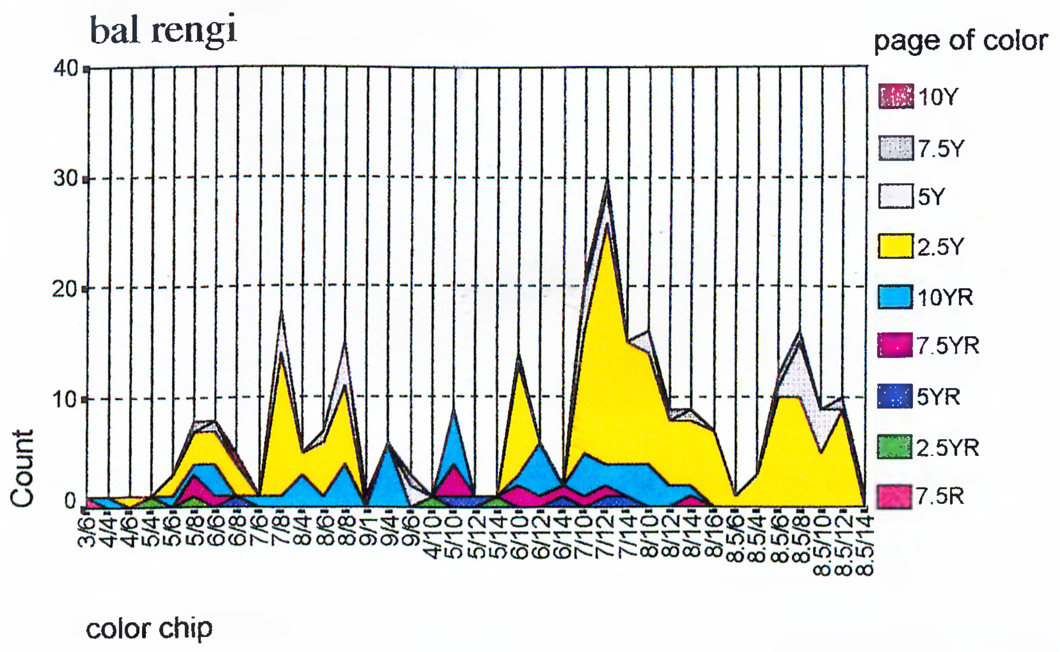


Figure 6.27 c. Stacked area chart showing the cumulative number of responses for “bal rengi”

Fildişi *(Ivory):*

"Fildişi" is a non-basic color term which unites the data from different subjects around color chips having high value of brightness and low value of chroma. Like the color preferences of "bej", nearly all color chips having a lightness of 9, and chroma between 1 and 4 are considered as "fildişi" by most of the subjects. Among this large probability, color chips that are more agreed upon are given below with their color pages (Figure 6.28a):

Color Page:	Chips		
10 YR	9/1	9/2	
2.5 Y	9/2	9/4	
5 Y	9/2	9/4	8.5/2

Figure 6.28 a. Presentation of color chips constituting the range for "fildişi".

Color pages for "fildişi" and "bej" are same except the color page 5 Y which is only referred in the selection of necessary color chips of "fildişi". Pearson Correlation coefficient, supporting this similarity can be seen in Appendix 3.2

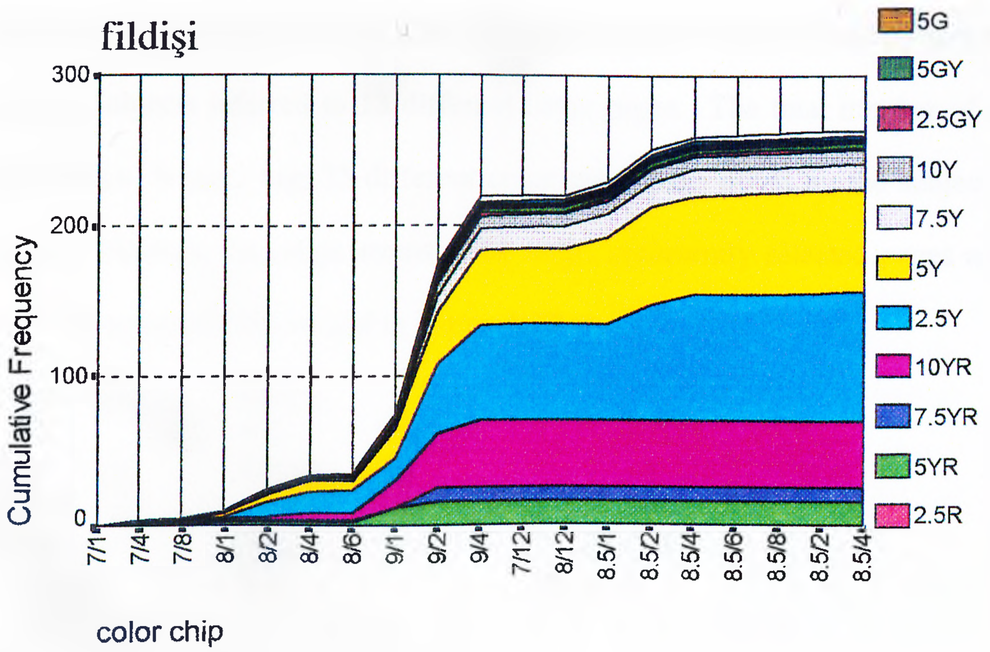


Figure 6.28 b. Cumulative frequency distribution of responses for "fildişi" using stacked area chart

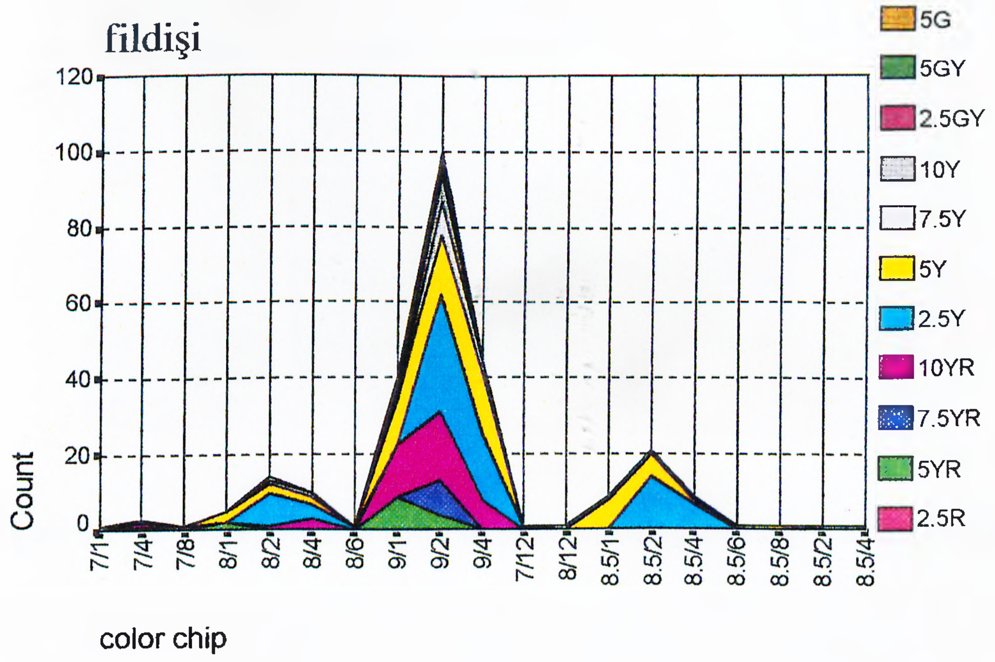


Figure 6.28 c. Stacked area chart showing the cumulative number of responses for "fildişi"

Zeytin Yeşili *(Olive Green):*

It is a color term that holds a number of different color chips in the constructed color range. Subjects referred to 13 different color pages. The total number of selected color chips is quite big; 35 different color chips were noted by the subjects of the study. Although the range seems to be large, recurrently selected pages and color chips are presented below and in Figure 6.29 a:

Color Page:	Chips:			
7.5 Y	6/8	5/6		
10 Y	6/8	5/6		
2.5 GY	6/10	5/6	5/8	4/6
5 GY	6/8	4/4	4/8	3/6

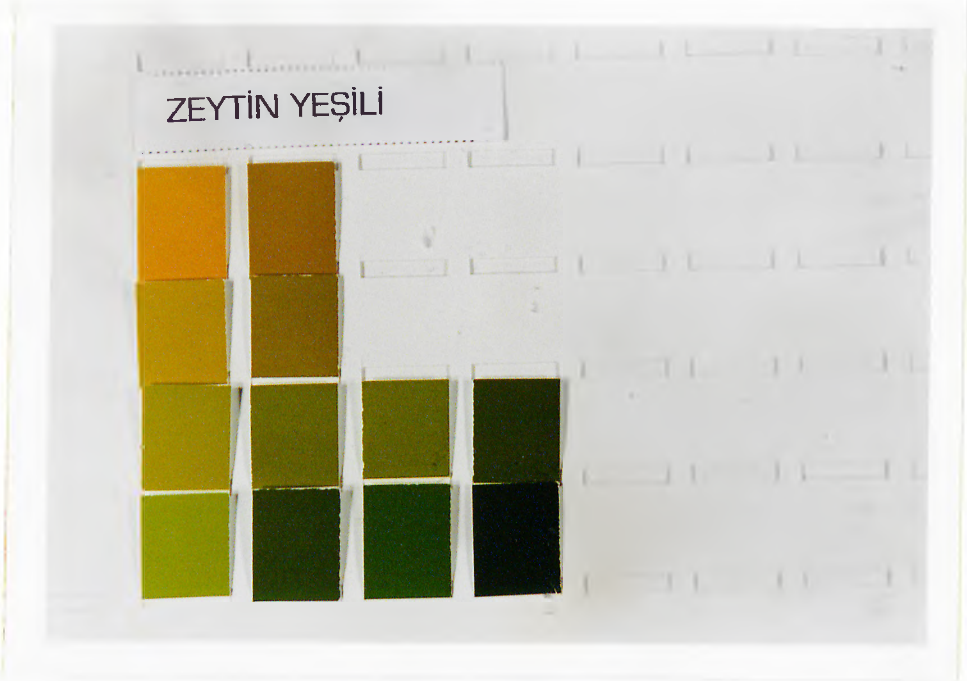


Figure 6.29 a. Presentation of color chips constituting the range for “zeytin yeşili”.

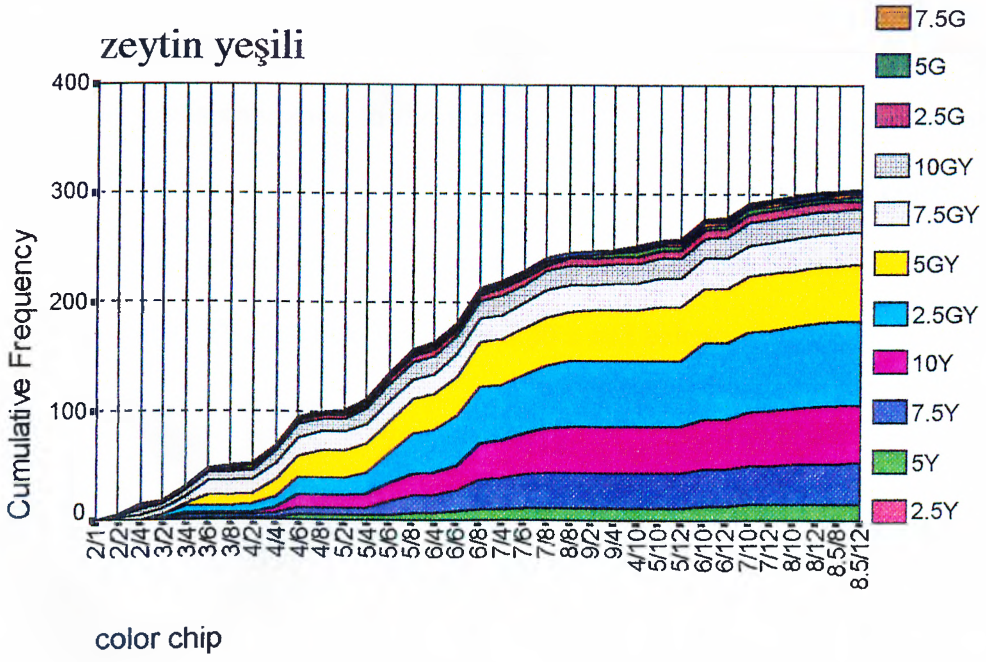


Figure 6.29 b. Cumulative frequency distribution of responses for "zeytin yeşili" using stacked area chart

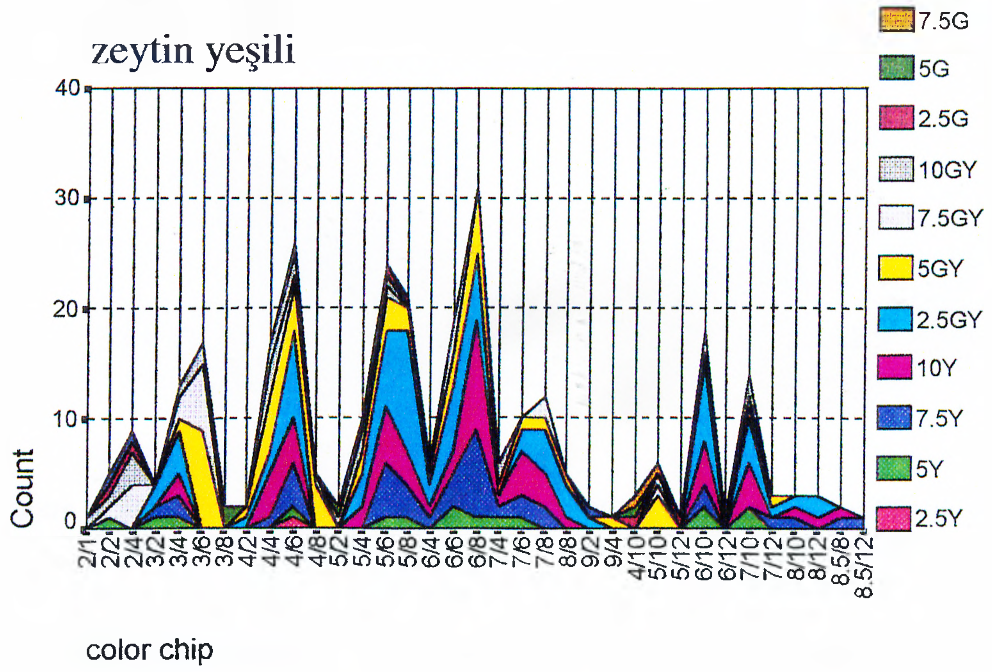


Figure 6.29 c. Stacked area chart showing the cumulative number of responses for "zeytin yeşili"

Fıstık Yeşili *(Pistachio Green):*

Like "zeytin yeşili" selected chip number from a total of 12 pages is again quite large (30), when compared to the number obtained from the analysis of other non-basic color terms. Color pages and the distribution of the selected color chips over these pages are summarized in Figure 6.30 b and c. Most salient color chips among this huge range are presented in Figure 6.30 a and below:

Color Page:	Chips:		
2.5 GY	8/12	7/10	7/12
5 GY	7/12		
7.5 GY	6/12		

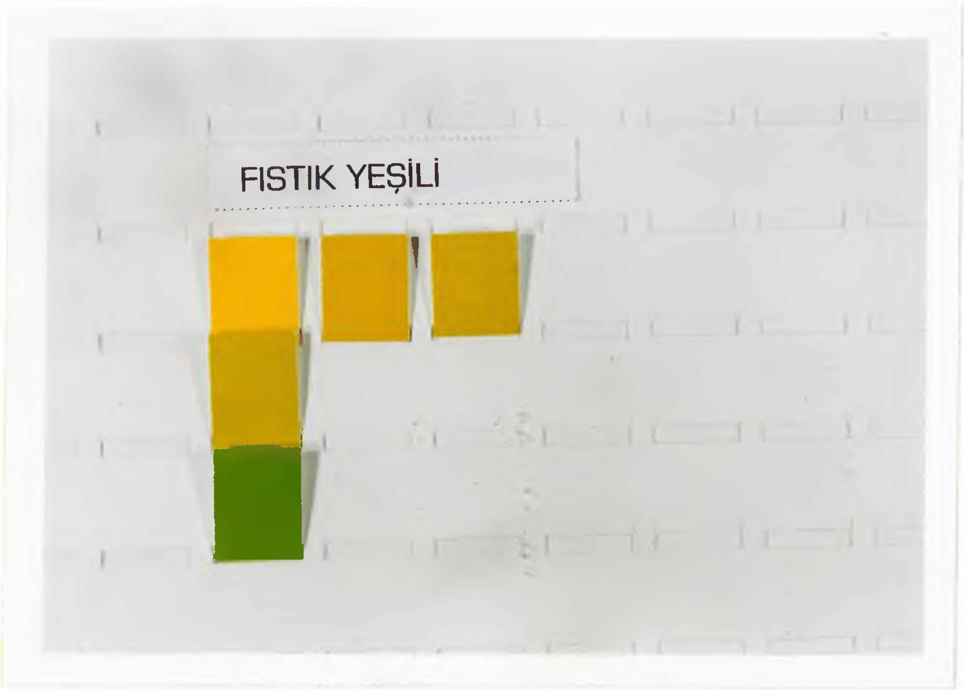


Figure 6.30 a. Presentation of color chips constituting the range for "fıstık yeşili".

The color page preferences of the three non-basic color terms, from the green region of the spectrum, investigated in this dissertation, show similarities but the degree of relationship is moderate (appendix 3.2).

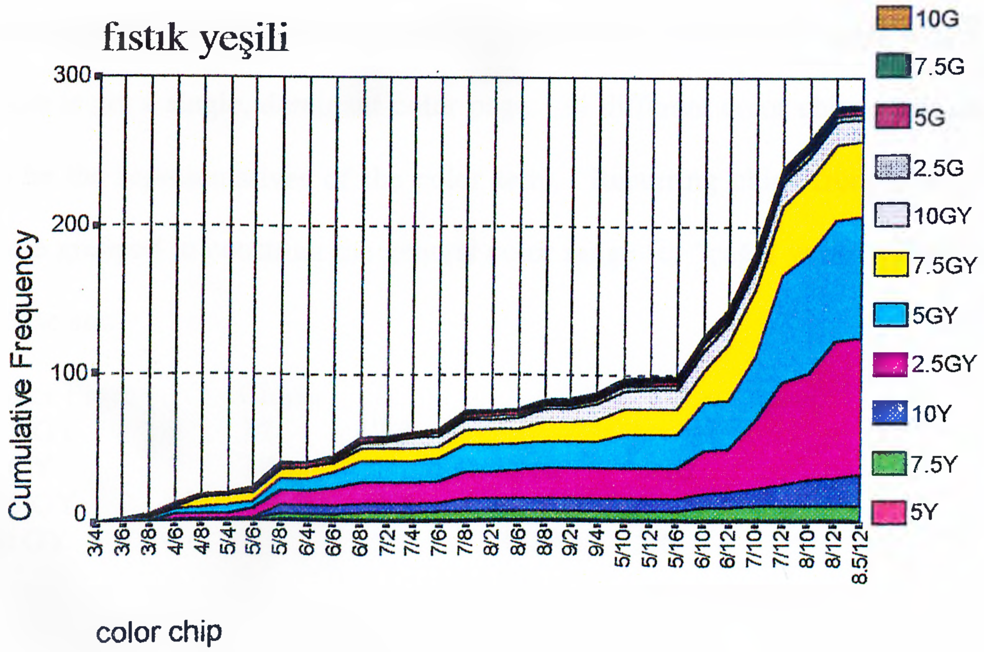


Figure 6.30 b. Cumulative frequency distribution of responses for "fıstık yeşili" using stacked area chart

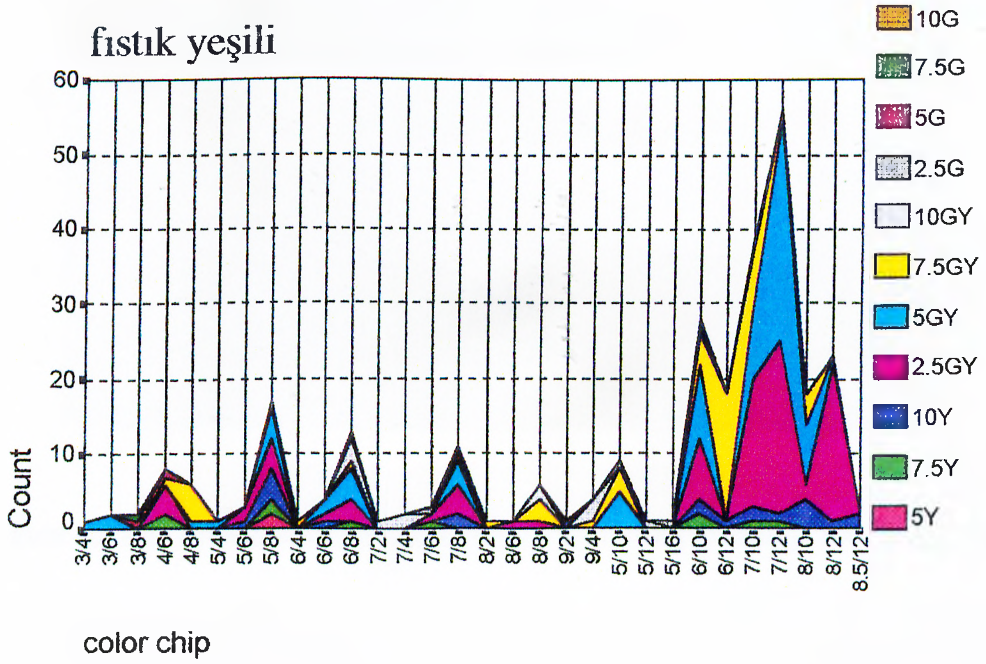


Figure 6.30 c. Stacked area chart showing the cumulative number of responses for "fıstık yeşili"

Çağla Yeşili *(Almond Green):*

As could be understood from the graphs attached to the text (Figure 6.31 b and c), there is not a single, dominant color page. 34 different color chips were considered to be the representatives of the color term. Recurring chips from different pages were grouped to construct the general color range for "çağla yeşili" (Figure 6.31 a). These are:

Color Page:	Chips:			
2.5 GY	7/6	7/8		
5 GY	7/6	7/12	6/10	5/10
7.5 GY	5/6	5/8		
10 GY	7/6	6/6	6/10	5/6

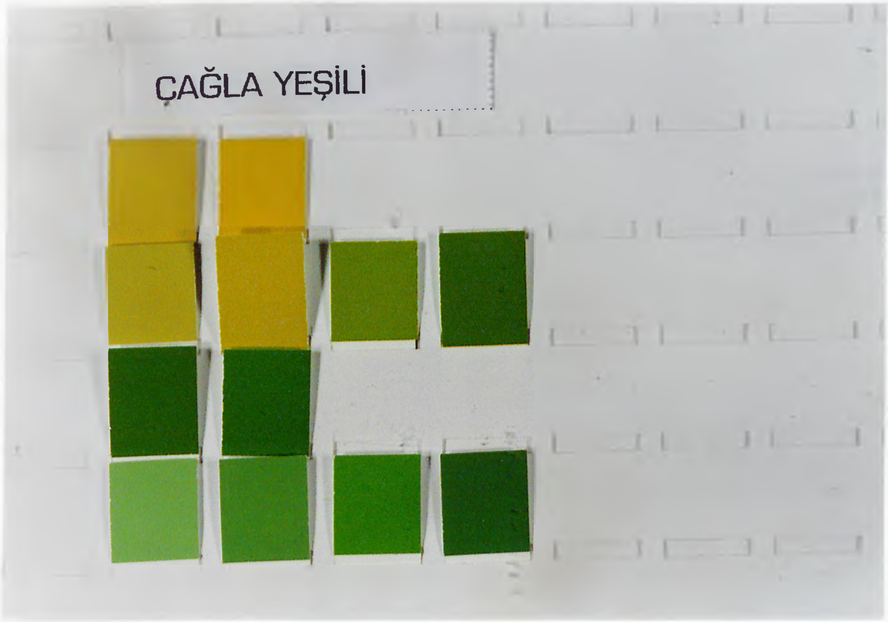


Figure 6.31 a. Presentation of color chips constituting the range for "çağla yeşili".

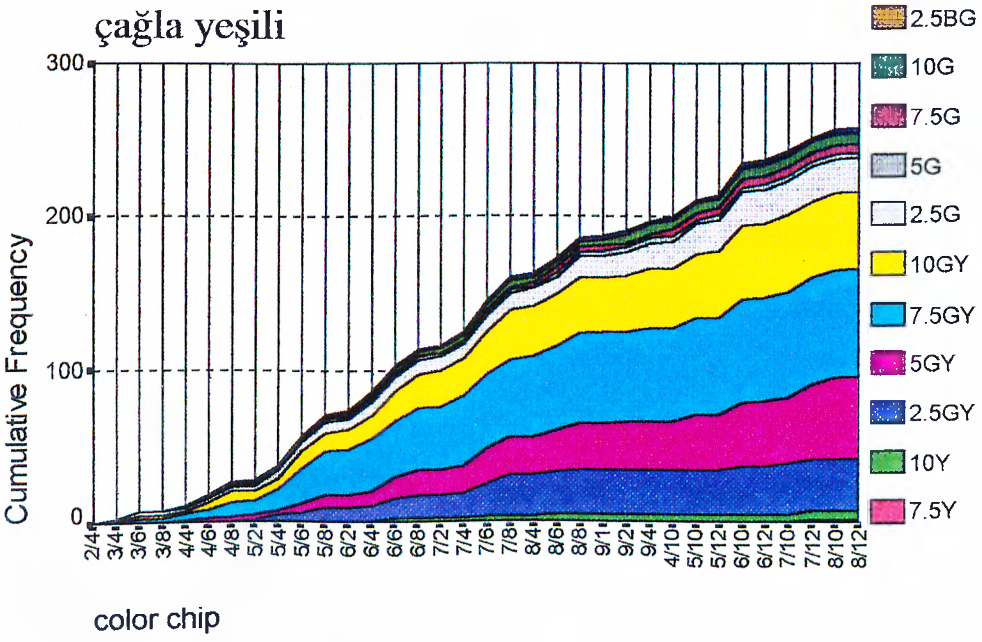


Figure 6.31 b. Cumulative frequency distribution of responses for "çağla yeşili" using stacked area chart

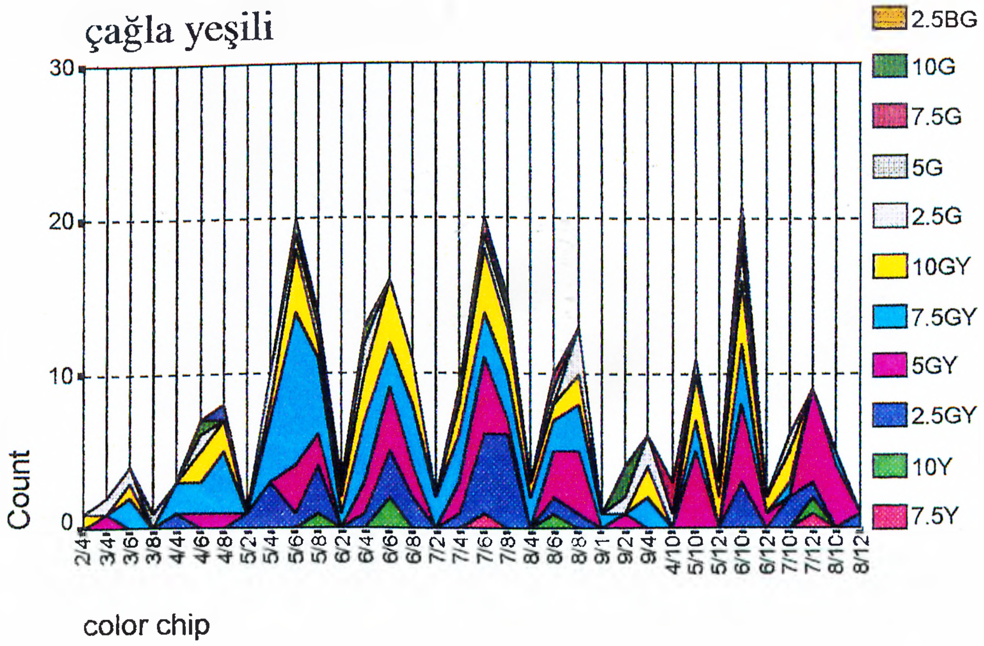


Figure 6.31 c. Stacked area chart showing the cumulative number of responses for "çağla yeşili"

Lacivert *(Navy Blue):*

It is a non-basic color term that is known by the 98.8 % of the respondents of the study. The color range exemplified for "lacivert" contains very close color chips having same values but differ only in chroma. Two color pages 5 PB and 7.5 PB are recurringly referred during the tests. Figure 6.32 b and c display the distribution of the data collected for this non-basic color term. Salient color chips from these pages are (Figure 6.32 a):

Color Page:	Chips:		
5 PB	2/4	2/6	2/8
7.5 PB	2/4	2/6	2/10

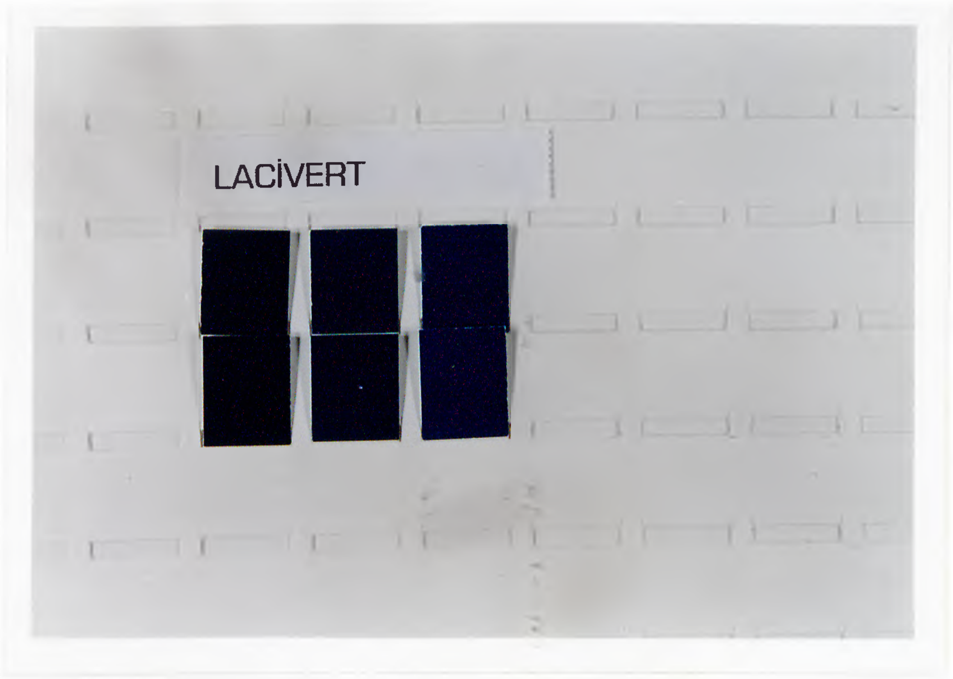


Figure 6.32 a. Presentation of color chips constituting the range for "lacivert".

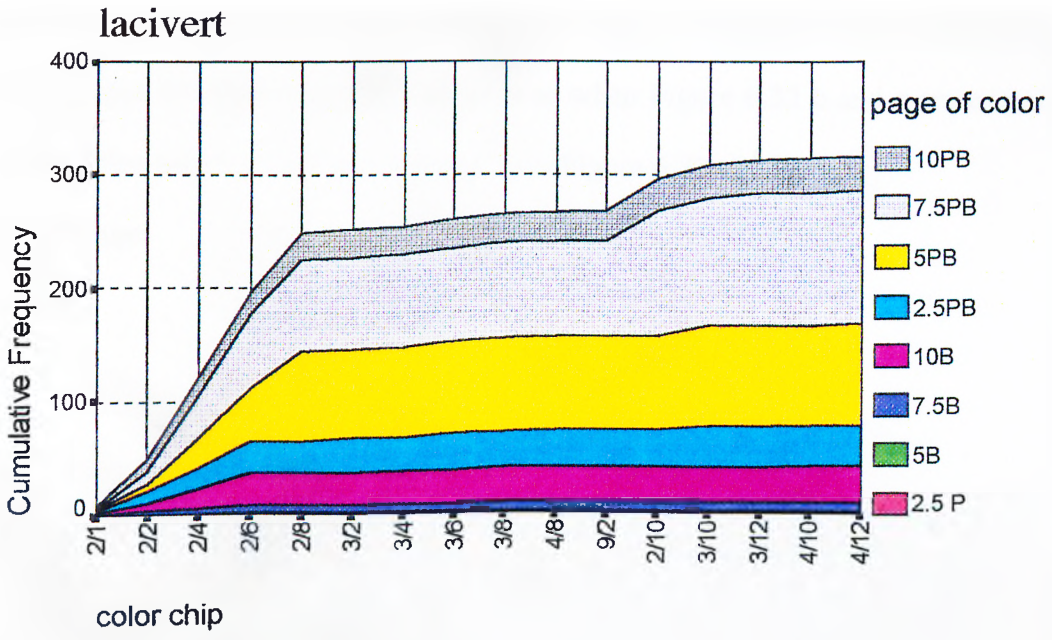


Figure 6.32 b. Cumulative frequency distribution of responses for "lacivert" using stacked area chart

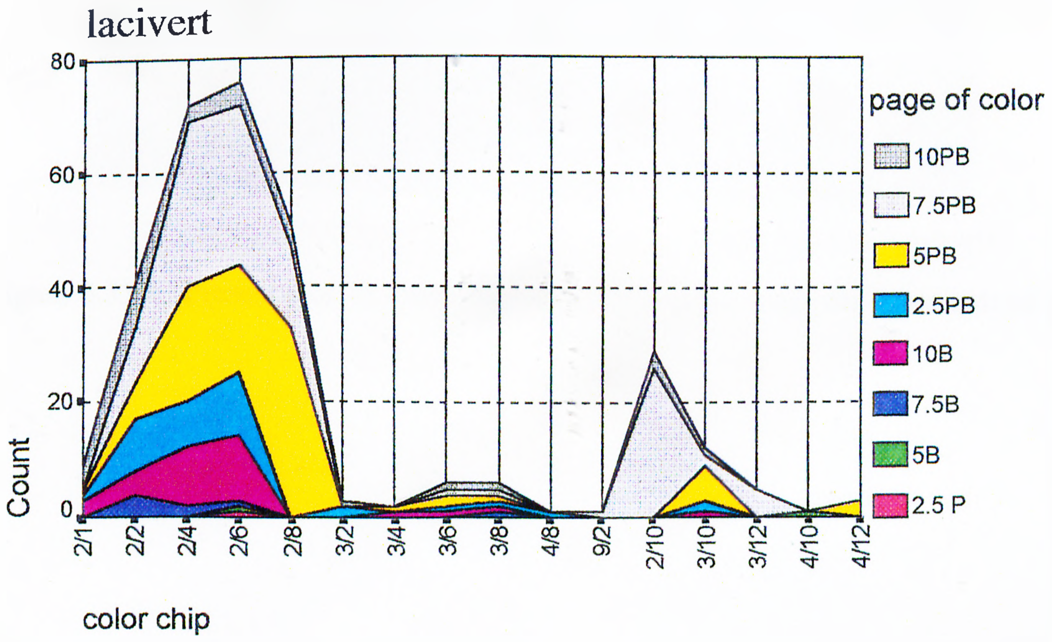


Figure 6.32 c. Stacked area chart showing the cumulative number of responses for "lacivert"

Gece Mavisi *(Night Blue):*

It is the last color term investigated in the study. Similarity in the preference of color pages between "lacivert" can be seen when Figure 6.33 b and c are examined. Color chips selected for "gece mavisi" are (Figure 6.33 a):

Color Page:	Chips:	
5 PB	2/8	3/10
7.5 PB	2/10	3/12

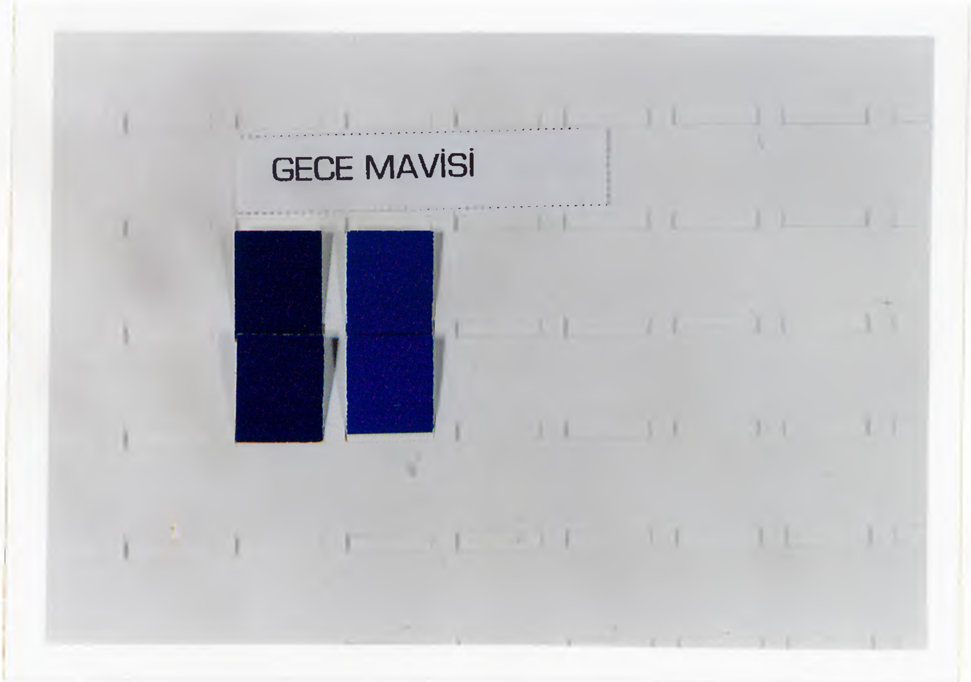


Figure 6.33 a. Presentation of color chips constituting the range for "gece mavisi".

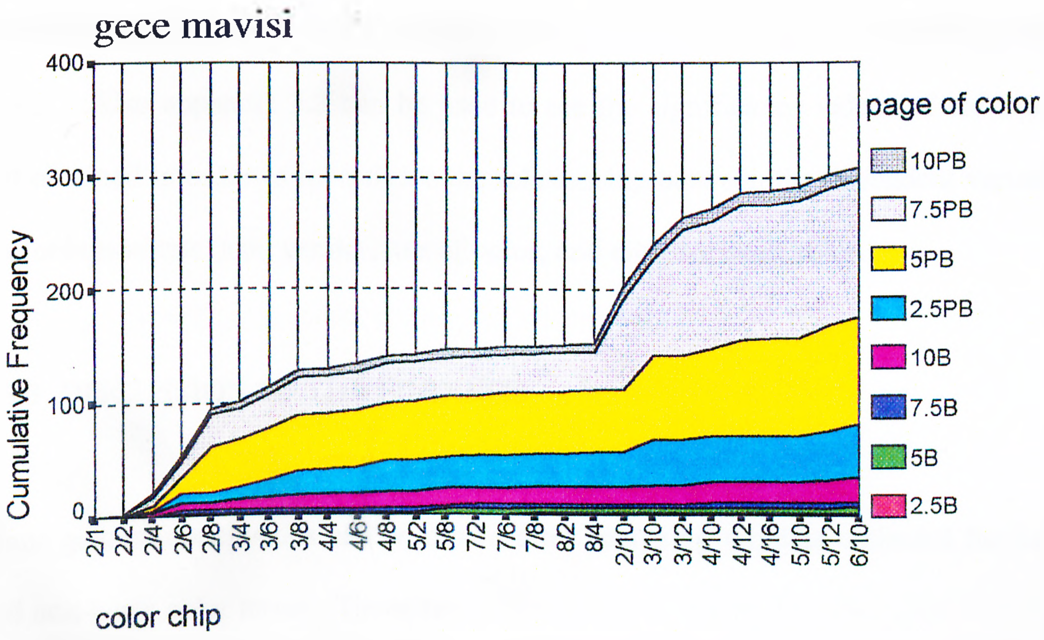


Figure 6.33 b. Cumulative frequency distribution of responses for "gece mavisi" using stacked area chart

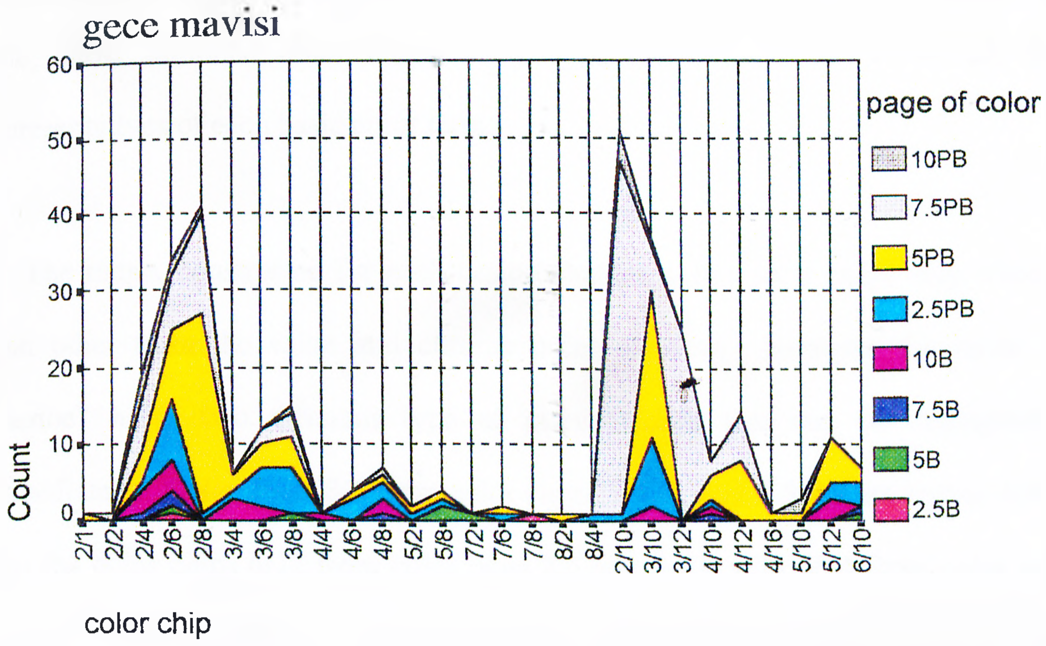


Figure 6.33 c. Stacked area chart showing the cumulative number of responses for "gece mavisi"

Appendix 3.2 summarizes the statistical values of the Pearson Correlation Coefficients, indicating relationship between the color pages, for different color terms. Also appendix 3.3 can be used to see the significance values of chi-square test obtained in order to investigate the relationship between the dependent variables and independents (age, gender, use of color, and city) for each color.

6.3.3 DISCUSSION OF THE FINDINGS

Some general conclusions can be drawn after analyzing the data collected for basic and non-basic color terms. These are:

1. For all the basic color terms, the color chips included in the color ranges are the most saturated chips of the referred pages. The lightness value and color pages of the selected chips may differ according to the assigned color term but, whatever the case, most saturated color chips are chosen by the subjects to be the best representatives of each basic color term.

2. The range, constructed for each basic color term, has color chips very close to each other from the value and chroma point of view. However the range for "pembe" holds two different type of color stimuli that can be distinguished immediately. Color chips 8/6 from color pages 2.5, 5, and 7.5 RP are lighter colors than the color chips 6/12 from color page 2.5 and 5 RP with 5/14 from color page 7.5 RP. Thus two different "pembe" responses exist for this basic color term. The image of "pembe" in mind is either a light color or a dark one.

3. Responses for "yeşil" are concentrated on the GY (green-yellow) pages of the system, while the system has its own page for green (G).

4. The visualized or selected "mavi" responses are most of the time from the color chips placed in the PB (purple-blue) pages of the Munsell Color System. Only one blue page of the system, the 10 B, was used by the subjects to indicate this color.

5. The color range arranged for basic color terms, more or less, hold color chips close to each other. The variation in the brightness and saturation values of the selected color chips are very close and sometimes exactly the same for different pages belonging to same color (e.g., color range "mavi" holds the following stimuli: chip 5/12 of 10 B page, 5/12 of 2.5 PB, and 4/12 of 5 PB page).

6. The relationship between the dependent and independent variables were analyzed with necessary techniques of statistics. Calculated values of necessary statistical analysis are given in Appendix 3 at the end of the dissertation. Besides these, the frequency distribution of color chips for each color term was examined. Significant relationship, if exists, between each independent variable and dependent variable are described by giving examples for the necessary cases. Each chip of the Munsell System is considered as a separate response even if color nuance between adjacent chips are negligible.

After the application of the procedure explained above, except basic color term "sarı", the independent variables seem to have effects on all other color terms (Appendix 3.3). Gender, age, using color in the work field and the city of living are all different qualities of the individuals examined during the tests. Unequal response patterns are obtained from different subjects.

Having realized that some color chips of the system have really small color nuances in between, after obtaining the statistical values, the frequency distribution of each case indicating significant relationship between the dependent and independent variables has been examined. The reason for this second procedure was to detect if there were really critical differences in the responses collected from the subjects. After analyzing the data in this manner, I can suggest that, for most of the basic color terms, these perception differences are not so distinct. Although each different color chip, appearing in the Munsell Color System, is considered as a different stimuli, color nuances for the neighboring chips are small. For example, the color range for "kırmızı" or "turuncu" includes 4 different color chips from different color pages. If the color chips are examined carefully, it can easily be visualized that the variance is very small. Same condition is valid for all basic color terms, thus it is not false to claim that Turkish People have enough agreement and common understanding in determining the range for basic color terms, although differences in perception are recorded depending on the independent variables.

7. Non-basic color terms are used to make finer adjustments, descriptions, and definitions, using surface characteristics of colored objects. A basic color term, on the other hand, represents a general range of color than a specific one. Consequently, the constructed range for a non-basic color term is supposed to have less and closer color chips selected by the subjects, when compared with the range constructed for a basic color term. However, observed situations, for most of the

non-basic color terms, do not support this assumption. The range assembled for non-basic color terms include more color chips, having different values of brightness and saturation, when compared with basic color terms.

8. "Leylak", "Kan Kırmızısı", "Limon Sarısı", " Kanarya Sarısı", "Gece Mavisi", and "Lacivert" are the non-basic color terms that concentrate the responses of subjects into a smaller range. On the contrary, "Eflatun", "Kiremit Rengi", "Ela", "Zeytin Yeşili", "Fıstık Yeşili" and "Çağla Yeşili" are the color terms that have wider distribution of color chips on different color pages.

9. Color chips selected for "sarı" and "kanarya sarısı" are very close to each other. It is not false to conclude that, these two color terms represent nearly the same color range although they are different than each other linguistically.

10. Likewise the mentioned pair above, "turuncu" and "kavuniçi" holds similar and sometimes same color chips. Although one of them is a basic color term, and the other is a non-basic color term, the images of the color in the minds of Turkish Society are almost the same. It is also surprising to realize this type of relationship between these two different color terms, when the surface color of the referred objects are taken into account. When the color term "bal rengi" was assigned to the subjects of the study, most of them asked the question 'What type of 'bal' should we consider?'. However none of the subjects thought about the different types of 'kavun', while selecting a color chip for "kavuniçi". Although the actual surface colors of two fruits, 'turunç' and 'kavun', are really different from each other, responses showed that they are perceived identical. Thus it can be stated that the

non-basic color term “kavuniçi” can be used to name a color stimuli that is “turuncu”.

11. “Kan Kırmızısı” is the only non-basic color term that has a great amount of agreement both on its color page and color chips. Also an exceptional case was observed when the data for “kırmızı” and “kan kırmızısı” was compared. The number of selected color chips, in the constructed range for a non-basic color term, is always more than the number of chips in the range constructed for a basic color term. However, in the case of “kan kırmızısı” the number of chips are only two whereas there are four color chips in the range for “kırmızı”.

12. “Eflatun” and “leylak” are two non-basic color terms that concentrate the preferences of the subjects into color ranges that have similar color chips. Besides that, the collected data for these terms also show similarities. For “eflatun”, a total of 27 color chips were selected out of 10 color pages and for “leylak”, 26 color chips were selected from 11 different pages. The difference is in the variety of color chips in the range constructed for each color term. Although “eflatun” is known by the 78.9 % of the subjects, the range has more color chips than the range for “leylak”, which is a non-basic color term known by the 62.4 % of the investigated subjects. It can be concluded that even though “leylak” is not a color term referred frequently, it has more definite representation in the minds of Turkish People than the more frequently used and known color term “eflatun”.

13. “Bej”, “krem”, and “fildişi” are three different color terms supposed to carry different color percepts. However, not only the color pages, but also some of the

color chips picked up, are the same for these non-basic color terms. In literature (Davaz 1991, and appendix 2.1) "fildişi" is included in white, "krem " is included in yellow, and "bej" is included in the brown section of color terminology. It can be argued that, the color represented by these different color terms, are actually the same in the minds of Turkish People.

14. "Lacivert" is a non-basic color term that was picked up as quickly as a basic color term. It can be a potential word to be a basic color term, as in the case of light blue's being a basic color term for Russians (Kay and McDaniel 641). The color range exemplified for "lacivert" contains very close color chips from two color pages, 5 and 5.7 PB. Selected color chips have same lightness values and they show small variations depending on the chroma values.

15. Turkish People, during the investigation, show no strict distinction in choosing the best representatives for very close color pairs. If we examine the color ranges, responded, it is clearly seen that same color chips from same pages were used in order to represent two different non-basic color terms, such as in the case for "bordo" and "vişne çürüğü", "krem" and "fildişi". This may be due to the close color values of these pairs that make finer adjustments difficult. On the other hand, one other reason may hold the truth that, these color pairs, in fact, are same for Turkish people. Thus Turkish People, sometimes and for some specific colors, have tendency to use a single term for different stimuli as they really could not observe or detect the real color value it carries.

16. Among all the non-basic color terms, the ones belonging to the green region of the spectrum were problematical. Total selected chip number exceeds 35, which means a great variation in the perception and visualization. Subjects concentrated on a smaller number of color chips for "fıstık yeşili" when compared to the other non-basic color terms representing a portion from the green region of the color spectrum. The variation of color chips in the range assembled for "çağla yeşili" is worth mentioning as it holds very differently colored chips.

Like "çağla yeşili", responses for "zeytin yeşili" resulted in the formation of a color range having a number of different color chips. As it could be visualized from the photographs there is no distinct and similar representation of these two non-basic color terms in the minds of the speakers of Turkish language. Although they are frequently used in daily life language, these color terms can cause certain misinterpretation in the communication between the individuals.

17. "Çingene pembesi" is a non-basic color term that is worth mentioning. It really has an image representation nearly for all of the members of the society although there is no object to look at, or to refer for the actual color carried by this word.

18. It can be concluded that, the risk of understanding different colors is high, when a non-basic color term is vocalized. The image of the color in one's mind may totally be different than the other's while using these color terms in communication.

19. There is a belief that men are not as successful as women in the discrimination of color. During the investigations, no situation supporting this belief was recorded.

When the frequency distribution of the data for different colors were examined, it was seen that men also respond in the way that women do. Of course there had been cases in which some male subjects had difficulty in identifying the color, but these cases can not be generalized for all men and for color phenomena.

20. If our visual mechanisms do not work different, and we see in the same way like our species do, there must be some other factors influencing our color naming. One of the important factors is culture as accepted. Age, gender and profession are some other factors investigated in the study. However it can not be concluded that all these factors influence our general color perception of all colors. For example, gender is a factor affecting our perception and naming of "bordo", "çingene pembesi", "kavuniçi", "bej" and "bal rengi" (see appendix 3.3), but not for other colors. Thus, conclusions on the affect of the independent variables on dependents of color must carefully be investigated. It is not true to generalize the findings of one color term for a whole range of colors.

6.3.4 RESEARCH NOTES

The following notes and comments obtained from the execution of the experiment were included as part of the experimental research as they may guide or be interesting for the researchers of the field. This document of observations, thoughts, and records were collected during the investigation with no scientific indent, thus they are unplanned data. However they are part of subjects' attitudes obtained during the experiments and may guide other investigations in the future.

1. Specific knowledge requiring color words were eliminated immediately by the subjects.

e.g., Kök Kırmızısı Aşı Boyası Sülyen Rengi Doru etc.

2. "Türkuvaz" is known as a color name but the color it carries could not have been identified by most of the subjects.

Although "Türkuvaz" is also known as "Türk Mavisi", the color term "Türk Mavisi" was eliminated by all the subjects. Same is true for "Bayrak Kırmızısı" and "Türk Kırmızısı" pair.

3. Basic color term "Yeşil" was identified by the same chips most of the time, while more definite color terms of green (e.g., Çağla Yeşili) showed variations during the naming process.

4. The color preference of Turkish Subjects for "Green" is from the Green-Yellow page of the Munsell Book rather than the Green page.

5. 4 different color names were found that describe "Buz". 1- Buz Mavisi, 2- Buz yeşili, 3- Buz pembesi, and 4- Buz beyazı. So as not to direct subjects to a color, the name was given as "Buz Rengi" without any color specification after the term "Buz". The results showed that the preferences were from the PB and B pages. No one responded to the color represented by a pink or a green chip.

6. More saturated color chips were preferred for the representation of basic color terms.

7. Many of the subjects were surprised to realize the huge range of colors.

8. Several subjects complained that Munsell System does not carry the color chip for "Çingene Pembesi". Most of the subjects searched for a brighter and vivid pink to attach for the assigned color name.

9. One of the subjects did not respond to the color term "turuncu". Also 3 other different subjects said that they do not know the color term, but responded accepting the term as "portakal rengi" without any clue what color does "turuncu" look like.

10. Subjects, most of the time were unsatisfactory with the yellow range offered by Munsell Color System. They stated that the system did not include the yellow they have in mind. They referred to the row of chips having lightness value of 8.5 most of the time.

11. While searching for the necessary chip to select, subjects sometimes used additional words, adjectives qualifying the color that they looked for. For example, word "*yeşilimsi kahve*" was used for describing "ela", or "*canlı sarı*" for "kanarya sarısı".

12. Although some color names are used regularly in daily life, without analyzing, judging the exact value they carry, some of the non-basic color terms are

investigated by the subjects after they are asked to select a chip to represent the color term. "Bal rengi", and "gül kurusu" can be given as examples to the condition explained above. Subjects, sometimes ask the question ' Which honey's color?' or 'What color of rose should we think to respond to "gül kurusu"?'.

13. One of the amazing questions came for the color term "zeytin yeşili". Some subjects asked 'Is it the color of black olive or the other?' although a color range (green) is attached to the object to be qualified.

14. Nearly 40 % of the respondents could not select a color chip for "çağla yeşili" in Edirne. Besides not selecting a chip, they said that they have never heard of the color term. After a while it was realized that, they did not use the word "çağla" to name the specified fruit, but used the word "badem" instead.

15. "Kızıl" was related with the hair color in all the cities investigated, except Edirne. None of the subjects in Edirne pronounced the concept of hair. When asked, 'What color do you think "kızıl" is?', most of the subjects described a kind of red, and referred to other color names (e.g., "alev kırmızısı", "ateş kırmızısı") in order to exemplify the color they had in mind.

16. "Parlement Mavi" is the most frequently used color term when non-basic color term "gece mavisi" was assigned.

17. Only one subject selected a chip for "bordo" from the blue region of the spectrum in Trabzon. Reason was, I believe, she was always repeating the words

'bordo-mavi', the colors of Trabzonspor, while thinking for the appropriate chip and finally decided on a blue chip.

18. Some of the subjects were selected from the professions dealing with color, on purpose, to investigate their approach to color. Identification processes of these subjects showed some facts about how industrialization affects the color perception of people. People, using color as a tool in their work (wool dyers, carpet weavers, painters, embroiders, etc.) naturally use colored details. When they are in need of any color, they refer to the codes, numbers given to the colored material. They never use a specific color name to reach to the color they are looking for. For example, no color name exists for the twines of needle workers. Instead of asking one to give the "gül kurusu" twine they only pronounce the code attached to the material by the related industry.

19. Workers of certain industries (especially wool dyers and carpet weavers) are accustomed to see, perceive and use colors in the way the colors presented to them. For example, when individually interviewed workers from dyeing departments of Sümer Halı were asked to show what is "X" for them, they responded that the color they use for the mentioned color term did not exist in the system. These people are used to see and name colors in the way they are offered to them.

20. Most of the subjects asked the following questions after completing the tests:

- Did I choose the true color chip for the assigned terms?,
- Could you show me what color is "X" that I do not know?

These questions show that people believe in existance of true reds, purples or other colors for human beings, although color is a subjective phenomenon rather than an objective one.

7. CONCLUSION

Concept of color recalls different ideas for each individual. To understand and appreciate the aspects of color, one must experience at least basic concepts of color from different disciplines. On the scientific side, physics of light, biology of the nervous system, complexity of the mind, and color use of the living organism to adopt itself to its natural environment can be included in the field of color study. In the humanities, the history of color in art, role of culture and language in color concepts, principles of color for a painter, etc., are different topics of color to be experienced. Whatever the case, all our concepts of color are expressed in language. Thus the perception of color is in the mind of the observer, and communicated with others using necessary color terms in language.

Considering the fact emphasized above, an experimental research has been done in order to identify the color terms in Turkish, and investigate their appearance in minds of the native speakers of Turkish language. The main purpose of this study is to construct a color palette, a color range that reflects the perception of Turkish Society on the basic, and commonly known non-basic color terms in Turkish language.

It is very difficult to set standards, since color is mostly a subjective consideration. Unconsciously aesthetic and emotional judgments are involved in the preferences.

There is no objective criterion to test the validity of the responses of subjects, other than the wavelength of light causing color. Thus, color ranges constructed in this study reflects the perception of the majority of the society rather than exactly measured values. All the information gathered from the tests are presented in graphs to outline the total response variation obtained for the evaluation of color naming of Turkish Society.

Classified color ranges, for most of the basic color terms, include very close color chips. Most of the chips selected by subjects have equal values either for brightness or saturation. On the other hand, the results obtained for most of the non-basic color terms show differences between the grouped color chips. It can be concluded that, when a basic color term is vocalized, the visualized or portrayed color in minds of the Turkish Society is approximately the same. Thus, in the perception of color carried by basic color terms, neurophysiology of vision (biological factors) plays a more important role than the cultural factors, since the data obtained from different regions of Turkey show similar behavior.

Rather than applying the general name of a color, people derived more descriptive color names, from the surface qualities of certain objects, animals, metals or natural phenomena, to communicate with each other. These types of color names are known as non-basic color terms and they are used to make finer discriminations. However, after analyzing the results, it can be concluded that the performance of non-basic color terms is not found to be as expected. Although non-basic color terms are proposed in language to satisfy the inadequate identification by basic color terms, they have different resemblance in minds of different individuals of Turkish Society.

General agreement on a specific mental picture is hard to obtain for most of the non-basic color terms. The reason may be that, non-basic color terms are of more recent origin, and have not been used with necessary definiteness frequently when compared to basic ones. Uncertainty of how to apply these non-basic color terms, may cause people to use the general name of the color most of the time, rather than the derivative one.

Considering the findings, non-basic color terms must be avoided in the communication between different disciplines if the exact color samples of the products are not available. Communication, only with color terms, is not appropriate as the risk of misunderstanding the vocalized non-basic color term is high for Turkish Society.

As described in the section 4.2 of the dissertation, basic color terms are the most frequently occurring color words in language and literature. It was argued by Zipf (refer to section 4.2) that the length of a word, measured in phonemes or syllables, is negatively correlated with the frequency of its usage. Thus terms such as red, blue, etc. are frequently used in English as they satisfy the criterion explained above. Contrarily, color terms "kırmızı", "turuncu", and "kahverengi" in Turkish language are the most frequently used basic color terms although they have more number of phonemes and syllables when compared with other color less used non-basic terms such as "kızıl", "ela", "krem" and "bej".

Age, gender, profession, and living in a specific city may be effective factors on perception of color but it is difficult to generalize the influence of these variables on color, especially on the non-basic color terms, for this study. Because, each of these variables showed different measured values for the particular color terms investigated. For example, age played a dominant role for one color term (gül kurusu), where gender is important for another (bordo), but there was no effect of age on "bordo" and of gender on "gül kurusu". In another example, we see the effect of professional use of color on "kanarya sarısı" while no effect of the other three independent variables was detected for the same color term.

As it could be seen from the statistical data (appendix 3.3), the significant effect of gender was observed in only five of the color terms investigated. Similarly, the effect of using color in the professional field was significant on color naming for only nine color terms out of 32. On the other hand, the significant effect of age was observed in 14, and the significant effect of city was observed in 17 of the cases investigated. It can be concluded that the independent variables of gender and work do not influence the color naming of Turkish subjects. A further study may be designed to investigate the effect of age and city in color naming in a more detailed manner.

It is worth mentioning here that, language and perception work separately. Although cultural relativists claim that color words rule the perception, some of the observed cases in Turkey does not favor this hypothesis. From the beginning of the project, and especially in the procedures of elimination, it was discovered that although subjects said that they knew the color term, they could not show or chose a color chip to represent the color word they knew. Color terms "ela", and "leylak" can be given as examples to this situation. 92 % of the subjects investigated in the second phase of the research for “ela”, and 86 % of the same subjects for “leylak” stated that they knew the color term. However, 48% of the subjects in the third phase of the research for “ela”, and 38 % for “leylak” could not pick up a chip as they could not visualize the color of the term. Because of this reason, it is convincing to think on the hypothesis of the relativists again, before accepting that language determines perception.

It is surprising to discover that color terms are not used in the communication between individuals who use color in their work. Like this manner, workers of certain industries (carpet weavers, wool dyers, etc.) recall the color of the material with the names offered by the designers or executives. In the first case mentioned above, certain codes, and numbers take the place of color names in the identification of the colored material. In the second case, predetermined, subject or profession based color terms are given to the workers with samples, which cause them to remember certain shades with certain names. Also only basic color terms having coded extensions (e.g., Kırmızı 1021, Mavi-3, etc.) are used in the definition of a large color scale. All of these conditions prevent the communication of non-basic color terms between the speakers of Turkish and cause certain culture based color terms to be lost from memory, and overlooked.

It is hoped that the available knowledge summarized in the archival part of this study will be informative for the people interested in the concept of color and many different fields can get benefit from the experimental research that figures out the range of colors noted by Turkish Society. A standardization process between different fields may begin to eliminate the chaos in color. It would be pleasing if this dissertation can also be used in the field of education, at least to make aware of the students, of the richness of color terms in Turkish.

The research also provides details which can be useful in the field of marketing. Findings are important for many industries (especially for textile, paint, and dye producers) as they may guide for the selection, representation of both basic and non-basic colors before their application in the market. It gives clues, in paying attention to certain colors, or about at least checking them out first with the users. Foreign companies can also benefit from the study, in exemplifying, naming the color samples of certain products that will be distributed in Turkey, or produced for Turkish Society.

Design of a further study that investigates and determines the wavelengths of the color terms can be interesting. It will be possible, by then, to place the assembled ranges of the studied color terms into the color spectrum. With this further study, certain membership functions(see figure 4.1 in section 4.3 of the dissertation) can be established, which can be used to determine the composites for each perceived color.

It is important to set and use standards for color. In most of the civilized countries, there are color standards published by relevant institutions (e.g., Standard specification for colors for identification, coding and special purposes by British Standards Institution) which are widely used by the public and commercial trade. Similar standardization is necessary for Turkish Society to limit, or if possible to eliminate, the color chaos experienced by the individuals. A color standard, composed of color samples represented by color terms, for Turkish people can be designed as a further study.

REFERENCES

Agoston, G.A. *Color Theory and Its Application in Art and Design.* New York: Springer-Verlag, 1987.

Baron, Robert. *Essentials of Psychology.* Boston: Allyn and Bacon, 1996.

Berlin, Brent, and Kay, Paul. *Basic Color Terms.* Berkley: University of California Press, 1969.

Bernasek J. and Haude, Richard. "Color-Naming and Color-Matching by Preschool Children as a Function of Visual Field and Sex." *Perceptual and Motor Skills* 77 (1993): 739-747.

Berry, W. John et al. *Cross-cultural Psychology: Research and Application.* Cambridge: Cambridge University Press, 1992.

Bornstein, M., Kessen, W., and Weiskopf, S. "The Categories of Hue in Infancy." *Science* 191 (1976): 201-202.

Bornstein, Marc H. "Color vision and color naming: A psychophysiological hypothesis of cultural difference. "*Psychological Bulletin* 80 (4) (1973): 257-285.

- - -. " The influence of visual perception on culture." *American Anthropologist* 77 (1975) : 774-798.

- - -. "On the Development of Color Naming in Young Children: Data and Theory." *Brain and Language* 26 (1985): 72-93.

Boynton, Robert. "Insights gained from naming the OSA colors." *Color Categories in Thought and Language.* Ed. C.L. Hardin and Luisa Maffi. Cambridge: Cambridge University Press, 1997. 135-150.

Boynton, Robert and Olson, Conrad. "Locating Basic Colors in the OSA space." *Color Research and Application* 12 (1987): 107-123.

British Standards Institution. *British Standar Specification for Colors for identification, coding and special purposes.* BS 381C: 1988.

Brown, Roger. "In Memorial Tribute to Eric Lenneberg." *Cognition* 4 (1976) : 125-153.

Casson, Ronald W. " Color shift: evolution of Ebglish Color Terms." *Color Categories in Thought and Language.* Ed. C.L. Hardin and Luisa Maffi. Cambridge: Cambridge University Press, 1997. 224-239.

Clearwater Yvone. *Space Station Habitability.* California: National Aeronautics and Space Administration, 1986.

Collier, George A. et al. " Further evidence for universal color categories." *Language* 52(4) (1976): 884-890.

Color Catalogues of selected paint manufacturers (DYO, CBS, MARSHALL)

Color Naming Practices in "IAED 571- Lighting and Color" Lectures. Bilkent University.

Conklin, Harold C. "Color categorization: Review of Basic Color Terms, by Brent Berlin and Paul Kay." *American Anthropologist* 75(4) (1973): 931-942.

Cornsweet, Tom. *Visual Perception.* Orlando: Academic Press, Inc., 1970.

D'Andrade, R.G. "The Cultural Part of Cognition." *Cognitive Science* 5 (1981): 179-195

Davaz, Ayşe. *Renk Kavram Sözlüğü.*_ İstanbul: Ofset Yapımevi, 1991.

Davies, I.R.L. et al. "Color Terms in Setswana: a linguistic and perceptual approach."*Linguistics* 30 (1992): 1065-1103.

De Valois, Russell L., Abramov I., and Jacobs G.H. " Analysis of response patterns of LGN cells." *Journall of Optical Society of America* 56 (1966): 966-977.

De Valois, Abramov I. and Mead W. M. "Single Cell Analysis of Wavelength Discrimination at the Lateral Geniculate Nucleus in the Macaque." *Journal of Neurophysiology* 30 (1967): 415-433.

Eiseman, L., and Lawrence Herbert. *The Pantone Book of Color.* New York: Harry N. Abrahams, Inc., Publishers, 1990.

Flynn, J. E., Segil, W. and Steffy, A. *Architectural Interior Systems.* New York: 1988.

Flynn, J E. and Spencer, T. J. "The Effects of Light Source Color on User Impression and Satisfaction." *Journal of Illuminating Engineering Society* (1977): 167-179

Friedl, Erica. "Colors and culture change in Southwestern Iran." *Language in Society* 8 (1979): 51-68.

Gage John. "Color and Culture." *Color: Art and Science.* Ed. Trevor Lamb and Janine Bourriau. Cambridge: Cambridge University Press, 1995. 175-193.

Gürbüz, Uğur. *Türk Halılarında Doğal Renkler ve Boyalar.* Ankara: Ajans Türk Matbaacılık Sanayi A.Ş., 1988.

Harmancıoğlu, Mustafa. *Türkiyede bulunan önemli bitki boyalarından elde olunan renklerin çeşitli müessirlerekarşı yün üzerindeki haslık dereceleri.* Ankara: Ankara Üniversitesi basım evi, 1955.

Heider, Eleanor Rosch. "Probabilities, sampling and ethnographic method: The case of Dani color names." *Man* 7 (3) (1972): 448-466.

- - -. "The Nature of Mental Codes for Color Categories." *Journal of Experimental Psychology: Human Perception and Performance* 1 (4) (1975): 303-322.

IES Lighting Handbook. Reference Volume. Section 5, 1984.

Jameson Kimberly and D'Andrade R. G. "It's not really, red, green, yellow, blue: an inquiry into perceptual color space." *Color Categories in Thought and Language*. Ed. C.L. Hardin and Luisa Maffi. Cambridge: Cambridge University Press, 1997. 295-319.

Judd, D.B and Wyszecki, G. *Color in Business, Science, and Industry*. New York: John Wiley and Sons, 1975.

Kay, Paul, and McDaniel, Chad K. "The linguistic significance of the meanings of basic color terms." *Language* 54(3) (1978): 610-646.

Kay, Paul and Kempton, Willett. "What is the Sapir-Whorf Hypothesis?". *American Anthropologist* 86 (1984): 65-79.

Kay, Paul, Berlin, Brent, and Merrifield, William. "Biocultural implications of color naming." *Journal of Linguistic Anthropology* 1 (1) (1991): 12-25.

Lammens, J.M.G. "A Computational Model of Color Perception and Color Naming." Ph.D.Diss. Sate University of New York at Buffalo, 1994.

Lloyd, Richard Earl. "Color Sensation and The Realization of Color on Exterior Architecture: An Archival and Experimental Study on Color Perception." Ph.D. Diss. University of California, Berkeley, 1987.

Lucy John A. "The Linguistics of 'Color'." *Color Categories in Thought and Language*. Ed. C.L. Hardin and Luisa Maffi. Cambridge: Cambridge University Press, 1997. 320-346.

Lucy, John A. and Shweder, Richard A. "Whorf and his critics: Linguistic and Nonlinguistic Influences on Color Memory." *American Anthropologist* 81 (1979):581-606.

Lyons, J. *Semantics*. Cambridge: Cambridge University Press, 1977.

- - - . *Language, Meaning and Context*. London: Fontana/Collins, 1981.

- - - . "Color in Language." *Color: Art and Science*. Ed. Trevor Lamb and Janine Bourriau. Cambridge: Cambridge University Press, 1995. 194-224.

Maffi, Luisa and Hardin, C. L. "Closing Thoughts." *Color Categories in Thought and Language.* Ed. C.L. Hardin and Luisa Maffi. Cambridge: Cambridge University Press, 1997. 347-372.

Mahnke, Frank H. *Color, Environment, and Human Response.* New York: Van Nostrand Reinhold, 1996.

Matsuzawa, Tetsuro. "Color Naming and Classification in a Chimpanzee (Pan troglodytes)". *Journal of Human Evolution* 14 (1985): 283-291.

McNeill, N. B. "Color and Color Terminology." *Journal of Linguistics* 8 (1972): 21-33.

Munsel, A. H. *A Color Notation.* Baltimore: Macbeth, 1981.

Munsell Book of Color : Glossy Finish Collection. Baltimore, Maryland: Macbeth Division of Kollmorgen Instruments Corporation, 1991.

Nassau, Kurt. *The Physics and Chemistry of Color.* New York: John Wiley & Sons, 1983.

Öztürk, İsmail. *Dokumacılık Alanında Kullanılan Bitki Boyaları.* Ankara: Kültür Bakanlığı Milli Folklor Araştırma Dairesi.

Padgham, A. and Saunders, E. *The Perception of Light and Color.* New York: Academic Press, 1975.

Ratner, Carl. "A Sociohistorical Critique of Naturalistic Theories of Color Perception." *The Journal of Mind and Behavior* 10 (1989): 361 372.

Rohles, F.H, Bennet C. and Milliken George A. "The Effects of Lighting, Color, and Room Decor on Thermal Comfort." *ASHRAE Transactions* 87 (2) (1981): 511- 527.

Romney, A. et al. "Culture as Consensus: A Theory of Culture and Informant Accuracy." *American Anthropologist* 88 (1986): 313-338.

Sahlins, Marshall. "Colors and Cultures." *Semiotica* 16 (1) (1976): 1-22.

Segall, M., Donald Campbell, and Melville Herskovits. *The Influence of Culture on Visual Perception.* New York: The Bobbs-Merrill Company, Inc, 1966.

Sivik, Lars. "Color Systems for Cognitive Research." *Color Categories in Thought and Language.* Ed. C.L. Hardin and Luisa Maffi. Cambridge: Cambridge University Press, 1997. 151-193.

Sloane, Patricia. *The Visual Nature of Color.* New York: Design Press, 1989. Van Nostrand Reinhold,1988.

Wattenwyl, Andre von, and Heinrich Zollinger. "Color-term salience and neurophysiology of color vision." *American Anthropologist* 81 (1979): 279-288.

Whorf Benjamin Lee. *Language, Thought and Reality.* Ed. John B. Carroll, Cambridge, Massachusetts: MIT press, 1991.

Witkowski, Stanley R., and Cecil H. Brown. "An explanation of color nomenclature universals." *American Anthropologist* 79 (1977): 50-57.

---. "Lexical encoding sequences and language change: Color terminology systems." *American Anthropologist* 83 (1981): 13-27.

---. "Whorf and universals of color nomenclature." *Journal of Anthropological Research* 38(4) (1982): 411-420.

Wooten, Bill and Miller David L. "The Psychophysics of Color." *Color Categories in Thought and Language.* Ed. C.L. Hardin and Luisa Maffi. Cambridge: Cambridge University Press, 1997. 59-88.

Wright, A. A., and Cumming W.W. "Color Naming Functions for the Pigeon." *Journal of the Experimental Analysis of Behavior* 15 (1971): 7-17.

Wyler, Siegfried. *Color and Language.* Tubingen: Narr, 1992.

Wyszecki, G. And Stiles, W.S. *Color Science: Concepts and Methods, Quantitative Data and Formulae.* New York: John Wiley & Sons, 1982.

Zeyrek, Hasan H. "Dil-içi Dünya Görüşü Açısından İngilizce/Türkçe Renk Adları." Unpublished Master Thesis. Marmara Üniversitesi Sosyal Bilimler Enstitüsü Yabancı Diller Anabilim Dalı İngiliz Dili Eğitimi Bilim Dalı, 1992.

Zimmer, Alf C. "What really is turquoise? A note on the evolution of color terms." *Psychological Research* 44 (3) (1982): 213-230.

APPENDICES

APPENDIX 1

APPENDIX 1-a. Wald (1945) isolated macular pigment and identified it as xanthophyll, a carotenoid that absorbs heavily in the blue (with marked bands at 455 and 480 nanometers). The concentration of carotenoids in the body depends upon dietary habits, and it is not surprising to find that the density of macular pigment varies widely among individuals. Such variation has been thought to change measures in visual psychophysics from normal to tritan, and systematic racial differences in density have been most frequently implicated in concomitant tritan-like deficiencies in spectral sensitivity and color matches (Bornstein, Color Vision 276).

APPENDIX 1-b. Intraocular pigmentation parallels mesodermic pigmentation in its global distribution, and that distribution is adapted to the distribution of higher intensities as well as proportionately greater ultraviolet components in available daylight. The spectral distribution of daylight is, in general, a decreasing function from short to long wavelengths independent of cloud color. Moreover the spectral distribution as well as the intensity and the amount of daylight reaching the earth is not uniform over different areas of the globe. Specific local variations with altitude and latitude exist: the greater the thickness of the atmosphere traversed, the lower the intensity of ultraviolet light. Thus sunlight reaching global areas with a greater altitude or equatorial proximity is richer in ultraviolet components. Moreover the highest values of ambient light intensity as well as largest mean annual amounts of solar radiation have been recorded in the tropics, with a steady decrease toward the poles (Bornstein, Color Vision 276-277).

APPENDIX 2

APPENDIX 2.1 - Complete list of color names

BEYAZ

Ay beyazı
Buz beyazı
Çin beyazı
Çinko beyazı
Fildişi
İnci beyazı
Kar beyazı
Kemik beyazı
Kirli beyaz
Köpük rengi
Krem rengi
Kurşun beyazı
Kırık beyaz
Platin
Porselen beyazı
Sedef
Sis beyazı
Soğuk siyah
Süt beyaz
Sütkırı (at rengi)
Titanyum beyazı
Yumurta kabuğu

SİYAH

Abanoz
Açık siyah
Antrasit *(Fr)*
Barut rengi
Çini siyahı
Fildişi Siyahı
Jet siyahı
Katran
Kemik siyahı
Kestane karası
Kömür karası
Kurum rengi
Kuzguni
Lamba siyahı
Platinyum siyahı
Rastık rengi
Soğuk siyah
Sıcak siyah

GRİ

Açık gri
Anrasit grisi *(Fr)*
Asfalt rengi
Beyaz yaldız
Boz gri
Bulut grisi
Çelik grisi
Çimento grisi
Demir grisi
Duman rengi
Fare grisi
Füme
Granit grisi *(Fr)*
Gümüş rengi
Gümüş yaldız
Gümüşi
Güvercinboynu
Güvercingöğsü
İnci grisi
Kimyoni
Koyu gri
Kristal grisi *(Fr)*
Kül rengi
Kum rengi
Kumru tüyü
Kurşuni
Kır
Leylak grisi
Metal *(Fr)*
Metal grisi
Midye grisi
Mink grisi
Orta kurşuni
Paris grisi
Pastel gri
Sincabi
Sis grisi
Sıçan tüyü
Şafak grisi
Taş rengi
Toz gri
Uçuk gri
Vapur dumanı

KAHVERENGİ

Açık kahverengi
Açık kestane
Antik bej
Aşı
Bambu rengi
Barut bej *(Fr)*
Bej
Bitüm *(Fr)*
Boz
Bronz rengi
Çamur rengi
Ceviz
Çikolata rengi
Çöl rengi
Demir oksit
Demir pası rengi
Doru
Ela
Fındık kabuğu r.
Fındıki
Haki
Kakao
Karamela *(İt)*
Kestane
Kiremit
Koyu kahverengi
Koyu kestane
Koyu siyena
Koyu tuğla
Kum rengi
Kumru
Kına
Kızıl kestane
Mantar beji
Meşe rengi
Okr *(Fr)*
Ombra *(İt)*
Sepya *(Fr)*
Siyena *(İt)*
Sütlü kahve
Şark kahvesi
Taba
Tahıl
Tarçın
Tatlı kahve
Terakotta *(İt)*
Terdesiyen *(İt)*
Titian
Tiziano *(İt)*
Toprak rengi
Tuğla rengi
Tütün rengi
Van Dyck kah.re.
Vizon
Yanık kahve
Yanık kil
Yanık okr *(Fr)*
Yanık Siyena *(İt)*
Yanık şeker ren.

Appendix 2.1 (cont.'d)

PEMBE

Açık pembe
Amatist pembe.
Bebe pembesi
Begonya
Bengal pembesi
Buz pembesi
Çay pembesi
Çilek pembesi
Çingene pembe
Damask (Fr)
Fuşya (Fr)
Gül
Gül pembesi
Gülkurusu
Hint pembesi
Japon gülü
Koyu pembe
Mercan
Midye pembesi
Mısır çiçeği p.
Orkide pembesi
Pastel pembe
Roz madeira
Roze (Fr)
Soluk pembe
Som pembesi
Şeftali
Şeftali çiçeği
Şeker pembesi
Ten rengi
Toz pembe
Uçuk pembe
Yaban gülü
Yanık pembe

KIRMIZI

Açık kırmızı
Al
Al-alaca (Krims)
Alev kırmızısı
Alfa-rosso kırm.
Alizarin (Fr)
Ateş kırmızısı
Aşı Boyası
Bakır kırmızısı
Bayrak kırmızı
Bordo (Fr)
Çilek kırmızısı
Çin kırmızısı
Demir oksit
Domates kırmızı.
Elma kırmızısı
Erguvan
Fes rengi
Garans (Fr)
Gelincik kırmızısı
Grena (Fr)
Gül kurusu
Gül kırmızısı
Gülbahar
Gurup rengi
Güvez
Horoz ibiği
Istakoz kırmızısı
İngiliz kırmızısı
Kadmiyum k.(Fr)
Kan kırmızısı
Karanfil kırm.
Kardınal k. (Fr)
Karmen (Fr)
Kehribar kırm.
Kiraz kırmızısı
Kiremit kırmızısı
Kök kırmızısı
Kongo kırmızısı
Koyu kırmızı
Krimson (İng)
Krom kırm. (Fr)
Kına
Kızıl
Kızıl kahverengi
Kızılcık rengi
Lake
Lal
Madder (İng)
Magenta (Fr-İng)
Maun
Mercan
Minium (İng)
Nacarat (Fr)
Narçiçeği
Pas
Pastel kırmızı
Pompei kırmızısı
Rembrant kırm.
Salça kırmızısı
Skarlet (İng)
Soluk kırmızı
Somon (Fr)
Sülüğen
Sülüğen rengi
Şafak kırmızı
Şarabi kırmızı
Şaraptortusu
Sıklamen
Tarçıni kırmızı
Titien kırmızı
Toprak kırmızısı
Türk kırmızısı
Venedik kırmızısı
Vermiyon (Fr)
Vişne
Vişne çürüğü
Yakut
Yanık karmen k.
Zincifre

SARI

Acı sarı
Açık fildişi
Açık krem (Fr)
Açık sarı
Altın sarısı
Amber sarısı
Ayva sarısı
Bahar sarısı
Bal köpüğü
Balrengi
Başak sarısı
Bebe sarısı
Buğday sarısı
Cehri
Çiğdem boyası
Çingene sarısı
Çinko sarısı
Citron (Fr)
Demir oksitler
Devetüyü
Fildişi
Güneş sarısı
Hardal
Hint sarısı
Ihlamur rengi
Kadmiyum s.(Fr)
Kamışi
Kanarya sarısı
Kayısı sarısı
Kehribar sarısı
Kirli sari
Koyu krem (Fr)
Koyu sarı
Krem
Krom sarıs (Fr)
Kula
Limon
Limon sarısı
Limonküfü
Madder sa.(İng)
Mimoza sarısı
Okr sarısı (Fr)
Orkide sarısı
Öd rengi
Papatya sarısı
Pastel sarı
Safir sarısı
Safran sarısı
Saman sarısı
Sarı yaldız
Siyena sarısı (İt)
Soluk sarı
Şampanya (Fr)
Şeftali
Taba (Fr)
Tahini
Tirşe
Toprak sarısı
Tütün rengi
Uçuk sarı
Vanilya
Yaldız
Yanık amber
Yumurta sarısı

MOR

Açık leylak
Açık menekşe
Akdeniz leylağı
Ametist (Fr)
Böğürtlen rengi
Eflatun
Erguvan
Fuşya moru (Fr)
Galibarda
İmparator rengi
Kara dut rengi
Kara üzüm ren.
Kök moru
Koyu leylak
Kurşuni mor
Lavanta
Leylak
Maddermor(İng)
Magenta(Fr-İng)
Menekşe
Menekşe moru
Mor sümbül
Mürdümeriği r.
Patlıcan moru
Piskopos erguv.
Siyah üzüm r.
Sümbül
Şarabi mor

Appendix 2.1 (cont.'d)

YEŞİL

Abant yeşili
Acı biber yeşili
Acı yeşil
Açık jade (Fr)
Açık yeşil
Amazon yeşili
Avokado yeşili
Badem yeşili
Bahar yeşili
Bakır pası yeşili
Bakır yeşili
Beril
Bohemya yeşili
Bursa yeşili
Buz yeşili
Camgöbeği
Çağla yeşili
Çam yeşili
Çimen yeşili
Çin yeşili
Deniz köpüğü y.
Deniz yeşili
Dudu yeşili
Duman yeşil
Elma yeşili
Fildişi yeşili
Filiz yeşili
Filizi
Fıstık yeşili
Fıstıki
Fıstıkiçi
Göl yeşili
Haki
İngliz yeşili
Jade (yeşim-Fr)
Japon yeşili
Kadmiyum y. (Fr)
Kobalt yeşili (Fr)
Koyu tundra
Koyu yeşil
Kristal yeşil
Krom yeşili (Fr)
Küf
Küf yeşili
Kursak yeşili
Kıbrıs yeşili
Lak yeşili
Limon çiçeği
Limon yeşili
Limonküfü
Mat yeşil
Mentol yeşili
Mineral yeşili
Nefti
Nehir yeşili
Nil yeşili
Ördek yeşili
Ördekbaşı
Orman yeşili
Orta yeşil
Ot yeşili
Pas yeşili
Pastel yeşil
Petrol yeşili
Sis yeşili
Soluk yeşil
Su yeşili
Tavus yeşili
Tirşe
Toprak yeşili
Tunç yeşili
Türbe yeşili
Türk yeşili
Türkuvaz yeşili
Uçuk yeşil
Veronoz y. (Fr)
Viridian (İng)
Yağ yeşili
Yaprak yeşili
Yayla yeşili
Yosun rengi
Zaman yeşili
Zehir yeşili
Zeytin yeşili
Zümrüt yeşili

MAVİ

Açık mavi
Açık türkuvaz(Fr)
Akua
Akvamarin (Fr)
Arduvaz m. (Fr)
Azür mavisi (Fr)
Bebe mavisi
Boncuk mavisi
Buz mavisi
Buzul mavisi
Camgöbegi
Cennet mavisi
Ciyan
Çelik mavisi
Çini mavisi
Çin mavisi
Çividi
Çivit
Dağ mavisi
Deniz mavisi
Donanma mavisi
Duman mavisi
Ecevit mavisi
Ege mavisi
Firuze
Gece mavisi
Gök mavisi
Göl mavisi
Göztaşi mavisi
Havacı mavisi
Havai mavi
İndigo (Fr)
Kar mavisi
Kobalt mavi. (Fr)
Koyu mavi
Koyu turkuvaz
Kurşuni mavi
Lacivert
Lapis Lazuli (Fr)
Lavanta mavisi
Lila
Maden mavisi
Madeni mavi
Meneviş mavisi
Metalik mavi
Mine
Nehir mavisi
Okyanus mavisi
Ozon mavisi
Pastel mavi
Pastel türku. (Fr)
Petrol mavisi
Prusya mavisi
Pudra mavisi
Safir mavisi
Saks mavisi
Seruleum m.(Fr)
Sis
Sis mavisi
Soluk mavi
Su mavisi
Süt mavisi
Toz mavisi
Türk mavisi
Türkuvaz (Fr)
Uçuk mavi
Uçuk mavi
Ufuk mavisi
Ultramarin (Fr)
Uludağ mavisi

TURUNCU

Açık kayısı
Açık turuncu
Alüminy. bronzu
Bakır
Bakır kırmızısı
Balkabağı rengi
Bronz yaldız
Gurup rengi
Havuç rengi
Kadmiyum t. (Fr)
Kavuniçi
Kayısı
Kiremidi (es.t.)
Kiremit rengi
Kök turuncusu
Krom sarısı t .Fr
Krom turun. (Fr)
Madder t. (İng)
Mandalina rengi
Mercan
Okr kahve.(Fr)
Okr kırmızısı (Fr)
Okr turuncu (Fr)
Oranj
Pas rengi
Pastel turuncu
Pekmez köpüğü
Pişmiş ayva
Portakal rengi
Soğan kabuğu
Taba (Fr)
Tarçın rengi
Terrakotta (İt)
Titian (İng)
Turuncu okr (Fr)
Tütün rengi
Vermiyon tr. (Fr)
Yanık okr
Yanık Siyena
Yanık turuncu
Yanık İtalyan top
Yanık İtalyan top
Yavruağzı

APPENDIX 2.2 - Second color list, constructed after the elimination procedure in the second phase of the research project

1 Abanoz
2 Acı biber rengi
3 Acı sarı
4 Acı yeşil
5 Al-alaca
6 Alev rengi
7 Altın rengi
8 Amber rengi
9 Asfalt rengi
10 Aşı boyası
11 Ateş rengi
12 Ay rengi
13 Ayva rengi
14 Badem rengi
15 Bahar sarısı
16 Bahar yeşili
17 Bakır pası rengi
18 Bakır rengi
19 Bal köpüğü
20 Balkabağı rengi
21 Balrengi
22 Barut rengi
23 Başak rengi
24 Bayrak kırmızısı
25 Bebe mavisi
26 Bebe pembesi
27 Bej
28 Boncuk mavisi
29 Bordo
30 Boz
31 Böğürtlen rengi
32 Buğday rengi
33 Bulut rengi
34 Buz rengi
35 Cam göbeği
36 Ceviz rengi
37 Çağla rengi
38 Çam yeşili
39 Çamur rengi
40 Çay rengi
41 Çelik rengi
42 Çiğdem boyası
43 Çikolata rengi
44 Çilek rengi
45 Çimen rengi
46 Çimento rengi
47 Çingene pembe
48 Çingene sarısı
49 Çini rengi
50 Çinko sarısı
51 Çivit
52 Dağ rengi
53 Demir pası rengi
54 Demir rengi
55 Deniz rengi
56 Devetüyü
57 Domates rengi
58 Doru
59 Duman rengi
60 Ecevit rengi
61 Eflatun
62 Ela
63 Elma rengi
64 Erguvan
65 Fes rengi
66 Fındık kabuğu rengi
67 Fıstık rengi
68 Fildişi
69 Filiz rengi
70 Firuze
71 Fuşya
72 Füme
73 Gece mavisi
74 Gelincik rengi
75 Gök kır
76 Gök rengi
77 Göl rengi
78 Göztaşi rengi
79 Gurup rengi
80 Gül kurusu
81 Gül rengi
82 Gümüş rengi
83 Haki
84 Hardal
85 Havuç rengi
86 Horoz ibiği
87 Ihlamur rengi
88 Istakoz rengi
89 İnci rengi
90 Japon gülü
91 Kamışi
92 Kan rengi
93 Kanarya sarısı
94 Kar rengi
95 Kara dut rengi
96 Kara üzüm rengi
97 Karanfil rengi
98 Katran
99 Kavuniçi
100 Kayısı rengi
101 Kehribar rengi
102 Kestane
103 Kına
104 Kır
105 Kızıl
106 Kızılcık rengi
107 Kimyon rengi
108 Kiraz rengi
109 Kiremit rengi
110 Kobalt
111 Kök kırmızısı
112 Kök moru
113 Kök turuncusu
114 Kömür rengi
115 Köpük rengi
116 Krem rengi
117 Kristal rengi
118 Kula
119 Kumru tüyü
120 Kursak rengi
121 Kurşuni
122 Kurum rengi
123 Kuzguni
124 Küf rengi
125 Kül rengi
126 Lacivert
127 Lal
128 Lavanta rengi
129 Leylak
130 Limon çiçeği ren
131 Limon rengi
132 Limonküfü
133 Mandalina rengi
134 Maun
135 Menekşe
136 Meneviş rengi
137 Mercan
138 Meşe rengi
139 Metal rengi
140 Mor sümbül
141 Mürdümeriği r.
142 Nane rengi
143 Narçiçeği
144 Nefti
145 Nehir rengi
146 Orman rengi
147 Ot rengi
148 Öd rengi
149 Ördek başı
150 Papatya sarısı
151 Pas rengi
152 Patlıcan rengi
153 Pekmez köpüğü
154 Petrol rengi
155 Pişmiş ayva
156 Platin
157 Porselen rengi
158 Portakal rengi
159 Pudra rengi
160 Rastık rengi
161 Safir rengi
162 Safran rengi
163 Salça rengi
164 Saman rengi
165 Sarı yaldız
166 Sedef
167 Sincabi
168 Sis rengi
169 Soğan kabuğu
170 Su rengi
171 Sülüğen rengi
172 Süt rengi
173 Sütkırı
174 Sütlü kahve
175 Sıçan tüyü
176 Şafak rengi
177 Şarabi
178 Şaraptortusu
179 Şark kahvesi
180 Şeftali
181 Şeftali çiçeği
182 Şeker pembesi
183 Taba
184 Tahini
185 Tahıl
186 Tarçın rengi
187 Taş rengi
188 Ten rengi
189 Tirşe
190 Toprak rengi
191 Toz pembe
192 Tuğla rengi
193 Tunç rengi
194 Türbe rengi
195 Türk kırmızısı
196 Türk mavisi
197 Türkuvaz
198 Tütün rengi
199 Vanilya
200 Vapur dumanı
201 Vişne
202 Vişne Çürüğü
203 Vizon
204 Yaban gülü
205 Yağ rengi
206 Yakut
207 Yaldız
208 Yanık şeker ren.
209 Yaprak rengi
210 Yavruağzı
211 Yeşim taşı rengi
212 Yosun rengi
213 Yumurta kabuğu
214 Yumurta sarısı
215 Zehir rengi
216 Zeytin rengi
217 Zümrüt rengi

APPENDIX 2.3 - The questionnaire and the final list of color names used in the experimental research

İsim: Yaş: Cinsiyet:

Son 10 yılda en uzun süre yaşadığınız il ve süresi:

Aşağıda ismi verilen renkleri size sunulan renk örnekleri arasından seçiniz.

Mor

Pembe

Kırmızı

Turuncu

Kahverengi

Sarı

Yeşil

Mavi

Patlıcan Moru

Leylak

Eflatun

Çingene Pembesi

Gül Kurusu

Yavruağzı

Bordo

Kızıl

Kan Kırmızısı

Vişne Çürüğü

Kiremit Rengi

Kavuniçi

Ela

Bej

Kanarya Sarısı

Krem

Limon Sarısı

Bal Rengi

Fildişi

Zeytin Yeşili

Fıstık Yeşili

Çağla Yeşili

Lacivert

Gece Mavisi

APPENDIX 2.4 - The list of schools, companies and institutions used in the third phase of the experimental research

1. ANKARA (130 subjects)

Altındağ Şerife Uludağlı Kız Teknik Öğretim Olgunlaşma Enstitüsü

Bilkent Üniversitesi

Gazi Üniversitesi Mesleki Eğitim Fakültesi

2. DİYARBAKIR (42 subjects)

Merkez Kız Teknik Öğretim Olgunlaşma Enstitüsü

3. KAYSERİ (33 subjects)

Kocasinan Atatürk Kız Teknik Öğretim Olgunlaşma Enstitüsü

4. TRABZON (37 subjects)

Merkez Kız Teknik Öğretim Olgunlaşma Enstitüsü

5. EDİRNE (37 subjects)

Anadolu Meslek Lisesi

6. ISPARTA (30 subjects)

Sümer Halı İşletmeleri

APPENDIX 3

APPENDIX 3.1- Statistical values, obtained from the chi-square test of color pages and color chips of the investigated color terms

color term		value	d.f.	significance (p)
mor	*(purple)*	430.94	210	.0001
pembe	*(pink)*	583.86	171	.0001
kırmızı	*(red)*	266.80	36	.0001
turuncu	*(orange)*	1439.46	128	.0001
kahverengi	*(brown)*	522.56	153	.0001
sarı	*(yellow)*	677.81	72	.0001
yeşil	*(green)*	737.33	264	.0001
mavi	*(blue)*	1039.95	189	.0001
patlıcan moru	*(eggplant purple)*	289.75	231	.0052
leylak	*(lilac)*	632.13	250	.0001
eflatun	*(violet)*	407.04	234	.0001
çingene pembesi	*(gypsy pink)*	526.90	112	.0001
gül kurusu	*(rose)*	814.49	310	.0001
yavruağzı	*(salmon)*	951.222	286	.0001
bordo	*(Bordeaux red)*	649.43	228	.0001
kızıl	*(scarlet)*	712.37	225	.0001
kan kırmızısı	*(blood red)*	477.28	78	.0001
vişne çürüğü	*(cherry)*	236.48	133	.0001
kiremit rengi	*(tile red)*	811.04	189	.0001
kavuniçi	*(melon yellow)*	988.65	224	.0001
ela	*(hazel)*	1240.19	740	.0001
bej	*(beige)*	990.23	450	.0001
kanarya sarısı	*(canary yellow)*	319.04	52	.0001
krem	*(cream)*	541.35	272	.0001
limon sarısı	*(limon yellow)*	235.32	70	.0001
bal rengi	*(honey yellow)*	959.04	288	.0001
fildişi	*(ivory)*	577.11	252	.0001
zeytin yeşili	*(olive green)*	710.01	408	.0001
fıstık yeşili	*(pistachio green)*	1051.24	319	.0001
çağla yeşili	*(almond green)*	445.45	363	.0019
lacivert	*(navy blue)*	341.58	105	.0001
gece mavisi	*(night blue)*	566.66	182	.0001

APPENDIX 3.2- Pearson Correlation Coefficients investigating the degree of relationship between two different color pages (values are given only for color pairs that show positive relationship close to moderate, moderate and high)

color pages	coefficent num.	p
leylak- eflatun	.3859	.001
gül kurusu- çingene pembesi	.3066	.001
pembe- çingene pembesi	.2969	.001
patlıcan moru- leylak	.3143	.001
kırmızı- vişne çürüğü	.2901	.001
pembe- gül kurusu	.2763	.001
kızıl- kiremit rengi	.2529	.001
bej- krem	.4177	.001
fildişi- bej	.4491	.001
zeytin yeşili- fıstık yeşili	.5020	.001
zeytin yeşili- çağla yeşili	.3495	.001
fıstık yeşili- çağla yeşili	.3856	.001
lacivert- gece mavisi	.3907	.001

APPENDIX 3.3- Statistical analysis values of applied the chi-square test in order to investigate the relationship between dependent and independent variables of the study.

MOR *(Purple)*

	value	df	significance
city	**185.77427**	**126**	**.00043**
age	57.78396	63	.66214
gender	23.84463	21	.30065
work	25.66200	21	.21963

PEMBE *(Pink)*

	value	df	significance
city	**151.85562**	**114**	**.01027**
age	**97.32601**	**57**	**.00070**
gender	18.17651	19	.51068
work	**34.22412**	**19**	**.01729**

Independent variables ‘city’, ‘age’, and ‘work’ seem to have relation with the naming of “pembe”. When the frequency distribution of the selected chips was examined, it was seen that subjects included in the third and fourth age group chose close color chips than the others, and they mostly noted color chips having an 8 value of lightness to be the best representatives of “pembe”. Besides, subjects who use color in their work field refer also to lighter colors while the subjects who do not use any colored material in their work chose saturated and darker colors (e.g., color chip 5/14 of page 7.5 RP) as equally as the lighter ones (e.g., color chip 8/6 of page 7.5 RP). Most of the subjects investigated in Kayseri and Isparta refer to lighter color chips. Contrarily the data collected from the other cities, except Edirne, show equal distribution among the light and dark examples of “pembe”. Edirne is the only city where the investigated subjects chose more saturated and dark color chips, e.g. 6/12 of page 5 RP, or 5/14 of 7.5 RP, to be the representatives of this basic color term.

KIRMIZI *(Red)*

	value	df	significance
city	**87.94244**	**54**	**.00241**
age	**50.34278**	**27**	**.00415**
gender	6.47035	9	.69208
work	**37.85121**	**9**	**.00002**

When the statistical values above are considered, it can be stated that there is a relation between the identification of “kırmızı” and all the independent variables except gender. Although chip selection does not vary much in every city investigated, color chip 3/12 of page 7.5 R in Edirne, and color chip 4/12 of 5 R in Isparta were salient in addition to other chips. The group using color in their work refer to the color chips 4/14 and 4/16 of color page 5 R, and sometimes to 4/12 of the same page, while the non-users of color chose color chip 5/16 of page 7.5 R instead of color chip 4/12 of page 5R.

TURUNCU *(Orange):*

	value	df	significance
city	**152.69244**	**96**	**.00021**
age	**83.08908**	**48**	**.00125**
gender	18.09957	16	.31810
work	**39.89245**	**16**	**.00081**

The frequency distribution analysis of “turuncu” shows that subjects’ notation on this color is grouped around the dominating color chips mentioned in page 113. However age group 3 and work group 1 adds chip 5/16 of page 10R to this range, but the cumulative count is not as much as the other color chips. Besides this identification, the color chip preferences of the subjects using color in their work includes various different chips than the rest of the population. City wise, subjects in Isparta equally chose color chips 5/16 of color page 10 R, and 6/12 of page 2.5 YR in addition to the ones included in the range.

KAHVERENGİ *(Brown):*

	value	df	significance
city	125.11396	102	.05986
age	60.87656	51	.16203
gender	23.63398	17	.12973
work	18.21000	17	.37571

SARI *(Yellow):*

	value	df	significance
city	69.35187	72	.56658
age	45.79282	36	.12704
gender	13.93744	12	.30472
work	16.09163	12	.18708

YEŞİL *(Green)*

	value	df	significance
city	**200.48023**	**132**	**.00011**
age	67.79275	66	.41582
gender	17.36711	22	.74278
work	26.95341	22	.21300

Kayseri is the only city that holds subjects having similar response when the term "yeşil" was assigned. More than 50% of the subjects chose color chip 5/12 in color page 10 GY and 2.5 G among all other chips. On the other hand, subjects in Isparta refer also to the color chips 3/6 and 4/6 of page 2.5 G as frequently as they refer to the range mentioned in page 119.

MAVİ *(Blue):*

	value	df	significance
city	**160.30232**	**126**	**.02107**
age	71.42558	63	.21818
gender	24.10725	21	.28789
work	22.10369	21	.39356

The indicated relationship between city and response pattern for "mavi" may resulted from the huge range of collected response in Isparta, where color chips 7/8, 8/4, 5/10, and 6/10 in color page 2.5 PB are as dominant as the range mentioned for general. Also respondents from İstanbul are the only subjects that chose color chip 2/6 of page 2.5 PB among the best representatives of "mavi". Besides, color chip 7/8 placed in page 2.5 PB of the system is as salient as the chip 5/12 of the same page for the respondents in Kayseri, which means the preference is equally distributed between light and dark values of the stimuli.

PATLICAN MORU *(Eggplant Purple):*

	value	df	significance
city	**191.51385**	**126**	**.00015**
age	**85.90889**	**63**	**.02915**
gender	27.51037	21	.15459
work	28.83644	21	.11798

A relation between the dependents and independent variables 'city' and 'age' are indicated above resulting from the chi-square test applied to the data. If the frequency distribution of the selected chips of "patlıcan moru" over age is investigated, age group 3 and 4 chose color chip 2/2 of page 2.5 P (one of the chips closer to black due to its low brightness value) as frequent as the other chips included in the range.

Color chip 3/6 in page 2.5 P shows distinct repeated occurrence for the subjects of İstanbul although non of other cities has this stimulus salient. Again color chip 2/2 of page 2.5 P has similar occurrence with the other color chips in Diyarbakır and Isparta. Among the subjects from 7 different cities, Ankara is the only one that shows remarkably narrow preference of color chips. Only color chips 2/4 and 2/6 from page 2.5 P have been chosen frequently than the rest included in the assembled range.

LEYLAK *(Lilac):*

	value	df	significance
city	123.57575	150	.94370
age	77.04006	75	.41316
gender	27.71711	25	.32104
work	27.07601	25	.35210

EFLATUN *(Violet):*

	value	df	significance
city	**226.50441**	**156**	**.00019**
age	**105.58053**	**78**	**.02052**
gender	38.20518	26	.05796
work	32.13087	26	.18883

Statistically analyzed data for "eflatun" show a relationship between the selected color chips and the independent variables 'age' and 'city'. If the frequency distribution of the data was examined for these two variables, it is seen that age group 1 used the color chip 4/12 of page 2.5 P more regularly than the remaining age groups. Also the total number of chips selected by the age group 2 is remarkably different than the other age groups.

Responses to "eflatun" of the subjects from different cities show variations, and these differences have almost equal contribution in the formation of the color range constructed for "eflatun".

ÇİNGENE PEMBESİ *(Gypsy Pink):*

	value	df	significance
city	**145.04905**	**96**	**.00091**
age	36.67265	48	.88347
gender	**68.89870**	**16**	**.00001**
work	20.92046	16	.18159

"Çingene pembesi" is one of the non-basic color terms that indicate relationship between preferences and gender. Although no distinct variation observed, male's preferences are less in number than the females. Male subjects concentrate on the 6/12 chip of the 2.5 RP page whereas female subjects mostly chose 5/14 chip of either 7.5 RP or 10 RP color page.

When we examine the response patterns in different cities, Kayseri and Isparta show close distributions. The data obtained for these cities fits to the constructed color range while there are some outliers in the other investigated cities.

GÜL KURUSU *(Rose):*

	value	df	significance
city	217.53645	186	.05649
age	**121.08810**	**93**	**.02679**
gender	43.51837	31	.06711
work	**51.05810**	**31**	**.01309**

It is seen that the significance value of the chi-square test suggests a relationship between the dependent color chips and the independents 'age' and 'work'. After analyzing the frequency distribution of each independent variable, it can be stated that, there is no color chip having at least 10 % consensus on in the age group 4, while the collected data of other age groups holds several chips having 10% or more agreement. Subjects using color in their work mostly refer to the color chips 3/10 of page 7.5 and 10 RP. Subjects that do not have a color related work select color chip 2/8 of page 10 RP in addition to the chip 3/10.

YAVRUAĞZI *(Salmon):*

	value	df	significance
city	**205.41539**	**132**	**.00051**
age	**94.48035**	**66**	**.01229**
gender	28.27977	22	.16659
work	**34.72744**	**22**	**.04136**

Isparta is the only city where subjects chose color chip 9/2 of page 10 R having an agreement more than 10 %. Except Ankara, Edirne and Isparta, color chip 7/8 of page 7.5 and 10 R were also salient among other color stimuli constituting the range for this non-basic color term. People using color in their work, are less concentrated (23 %) on color chip 8/6 of page 2.5 YR, whereas a 33 % agreement is recorded on the same chip from the responses of non users.

BORDO *(Bordeaux Red):*

	value	df	significance
city	120.78248	114	.31401
age	49.91312	57	.73574
gender	**43.74376**	**19**	**.00102**
work	15.12281	19	.71476

Significance value obtained from the Chi-square test suggests a relationship between the notification of "bordo" and 'gender'. Male subjects agree on a color chip more than the female ones. For example 41 % of the males agree on the color chip 2/8 of page 2.5 and 5 R while only 21 % of the females select that chip to be the representative of "bordo". The response pattern of males shows more distribution over different chips than the female subjects.

KIZIL *(Scarlet):*

	value	df	significance
city	165.17066	150	.18776
age	77.97846	75	.38425
gender	33.75853	25	.11317
work	29.45771	25	.24524

KAN KIRMIZISI *(Blood Red):*

	value	df	significance
city	72.59520	78	.65152
age	**59.70182**	**39**	**.01802**
gender	6.35126	13	.93254
work	18.18890	13	.15048

Referring to the values above, it can be concluded that 'age' effects the naming process for "kan kırmızısı". When the frequency distribution of each age group was examined, it was noted that, age group 4 is the only one showing variation. The reason is that, the subjects of age group 4 also select color chip 4/12 of color page 7.5 R dominantly that is less saturated than the range constructed.

VİŞNE ÇÜRÜĞÜ *(Cherry):*

	value	df	significance
city	123.28453	114	.26017
age	48.50253	57	.78111
gender	26.29754	19	.12211
work	26.18013	19	.12525

KİREMİT RENGİ *(Tile Red):*

	value	df	significance
city	**205.65713**	**162**	**.01152**
age	70.07746	81	.80152
gender	35.29004	27	.13167
work	23.22526	27	.67285

Nearly, all subjects from different cities, played an equal role in the construction of the color range. Responses from different cities are most of the time different from each other, thus no dominant color chip exists that everyone agreed on. It is one of the extreme case that the color range is made up of so many color chips with no salient perception on the assigned color term.

KAVUNİÇİ *(Melon Yellow):*

	value	df	significance
city	**206.59256**	**168**	**.02283**
age	98.06458	84	.13993
gender	**41.92396**	**28**	**.04408**
work	40.41343	28	.06072

When the frequency distribution of the data is investigated for each city, one distinct difference is seen depending on the response pattern of subjects in Isparta. Although responses of each city, including Isparta, are almost similar, exceptionally color chip 8/6 of page 5 YR in Isparta have considerable frequency of occurrence. Color chip 8/6 of page 5 YR is a lighter color when compared to the whole range constructed for "kavuniçi". On the other hand male respondents chose lighter colors when compared to the female subjects.

ELA *(Hazel):*

	value	df	significance
city	224.28672	222	.44442
age	125.79718	111	.15952
gender	37.81305	37	.43200
work	35.49063	37	.53984

BEJ *(Beige):*

	value	df	significance
city	170.15427	150	.12439
age	75.30524	75	.46838
gender	**42.06531**	**25**	**.01768**
work	**37.86527**	**25**	**.04768**

KANARYA SARISI *(Canary Yellow):*

	value	df	significance
city	76.55593	78	.52506
age	47.67431	39	.16064
gender	15.96358	13	.25110

work	**25.93667**	**13**	**.01734**

When the response distribution of subjects using and not using color in their work was examined, a concentration on the 8.5/14 chip of 7.5 Y page is dominant for the non-users (38 %) whereas users' concentration is on the 8.5/12 color chip of page 5 Y having a 22 % value.

KREM *(Cream):*

	value	df	significance
city	**162.41772**	**102**	**.00013**
age	**69.35914**	**51**	**.04449**
gender	22.50998	17	.16589
work	**42.58403**	**17**	**.00055**

Although the color range holds very close colors chips having same lightness values and adjacent chromas, subjects of İstanbul and Isparta frequently refer to color chips having different values. For example 15 % of the subjects investigated from İstanbul select chip 8.5/2 from page 2.5 Y, as well as they select chip 9/2 from the same page with same frequency. In Isparta color chip 8/4 from page 2.5 Y is also picked up having a 14 % frequency. In addition to that color chip 8/4 of page 2.5 Y is also a dominant preference for the subjects of age group 3. Color chip 9/1 from page 10 YR and 2.5 Y is also a notable response that is dominantly selected by the group of subjects who use color in their field of study.

LİMON SARISI *(Lemmon Yellow):*

	value	df	significance
city	76.39659	84	.71002
age	47.99654	42	.24274
gender	17.49978	14	.23052
work	20.63662	14	.11131

BAL RENGİ *(Honey Yellow):*

	value	df	significance
city	246.09447	216	.07818
age	**142.69285**	**108**	**.01423**
gender	**75.90218**	**36**	**.00011**
work	**51.44367**	**36**	**.04586**

14 % of the subjects stated they could not assign a chip to "bal rengi". The significance values expressed suggest a relationship between the selected color chips and the independent variables 'age', 'gender', and 'work'. Frequency distribution of the data for gender shows interesting results. Only 8 % of the male subjects did not respond to this color while the value is 16 % for females. Besides, no single color chip was selected by at least 10 % of the females to represent the term. Contrarily, 23 % of the male subjects agreed on chip 7/12 and 10 % on chip 6/10 of page 2.5 Y. Close situation exists between the users and non-users of color. Responses of the non-users of color are grouped around the color chips 7/10 and 7/12 from page 2.5 Y more than 10 %, while no chip exists agreed on by the users of color. Also 18 % of

the subjects using color in their work could not show a chip to reflect the color image carried by “bal rengi”.

FİLDİŞİ *(Ivory):*

	value	df	significance
city	123.74313	108	.14276
age	**98.80696**	**54**	**.00019**
gender	23.66664	18	.16626
work	25.10503	18	.12205

When the responses of different age groups are mapped, it was seen that 32 % of the subjects included in age group 1, and 14 % of the subjects included in group 2 could not identify the color that is meant by “fildişi”. Other two age groups respond to the term with higher recurrence. In all age groups, color chips 9/1 of page 10 YR, 9/2 and 9/4 from the other pages mentioned were dominant and no outliers exist different from the chips constructing the range.

ZEYTİN YEŞİLİ *(Olive Green):*

	value	df	significance
city	226.13494	204	.13758
age	**129.72930**	**102**	**.03327**
gender	30.42976	34	.64335
work	35.32900	34	.40524

Preferences among different age groups varies on different color chips. The number of the total chips noted by the age group 1 and 2 are considerably larger than the ones selected by age groups 3 and 4. Although each color chip selected by different age groups seem to be different color percepts, they play equal importance in determining the necessary color chips in the color range obtained for “zeytin yeşili”.

FISTIK YEŞİLİ *(Pistachio Green):*

	value	df	significance
city	**277.25261**	**174**	**.00001**
age	98.26357	87	.06485
gender	30.08192	29	.40992
work	40.00282	29	.08389

Color chip preferences of the subjects in each city show variations. It is amazing to analyze that 30 % of the subjects in Kayseri, 29 % in Trabzon, and 21 % in Edirne could not specify a color chip for “fıstık yeşili” while the value varies between 4 and 6.7 % for other cities. Except color chip 7/10 and 7/12 from page 2.5 GY, and chip 7/12 from page 5 GY, no other color chip is commonly selected by the subjects from different cities.

ÇAĞLA YEŞİLİ *(Almond Green):*

	value	df	significance
city	**234.35354**	**198**	**.03932**
age	**142.44118**	**99**	**.00280**
gender	19.76986	33	.96655
work	35.45896	33	.35303

30 % of the subjects from the age group 1, and 21 % from the age group 2 could not pick up a color chip to represent the assigned color term. For the age group 3 and 4 this percentage is in between 5 and 8.

If we consider responses from different cities, it is clearly analyzed from the frequency distributions of the data that no dominant color chip (all the counts are below 10 %) exists for Ankara, Edirne and Diyarbakır. It is surprising to note that 54 % of the subjects in Trabzon and 37 % in Edirne stated that they can not pick up a chip for "çağla yeşili".

LACİVERT *(Navy Blue):*

	value	df	significance
city	109.55251	90	.07892
age	44.50826	45	.49266
gender	**37.36141**	**15**	**.00112**
work	17.34281	15	.29879

When the responses from two gender groups were mapped, it was analyzed that both male and female subjects agree on the same color chips. What they only differ is that, female subjects assign color chip 2/2 of page 7.5 PB more than color chip 2/10 of the same page, which is regularly selected by male subjects instead of color chip 2/2.

GECE MAVİSİ *(Night Blue):*

	value	df	significance
city	**197.85435**	**156**	**.01312**
age	**120.65669**	**78**	**.00140**
gender	30.06732	26	.26483
work	**40.21923**	**26**	**.03712**

Different than the color chips present in the range constructed for "gece mavisi", color chip 4/12 of page 7.5 PB in Edirne, and chip 5/12 in Isparta are regularly selected by the subjects of these cities. Consensus on a smaller range (chips 2/6, 2/10, and 3/10 on the mentioned color pages) is observed for the subjects using color in their work field, while the non-users of color agree on 5 different color chips regularly; 2/6, 2/8, 2/10, 3/10 and 3/12 of the same color page 7.5 PB.

APPENDIX 4

GLOSSARY

Achromatic: Possessing no hue: being or involving black, gray, or white.

Brightness: One of the three physiological dimensions of color perception by which visual stimuli are ordered continuously from light to dark and which is correlated with light intensity

Chromatic: Having color, or relating to color or color phenomena or sensations.

Emic: of relating to , or involving analysis of linguistic or behavioral phenomena in terms of the internal structural or functional elements of a particular system.

Etic: of relating to, or involving description of linguistic or behavioral phenomena considered in isolation from a particular system or in relation to predetermined general concepts.

Epistemology: The study or theory of nature and grounds of knowledge especially with reference to its limits and validity.

Ethnology: A science that deals with the division of the mankind into races and their origin, distributions, relations and characteristics.

Etymology: The history of linguistic form shown by tracing its development since its earliest recorded occurrence in language where it is found.

Lexeme: A meaningful linguistic unit that is an item in the vocabulary of a language.

Linguistics: The study of human speech including the units, nature, structure, and modification of language.

Neurophysiology: Physiology of nervous system.

Pragmatics: A branch of semiotic that deal that deal with the relationship between signs or linguistic expressions and their users.

Psychobiology: The study of mental life and behavior in relation to other biological processes.

Psychology: Science of mind and behavior.

Psychophysic: A branch of psychology that studies the effect of physical process.

Physiology: A branch of biology that deals with the functions and activities of life or of living matter (as organs, tissues, or cells) and of the physical and chemical phenomena involved.

Salient: Something that project outward or upward from its surroundings.

Saturation: How pure or strong a color is (free of black, or white, or gray).

Semiotic: A general philosophical theory of signs and symbols that deals especially with their funtion in both artifically constructed and natural languages and comprises syntactics, semantics, and pragmatics.

Semantics: The study of meanings. The historical and psychological study and the classification of changes in the signification of words or forms viewed as factors in linguistic development.

Shade: Darkening a pure paint color by adding its complement.

Syntactics: A branch of semiotic that deals with the formal relations between signs or expressions in abstraction from their signification and their interpreters.

Tint: The lighter values of color made by adding white to a pure color.

Tone: The darker values of color made by adding black to a pure color.