IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 9 Ser.3 (September. 2023), PP 04-08
www.iosrjournals.org

A Study On Color Perception Among Male And Female Medical Students

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Abstract:
Background: *The three types of cone systems and variable ratios of stimulation in response to various wavelengths are what allow humans to experience hundreds of different hues of color. Men and women may view the look of color differently from a perceptual and cognitive standpoint. In order to compare and evaluate the color vision of male and female medical students, this study was designed.*
Materials and methods*: The study was conducted in the Department of Physiology, Sree Mookambika Institute of Medical Sciences, Kulasekharam. 93 healthy medical students (39 male and 54 female students) between the ages of 18 and 21 participated in this study. The Farnsworth-Munsell-Munsell test was used to assess color perception. Color perception among both male and female students and also between myopes and non-myopes was compared. The study also included the favorite color of the students.*
Results: *The mean age of the study population was 19.01± 0.715 years. 38 students were myopic, 8 were hypermetropic, and 1 student had astigmatism. Nine students had an error score greater than 10. Out of which 7 were male and 2 were female. The error score for both male and female students was found to be statistically significant (p<0.05). The error scores among myopes and non-myopes were not statistically significant. Black was the favorite color of both males and females.*
Conclusion: *Women have a wider color spectrum than men. Myopes and non-myopes did not perceive colors differently in any discernible way.*
Key words: *color perception, myopes, FM 100-hue test, gender variation*

Date of Submission: 01-09-2023 Date of Acceptance: 11-09-2023

I. Introduction

The ability to distinguish between differences in light composed of various frequencies, known as color vision, is a characteristic of visual perception. When white light was split into its component colors using a dispersive prism, Isaac Newton found that the colors could be reunited back into white light by passing them through a separate prism. The visible light spectrum ranges from about 400 to 750 nanometers. [1] It is also known as the optical spectrum of light or the spectrum of white light. More colors can be distinguished by the human eye and brain than there are on the spectrum. The brain uses purple and magenta to bridge the gap between red and violet. Unsaturated hues like pink and turquoise, as well as brown and tan, can be distinguished. However, some animals have a different visible range, often extending into the infrared range (wavelength greater than 700 nanometers) or ultraviolet (wavelength less than 380 nanometers).[2]

Neurons that are designed to detect light are called photoreceptors. In the majority of vertebrate eyes, rods and cones are the two main types of photoreceptors. Cones are in charge of vision in brighter environments, whereas rods are in charge of vision in low light. Unlike rods, which contain a single photopigment, there are three types of cones that differ in the photopigment they contain. Each of these photopigments has a different sensitivity to light of different wavelengths, and for this reason they are referred to as "blue," "green," and "red," or, more appropriately, short (S), medium (M), and long (L) wavelength cones, terms that more or less describe their spectral sensitivities. [3]

Color blindness, or color vision deficiency (CVD), is the decreased ability to see color or differences in color. [4] Males are more likely to be color blind than females because the genes responsible for the most common forms of color blindness are on the X chromosome. [4] Although color blindness is typically an inherited disorder, it can sometimes result from certain diseases or drugs.

Monochromacy is an exceedingly rare disorder, sometimes known as total color blindness, that causes one-dimensional color and light perception because two or all three cone cells are missing. Dichromacy is a disorder in which one type of cone cell is absent or defective, making it impossible to see a particular range of light. Protanopia, which describes the inability to detect red light, and deuteranopia, which describes the inability to see green light, are two different forms of the condition. People with tritanopia are unable to see blue light. All three types of cone cells in trichromacy are active; however, one type of cone cell has a somewhat erroneous perception of light. Reduced sensitivity to red, green, and blue light are all characteristics of protonomaly, deuteranomaly, and tritanomaly, respectively. The most frequent type is red-green color blindness, which is followed by blue-yellow color blindness and total color blindness.

About 8% of men exhibit a hereditary deficiency in color perception, but recently it was recognized that there are measurable differences in color perception even amongst people with normal color vision. [5] Color and gender' is a significant and complex topic. The commonly used current color convention of "pink for girls" and "blue for boys" may have some logical justification. According to conventional wisdom, men are more at ease with muted and gentle colors, whereas women typically like brighter and more satisfying hues. The reason may be linked to hormonal, developmental, and environmental differences among both the sexes.[6]

The purpose of this study was to determine whether or not males and females with normal color vision see colors differently. To assess the differences in color perception between myopes and non-myopes among boys and girls, both groups of myopes and non-myopes were included. In this investigation, we used the software-based Farnsworth Munsell 100 Hue Color Perception Test. This approach takes less time and produces more accurate results than previous manual approaches.

II. Materials and methods

Study population

The present work was a cross-sectional study conducted in the Department of Physiology, Sree Mookambika Institute of Medical Sciences, Kulasekharam, from November 2023 to May 2023. The study was done in the research lab from 12:30 to 2:00 p.m. 93 healthy medical students between the ages of 18 and 21 participated in this investigation. There were 39 male students and 54 female students. 47 students wear glasses for problems with visual acuity. A history of any other ocular diseases was asked about and ruled out. Subjects with uncorrected myopia, a history of color blindness, eye conditions such as conjunctivitis, iritis, retinitis, migraines, eye surgery, glaucoma, cataracts, a history of using tobacco or alcohol, diabetes, hypertension, or ischemic heart conditions were all rejected.

Ophthalmological examination

In case record form, information on the general examination and the eye examination were documented. For visual acuity and color vision, the Snellen's chart and the Ishihara chart were employed, respectively. To check for any abnormalities in the cornea or lens, all of the students underwent an ophthalmological examination using a torch. Those participants who had abnormalities were excluded. Prior to the study, we conducted a pilot study with 10% of the class to assess the reliability and validity of the Farnsworth-Munsell test, which was found to be significant for studying how various groups see color.

Data collection and analysis

To compare the color perception of the software-based computer scanning system, the Farnsworth-Munsell 100-hue color perception test was used. Within 15 seconds, the test's results can be provided. With the help of the free FM 100 hue color perception test available online at www.xrite.com, we evaluated the students' color perception. These include the four rows of various color combinations and shades. The last box of each row's color is fixed on both sides. This must be arranged in a single row according to each color's hue, saturation, and brightness. This technology automatically calculates a total error score after the test is over. An error score of '0' indicated that there was no color blindness. As the error score increases, color perception decreases. An error score above 40 is considered abnormal.

The data was entered into a Microsoft Excel 2007 sheet, and the proper software was used for the analysis. Based on the unpaired t test, statistical analysis was performed.

III. Results

The age of the study participants ranged between 18 and 21, with the mean age being 19.01± 0.715 years. 38 students were myopic, 8 were hypermetropic, and 1 student had astigmatism. All 47 students wore appropriate glasses for the correction of their refractive errors. Table 1 shows the baseline characteristics of the study groups.

Table 1. Baseline characteristics of the study groups

Characteristics		**Frequency**	**Percentage**
Age	18	22	23.7
	19	49	52.6
	20	22	23.7
Gender	Male	39	41.9

	Female	54	58.1
Glasses	Yes	47	50.5
	no	46	49.5
Nature of the visual deficit	Myopia	38	40.9
	Hypermetropia	8	8.6
	Astigmatism	1	1.1

29 students had an error score of '0', and 25 students had an error score of '2'. Nine students had an error score greater than 10. Out of which 7 were male and 2 were female. The error score for both male and female students was found to be statistically significant (p<0.05). Table 2 shows the association between gender and visual perception.

Table 2. Association of gender with visual perception

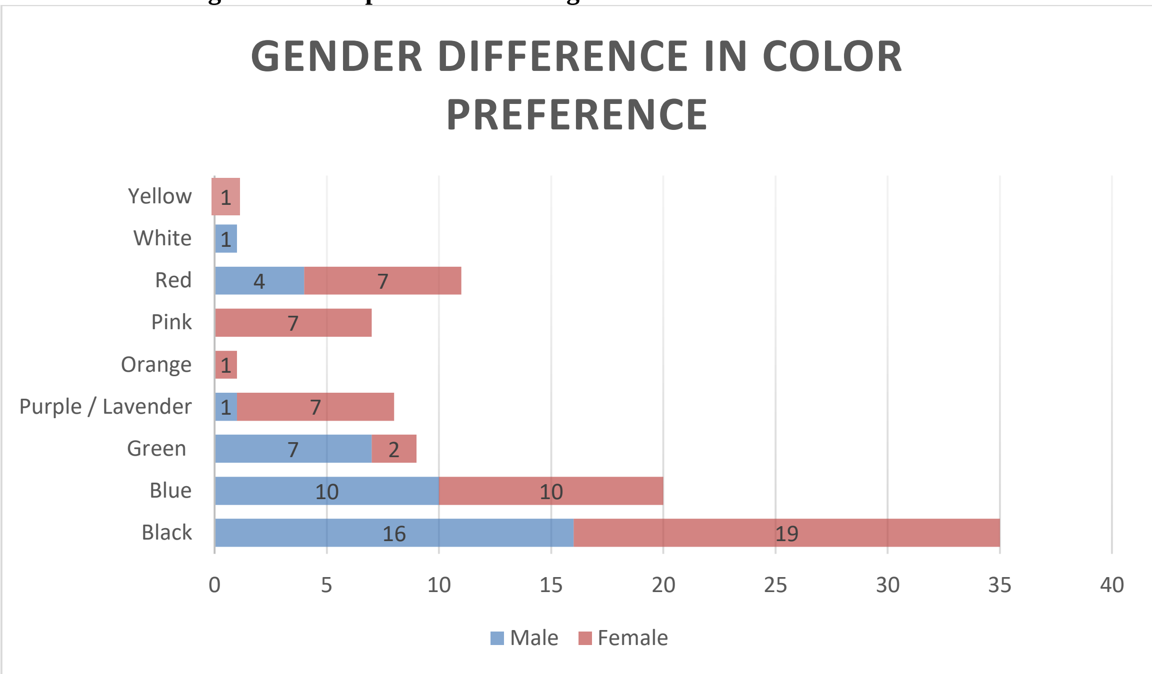
Characteristics		**Gender**		**p value**
		Male	**Female**	
Wear glasses	Yes	20 (42.55%)	27 (57.45%)	0.903
	No	10(27.03%)	27 (72.97%)	
Nature of the visual deficit	Myopia	15(39.47%)	23(60.53%)	0.562
	Hypermetropia	4(50%)	4(50%)	
	Astigmatism	1(100%)	0	
Error score	0	15(51.72%)	14(48.28%)	**0.013***
	2	4(16%)	21(84%)	
	4	5(31.25%)	11(68.75%)	
	6	4(50%)	4(50%)	
	8	4(66.67%)	2(33.33%)	
	10 – 20	6(85.71%)	1(14.29%)	
	21- 40	1(50%)	1(50%)	

The error score was also compared between myopes and non-myopes, and the results were not statistically significant. Additionally, a comparison of male and female students' favorite colors was conducted. Both groups preferred black more than the other colors. Table 3 shows the comparison of error scores among myopes and non-myopes, and Figure 1 shows the color preference among male and female students.

Table 3. Comparison of error score among myopes and non-myopes

		Non myopes	**Myopes**	
Error score	0	19(65.52%)	10(34.48%)	0.730
	10 - 20	3(42.86%)	4(57.14%)	
	2	15(60%)	10(40%)	
	21 - 40	1(50%)	1(50%)	
	4	9(56.25%)	7(43.75%)	
	6	4(50%)	4(50%)	
	8	4(66.67%)	2(33.33%z)	

Figure 1. Color preferences among male and female medical students



IV. Discussion

This study demonstrates that the total error score is high in the male group and low in the female group, indicating that women are better at differentiating between a wider variety of colors than men. Sexual dimorphism may be the cause of this variation. The genes that encode the photopigment of long-wavelength-sensitive cones in the retina are more common in females. [7] X chromosomes are found on both females. On the two X chromosomes of these chromosomes are the genes for the many forms of red pigment. In females, some types of cones that contain red and green pigment are active on one X chromosome, while other types of cones that contain red and green pigment are triggered on the other X chromosome (though less so for the green pigment-containing cones). As a result, the two X chromosomes contain several types of different red and green cones. On the X chromosome, the red cones are also much closer to one another. This is called the super color vision power of the female. [8]

A study done by Nidhi Jain et al. also suggested that females perceive color better than males. [9] This correlates with our study. Another study done by Gargi et al. revealed that females perceive color better than males, and non-myopes also had better color perception when compared to myopes. [10] In our study, there were no significant differences in color perception among myopes and non-myopes.

A study done by Miranda on gender, experience, and value in color perception showed that there were no significant differences in color perception among males and females. [11] This is contrary to the present study. A study done by Jerin Thomas et al. suggested that men perceive colors faster than women, which again is not in line with our study.[12]

A study by Guilford and Smith found that men were generally more tolerant of achromatic colors than women. Thus, women might be more color-conscious, and their color tastes might be more flexible and diverse. [13] In a study done by Arslan et al. on the effect of refractive errors on color vision, it was found that subjects with refractive errors had higher error scores when compared with emmetropes. [14] Our study showed no such difference.

V. Conclusion

This study comes to the conclusion that women have a wider color spectrum than men. Myopes and non-myopes did not perceive colors differently in any discernible way. Both male and female students chose the color black as their favorite. We advise conducting more research among a large population, including elderly people, as this study was only conducted among medical students.

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