

## GENDER BASED ALTERATION IN COLOR PERCEPTION

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**Abstract :** Human beings are able to perceive hundreds of shades of color which depends on the three types of cone system and various ratios of stimulation in response to different wavelengths. Perceptually and cognitively, men and women may experience appearance of color differently. Therefore, this study was planned to assess and compare color vision in male and female subjects. This study was carried out in the department of Physiology, SGRRIM&HS, Dehradun on 60 ocular healthy subjects (equal number of males and females) of 17–22 years of age group. The task was to match 22 test color strips with 2 shade charts of different colors. Total number of correct answers and total time taken in matching all the test color strips with the shade charts was recorded in both the sexes and analyzed. The results of this study showed that overall, females gave more correct responses ( $P<0.001$ ) and also took less time ( $P<0.01$ ) than males. Color wise also, females gave more correct responses especially for red ( $P<0.001$ ) and green color ( $P<0.01$ ). The conclusion states that the females can see more shades of colors than males.

**Key words :** color vision  
shades of color

cone system  
gender variation

### INTRODUCTION

Indeed, 'Vision' is the most important sense as about 80% information which we get through all the senses, is visual. This visual information becomes even more meaningful and informative when these are colorful. In fact colors not only provide the objective information about the world, it impinges on our psyche, attitude and feelings (1).

Color sense or vision is the ability of the eyes to discriminate between the light rays of different wavelengths. Our visual system works out the color by comparing the relative rates at which photons of light rays are absorbed in different classes of cones in retina exposed to bright light – photopic vision. Interpretation of any color needs initial processing in the three cell layers of retina and then signals from different cone

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systems on reaching brain are compared to be perceived (2, 3, 4).

About 8% of men exhibit a hereditary deficiency of color perception but recently it was recognized that there are measurable differences in the color perception even amongst the people with normal color vision (2). The subject of 'color and gender' is an important and intricate topic. There may be some logic behind the widely accepted modern color convention of 'pink-for-girls' and 'blue-for-boys'. Here convention seems to be that women tend to prefer brighter and gratifying colors and men are more comfortable with stifled and soft colors. The reason may be linked to hormonal, developmental and environmental differences amongst both the sexes (5).

Therefore, this study was planned in a very simple and interesting manner to evaluate the difference of normal color vision between two sexes of the same age group.

#### MATERIALS AND METHODS

The study was conducted in the department of Physiology, SGRRIM&HS, Dehradun. Institutional Ethical Committee approved this study. 60 young and healthy subjects of 17–22 yrs of age having normal visual acuity volunteered in this study. Informed consent from all the subjects was taken. The subjects were divided into two groups – Group 1 had 30 male subjects and Group 2 had 30 female subjects. History of any disorder related to ocular diseases was ruled out.

The test was done in bright sunlight between 12.00–3.00 pm. There were 22 test

color strips and 2 shade charts (Fig. 1) having various shades of different colors, and they were numbered with secret code numbers. These test color strips and shade charts were given to each subject. Then each subject was asked to match all the test color strips one by one with the shade charts and the code numbers were noted down. Total number of correct answers was also evaluated. Total time taken in the matching of all test color strips with shade charts was also recorded by stop watch for each individual. Statistical analysis was done by using unpaired student 't' test. The level of significance was –

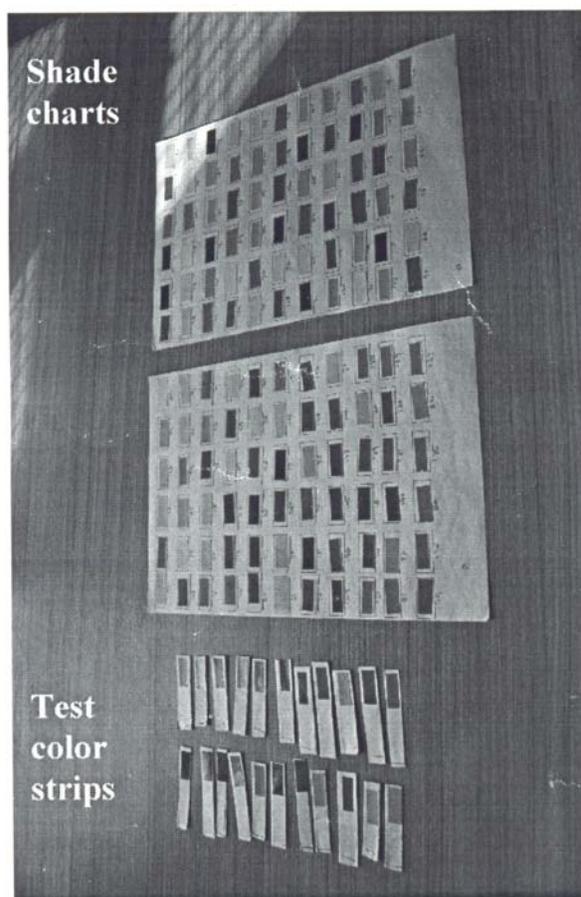


Fig. 1: Shade charts and test color strips.

P<0.05 – Significant

P<0.01 – Moderately significant

P<0.001 – Highly significant

## RESULTS

The mean age of the male subjects was 18.5±1.25 (range between 17–22 years of age) and of the female subjects was 18±1.25 (range between 17-19 years of age).

1. Overall, out of 22 test color strips, the total number of correct responses was compared in both males and females.

a) It was found that females gave more correct responses as compared to males and this difference was statistically highly significant (Table I).

b) Other than this females also took less time than males in matching all the test color strips with the shade charts and this difference in duration was also found statistically moderately significant (Table I).

2. Now color wise correct response for both the sexes was analyzed statistically. It

TABLE I: Gender variation – Total no. of correct responses with time taken.

Subjects	(Number of color strips=22)	Time taken (sec)
Male (n=30)	12.8±3.26	8.24±3.07
Female (n=30)	17.57±1.59	6.35±1.88
P value	<0.000***	<0.01**

\*\*P<0.01 Moderately significant.

\*\*\*P<0.001 Highly significant.

was found that for each color females gave more correct responses as compared to males. Although for blue, black and yellow colors the difference in correct responses was not statistically significant BUT for red and green colors it was found statistically highly significant (Table II & Fig. 2).

TABLE II: Gender variation – Color wise correct response.

	Male (n=30)	Female (n=30)	P value
Black	23.25±7.4	26±2.45	>0.05
Blue	23.25±2.8	24.75±5.38	>0.05
Green	15±1.7	23.5±4.93	<0.01**
Yellow	16.5±7.4	24.25±6.85	>0.05
Red	8.5±5.5	20.5±2.38	<0.001**

\*\*P<0.01 Moderately significant.

\*\*\*P<0.001 Highly significant.

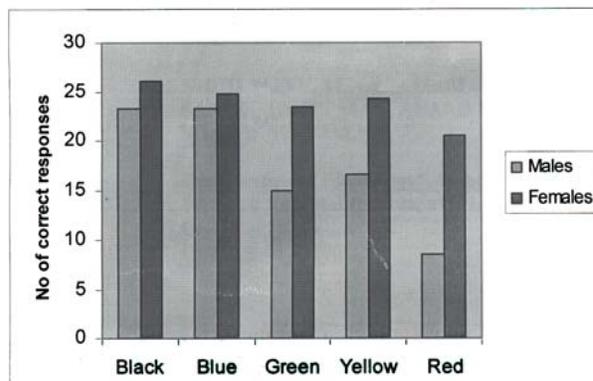


Fig. 2: Gender variation for individual color correct responses.

## DISCUSSION

In the study, female subjects showed statistically significant better matching of colors in comparison to their male counterparts and that too taking less time. One of the possible physiological factors underlying these differences is a sexual dimorphism in

the gene that encodes the photo pigment of the long wavelength sensitive cones in the retina (6). More than 95% of all variations in human color vision involve the red-green receptors in men's eyes. Wald suggested that the genes for red and green receptors were altered in men. He also thought that these genes must lie near each other on the x-chromosome (7). Anomalous color vision, which is usually a genetically determined normal state, is always a decrease in fineness of color perception. It is predominantly seen in males as it is carried on X-chromosome (8).

Dr. Neitz who conducted his research on female color vision, said only women have the potential for super color vision. That is because the genes for the pigments in red and green cones lie on the x-chromosome and only women have two x-chromosomes, creating the opportunity for one type of red cone to be activated on one x-chromosome and the other type of red cone on the other one. In a few cases, women may have two distinct green cones on either x-chromosome but these two red cones may be very close to each other in the wavelengths. So only few additional shades are perceived (9).

Bimler in his study suggested relative differences in the salience of color-space axes, with the males tending to attend more to a lightness axis and less to a red-green axis. They are also less reliable in their judgements. This may be due to existence of photo pigment heterozygosity among females while males are hemizygous, and gender differences in overall color awareness (6, 10, 11, 12, 13).

Red and green cones may be more

developed in females and this is proved by their liking towards shades of red and green colors. Red and green cones may be less developed in males therefore male subjects liked mostly shades of black and blue colors. These findings may also be related to the high incidence of red green color blindness in males (1, 11, 14).

Color perception represents a major adaptive advantage which has been given by evolutionary pathways. It is such an important mechanism of biological signaling, a source of information from the environment. There are factors other than those related with physiological visual processes influencing such perception, which may be linked to the presence of estrogen receptors on the retina (13).

Guilford and Smith (1959) found men were generally more tolerant towards achromatic colors than women. Therefore, they proposed that women might be more color-conscious and their color tastes more flexible and diverse (1).

In a study on Nepalese, Curtis & Bolton (1978) found that women consistently listed more color names than men. Greene (1995) examined the color identification and vocabulary skills of college students. The results showed that women recognized significantly more elaborate colors than did the men (1).

At the end of this study we came to the conclusion that the females can see more range of colors as compared to males. In other words, the beautiful world is more colorful to the females.

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Color palettes and types of toys are gendered characteristics of the toys marketed to either boys or girls. The results of the study mentioned above, showed that "toys that were pastel colored were much more likely to be marketed as toys for 'only girls', while bold colored toys were much more likely to be marketed as toys for 'boys only'" and also found that blue was a more gender-neutral color.Â ASOS, a famous online fashion company based in the UK, is one of the companies making gender neutral lines. Paired with glaad, they recently dropped a line that is gender neutral.[20] In addition, Wilde Vertigga, Kirrin Finch, One DNA, S.K. Manor Hill, Cilium, Official Rebrand, and Beau Novo are all companies who promote gender neutral clothing.