

Chandrakumar L.
THEORIES OF COLOUR VISION
Tutor: Dr. Fomenko V.N.
Department of Normal Physiology
Belarusian State Medical University, Minsk.

The question about the nature of colour vision is discussed since 17th-19th Centuries. Many scientists and renowned personalities discussed the subject of colour perception, like Franciscus Aguilonius who stated that viewed colours in perception could be considered as intermediate stages between black and white. Later Newton found that white colour is a reconstitution of the seven colours through the two prisms refractive test.

Trichromatic theory was firstly created by Thomas Young, an English physician, around the 19th century, and refined later by German scientist Hermann von Helmholtz. So here comes one of the main theoretical ideas of it as which states that the eye's retinal photoreceptors consist of 3 different coloured cones which can perceive the colour vision according to the specific light's wavelength and frequency. James Maxwell (1831-1879) has done an experiment to check the possibility of getting a colour by three colour light mixture comparing to its monochromatic light. Experiments made by some other scientists also refines the trichromatic theory which by form of the spectral locus in the colour triangle (Clerk Maxwell 1890). Other works were concentrated on abilities to adaptation of photoreceptor cells to strong monochromatic light (Wright, 1934), and directional sensitivity of retina (Stiles, 1939). Through the microelectrode technique the electroretinogram analysis of mammals and amphibians colour distribution in cones were observed in relation to the three basic colours (Graniti, 1941).

On one side these experiments conducted to support the trichromatic theory on the other hand a contradictive theory was conducted by Herbert E. Ives was (1918) at the earlier times but it was neglected as he considered the trichromatic theory as a doubtful theory. He stated with the experiment of metameric matching of the monochromatic light colour with the compound light which is a mixture of three. The results were supporting trichromatic theory until he found the compound light was having a leading red-light strand and a tailing green light strand having yellow beam in between while monochromatic had the pure yellow light when the ray was scanned. The rise of opponent process theory was because of the valid questions asked on the colour vision peculiarities which the trichromatic theory didn't explain completely: the phenomenon of after-imaging, like greenish hue after-image after exposure of a red image along with a fact that greenish red or bluish yellow colours are seemed to be impossible because of the red opposing green and blue opposing yellow in some not fully discovered ways.

The opponent process theory was proposed by Ewald Hering (1878) and then it was refined and expanded (Richard Solomon, 1970). The stated idea of Hering was that the colour shouldn't be based on only three primary cones but instead they should have pairs of opposing colour pigmented cells, as the black-white, red-green, blue-yellow receptors. It was validated using a test method of hue cancellation (Leo Hurvich, 1957) when adding the opposing colour its opponent from mild to equal amount to find out the result at reaching at the neural point (Dorothea Jameson, 1957). While it was strongly rejected with some other experiments where they concluded the hues did not match with the altered hue cancellation methods (Jameson K, D'Andrade R.G. 1997).

After all the experiments that have been conducted to till date; the trichromatic theory and opponent process theory seems to be relevant and accepted in both ways, and their mechanisms Complementary theory states both are seemed to be acceptable but not fully completed.