# Effects of colored lights on man

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Colored lights have different effects on man. They may induce indifference, melancholy, or may have sedative effect and cause contemplation in him. Exciting colors are red, orange, yellow, and purple. The soothing colors include green, blue, indigo, and violet; pleasing colors include green purple, and blue.

Commonly, red is associated with anger, warmth, and courage; blue with calmness; purple with stability and pomp. Yellow is associated with gaiety and warmth, and greenish-yellow, cowardness and disease.

The lighter or more saturated the color is, the more it connotes happiness and warmth. The darker and more saturated the color is, the more it connotes forcefulness. Greater brightness and greater saturation produce pleasantness, showiness, while greater saturation alone induces elegance. Hue is associated with excitement and elegance.

Although there is a general agreement that colors toward the red end of the spectrum appear to be nearer, and that colors toward the blue end appear to be farther away, experiments did not give evidence to such hypothesis, and the results were that colors in themselves do not have the quality of depth. However, artists have succeeded in their suggestion of the effect of color as indicative of distance. Accordingly, the responses of their students may be conditioned.

After experiments conducted by C.E. Ferree and G. Rand (1919) on the eye using different illuminants, it was found that when reading under different colored lights, the fatiguing effects and feelings of discomfort appeared to be dependent upon the characteristics of the specific wavelength. For instance, a feeling of discomfort under unsaturated yellow light appeared after 116 seconds with a loss of efficiency of 5.43 percent. For reddish-yellow, the loss of efficiency was 7.57 percent, and the feeling of discomfort occurred after 94 seconds. Reading under unsaturated yellow light with green added caused the fatiguing effect to appear after 48 seconds, and it is accompanied by a loss of efficiency of 24 percent. For greenish light it was 39.14 percent within 25 seconds, and for bluish-green it was 54.86 percent in just 14 seconds.

With regard to the effect of colored light on acuity, it was found that the colors toward the red end of the spectrum are more favorable to acuity than green.

The values of red are from 20 percent to 50 percent above that of green. The values for blue are similar to green, but somewhat lower.

Sensations of color have intensity, saturation, and tonality. The intensity depends upon the quality of light. Saturation depends upon the relative purity of colors. Degrees of saturation are known as shades, and these shades can give rise to the sensation of depth. Tonality is the quality of the color on the scale of the spectrum.

Color contrast of more than 0.65 is of little importance to visibility regardless of the condition of colors. For instance, visibility of red on a neutral background is higher at a contrast of up to 0.15, while for green or blue, 0.30 contrast gives maximum visibility. For yellow, 0.10 contrast gives a high visibility level. Values of contrast above these ratios reduce the visibility of color contrast by less than 5 percent depending upon the color of the background. With a red background, all colors increase in visibility, more than when the background is grey, and the reduction of visibility due to an increase of contrast more than 0.50 will be about 2 percent. When the red background is replaced by yellow, the visibility levels of all colors varies less than 2 percent from the visibility of those on a neutral background when the contrast is about 0.40. When the color is lighter than its background, the visibility level becomes less than when the color is darker than the background. When the background is moved backward from the color, the visibility level increases.

Color of light has an effect on the appearance of the object because differences in the spectral energy of light do not appear as difference in the color of light, but of the object itself. Every object reflects wavelengths with different proportions. If the light falling on the object is rich in the wavelength that the object also reflects more of, the object will appear to be more intense than the reverse, that is, when the wavelength is not rich in the wavelength reflected by the object, the appearance of the object is less intense. Also, the level of illumination contributes to the degree of such intensity. It is clear then, that light is modified before it reaches the eye. For example, on a day with a clear blue sky and in a room with a window facing a park, the light reaching an observer in the room is not that of daylight, but it is a mixture of colors that are reflected from the park, from the furnishings, and from the boundaries of the room. Some of the wavelengths may decay, while others are in intensified according to the reflectivity of the objects and the surroundings and according to the composition of light when it first fell on the object.

The color of objects as perceived are not only due to their reflective characteristics, as described above, but also due to their texture and surface finish. If the surface of the object is smooth, the reflection from such a surface may wipe out all colors, when viewed from a certain angle, and increase or darken the perceived colors when viewed from other angles.

The object appears natural only when its surface diffuses light in all directions. According to B. Judd and A. Eastman (1971), the color distribution of the image of the object in the retina differs from the spectral distribution as reflected from the object. They relate these attributes to the chromatic aberration. They also showed that the addition of external chromatic component may reduce the visibility level rather than increasing it. Chromatic aberration occurs because the eye's lens focuses each wavelength in different planes parallel to the retina. For instance, the eye has a longer focal length for red light than for blue light. In this case, the red will be focused in the retina, while the blue is cast as a blurred circle surrounding the red, when the image is formed on the retina. On the other hand, if the image is formed behind the retina, the blue will be in focus while the red will appear blurred with the blue in the center. Astigmatism may also contribute to the blurring of colors depending on the degree of distortion of the surface of the cornea and its shape. Still, Beck pointed out that accommodation could cause astigmatism for the nearer distant even if it could not be detected in the relaxed eye. Campbell and Westheimer (1959) suggested that such chromatic aberration might be used by the observer as an information code for depth perception. Kaufman (1974) stated that the iris constricts to reduce the bundle of light entering the eye to reduce the sizes of the blurred colors, and he related this to the activity of the cerebral cortex.

Eriksen and Halee (1955) have shown that color alone is not sufficient to give information to the observer, but color and shape can give information better and faster than color alone, if the light is intense. On the other hand, Smith and Thomas (1964) postulated that color is superior to shape at relatively lower levels. Both of these results were obtained from unstructured field experiments. Structuring the field may give different data according to the knowledge of the subject about the object. For instance, when we have knowledge about an object, any faint light can reveal it at once regardless of its color.

As colors become more and more distant they lose their intensity and appear bluish because the molecules suspended in the atmosphere inhibit the necessary amount of light reaching the eye. With distance, colors lose also contrast and accordingly their contours disappear, and hence they give no cues.

Adaptation of the eye to colors is a natural process which occurs though not noticed in our daily experience. If the retina is subjected to a color for a prolonged time, the color gradually tends to appear to be grey. The explanation for this phenomenon lies in the arousal of the antagonistic process involved in the maintenance of retinal experiences.

The visual systems of people in different countries are identical, but because ultraviolet radiation differs from location to location according to the altitude, increasing with altitude and with proximity to the equator, this excess in ultraviolet radiation causes an increase in the density of the yellow pigmentation at the cornea, the lens, the pigment epithelium, and at the maculalutea. This yellow pigment absorbs the short-wavelength radiation before it reaches the eye, and these results in a decrease in the spectral sensitivity of the eye to those wavelengths. This in turn, causes confusion of short-wavelength stimuli in color matching and color naming, and in rare cases, it decreases visual acuity. As a result, people confuse blue with green, or the reverse, or blue and green as being darker, or in extreme cases as being black, depending upon the interrelated factors. This case is mostly serious among the darkly pigmented peoples who confuse a great number of terms in more inclusive identities.