

Definition

Color blindness is an abnormal condition characterized by the inability to clearly distinguish different colors of the spectrum. The difficulties can be mild to severe. It is a misleading term because people with color blindness are not blind. Rather, they tend to see colors in a limited range of hues; a rare few may not see colors at all.

Alternative Names

Color deficiency; Blindness – color

Description

Normal color vision requires the use of specialized receptor cells called cones, which are located in the retina of the eye. There are three types of cones, termed red, blue, and green, which enable people to see a wide spectrum of colors. An abnormality, or deficiency, of any of the types of cones will result in abnormal color vision.

There are three basic variants of color blindness. Red/green color blindness (deuteranopia) is the most common deficiency, affecting 8% of Caucasian males and 0.5% of Caucasian females. The prevalence varies with culture.

Blue color blindness (protanopia) is an inability to distinguish both blue and yellow, which are seen as white or gray. Protanopia is quite rare and has equal prevalence in males and females. It is common for young children to have blue/green confusion that becomes less pronounced in adulthood. Blue color deficiency often appears in people who have physical disorders such as liver disease or diabetes mellitus.

A total inability to distinguish colors (achromatopsia) is exceedingly rare. These affected individuals view the world in shades of gray. They frequently have poor visual acuity and are extremely sensitive to light (photophobia), which causes them to squint in ordinary light.

Researchers studying red/green color blindness in the United Kingdom reported an average prevalence of only 4.7% in one group. Only 1% of Eskimo males are color blind. Approximately 2.9% of boys from Saudi Arabia and 3.7% from India were found to have deficient color vision. Red/green color blindness may slightly increase an affected person's chances of contracting leprosy. Pre-term infants exhibit an increased prevalence of blue color blindness. Achromatopsia has a prevalence of about 1 in 33,000 in the United States and affects males and females equally.

Causes, incidence, and risk factors

Color blindness occurs when there is a problem with the color-sensing materials (pigments) in certain nerve cells of the eye. These cells are called cones. They are found in the retina, the light-sensitive layer of tissue at the back of the inner eye.

If you are missing just one pigment, you might have trouble telling the difference between red and green. This is the most common type of color blindness. Other times, people have trouble seeing blue-yellow colors. People with blue-yellow color blindness almost always have problems identify reds and greens, too.

The most severe form of color blindness is achromatopsia. A person with this rare condition cannot see any color. Achromatopsia is often associated with lazy eye, nystagmus (small, jerky eye movements), severe

light sensitivity, and extremely poor vision.

Most color blindness is due to a genetic problem. (See: X-linked recessive) About 1 in 10 men have some form of color blindness. Very few women are color blind.

The drug hydroxychloroquine (Plaquenil) can also cause color blindness. It is used to treat rheumatoid arthritis, among other conditions.

Red/green and blue color blindness appear to be located on at least two different gene locations. The majority of affected individuals are males. Females are carriers, but are not normally affected. This indicates that the X chromosome is one of the locations for color blindness. Male offspring of females who carry the altered gene have a 50-50 chance of being color-blind. The rare female that has red/green color blindness, or rarer still, blue color blindness, indicates there is an involvement of another gene. As of 2001, the location of this gene has not been identified.

Achromatopsia, the complete inability to distinguish color, is an autosomal recessive disease of the retina. This means that both parents have one copy of the altered gene but do not have the disease. Each of their children has a 25% chance of not having the gene, a 50% chance of having one altered gene (and, like the parents, being unaffected), and a 25% risk of having both the altered gene and the condition. In 1997, the achromatopsia gene was located on chromosome 2.

The inability to correctly identify colors is the only sign of color blindness. It is important to note that people with red/green or blue varieties of color blindness use other cues such as color saturation and object shape or location to distinguish colors. They can often distinguish red or green if they can visually compare the colors. However, most have difficulty accurately identifying colors without any other references. Most people with any impairment in color vision learn colors, as do other young children. These individuals often reach adolescence before their visual deficiency is identified.

Color blindness is sometimes acquired. Chronic illnesses that can lead to color blindness include Alzheimer's disease, diabetes mellitus, glaucoma, leukemia, liver disease, chronic alcoholism, macular degeneration, multiple sclerosis, Parkinson's disease, sickle cell anemia, and retinitis pigmentosa. Accidents or strokes that damage the retina or affect particular areas of the brain eye can lead to color blindness. Some medications such as antibiotics, barbiturates, anti-tuberculosis drugs, high blood pressure medications, and several medications used to treat nervous disorders and psychological problems may cause color blindness. Industrial or environmental chemicals such as carbon monoxide, carbon disulfide, fertilizers, styrene, and some containing lead can cause loss of color vision. Occasionally, changes can occur in the affected person's capacity to see colors after age 60.

Symptoms

Symptoms vary from person to person, but may include:

Trouble seeing colors and the brightness of colors in the usual way

Inability to tell the difference between shades of the same or similar colors

Often, the symptoms may be so mild that some persons do not know they are color blind. A parent may notice signs of color blindness when a child is learning his or her colors.

Rapid, side-to-side eye movements and other symptoms may occur in severe cases.

Prognosis

Color blindness that is inherited is present in both eyes and remains constant over an individual's entire life. Some cases of acquired color vision loss are not severe, may appear in only one eye, and last for only a short time. Other cases tend to be progressive, becoming worse with time.

