
Colour vision deficiency (colour blindness)

Summary

- People who are colourblind usually have difficulty with the colours green, yellow, orange and red.
 - Colour blindness is usually inherited and affects more boys than girls.
 - Colour blindness is caused by a lack of particular colour-sensitive cells in the back of the eye.
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People who have a colour vision deficiency have difficulty seeing some colours or see them differently from other people. Colour vision deficiency is often inherited, and affects more males than females. Out of 20 males, it is likely that one or two will have a colour vision problem.

The term colour vision deficiency is more accurate than the term 'colour blind'. People who can't see all colours can still see some colours, and will see other things, such as fine detail, as clearly as people with full colour vision.

In the most common form of colour vision deficiency, people cannot see the red and green components of colours. They may confuse red and green with each other or with yellow.

Eye cells and vision

All the cells and nerve pathways in the eye and brain are present from birth. In the retina, at the back of the eye, the two types of cells are rod cells and cone cells.

Rod cells are sensitive to light. We use rod cells to see things around us at night, but only in shades of black, grey and white. There is only one type of rod cell.

Cone cells react to brighter light and help us to see detail in objects. They also support colour vision. Usually, there are three types of cone cell, which respond to long (red), medium (green) and short (blue) wavelengths of light. By comparing the responses from the three types of cones, the visual system of the brain produces the wide range of colours that most people see. Someone who has colour vision deficiency lacks one or more of these types of cone cells, or may have an altered response due to a genetic change or eye disease.

Symptoms of colour vision deficiency in children

The signs that your child may have a colour vision difficulty include trouble recognising and identifying different colours or an inability to separate things by their colour. Parents may find signs of colour vision deficiency when children are learning to name the colour of objects.

What causes colour vision deficiency

Colour vision deficiency is most commonly a genetic condition. It occurs due to a change in one (or more) of three genes that are involved in the production of visual photopigments (known as opsins). The genes involved are *OPN1LW*, *OPN1MW* and *OPN1SW*. The *OPN1LW* and *OPN1MW* genes are on the X chromosome. *OPN1SW* is on chromosome 7.

Colour vision problems can also arise later in life due to disease, trauma or exposure to toxins.

Red–green colour vision deficiency

Red–green colour vision deficiency is the most common inherited type. It occurs in about eight per cent of males and only about 0.4 per cent of females. This is because the genes that lead to red–green colour vision deficiency blindness (*OPN1LW* and *OPN1MW*) are on the X chromosome (they are 'sex-linked').

Males have only one X chromosome and females have two. In females, a functional gene on only one of the two X

chromosomes is sufficient to produce normal colour vision. In males, there is not another copy of the gene to compensate for the genetically changed copy.

Blue–yellow colour vision deficiency

Changes in the OPN1SW gene cause blue-yellow colour vision deficiency. This makes it difficult to tell the difference between shades of blue and green. Yellow may also be hard to identify – it may look violet/grey or pink, depending on the gene change involved.

Blue-yellow colour vision deficiency is very rare, affecting only about one in 10,000 individuals of either sex. Males and females are affected equally because the gene is located on a non-sex chromosome.

Non-inherited genetic colour vision deficiency.

Colour vision deficiency is not always inherited. It can also be due to other causes, including:

- a chromosomal change during early development
- trauma that causes brain or retinal damage
- disease – such as degenerative eye disease (for example, macular degeneration, glaucoma and retinitis pigmentosa), diabetes, Alzheimer’s disease, leukaemia, liver disease, chronic alcoholism, multiple sclerosis, Parkinson’s disease and sickle cell anaemia
- exposure to toxins.

Challenges of colour vision deficiency

Many tasks that we do each day rely on us being able to separate things by their colour. There are varying degrees of colour vision deficiency. The degree of intensity of the light and the size of the object can also affect colour vision ability.

If people are not able to see the difference in colour, they have to rely on other cues. For example, a person may only be able to tell red and green traffic lights apart by their position (red above green). On a dark, wet night this may be difficult to do.

Driving and colour vision deficiency

People with red–green colour vision deficiency are able to get a car or motorcycle licence. They can also get a commercial driver licence. However, people with reduced contrast sensitivity may have some restrictions placed on their licence, such as not being permitted to drive at night.

VicRoads suggests that health practitioners advise drivers with a significant colour vision deficiency about how this may affect their responsiveness to traffic lights and other road signals, and the need to adapt their driving accordingly.

Most people who are colour vision deficient can identify the difference between the red and green lights used in modern traffic lights.

Occupations and colour vision deficiency

People who have a colour vision deficiency may be restricted in carrying out certain occupations where reliable colour recognition is required.

Common occupations that may have colour vision requirements include:

- police – as part of the minimum medical requirements, Victoria Police applicants are required to have a review of their vision by an ophthalmologist or optometrist
- maritime careers – while having colour vision deficiency does not prevent people from obtaining a recreational boat licence, it may affect your application for employment in maritime roles. Talk to prospective employers for advice
- defence force – colour vision deficiency will restrict the areas of employment that are available to you within the Australian Defence Force. A Defence Recruiter will be able to tell you which jobs are suitable for you.

In Australia, it is possible for people with colour vision deficiency to become:

- pilots
- electricians
- commercial drivers.

Diagnosis of colour vision deficiency

If activities at school are colour coded, children with colour vision problems may have problems with those tasks. It is often recommended that all children, especially males, have a routine colour vision check while in the early years of school.

Colour vision testing can be done by ophthalmologists (eye specialists) and optometrists, using specially designed charts. Some school health services will also be able to test children's colour vision.

If a colour vision deficiency is found, further testing may be needed to tell exactly what the nature of the deficiency is.

Colour vision deficiency is quite common and has minimal impact on a child's long-term health

Treatment for colour vision deficiency

There is generally no treatment to cure colour vision deficiency. However, most people with colour vision deficiency will find that they have few limitations. In fact, some people don't discover they have colour vision deficiency until they are adults. Adjustments such as taking cues from others or using visual cues that don't rely on colour, are some of the ways to adjust for colour vision deficiency.

Apps are available for mobile devices to assist with colour identification.

Genetic counselling and colour vision deficiency

If you or a family member have been diagnosed with colour vision deficiency, or if colour vision deficiency runs in your family, it can be helpful to speak to a genetic counsellor.

Genetic counsellors are health professionals qualified in both counselling and genetics. As well as providing emotional support, they can help you to understand colour vision deficiency and what causes it, how it is inherited, and what a diagnosis means for your or your child's health and development. Genetic counsellors are trained to provide information and support that is sensitive to your family circumstances, culture and beliefs.

If colour vision deficiency runs in your family, a genetic counsellor can explain what genetic testing options are available to you and other family members. You may choose to visit a genetic counsellor if you are planning a family, to find out your risk of passing colour vision deficiency on to your child.

The **Genetic Support Network of Victoria (GSNV)** is connected with a wide range of support groups throughout Victoria and Australia and can connect you with other individuals and families affected by colour vision deficiency.

Where to get help

- Your **GP (doctor)**
- **Ophthalmologist**
- **Optometrist**
- **VicRoads** Tel. **13 11 71**
- **Victorian Clinical Genetics Services** Tel. **1300 118 247**

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