

Colour Blindness

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Myths & Misunderstandings...

about Colour Blindness

What is Colour Blindness?

- Also known as colour vision deficiency
- Most related to a genetic condition
- Affecting 5 to 8 percent of men; 0.5 percent of women

Symptoms:

- Trouble seeing colours and brightness of colours in the usual way
- Inability to tell the difference between shades of the same or similar colour

Colour Blindness Cont'd

- Most people can see colours, but have difficulty differentiating between:
 - particular shades of reds and greens (most common) or
 - blues and yellows (less common)
- Most severe form of colour blindness - not being able to identify any colour, is called Achromatopsia. Only see things as black and white or in shades of grey.

What Causes Colour Blindness?

Genetic Causes:

- Within the retina, more than 120 million structures, called rods. Rods are sensitive to light. They are more sensitive and capable of producing vision in low light situations; are not sensitive to colour.
- Also part of the retina, is a structure called cones. In order to process colour, the eyes uses its 6 - 7 million cones located in the centre of the retina. Cones are sensitive to particular ranges of light wave lengths within which colours can be seen (400 to 700 nanometers).
- You have 'red', 'blue' and 'green' cones. You need all 3 types in order to see colour properly.

Wavelengths and colour deficiencies

For instance,

- Blue light has wavelength of 475 nm
- Red light has wavelength of 650 nm

Within most people's genetic code are genes which can determine which cones will be sensitive to certain wavelengths. When those genes malfunction, cones will be sensitive to the wrong wavelengths, which will in turn produce colour deficiencies. This is because not enough cones are sensitive to particular wavelengths and therefore, are not able to process certain colours.

Disease / Injury & Colour Vision Deficiency

Colour blindness can be caused by disease or injury damaging the optic nerve or retina. Some specific diseases that can cause colour deficits are:

- Diabetes
- Glaucoma
- Macular degeneration
- Alzheimer's disease
- Parkinson's disease
- Multiple Sclerosis
- Chronic Alcoholism
- Leukemia
- Sickle cell anemia

Medications & Aging are other causes for colour vision deficiency.

Variations of Colour Blindness

Protanomaly

- 1 in 100 men
- Difficulty seeing red - saturation and brightness of this colour are extremely reduced.
- Cones are processed as having a shifted colour, something closer to a pale green.
- Violet (mix of red & blue) may be seen as blue.

Deuteranomaly

- 5 in 100 men
- Difficulty seeing green
- Colours in the red, orange, yellow and green part of the colour spectrum trend toward red
- No change in ability to see a colour's brightness

Variations of Colour Blindness (2)

Dichromasy

- 2 in 100 men
- More obvious to the affected person.
- No difference between red, orange, yellow and green.

Protanopia

- 1 in 100 men
- Red, orange and yellow are reduced in terms of brightness.
- Can confuse reds with dark gray or even black.
- Any colour composed of red, orange or yellow is often seen as blue as a result of red light not being processed.

Variations of Colour Blindness (3)

Deuteranopia

- 1 in 100 men
- Same as Protanopia with the exception of the loss of perceived brightness of colours.
- Still cannot tell the difference between red, orange, yellow and green.

Video - [What It's Like to Be Colour
Blind](#)

Case Study - Nick, Colour Blindness Diagnosed

- Nick's routine eye tests at school first alerted his parents that he was colour blind in the red-green colour system. To him, red and green objects look the same colour, and he has trouble distinguishing between them.
 - "He was doing well at school, reading fine, getting good grades in most subjects so we weren't really worried. He was very keen on fitness and, when he was about 15 started thinking about what he wanted to do as a career. His elder brother is in the Royal Navy and Nick became very keen on the idea of joining the army. I wasn't that keen but I still felt for him when, of course, his colour blindness made him ineligible. The same went for the police, which was his next choice." (Mother of Nick)

Case Study Cont'd - Limited Career Options

- Nick began to think seriously about working in IT and decided instead to become a web designer.
 - “This is when we began to see exactly how important full colour vision is – after Nick had finished his first year... which really enjoyed. Or so we thought. He did really badly in his exams at the end of the first year and when he came home, he announced he wasn't going back to complete his degree.” (Mother of Nick)

Case Study Cont'd - Limited Career Options (2)

- Nick had really struggled with the computer work because he could not see a difference between green and red images on screen.
 - “There is a website called Vischeck – you can google it and find it easily – this shows you what a screen looks like to someone who is colour blind and it’s quite an eye opener. Not being able to see different colours really affects the way you see websites on screen, and to a web designer, not seeing what everyone else sees is a disaster.” (Mother of Nick)

Disclosing his colour blindness

- Nick's parents arranged to see an ophthalmologist and asked him if anything could be done.
 - “There is no cure for colour blindness and no special lenses that you can wear but he did tell us that there are tools that can help and the first thing that Nick needed to do was tell his lecturers at university. It turned out that he hadn't mentioned it at all, so they had no idea...”
- Nick went back school and explained about his colour blindness to his lecturers/tutors.
 - “They were annoyed because he hadn't told them – they had just assumed his poor grades were because he wasn't that committed. When they found out, they told Nick that the IT department had many different tools that could help, including a pixel checker – I don't know the proper technical name – but it displays the name of the colour whenever you point your mouse at an object on the screen”

Functional Implications

How does being colour blind affect one in everyday life? in the digital world?

Should we use colour?

Are there "curb cut" benefits to considering colour blindness?

Things to consider:

- Communicate information through more than colour
 - shape
 - text
- When using multiple colours, ensure they work in grey scale
- Avoid using colours together that are commonly a problem
- Stick within [W3C contrast guidelines](#)
- Provide a way to change contrast
 - <http://en.wikipedia.org/wiki/Photophobia>

Web Links

Simulation:

www.webexhibits.org/causesofcolor/2.html

Example of a website that does not take into account colour blindness:

www.veen.com/jeff/

More info about colour blindness:

www.preventblindness.org

www.nlm.nih.gov/medlineplus/