Using colour wisely

In his second article, Richard Truscott suggests how to choose and test colour schemes to suit all viewers.

The previous article (Spring 2005 *Communicator*, pages 26–27) described causes and effects of deficiencies in colour vision. This article describes:

▪ Colour schemes suitable for all viewers
▪ How to test the suitability of colour schemes.

The majority of colour-deficient viewers see red and green differently from other viewers. This affects how they see all colours, because all colours are a mixture of red, green and blue.

Some colours appear darker or lighter to a colour-deficient viewer. For example, protanopes are less sensitive to red light, so any colour containing red will appear darker to them. Yellows are very bright for all viewers.

Designing colour schemes

Ensure that a scheme works for all viewers by designing it to meet the worst case (dichromatic deficiency). Light and Bartlien (2004) suggest the following rules for designing schemes.

1. Avoid the use of spectral schemes to show sequential data because spectral colours carry no magnitude message. Viewers do not see violet and red as having a different magnitude even though they are at opposite ends of the spectrum.
2. Use yellow with care, and avoid colours containing yellow and green because colour-deficient viewers often confuse them with orange. Yellow appears bright to both normal and deficient viewers. Yellow should be used as the centre value in schemes showing data with a mid point value.
3. Use the colour intensity (brightness) to reinforce the hue (colour). It is better to produce ranges by varying the intensity of one colour than by using a range of colours.

Light and Bartlien's article suggests a number of schemes for different purposes. Most of their schemes show geographical data, such as temperatures and rainfall, covering a range of values and sometimes centred on a mid-point. They suggest a colour scheme for categorical data that uses light and dark shades of six colours. This scheme is suitable for colouring process and flow charts. Figure 1 shows for normal sighted viewer the true colours (top line) and how they appear to a "worst case " dichromatic viewer (bottom line).

Ridgen (1999) does not suggest a particular scheme but suggests using 'web safe' colours, which are:

▪ Viewable on all web browsers.
▪ Viewable on all platforms.

Web safe colours are a subset of 216 colours from all the colours available. To be web safe the Red, Green, Blue values must be one of the following 0, 51, 102, 153, 204, and 255.

Testing colour schemes

Ridgen suggests testing schemes with Paint Shop Pro, using a special palette of colours that simulates colour deficiency. The referenced article shows where to obtain this palette and how to apply it.

If you use Photo Shop, a plug-in that simulates colour deficiency is available as a free download from Vischeck. After downloading, the Vischeck plug-in appears in the Filter menu. Selecting the Vischeck menu option dialog gives you a choice of what type of colour vision defect you wish to simulate.

If you do not want to download the plug-in or do not have Photo Shop, you can use the Vischeck website to test your scheme, by entering the URL of a web page or uploading an image.

An example

In Figure 2 the same flow chart is shown five times. The five parts of the figure show; the original chart, a colour key, how the original would appear to three types of colour deficiency.

Original

This part of Figure 2 shows the flow chart for the normally sighted viewer. The colour scheme used is the one suggested by Light & Bartlien (see Figure 1).

Colour key

This part of the figure shows the names of the colours.

Deuternanope

This part is a simulation for normally sighted viewers of how a deuternaope viewer sees the original. Deuternaope viewers have difficulty with colours containing red & green. This is the more common form of red/green colour deficiency. This viewer see the:
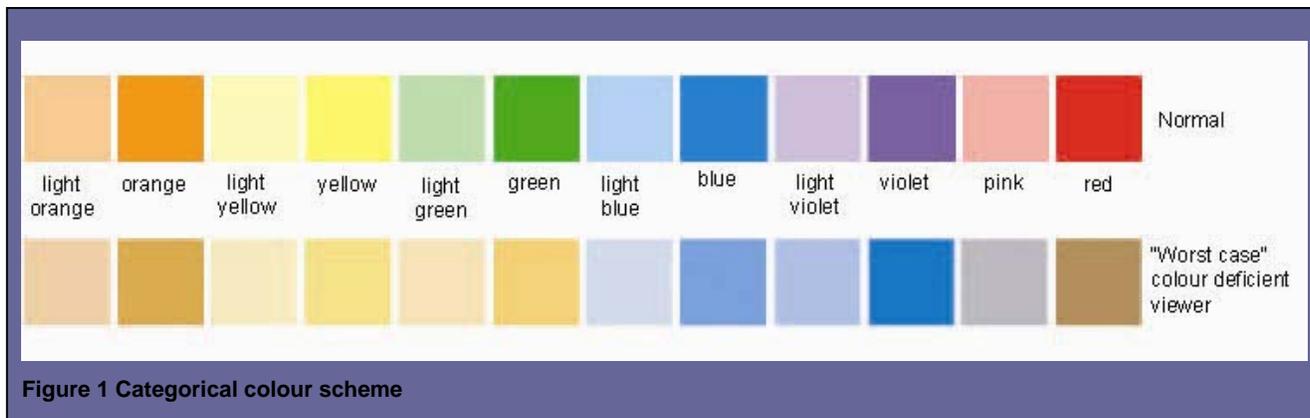

light orange · orange · light yellow · yellow · light green · green · light blue · blue · light violet · violet · pink · red — Normal

"Worst case" colour deficient viewer

Figure 1 Categorical colour scheme

Illustration

- The green as yellow.
- The pink as a blue/grey
- The orange background as a mid brown.
- The light yellow as light brown.
- The greys of course are unchanged.

Protanope

This part is a simulation for normally sighted viewers of how a protanope viewer sees the original. Protanope viewers have difficulty with colours containing red & green. This viewer sees the:

- The green as yellow.
- The pink as a blue/grey
- The orange background as a mid brown.
- The light yellow as light brown.
- The greys of course are unchanged.

Tritanope

This part is a simulation for normally sighted viewers of how a tritanope viewer sees the original. Tritanope viewers have difficulty with colours containing blue & yellow. This is a very rare form of colour deficiency. This viewer sees the:

- The green as blue.
- The pink as a pink.
- The orange background as a lighter pink.
- The light yellow as white.
- The greys of course are unchanged.

The simulated colours for the deuternaope and protanope are very similar because they both have difficulty with colours containing red and green.

References

Light, A and Bartlein, P J (2004) 'The end of the rainbow? Color schemes for improved data graphics.' *EOS Transactions of the American Geophysical Union* 85(40):385. http://geography.uoregon.edu/datagraphics/EOS/index.htm

Data Graphics Research (2004) *Color Schemes Appropriate for Scientific Data Graphics*, Department of Geography, University of Oregon (USA). http://geography.uoregon.edu/datagraphics/color_scales.htm

Christine Ridgen (1999), 'The eye of the beholder — Designing for colour-blind

users', *British Telecommunications Engineering*, Vol 17, Jan 1999.

BTexact Technologies, *Safe Web Colours for colour-deficient vision*: http://more.btexact.com/people/rigdence/colours

Vischeck website for producing simulations of how colours appear to colour-deficient viewers: www.vischeck.com/vischeck

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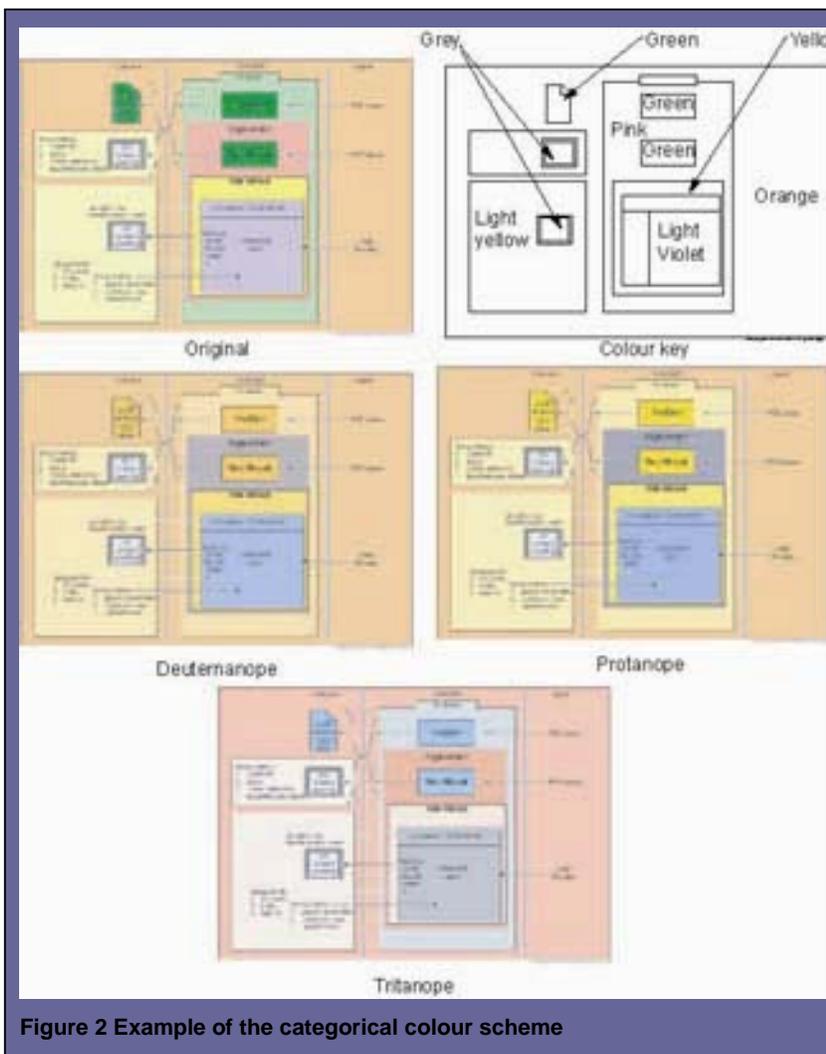Website: www.sanger.ac.uk

Figure 2 Example of the categorical colour scheme