- Friday, March 1, 1996
  Questions Related to Colour Vision

1.1 Here are the minutes for the YORKVIS discussion group for March 1996

1.2 The meeting was given by Pete Kaiser. He had previously circulated a request for questions related to colour vision that he would try to answer. He had enough to occupy the meeting but was disappointed that there had been no questions from graduate students.

2.0 There were four questions covered:

2.1. What is the "fluttering heart" and are we any closer to understanding it?

2.1.1. This is where a blue shape on a red background (and visa versa) appears to move around. Described by Helmholtz, there seems to be very little work done on it since.

2.1.2. Michael von Grunau (1975) decided it was due to a 'genuine delay' rather than a phase delay in the systems involved and that it relied on the colours abutting: a border destroyed the effect.

2.1.3. This seems to be a significant and robust effect just waiting for further investigation.

2.2. What is the RETINEX theory (in 25 words or less)?

2.2.1. It is a theory proposed by Edwin Land. Named after contributions from the RETINa and the cortEX.

2.2.2. " a framework for computing perceived colours on the basis of the relative intensities of three wavelengths and their spectral interactions". Usually evoked to explain colour constancy. (aside: colour isn't that constant, by the way).

2.2.3. The need for a theory of this type originated from Land's demonstrations of the significance of context when matching colours.

2.2.4. DM Regan, who was present at the discussion, attended Land's first UK presentation of the RETINEX theory in London in 1957. Some interesting anecdotes and comments concerning the sociology of science were shared.

2.3 What are double opponent cells?

2.3.1. These are cells whose receptive fields can be divided into two areas, a centre and a surround and in which both the centre and the surround each show colour opponency. Colour opponency is where a cell is excited by light of one wavelength but inhibited by light of a different wavelength.

2.3.2. They are found in mammalian cortex, especially in the so-called 'blob' areas (Hubel and Wiesel, 1968), and in goldfish retina (Daw, 1968).

2.3.3. How they derive their properties and what their role might be is still unknown.

2.4 Please explain the 'rounded triangle'.

2.4.1. This turns out to refer to the "CIE" colour diagram. Pete gave a very lucid account of this confusing diagram,

2.4.2. How can we define a colour eg. sky blue or grass green?

a) Calculate colour matching functions. This is done by matching monochromatic lights with mixtures of three primary lights (usually 460, 530 and 650 nanometers but they do not have to be these values). For each test light there is a unique combination of the three primaries that matches it. The contribution of each of the primary lights as a function of wavelength is measured. Although this varies from observer to observer, an average value is taken as representing a "standard observer". We don't have to do this every time, of course, since they have already been calculated for us!

b) take a spectral power distribution of the light in question (amount of each wavelength present)

c) for each wavelength, multiply this power distribution by the corresponding value of each of the colour matching functions to obtain three new functions. I think of this as passing the light in question through three filters, but Pete thinks this analogy is misleading. Then for each of these functions, sum the output across wavelength (integrate) to obtain three numbers.

d) express each as a fraction of the whole and plot two of them (the 650 and 530) against each other (x and y respectively). The output of third function, when expressed as a fraction of the total, is redundant because they all add up to 1.

e) on this plot, monochromatic lights plot as a 'rounded triangle' and all other 'real colours' plot under this curve.

Pete adds (I take no responsibility for his spelling!): Any two colors that plot in the same place in the CIE chromaticity diagram means ONLY that these two color match for the CIE standard observer. A specific location of a stimulus in this chromaticity space does not _necessarily_ tell us anything about how the stimulus appears. To the extent that any individual is similar to the CIE standard photopic observer, two colours that plot in the same place in the chromaticity diagram will also match for that individual.

3.0 So thanks to Peter for this entertaining and useful meeting.

3.1 I have sent a timetable of forthcoming meetings around separately. If anyone wants any more details please contact me.

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