

# The Awareness of Colour

## How Red is a Rose?

Most mammals do not have trichromatic vision, but through a lucky monkey mutation, after the South American continent separated from Africa, only African apes have colour vision far into the reds. Our hominid ancestors thus inherited the ability to see farther into the red end of the visible spectrum, than the monkeys in South America.

(Note 7 Color qualia).

In turn, this enables our human brain to build a model of reality in colours ranging from deep reds to blue violet. (In spite of the fact that the underlying colourless electromagnetic waves from 400nm to 770nm have nothing other than wavelength, that resembles our perceptual phenomena, or the so called 'qualia', of colour.)

(Note 8 CIE LUV).

Our brain's colourful re-representation of nature had an obvious evolutionary advantage that gave our ancestors the ability to distinguish ripe red fruits from green leaves.

(Note 10 colour contrast)

Clearly, our art is constrained by the limits of our colour vision. If our brains interpreted each and every wavelength as a separate colour sensation, our world would contain hundreds of millions of colours instead of only seven. The 'art' that we would then produce would be totally incomprehensible to our present faculties. This is the reason why art produced by one species is meant for viewing by the same species. It is difficult if not impossible for humans to appreciate the beauty of a whale song even though both have mammalian brains! A bee can appreciate the attractive beauty of a flower in ultra-violet – a light wavelength that is totally invisible to us!

The farther the reds, the blues and the greens deviate from the central standard white daylight mixture, (of our Sun), the more interesting the perception is in our minds. Thus, awareness of saturated colour (qualia) is a virtual feast for our colour senses – eye candy to trigger our pleasure. A mixture of ALL colours, such as the spectrum of visible light from *our* Star, is interpreted by our brain model as a neutral white. We have a natural interest (survival instinct) in deviations from any norm. The perception of saturated color has a cross-cultural attraction. (Note 9 color names).

The ancient Greeks painted their statues. We see them now as white marble--- they enjoyed them in full colour. (Note 11 Ancestral preferences).

The appreciation of colour in art objects, is a historic evolutionary fact. Colour as we humans perceive and know it, does not exist in the physical world. It is a mind phenomenon that appears only in our conscious awareness. (Practically speaking, it was not necessary to convert all the colourless millions electromagnetic frequencies into millions of different brain codes or colours. Since our working memory is only about 3 bits ( $2 \times 2 \times 2 = 8$  things), we can handle less than eight different colour codes at a time. Hence our brain's colour spectrum has only 7 different distinct colour categories.) Since each of us has slightly different combinations of genes, we can expect that some of us will see colours differently. In fact, about 10% of males lack the red mutation and have trouble differentiating reds from greens. Furthermore, one in a hundred are deficient in yellow---blue. (Note 12 Y-B contrast)

In fact, since we have receptors in our retinas that distinguish ranges of frequencies which we see as the reds, the greens, and the blues, we can create any perception of colour by the additive combination of red, green and blue. Thus, each pixel on your monitor

screen is made up of three dots of each red, and green and blue. Eight bits (8x8x8) of data applied to each dot creates 256 levels of brightness for each of the 3 colours. Hence 24-bit colour produces 256x256x256 or 16,777,216 different colour combinations. The reason for selecting 24bits of information for each pixel is because our eye-brain system can distinguish the *differences* between 16 million different colour combinations. (Note 9B Pixel colour) Evolution didn't just stop at our ability to discriminate 3 different colours but we can also discriminate approximately 8 different intensities in each colour. If we visualize the brain's ability to discriminate 3 different colours at 256 different levels as a 3-dimensional colour space, we get over 16 million different colour discriminations. Very clever for a brain with only 3 bits of working memory!

In general, 'colour', and other qualia (smell, taste, beauty), exist in the physical world only as processes of neuronal activity inside our brains. A piece of marble is just a stone regardless of its shape, but only to our conscious mind can it become a beautiful statue – a work of art. (Venus de Milo is only a white calcium carbonate rock!) (Note 11A).

In our Quantum age it has become clear that all 'qualia' exist only in our mind. But then we must also admit that 'art', as we see it, exists only in our mind's eye, and that beauty, really and truly, exists only in the mind of the beholder. Since every brain is different genetically and experientially, one person can never know what another is 'seeing'. Even the activation of our 'mirror neurons', which attempt to duplicate another persons' feelings, in our own head, does not enable us to know what that other world actually looks like. My father was colour deficient in red and believed that what he saw was what everyone else saw, until confronted with pseudo-isochromaticity charts. His universe was different from mine, and I will never know

what it was like. Even if two people correctly identify images on the colour charts, it simply means that they can equally well discriminate the **differences** between red or green. The actual sensation (qualia) representing the electromagnetic frequency of 'red' in one brain, most likely is not the same sensation inside another person's brain.

So! As an artist I must be aware when using colour that it is the **contrasts** between the red-greens and the yellow-blues that communicate more than the actual colours themselves. The same idea applies to the use of values. Once when I was teaching at George Brown College, I met a man who was instructing industrial arc-welding. We got to talking and he laughed about being fired as a house painter. He was colour blind in *both* red-green and yellow-blue. He explained that he could only teach electric arc because gas welding required adjusting the yellow-blue flame. To this day I cannot imagine the different world he was living in! I can't imagine him painting a black and white house with cans of paint with different colour labels on them. Of course, his condition was rare, but henceforth I have always been extra careful in using lots of black-white contrasts as well as chroma and shape/size contrasts in my paintings. (Note 27A)

What we see on a monitor screen is the result of ADDITIVE colour mixtures, and what we as artists paint with are paints that SUBTRACTIVE colours. A paint that appears as green is subtracting wavelengths on either side of green and reflecting greenness. In practice it is useful to construct a color wheel using your favorite paints and identify each with its manufacturers colour code. For example: Hansa yellow PY97, Phthalo green BS PG36, Ultramarine Blue PB29, and Quinacridone Magenta PR122 etc.

OK! As an artist we can conclude the following:

1. We are aware of only the 'visible' portion of the entire electromagnetic spectrum that stretches from low frequency radio waves to X-rays and beyond.
2. At least 10% of males is colour deficient in the Reds and 1% has difficulty in distinguishing yellow-blue contrasts.
3. The brain code (qualia), for any particular colour, is probably different for each of us. What we can agree on is that there is a difference between red-green and between yellow-blue and between white-black.
4. Colour contrast deficiency can be demonstrated by using pseudoisochromaticity charts. There is no way to compare what one person actually sees as a colour with what someone else is aware of inside their brain.
5. It is most effective to emphasize your main message, idea, concept, by using contrasts. Reserve analogous colours for your background.