Understanding Color: Past, Present, and Future Tense

With the advent of digital color increasingly used by artists from all walks of life comes a mixed blessing. Although we understand color a lot better than in previous centuries—and even better than a decade ago—artists and photographers are still bound by misconceptions that are further tangled by self-proclaimed "color gurus", who continue to evaluate color by empirical methods. The truth is that the nature of color as perceived by the human eye, is a combination of sensory input and interpretation by the brain. We actually *feel* color as we see it; as a result, we tend to fall into the trap of depending on numerical values to describe to others only what we see, stripped of the emotional connotation of what we both perceive and interpret.

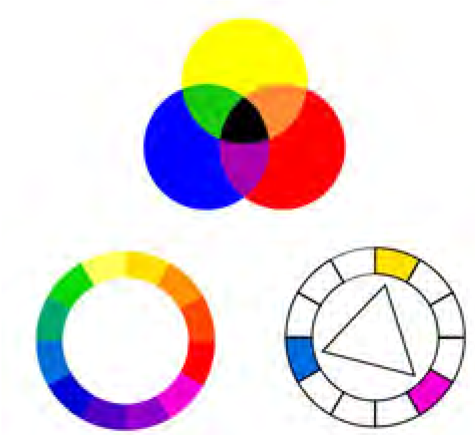
With the development of HDR devices and affordable color printers, the world is in color for every expressive individual—there is a virtual explosion before us as we adopt and accept new technology. However, to get a grasp on our new uses for color, a new way of understanding and *managing* color and color schemes is badly needed.

Bringing Our Senses to Our Senses

Our thoughts and understanding of color have their origins in art and mythology. Science eventually designed a rational framework for color, but our understanding at present remains bound to hard and fast numbers.

The *physical* understanding of light and the *biological* understanding of the way the eye works with the brain is a first step to mending the schism between perception and emotion. The *next* big leap comes from the understanding of information processing – the way the brain processes information and the way in which this capability has evolved.

The reaction to color—like our reaction to pleasing music, aromatic perfumes and savory meals—is experienced primarily in the mind. The sensory organ provides the signals required for the experience. Therefore, by understanding the way the human mind experiences color, we can build a new understanding that is above and beyond what is currently known.



Color in the Past

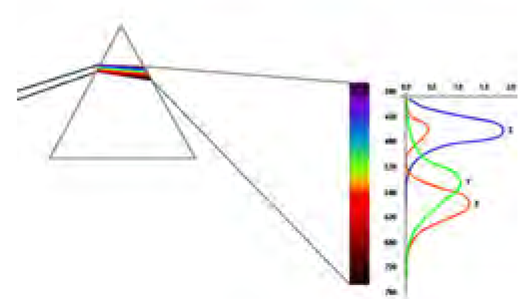
Early artists struggled to achieve a chromatic range from a limited number of pigments. Early understanding of color was based on resolving the dilemma of creating colors the artist emotionally sought from pigments. Knowledge about color evolved to enable the *mixing* of colors to arrive at a desired color. Many early artists such as Leonardo DaVinci not only had a mature working understating of pigment mixing, but also went on to contributed to the development of various color theories.

Among the color theory pioneers was Johannes Itten, painter and teacher.

Itten knew from experience that yellow paint mixed with blue paint made green paint. It was clear to him and other artists before him who mixed pigments that red, yellow and blue are the primary colors. Improving on the widely adopted models for color definition, he created rules for which colors go well together, which colors are harmonious.

From Color Pigments to Light

The understanding of color derived from light came far after the art of pigment mixing. Sir Isaac Newton is largely accredited with the discovery that light was made of a spectrum of colors.



Newton, after discovering the physical spectrum, wrapped the spectrum into a circle and named the seven hues we often refer to in today's color wheel. He saw 7 colors, but this perception wasn't very scientific.

From Light to Our *Reception* of Light

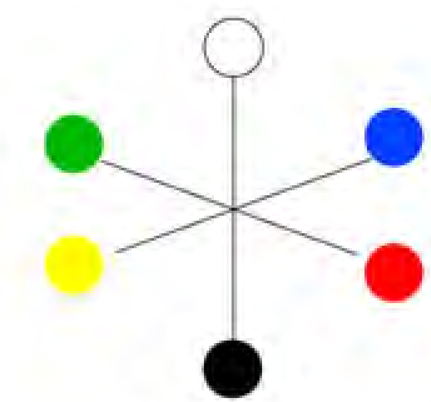
The understanding of how the eye sees color was the next big leap, a result of anatomical observations of a frog's eyes. It became evident at around 1800 A.D. that the human eye has three different color receptors, red, green and blue—which were annotated as RGB. With these three primary additive colors, all other colors could be created by combining various intensities of these components. In the additive color model, all RGB components present at full intensity create white; no light creates black. To the present day this remains the basis of color mixing using light.

Aron Sigfrid Forsius designed a color sphere in 1611.

Organizing the Light We See

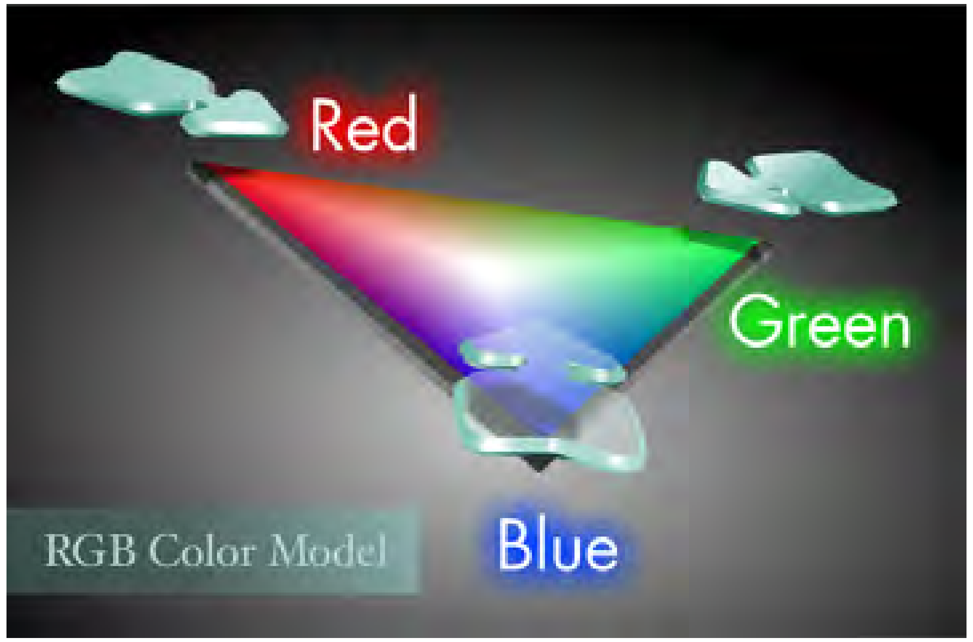
There have been many attempts to build a coherent framework in the form of a *model* to describe the relationship between colors we see.

Color spaces have been very popular to describe the relationship between colors and in fact a color space also describes the outer limit within which colors can exist. For example, in a computer color model of RGB color, red, green and blue exist at opposing points, converging on white in the center. In addition to showing the relationship between the primary colors, color models also describe the "container" for color space.



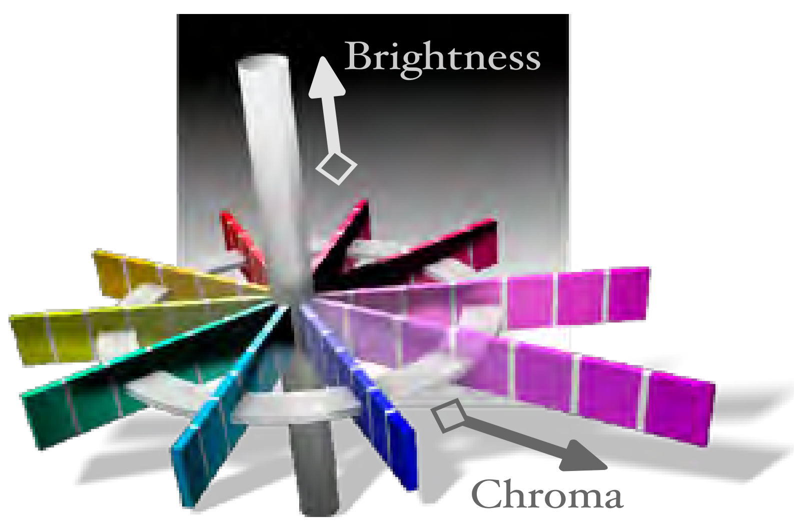
Psychologist Ewald Hering observed in 1878 that our mind handles coloras 3 opposing pairs: red-green, blue-yellow and white-black.

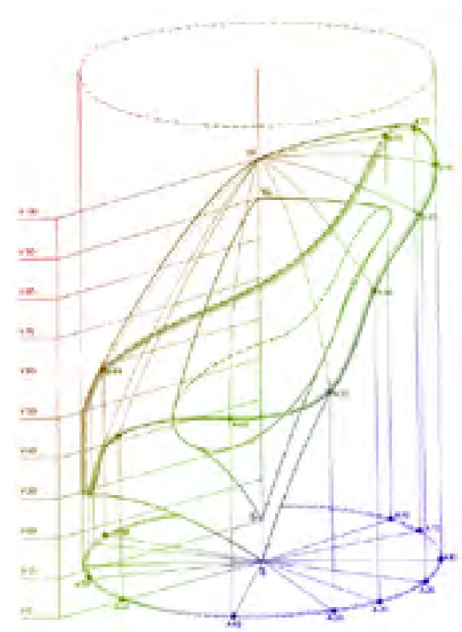
In the computer graphics model of RGB color, there are 256 increments for the brightness of each color component, expressed as 8 bits of information per color channel. Following the math, 8 bits of binary information is 2 to the 8th power, times three channels, resulting in 16.7 million possible colors. This is all very neat and tidy from a purely mathematical approach, but color models do not take into account our emotional grasp of colors—how they impact on our brain.



Color spaces have been idealized as spheres, cones and cylinders; we like the world to be easy! But in truth these modeling theorem fall apart because a true model of the color spectrum as our eye passes the information to the brain is somewhat irregular if all colors are arranged with distances that reflect our idea about the differences between the colors.

The artist Albert Henry Munsell build a very elaborate color tree, based on a decimal division of the visible spectrum.





'Coloroid' color space as validated with 70,000 users by Antal Nemcsics1974

The Reality of Color doesn't Change; therefore our *Understanding* must Change

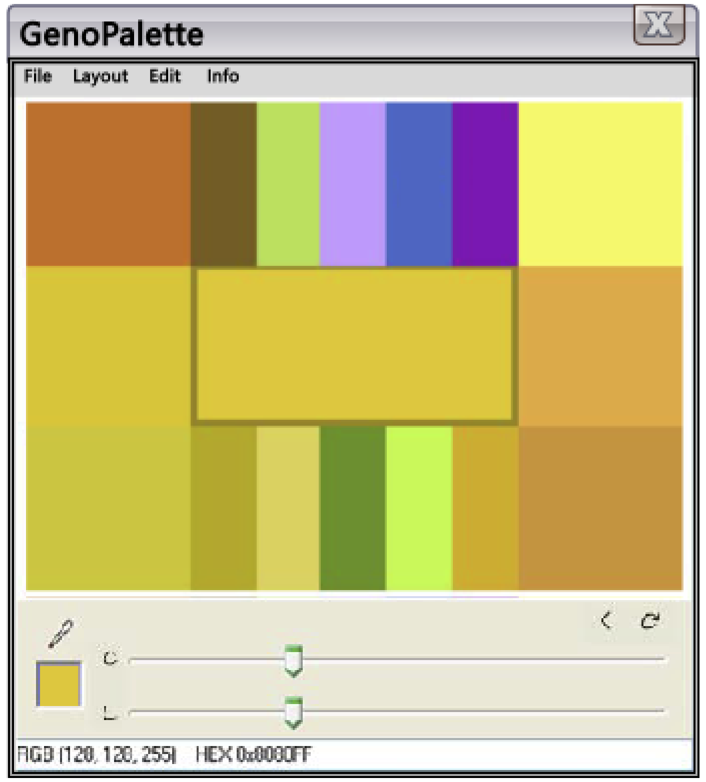
To bring our understanding of color up to date here, a new definition of color must be made. Existing theories with newfound "scientific understanding" defined color spaces—relationships—as *downstream*. This downstream definition is useful for defining pigment colors and exact frequency of light, but the downstream definition does not operate in the domain of the mind.

New understanding of color enables us to map color in the "mind's eye", the true symbiotic relationship between the eye—the sensing organ, and the brain—the interpreter of the eye's gathered information. When we put together the eye's raw data and the brain's handling of color data, it enables us to understand also the complex relationships between colors, making the older theories based on color wheels simplistic and relatively crude.

These crude theories of color have created a somewhat harsh world of color that we see today. Most of our accepted theories are an outgrowth of early artist's desperate search for "pure colors" that they did not have to work with due largely to the dependence on subtractive color models. However, today's chemical industry has made pure colors plentiful and simple RGB-based computer programs have flooded our screens with these pure and saturated colors; unfortunately these fluorescent, overstimulating colors are not to be found in nature. These colors are artificial; they reside at the edges of our perceptive capabilities. It is the brain's tendency to be attracted to brilliant colors, realistic or not, just as we as a people face a near addiction to overly sweetened foods and excessively loud music. Our brains always seek stimulation and untrained, prefer excitement to relaxation; in sounds, smells, and (unfortunately for today's digital artist) in color.

A new Approach to Color: Putting the Eye and Brain Together

Having seen the virtual brick wall between existing color theory and human accessibility to choosing colors, the engineers at Genometri have chosen to abandon the theory in pursuit of color definition based on human response to color. Genometri considers this to be the next step in working with color; although Genometri uses empirical data in products such as GenoPalette and GenoSwatch, they rely more on human response than mathematics to provide users with color palettes that give our eyes the same sort of pleasure we get when viewing the natural world in which we all live.



The belief is in a balance and a harmony in color specification: it's alright to stimulate our senses, but there is a middle ground between the subdued hues used by historic artists and the garish neon shades overused on many websites. Part of Genometri's mission is to calm our overstimulated senses and to provide artists with the tools to relax the audience's eyes.

The color combinations displayed by GenoPal look often very good together; you'll see that if you download the trial versions for Windows and OS X. The color schemes GenoPal produces are related to our perception of the world around us. We all enjoy the endless color variation in flowers in a field, and the lights and shadows of a mountain range in the afternoon sunlight.

The pleasure we get from scenes of nature is part of the goal of Genometri.

When we compare similarities and differences in color groups, a type of pattern recognition happens, and it is a joyful activity for our mind. Evaluating natural colors is like listening to harmonies in music, where a theme is introduced, it is repeated and variations are then presented. Drawing comparisons between music and watching color has a tradition; Newton and Goethe both went this route.

In the years to come, you will see more evidence of Genometri's rethinking about the way we think about color in products, and the information they freely present to you the audience. GenoPal is only the first attempt to break away from the traditional methods of color picking, and there will be more. GenoPal's palettes look good because the swatches have something to do with each other in a non-empirical way, the way our minds evaluate and are attracted to colors found in nature—the relationships seem logical to your eye. Sometimes it is not quite obvious what the color swatches share, so your mind gets into an examination process.

To sum it up, make the comparison between a typical color picker in a design application and Genometri applications like this:

You can make a statement in a speech. And the audience reacts.

Or you can write a poem.

If it's a good poem, the audience is transcended from simple digestion to savoring, giving pause, and then the pure satisfaction of having been engaged in a work of art.

—Gary David Bouton,

with *acer* @

genometri®

Acknowledgement : Some pictures courtesy of www.colorsystems.com