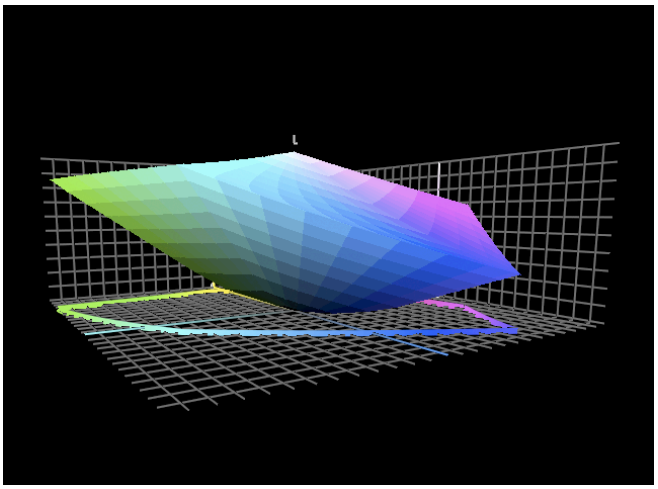
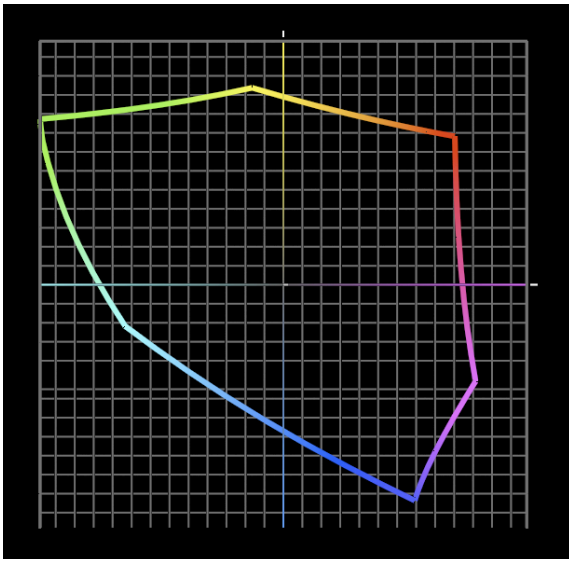
TECHNIQUE

COLOR THEORY





While color is often represented in two dimensions, three-dimensional chromaticity diagrams offer a more descriptive view of both color and color relationships given color's three basic elements: hue, saturation, and luminosity.

What is color theory?

It's not color management – a science of measuring color physically and describing it mathematically. It's not color adjustment – techniques for changing a color's appearance. It's not color psychology – a social science of charting and describing human response to color. It is impacted by all three above disciplines (it rests at their intersection), yet it constitutes a separate discipline in and of itself. Color theory is a language that conceptually and perceptually describes the elements of color and their interactions.

Part physical, part biological, part cognitive, and part psychological (universally, culturally, and individually psychological), color theory is perceptually based. Color theory often describes optical responses (which the other color disciplines take into account but do not focus on specifically), some of which are described as "illusions" but are nonetheless perceived.

It does not describe physical absolutes, as color management does. Instead, it describes perception, which is context-sensitive, thus relative rather than absolute. It does not describe the mechanics of changing color appearance, as color adjustment does. Instead, it addresses what to do and why to do it rather than how to do it. It does not describe responses unique to culture or individual, as color psychology does. Instead it focuses on universal psychological responses to color, such as temperature.

How can color theory be used?

Color theory can help describe what is perceived more precisely. It offers a language that is shared and reasonably precise. Color theory can help make perception more precise. Language encodes thought and a more precise and nuanced language can lead to more sensitive perception. Color theory can help analyze what makes some color relationships particularly

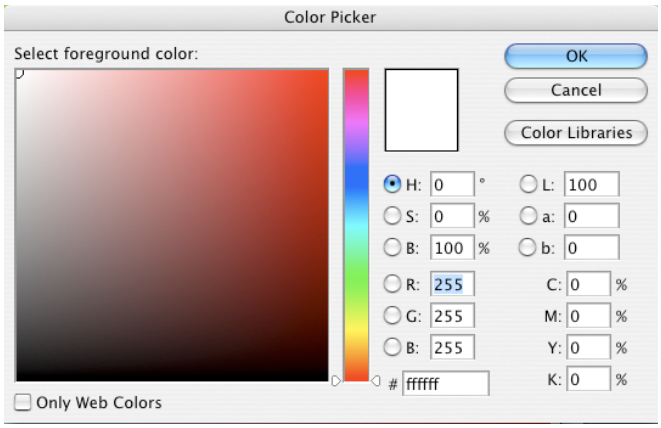
successful and what makes others less successful. It illuminates the dynamic interactions between the elements of color, which can be used to guide decisions in selecting and adjusting color relationships.

Color theory is best used to inform color choices rather than to make them. Theory lays a foundation for exploration (guiding inquiry toward areas with greater potential and away from areas with less potential). It is not a substitute for discovery. Jazz musicians Keith Jarrett and Theolonius Monk mastered music theory, but even they were surprised by their most original compositions; their compositions were informed and empowered by theory but not determined by it. Theory is the sum of what we know, but it does not contain what we do not yet know. It can prime conditions for a breakthrough, but it cannot make one. It can be used to empower a unique or authentic sensibility, but it is not a substitute for one.

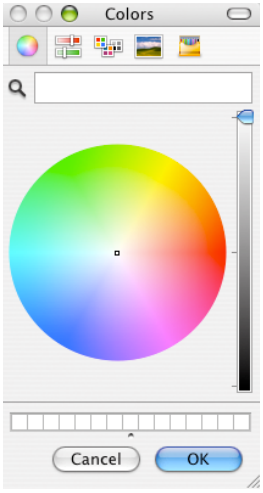
If color theory is a language what is its vocabulary?

The language of color theory can be confusing, due in part to being not as widely known as it should be and in part to its varied terminology (its vocabulary has not been decisively defined).

At its most basic, color consists of three elements – hue (red, orange, yellow, green, blue, purple), saturation (neutral, semi-neutral, semi-saturated, saturated, super-saturated), and luminosity (dark, light).



1. The Adobe color picker is two-dimensional and charts permutations of luminosity and saturation of a single hue.



2. The Apple color picker is a two-dimensional color wheel charting all hues with permutations of saturation at one level of luminosity, specified by an accompanying slider.

Many words can be used to describe the same elements, which leads to confusion. Color is often used to describe hue, which is only one aspect of color. Color is the combination of three elements: hue, saturation and luminosity. Brightness, also called luminosity or value, can be confused with saturation. Saturation, also called intensity or chroma (sometimes confused with hue), can be confused with how much colorant permeates a surface, which – though related – is a separate factor.

If you're confused now, that's perfectly normal. A widespread adoption of a consistent set of words would go a long way toward making communication about color more precise, but it hasn't happened yet. For the purposes of these articles, I'll default to the terms hue, saturation, and luminosity as they are useful terms in Photoshop (where they describe blend modes and are nearly identical to the HSB readouts in Photoshop's Info palette).

These three elements can be represented numerically. Photoshop provides readouts in its Info palette in several color modes, including HSB (hue, saturation, brightness) – found in the submenu beneath the arrow. Luminosity is represented on a scale of 1 to 100. (It's a scale of 1 to 10 times 10. Put another way, it's the photographic zone system times ten.) Saturation is also represented on a scale of 1 to 100. Hue is represented on a scale of 0 to 360 – the number of degrees in a circle or wheel.

4. Bisecting a color wheel with a straight line defines complements – colors that produce a neutral color when mixed in equal proportions. Increasing one color reduces its complement. Three complementary axes are particularly important in color adjustment – red/cyan (0/180), yellow/blue (60/240), green/magenta (120/300).

This representation of color makes hue the only element of color for which the numerical language is conceptually challenging. Several things will make using this scale easier. You can think of the color wheel as a clock, where every hour (or 30 degrees) you get a new color. The wheel starts at a warm yellow-red (0 degrees), 30 degrees is orange, 60 is yellow, 90 is warm yellow-green, 120 is green, 150 is cool blue-green, 180 is cool green-blue or cyan, 210 is blue, 240 is warm red-blue, 270 is purple, 300 is magenta, 330 is cool blue-red. An image could be considered to be monochromatic if it uses hues constrained within 30 degrees or less from one another. Analogous hues are within 60 degrees of one another. Complementary hues are 180 degrees apart.

Linguistic descriptions of color are less precise than numeric descriptions of color. Consider forming consensus around terms such as "sea foam" or "dusty rose." What color is mauve? More to the point, how many colors can the term "mauve" describe?

Using numbers to describe the elements of color leads to a more precise definition of color. Consider the usefulness of specification systems like Pantone. In numerical systems there is only one color for a single number or set of numbers. In addition to precision, one of the characteristics that makes a numerical system useful conceptually is its simplicity. Compare memorizing the numbers in the Pantone system with understanding

5. The line drawn between 90 and 270 degrees separates warm from cool colors; left of this line is cool; right of this line is warm. Warm and cool are psychological descriptors of color and are relative. Two colors can be considered absolutely warm (red) and cool (cyan). Any move toward red can be considered a warming adjustment. Any move towards cyan can be considered a cooling adjustment.

the numerical scales in HSB. Not all systems are simple enough to be used conceptually – HSB is.

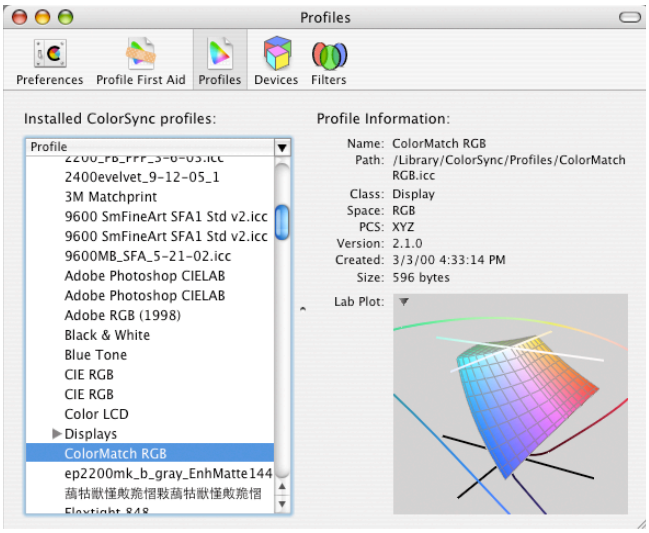
Words and numbers provide one kind of perspective, pictures represent another. Color can be graphed. While color has three components, it is typically graphed in two-dimensions. (The widespread use of computer imaging and its potential for 3D imaging may change this in the near future, but it hasn't changed yet.) This means in any two dimensional diagram of color, the representation of one element of color is limited. Nonetheless, even two dimensionally, graphing color is quite useful.

A classic way of representing color is in a circle or wheel. Creating and using color wheels to describe color and analyze color relationships is a time honored tradition dating back to Leonardo DaVinci. Some of the most famous color wheels were created by Newton, Goethe, and Munsell. Color wheels can be particularly useful when colors are plotted on them and when geometric shapes are imposed upon them. You are then able to identify a variety of relationships between colors, both colors that exist in a composition and colors that do not. A straight line can be drawn through the center of the circle to define warm versus cool colors (a specific line between 90 and 270 degrees) or to identify complementary colors (any line). Concentric circles can be used to define the level of saturation a color or set of

6. Concentric circles can be imposed upon a color wheel to define a color, or set of colors, saturation level – neutral, semi-neutral, semi-saturated, saturated, or supersaturated.

7. Shapes can be imposed upon a color wheel to help identify a variety of ways to structure hues.

colors contains. Triangles can be used to identify types of color interactions – primary or secondary colors, monochrome, analogous, or complementary colors. More complex geometric shapes – triangles, rectangles, pentagons, hexagons, octagons – can be used to help identify colors that may be used with one another to create logical color structures. For this, you are likely to find the Apple color picker (a wheel inside Photoshop) particularly useful (Photoshop: Preferences: General: Color Picker: Apple). Color wheels are excellent for displaying relationships between hue and saturation but are limited in their ability to display corresponding luminosity relationships. An accompanying sidebar may be used to include this information. This arrangement may be seen as a single diagram but it is actually two. When color is graphed two-dimensionally, we need a minimum of two diagrams to display all three elements of color.



3. The Apple ColorSync utility can graph ICC profiles, displaying color in three-dimensions.

There are many other useful terms in the lexicon of color theory and distinctions that can be made, but the elements mentioned here are the essentials on which you can base your conceptual foundation of color. With this language of color at your disposal you can sharpen your perception of color, better understand existing color dynamics, make predictions about how color modifications will affect an image, and communicate more clearly about color – before, during, and after working with color.