Color

Design Principles and Problems
Paul Zelanski & Mary Pat Fisher

Chapter : Color
pp. 227-250
Oil on canvas, 6’9 1/2” X 9’6”
Collection of Mr. and Mrs. David Pincus
Black Reflections, 1959
Franz Kline (American, 1910–1962)
Oil and pasted paper on paper, mounted on Masonite
19 x 19 3/8 in. (48.3 x 49.2 cm)
Gift of Mr. and Mrs. Norman Schneider, 1964 (64.146)
Franz Kline used colors as a great chef would use herbs.

Color is an extraordinarily rich tool for artists. It is also extremely complex. Unlike learning the skillful use of the elements of design explored, just beginning to appreciate what color can do requires comprehensive study.
Characteristics of Color

When a ray of white light from the sun passes through a glass prism or a spray of water its energy is broken or refracted into the rainbow spectrum of colors that humans can see. This visible spectrum of light refracted through a prism ranges from red to violet. The colors which we can distinguish correspond to different wavelengths, or frequencies, of electromagnetic radiation. There are many other wavelengths that we cannot see at all; infrared, ultraviolet, x-rays, and radio waves are invisible to us.
Some Artists reproduce the colors of the visible spectrum using **pigments**, substances that reflect approximately the same color as it is seen in the band of the same name in a spectrum of refracted light. For instance, yellow pigment absorbs all colors except yellow, reflecting yellow back to the observer. No color actually exists until this reflected wavelength of light is received by the eye and interpreted by the brain.

In **reflected colors** there are many variations on the pure colors of the refracted light spectrum. Over the years, theorists have devised many different ways of squeezing these variations into a single theory of the relationships among the colors that we see.

In the seventeenth century, Isaac Newton noticed that the red-purple at one end of the visible spectrum looked very similar to the purple at the other end. He therefore drew the two ends of the spectrum together, producing the first **color wheel**.

Newton’s color wheel, from *Optice* by Sir Isaac Newton. 1706. The names of the color are in Latin. Rare Book and Manuscript Library, Columbia University, New York.
Pigments for sale at a market stall in Goa, India.
Hue

Color wheels are two-dimensional models of color relationships that deal only with hues – the names of colors. Hues opposite each other on a color wheel are said to be **complementary**; hues next to each other are called **analogous**. If complementary hues are juxtaposed, each appears brighter, if closely analogous hues are juxtaposed, they tend to blend visually, and it may be difficult to see the edge that separates them.
Even in simple color-wheel models, controversies have arisen over which few hues are the basic ones from which all other hues can be mixed. There are at least five different possibilities that seem to be true, depending on the situation. In light mixtures, as in film, photography, computer graphics, and TV, where refracted light operates, all hues can be obtained from combinations of the rays that produce red, green, and blue-violet.

Refraction of light
In mixing pigments, where reflected rather than refracted light operates, the primaries are traditionally considered to be red (magenta), yellow, and blue (turquoise). The secondaries in pigment mixtures are orange, green, and purple (violet). If secondaries and primaries are mixed, a third set of hues is created: **tertiaries.** In pigment mixtures, these can be called orange-yellow (the hue obtained by combining orange and yellow), red-orange, red-purple, purple-blue, blue-green, and yellow-green. If reflected colors that lie opposite on each other are mixed, they produce a neutral gray.
Finding that actual pigment mixing based on this traditional pigment wheel did not necessarily produce colors that varied from each other in equal steps, **Albert Munsell** worked out a third color circle with five “principal” colors that relate to each other and to intermediary mixed colors on a more precise numerical basis. Munsell’s principle colors were red, yellow, green, blue, and purple.
Wilhelm Ostwald worked out still another color circle that was based chiefly on how colors are perceived by the eyes and the brain rather than on the light or pigment mixtures in the world that we experience. In Ostwald’s color theory, the primary colors are red, yellow, sea green, and blue – four in all.
Yet another system was devised by Arthur Hoener. It deals with the relationships between certain colors and the background against which they are presented. In this system orange, green, and violet can be used as primaries to produce yellow (orange plus green), blue (green plus violet), and red (violet plus orange). If, for instance, you stare at a medium circle for a time and then glance immediately at a white area, you will “see: it’s complement red emerging from the white. A lighter green circle will make the background appear greenish; a dark-green circle will make the background appear whiter, and the green will look almost black. If two colors are presented in the right amounts against a light-colored background, their effects will mingle, producing an overall illusion of a single color that is different from either. Whereas the classic theory of pigment mixtures defined yellow and red as primaries, claiming that they cannot be combining any two colors, Arthur Hoener demonstrated that yellow and red can be mixed using pigments. If you look closely at the “yellow” shape coming down from the upper right of Hoener’s Penuous, you will discover that it actually consists of green and orange circles on a light background. And the “red” shape coming up from the bottom is actually violet and orange circles on a light background. Hoener referred to this optical color mingling of color energies as synergistic color mixing. By transcending the dogmatic “rules” of color mixing, he greatly expanded our knowledge of how colors work together.
Arthur Hoener. *Penuous*. 1974, acrylic on masonite, (60 x 60 cm.)
Value

Hues are not the only variations we see in colors. Another variation is value – their degree of lightness or darkness.
Georgia O’Keeffe used an extremely limited hue palette in her 1977 painting *From a Day with Juan, II*. The only hues used are blue and gray. Yet by gradually varying their value from very light at the bottom to very dark at the top. O’Keeffe provided a great range of color sensations. If you cover the middle of the painting you will see how different the two extremes are. The top has very strong emotional impact, the bottom a very delicate one. The transitional area through the middle – especially where the grays are changing – has a mystical quality. This is a fantastic range of sensation, yet it is based merely on value changes in two hues.
Saturation

The third characteristic of color that theorists have isolated is saturation (also know as chroma or intensity). This is a measure of the purity and brightness, or grayness, of a color. Janet Fish’s Cut Peach and Blue Vase uses all the colors of the spectrum at high saturation. They appear almost as pure as transparent jewels with light passing through them. In comparison, the color in works by Paul Zelanski and Robert Lazuka are of low saturation, dulled as if by thin layers of grayed paint of top of purer hues.

In pigments there are two major ways of graying a pure color of maximum saturation without changing its value: Mix it with gray of the same value, or mix it with its complementary of the same value (the color that lies opposite it on the color wheel). When mixed, complementaries will neutralize each other until – mixed in the right proportions – they form a gray that resembles neither, represented by the gray in the center of the color wheel.

There is another way of changing saturation that can be explained only by the color principle that is true in all situations: Colors are affected by the colors that around them. In any combination of colors, adjacent colors will affect our visual perception of their hue, value, and saturation. Even when working with very few hues artists can vary their effects by the ways they are combined.
An example of work by Paul John Zelanski
Robert Lazuka
*Inside Outside* (1995)
19" x 25"
Color Solids

To devise a single system for portraying the relationships among colors along the three variables discussed – hue, saturation, and value – color theorists have developed a variety of color solids. These models typically show value as measurement up a vertical pole, from black at the bottom to white at the top. Saturation is represented as horizontal measurement away from this vertical pole, from neutral grays in the center to maximum saturation at the outer limit of this line. Varying hues are shown as positions on the circumference of the circle, just as they are in two-dimensional color wheels.
The neutral values in steps of 1 from 0 to 10

A circle of 10 hues at value 5 and chroma 6

The chromas of purple-blue in steps of 2 from 0 to 12, at value 5
Phillip Otto Runge’s *Farbenkugel (color sphere)*, 1810, showing the surface of the sphere (top two images), and horizontal and vertical cross sections (bottom two images).

Color sphere of Albert Henry Munsell, 1900
HSL and HSV are two related representations of points in an RGB color model that attempt to describe perceptual color relationships more accurately than RGB, while remaining computationally simple. HSL stands for hue, saturation and lightness, while HSV stands for hue, saturation and value.
Although this and other color solids are useful means of standardizing color names and of demonstrating some color relationships they should not necessarily be accepted as reality. Color wheels and color solids are a partial map of how we perceive colors. There is much that we do not yet know. Color theory is in a constant state of change, and different people perceive colors somewhat differently. Rather than being dogmatic about color theories, it is better to explore with an open mind what colors can do.
Computer Color Choices

Color exploration in computer graphics offers almost limitless possibilities. Sophisticated 24-bit computer graphics systems make available over 16 million possible colors from which to choose, far more than the human eye even distinguish. These are all created from combinations of the three primaries – red, green, and blue-violet. In time, color generated by and mixed on the computer will have a tremendous effect on perception and use of color.
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Artwork created using both traditional and digital methods during the production of the digital fiction piece *The Diary of Anne Sykes*  

Designed, coded and written by Andy Campbell  

Dreaming Methods - experimental venture combining fictional narratives with atmospheric multimedia designed to be read and experienced on-screen.  
http://www.dreamingmethods.com/
Color Prejudices and Color Combinations

Prejudices toward a particular color theory can prevent you from making your own discoveries. Many of us are victims of prejudices for or against particular colors and color combinations. In everyday speech we use color names in ways that implant or reinforce stereotypical ideas of their fixed emotional connotations.

Yellow, for instance, is often associated with negative connotations: A “yellowbelly” with a “yellow streak” is a disloyal coward, “yellow journalism” is distorted and sensationalist, a dishonorable discharge from the service comes on a “yellow paper.” Red is typically associated with anger, passion, and warmth; blue and green with coolness and calm. Some of these associations probably come from typical experiences with our environment. We see fire and angry faces as red and therefore link the color with warmth and passion. We see skies as blue and therefore tend to link blue with the seeming coolness and distant serenity of the sky. But the sky at sunset may be red, an extremely hot object may glow white or blue, and to a person in an ice-bound land, red may bring a sense of peace. To limit ourselves to more familiar color associations, defining them as universals, is to overlook the exciting possibilities of presenting blue in a passionate, emotional design and red in a serene setting. We can do whatever we like with color, so long as we can make it work.
We may also be unwitting victims of prejudices toward certain color combinations. Color theorists have long tried to specify rigidly “the” combinations that work and how they work. Color combinations are said to produce a quiet, restful effect if they avoid strong contrasts and colors of high intensity. Two schemes thought to create this effect are *monochromatic* (using a single hue in a range of values) – and *analogous* (using three to five hues adjacent to or near each other on the color wheel, such as blue, blue-green, and green.)
Pablo Picasso. *La Vie*. 1903
Oil on canvas 196.5 x 129.2 cm
Fabric squares represent a monochromatic scheme using a single hue in a range of values
**Analogous**
using three to five hues adjacent to or near each other on the color wheel, such as blue, blue-green, and green
Color Combinations

Color combinations with strong contrasts are thought to produce a bolder, more exciting effect. These include *complementary* schemes built on a pair of hues that lie opposite each other on the color wheel, such as the red and green of Toulouse-Lautrec’s painting of a scene from Carlo Pallavicino's Venetian opera *Messalina* (1680).
Complementary scheme built on a pair of hues that lie opposite each other on the color wheel

Henri de Toulouse-Lautrec
painting of a scene from the opera "Messalina" at Bordeaux Opera
cover from playbill
Dallas Opera 2009/2010 season
Otello
Margot and Bill Winspear Opera House
Double complementary schemes
two adjacent hues plus the complements of each

Split complementary schemes
any hue plus the two hues to either side of its complement
Split Complement tile design
by: Tatiana Tsevetkova
Split Complement tile design
By: Ami Inose
**Triad schemes**

combine any three hues that are of equal distance from each other on the color wheel

*P.Fix-Masseau, Periodical Cover, 1948.*
Tetrad schemes
combine any four hues of equal distance from each other on the color wheel
“Advancing” and “Receding” Colors

Any color can be brought forward or pushed back in space by the visual clues to spatial organization given to it.
Richard Lytle’s painting *Early Sound Cantabria* overthrows the notions of advancing and receding colors by making the same colors advance and recede in the same painting. Where reddish-brown areas are shown in the foreground (the bottom of the painting), associated with large objects, they seem to advance. The large reddish-brown area in the lower center of the painting seems very close to the viewer. But in the next strip to the right, the reddish-browns shown in the upper part of the painting seem to recede as background.

Lytle contradicts the advancing-and-receding rule again and again by continually reversing the position of his colors, as though he were shifting colored films. The painting holds our attention as we try finding logic in the receding and advancing color forms. Lyle has used images that continue despite the color changes and has held the whole composition together by a chain of dark values.
Richard Lytle.
*Early Sound Cantabria.*
1972.
Oil on canvas, 7’ x 7’6”
Hues and values themselves may be used as clues to spatial organization. The greater the contrast in value and/or hue between two areas, the greater the distance between them will appear. If heavy black type is placed on a white groundsheet, the type will seem closer than the groundsheet, coming out toward us rather than occupying the same space as the page. This is because the black contrasts sharply with the white paper. The stronger the contrast between figure and ground, the farther apart they seem to be in space. As they approach each other in value and hue, they seem to exist more and more on the same plane.
Guglielmo Achille Cavellini

Flowerscape, 2004, Fruit stickers, acrylic on wood panel
14 ½ x 18 ½ x 1 ¼ inches
Guglielmo Achille Cavellini  
(1914-1990-2014)  
There is no artist in modern times, perhaps in all of time, who tried to insures (some would say purchase) his place in art history with the intensity of the Italian artist Guglielmo Achille Cavellini. His art of “self-historification” was based on the premise that no one knew the artist better than himself (or herself), and that he (or she), rather than critics and historians, was better able to guide the public towards an appreciation of the artist’s life and work. Through a series of self-produced books, performances, festivals, portraits, novelty items, and voluminous correspondence, he sought to ingratiate himself with critics, curators, and artists the world over. In doing so, he laid the foundation for the future examination of his art based on a vocabulary of his own devising.
Roy Lichtenstein has used overlapping as a clue to three-dimensional relationships in his *Interior with Mirrored Closet*. But the values are so flat and the shapes so simple that there is a fascinating interplay of ambiguities as to where these highly contrasting colors lie in space. There is a great deal of spatial tension between the dark and light diagonal lines.
Roy Lichtenstein


Painted and printed paper on board (collage for painting) 30 1/4 X 36 1/4 inches
“Subjective” Versus Local Color

Use of local color reports the actual colors of objects, as we would perceive them. A *Night in the Bike Store (Red’s Dream)* is a tour de force of the ability of computer graphics to create the complexities of local color, including highlight and shadow effects.
Produced by Pixar, Richmond, CA.
By contrast, George Segal has used color subjectively to create mood and mystery.
Segal, George, 1924-
Street Meeting
Date 1977
Material plaster, wood
Measurements 96x95x52'
Subject Sculpture--United States--20th C. A.D

University of California, San Diego

The George and Helen Segal Foundation / Licensed by VAGA, New York, NY.
Matisse, Henri

*Green Stripe (Madame Matisse)*

1905 (165 Kb); Oil and tempera on canvas, 40.5 x 32.5 cm (15 7/8 x 12 7/8 in); Royal Museum of Fine Arts, Copenhagen
In this portrait of his wife, Matisse used solid colors throughout, and depended entirely upon the intensity of his colors to create depth and shape. Thick black lines and rough brush strokes completed the image. Although it isn’t necessarily a flattering portrait, Matisse did exactly what he intended to, creating a stylistic and primitive painting that deliberately celebrated the use of color.
Monet, Claude, 1840-1926  
*Poplars*  
1891  
oil on canvas  
81.9x81.6cm  
Metropolitan Museum of Art (New York, N.Y.)  
Impressionism Landscape Light --France--19th C. A.D  
University of California, San Diego

The label subjective color is often misapplied to works in which the artist has observed and reported local colors very carefully. Monet’s *Poplars* is an example of color use that is often mislabeled subjective. Monet watched the colors of the same objects change as the light they reflected constantly changed. In *Poplars* he observes that the trees on the riverbank seen perhaps for a few fleeting moments during sunrise or sunset on a warm, hazy day actually appear to be blue and red rather than green and brown. A shadow is falling on them, darkening their values, while trees in the background are bathed in golden sunlight. Although these colors do not conform to stereotyped notions of what colors trees “are,” the colors Monet used are truly local – the colors he saw – under specific, short-lived lighting conditions.
Simultaneous Contrast

Our perception of color is affected by the environment in which we see that hue. Because a color is rarely seen by itself, the surrounding colors will influence and in many cases, alter the color perceived.

This visual phenomenon is known as **simultaneous contrast** and occurs when one color is seen on differing backgrounds. It is commonly associated with complements, but it can also occur in any situation when two or more hues are placed next to each other. This is because the appearance of color is relative and is always affected by the surrounding hues.
For example, when a hue of yellow is placed next to a neutral gray, the gray will appear to have a cool or violet cast to it. If that same gray is then placed on a violet ground, it will have a warm or yellowish cast to it.
A similar color transformation will occur if we place the same midvalue red hue on contrasting backgrounds. The hue in the square literally seems to change color. On the darker background, the midvalue color will appear lighter than it really is, and on the light background, the opposite will occur.
Simultaneous Contrast

http://web.mit.edu/persci/gaz/gaz-teaching/flash/contrast-movie.swf

http://www.worqx.com/color/itten.htm

http://library.thinkquest.org/27066/theeye/nlsimcontrast.html

M.E. Chevreul – simultaneous contrast
http://www.fulltable.com/vts/c/cbk/c/c.htm
Optical Color Mixtures

A color interaction intentionally used by certain artists and designers is optical mixing of colors. Nineteenth-century French pointillist painters, such as Monet and Seurat, placed dots of unmixed colors on or near each other. When seen from a distance, the colors tended to blend to create new color sensations. Instead of mixing their paints on a palette, the pointillists forced viewers to mix them optically. When it works, this technique evokes luminous color sensations that pulsate with life, for the colors are being continually created behind the viewer’s very eyes.
Seurat, Georges
The Models
1886-1888
Barnes Foundation, Merion, Pennsylvania
oil on canvas
detail:
Seurat, Georges
The Models
1886-1888
Barnes Foundation, Merion, Pennsylvania
oil on canvas
From a great distance – or in a small reproduction – Chuck Close’s 8 ½ foot high self portrait painting begins to resemble the local colors of his actual face. But at close range, our eyes cannot mix the dots of juxtaposed colors, so they take on an identity of their own. For the artist to work at this range with colored shapes that have their own identity and yet create an overall optical effect that can be perceived only at a distance is a striking achievement.
Chuck Close, American, born 1940

*Self-Portrait*

1997

Oil on canvas

8' 6" x 7' (259.1 x 213.4 cm)

The Museum of Modern Art

Gift of Agnes Gund, Jo Carole and Ronald S. Lauder, Donald L. Bryant, Jr., Leon Black, Michael and Judy Ovitz, Anna Marie and Robert F. Shapiro, Leila and Melville Straus, Doris and Donald Fisher, and purchase
Detail:

Chuck Close
*Self-Portrait*
1997
Oil on canvas
Another optical color mixture extensively explored by the color theorist Josef Albers involves **middle mixtures**. These are three analogous colors that relate to each other as parents and child: The third contains equal parts of the first two. A middle mixture of the hues blue and green would be blue-green. A middle mixture of dark and light values of the same hue would be a medium value. If the middle mixture is presented in the right proportions between the parents, their colors will seem to *interpenetrate* it. In *Intersecting Orange* from Josef Alber’s *Homage to the Square* series, the middle mixture – the orange band – develops a red-orange glow near the yellow-orange and a yellow-orange glow near the red-orange, but is actually painted uniformly in a single color. Alber’s explanation for the optical mixture is that a color seems to subtract its own color from colors placed next to it. Alber’s work clearly demonstrates the only absolute principle of color use: *Colors are affected by the colors around them*. We never see colors in isolation, but rather in juxtaposition to other colors with inevitably affect the way we perceive them.
Josef Albers, *Homage to the Square*, 1967
Oil on masonite. JAAF: 1976.1.665
60.96 x 60.96 cm (24 x 24 inches)
©2007 The Josef and Anni Albers Foundation / Artists Rights Society (ARS), New York
Barnett Newman  
*Vir Heroicus Sublimis*  
1950-51. Oil on canvas, 7'11 3/8" X 17'9 1/4"  
The Museum of Modern Art, New York (gift of Mr. and Mrs. Ben Heller)
The Latin title *Vir Heroicus Sublimis* of this painting can be translated as "Man, heroic and sublime." It refers to Newman’s essay "The Sublime is Now," in which he asks, "If we are living in a time without a legend that can be called sublime, how can we be creating sublime art?" His response is embodied in part by this painting—his largest ever at that time. Newman hoped that the viewer would stand close to this expansive work, and he likened the experience to a human encounter: "It's no different, really, from meeting another person. One has a reaction to the person physically. Also, there’s a metaphysical thing, and if a meeting of people is meaningful, it affects both their lives."
Aware of the strong effects that colors have on each other when looked at in juxtaposition, Barnett Newman created extraordinary visual sensations in his *Vir Heroicus Sublimis*. As you look at the painting, many things happen within your visual perception, if you give the optical sensations time to develop. The white stripe appears to develop. The white stripe appears to develop a yellow cast because the bluish-red surrounding it subtracts blue and red from the white, leaving the only remaining primary: yellow. The other stripes change, too, they interact with the red background. The center of the painting may appear to be spotlit, reflecting a lighter value. Afterimages of the four stripes that Newman painted begin to appear along the painting, turning it into a dynamic parade of ever-changing vertical stripes of many hard-to-describe colors. Some of these are strategically placed so that they may even overlap and mingle their color energies. Newman has thus evoked an extraordinary range of color sensations with an extremely limited palette.
Color is so complex and rich in potential that the more you experiment with it, the more it will surprise you. The color theories of the past point to only some of the possibilities. It is up to you to explore further. The problems that follow merely scratch the surface. They are only appetizers – hopefully they will whet your taste for a full course on color alone.
source:

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