



Color

All colors are the friends of their neighbors
and the lovers of their opposites. Marc Chagall

Color can convey a mood, describe reality, or codify information. Words like “gloomy,” “drab,” and “glittering” each bring to mind a general climate of colors, a palette of relationships. Designers use color to make some things stand out (warning signs) and to make other things disappear (camouflage). Color serves to differentiate and connect, to highlight and to hide.

Graphic design was once seen as a fundamentally black-and-white enterprise. This is no longer the case. Color has become integral to the design process. Color printing, once a luxury, has become routine. An infinite range of hues and intensities bring modern media to life, energizing the page, the screen, and the built environment with sensuality and significance. Graphics and color have converged.

According to the classical tradition, the essence of design lies in linear structures and tonal relationships (drawing and shading), not in fleeting optical effects (hue, intensity, luminosity). Design used to be understood as an abstract armature that underlies appearances. Color, in contrast, was seen as subjective and unstable.

And, indeed, it is. Color exists, literally, in the eye of the beholder. We cannot perceive color until light bounces off an object or is emitted from a source and enters the eye.

Our perception of color depends not solely on the pigmentation of physical surfaces, but also on the brightness and character of ambient light. We also perceive a given color in relation to the other colors around it. For example, a light tone looks lighter against a dark ground than against a pale one.

Likewise, color changes meaning from culture to culture. Colors carry different connotations in different societies. White signals virginity and purity in the West, but it is the color of death in Eastern cultures. Red, worn by brides in Japan, is considered racy and erotic in Europe and the United States. Colors go in and out of fashion, and an entire industry has emerged to guide and predict its course.

To say, however, that color is a shifting phenomenon—both physically and culturally—is not to say that it can’t be described or understood. A precise vocabulary has been established over time that makes it possible for designers, software systems, printers, and manufacturers to communicate to one another with some degree of clarity. This chapter outlines the basic terms of color theory and shows ways to build purposeful relationships among colors.

Opposites Attract Strong color contrasts add visual energy to this dense physical montage made from flowers. Blue and purple stand out against pink, orange, and red. Nancy Froehlich and Zvezdana Rogic.



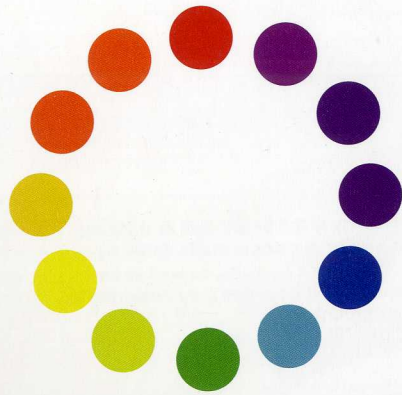
Complementary and Analogous Colors
 This diagram shows combinations of primary, secondary, and tertiary colors.
 Robert Lewis, MFA Studio.

Basic Color Theory

In 1665 Sir Isaac Newton discovered that a prism separates light into the spectrum of colors: red, orange, yellow, green, blue, indigo, and violet. He organized the colors around a wheel very much like the one artists use today to describe the relationships among colors.¹

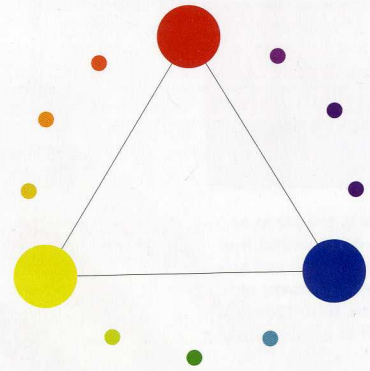
Why is the color wheel a useful design tool? Colors that sit near each other on the spectrum or close together on the color wheel are analogous. Using them together provides minimal color contrast and an innate harmony, because each color has some element in common with others in the sequence. Analogous colors also have a related color temperature. Two colors sitting opposite each other on the wheel are complements. Each color contains no element of the other, and they have opposing temperatures (warm versus cool). Deciding to use analogous or contrasting colors affects the visual energy and mood of any composition.

1. On basic color theory and practice, see Tom Fraser and Adam Banks, *Designer's Color Manual* (San Francisco: Chronicle Books, 2004).



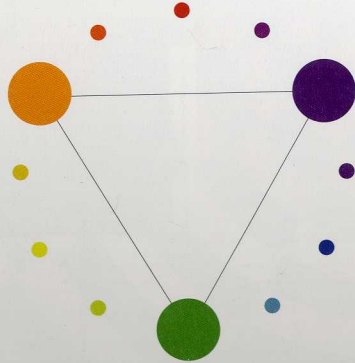
The Color Wheel

This basic map shows relationships among colors. Children learn to mix colors according to this model, and artists use it for working with pigments (oil paint, watercolor, gouache, and so on).



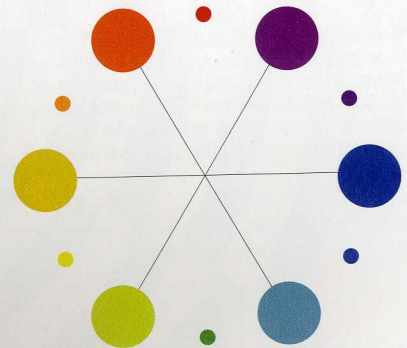
Primary Colors

Red, yellow, and blue are pure; they can't be mixed from other colors. All of the other colors on the wheel are created by mixing primary colors.



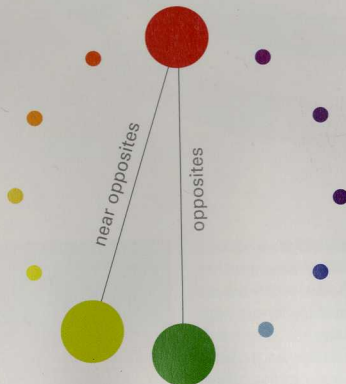
Secondary Colors

Orange, purple, and green each consist of two primaries mixed together.



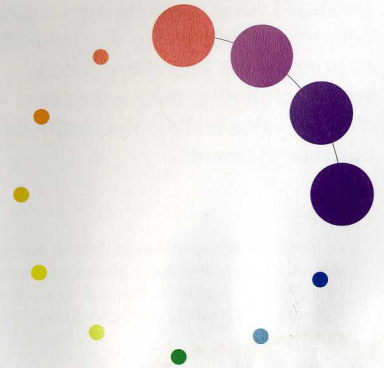
Tertiary Colors

Colors such as red orange and yellow green are mixed from one primary and one secondary color.



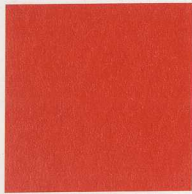
Complements

Red/green, blue/orange, and yellow/purple sit opposite each other on the color wheel. For more subtle combinations, choose "near opposites," such as red plus a tertiary green, or a tertiary blue and a tertiary orange.



Analogous Colors

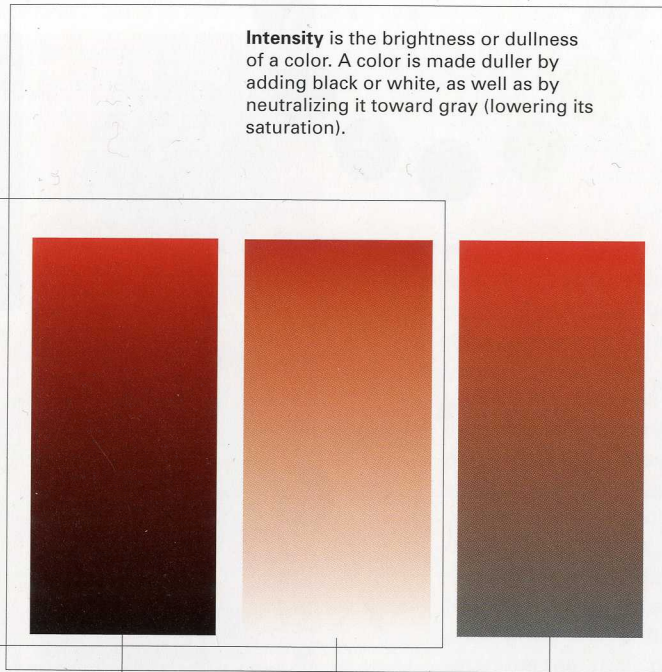
Color schemes built from hues that sit near to each other on the color wheel (analogous colors) have minimal chromatic differences.



Hue is the place of the color within the spectrum. A red hue can look brown at a low saturation, or pink at a pale value.

Intensity is the brightness or dullness of a color. A color is made duller by adding black or white, as well as by neutralizing it toward gray (lowering its saturation).

Value is the light or dark character of the color, also called its luminance, brightness, lightness, or tone. Value is independent of the hue or intensity of the color. When you convert a color image to black and white, you eliminate its hue but preserve its tonal relationships.



Aspects of Color

Every color can be described in relation to a range of attributes. Understanding these characteristics can help you make color choices and build color combinations. Using colors with contrasting values tends to bring forms into sharp focus, while combining colors that are close in value softens the distinction between elements.

Shade is a variation of a hue produced by the addition of black.

Tint is a variation of a hue produced by the addition of white.

Saturation (also called chroma) is the relative purity of the color as it neutralizes to gray.



These colors are close in value and intensity, and just slightly different in hue.

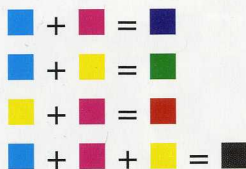
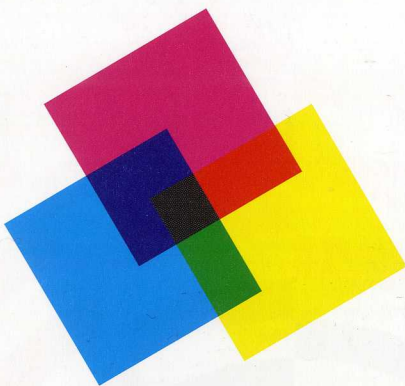


These colors are close in hue and value but different in intensity.



Graduated Color Wheel Each hue on the color wheel is shown here in a progressive series of values (shades and tints). Note that the point of greatest saturation is not the same for each hue. Yellow is of greatest intensity toward the lighter end of the value scale, while blue is more intense in the darker zone.

Use the graduated color wheel to look for combinations of colors that are similar in value or saturation, or use it to build contrasting relationships. Robert Lewis, MFA Studio.



Color Models

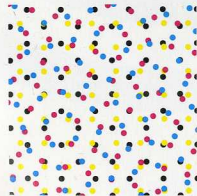
Surfaces absorb certain light waves and reflect back others onto the color receptors (cones) in our eyes. The light reflected back is the light we see. The true primaries of visible light are red, green, and blue. The light system is called "additive" because the three primaries together create all the hues in the spectrum.

In theory, combining red and green paint should produce yellow. In practice, however, these pigments combine into a blackish brown. This is because pigments absorb more light than they reflect, making any mix of pigments darker than its source colors. As more colors are mixed, less light is reflected. Thus pigment-based color systems are called "subtractive."

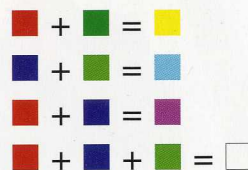
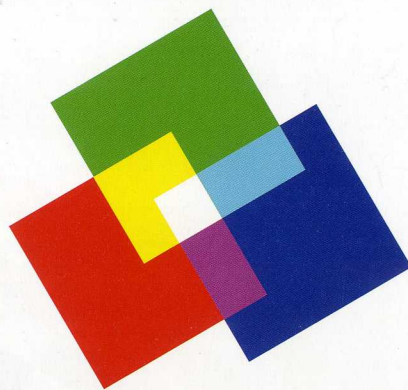
Offset and desktop printing methods use CMYK, a subtractive system. Nonstandard colors are used because the light reflected off cyan and magenta pigments mixes more purely into new hues than the light reflected off of blue and red pigments.

CMYK is used in the printing process. While painters use the basic color wheel as a guide for mixing paint, printing ink uses a different set of colors: cyan, magenta, yellow, and black, which are ideal for reproducing the range of colors found in color photographs. C, M, Y, and K are known as the "process colors," and full-color printing is called "four-color process." Ink-jet and color laser printers use CMYK, as does the commercial offset printing equipment used to print books such as this one.

In principle, C, M, and Y should produce black, but the resulting mix is not rich enough to reproduce color images with a full tonal range. Thus black is needed to complete the four-color process.

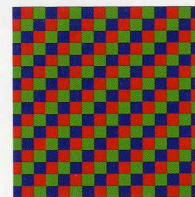


Transparent Ink Printer's inks are transparent, so color mixing occurs as colors show through each other. Color mixing is also performed optically when the image is broken down into tiny dots of varying size. The resulting colors are mixed by the eye.

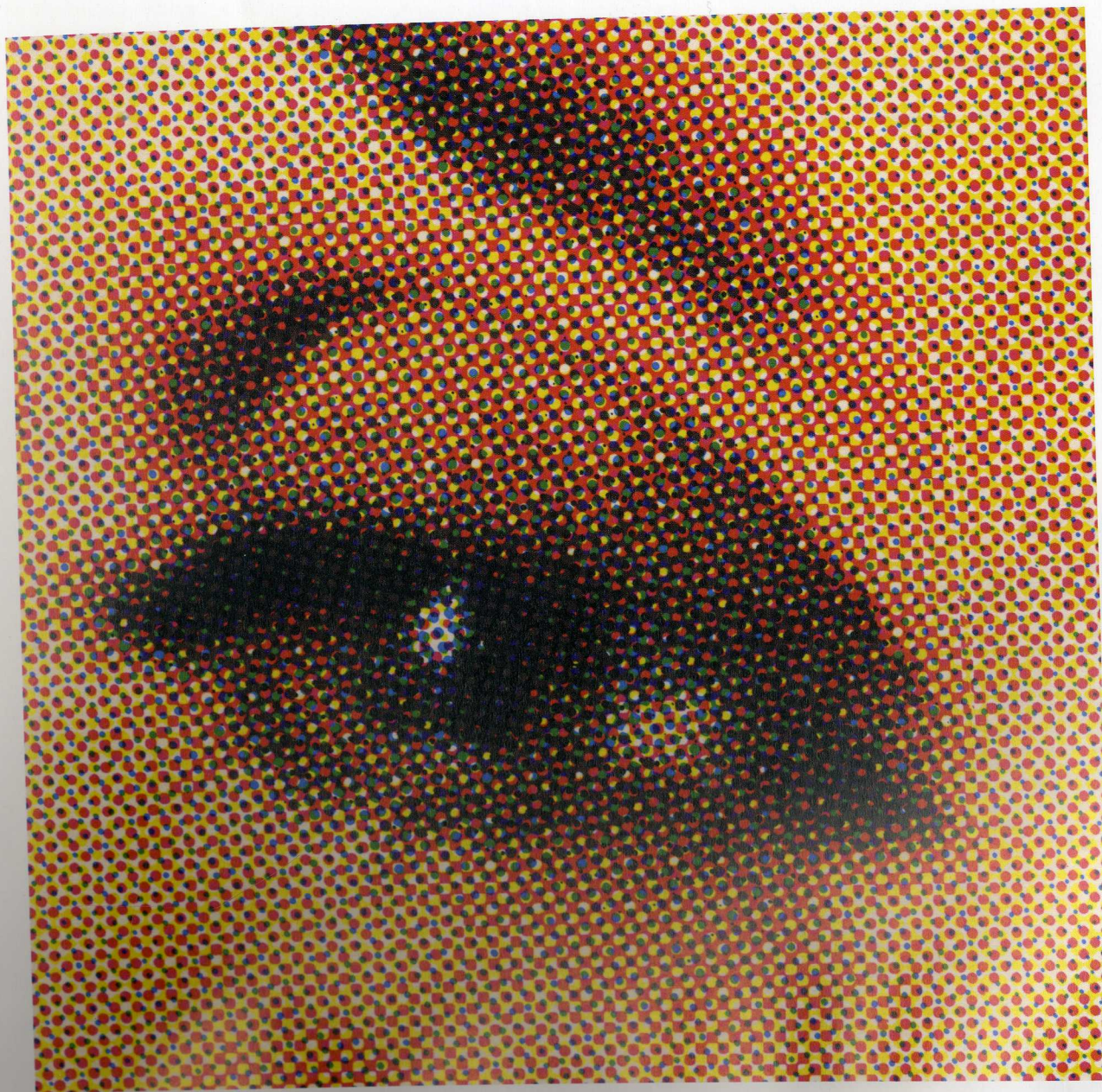


RGB is the additive system used for designing on screen. Different percentages of red, green, and blue light combine to generate the colors of the spectrum. White occurs when all three colors are at full strength. Black occurs when zero light (and thus zero color) is emitted.

Any given color can be described with both CMYK and RGB values, as well as with other color models. Each model (called a "color space") uses numbers to convey color information uniformly around the globe and across media. Different monitors, printing conditions, and paper stocks all affect the appearance of the final color, as does the light in the environment where the color is viewed. Colors look different under fluorescent, incandescent, and natural light. Colors rarely translate perfectly from one space to another.

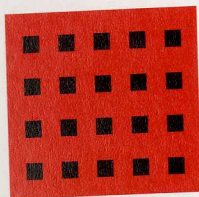


Transparent Light The medium of light is also transparent. The colors of an emitted image are generated when different colors of light mix directly, as well as when tiny adjacent pixels combine optically.

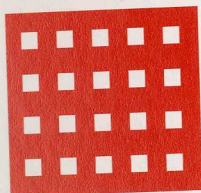


Optical Color Mixing This detail from a printed paper billboard shows the principle of four-color process printing (CMYK). Viewed from a distance, the flecks of color mix together optically. Seen up close, the pattern of dots is strongly evident.

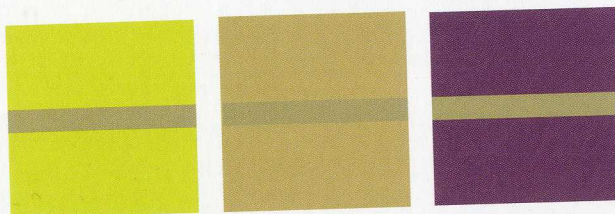
Whatever color model your software is using, if you are viewing it on screen, it is RGB. If you are viewing it in print, it is CMYK.



Bezold Effect Johann Friedrich Wilhelm von Bezold was a German physicist working in the nineteenth century. Fascinated with light and color, he also was an amateur rug maker. He noticed that by changing a color that interwove with other colors in a rug, he could create entirely different results. Adding a darker color to the carpet would create an overall darker effect, while adding a lighter one yielded a lighter carpet. This effect is known as optical mixing.



Vibration and Value When two colors are very close in value, a glowing effect occurs; on the left, the green appears luminous and unstable. With a strong value difference, as seen on the right, the green appears darker.



One Color, Different Effects The neutral tone passing through these three squares of color is the same in each instance. It takes on a slightly different hue or value depending on its context.

Interaction of Color

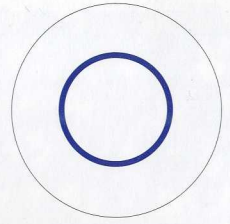
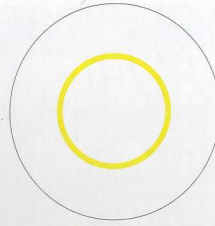
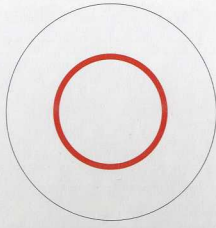
Josef Albers, a painter and designer who worked at the Bauhaus before emigrating to the United States, studied color in a rigorous manner that influenced generations of art educators.² Giving his students preprinted sheets of colored paper with which to work, he led them to analyze and experience how the perception of color changes in relation to how any given color is juxtaposed with others.

Colors are mixed in the eye as well as directly on the painter's palette or the printing press. This fact affects how designers create patterns and textures, and it is exploited in digital and mechanical printing methods, which use small flecks of pure hue to build up countless color variations.

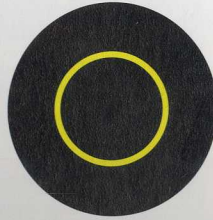
Designers juxtapose colors to create specific climates and qualities, using one color to diminish or intensify another. Understanding how colors interact helps designers control the power of color and systematically test variations of an idea.

2. See Josef Albers, *Interaction of Color* (1963; repr., New Haven: Yale University Press, 2006).

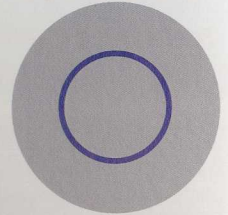
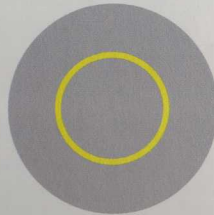
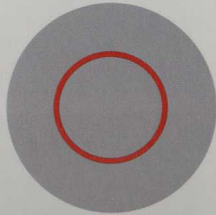
Color + White



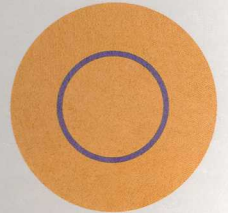
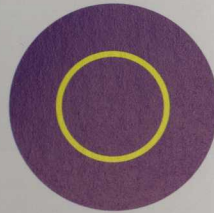
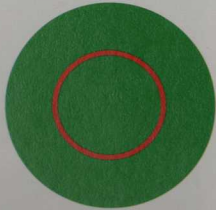
Color + Black



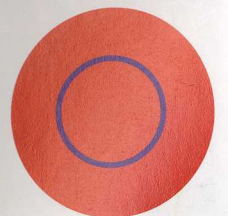
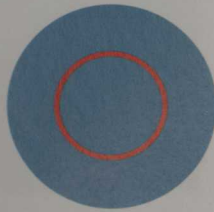
Color + Gray



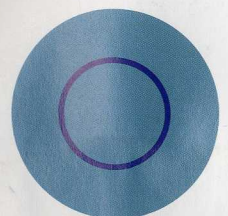
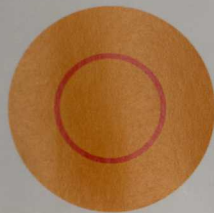
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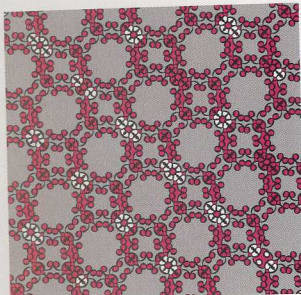
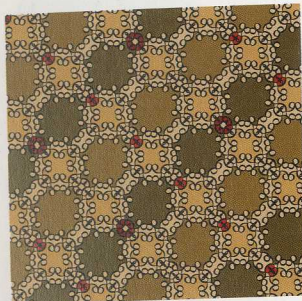
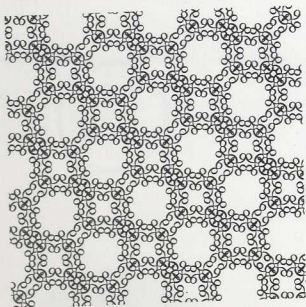


Near Complements



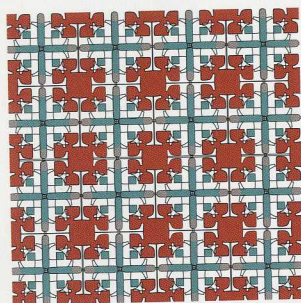
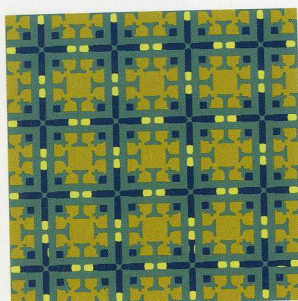
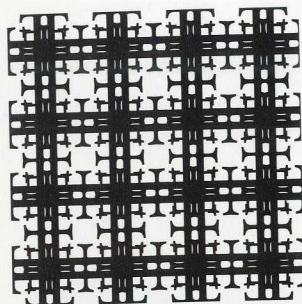
Analogous Colors





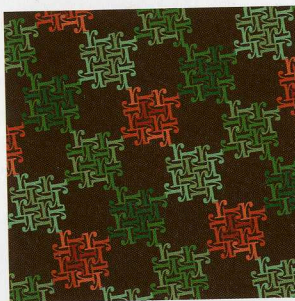
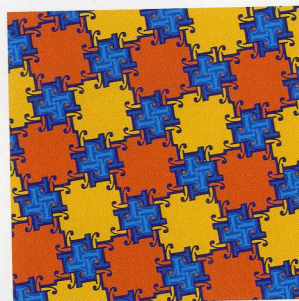
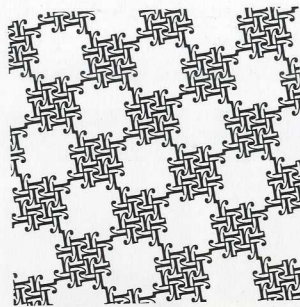
Joanna Marshall

Neutral earth tones combine to make a quiet overall pattern, while a palette with strong contrasts of value and hue yields a more linear effect.

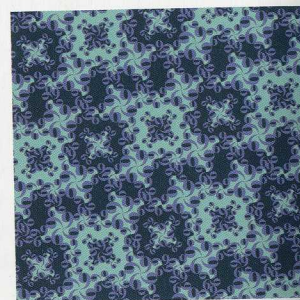
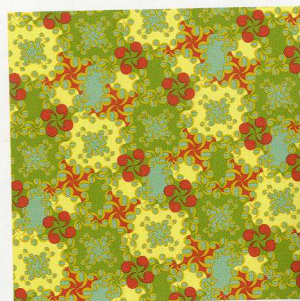
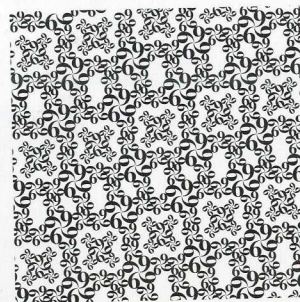


Katie Evans

By changing the colors of background and foreground elements, completely new forms appear and disappear.



Elizabeth Tipson

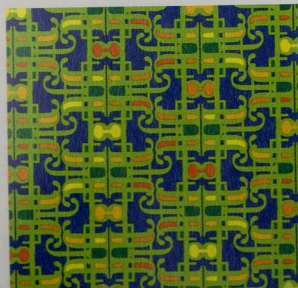
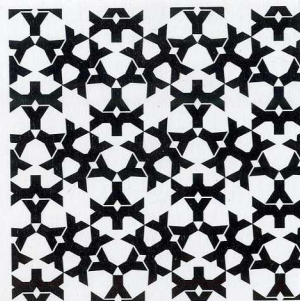
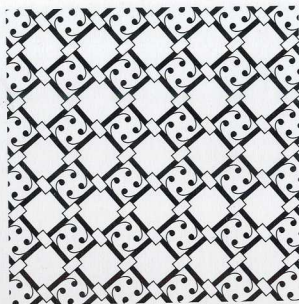
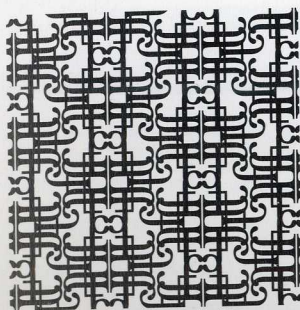


Ellen Kling

Colors close in value but different in hue create a vibrant yet soft effect. The effect becomes even softer when analogous colors are used.

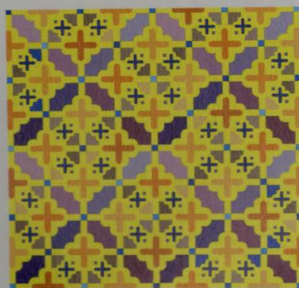
Selective Emphasis These studies use typographic pattern to explore how color alters not just the mood of a pattern, but the way its shapes and figures are perceived. Color affects both the parts and the whole. Each study begins with a black and white pattern built from a single font and letterform.

Experiments with hue, value, and saturation, as well as with analogous, complementary, and near complementary color juxtapositions, affect the way the patterns feel and behave. Through selective emphasis, some elements pull forward and others recede. *Typography 1*. Jennifer Cole Phillips, faculty.



Anna Eshelman

The similarly muted hues of olive and brown sit back, allowing a pale yellow pattern to come forward. Next, gradations of yellow, orange, and red weave through a green background of equivalent value, causing the dark blue shapes to command attention.



Anna Eshelman

Julie Diewald

In the first color study above, the complementary orange and blue squares vibrate against each other, while the analogous yellow and green play a more passive role. In the second study, the dark blue and burgundy tones frame and push forward the brighter blues in the center.



Anna Eshelman

The muted neutral hues allow the forms to gently commingle, while contrasting hues and values break the elements apart.



Passion, Palettes, and Products What began as a love for Portuguese tile patterns on a trip to Lisbon evolved into an intensive investigation into pattern, form, and color, manifesting itself in an MFA thesis project and now an online business.

Textile designers often create numerous color ways for a single pattern, allowing the same printing plates or weaving templates to generate diverse patterns. Different color palettes make different elements of the pattern come forward or recede. Jessica Pilar, MFA Studio.

