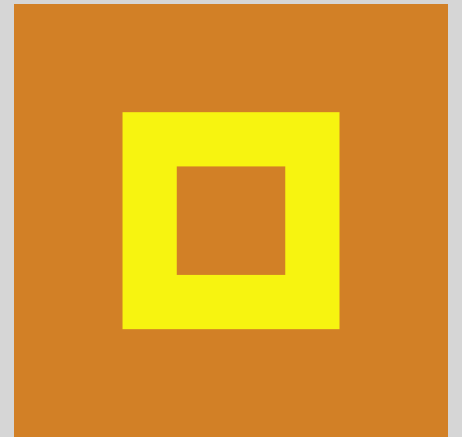
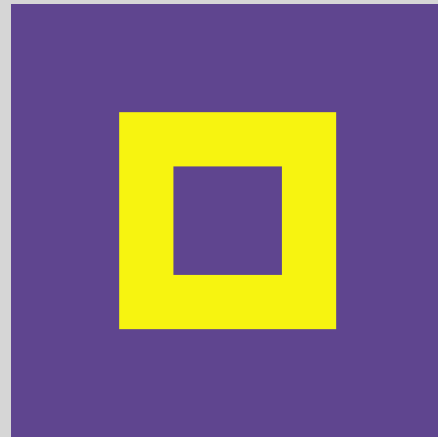
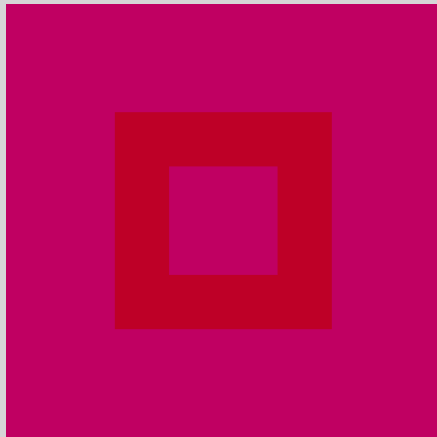
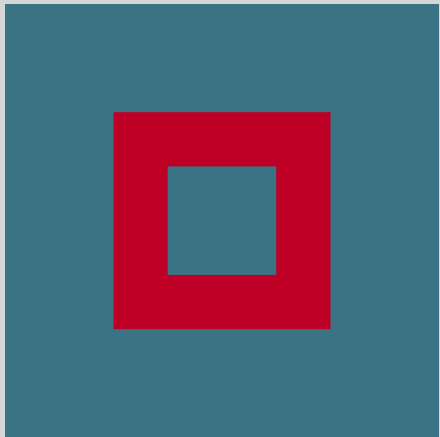
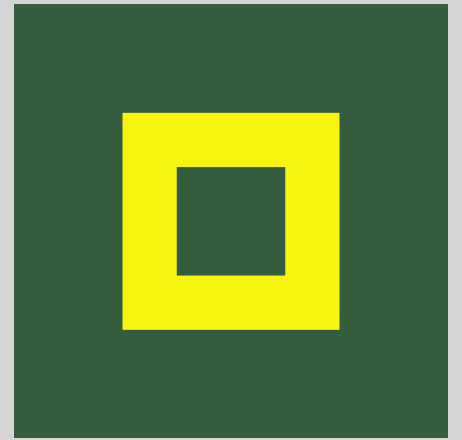
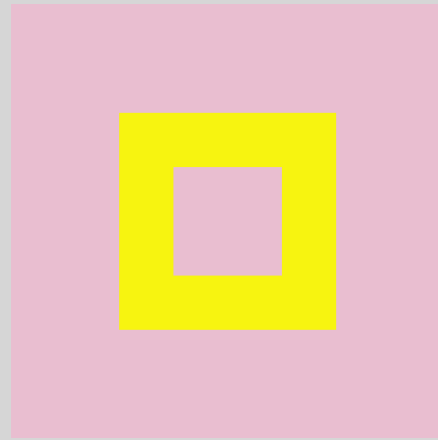
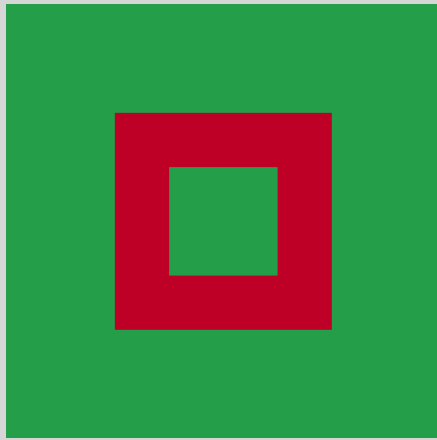
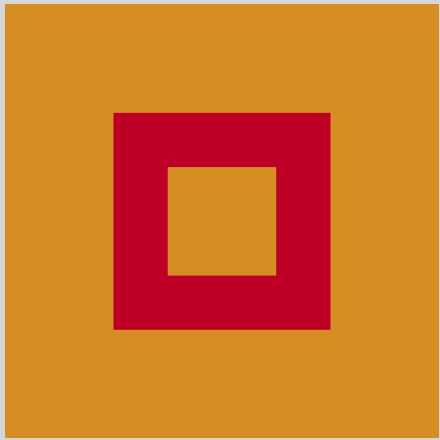


COLOR INTERACTION



COLOR CONTRAST

Designing with color means controlling color contrast. How do colors interact with each other to make an effective design?

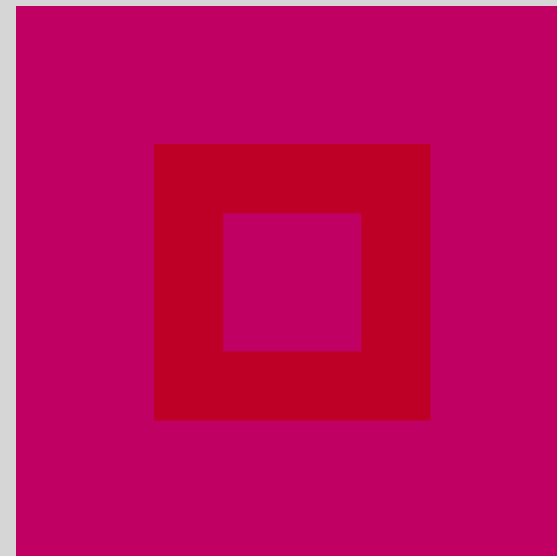
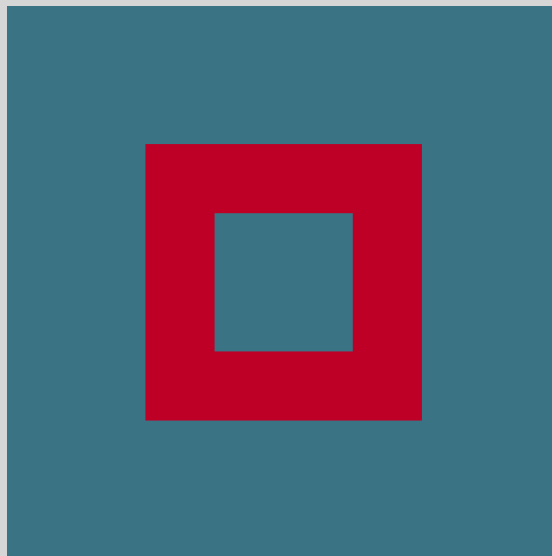
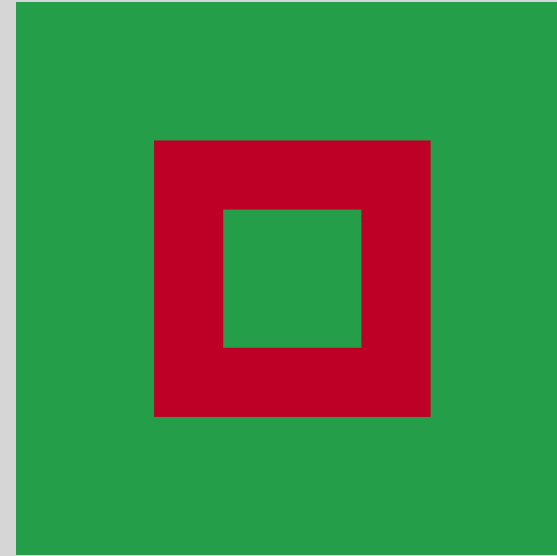
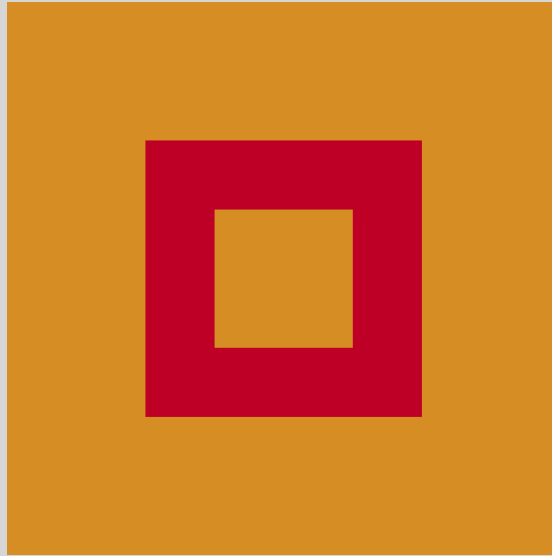
Color can be used to imply harmony or discord, flatness or depth. It can convey emotion or a lack thereof. Every color has its own special character. This character can be modified through alterations of saturation and value, but the most surprising and effective manipulations of color can be seen when colors interact with each other.

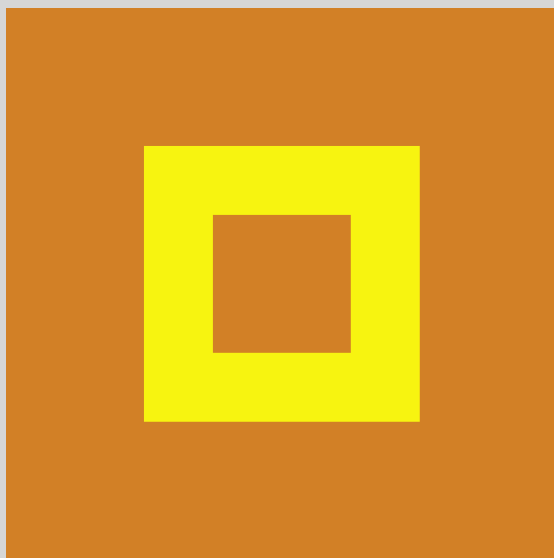
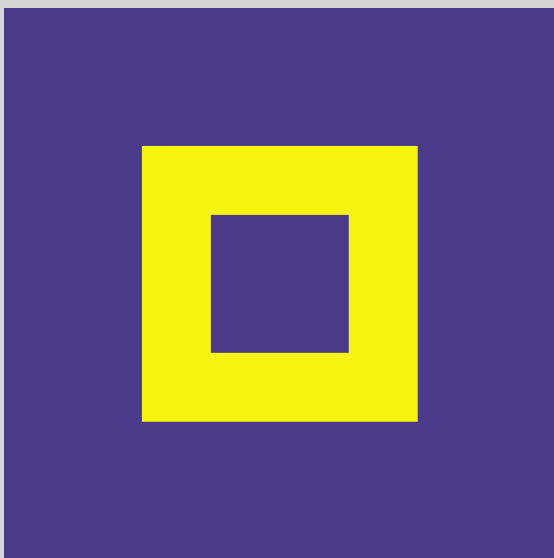
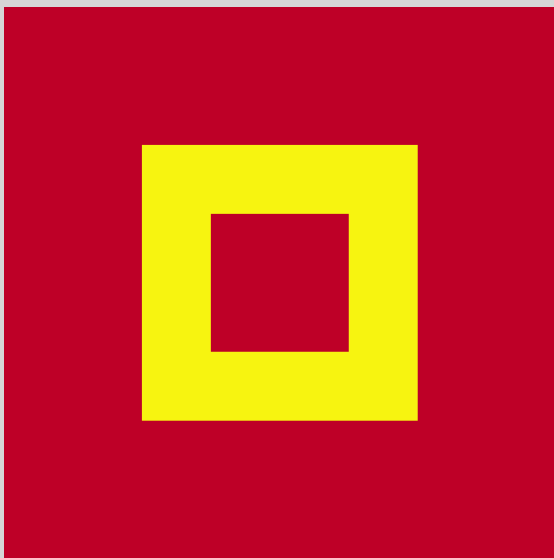
This document is a brief introduction to the seven varieties of color contrast as outlined by the Bauhaus teacher and color theorist Johannes Itten (1888-1967).

VARIETIES OF COLOR CONTRAST

- **CONTRAST OF *HUE***
 - **CONTRAST OF *VALUE***
 - **CONTRAST OF *TEMPERATURE* (COLD-WARM COLORS)**
 - **COMPLEMENTARY CONTRAST**
 - **SIMULTANEOUS CONTRAST**
 - **CONTRAST OF *SATURATION***
 - **CONTRAST OF *EXTENSION***

Colors exert an influence on each other. A color's expressive character can be changed by placing it in a context with other colors. The example below shows how the nature of red-orange can be altered by surrounding it with other saturated hues. See the following page for the same illustration using yellow.

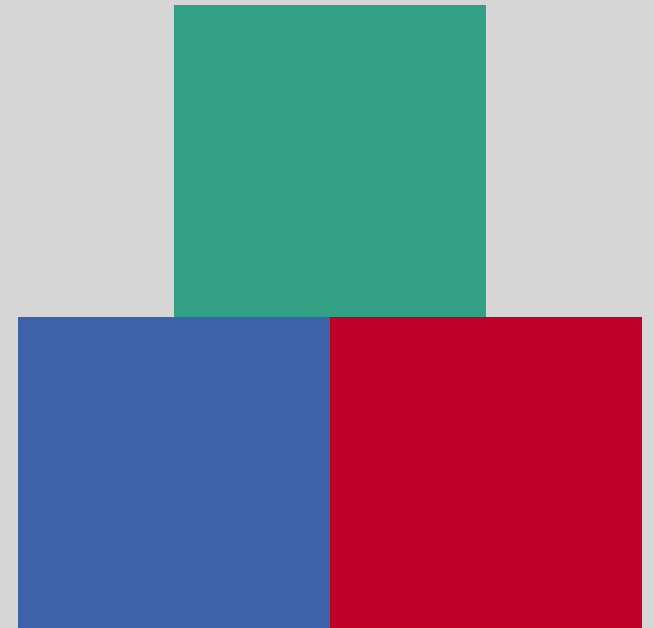
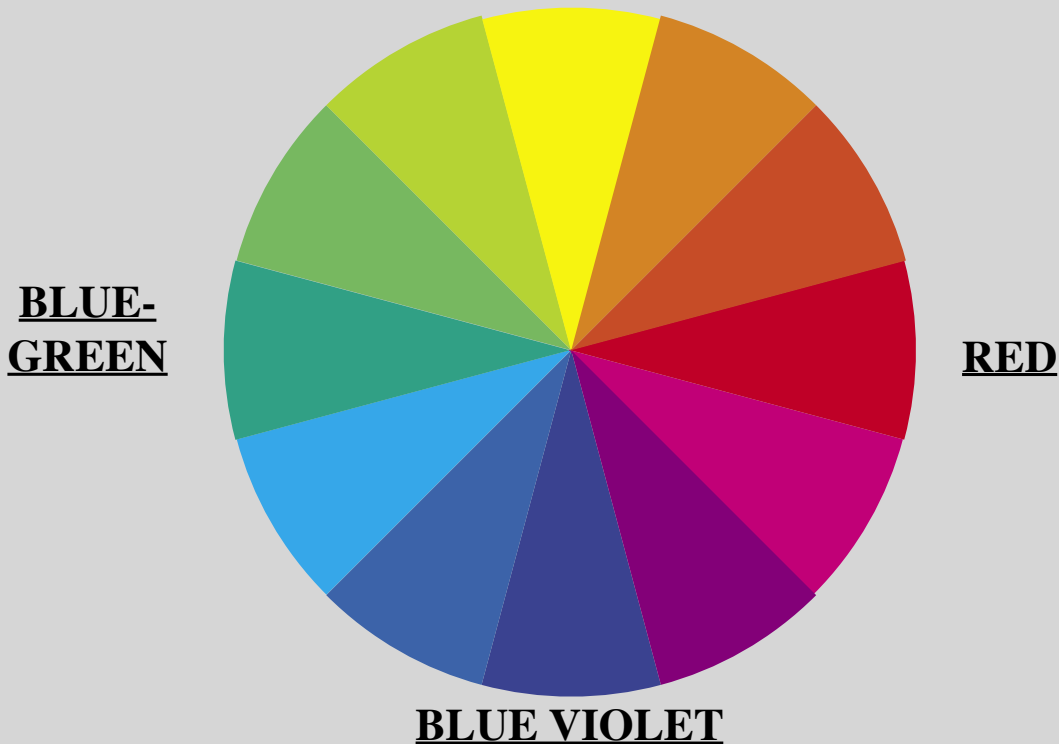




Contrast of Hue

This is really what it sounds like. The difference between colors in their most saturated state.

The greatest amount of Hue contrast is between the three additive primaries. Any other combinations have a comparatively decreased contrast



Contrast of Hue *(examples)*



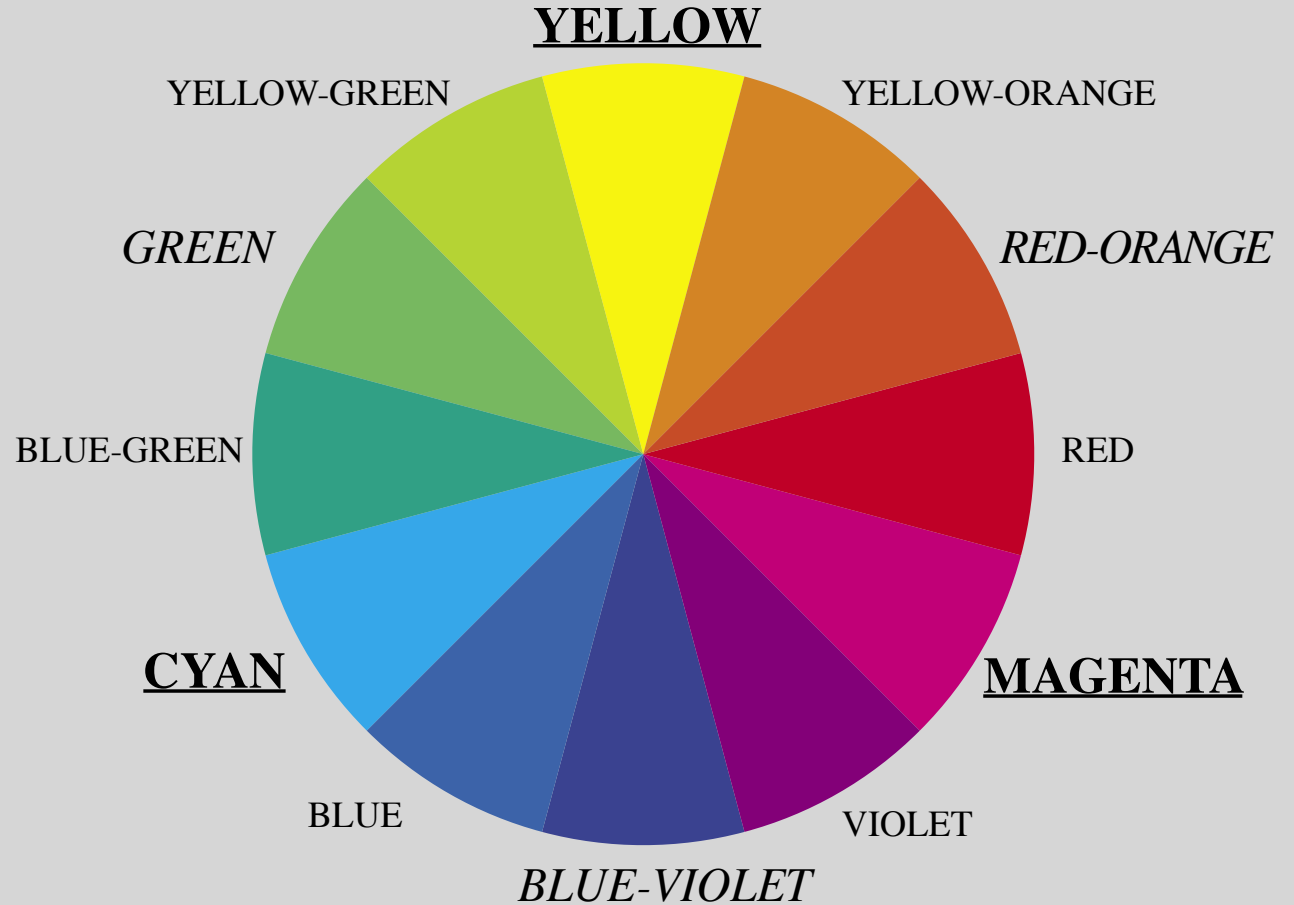
Henri Matisse



Henri Matisse

Contrast of Value

Each color in its most saturated state has its own value. If we look at the hue circle it is clear that some hues are lighter or darker than others. Value plays an important role in the way that colors interact.

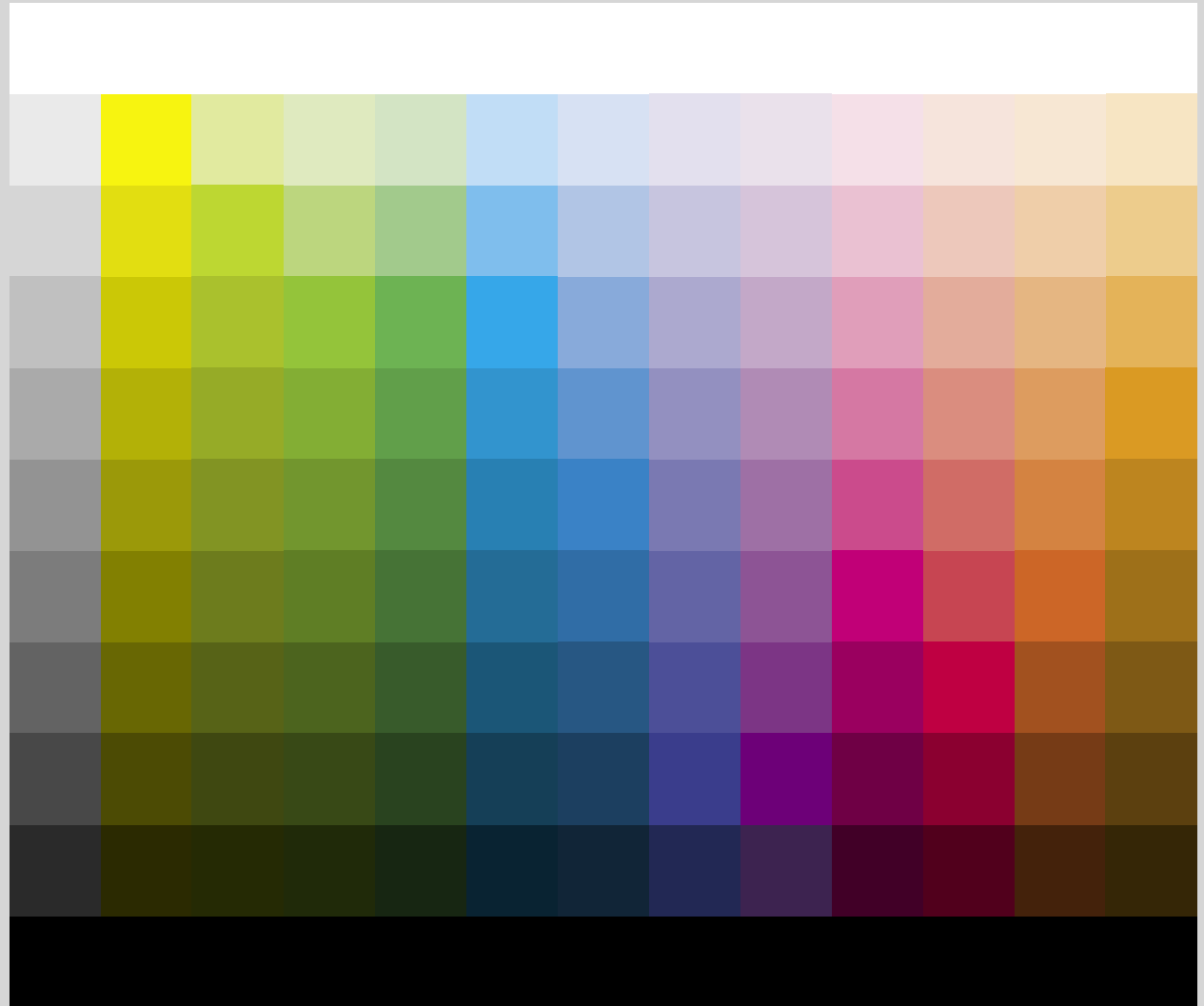


Contrast of Value

“Equality of light and dark relates colors to each other, tying or bracketing them together. Light-dark contrast between them is extinguished. This is an invaluable resource of artistic design.”

– Johannes Itten

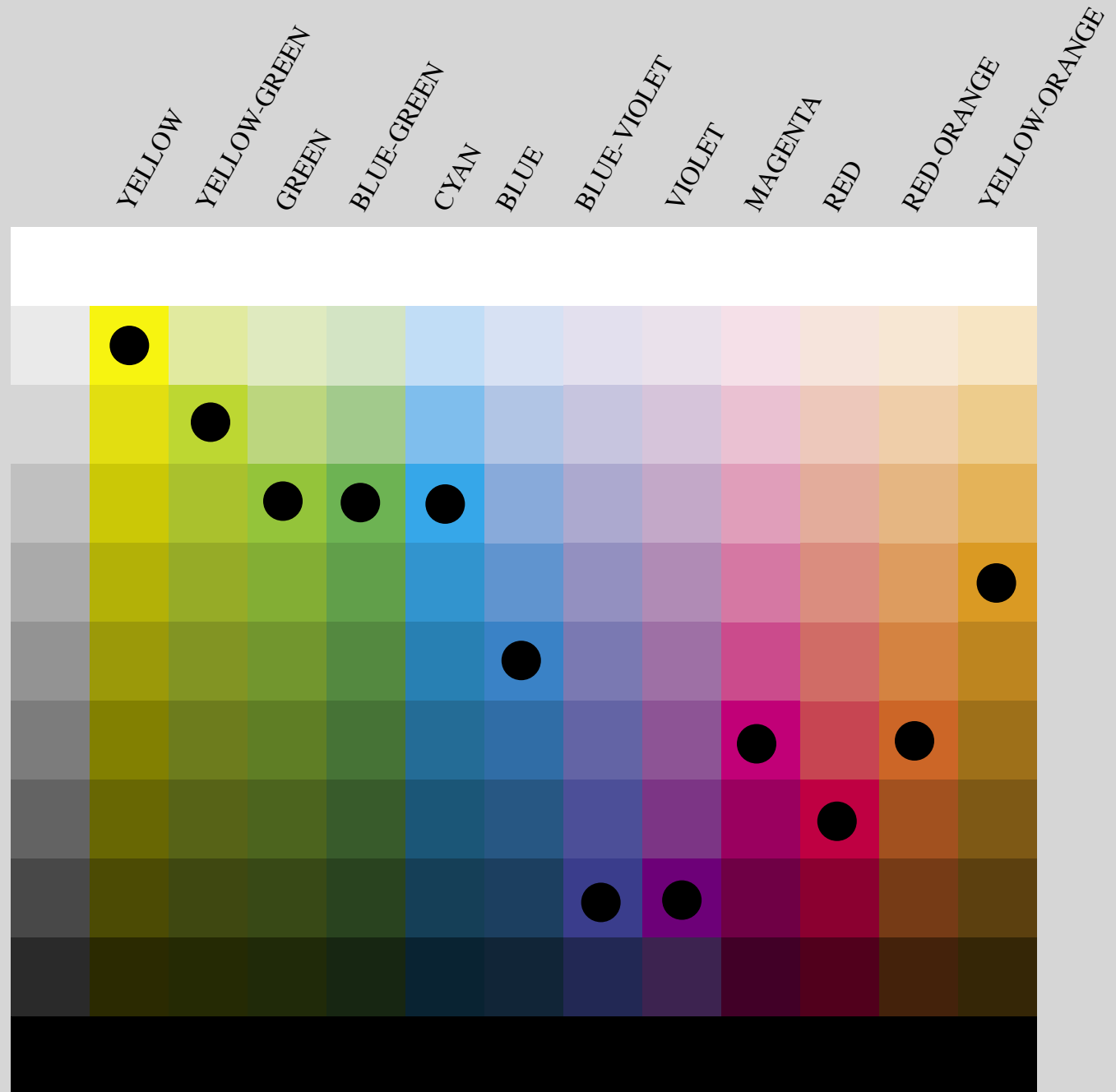
This illustration places the 12 hues in relation to their relative value (found in the value scale on the left). A fully saturated hue can have an entirely different impact than another hue which has been modified to match its value.



Contrast of Value

The Black dot represents the hue's placement next to its relative value.

Look at the difference in character between the fully saturated yellow and the red which has been tinted to match its value. Look at the fully saturated blue and its equivalent yellow orange



Contrast of Value (examples)

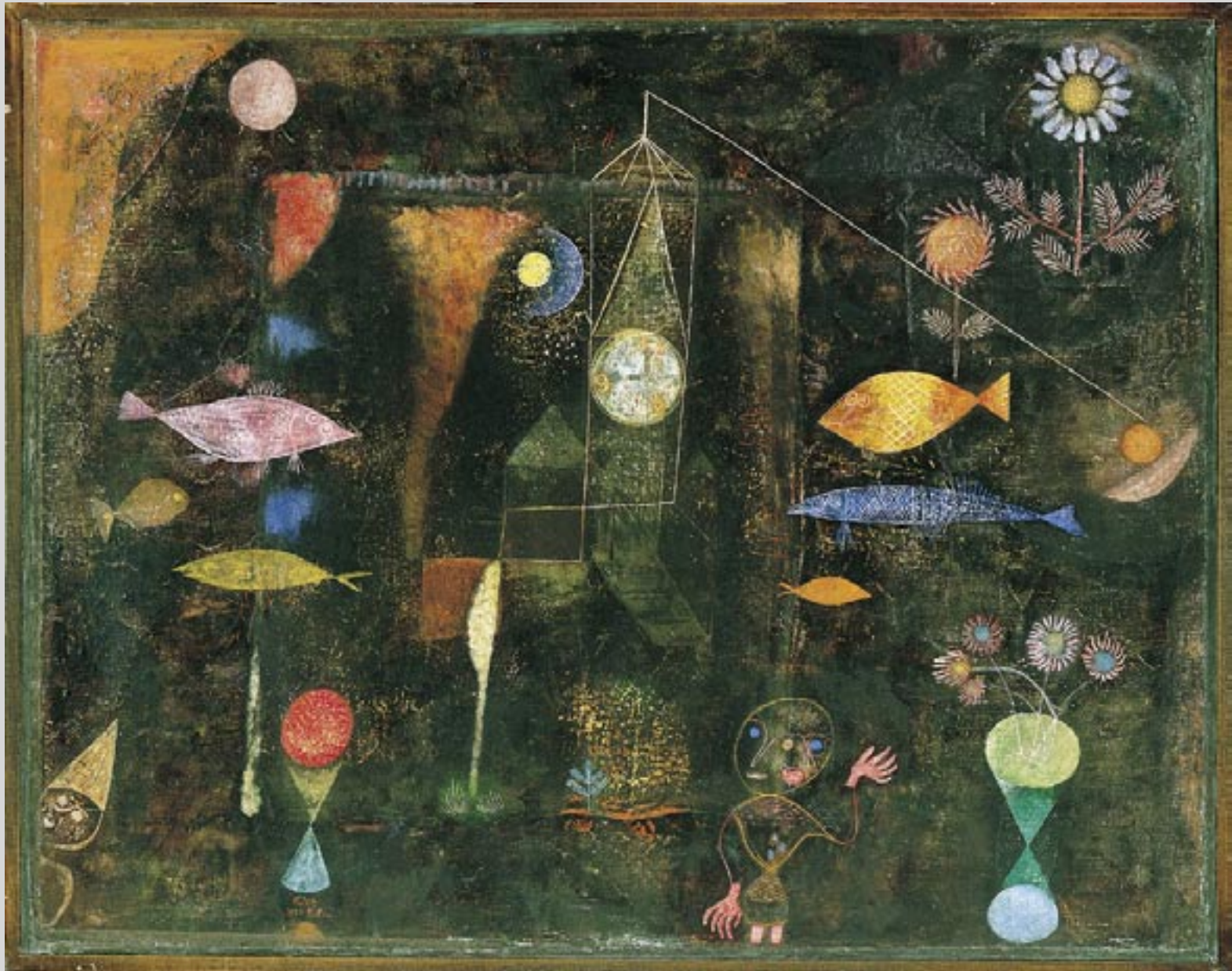


Andy Warhol



Caravaggio

Contrast of Value (examples)

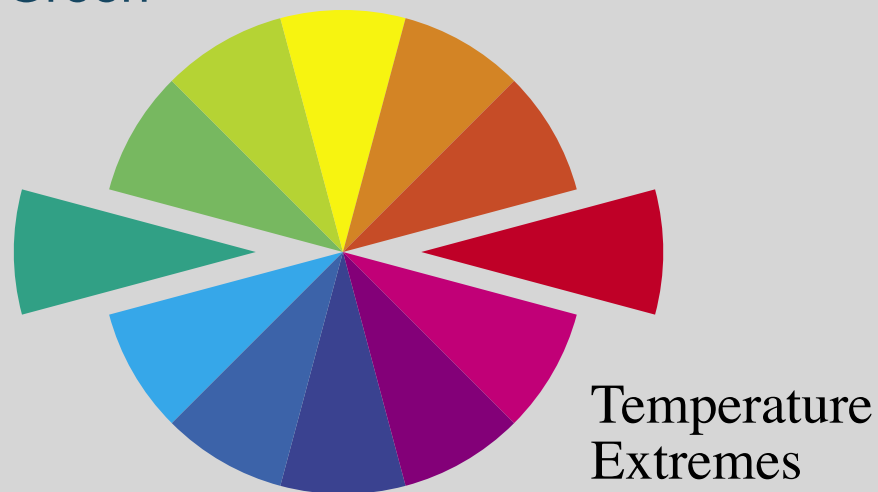


Paul Klee

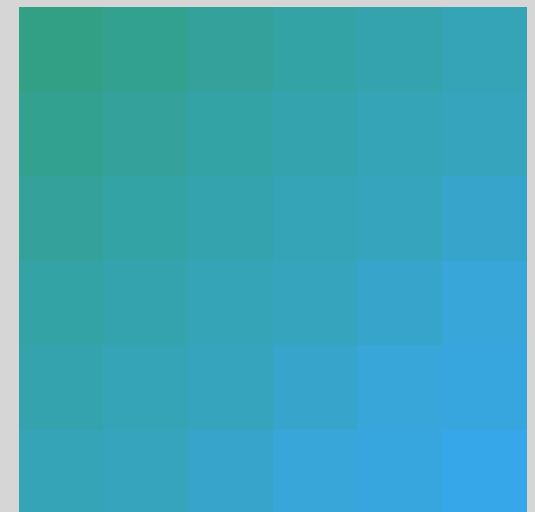
Contrast of Temperature (cold-warm)

Colors are said to be either warm or cool. Generally yellow to violet in the hue circle are assumed to be warm colors while yellow-green to blue violet are thought to be cool colors. It is more accurate to say that colors are cool or warm in relation to each other. See the examples at right of temperature contrast within a range of red and a range of green.

The vertical axis of the Hue circle contains Yellow & Blue Violet, the extremes of value contrast. The Horizontal axis contains the extremes of temperature contrast: Red & Blue-Green

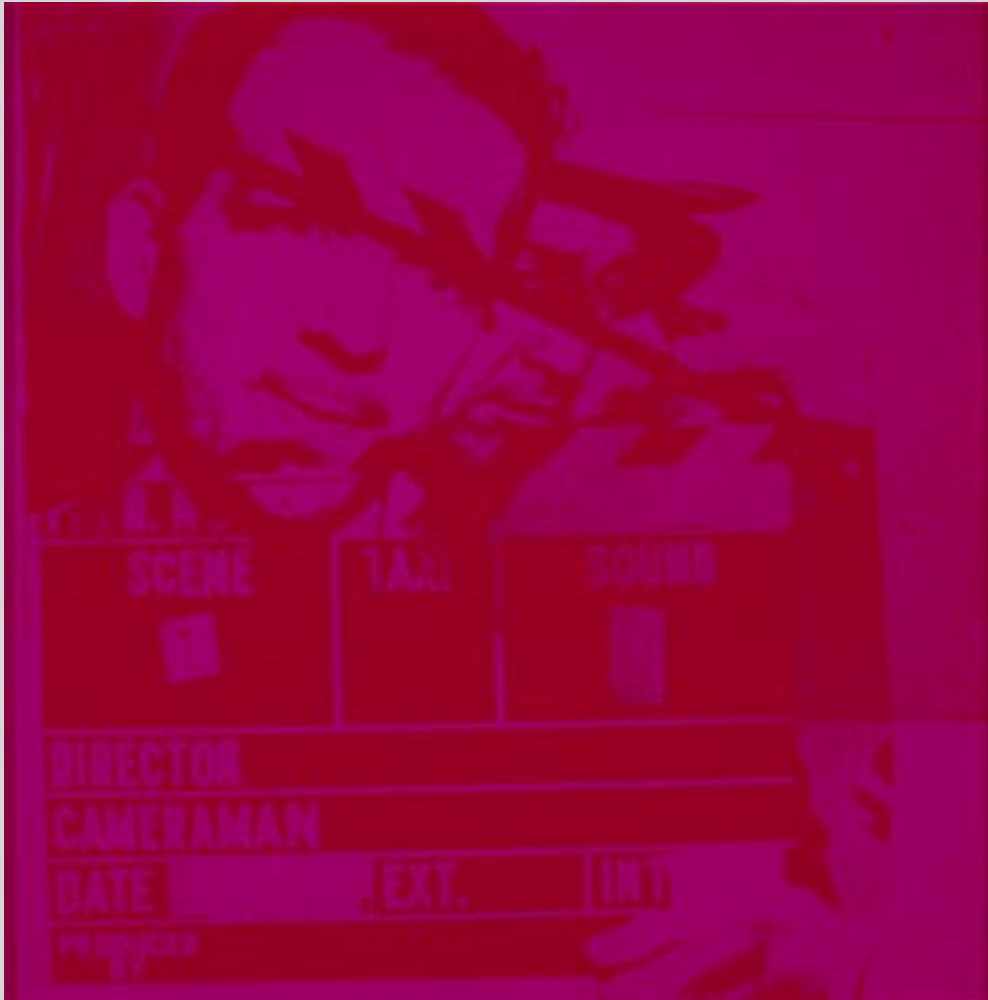


Temperature Modulation Red



Temperature Modulation Blue-Green

Contrast of Temperature (cold-warm) (examples)



Andy Warhol

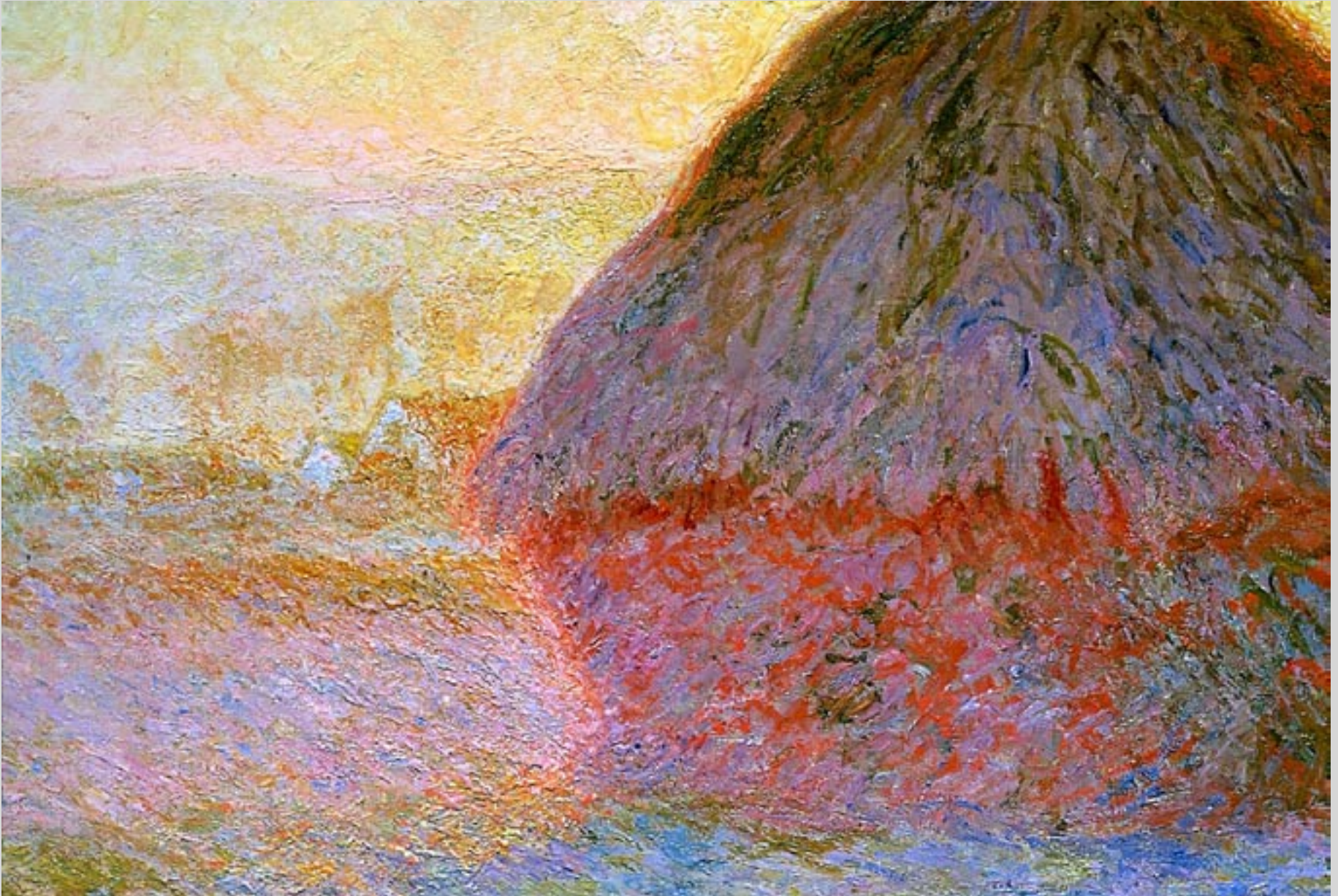
A cool red (magenta) and a warm red



Andy Warhol

A Cool Yellow and a Warm Violet

Contrast of Temperature (cold-warm) *(examples)*



Claude Monet

Contrast of Temperature (cold-warm) *(examples)*



Claude Monet

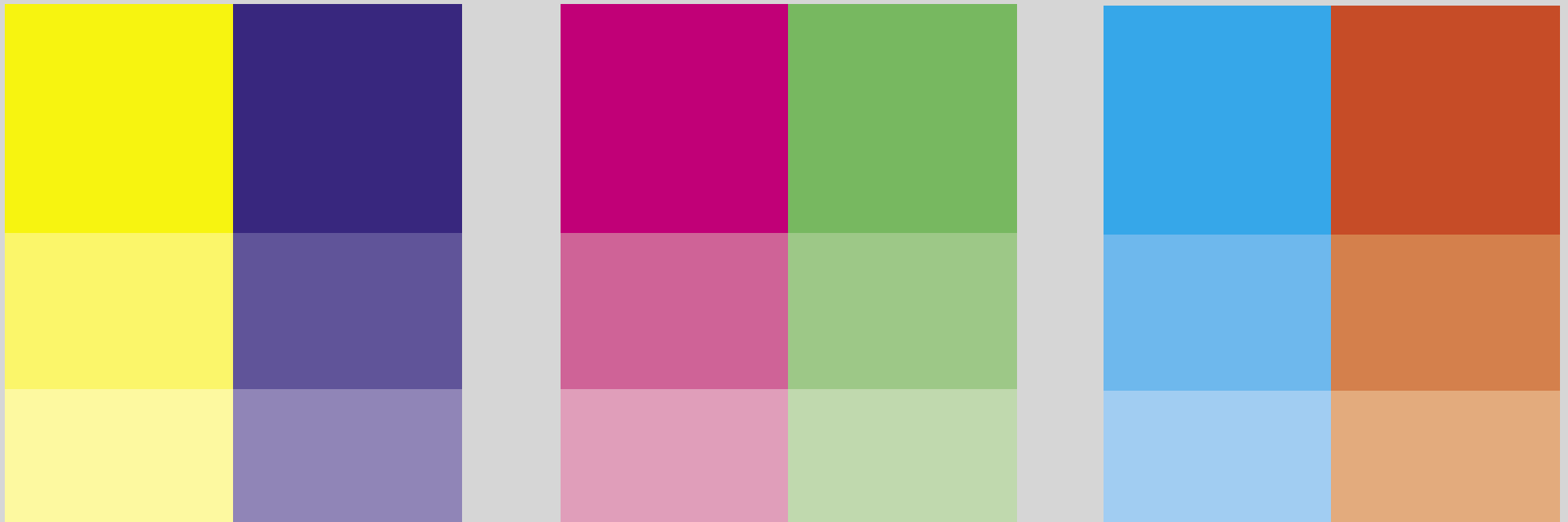


Claude Monet

Complementary Contrast

Every hue has a compliment. It exists across the hue circle, but, as we have seen, it also exists as an afterimage of that color. While the compliment of a color appears as the color's opposite, they also exert a kind of balance.

The pairs of colors and compliments in the hue circle have very different effects. Note the variations of value, saturation and temperature contrasts between the primaries and their compliments.



Complementary Contrast (examples)



Ernst Ludwig Kirchner



Henri Matisse

Simultaneous Contrast

“Simultaneous contrast results from the fact that for any given color the eye simultaneously requires the complementary color, and generates it spontaneously if it is not already present. By virtue of this fact, the fundamental principle of color harmony implies the rule of complementaries.

The simultaneously generated complementary occurs as a sensation in the eye of the beholder, and is not objectively present. It cannot be photographed. Simultaneous contrast may with reason be placed on a par with **successive contrast**.”

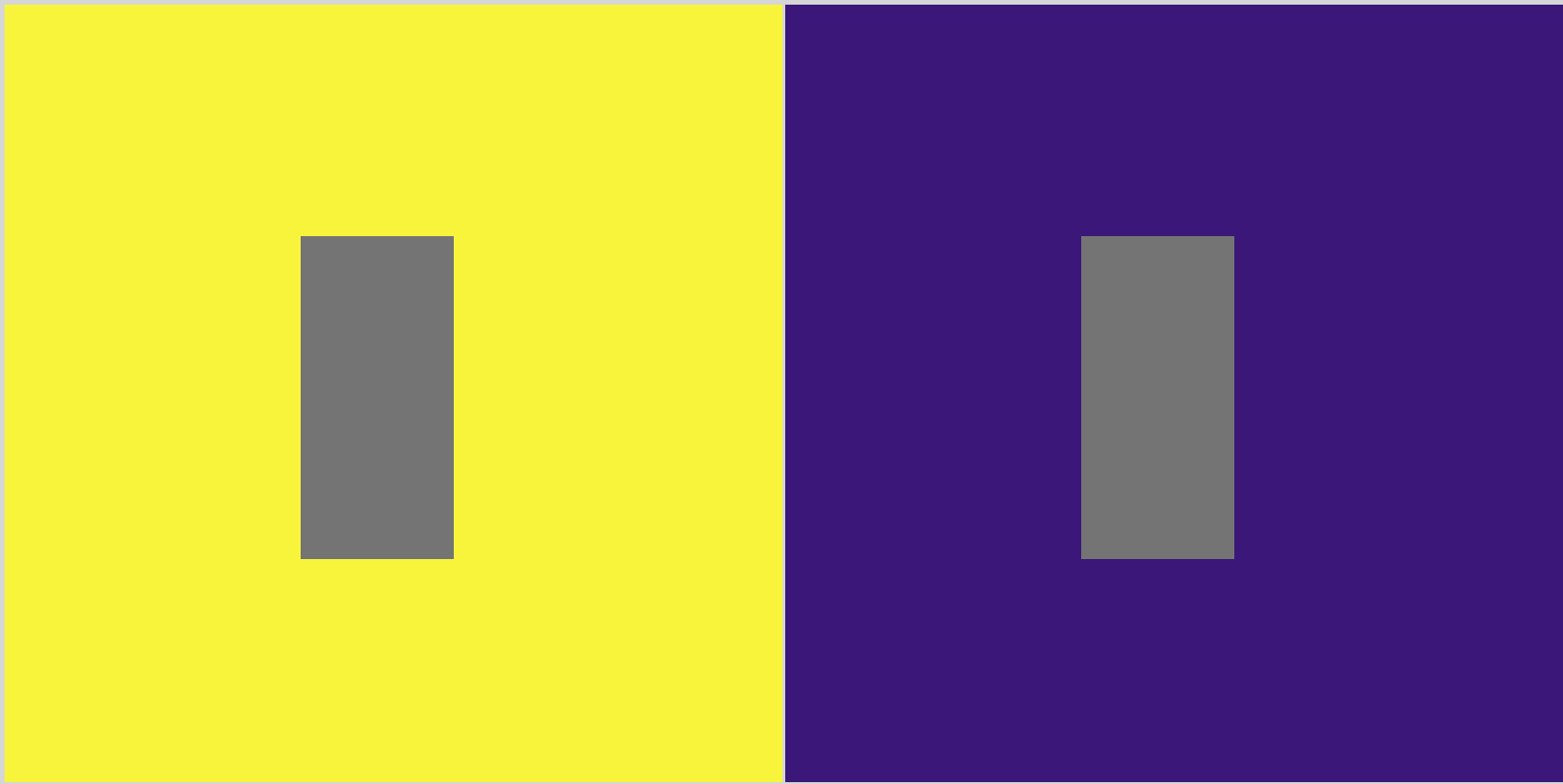
- Johannes Itten



web link: Color Illusions
click on the applet link

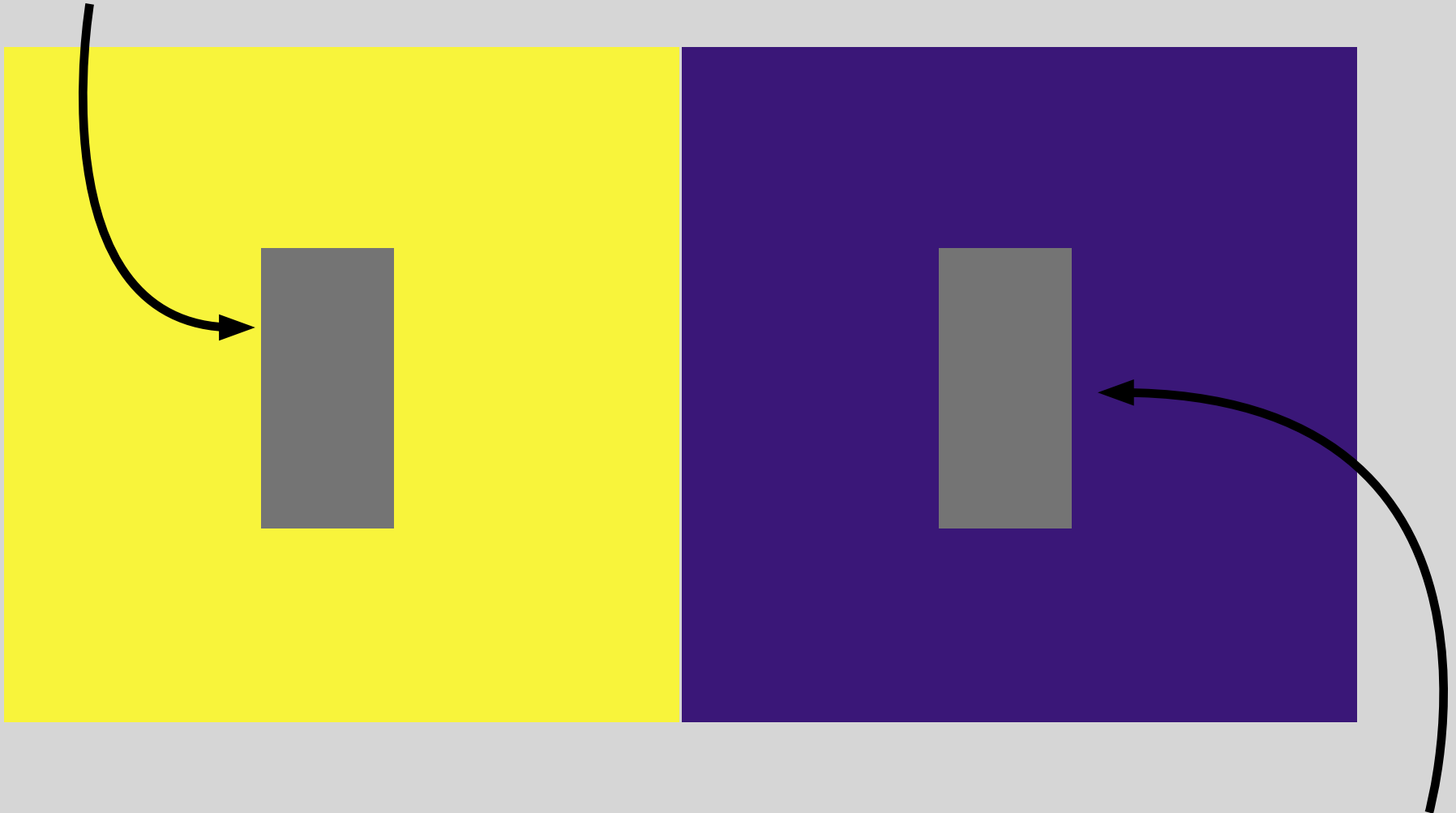
Simultaneous Contrast

Simultaneous contrast is when one color is made to look like two. When one color surrounds another it effects that color by mixing in its after-image



The gray square on the left shifts towards blue violet (yellow's compliment) and the gray square on the right shifts towards yellow (blue violet's compliment). There is a hue shift and also a value shift which makes the gray on the left seem darker and the gray on the right lighter.

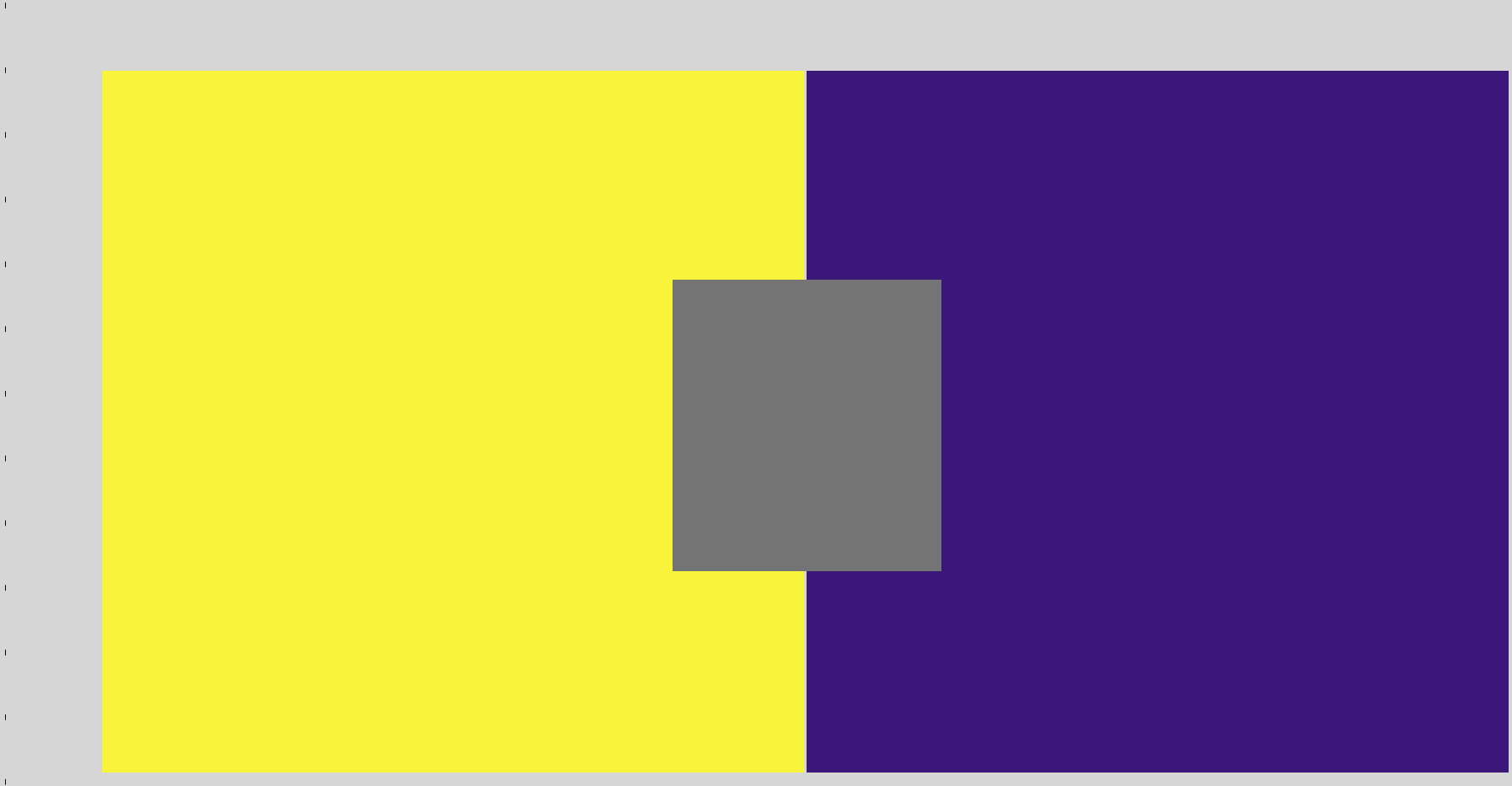
*The gray square on the left shifts
towards the dark color blue-violet
(yellow's compliment)*



*The gray square on the right shifts
towards the light color yellow
(blue violet's compliment)*

Simultaneous Contrast

The two grays are identical. The shift in hue and value is purely perceptual.



Simultaneous Contrast

Simultaneous contrast can be affected by shifts in Hue, value and saturation.

Hue - The center color appears to change in hue



Value - The center color appears to change in value

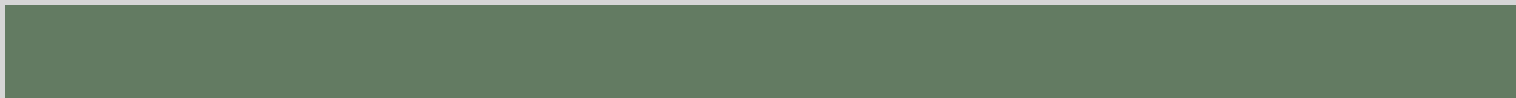
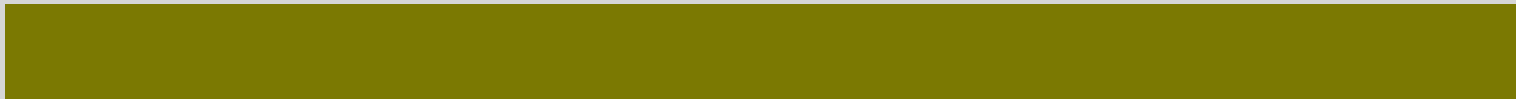


Saturation - The center color appears to change in saturation



Simultaneous Contrast

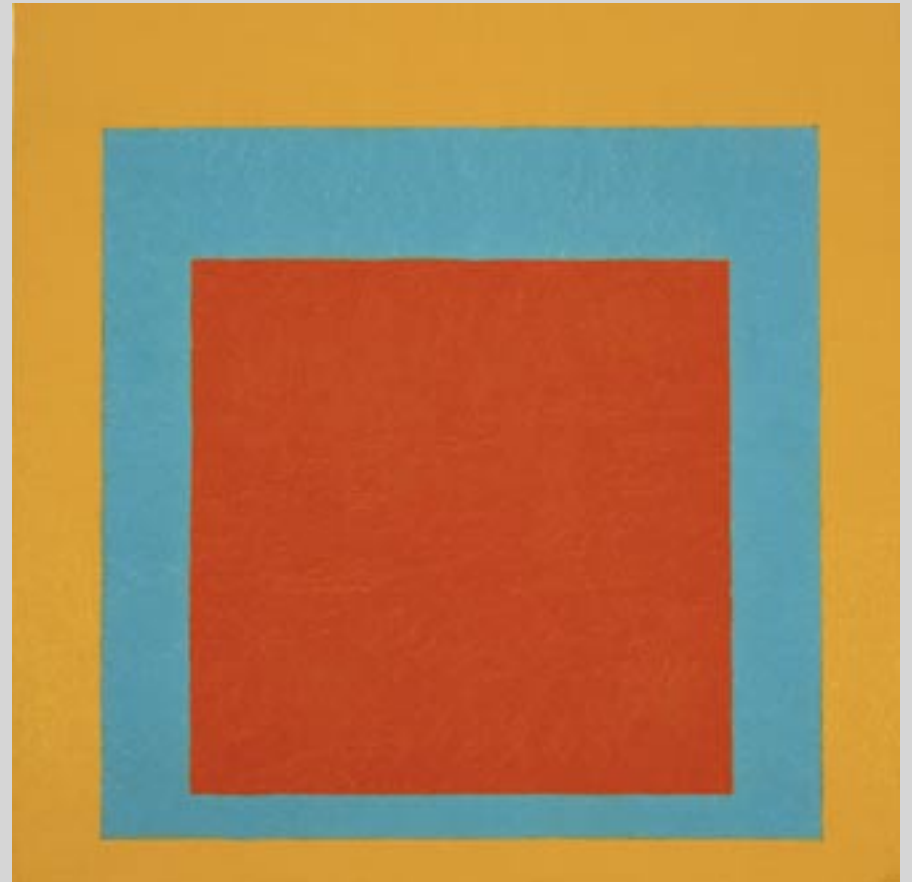
Simultaneous contrast can be affected by shifts in Hue, value and saturation.



Simultaneous Contrast



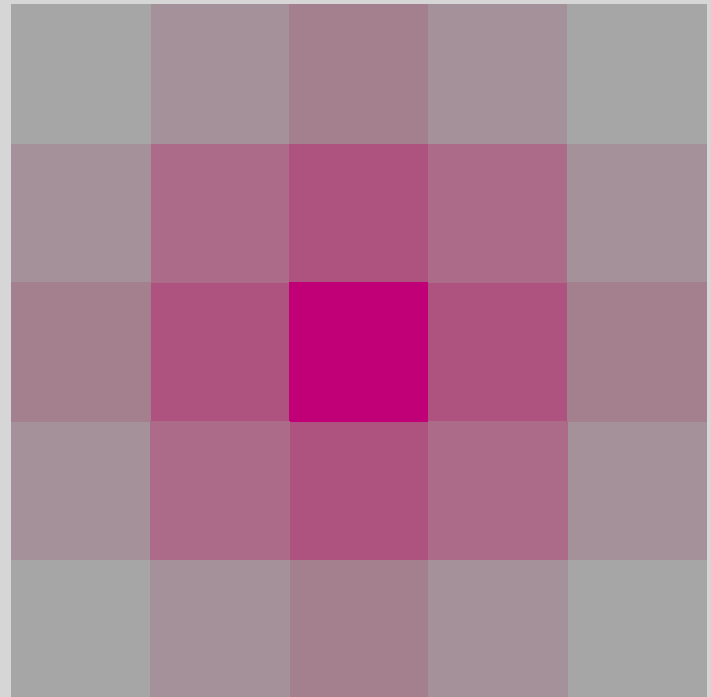
Joseph Albers



Joseph Albers

Contrast of Saturation

Increasing or decreasing saturation can be an effective way to contrast colors in a composition. Pure colors that are mixed with gray will yield desaturated colors, colors can also be diluted by adding white, black, or the color's complement. Contrast of saturation is most easily seen when the variations are executed in a single hue (see below), the examples that follow show contrast of saturation with a number of different hues.



Contrast of Saturation (examples)



Ad Reinhardt



Paul Klee

Contrast of Saturation *(examples)*



Paul Klee



Joseph Albers

Contrast of Saturation *(examples)*



Andy Warhol

Contrast of Extension

This is contrast of the size and intensity of color shapes, the contrast of proportion. Factors of extension are the proportional size of the color areas and the intensity of the colors. Hue, value and saturation are all important in determining the proportional strength of different color areas.

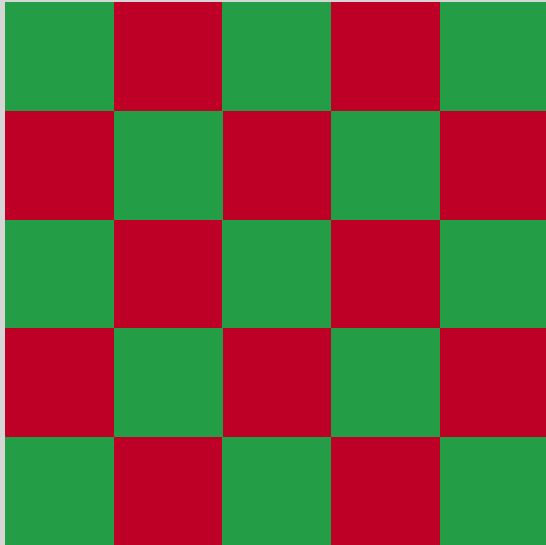
What is the visual impact of a pure color?

Goethe devised a numeric ratio for the visual balance of the primary and secondary colors. His goal was to find the proportions by which the colors could be organized so that no one color would dominate the others. The Hue circle at right (using the traditional primaries) is a visual representation of these proportions. The sizes of the color areas are based on a combination of the color's value and saturation. Yellow, therefore is the strongest and receives a smaller portion of the circle while violet being much darker is the largest area.

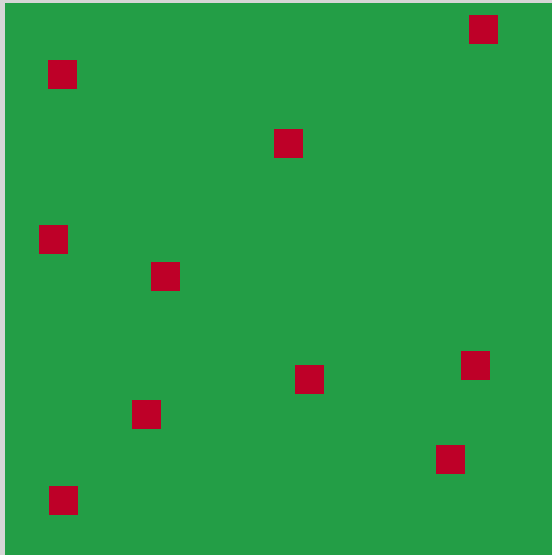
Balancing areas of colors in this way actually minimizes the contrast of extension since it creates harmony.



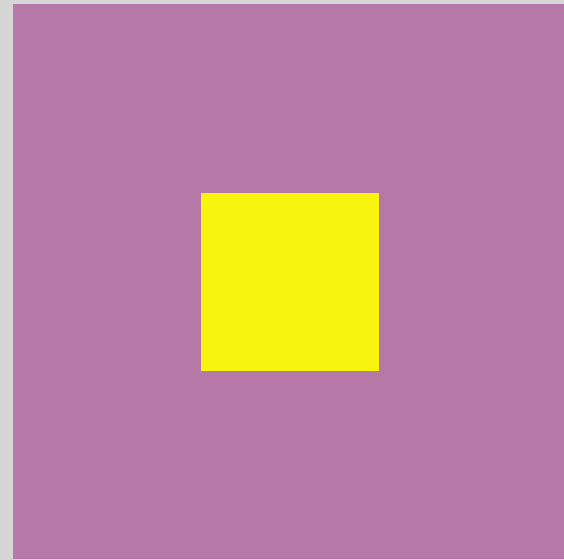
Contrast of Extension



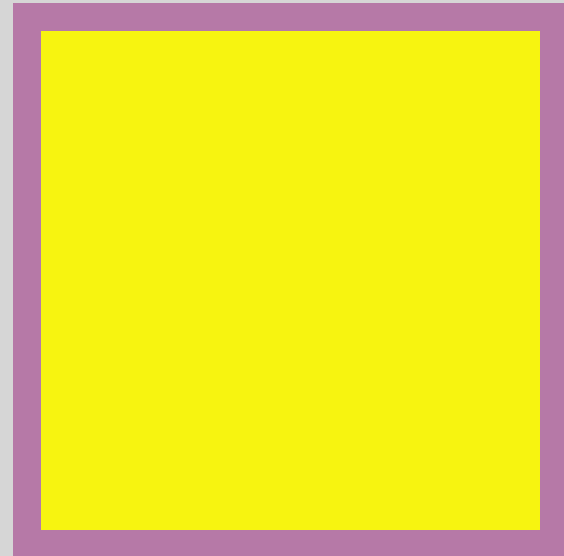
Equal measures of red and green



A small area of red can have a great visual impact on a large field of green.

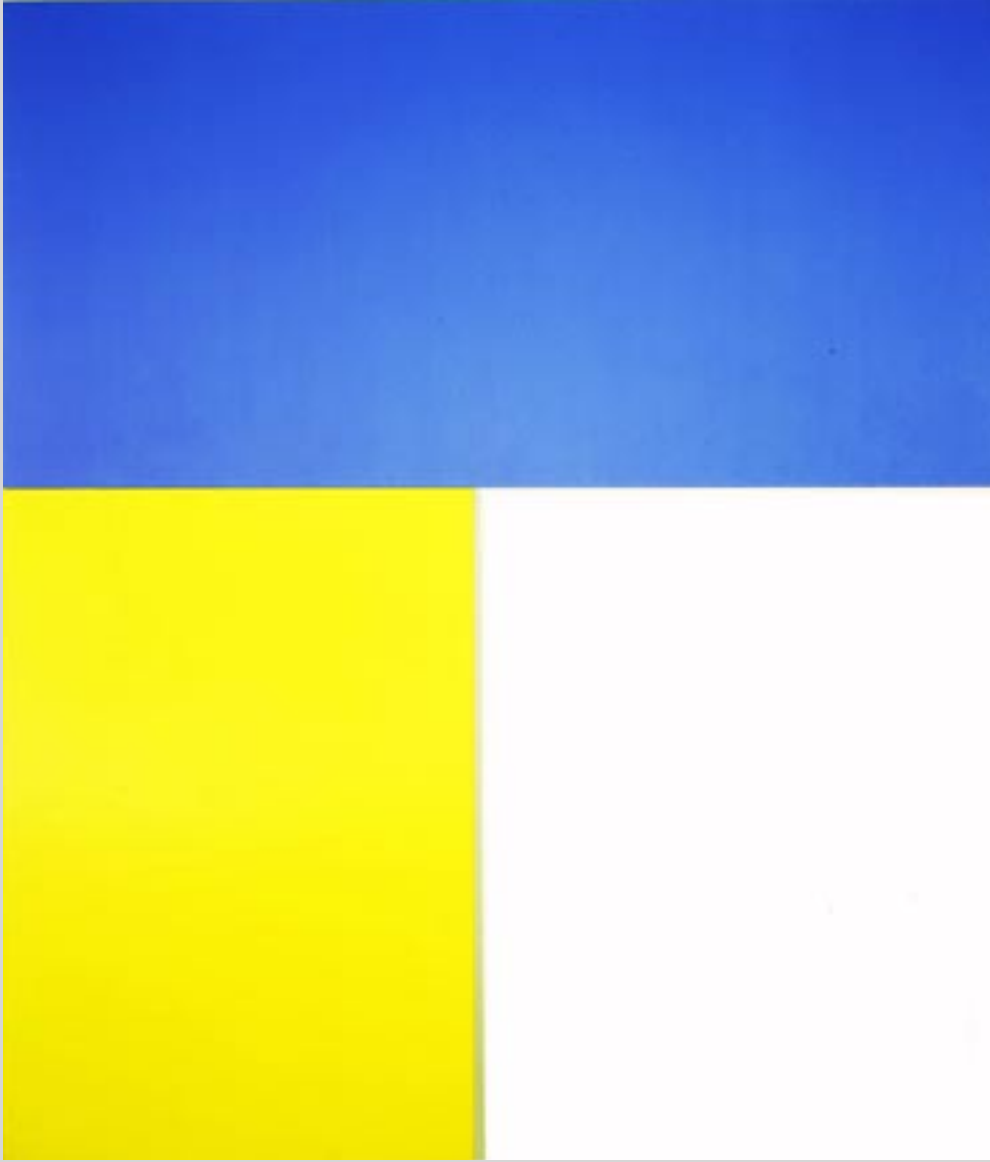


The proportion of yellow to violet allows for the perception that the yellow shape is in front of the violet shape.

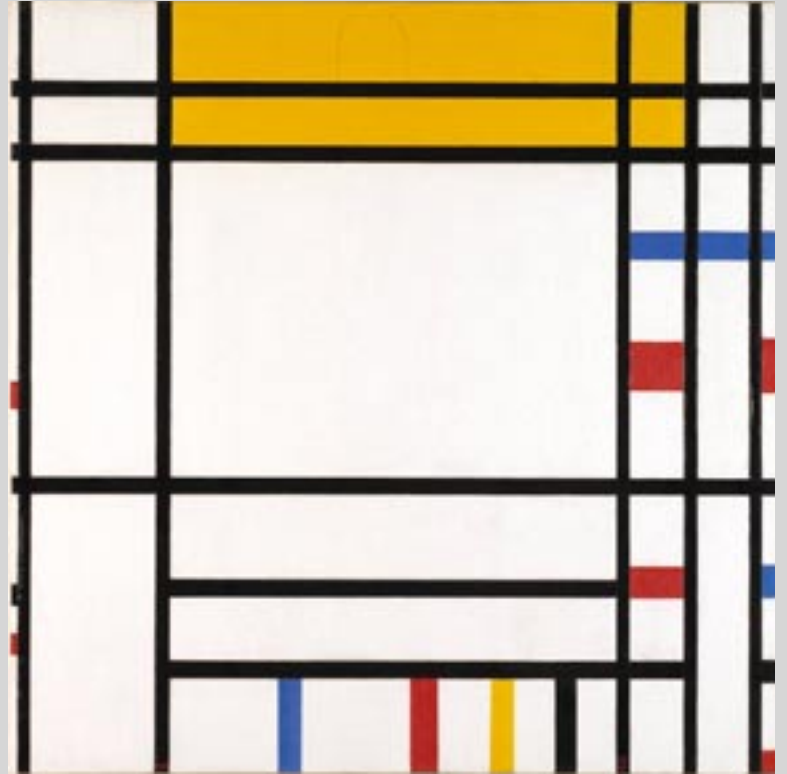


The proportion of yellow in this illustration encourages the perception that the violet is a frame in front of the yellow shape.

Contrast of Extension *(examples)*



Ellsworth Kelly



Piet Mondrian

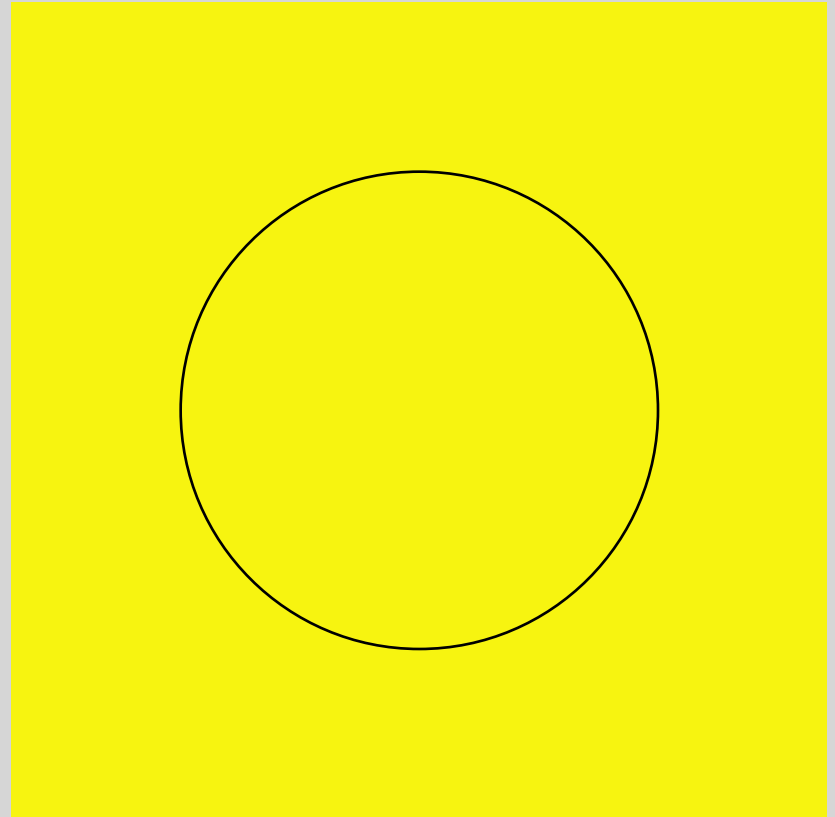
Contrast of Extension

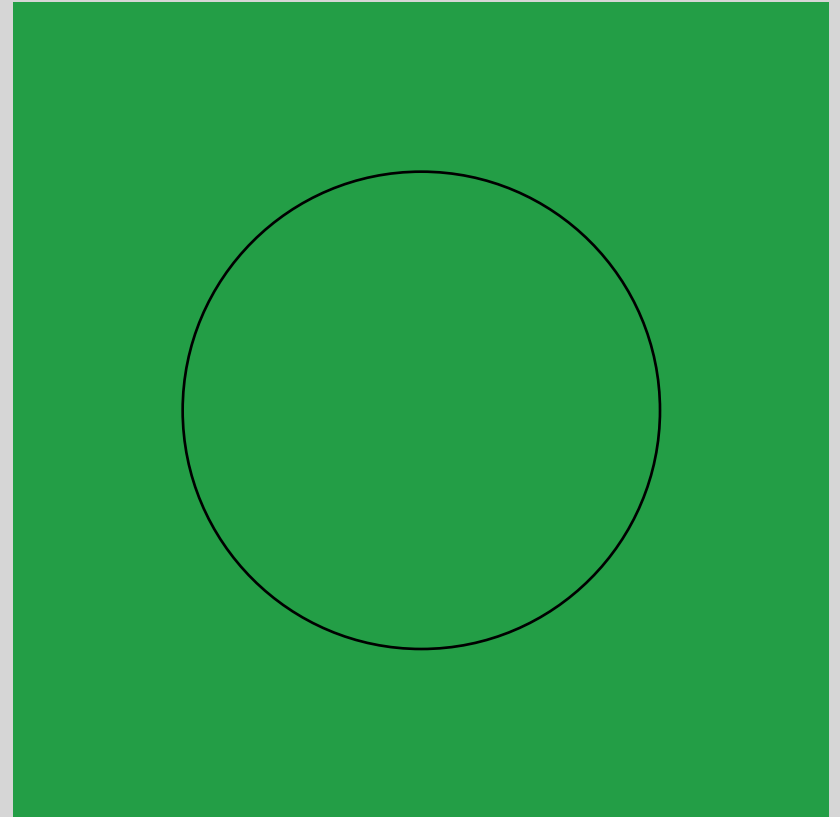


Henri Matisse

Successive Contrast

Successive contrast occurs when a color is viewed on one background and then another in rapid succession.





BACK

Created on 12 June 1997.

Last modified on 5 August 2000.

Simultaneous Contrast: Chromaticity

- *Your browser does not appear to be capable of running Java applets.*
 - [Introduction](#)
 - [Applet instructions](#)
 - [Discussion](#)
 - [Main illusion index](#)
 - Next stop: [full tour](#) :- [influence of context](#)
-

Introduction

The term *simultaneous contrast* is often used to describe variations in *luminance* between objects and their surroundings, but simultaneous contrast effects can also be demonstrated for differences in *chromaticity* (referred to more informally as *hue*, or, more informally still, *colour*) alone. This can be demonstrated, often very convincingly, with a pattern in which two large X characters are drawn in the same colour on backgrounds of differing hue. The colour of the X's is in fact a perceptually equal mixture of the two surrounds. When the colours of the backgrounds are equiluminous, a *reverse ground* effect occurs in which each X is perceived as being the colour of the opposite background.

The demonstration applet allows you to explore this effect by adjusting the luminance of each background in the pattern. You can also use it to determine how robust the illusion is with a couple of controls that aim to destroy or interfere with it.

The interactive demonstration

When the applet window first appears you will see two large X characters, one drawn against a yellow background and the other against a gray background. Depending on the characteristics of your display (and to some extent the ambient lighting) you may need to adjust the luminance of one or both backgrounds in order to achieve the colour reversal effect. The *Yellow* and *Gray* sliders can be used for

this purpose. In most cases you will find that the gray slider must be set to the left of the yellow slider for the effect to occur. You should set the gray slider just left of center, then move the yellow slider from that position towards the right until it appears reasonable to describe the left X as gray and the right X as yellow. (Some fine tuning is in order at this point to achieve the strongest possible effect.)

When showing this illusion to an audience, it has proven effective to quietly set the yellow and gray sliders with neither explanation nor introduction to the effect. Then state the claim that the two X's are the same colour and ask the audience to tell you whether they believe you. (This is of course a trick question, as explained in the [discussion](#) section below.)

If enough people are willing to agree that the colours of the X's are apparently different, you can then use the remaining controls to test the strength of that perception. The *Thickness* slider simply adjusts the thickness of the X characters. (The original author of this page has not found this control to be particularly useful, but your mileage may vary.) Selecting the *Connected* switch usually elicits the first "Ahh" from the audience as it becomes possible to trace the pattern from a point where it is apparently yellow to one where it is apparently gray. The *White top* switch replaces the backgrounds in the top half of the pattern with white on both sides. This is usually sufficient to destroy the illusion, although you may be able to cause it to return by focusing your attention solely on the bottom half of the pattern.

As for all demo applets, the *Dismiss* button at the bottom of the applet window will remove the window from the screen. Selecting the APPLET link at the top of this page will then return it to the screen just as you left it.

Discussion

Although this illusion is very simple, it deals directly with a very important issue in Computer Graphics and Human-Computer Interaction. Namely, are the two X's the same colour? The pixels of both X characters are generated by storing identical colour values in the frame buffer. In this sense they certainly are the same colour. On the other hand, what does "colour" really mean? We know to describe the left hand background as "yellow" because we have learned to attach that label to the perceptual experience it evokes. In this sense, we describe the left X as gray and the right X as yellow (assuming that the illusory effect has been achieved) because those are the labels we have learned to associate with the perceptual experience each X provides. In this sense, the two are definitely not the same colour.

At this point you may find yourself thinking that it is still more sensible to say that the two X's are in fact the same colour. The fact that they *appear* to be different is, after all, only an illusion. To do this, however, is to elevate the importance of the frame buffer to a level greater than that of the observer. It is humans who give names to colours based on what they perceive. If it *looks* yellow, then it *is* yellow, regardless of what its tri-stimulus values may be. Ideally, when human and computer disagree, it should be the computer that compensates for the predictable properties of the human visual system, not the

observer that must adapt to the rigid behaviour of the machine.

It may never be possible to incorporate all of the visual system's subtleties into rendering algorithms, if only because these properties differ somewhat from one observer to another. On the other hand, anticipating the larger and more predictable effects should not be difficult.

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