

Understanding Color

How to Use It to Express Your Creative Vision

Mark Fitzgerald

Mark@DDRoom.com ~ (503) 977-2400

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This class is sponsored by Glazer's Camera

The screenshot shows the Glazer's Camera website homepage. At the top, there is a navigation bar with the Glazer's logo, a search bar, a 4.5-star rating, and icons for Gift Cards, Login, and a shopping cart. The main content area features four promotional cards:

- PhotoFest May 31 - June 2**: A card with a background image of a photo festival. Text: "Join us for Seattle's largest photo and video event of the year. Featuring workshops, demos, photowalks, and our largest sale of the year!" A red "Learn More" button is at the bottom.
- Rent**: A card with a background image of a person in a field. Text: "Photo, Video, Audio, Lighting, and Grip. We are the Northwest's largest rental house." A red "Learn More" button is at the bottom.
- Repairs & Sensor Cleaning**: A card with a background image of a camera lens. Text: "We offer in-house repairs and sensor cleaning or can facilitate warranty repairs." A red "Learn More" button is at the bottom.
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This Class is Being Recorded

The link for the video will be sent Monday



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Overview

- ✓ **Color is an important element of the visual arts.** As photographers we often need to work with the color presented to us in the scenes we photograph. With that said, we still have significant control over color in postproduction.
- ✓ **We adjust aspects of color, such as:** white balance, hue and saturation but we often don't think about how colors work together – or against one another.
- ✓ **Understanding color** and how viewers experience it is an important concept that is often overlooked.
- ✓ **The primary goal of this class** is to take you deep into the subject of color – how we see and experience it and how we can manage it in our work to intentionally make the creative statements instead of leaving it to chance!

Class 1 – Exploring Concepts

1. Color & How We See It
2. The Psychology of Color
3. Comparing Color Systems
4. Exploring Color Schemes
5. Understanding Simultaneous Contrast
6. Simultaneous Contrast's Influence on Art

Class 2 – From Concept to Practice

1. Questions from First Class?
2. Color Models & Color Spaces
3. Measuring and Evaluating Color
4. Color Correction vs. Color Grading
5. Adjusting Global Color
6. Adjusting Local Color

Color & How We See It

*“Color is the most relative medium in art.”
Josef Albers, Interaction of Color, (1963)*

What is Color?

- ✓ In 1665 **Isaac Newton** used a prism to bend white light into a visible spectrum. He discovered that white light is composed of individual color ranges (wavelengths).
- ✓ **Wavelengths of light:** 390 nm (nanometers) to 700 nm is known as visible light. (Blue=short, Green=medium, Red=long,).
- ✓ **We see a particular color** when light strikes the surface of an object. The object absorbs some of the light's wavelengths and reflects others back to us. The reflected light is the color we see. White results when all wavelengths are reflected. Black is when none are reflected.
- ✓ **Color Temperature:** Used to describe light emitted by a light source. Kelvin degrees are used to measure color temperature.
- ✓ The color of an object **depends on two factors** – the color of the light source striking it and which wavelengths of light the object absorbs and reflects.

How We Perceive Color

- ✓ The human eye has photoreceptors called Rods and Cones. Cones have light-sensitive receptors that enable the eye to perceive color. **Each cone is sensitive to red, green or blue light (RGB).** (Rods are mostly sensitive to changes in brightness, not color.)
- ✓ It's estimated that humans with good color perception can distinguish up to **10 million variations** in color.
- ✓ **Our eyes compensate and adjust to** changes in the brightness and the color of light. Our color perception diminishes when light levels are reduced.
- ✓ **Retinal fatigue (Color Fatigue):** Caused by staring at one color or brightness tone; the cells that detect that color or tone will become fatigued. The after image is a result of photoreceptors that are out of balance. It takes between 10–30 seconds for the fatigue to wear off and restore balance.

Why Do We See Color Differently?

- ✓ **Color is a learned skill** – Color Memory – Can we accurately remember the exact color of a known object?
- ✓ **Surrounding Colors** – Simultaneous Contrast – Colors affect other surrounding colors. (*More on this later.*)
- ✓ **Color Constancy** – Our brains adjust our perception of white based on hints from surrounding colors.
- ✓ **Color of the light** illuminating an object. *Metamerism* is when two different colors look alike due to the light source.
- ✓ **Blood glucose (sugar) levels** - Diabetics can have a blue-yellow vision deficit.
- ✓ **Age** can affect color perception in people 70 and above.
 - ☞ *A person's two eyes can each distinguish color differently.*

Human Color Deficiencies

- ✓ Types of **Color Deficiencies**:
 - **Protanopia** makes red look more green and less bright.
 - **Deuteranopia** is the most common type of red-green color blindness. It makes green look more red.
 - **Someone with both** protanopia and deuteranopia is unable to tell the difference between red and green.
- ✓ 1 out of 255 women and 1 out of 12 men have some form of color vision deficiency.
 - ☞ <https://www.color-blindness.com/color-blindness-tests/>
 - ☞ <https://www.xrite.com/hue-test>

Psychology of Color

How Does the Color We See Affect Us?

From Physics to Perception

- ✓ **Johann Wolfgang Goethe** (1749-1832) wrote *Theory of Colours* in 1810 where he developed the concept of emotions in color and color harmonies.
- ✓ He ignored the Newton's wavelength theory and **concentrated on the perception of color.**
- ✓ Unlike Newton who was scientific, **Goethe was interested in perception and subjectivity** that reveal the essential character of color. Visual phenomena are more important than theory.
- ✓ Goethe **wanted to develop rules** for the use of color, much like rules for composition, etc. "*To place the doctrine of colours nearer, in this sense, within the philosopher's reach, was the author's wish...*" (Theory of Colours)
- ✓ <https://www.youtube.com/watch?v=QnfVIENcHbU>

6 Principles of Color Psychology

1. A color can have a specific **meaning**.
2. Meaning is either based on **learning and/or biology**.
3. We **automatically evaluate** colors as we perceive them.
4. **Behavior is influenced** by the evaluation process.
5. The influence of a color is **typically automatic**.
6. It is important to consider **context** when evaluating the meaning of color.

Color Psychology

- ✓ **Color influences perceptions** that are not obvious and can cause certain subconscious emotions.
- ✓ **Egyptians** studied the affects of color on mood and believed they could be used for healing processes.
<https://www.ancient.eu/article/999/color-in-ancient-egypt/>
- ✓ Psychiatrist and psychoanalyst **Carl Jung** (1875-1961) is most prominently associated with the pioneering stages of color psychology. He once said, "*Colors are the mother tongue of the subconscious*" and they are a "*primary element of our existence*".
- ✓ Jung believed we have a **universal response to color as well as a societal response**.

Color & Marketing

- ✓ A color can subconsciously influence our decisions, depending on its meaning.

Color Meaning in the West

Red	Yellow	Green	Blue	Pink	Violet	Orange	Brown	Black	White
Lust	Competence	Good Taste	Masculine	Feminine	Authority	Warmth	Rugged	Grief	Happiness
Power	Happiness	Envy	Competence	Sophistication	Sophistication	Excitement		Sophistication	Sincerity
Excitement	Inexpensive	Eco Friendly	High Quality	Sincerity	Power			Expensive	Purity
Love	Low Quality	Health	Corporate					Fear	
Speed			Reliability					Death	
Anger									

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Color Meanings Worldwide

- ✓ Color can mean different things to people in different cultures.
 - The color red in **the West** is linked to passion and excitement.
 - In **Asian cultures** it is the color of excitement and celebration.
 - In **Latin America** it is the color of religion, particularly when paired with white.
 - In the **Middle East** it's associated with caution and danger.
- ✓ <http://www.six-degrees.com/pdf/International-Color-Symbolism-Chart.pdf>
- ✓ <https://www.webdesignerdepot.com/2012/06/color-and-cultural-design-considerations/>

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Color Affects Our Senses

- ✓ Color can affect the **choices we make** such as; the food we eat the things we buy, and the way we feel.
- ✓ There is a strong relationship between **color and smell**. Research shows this relationship is common across multiple cultures: <https://www.medicaldaily.com/smelling-colors-our-brains-associate-odors-color-fruity-smells-are-pink-294002>
- ✓ Color affects **how things taste**; wine for example: <https://pubmed.ncbi.nlm.nih.gov/31732050/>
- ✓ Some people can **feel (touch) and taste** colors: <https://www.thesynesthesiatree.com/2021/02/colour-tactile-colour-touch-synesthesia.html>
- ✓ **Chromesthesia**: 1 in every 2000 people see colors when they hear sounds: <https://soundcolorproject.com>

Philosophy of Color

- ✓ **Is color inside or outside?** Does it exist outside human consciousness? Philosophers have struggled with this question since the time of Aristotle.
- ✓ **Antirealist**: The appearance of color is an illusion. Color does not exist outside human consciousness. It is created in the mind and projected onto the world. (*Coloring Book Hypothesis*)
- ✓ **Realist**: Colors are physical properties assigned to objects. Not based on the psychological state of the observer. Viewing conditions and physiology can affect its appearance but color is a physical property assigned to objects.
- ✓ Is the dress blue or white?
<https://www.wired.com/2015/02/science-one-agrees-color-dress/>

2 Color Systems

Reflected Light & Transmitted Light

Two Main Color Systems

- ✓ A color system is a method of **logically understanding color and color variation**. It also details results of mixing colors together and the relationships of colors to each other.
- ✓ There are two main color systems:
 - ✓ **Additive Color:** Color primaries of Red, Green, Blue. Relates to *transmitted light*. Called Additive because equal amounts of primary colors added together = white.
 - ✓ **Subtractive Color:** Color primaries are Red, Blue, Yellow. Mostly relates to *reflected light*. Called Subtractive because equal amounts of primary colors subtracted = white.
- ✎ *Primary colors are basic colors that cannot be created by mixing other colors.*

Additive Color System

- ✓ Color primaries are **Red, Green, Blue** (RGB). When these primaries are combined equally, the result is white. Additive color theory deals with **transmitted light**.
- ✓ **Computer displays** use RGB transmitted light.
- ✓ **Cameras** use RGB photo receptors on their sensors.
- ✓ **Editing apps** like Lightroom Classic and Photoshop (typically) use an additive system when mixing or correcting color.
 - ✂ *Displays, cameras, and apps use additive color to create subtractive colors when printing with pigment dyes.*

The Additive Color Wheel

- ✓ **Primary colors:** Three basic colors that cannot be created by mixing other colors. They are *Red, Green, and Blue*.
- ✓ **Secondary colors:** Created by mixing two primary colors. There are 3 of these. *Cyan, Magenta, Yellow*.
- ✓ **Tertiary colors:** Created by mixing a primary color with an adjacent secondary color. There are 6 of these. *Orange, Chartreus, Spring Green, Azure, Violet and Rose*.
- ✓ **Complementary colors:** Two colors that are opposite each other. *Red-Cyan, Green-Magenta, Blue-Yellow*. Complementary colors cancel one another out.
- ✓ **Gray:** A tone that does not have a color hue.
- ✓ **White:** Equal amounts of primary colors.

Subtractive Color System

- ✓ **Color primaries are Red, Blue and Yellow.** When these primaries are combined equally, the result is black*. It's called subtractive because to achieve a white canvas, all pigment must be removed.
- ✓ Subtractive color theory deals with **reflected light**. When light shines on an object, pigment absorbs some color wavelengths and reflects other wavelengths that we see.
- ✓ The subtractive color system is **used when mixing pigments**, such as paint and inkjet ink.

* *When mixing color pigments with ink or paint, equal amounts of RYB usually results in a muddy brown. Black is added to create darker, black-like tones.*

The Subtractive Color Wheel

- ✓ **Primary colors:** Three basic colors that cannot be created by mixing other colors. They are Red, Blue and Yellow.
- ✓ **Secondary colors:** Created by mixing two primary colors. There are 3 of these. *Green, Orange and Violet.*
- ✓ **Tertiary colors:** Created by mixing a primary color with an adjacent secondary color. There are 6 of these. *Red Orange, Yellow Orange, Yellow Green, Blue Green, Blue Violet, and Red Violet.*
- ✓ **Complementary colors:** Two colors that are opposite each other. Red-Green, Blue-Orange, Yellow-Violet.
- ✓ Complementary colors **cancel each other**. Combining complementary subtractive colors reduces hue with the result being similar to gray.

Knowing the Difference

- ✓ **Why is it important** to know the difference between Additive and Subtractive color?
- ✓ Most of the **art and design world uses the subtractive** color model when creating, evaluating and comparing color.
- ✓ **As photographers** we typically use the additive color model when managing and adjusting color. (*For example when examining color harmonies in the next section.*)
- ✓ When working with color in film darkrooms or using digital editing programs, we need to be fluent with the **Additive color model** because it is the “color language” of light and photography.

Subtractive Color Schemes

Relating Colors to Each Other

Basic Color Terminology

- ✓ Color is comprised of *Hue*, *Saturation* and *Brightness*.
 - **Hue:** The name of a particular color, such as red or blue. Hue is measured in degrees depending on location on the color wheel. Starting with red at 0 degrees, the main hue changes every 30 degrees to 12 distinct hues.
 - **Saturation:** The purity of a color which is sometimes referred to as Intensity. Desaturate a color by adding gray or by adding its complementary color.
 - **Brightness (Luminance):** The lightness or darkness of a color. (*Sometimes referred to as Value.*)
- ✓ **Neutral Gray:** A balanced combination of equal amounts of the primary colors.

Common Color Schemes

- ✓ **Monochromatic** color is created by adding black, white or gray to a single hue. This creates multiple tints, shades and tones.
- ✓ **Analogous color:** Next to each other on color wheel. Can induce a calm, harmonious viewing experience. When placed next to one another, they tend to soften each other.
- ✓ **Complementary:** Colors on opposite sides of the color wheel. Produces maximum color contrast. Complementary colors intensify each other especially when placed side-by-side.
- ✓ **Split complementary:** One key color and two other colors adjacent to its direct complementary.
- ✓ **Double Split Complementary:** Two adjacent colors paired with two adjacent complementary colors.

Exploring Color Schemes

- ✓ Here are a couple of good resources for exploring color schemes.
- ✓ **Adobe Color Wheel:** This is a great place to begin.
<https://color.adobe.com/create/color-wheel> (*This tool is intended for designers so it uses the Additive color model.*)
- ✓ **Paletton:** A fun place to explore color schemes. paletton.com
- ✓ If you are a **Photoshop** user you can use the Adobe color themes Photoshop extension – *Window > Extensions > Adobe Color Themes*
 - 📺 *An excellent video that shows color schemes in photography:*
Secrets of Color Grading – Joanna Kustra
<https://www.youtube.com/watch?v=mC8ol2-V7Ck>

Color Harmony

- ✓ To create color harmony, select the **most important color** and then add secondary and/or accent colors to support main color.
- ✓ Color harmony can sometimes be **balanced or discordant** (analogous or complementary).
- ✓ **Create harmony or tension** by controlling the proportion, saturation and brightness of colors.
- ✓ **Less saturated colors** are more harmonious while saturated colors create more *color contrast*.
- ✓ Add complementary tints and shades of the **key color** to the neutral colors in the composition.
 - **Tint:** White added to a color.
 - **Shade:** Black added to a color.

Simultaneous Contrast

Color Does Not Exist in Isolation

What is Simultaneous Contrast?

- ✓ Early 19th century **French chemist Michel Eugène Chevreul** was hired to investigate why dyes used in tapestries provide inconsistent results. He realized the problem wasn't the dyes, it was the way certain hues on fabric were being combined optically.
- ✓ In his book, "*The Law of Simultaneous Color Contrast*" (1839), Chevreul developed the rule of simultaneous contrast. One of the things it suggests is if two colors are close in proximity, each will take on the hue of the complement of the adjacent color.
- ✓ When our eyes are exposed to one color or brightness for a period of time, the **color begins to lose** some of its saturation and appear more gray as our eyes adapt to the color, which can affect the way other colors appear.
- ✓ **This can affect** the way an image looks in print or onscreen as opposed to the original scene we photographed.

 *Also called simultaneous color contrast or simultaneous color.*

Effects of Simultaneous Contrast

- ✓ A color will **influence an adjacent color's hue** causing the adjacent color to display hues of the complement of the first color.
- ✓ Simultaneous contrast is affected by **proximity and saturation**. The closer the adjacent colors are to each other, and the more intense they are, the greater the effect.
- ✓ The effect of simultaneous contrast **is lessened** when a neutral colored area is placed around one of the colors.
- ✓ Simultaneous contrast **intensifies when** adjacent colors are highly saturated; simultaneous contrast is weaker when adjacent colors are less saturated - or more neutral.
- ✓ A highly saturated color will look more saturated next to a less saturated color. A less saturated color will look less saturated next to a highly saturated color.

Simultaneous Contrast Examples

- ✓ **Dark next to bright** makes the bright color look brighter and the dark color look darker. To make a light color look lighter, place a darker color next to it.
- ✓ If two colors are of a **similar brightness**, the less bright they'll both look when placed next to each other.
- ✓ Simultaneous contrast is **most intense** with complementary, saturated colors.
- ✓ To make a **warm color look warmer**, place it next to a cooler color and vice versa.
- ✓ To make a **color look more intense**, place it next to a less intense color.

Simultaneous Contrast Examples

- ✓ A **bright color next to a muted color** makes the muted color look duller.
- ✓ Placing a **color next to its opposite** in *hue, value, or saturation* intensifies simultaneous contrast.
- ✓ **Lowering tonal contrast lessens** the effect the two adjacent colors have on each other.

Successive Contrast

- ✓ Successive contrast is the effect a **previously viewed color** (inducing color) has on the currently viewed color. *Think of retinal fatigue.*
- ✓ The **after-image of the previous color** affects the current color and alters its appearance.
- ✓ The best **way to mitigate** this is to choose an *inducing color* that is neutral gray. For example a bright, saturated color behind your computer display can affect your color perception when looking at the display. It's better to have a neutral color behind your display.

Simultaneous Contrast & Art

Chevreul's Book Changed Everything

Impressionist Painting

- ✓ When Chevreul's book was first published, it was not widely read. **It took a several years for the art community** to take notice. Eventually it was one of the main elements responsible for the development of the Impressionist painting style.
- ✓ Impressionist painters tried to **capture the effects of light**.
- ✓ Before Impressionism, painters would represent subjects with different tones of the **local color** (*actual color of the object they were painting*) to show volume as well as light direction and intensity that illuminated the subject.
- ✓ Impressionist painters were more interested in **using color that was perceived by the eye** under the lighting and atmospheric conditions affecting the subject. *For example, the color of light affects white balance but the actual color of the subject (local color) remains constant.*

Expression Through Color

- ✓ **The Night Café** – Van Gogh in a letter to his brother, Theo, said that he was trying to convey "the terrible passions of humanity" through the use of clashing colors.
- ✓ *"Instead of trying to exactly what I see before me, I make more arbitrary use of color to express myself more forcefully."*
Vincent Van Gogh (*Letter to Theo van Gogh, 11 August 1888*)

Impressionist Color Selection

- ✓ Impressionists tended to use **complementary colors next to** one another, rather than mixing colors together. This allowed the colors to mix optically when viewed.
- ✓ Many impressionist painters used a **limited palette**. This was often a few warm and cool colors and white.
- ✓ Impressionists **tended to avoid the dark earth colors** such as umbers, siennas, and lamp black that were common in traditional painting at the time. They chose instead to work in hues closer to the colors of the light spectrum: violet, indigo, blue, green, yellow, orange, and red, often mixed with white.

Color in the Shadows

- ✓ The Impressionists were known for using simultaneous contrast in the shadows. **They abandoned the old idea** that the shadow of an object was made up from the color of the object with some brown or black added. Instead they used saturated color in their shadows that was mixed with the complementary of the object casting the shadow.
- ✓ For example, blues and violets would be **mixed into shadows** of objects that were orange and yellow.
- ✓ Many **impressionists did not use black**. The Impressionist Renoir is quoted as saying “No shadow is black. It always has a color. Nature knows only colors...white and black are not colors.”
- ✓ If a shadow is cast on something white, like snow, the **shadow is rarely just a different shade gray**.

Impressionist Used Simultaneous Contrast

- ✓ *"To exaggerate the fairness of hair, I come even to orange tones, chromes and pale yellow ... I make a plain background of the richest, intensest blue that I can contrive, and by this simple combination of the bright head against the rich blue background, I get a mysterious effect, like a star in the depths of an azure sky."* (Letter to Theo van Gogh, 11 August 1888)
- ✓ **Monet eventually stopped using earth colors and browns.** *"The point is to know how to use the colors, the choice of which is, when all's said and done, a matter of habit. Anyway, I use flake white, cadmium yellow, vermilion, deep madder, cobalt blue, emerald green, and that's all."* Monet by Himself, p196, edited by Richard Kendall, MacDonald & Co, London, 1989.

Neo-Impressionism and Pointillism

- ✓ While Impressionist painters like van Gogh and Monet painted quickly to catch the light, Neo-Impressionist like Georges Seurat and Paul Signac used a **meticulous approach** to applying color.
- ✓ **Pointillism:** The use of optics and color theory. Instead of mixing colors to create a specific color, they used small areas of pure color hues that would interact visually to create more striking color than could be achieved by mixing paint.
- ✓ **Instead of using muted hues**, like gray or brown, they placed small areas of complimentary colors near each other to create the optical phenomena of muted color.
- ✓ They place **complimentary colors near each other** to enhance them.
- ✓ <https://artsandculture.google.com/asset/a-sunday-on-la-grande-jatte/twGyqq52R-IYpA?hl=en>

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Useful & Interesting Videos

- ✓ **Using Adobe Color Themes**
<https://helpx.adobe.com/photoshop/using/adobe-color-themes.html>
- ✓ **Munsell Color website** – <https://munsell.com/>
- ✓ **Color philosophy:**
<https://newrepublic.com/article/121843/philosophy-color-perception>
- ✓ **Color grading by country.** https://www.boredpanda.com/different-places-hollywood-movies/?utm_source=google&utm_medium=organic&utm_campaign=organic
- ✓ **Story of Kodak's Shirley Card**
<https://www.npr.org/2014/11/13/363517842/for-decades-kodak-s-shirley-cards-set-photography-s-skin-tone-standard>
- ✓ **The Hidden Power of Colours - Patricia Thenisch**
<https://www.youtube.com/watch?v=djRfhanEsnw>

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Interesting Books

- ✓ *Theory of Colors* – Johann Wolfgang Goethe
- ✓ *On the Law of Simultaneous Contrast of Colors* – M.E. Chevreul & Dan Margulis
- ✓ *Interaction of Color* – Josef Albers:
<http://interactionofcolor.com/> (There is also a nice interactive mobile app of this book)
- ✓ *Lifelike: A Book on Color in Digital Photography* – Pavel Kosenko <https://blog.dehancer.com/lifelike-book/>
- ✓ *Outside Color: Perceptual Science and the Puzzle of Color in Philosophy* – M. Chirimuuta:

Final Thoughts & Questions