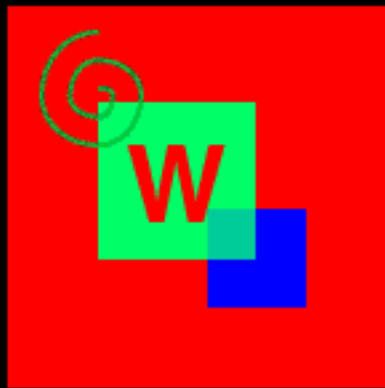


COLOR LOGIC FOR WEB SITE DESIGN



JILL MORTON

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Revised 2016

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for Bryan Villados

ABOUT THIS PDF

How to Use Adobe Reader (Acrobat)

Computer Colors

About Printing

Introduction

This publications has been developed and created to be viewed on-screen, as a PDF.

Due to the variety of monitors and printers currently in existence, there will inevitably be differences in color from screen to screen, and if printed, from printer to printer.

How to use Adobe Reader

Adobe Reader, formerly known as Acrobat, gives you exceptional control in accessing the information in this publication. The following tips are provided to assist you.

Viewing Options

Control the viewing size of the pages in this publication by selecting any one of the options under **View** on the menu bar or any of the page buttons on the tool bar. Options include full magnification, fit the page in window, fit the visible width of the page in window, and other selections.

Navigation and Bookmarks

Click on the "Pages" or "Bookmarks" tab at the upper left area of the window that displays this publication. It will open icons of each page. Click on any item to link directly to the page.

Use the arrows at the top to view the next page, the last page or the previous page.

How to Find Things

Select Edit > Find on the menu bar. A dialog box will appear. Enter the text to be found and click "Find." When the program finds the text, the page containing the text is displayed with the text highlighted. If you want to find more occurrences of the text, select "Find Again" in the same dialog box.

Computer Colors

This publication was designed for electronic distribution and computer viewing. The layout, fonts and colors were chosen for this environment. Every effort has been made to reproduce colors accurately. All illustrations were prepared on a system with full gamma correction and color synchronization.

Note!

Colors may vary on different computer systems. Some Windows PCs do not have built-in color correction and typically require a video or graphic card for accurate color readings and full gamma correction. Anti-glare screens will cause color distortions.

16 - 24 bit color, a high quality monitor and fully corrected gamma deliver the best results.

About Printing

Printing PDFs is an easy task on inkjet and all true postscript laser printers.

About color differences in print

This publication was designed for on screen viewing using the RGB color model. Printers use the CMYK (cyan, magenta, yellow, black) color model. Therefore, colors of this ebook on your computer monitor will appear different when printed with CMYK inks.

Warning: Printing this publication may consume a large quantity of ink.

TABLE OF CONTENTS

Introduction	2
DEFINING COLOR	7
COLOR HARMONY FORMULAS.	26
COLOR AND HARMONIOUS DESIGN	70
COLOR DESIGN THEORIES	85
ADVANCED COLOR DESIGN THEORY	92
THE VISUAL AND PERCEPTUAL EFFECTS of COLOR	102
COLOR AND FUNCTIONAL DESIGN	124
HOW COLOR AFFECTS THE EYES	138
THE PSYCHOLOGICAL EFFECTS OF COLOR	163
COLOR AND COMPUTER TECHNOLOGY	178
APPENDIX.	203

INTRODUCTION

Color Logic

Today we see more images in a day than our early civilized ancestors saw in a lifetime. Historically, the technology for printing and paper making began in the ninth century in China. By the fifteenth century, Europeans had developed print-making for the production of religious icons, playing cards and books. The technological advances of the nineteenth and twentieth centuries have provided us with unlimited tools for communicating visual form. Consequently, we are bombarded with images from books, magazines, newspapers, film, television, the Internet, and last but not least, art museums and galleries.

What we see and how it was designed is not happenstance. There is a theoretical history to visual art which equals the development of theories that have contributed to modern science and technology. Color theory is part of formal aesthetic principles which have evolved over 30,000 years of Western civilization. Beginning in the Paleolithic era, cave drawings are testimony to the first organization of visual form and color palettes. The art of the earliest civilizations of the three river valleys, the Tigris, Nile and Euphrates, contributed to the evolution of visual theories. Their legacy of mosaics, frescoes, sculptures, architecture and other forms continues to inspire the arts today.

The pivotal moment in the development of the arts in Western civilization occurred in Greece. From literature to architecture, the ancient Greeks provided the foundation for all the art that followed. Of interest with respect to color, is that the triumphant architectural monument, the Parthenon, was polychrome. Today only the raw stone surfaces linger as evidence.

The technical analysis of color began with Sir Isaac Newton's discovery in 1666 that sunlight contains all the colors of the rainbow. He also developed the first color circle. Other early color pioneers were Goethe, Schopenhauer and Chevreul. In the early twentieth century, several members of the Bauhaus school of art and industrial design dedicated themselves to a formal analysis of color. The work of Johannes Itten and Josef Albers continues to form the foundation of most of color theory as we know it today.

Color Logic and Web Site Design

A web site is unlike any pre-existing visual form of communication. It is an interactive space through which the user navigates. The user's choices determine what is seen and how long it is seen.

In other two-dimensional art forms, the designer deals with set parameters. A magazine article, a business card, a painting or other traditional media exist as complete entities with a fixed size. With the exception of the home page, a web page typically does not exist in its entirety on a monitor screen. Users must scroll to see the rest of the page and other parts of the overall design. Monitor sizes and resolution, gamma differences, font sizes, pixel ratios and user options are all contributing at the same time to the instability of any given web page.

Consequently, the web designer is challenged to deliver a visual product for an extremely wide range of variables. An understanding of how color creates logical and engaging visual effects is essential to successful design for this flexible environment.

Why color matters on the web

The first page of a web site sets the tone for the shopping experience. As soon as visitors arrive, color must successfully capture their attention and convey a positive impression. People make up their minds about staying or departing in a matter of seconds. Moreover, as a visitor explores the site, appropriate colors function as a subliminal form of visual persuasion. In the final analysis, they affect the critical decision—to buy or not buy—or pursue other options for services or information.

Color functions in several powerful dimensions simultaneously on the web:

First, on an aesthetic level, the color combinations and design either create a pleasant visual harmony or a cluttered, chaotic experience.

Second, on a physiological level, color affects the mechanisms of the human eye. Muscles either relax or tense up, pupils expand or contract. The optical effects of visibility and readability are also affected by color.

Third, on a psychological level, color delivers powerful subliminal communication. It either reinforces and enhances the product or service or works against it.

Consequently, the web designer must address the aesthetic, visual/optical, and psychological factors that create a positive impression and a pleasant experience within the parameters of web site design.

This publication presents a pictorial guide to all aspects of color design theory. The definitions and theories are intended to be departure points for successful color compositions and are not intended to be rigid absolutes.

DEFINING COLOR

Introduction

80% of the brain is dedicated to processing visual information. Color and form are the two basic elements in this communication. It is said that form affects the intellect and color affects the emotions. Another difference worth noting is that form refers to a tangible entity. We know that a rectangular shape has sharp edges. If an object is small, we can assume that it is light. Consequently, we can easily describe form with a wide range of precise terms such as geometric, curved, concave, convex, large, small, heavy and light. By contrast, we can't put a color in our hands and feel it, weigh it, smell it or taste it. Color is purely visual.

An accurate definition is:

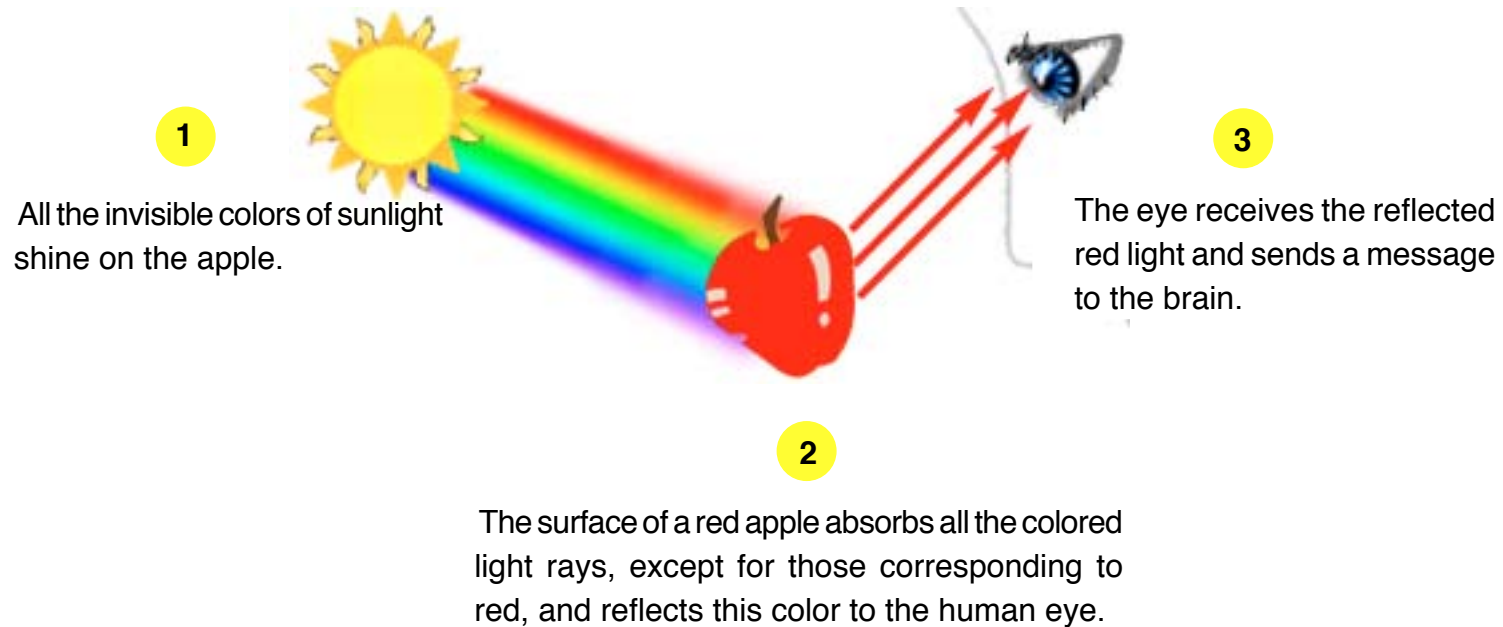
Color is the visual effect that is caused by the spectral composition of the light emitted, transmitted, or reflected by objects.

Fortunately, although color is intangible and perhaps more emotional, the English language does provide us with an adequate vocabulary to describe its properties and related theories. The author has used American English spelling and terminology and recognizes that certain terms may be different in other English speaking countries and that scientists may employ a different color vocabulary. For example, most artists in the United States use the term "saturation." This characteristic is also known as "chroma." When scientists analyze the color of light, saturation and chroma are not the same. Nevertheless, the terms are valid in the fine arts.

In conclusion, a basic understanding of color terminology is the first requirement of color theory. The analysis of color harmony and behavioral characteristics in subsequent parts of this publication will be built upon this foundation.

How We See Color

Color originates in light. Sunlight, as we perceive it, is colorless. In reality, a rainbow is testimony to the fact that all the colors of the spectrum are present in white light. Light goes from the source (the sun) to the object (the apple), and finally to the detector (the eye and brain).



Color Systems

Surface Color



Subtractive Color

An indirect mixture of reflected light

The local color of tangible objects, such as lemons, leaves, fabrics, paint, human skin and hair, results from the light they reflect after their surfaces absorb (or subtract) light rays. The surface of all colored objects consists of organic or chemical pigments. Different pigments possess different sensitivities to light. Consequently, they absorb only some portions of the light and specifically reflect others.

All colors mix to yield black or a dark neutral color. The absence of color is white.

Light



Additive Color

A direct mixture of light

In additive color systems, the eye receives the sum of the light energies, the colored light, that exists in one place. Sunlight is evidence of the purest form of this. Other examples can be found in the projected light that is emitted from a television screen, computer monitors and theatrical lighting.

All colors mix to yield white. The absence of color is black.

The Color Wheel

A color circle, based on red, yellow and blue, is traditional in the field of art. Sir Isaac Newton developed the first circular diagram of colors in 1666. Since then scientists and artists have studied and designed numerous variations of this concept. Differences of opinion about the validity of one format over another continue to provoke debate. In reality, any color circle or color wheel which presents a logically arranged sequence of pure hues has merit.



Primary, Secondary, and Tertiary Colors



PRIMARY COLORS
Red, yellow and blue

In traditional color theory, these are the 3 pigment colors that can not be mixed or formed by any combination of other colors. All other colors are derived from these 3 hues.



SECONDARY COLORS
Green, orange, and purple

Colors formed by mixing the primary colors.



TERTIARY COLORS
Yellow-orange, red-orange, red-purple, blue-purple, blue-green, and yellow-green.

Colors formed by mixing primary and secondary colors.

Primaries and Secondaries - Other Color Systems

Color as Light-Additive Color



Scientists recognize the light primaries of red, green and blue. When combined, red and green light rays produce yellow, blue and green produce cyan, red and blue produce magenta.

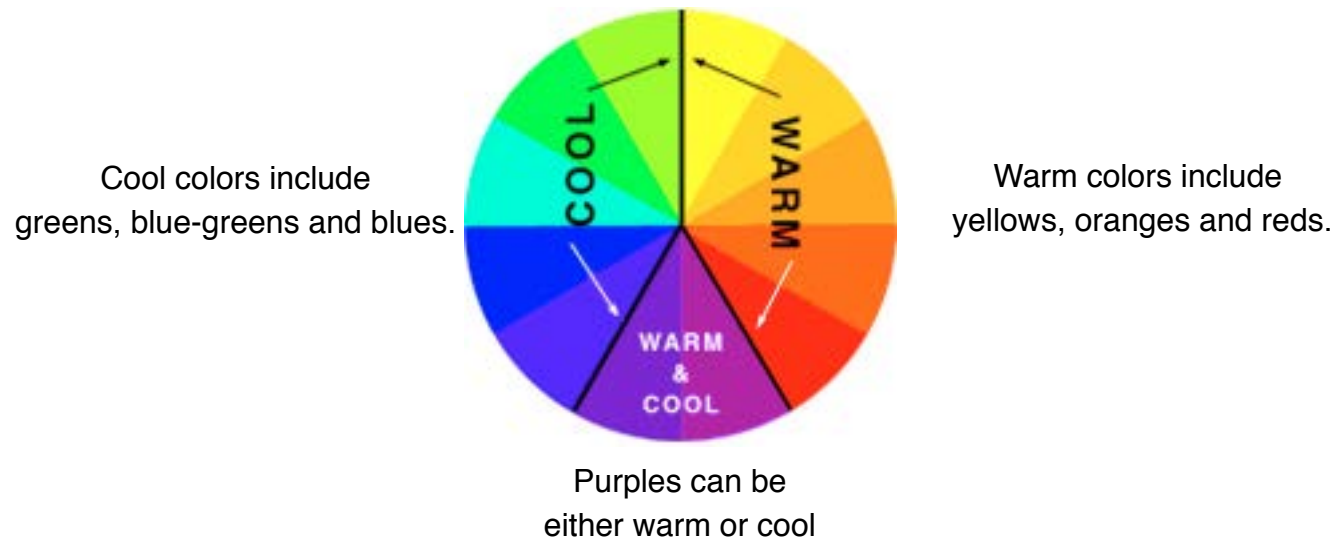
This color model is used in computer monitors, television sets, and theatre.

Print Colors

Printers depend on a different set of primaries: cyan, magenta, and yellow, the secondary colors of the additive system.

Warm and Cool Colors

Colors can be classified as warm or cool.



The blue-purple on the left is a cool purple.



The red-purple on the right is a warm purple.

The central purple can shift to warm or cool

Variations of warm and cool colors

Further temperature distinctions can be made for other colors.



A range of blues, from a warm purple-based blue at the left to a cool green-based blue at the right.

Compare the paint hues, Ultramarine Blue, a warm blue, and Phthalocyanine Blue, a cool blue



A range of reds, from a warm yellow-based red at the left to a cool blue-based red at the right.

Compare the paint hues, Cadmium Red Light, a warm red, and Alizarin Crimson, a cool red.



A range of yellows, from a very warm yellow at the left to a cool yellow at the right.

Compare the paint hues, Cadmium Yellow Medium, a warm yellow, and Cadmium Yellow Light, a cool yellow.

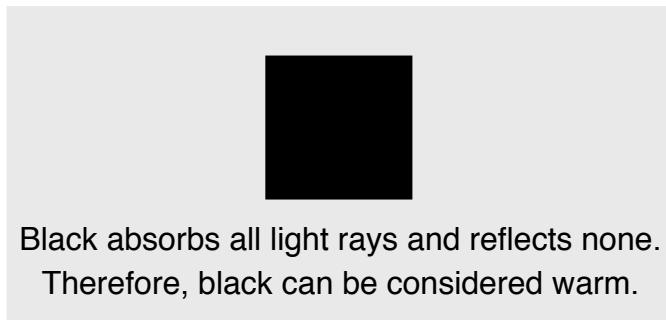
More variations of warm and cool colors

Greys

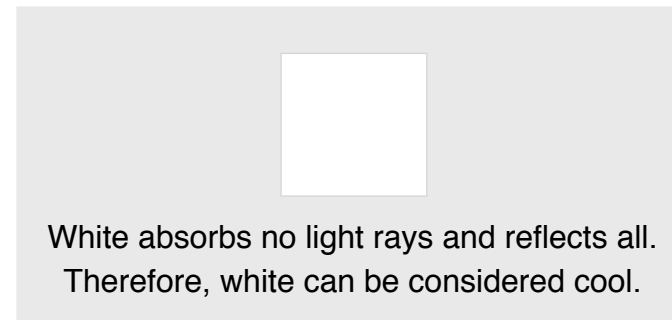


These greys range from warm grey at the left to neutral grey in the middle to cool grey at the right.
The neutral grey is "achromatic" and the warm or cool greys are "chromatic."

Interpretations of Black and White



Black absorbs all light rays and reflects none.
Therefore, black can be considered warm.



White absorbs no light rays and reflects all.
Therefore, white can be considered cool.

*Consider the fact that a black shirt, worn on a hot summer day, absorbs the sun's rays and is warm.
A white shirt reflects the sun's rays and is cool.*

Three Basic Attributes of Color



Hue

The specific color, for example, red or blue.



Value (Brightness)

The degree of lightness or darkness of a color.

The illustration demonstrates the range of blue, from very light to very dark.



Saturation (Chroma or Intensity)

The degree of purity of a color.

The illustration demonstrates the range of red, from pure to very muted.

Value (Brightness)



The degree of lightness and darkness of a color is reflected in the value scales above.

A very light color has a high value; a very dark color, a low value.

The different values in the blue scale at the left match the values in the grey scale at the right.

Comparing Values of Colors

The following pairs of colors illustrate comparative value relationships:



Equal value



Equal value

Seeing the difference between two different colors is more difficult than seeing the difference between a color and neutral grey.



The green is a lighter value than the brown.



The dark green is equal in value to the brown.



The yellow is a lighter value than the red.

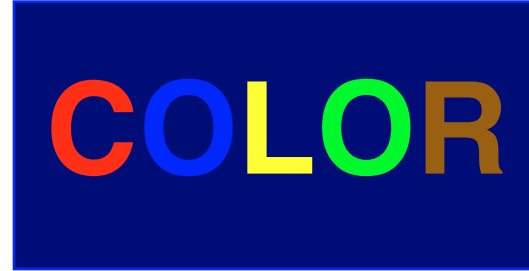
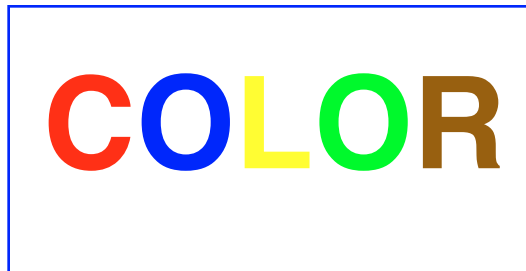


The blue is a darker value than the orange.

Why value matters

Seeing the relative differences in the lightness and darkness of colors is an absolute requirement for successful web site design. Value not only plays a pivotal role in creating color harmonies and spatial effects, but it also determines the readability of text.

These examples demonstrate the relationship of the values of colored forms to the values of two different backgrounds.



The white background creates sufficient contrast for all the colors except for yellow.
The dark background creates sufficient contrast for all the colors except for brown and blue.
View from a distance for the most accurate reading.

Saturation

Saturation defines the degree of purity of a color.

The terms "chroma" and "intensity" also refer to this characteristic.

The higher the proportion of pure chromatic color, the higher the saturation.

The addition of black, white, or another color lowers the saturation.



In each of these examples, the highest saturation is on the left, a lower saturation on the right.

The pure "parent color" is on the left the muted variation is on the right.

Chromatic and Achromatic Colors



Although this greyish color is very low in saturation, it exhibits the presence of some color. It is "chromatic."

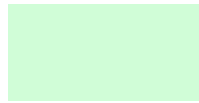


This color is a neutral grey and has no recognizable nuance of color. It is "achromatic."

Tints, Tones, and Shades



Variations of a pure color, such as green, can be defined by several other terms.



TINT

A color mixed with white



STONE

A color mixed with grey



SHADE*

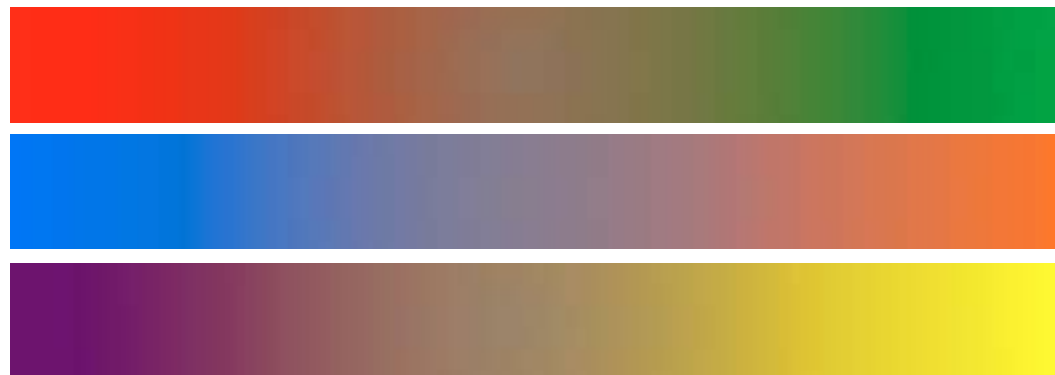
A color mixed with black

Tints, tones and shades are examples of less pure, less saturated colors.

** Sometimes the term "shade" implies any variation of a color. For example, "What shade of red is the color?" could imply "What variation of red is the color?"*

Complementary Colors

Fundamental complementary colors are colors that are opposite each other on the color wheel.
When mixed together they create grey or a neutral hue.



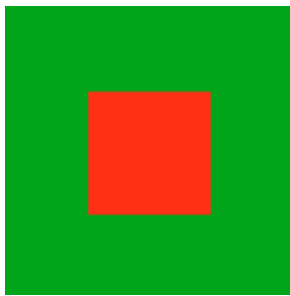
Adding the complement to any color creates a wide range of complex muted hues.

Fundamental Complementary Colors

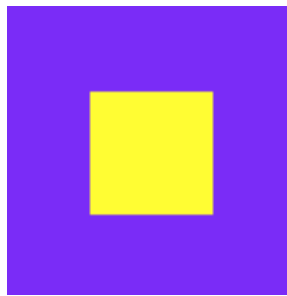
Fundamental complementaries correspond to the subtractive color system which artists use. They are based on visual relationships. In the judgement of the eye, they complete each other.

When complementary hues are adjacent to each other, they create harmonious relationships and incite each other to maximum brilliance. They are like two ends of a balancing scale, holding each other in equilibrium. Lowering their saturation lessens the contrast but maintains the balance.

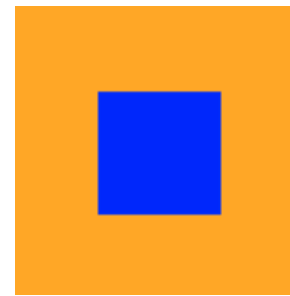
In addition to being harmonious, these primary complementary pairs exhibit other characteristics:



Red and green create a contrast of equal value.



Yellow and purple create a light and dark contrast.



Blue and orange create a warm/cool contrast.

Generative Complementary Colors

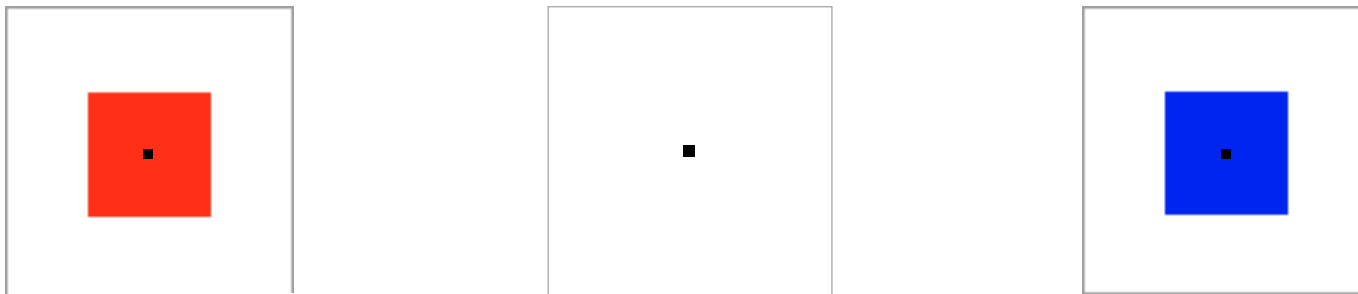
Generative complements correspond to the additive color system which scientists use.

When combined these two colors produce white or grey. Examples of complementary pairs are red and blue-green, yellow and blue. These correspond to the physiological complements generated by the human eye, a phenomenon known as "simultaneous contrast." For any given color, the eye simultaneously requires the complementary color and creates it, even if the color is not physically present.

This phenomenon can be demonstrated by the "after image" tests below.

Begin by looking at the red square at a very close distance. Cup your hands around your eyes to block out any distractions. Keep your focus on the black dot at the center of the red square for 30 seconds. Next, move your eyes to the center of the pure white square. Hold your eyes steady on the black dot.

You will see the "after image" color. Repeat for the blue square.



COLOR HARMONY FORMULAS

HARMONY DEFINED

The challenge of all designers can be summed up in two sentences:

We are faced with an inequality of shapes and colors.

The goal is to achieve balance—not symmetry, but balance.

This balance can also be called "harmony." It exists as a mid-point between monotonous and chaotic design. The human brain will reject what it can not organize, what it can not understand. The brain will also reject under-stimulating information. The visual task requires that we create a sense of order and that we sustain visual interest.

In summary, extreme unity leads to under-stimulation, extreme complexity leads to over-stimulation.

Harmony is a dynamic equilibrium. It implies connections with accents, not jolts.



Harmony can be defined as a pleasing arrangement of parts, whether it be color, music, poetry, or even an ice cream sundae.

Color and Harmonious Design

In all cultures, the aesthetic ideal is a harmonious visual image. Automotive design, perfume packaging, corporate reports and even postage stamps deliver coherent, pleasing visual information that engages us and may even convince us to purchase the product or service. In fact, we see more images in one day than our ancestors saw in a lifetime. Consequently, we subconsciously expect good design and the web designer must be able to deliver it.

All artists and designers—including architects, interior designers and store planners—apply established aesthetic principles to their work. In western culture, these formal concepts are the result of 30,000 years of a linear evolution of visual forms. In the eastern world, the evolution is non-linear and dates back even further. Regardless of the culture, color harmony is the foundation for attractive visual design.

Web sites are subject to the same color design criteria for success. The colors used on the pages' components — the navigation system, banners, buttons, images, and text—must all work well together. Some common attribute must unify them. This could be a particular range of a color, or a range of saturation or lightness of several colors with contrasting accents. Designers must be aware that the sum is greater than the parts.

The task is similar to creating music. When a variety of sounds relate to each other harmoniously, a pleasant auditory experience results. On the other hand, dissonant sounds jolt the ear and monotonous sounds don't engage the listener. If too many colors and too many images are combined without any underlying logic, the visual result is cluttered chaos. On the other hand, if color combinations are bland, the result is boredom.

This section provides a detailed analysis of color harmony for web site design. The formulas are grounded in formal color theory and are adapted for the web.

Harmonies & Non-Harmonies



Chaotic

There are too many colors. Harmony requires a sense of order & balance.



Harmonious

Pure colors & strong value contrasts create a successful dynamic effect



Monotonous

All the colors are muted, all the values are similar. Harmony requires contrast.



Harmonious

Muted and pure colors with close values create a more subdued, subtle harmony.

Harmony Guidelines

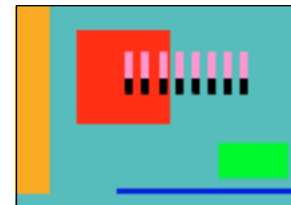
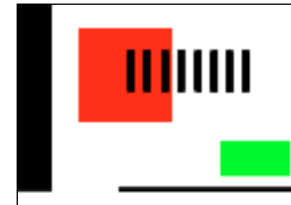
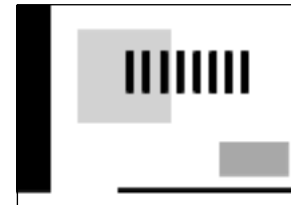
While no color scheme holds universal appeal, some guidelines for success are worth noting:

1. A good color scheme uses only a few colors, properly selected and blended. Use restraint. Most amateur designers make a common mistake: They use too many colors. The mantra for successful color design (and especially for web sites) is "More is less, less is more."
2. A little bit of color goes a long way. Using one variation of a color in only one area is a surprise. Don't repeat every color in the design.
3. Use an established harmonious color chord. A combination of warm and cool colors works best.
4. Experiment with dynamic and subtle color harmonies. Choose the best approach for your design. Dynamic harmonies with strong contrasts are attention-getting and energizing. Subtle harmonies with low contrasts are more fluid and low key. In some instances they are more sophisticated.



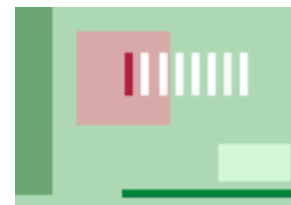
Design Guidelines for Dynamic Color Harmonies

1. Before you select any colors, create a thumbnail of the design in black, white and greys. Analyze the light and dark relationships and plan your areas of strongest value contrasts.
2. Use highly saturated colors and strong value contrasts, such as a very light background and darker shapes. If text is part of your design, readability depends on maximum value contrasts.
3. Stick to established color harmonies and don't overdo it. Most beginners make the mistake of using too many colors. More is less. Less is more. The example at the right is confusing. Similar to bad music, it is "untuned."
4. For innovative color harmonies, find an example of a dynamic color scheme in nature, the fine arts, print media, textiles, or other design sources. Use this as a departure point and resist the temptation to add other colors.



Design Guidelines for Subtle Color Harmonies

1. Before you select any colors, create a thumbnail of the design in black, white and greys. The values of all large shapes and the background should be close. Design easy transitions between them.
2. Select muted colors in a medium to high value range for the large areas. The more colors you use, the closer the values should be. Place these hues in the dominant areas first.
3. Create accents with value contrasts. Small quantities of much darker or lighter colors break the monotony of the close values used on the large forms and create visual interest.
4. Create accents with a pure color. Include a small area of a highly saturated version of at least one of the muted colors. This contrast will enliven the design.



Web Site Design Guidelines for Color Harmonies

Home or Splash Page

Follow the previous design guidelines for harmony. Establish sufficient value contrasts for text.

Linked Pages

1. When pages include a large amount of text, begin by establishing the right background and text colors for readability.
2. Create a thumbnail of the layout and graphics for each page. Begin with black, white and greys.
3. Explore several ways to carry over the thematic color palette from the opening page:
 - Use one or more colors from the palette in the banner.
 - Design a side or top navigation bar which includes one or more colors from the palette.
Experiment with light and dark variations of any of the colors.
If the pages include colorful graphics, side navigation bars should be neutral or very muted.
 - Repeat thematic color(s) in buttons or icons.

Note: Fonts and patterns also create consistency in banners and side bars.

About the harmony illustrations for web design

Graphic components and layouts vary from site to site and within any given web site. For example, e-commerce sites may include a large quantity of graphics; information sites may include only text. Some sites may have a graphic-rich "splash" (welcome) page, others may deliver the content immediately.

Graphic-intense sites benefit from web design components in subdued colors because bright dynamic colors may overpower or compete with the content. On the other hand, sites that contain mostly text benefit from more colorful design components.

This section includes a diverse assortment of harmonious color designs for splash and typical content pages with side or top navigation bars. Since the readability of text is a primary requirement for web site design, white or other light backgrounds can be substituted in any of the illustrations.

RGB and HEX formulas are provided on the page following the web design examples. These formulas are based on the 216 web-safe colors and include safe "hybrid" mixes of these colors.

Note: The scale of some of the web components has been exaggerated for the purpose of sufficiently illustrating the color harmonies.

Monochromatic Color Harmony



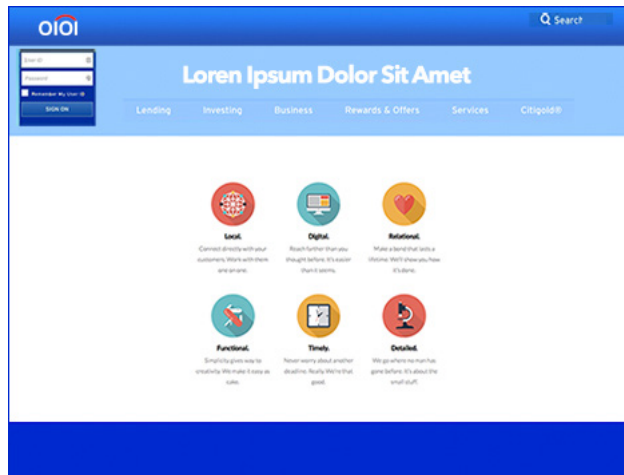
A monochromatic color harmony is based on several shades of one color. Any single color harmonizes with variations of itself (such as dark, light, vivid and muted shades of green). As an example, consider the many shades of green on a tree. The sunlit leaves are one shade of green, the shaded areas are a darker green, and the new leaves may be a lighter shade of green.

Application:

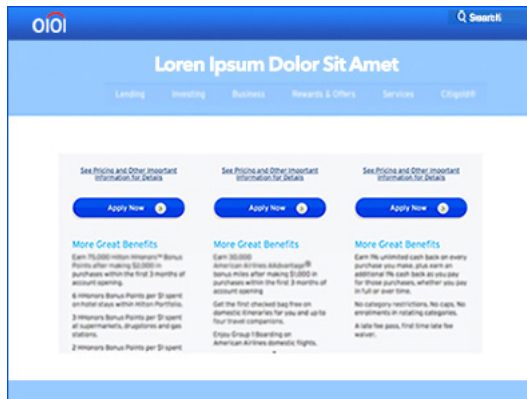
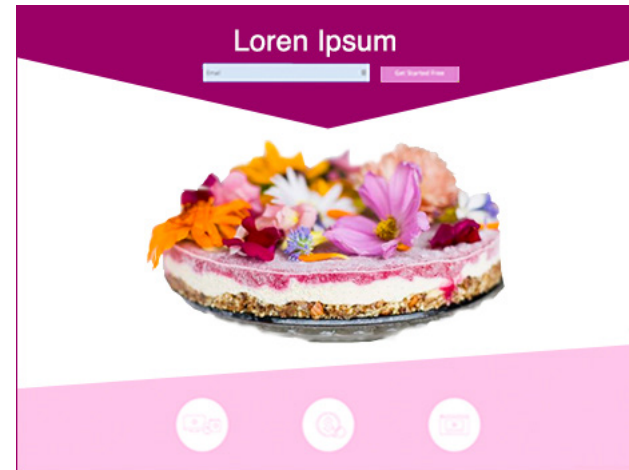
This color combination is appropriate for web sites with colorful content (such as merchandise or any colorful imagery). It is not advised for sites that contain only text as content. Page after page of a monochromatic color scheme is monotonous. As an alternative, individual sections within the site could be based on the same layout with monochromatic variations of a different color.

Monochromatic Harmony - Web Design Examples

#1



#2



HEX & RGB Formulas on the next page

RGB and HEX Codes

Monochromatic Harmony - Web Design Examples

#1

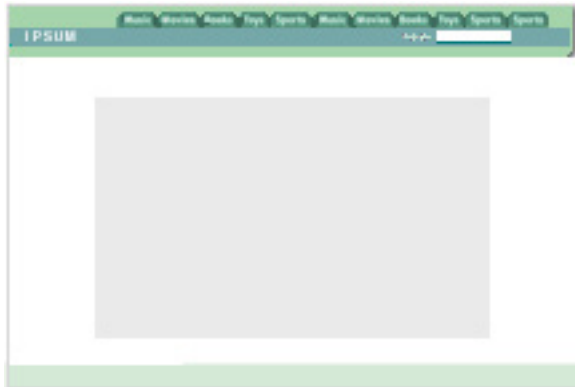
0033CC	99CCFF
R: 000	R: 153
G: 051	G: 204
B: 204	B: 255

#2

990066	FF66CC	FFCCFF
R: 153	R: 255	R: 255
G: 000	G: 102	G: 204
B: 102	B: 204	B: 255

Monochromatic Harmony - Web Design Layouts

#1



#2



#3



#4



HEX & RGB Formulas on the next page

RGB and HEX Codes
Monochromatic Harmony - Web Design Layouts

#1

99CC99	669999	CCE5CC
R: 153	R: 102	R: 204
G: 204	G: 153	G: 229
B: 153	B: 153	B: 204

#2

B2B2CC	7F7F99
R: 178	R: 127
G: 178	G: 127
B: 204	B: 153

#3

3399FF	66CCFF	334CB2
R: 051	R: 102	R: 051
G: 153	G: 204	G: 076
B: 255	B: 255	B: 178

#4

993300	CC9966
R: 153	R: 204
G: 051	G: 153
B: 000	B: 102

Analogous Color Harmony



An analogous color scheme consists of two or three colors that are side by side on a 12-part color wheel. These colors are “color neighbors.”

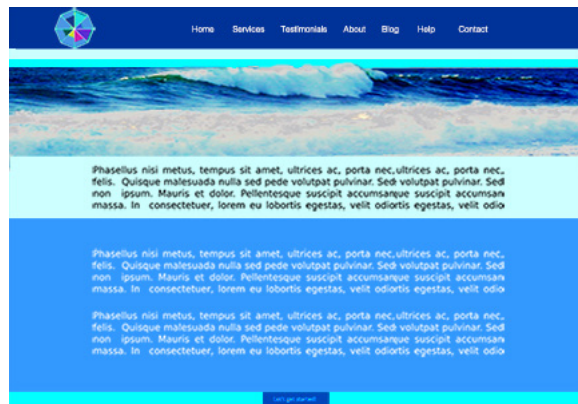
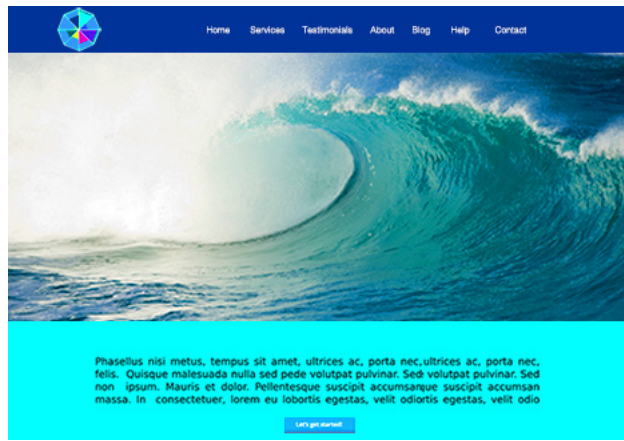
Application:

This palette can be used for a colorful effect on sites that lack graphic content. Muted analogous color combinations are appropriate for sites with colorful graphic content (such as photographs of merchandise or any imagery). Dynamic analogous colors may compete with graphics.

As a rule of thumb, limit the colors to no more than 3 colors that are situated next to each other on a 12-part color wheel.

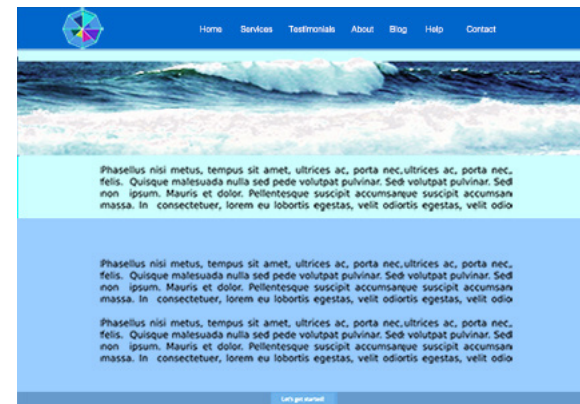
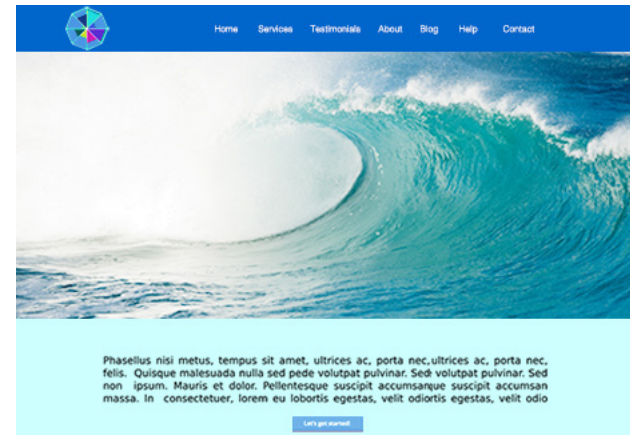
Analogous Harmony - Web Design Examples

#1



Bright blues and blue-green combined with strong value contrasts create a dynamic harmony.

#2



Muted and lighter blues and blue-green with closer value relationships create a subtle harmony.

HEX & RGB Formulas on the next page

HEX and RGB Codes
Analogous Harmony - Web Design Examples

#1

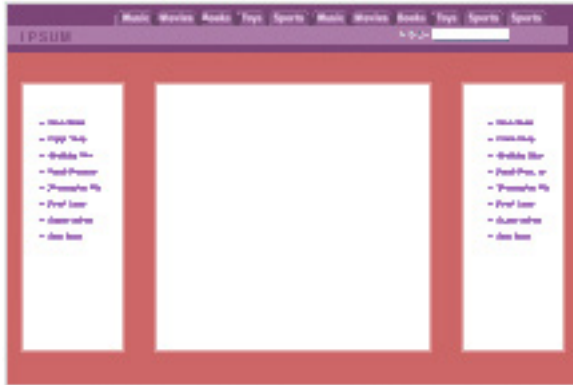
00FFFF	3399FF	003399	CCFFFF
R: 000	R: 051	R: 000	R: 204
G: 255	G: 153	G: 051	G: 255
B: 255	B: 255	B: 153	B: 255

#2

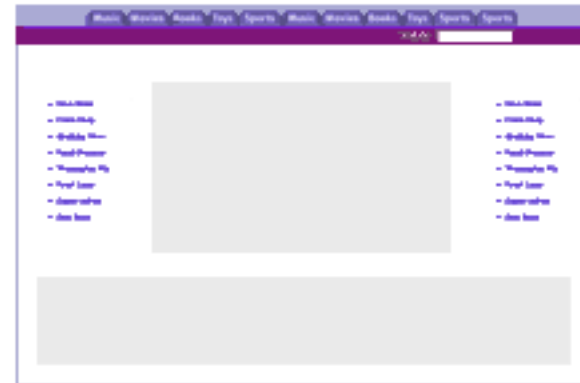
CCFFFF	0066CC	6699CC	99CCFF
R: 204	R: 000	R: 102	R: 153
G: 255	G: 102	G: 153	G: 204
B: 255	B: 204	B: 204	B: 255

Analogous Harmony - Web Design Layouts

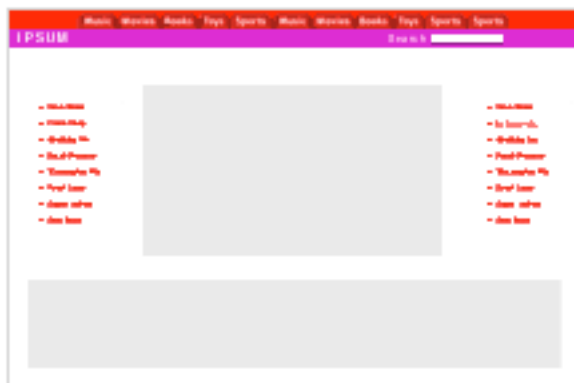
#1



#2



#3



#4



HEX & RGB Formulas on the next page

RGB and HEX Codes
Analogous Harmony - Web Design Layouts

#1

663366	996699	CC6666
R: 102	R: 153	R: 204
G: 051	G: 102	G: 102
B: 102	B: 153	B: 102

#2

9999CC	660066
R: 153	R: 102
G: 153	G: 000
B: 204	B: 102

#3

FF0000	CC00CC
R: 255	R: 204
G: 000	G: 000
B: 000	B: 204

#4

CC994C	993300	FFE5B2
R: 204	R: 153	R: 255
G: 153	G: 051	G: 229
B: 076	B: 000	B: 178

Complementary Color Harmony



A complementary color scheme consists of two colors positioned directly opposite each other on the wheel. This creates a high contrast between the two colors. Opposites attract. In the world of visual design, a color that is a direct opposite of one color makes the other color more dynamic and vice versa.

Application:

This palette can be used for a very colorful effect on sites that lack graphic content. Use muted complementary colors on sites with colorful graphic content (such as photographs of merchandise or any imagery).

Any monochromatic color scheme can be enlivened by adding a contrasting color.

Complementary Harmony - Web Design

#1



Bright yellow-greens and red-purple combined with moderate value contrasts create a dynamic harmony.

#2



Muted purples and yellow combined with moderate value relationships create a subtle harmony.

HEX & RGB Formulas on the next page

HEX and RGB Codes

Complementary Harmony - Web Design Examples

#1

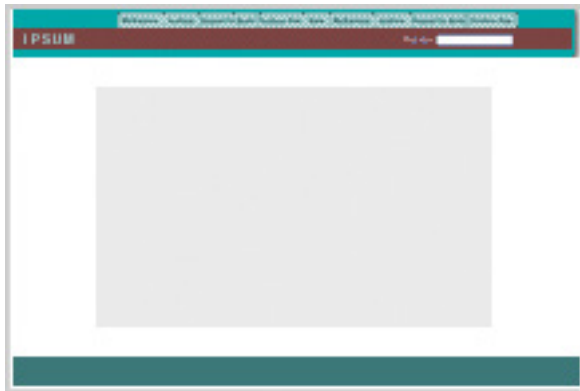
990099	669900	7FE533
R: 153	R: 102	R: 127
G: 000	G: 153	G: 229
B: 153	B: 000	B: 051

#2

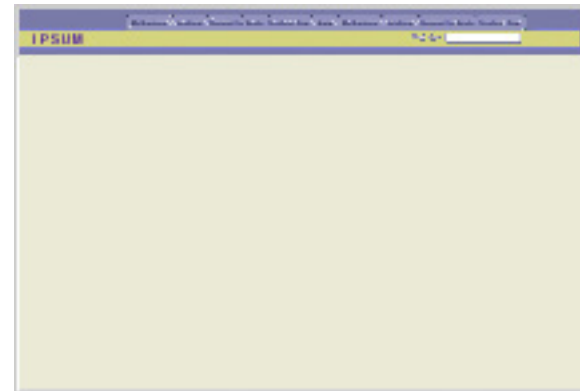
CCCC66	666699	B2B2CC	E5E5FF
R: 204	R: 102	R: 178	R: 229
G: 204	G: 102	G: 178	G: 229
B: 102	B: 153	B: 204	B: 255

Complementary Harmony - Web Design Layouts

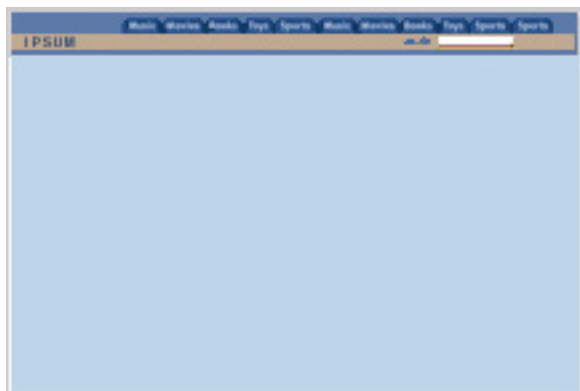
#1



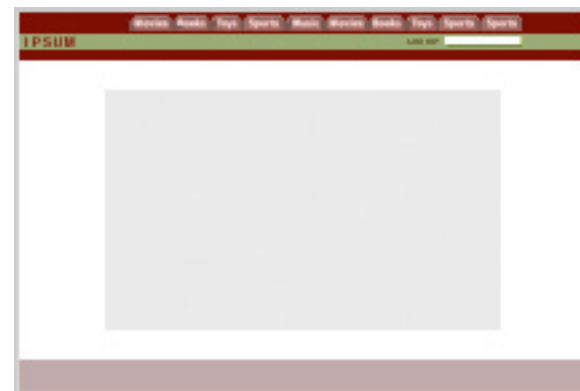
#2



#3



#4



HEX & RGB Formulas on the next page

RGB and HEX Codes
Complementary Harmony - Web Design Layouts

#1

009999	663333	336666
R: 000	R: 102	R: 051
G: 153	G: 051	G: 102
B: 153	B: 051	B: 102

#2

666699	CCCC66	E5E5CC
R: 102	R: 204	R: 229
G: 102	G: 204	G: 229
B: 153	B: 102	B: 204

#3

4C6699	B2997F	B2CCE5
R: 076	R: 178	R: 178
G: 102	G: 153	G: 204
B: 153	B: 127	B: 229

#4

660000	999966	B29999
R: 102	R: 153	R: 178
G: 000	G: 153	G: 153
B: 000	B: 102	B: 153

Complementary Harmony - Web Design Layouts

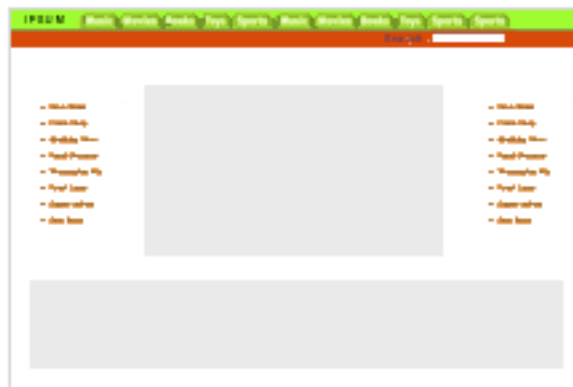
#1



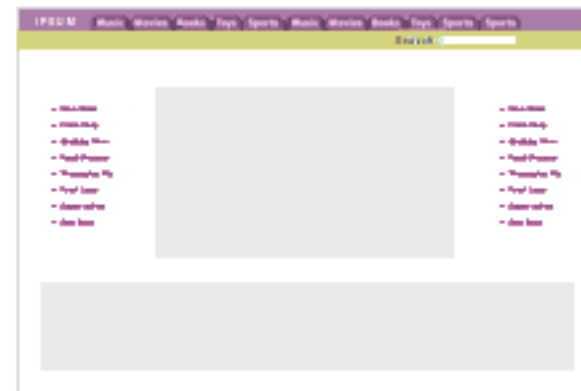
#2



#3



#4



HEX & RGB Formulas on the next page

RGB and HEX Codes
Complementary Harmony - Web Design Layouts

#1

0033FF	000099	FF6600
R: 000	R: 000	R: 255
G: 051	G: 000	G: 102
B: 255	B: 153	B: 000

#2

99CCCC	FF0099	FFE5F2
R: 153	R: 255	R: 255
G: 204	G: 000	G: 229
B: 204	B: 153	B: 242

#3

99FF00	99CC00	CC3300
R: 153	R: 153	R: 204
G: 255	G: 204	G: 051
B: 000	B: 000	B: 000

#4

996699	663366	CCCC66
R: 153	R: 102	R: 204
G: 102	G: 051	G: 204
B: 153	B: 102	B: 102

A Variation of the Complementary Color Harmony

Warm Cool Harmony



A simple formula for a colorful palette is two contrasting colors: one warm color and one cool color. Although it's not as precise a formula as the preceding complementary harmony, it is appropriate for web site design.

Split Complementary Color Harmony



A split-complementary color scheme consists of three colors: one color plus the two colors on either side of its complement, such as purple plus yellow-green and yellow-orange.

Application:

Split complementary colors create very Interesting and unusual color schemes. This palette is appropriate for sites that lack graphic content. It is not suitable for sites with colorful graphic content (such as photographs of merchandise or any imagery).

Split Complementary Harmony - Web Design

#1



#2



Bright blue, yellow-orange and red-orange combined with strong value contrasts create a dynamic harmony.

Muted blue, yellow-orange and red-orange combined with close value relationships create a subtle harmony.

HEX & RGB Formulas on the next page

HEX and RGB Codes
Split Complementary Harmony - Web Design Examples

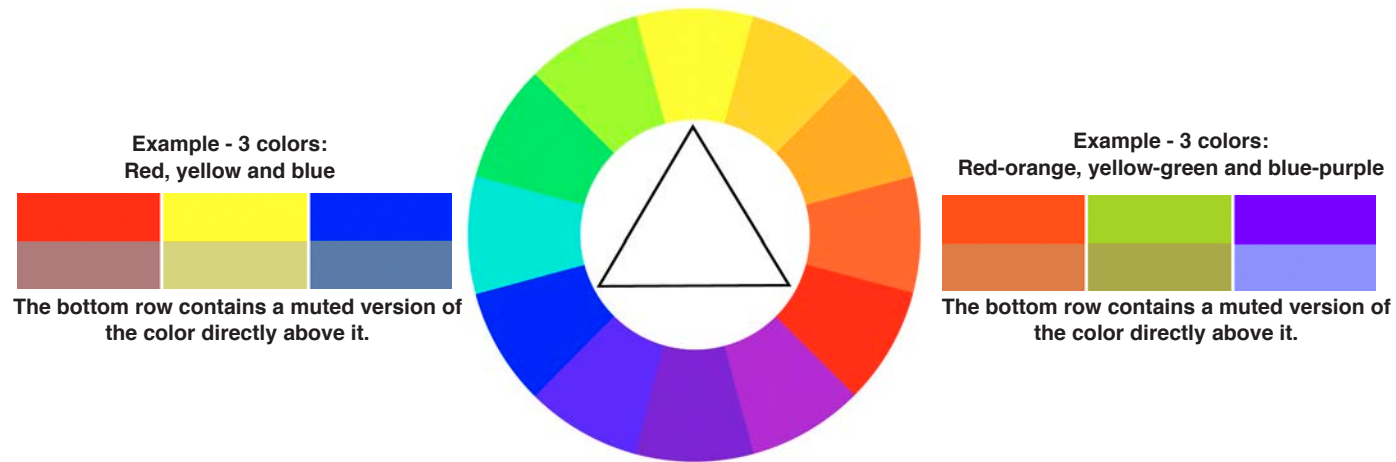
#1

003399	993300	CC6633	FF9900
R: 000 G: 051 B: 153	R: 153 G: 051 B: 000	R: 204 G: 102 B: 051	R: 255 G: 153 B: 000

#2

4C6699	99664C	B27F66	CC9933	E5E5CC
R: 076 G: 102 B: 153	R: 153 G: 102 B: 076	R: 178 G: 127 B: 102	R: 204 G: 153 B: 051	R: 229 G: 229 B: 204

Triad Color Harmony



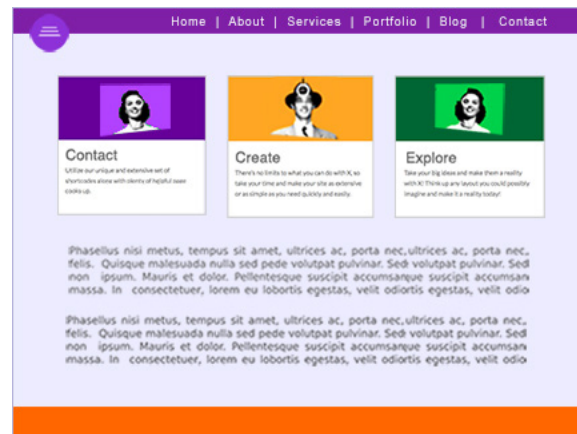
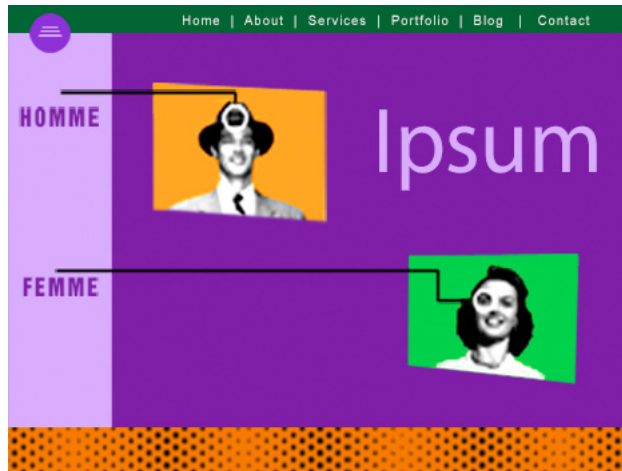
A triad consists of three colors that are equidistant from each other. These colors form an equilateral triangle. This palette creates a very colorful effect, even if the colors are dark or muted. Since this color scheme uses three distinct colors, extra caution is advised to prevent an overwhelming effect.

Application:

This palette is appropriate for sites that lack graphic content. It is not suitable for sites with colorful graphic content (such as photographs of merchandise or any imagery).

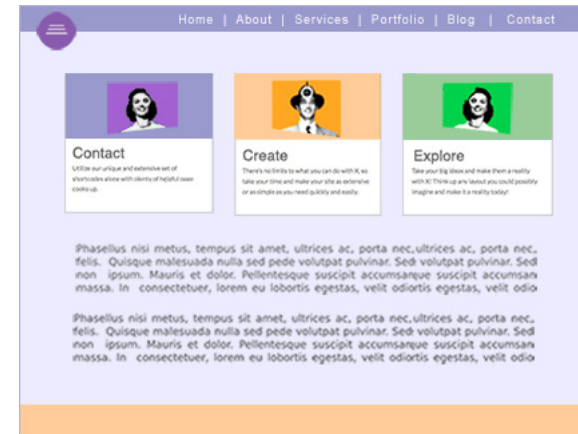
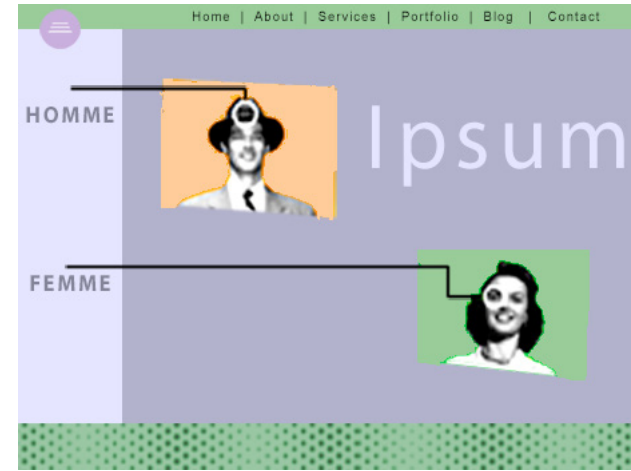
Triad Harmony - Web Design

#1



Bright orange, green and purple combined with strong value contrasts create a dynamic harmony.

#2



Muted orange, green and purple combined with close value relationships create a subtle harmony.

HEX & RGB Formulas on the next page

RGB and HEX Codes
Triad Harmony - Web Design Examples

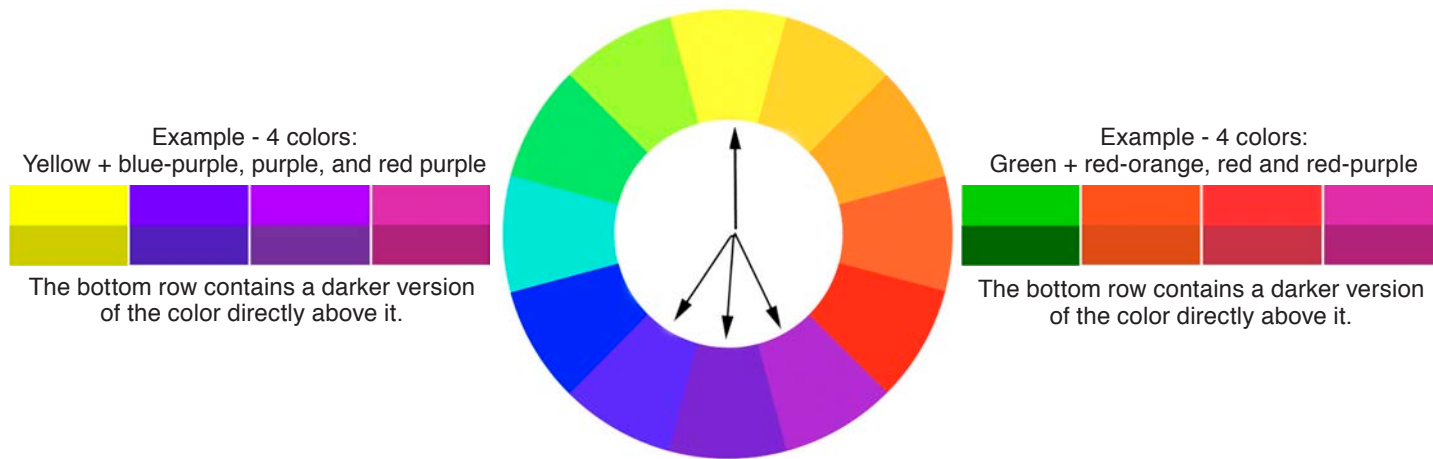
#1

660099	FF6600	006633
R: 102	R: 255	R: 000
G: 000	G: 102	G: 102
B: 153	B: 000	B: 051

#2

FFCC99	99CC99	9999CC
R: 255	R: 153	R: 153
G: 204	G: 204	G: 153
B: 153	B: 153	B: 204

Analogous Plus Complement Color Harmony



This harmony is based on analogous colors and the complement of the central analogous hue. For example: the analogous colors blue-purple, purple, and red purple combined with yellow (the complement of purple).

Application:

This palette is appropriate for sites that lack graphic content. It is not suitable for sites with colorful graphic content (such as photographs of merchandise or any imagery).

Analogous plus Complement Harmony - Web Design

#1



Bright yellows, yellow-orange and purple on a white background create a dynamic harmony.

#2



Muted blues, purples and yellow on a muted purple background create a relatively subtle harmony.

HEX & RGB Formulas on the next page

RGB and HEX Codes
Analogous plus Complement Harmony - Web Design Examples

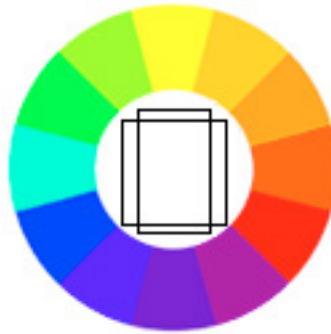
#1

FFFF66	FFCC66	6666FF
R: 255	R: 255	R: 102
G: 255	G: 204	G: 102
B: 102	B: 102	B: 255

#2

7F99B2	4C6699	E5E5FF	CCCC99
R: 127	R: 076	R: 229	R: 204
G: 153	G: 102	G: 229	G: 204
B: 178	B: 153	B: 255	B: 153

Tetrad Color Harmony



Example - 4 colors:
Yellow-green, yellow-orange, blue-purple, and red-purple



The bottom row contains a darker version of the color directly above it.

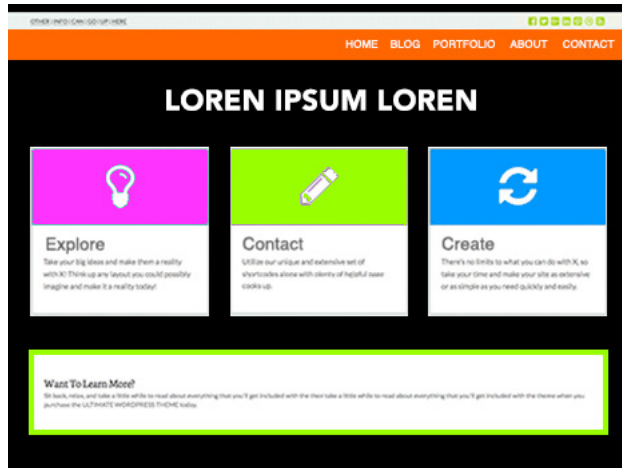
A tetrad is any two pairs of complementary colors whose positions form either a square or a rectangle. For example: red and its complement green plus orange and its complement blue.

Application:

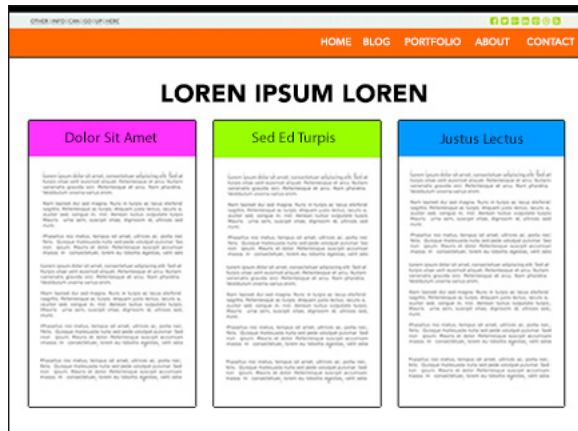
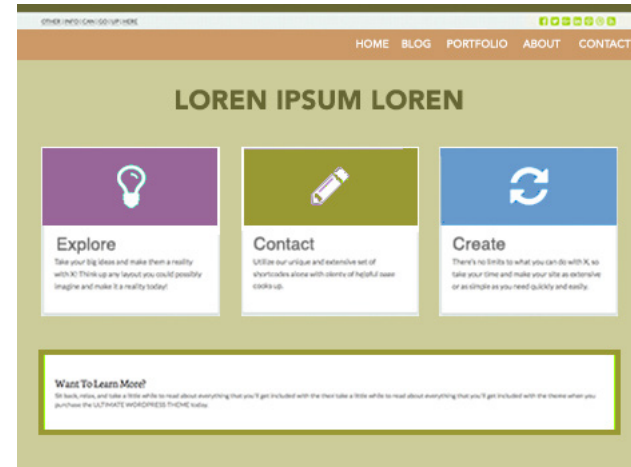
This palette is appropriate for sites that lack graphic content. It is not suitable for sites with colorful graphic content (such as photographs of merchandise or any imagery).

Tetrad Harmony - Web Design

#1



#2



Bright yellow-green, blue, orange, and red-purple on a black or white background create a dynamic harmony.



Muted yellow-green, blue, orange, and red-purple on a light background create a subtle harmony.

HEX & RGB Formulas on the next page

RGB and HEX Codes
Tetrad Harmony - Web Design Examples

#1

99FF00	0099FF	FF6600	FF33FF	333333
R: 153	R: 000	R: 255	R: 255	R: 051
G: 255	G: 153	G: 102	G: 051	G: 051
B: 000	B: 255	B: 000	B: 255	B: 051

#2

999933	6699CC	CC9966	996699	CCCC99
R: 153	R: 102	R: 204	R: 153	R: 204
G: 153	G: 153	G: 153	G: 102	G: 204
B: 051	B: 204	B: 102	B: 153	B: 153

Black and White plus One Color Harmony



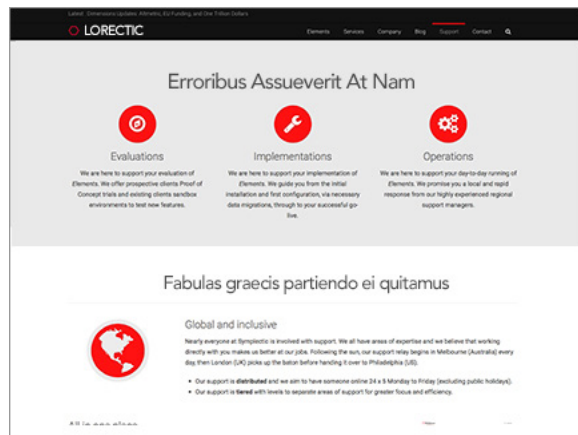
Black and white plus any one color create a harmony. For example: red, white and black.
Grey can also be used in this basic color harmony formula.

Application:

This color combination is appropriate for web sites with colorful content (such as merchandise or any imagery). It is not advised for sites that contain only text as content due to its limited color palette. However, a different color could be used for different sections within the site (as illustrated in the "Web Design Layout" examples).

Black, Grey, and White plus One Color Harmony - Web Design

#1



Black, greys, white, and red
create a dynamic ,harmony.

#2



Black, greys, white and yellow-green
create a dynamic harmony.

HEX & RGB Formulas on the next page

RGB and HEX Codes
Black, Grey, and White plus One Color Harmony - Web Design Examples

#1

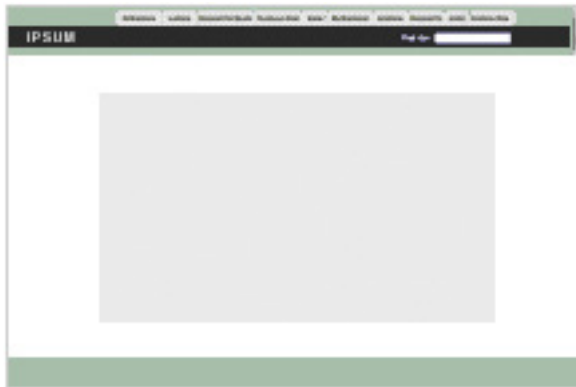
000000	666666	E5E5E5	FF3333
R: 000	R: 102	R: 229	R: 255
G: 000	G: 102	G: 229	G: 051
B: 000	B: 102	B: 229	B: 051

#2

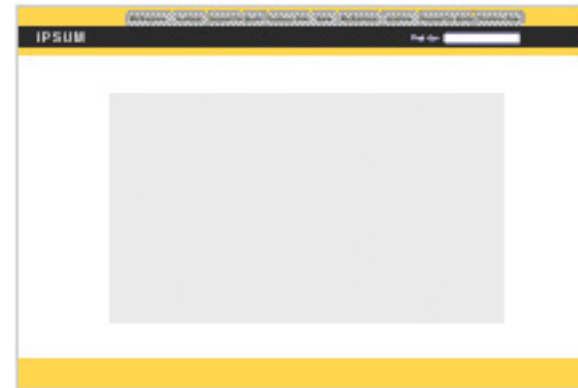
000000	999999	E5E5E5	B2CC33
R: 000	R: 153	R: 229	R: 178
G: 000	G: 153	G: 229	G: 204
B: 000	B: 153	B: 229	B: 051

Black, White and/or Grey + One Color Harmony - Web Design Layouts

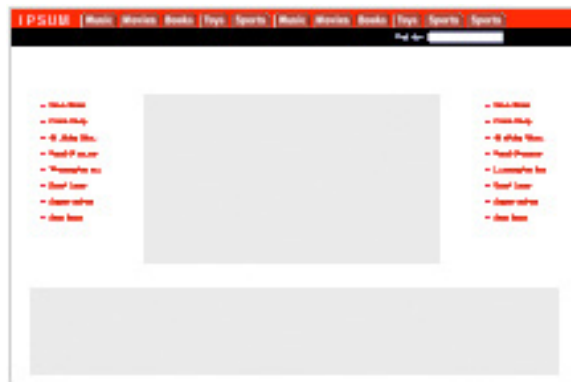
#1



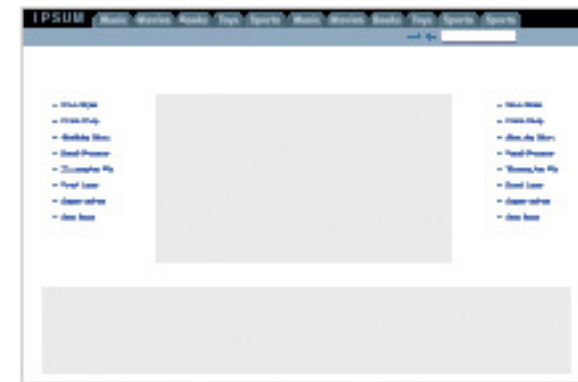
#2



#3



#4



HEX & RGB Formulas on the next page

RGB and HEX Codes
Black, White and/or Grey + One Color Harmony - Web Layouts

#1

000000	99B299
R: 000	R: 153
G: 000	G: 178
B: 000	B: 153

#2

000000	999999	FFCC33
R: 000	R: 153	R: 255
G: 000	G: 153	G: 204
B: 000	B: 153	B: 051

#3

000000	FF0000
R: 000	R: 255
G: 000	G: 000
B: 000	B: 000

#4

000000	7F99B2
R: 000	R: 127
G: 000	G: 153
B: 000	B: 178

COLOR AND HARMONIOUS DESIGN

An Eye for Design

Most people can intuitively determine good and bad color design. Web designers should periodically visit sites that have been around for many years and have gone through a series of make-overs. Analyzing color failures on the web provides invaluable insights and criteria for self-evaluation. Do the colors clash? Are there too many colors? ("I just don't like it" is not an informative answer.) Furthermore, evaluating whether the colors work symbolically with the products or services at the site completes the analysis. Examples of color failures (based on existing web sites) are provided below.

A merchandise site



There are too many colors and a complete absence of harmony. The background color is a poor choice for this type of merchandise and does not provide enough contrast for readability.

A service-oriented site

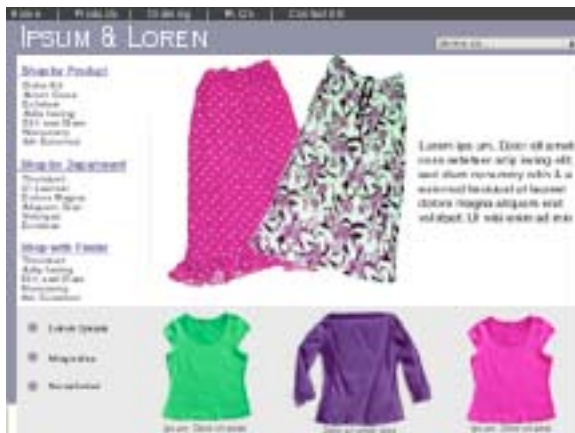


In spite of the superb layout, there are too many colors and some of the colors clash. The avocado green is out of sync with the dominant hues. Adding graphics would create chaos.

Color Harmony and Content

The most effective color palette for the major components of a web page depends upon the site's content. Colorful merchandise requires a neutral non-competitive color scheme for the navigation system, banners, background and text colors. Otherwise, these elements will overpower the products.

Colorful and mildly colorful products require fewer and more muted colors.



A neutral color palette works successfully if the products are colorful. Greyed hues don't compete and don't clash with the merchandise. Black and very dark hues are also successful.



A muted palette (with a restrained use of colors) can be used if the products are somewhat colorful. If the products are all within a specific range of hues, such as wood, the palette can incorporate similar shades and include a contrasting color.

A colorful web palette works successfully for achromatic (black, white, grey) or metallic products.



If the merchandise is relatively neutral, subtle colors enhance the display and add positive associations.



A variation of the standard palette can be used for different sections within the site.

If the site offers a service, appropriate colors will enhance the visitor's experience.

Monotonous and Boring



Employing a color scheme based on only one color (monochromatic) is acceptable if there are graphics, such as photos or maps, throughout the site. If the only content is text, the viewer's Interest will wane as the site is explored.

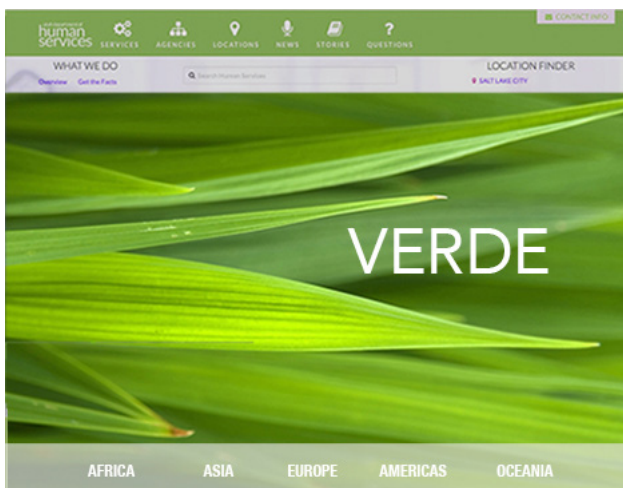
Colorful and Engaging



A combination of appropriate colors is far more interesting and inviting than a monochromatic color scheme. Contrasting colors also separate areas on a page and call attention to key navigational elements.

The Color Palette

Some sites treat the first page as a stunning facade – like a cover on a magazine. In this case, the "home" page is commonly referred to as the "splash" page. Other web sites defer to content and navigational components on the home page. Regardless of the design and content, all pages in the site must relate to each other. A harmonious color palette, or variations of the key palette for the same layout, provides the basis for consistency.



Home page



Site Pages

Merchandise Display

Displays that enhance the presentation of the merchandise encourage purchasing in sales environments in the real world and even more so on a computer screen, since the customer can't touch the actual object.

First of all, web sites must deliver an attractive image of the real item. As a starting point, designers must invest in the best photography. The picture must really be worth a thousand words.

Compare the effects in the illustrations below:



Bad photography and the cluttered background make the product look unattractive.



Good photography and the neutral background make the product look attractive.

About image backgrounds

An image's background significantly contributes to visual communication. For example, a car portrayed against a solid background emphasizes the design of the car. On the other hand, the same car in front of an elegant opera house or on rugged terrain communicates the aura or function of the car. Some products are so nondescript that a background is essential. Other products may benefit by the lure of the context more than anything else. Compare the effects in the images below:



Selling the benefit of the product may indeed be a better selling point. Therefore, designers should investigate contextual relationships. In the final analysis, the size of the image on the web page determines whether pictorial background details are appropriate. Designers may elect to add links to supplementary images as a way to communicate valuable information.

Guidelines for Merchandise Display

Any color or design that distracts from the merchandise discourages purchasing.

The following design examples are the most common errors:

1. Large frames, especially those in bright colors, overpower the merchandise. Frames are most successful when the size and color are appropriate for the image. Compare the effects in the illustrations below:



The frame is too large and too colorful for the product.



The scale and color are appropriate for the product.

2. Placing images on brightly colored backgrounds or patterns overpowers the merchandise.



Bright blue overpowers the colors of the clothing. White, black or an appropriate muted color is a more suitable.



Although the marble background harmonizes with some of the pottery, it competes with the textures and patterns of all the items.

3. The worst error is a combination of an overpowering frame and a colorful background.



Aqua and peach is a beautiful color combination. However, it distracts, competes, and even overwhelms the colorful merchandise.

The example above is based on an existing e-commerce site; other examples abound. The frequency of this error can only be attributed to some web designers' self-indulgent infatuation with color coupled with an unawareness of color design principles.

Presentation

Choosing the right background and frame for merchandise depends on the complexity and shape of the image and the desired effects.

Solid background



Suitable for strong shapes.
Appropriate colors enhance the image.

No background



Suitable for strong shapes.
Creates spaciousness on the page.

Thin frame (1-pt.line)



Suitable for images on complex backgrounds.
The frame contains the design.

Colored frame



Suitable for strong shapes and groups of simple forms.
The scale and color must be appropriate for the image.

Other Color Solutions for Merchandise

Color, when used appropriately, serves as a presentation-level attribute that enhances the attractiveness of a product. In e-commerce, the background color of a web page or the colored frame around the image must support and enhance—not overpower—the merchandise.

Some simple guidelines provide formulas for successful presentation of merchandise.

Bright-colored merchandise



Bright colors overwhelm or compete with colorful merchandise.



Dark colors, grey or white enhance colorful merchandise.

Light-colored merchandise



Dark colors overwhelm light-colored merchandise.



Light muted colors or white enhance light-colored merchandise.

Muted-colored merchandise



Bright colors overwhelm the muted-colored merchandise.



Very muted colors or white enhance the muted-colored merchandise

All merchandise

When in doubt, use white.

Other Considerations

E-commerce designers must make sure that customers know what they're buying. They must anticipate the kinds of questions that a customer might have and include visual and written information as answers. Adding a link to an enlargement or contextual picture provides important information for many kinds of merchandise. Likewise, multiple views should be provided for significant details. "How-to" instructions for functional products are also invaluable.

Furthermore, customers want accurate and useful written information—not just marketing copy. Text must be treated with the same professionalism as the visual elements of the web site. Use of appropriate font styles and layout complete the presentation. A combination of all of these elements creates a successful e-commerce environment.

COLOR DESIGN THEORIES

Area and Quantity

Different effects occur when colors occupy different areas in a composition. When a specific color is placed in one area, its behavior is relative to the surrounding colors and forms. Changing its location changes the effects. As a rule, any configuration of colors will strive toward contrast or assimilation. Colors will cluster by their mutual characteristics. Those with similar values, saturations and temperatures will group together. Colors will oppose one another as clusters in spite of their actual location in space.

The quantity of the color also creates different effects. The design principle of emphasis and subordination are at work in all arrangements of colors and forms.

Note: Since a web page is not a static fixed space, these principles may only apply to pages intended to fill the screen, such as a home page, or to individual graphics or combinations of graphic elements in close proximity.

Area Distribution

The area a color occupies will alter the effects of a design. These examples are based on the same composition and the same four colors. Only the placement of the color changes.

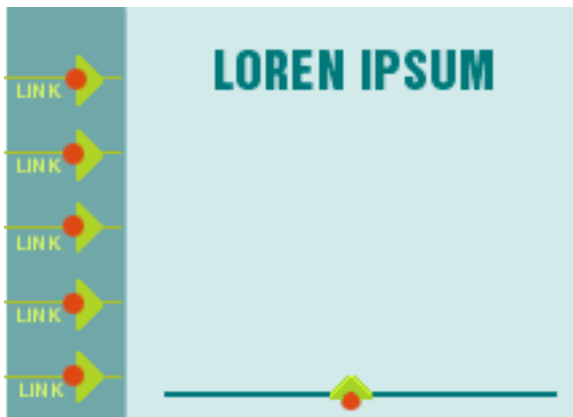


Notice how similar values cluster and how different forms become dominant.

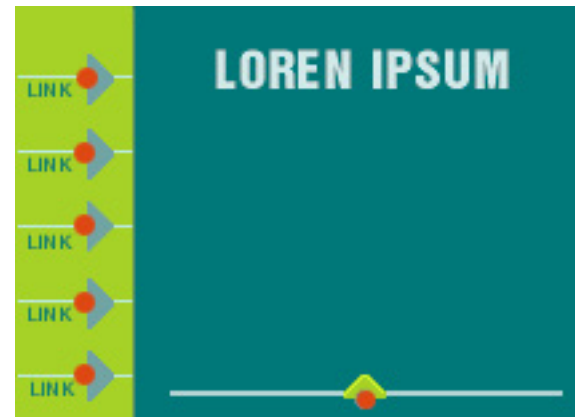
Area Distribution - Web Design

The same five colors are used in different areas on each web page layout. Varying degrees of success and failure are evident. For example, in #3 in the bottom row, the large red-orange area is a bad background for text content. Compare this with #1 in the top row.

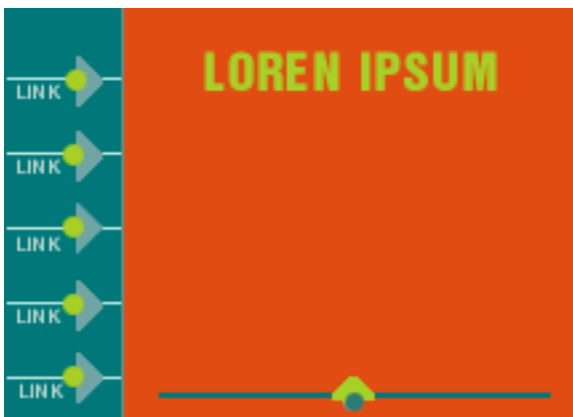
#1



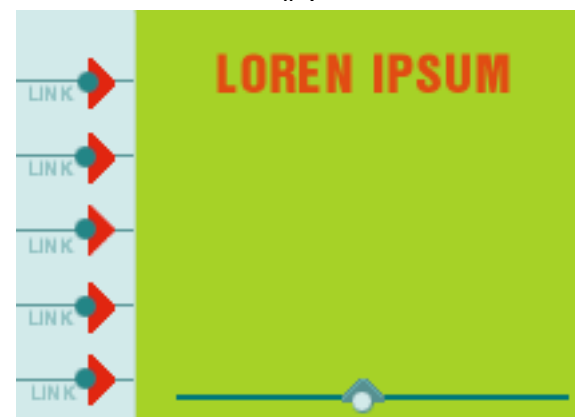
#2



#3



#4



Concentration or Dispersion

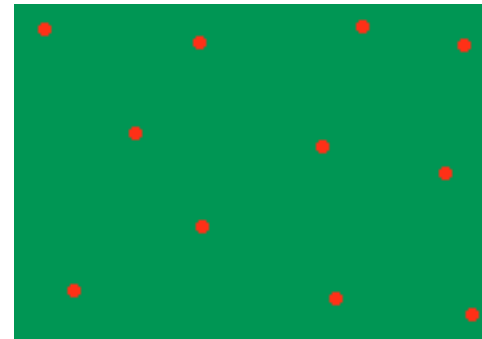
The quantity and placement of a color is influential. If a color is concentrated in one main area, the effect is quite different from being dispersed throughout the composition.

Concentration - Red



The red form is a powerful focal point. Red and its complement, green, occupy almost equal areas in the composition. The total effect is a dynamic equilibrium.

Dispersion - Red



Red is scattered in small quantities throughout the design. In this example, red is still dynamic, although it is no longer the focus.

Concentration or Dispersion - Web Design

Concentration - Red



Red is used as a background on this example of a home page. The heavy concentration of red reinforces its symbolism—in this case, good luck (in China) and dynamic energy.

Dispersion - Red



Red is used in smaller quantities on the menu bar at the top and the horizontal bars on the page. It successfully conveys the thematic symbolism and site identity from the home page at the left.

Note: Large quantities of bright intense colors should be avoided on content pages where readability is critical.

Concentration or Dispersion - Web Design

Concentration - Orange



Orange is used in only one area — on the button for the critical task of booking a tour. Since the color is concentrated in only this location, it pulls the button apart from the rest of the page's components.

Dispersion - Orange



Orange is used in several areas on the web page. Since the color is dispersed, it no longer functions as a singular focal point. In this example, it functions as part of the triad harmony on the web page.

ADVANCED COLOR DESIGN THEORY

COLOR INTERACTION

INTRODUCTION

When we experience color, it is always relative to its context. With the exception of the sky, the only unbounded form in our environment, color is part of a form which exist in a spatial arrangement of other colored forms, each with its own specific characteristics.

These theories are more significant for general design purposes. However, an understanding of color interaction will help the web designer stabilize color selections and resolve unexpected color mutations. On the other hand, these color shifts may be desirable and can be used to an advantage in web design.

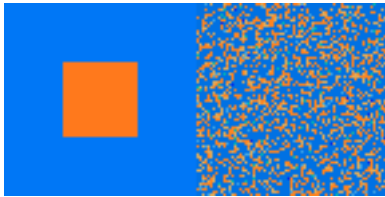


The relativity of color can be demonstrated by observing the effects colors have on each other. The relationship of values, saturations and the warmth or coolness of respective hues can cause noticeable differences in our perception of color.

During the past 150 years, several notable color theorists have studied these effects. This section includes information about the findings of Michel Chevreul, Wilhelm von Bezold, Josef Albers and Johannes Itten.

Chevreul's Theories

Chevreul (1786-1889), a chemist and director of a dye house in Paris, left a lasting impact on color theory. The following explains his principles of the visual effects of color:



1. Highly contrasting colors, used in sufficient quantities, will not change their optical hue and will make each other appear more brilliant. When present in small quantities, they will blend and create a duller new color. View this example at a distance to see the effect.



2. If colors are a little farther apart, not analogous and not complementary, one color will give the adjacent color a complementary tinge. In the example above, yellow next to a green gives the green a violet tinge.

**This is a frequent cause of color mutations in web site design.*



3. Colors adjacent to each other on the wheel tend to blend into each other and optically mix to create a new color. View these examples at a distance to see the effect. Chevreul also noted that analogous color schemes work best when the key hue is a primary.

The Bezold Effect

Wilhelm von Bezold, a nineteenth-century rug designer, found that changing only one color in a design alters its entire appearance.

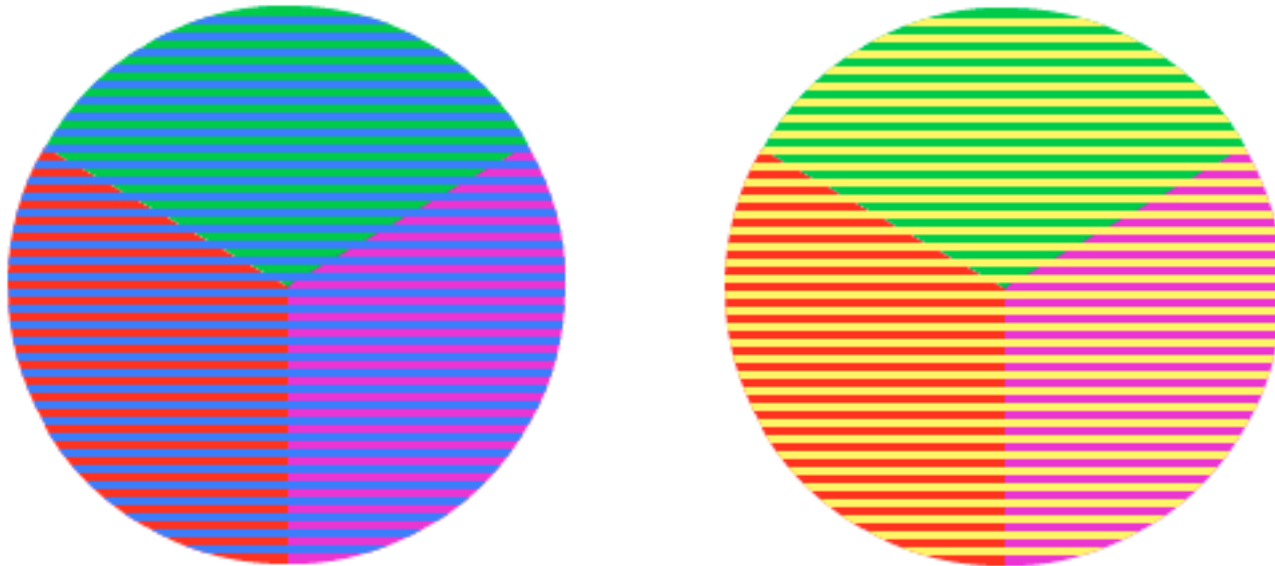


The dominant background color is changed from bright yellow to black. All other colors remain the same. As a result, different colors, forms and patterns become more or less predominant in each composition.

** Web designers can use the Bezold Effect to create a wider variety of design effects from one pattern and fewer colors.*

Bezold and Chevreul

In these "Bezold Effect" examples, the three colored areas on each circular form remain the same. Only the color of the stripes changes from blue at the left to yellow on the right. Chevreul's theories explain these color effects.



View these from near and far.

Albers and Color Metamorphosis

The color theorist Josef Albers (1888-1976), a member of the Bauhaus school of art and industrial design, focused on the interaction and relativity of color. These studies were documented in his book, *Interaction of Color*.

The examples on the following pages demonstrate how the same color will evoke different readings of its perceived hue, a metamorphosis which is caused by its surroundings. Individual perceptions may vary.

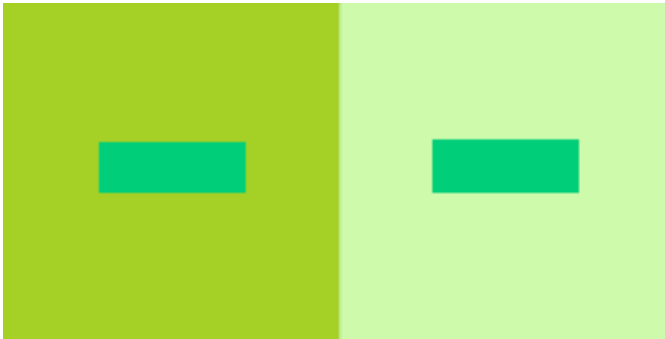
Similar color contextual mutations can be created with colored paper such as "Color-aid" or in graphic software such as Adobe Photoshop®.



About the "Color Metamorphosis" illustrations on the next four pages

1. All the colors used in the color mutations are derived from the 216 color "web-safe" palette.
2. RGB values for these hues are supplied as reference.
3. Printing these pages may result in different color readings.
4. The examples should be viewed on a system with full gamma correction.

Different readings of the same color
3 colors look like 4



The small green rectangle on the left appears to have a slight bluish tinge when compared to the green on the right.

RGB Values:

Left: R: 153 G: 204 B: 000

Right: R: 204 G: 255 B: 153

Center: R: 051 G: 204 B: 102



The small grey rectangle on the left appears to have a yellow tinge when compared to the grey on the right.

RGB Values:

Left: R: 051 G: 153 B: 205

Right: R: 000 G: 102 B: 102

Center: R: 102 G: 153 B: 153



PROOF: Block out the middle portion to see the same effects as the larger examples.

Different readings of the same color
3 colors look like 4



The small purple rectangle on the left appears to have a red-purple tinge when compared to the purple on the right.

RGB Values:

Left: R: 102 G: 102 B: 204

Right: R: 153 G: 051 B: 153

Center: R: 153 G: 102 B: 204



These mutations can be explained by the "Vampire Effect." The small purple rectangle is a combination of blue and red. The large blue-purple square at the left sucks the blueness out of the purple and leaves behind a red-purple. The large red-purple square at the right sucks the red out of the purple and leaves behind a blue-purple.

Different readings of the same color 3 colors look like 2



This color mutation is also known as a "reverse ground" effect. The mutating color on one side of the diagonal line almost matches the background of the square on the opposite side. The "Vampire Effect" applies to these color shifts.

RGB Values:

Left: R: 051 G: 204 B: 255
Right: R: 000 G: 255 B: 204
Center: R: 102 G: 153 B: 153

RGB Values:

Left: R: 153 G: 051 B: 255
Right: R: 102 G: 102 B: 255
Center: R: 102 G: 051 B: 255

Itten and Color Contrasts

Johannes Itten (1889-1967), another member of the Bauhaus, developed theories about color contrasts. In his book, *The Elements of Color*, he documents several kinds of color contrasts: hue, value, saturation, warm and cool, complementary, simultaneous and quantity.

Compare the contrast effects of different color backgrounds for the same red square.



Red appears more brilliant against a black background and somewhat duller against the white background. In contrast with orange, the red appears lifeless; in contrast with its generative complement, blue-green, it exhibits brilliance. Notice that the red square appears larger on black than on other background colors.

THE VISUAL AND PERCEPTUAL EFFECTS OF COLOR

About the Visual and Perceptual Effects of Color

Retailers know that a product has one-twentieth of a second to halt the customer's attention on a shelf or display. Furthermore, tests indicate that a black and white image may sustain interest for less than two-thirds of a second, whereas a colored image may hold the attention for two seconds or more.

These effects are the result of the science of color and visual perception. An understanding of these areas and how they define the behavioral characteristics of color gives the designer control over the focal point as well as successful composition.

About Color Movement

Color, although two-dimensional in character, actually moves in space as if it were a three-dimensional form. It advances, it recedes, it vibrates, it collapses inward or bulges outward. Color instantly gets attention—and it can be used to draw attention to the most important features of a web page.

These behavioral characteristics are the result of a complex relationship between colors, the shape of forms, the placement and the dominant axes of the forms.

These concepts can be applied to the web site design as a whole, as well as separate graphic elements such as banners, buttons, photographs, and drawings. They can also be used to orchestrate ideal and normal sequences of visual actions on a web page.

The Science of Color Movement

Optics - the physiological basis for the movement of color



1. Red focuses behind the retina. Therefore, the lens grows more convex to pull it forward.
We perceive that red areas are closer (advancing) and larger.
2. Blue is sharply refracted. This causes the lens to flatten out and pushes the blue image back.
We perceive that blue areas are moving backwards (receding) and smaller.

Tangency - the physical basis for the movement of color



Any form that overlaps another form is perceived to be in front of that form.

Other Factors

Color's behavioral characteristics relate to the size of the area it occupies and its placement.

Size



Large areas attract more attention
than small areas.

*Note: The only exception to these theories of color movement is animation.
Motion attracts attention first, regardless of the color characteristics.*

Examples of the Color Movement

When colors are isolated by grey, the following characteristics of movement can be defined.



Yellow is the most visible and illuminating of all colors.
It appears to be radiating from within. It moves outward and is difficult to contain.



Red is aggressive.
Simultaneously it vibrates within the area it occupies and advances.



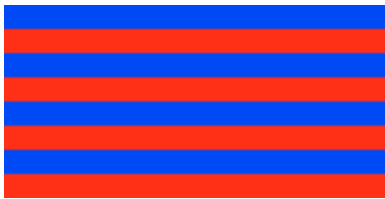
Blue is relatively stable and moves inward.



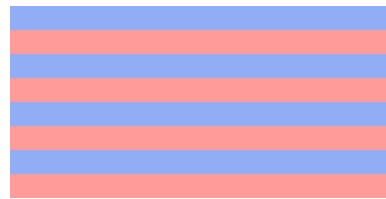
Green is tranquil and rotates towards the center.

Comparative Movement of Colors

When colors exist in equal relationships with other colors, the following characteristics apply:



Warm colors advance.
Cool colors recede.



Warm colors advance,
as long as the values are
close.



The color with the lighter
values advances. Darker
value recedes.



The color with the highest
saturation advances.
Lower saturation recedes.



The color with the highest
saturation advances, even if
it is a cool blue.



The area of the highest
contrast advances while
other areas recede.

Comparative Movement of Colors - Web Design

The previous principles are applied to a series of web site buttons.
The same effects will be noticed in any close grouping of images.



Warm colors advance.
Cool colors recede.



Warm colors advance, even
when values are changed, as
long as the values are close.



Lighter values advance.
Darker values recede.



The color with the highest
saturation advances.
Lower saturation recedes.



The color with the highest
saturation advances, even if
it is a cool hue (blue).



The area with the highest
contrast (black and yellow)
advances.

Movement and Shape - Angular and Curved Forms

All shapes advance.

Two-dimensional designs consist of a "figure-ground" relationship. Shapes are the figuration, the negative space or background is the ground.

Angular (geometric) forms advance the most and curved (organic) forms the least.



In spite of the fact that the background color is a very saturated warm hue and the foreground shapes are cool, a figure-ground relationship exists. Therefore, all forms advance, regardless of the colors involved. Varying degrees of ambiguity may occur when curved shapes are warm and bright and angular shapes are cool and less saturated.

Movement and Shape - Concave and Convex Forms

Concave and convex shapes embody specific characteristics of movement.



Concave shapes are passive and move inward.



Convex shapes are aggressive and push outward.



Concave/convex shapes combine these forces.

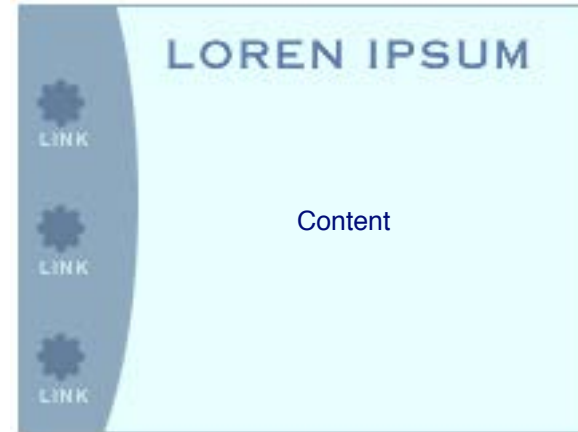


When the forms are muted blue and the background bright orange, the effects persist.

Color and Shape - Web Design



The concave shape of the navigation bar on the left is perceived as moving inward and yielding to the convexity of the lighter content area. The darker concave icons on top of the bar demonstrate similar characteristics.



The convex shape of the navigation bar on the left pushes outward and is more aggressive than the example on the left. It appears to overlap the concave content area. The darker convex icons on top of the bar demonstrate similar characteristics.

Movement and the Illusion of Transparency

The illusion of transparency can be created by a third color derived from the two basic colors. The intersecting area communicates information about the spatial positioning of the two colors.



1.

Yellow is in front of blue.



2.

Yellow is in front of blue and closer to it than it appears in the first example.



3.

Yellow and blue are on the same spatial plane.

Transparency and Web Design

Transparent effects can be used to create spatial illusions and to add visual interest to web designs.



Movement and the Placement of Color

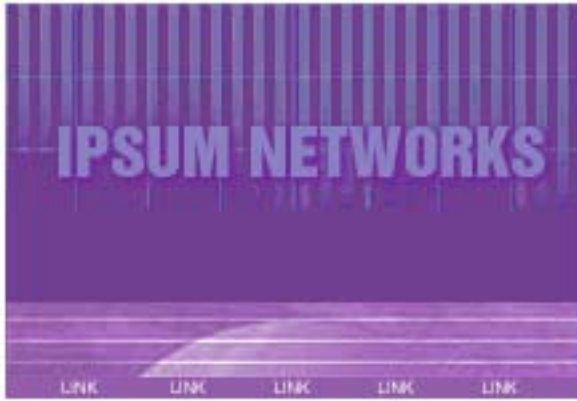
The lower portion of a composition is perceived as "figure" or shape, while the upper portion is read as "ground" or background. The color which occupies the lower portion of a composition usually advances.

This effect stems from our visual experiences of the natural landscape. The receding sky exists in the upper area of our field of vision, land and advancing forms are low.

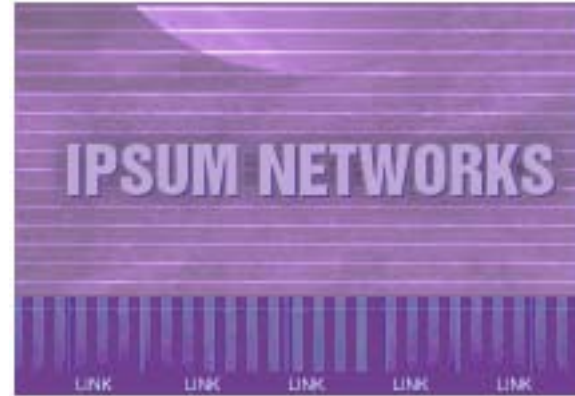


Warm and cool colors with equivalent values and saturation demonstrate this effect.
Some ambiguity appears in the example on the right.

Placement of Color - Web Design



The darker purple area at the top is perceived as a recessive background and the lighter purple area at the bottom, as an advancing foreground. Values and saturation also influence this effect — the darker colors at the top are recessive, the more saturated lighter colors at the bottom are advancing.

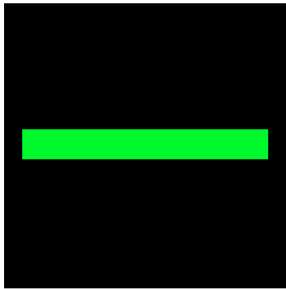


The lighter purple area at the top is perceived as a recessive background and the darker purple area at the bottom, as an advancing foreground. Since values and saturation do not influence this effect, the importance of color placement is more evident. The atmospheric quality of the top design does play a role.

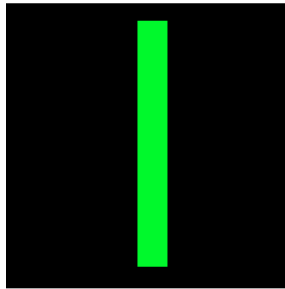
Note: Aside from the use of frames, this full-page effect of color placement would only be perceived on a home page on monitors with dimensions equal to those of the actual design. This effect can be used in smaller graphic designs on a page.

Movement and Axes

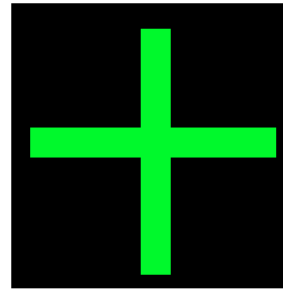
The primary axis of a form plays a role in its movement in space.



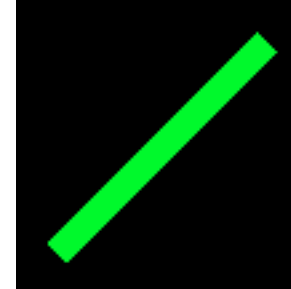
A horizontal axis is stable.



A vertical axis contains potential for movement.



The combination of horizontal & vertical is the most stable.



A diagonal axis is the most dynamic.

Applying highly saturated warm hues to horizontal forms and cool muted hues to angular shapes may create varying degrees of ambiguous effects.

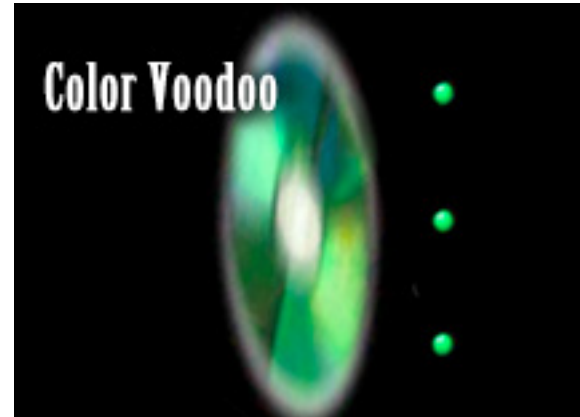
Note: This effect applies to graphics, photographs, and other imagery.

Movement and Axes - Web Design

This effect applies to pages that are intended to fill the screen, such as a splash page.



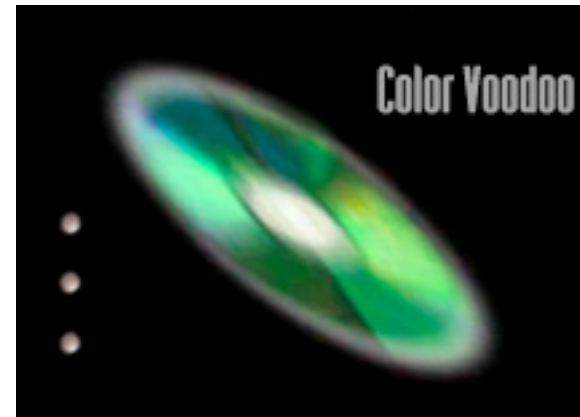
Horizontal



Vertical



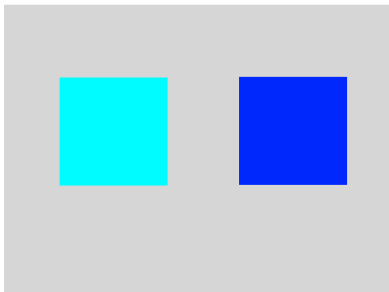
A combination of horizontal and vertical



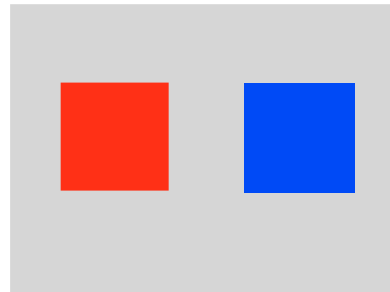
Diagonal

Movement - Color and Weight

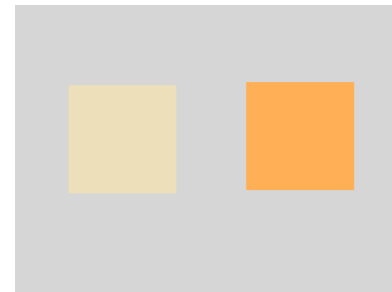
Colors possess qualities of heaviness or lightness relative to other forms and the placement of those forms in a composition. Heaviness descends. Lightness stays fixed or ascends.



Dark colors are heavier than lighter colors.



If hues are the same intensity and value, warm will be heavier.



Light, less saturated colors are less dense.

Note: This effect usually applies to graphic compositions..

Color and Weight - Web Design

A web page is not a static fixed space. However the effect of the weight of colors applies to pages that are intended to fill the screen, such as the home page. It also applies to self-contained graphics.



The dark horizontal navigation bar and patterned design at the bottom are too weighty in comparison to the other areas on the page. The relationships are not successful.



The dark horizontal bar at the top creates a balanced relationship with the medium-dark patterned design at the bottom. Placing weightier colored areas at the top holds other dark areas in equilibrium.

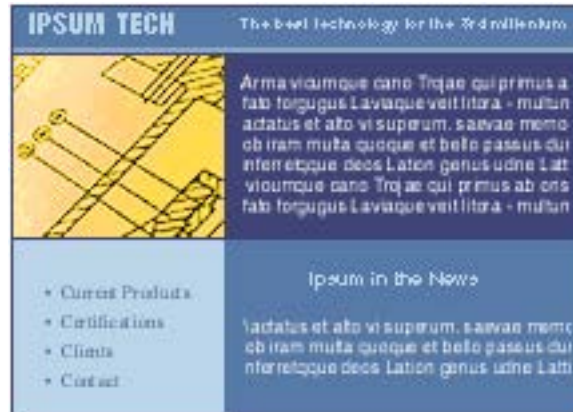
Movement - Time and Space

Color creates reactions which affect our perception of time in visual space.
Bright hues stop the eye and isolate themselves from the surroundings.



Yellow radiates within the space it occupies and attracts attention, especially against a dark background. Red is the most powerful. A light desaturated blue is the most passive.

Time and Space - Web Design



The eye is drawn to the bright yellow-orange area first. Next, it proceeds to the darker blue area at the right and later to the areas below. The effects are both spatial and temporal.

Perceptual Effects of Surface and Texture

These characteristics of the surface of a tangible object are influential. Shiny and smooth surfaces reflect more light and appear lighter. Dull and textured surfaces diffuse light and appear darker. Opacity and transparency also create different effects.



The experience of the surface effects of the color of an object in the physical world can only be created by illusion in paint, print, and web design.

Surface and Texture - Web Design

Texture and other surface effects can add a powerful dimension to graphic elements. Banners can become more professional and visually engaging. Also, a change of texture between buttons and the background can be extremely dynamic. In some situations, surface changes may be just as successful as a color change.



A combination of a textured design and a plain background based on the same color

A word of caution: Don't overdo it. Choose only one surface characteristic for buttons and banners. If some buttons have rough stone-like surfaces and other buttons a reflective watery surface, the effect will be chaotic. The same applies to the relationship between banners and buttons. Be consistent.

COLOR AND FUNCTIONAL DESIGN

Introduction

The previous chapters covered the ways that color functions in several powerful dimensions. Color harmony affects the aesthetic experience of a web site and the perceptual characteristics of movement and color relationships create a visual effect. This happens simultaneously. This chapter combines these key areas and explains how they apply to the functional aspects of web site design.

About Functional Design

Once inside a web site, the visitor must be able to move comfortably through the space, explore the content, and find what they need.

Using a retail store as an example, if a customer enters a store and finds a disarray of merchandise, a maze of confusing signs, narrow aisles and crowded conditions, he or she will turn around and walk out.

People will abandon an electronic space for the very same reasons. Visual clutter, a poorly designed layout, and obscure navigation create the same negative effects. A positive experience results from adhering to the same standards that apply off-line. Good navigation tools and strong internal organization of all the individual components on every page enable visitors and customers to find what they need quickly and easily.

This section is about functional spatial design. Web sites require that the designer manipulate space—and color is the key. For the human eye there is no space without its color, and no color that does not create its own space.

Navigation

A person must be able to locate departments within a physical site. Signs on doors, walls, or aisles and merchandise displays define specific areas in traditional interior spaces such as stores and offices. Multiple-level business sites place directories in prominent locations. Likewise, a web site must have clear, accessible directions.

Color is the primary tool that a designer can use to carve out a reliable area that will remain the same throughout the site. It delivers a consistent system that enables visitors to rely on its cues, speeds searching, and simultaneously enhances the visual effects and theme of the web site.

Compare the effects below:

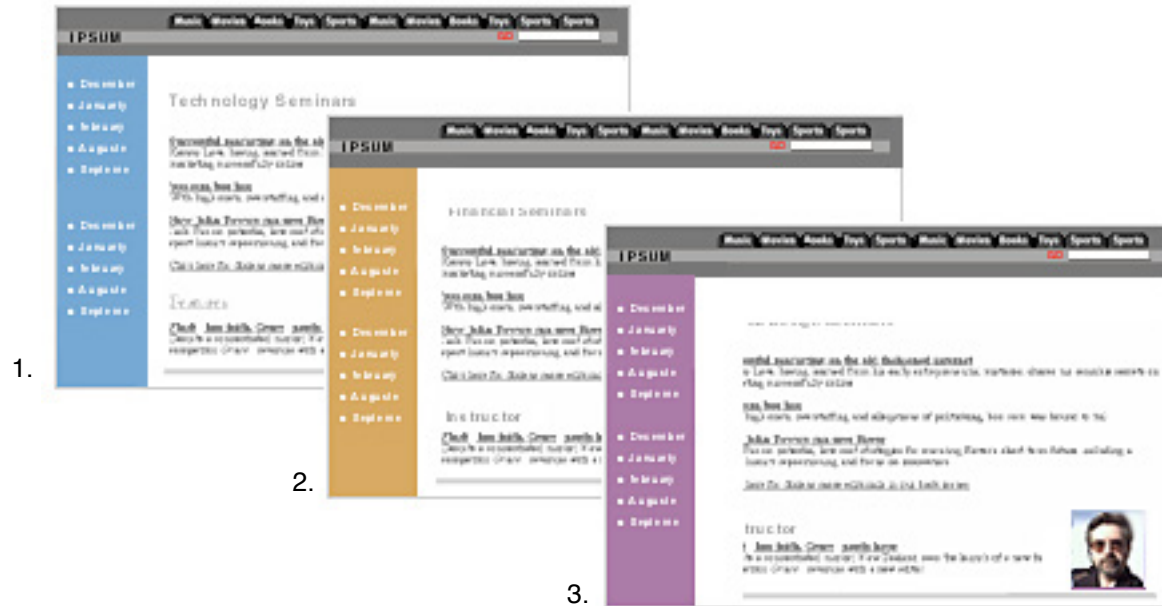


The navigation area at the left merges with the content area.



Color clearly separates the navigation area from the content area.

Colors can be used to distinguish and thematically symbolize main areas and sub-areas within the web site. For example, the same color can be used consistently in the top level of the navigation bar for the main areas in the site combined with a different color beneath for links within a section. As illustrated below, the colors of the vertical navigation area change.



The designer may elect to use the same navigational system on all pages or colored variations of the same system. For example, a different color may be used for different sections within the site. As illustrated below, the design is consistent; only the colors change.



Multi-colored tabs on the navigation bar can be used to color-code areas within the web site. In the example below, a different color is used on each of the tabs.



Linked pages reflect the thematic color.



A subtler effect can be achieved with different colored bullets or other icons.

Passage

Functional space requires ease of passage. Retailers know that their customers must be able to move comfortably through the store and that the width of the aisles significantly affects the shopping experience. For this very reason, professional architects and interior designers are called upon to mathematically analyze and implement ample space for physical passage, as well as for compliance with building codes and regulations for all commercial locations. Likewise, a web designer is required to structure space for comfortable visual passage.

A spacious layout is a difficult task given the flexible dimensions a web page may occupy. In spite of these constraints, color organizes space. When combined with formatting tools such as tables and style sheets, it creates functional "aisles" throughout an electronic store.

As a starting point, designers must evaluate "negative space" — those areas where the eye can rest, those no-thing spaces that create breathing room. Compare the spatial effects below:



Congestion



Easy passage

Color organizes space by grouping merchandise or other similar items together.
Compare the effects of the two clusters of images below:



Color can also be used to group blocks of text together, thus creating clearly defined space around the text areas. Assigning a web-safe color to table cells delivers this effect.

INSTALLATION

Lorem ipsum dolor
 sit amet, consectetur
 adipiscing elit.
 Sed do eiusmod
 tempor incididunt
 ut labore et
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TESTING

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SUPPORT

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INSTALLATION

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TESTING

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 Sed do eiusmod
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SUPPORT

Lorem ipsum dolor
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 velit esse
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 sint occaecat
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 est laborum.

Organizational graphics, such as colored horizontal and vertical bars, also serve as structural elements. They define where a space ends and where a next space begins, thereby establishing clear areas for the eye to travel.



Other graphic elements may adversely affect spaciousness on a web page. For example, background patterns or textures, no matter how small or how light in color, create congestion. A solid color or pure white background is the best choice for spacious effects. Also, large images are too heavy, too overpowering and take up too much space on a web page. When necessary, use a small thumbnail with a clickable link to an enlargement.

Color and Direction

After creating a spacious and navigable design (the infrastructure) for the site, the web designer must treat each individual page as if it were a separate area or department in a physical site such as a store or office . Well-defined interior organization of each page enables customers to find what they need quickly and easily, to get information about it, and purchase it—or explore other options. Since individual elements vary from page to page, as well as from site to site, different design solutions apply.

The mechanics of human vision provide the basis for how a person explores visual images as well as physical environments. Under normal conditions, the scanning eye makes a large number of tiny visual shifts; it remains in each position for less than one quarter of a second before moving on. Ideally, interest is intensified as the brain processes each sequence of signals. The goal is to have the customer finally take action by purchasing the merchandise or procuring the service.

The web designer must identify what ideal and normal sequences might entail: what the viewer should see first, where the eye should move next, and how much time the viewer's attention should be held by each area. For example, a customer will see an image of a watch, read the description, see the price and purchase it—or explore a similar item or move on to a different page.

Spatial Perception

There are several theories that explain how the brain and eye process visual information. Beginning with the visual experience as a whole, "signal detection" is always at work. In short, this theory means that the brain is able to understand and organize information when a minimum of colors and shapes exists within the visual field. Too many colors and shapes make it impossible to focus and find anything.

Compare the differences in the illustrations below:



A grocery store



A web page

As illustrated in the grocery store photograph above, the confusion of too many products and too many signs makes it impossible to focus. Likewise in web design, over-stimulation creates sensory overload and mental shut down. Therefore, unified design based on color harmony is essential.

A basic rule: Every color must have a purpose. Use colors only where they are really needed.

Emphasis and Subordination

Spatial logic is based on a hierarchy of dominant versus less dominant features. The formal term for this design theory is "emphasis and subordination." It can be likened to a star on a stage and a supporting cast. Web designers must assess and balance all elements on a page.

Emphasis and subordination applies to the entire page design as well as to separate components.

#1 - Page Design



The emphasis is on the merchandise. The muted hues of the navigation system are subordinate to the brighter hues of the merchandise.

#2 - Navigation Design



The emphasis is on the purple area at the top. The beige vertical area is less dominant and appropriate for links to sub-areas in the site.

Examples of Color Movement - Merchandise



Confusion and Congestion

1. The eye is drawn to the poorly framed merchandise.
2. The eye is drawn to the bright red color of the suggested retail price.
3. The eye is drawn to the recessive green color of the more important actual price.
4. The eye reads the description.
5. The eye might detect the "Order" button.
6. The eye might detect "Click to enlarge."



Clarity and Comfort

1. The eye is drawn to the merchandise.
2. The eye is drawn to the text area as a whole and immediately detects the price and "Order" button.
3. Now that critical purchasing information has been noticed, the eye reads the description.
4. The eye detects "Click to enlarge."

Purchasing

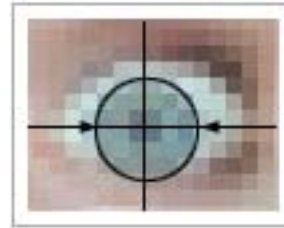
Highly visible cash registers are required in all retail environments. This is especially critical in e-commerce. An "Order" button, icon or text must be immediately visible. The navigation system must also include a link to the shopping cart and a help desk. Both the color and the location must be consistent throughout the site.

By controlling the eye's movement, the web designer enables the customer to initiate and complete a purchase. Examples of color movement in the previous pages demonstrate how color successfully achieves the final goal of e-commerce: a concluded sale.

HOW COLOR AFFECTS THE EYES

About the Optical Effects of Color

Color affects the mechanisms of the human eye. Muscles either relax or tense up, pupils expand or contract. As is the case with all muscles in the human body, fatigue and irritation result when the eye has to work too hard. These effects are unavoidable.



Web sites must address the mechanics of the human eye as a primary design element. Without question, the eyes must function efficiently when viewing web pages. If a web site is designed to optimize the visual processes, visitors will feel comfortable. On the other hand, complete disregard for how the human eye functions may create so much discomfort that the visitor will immediately depart the site.

Optics is an objective science with solid principles. This section covers the key areas that contribute to visual efficiency and comfort in the electronic environment.

Legible Text

Readability dictates color choice when it comes to web pages. Visitors must be able to read content with complete ease. Insufficient contrast, as illustrated in the examples below, forces the eye muscles to work excessively. As a result, the eyes become fatigued.

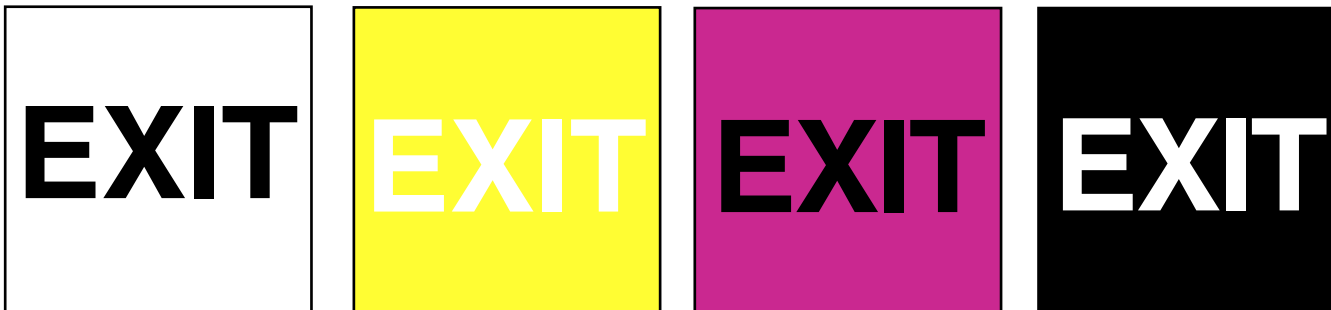
How easy is it to read this text?

The blue background does not have enough value contrast to create readability.

How easy is it to read this text?

Software manuals frequently use this poor contrast between background and text.

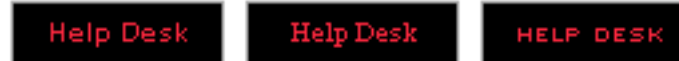
When the issue is visibility, the answer is high value contrast. The Americans with Disabilities Act, legislation (in the United States) requires high contrasts between light and dark colors on all signage so that the visually disabled can see this information. Compare the differences in high and low contrast on the "Exit" signs below.



Even if fonts are large and/or bold, insufficient contrast between text and background strains the eyes.
All of the examples below lack sufficient contrast for ease of reading.



Red text in a small font on black can be problematic. Even if it's marginally legible, as illustrated below, it won't stand out in the larger context of the entire web page.



Red and blue should not be used together — especially in text and background color combinations.
When viewing the examples below, fatigue, fuzziness and sometimes a 3-D illusion can occur.



These effects are caused by the way the eye attempts to focus in opposite directions.
It can be likened to a visual tug-of-war.

Strong contrast between text and background is required for maximum legibility and visual comfort. Black characters on a white background elicit faster reading performance than white characters on a black background. ² Most very dark colors on a very light background will also suffice.

Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu
Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu	Lorem ips um, Dolor sit amet, cons ectetuer adip iscing elit, sed diam nonu

All of these colors, with the exception of white, are mixtures of two web-safe colors. HEX and RGB shown below.

E5E5CC R: 229 G: 229 B: 204	FFFFE5 R: 255 G: 255 B: 229	FFFFFF R: 255 G: 255 B: 255	E5E5E5 R: 229 G: 229 B: 229	E5FFFF R: 229 G: 255 B: 255
E5CCCC R: 229 G: 204 B: 204	E5FFE5 R: 229 G: 255 B: 229	E5E5FF R: 229 G: 229 B: 255	CCE5E5 R: 204 G: 229 B: 229	FFE5CC R: 255 G: 229 B: 204

Technical Notation about Color Contrasts

Differences in computer systems may cause faulty readings of contrast.

Mac - Gamma 1.8



PC - Uncorrected Gamma 2.2



Color combinations that are designed on computers with 2.2 gamma (such as Windows PCs) appear much lighter on computers with 1.8 gamma (such as Macs).

Mac - Gamma 1.8



PC - Uncorrected Gamma 2.2



Color combinations that are designed on computers with 1.8 gamma (such as Macs) appear much darker on computers with 2.2 gamma (such as Windows PCs).

Designers must preview work on other computer systems to diagnose the degrees of contrast.

Value Contrasts - Buttons

The buttons below illustrate insufficient contrast between text and background.

Poor readability



The buttons below illustrate sufficient contrast between text and background.

Good readability



Value Contrasts - Graphics and Banners



Insufficient contrast in the area where the black text overlaps the dark purple.
The values are too close for readability.



Sufficient contrast between the black text and yellow.

Value Contrasts - Home Page Analysis

Bad Value Contrasts

Multi-colored patterned or textured backgrounds can create problems for text and graphics.



Not enough contrast

— between the title text & background colors

Not enough contrast

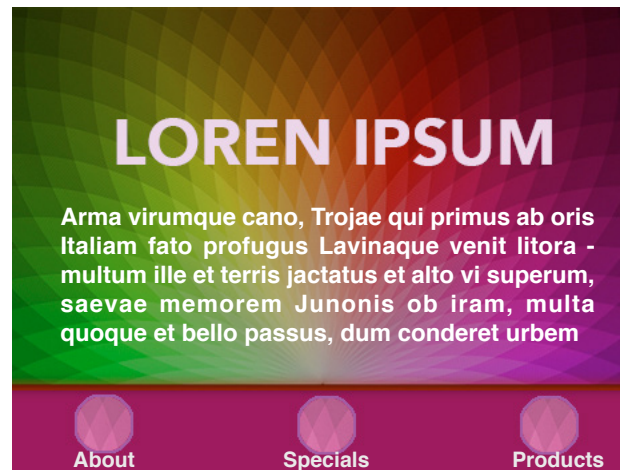
— between yellow text and background colors.

Not enough contrast

— between buttons and background colors on the horizontal bar.

Good Value Contrasts

The darker patterned background resolves the contrast problems and maintains a colorful effect.



Good contrast between

— lighter text and darker patterned background.

Light text and lighter

— buttons are used on the darker horizontal bar for a good contrast.

After-Image

Note: This concept was presented previously as a reference to the definition of generative complementary colors. It is repeated for the purpose of application to specific web design examples.

After-image can best be defined by a simple optical test: in the illustration below, stare at the black dot in the middle of the blue square for 30 seconds. Keep your focus steady on the black dot. At the end of 30 seconds, focus on the black dot in the middle of the white square on the right. To ensure the best results, make sure you hold your focus on the black dot both times.



What did you see? Chances are you saw a glowing yellow or orange transparent color in the middle of the white square.

This effect is known as an "after-image." Scientifically, when any hue is unrelieved by another "opposite" hue, the eye will create an after-image color. This forces the eye to perform excessive muscular action.

In application to web design, strong vivid colors in large areas on a page cause the same optical fatigue. An additional disadvantage is that monochromatic (one hue) color schemes are monotonous. Vivid colors should be toned down and an accent color should be added. If the dominant color is cool (any variation of blue, blue-green, green or blue-purple) an effective accent color could be a shade of a warm color (any variation of yellow, orange, red or red-purple). The reverse applies to a dominant warm hue. Compare the differences in the examples below:

#1 - Bright vivid blues



The excessive use of vivid blues creates optical fatigue and monotony. The product is lost in an overwhelming and monotonous sea of blue.

#2 - Muted blues and a warm accent

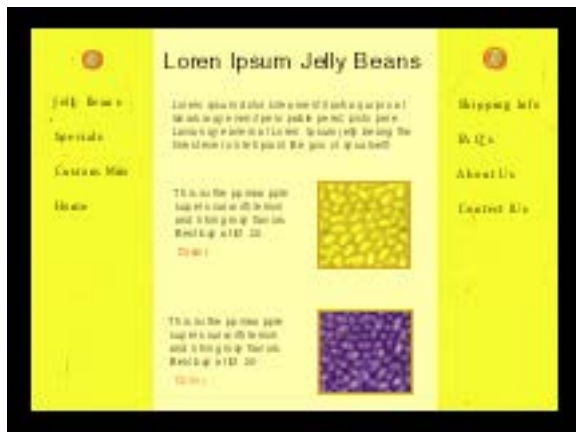


Muted blues are combined with a warm accent color. A bright blue is retained in small areas. The composition is more engaging and restful and the product is more predominant.

Irritation and Distraction

Pure yellow is the most luminous and visible of all the colors of the spectrum. It appears to be radiating from within and moves outward. If bright yellow occupies a large area in a store, whether it's a tangible wall in a physical store or a vertical navigation panel on an electronic web page, it will irritate the eye. Compare the effects of yellow on the two web pages below:

#1 - Pure yellow



Pure yellow occupies large areas on the side navigation bars. A softer yellow is used in the center area and a highly contrasting black in the background. There is too much yellow, too much pure yellow and too much contrast. This palette creates optical fatigue and overwhelms the merchandise.

#2 - Muted yellow



A softer yellow is used on the side navigation bars, with a creamy white in the center and a muted beige in the background. The muted hues and softer contrasts in this palette are more restful and less distracting. The eye focuses on the brighter colors of the merchandise.

In the broadest sense, any strong color demands voluntary and involuntary attention. Not only does this distract the viewer but it also fatigues the eye. Compare the effects below:

#1 - Strong vivid colors



Too many strong colors fatigue the eye and overpower the photographs.

#2 - Softer muted colors



Softer colors are restful to the eye and don't overpower the photographs.

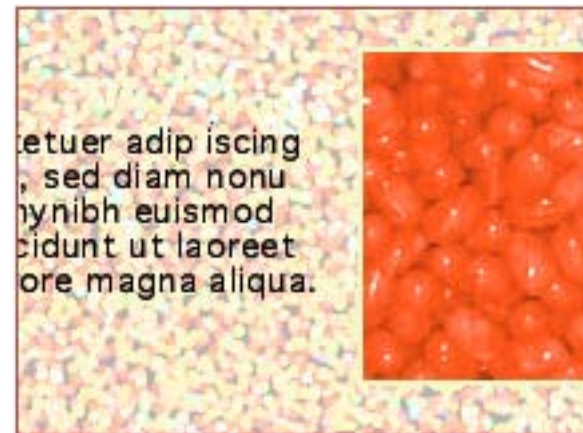
A possible exception would be a web site targeting younger visitors who prefer energizing bright colors. A more saturated palette may work in moderation as long as the hues don't overpower other content such as merchandise.

Distracting Patterns and Backgrounds

Highly contrasting patterns are fatiguing and distracting. They compete with the merchandise and may even draw attention away from it. Examine the effects in the illustrations below:



Enlargement



A background pattern may be tempting. In the example above, it looks like multi-colored jelly beans on a small scale and it also harmonizes nicely with the navigation bars and products. Nevertheless, the text is almost impossible to read. Taking everything into consideration, there are too many design elements competing with each other in the overall page composition. The background destroys what could have been a successful color scheme.

Other Distracting Backgrounds and Illegible Text



Pattern overwhelms text. Text is not readable.



Although the value contrasts are sufficient for readability, the background pattern is distracting.



The value contrasts are sufficient and the larger scale background lends itself to legible text.

Visual Comfort

1. Saturation

By definition, saturation refers to how muted (dulled) or vivid (bright) a color is. Recent research documents that this is a critical factor in the observer's estimation of comfort. The more muted the color, the more comfort is felt when viewing an image. The amount of saturated color in the image was also shown to be a critical factor affecting visual comfort.³

The muted (low saturation) color palettes in the examples below demonstrate these effects.



E5E5CC	FFFFE5	CCCCB2
R: 229	R: 255	R: 204
G: 229	G: 255	G: 204
B: 204	B: 229	B: 178

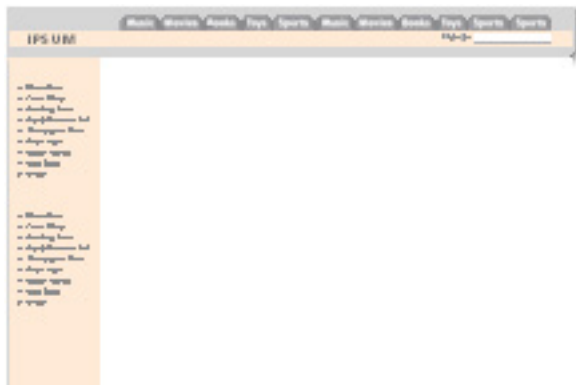
333366	4C6699	B2CCE5
R: 051	R: 076	R: 178
G: 051	G: 102	G: 204
B: 102	B: 153	B: 229

Regardless of the color palette, backgrounds for content text should be neutral or muted hues.

2. Low contrast

Although high contrast is essential for readability, low contrast in the colors used on the page's design components creates visual comfort. This contrast can refer to the values (lightness and darkness) of the colors or to the actual colors.

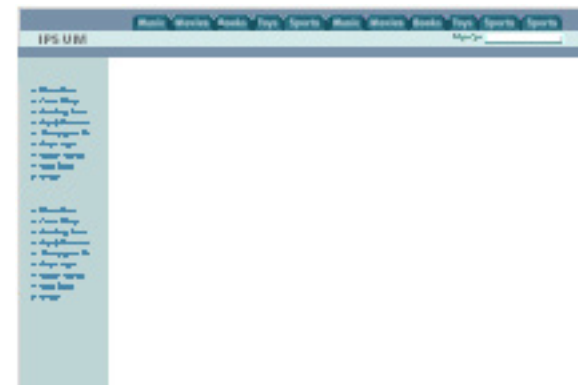
#1 - Low contrast between values



Both the grey and pastel orange colors are light. The minimal value contrast combined with the muted quality of both colors creates visual comfort.

CCCCCC	999999	FFE5CC
R: 204 G: 204 B: 204	R: 153 G: 153 B: 153	R: 255 G: 229 B: 204

#2 - Low contrast between colors



The muted blues and greens are "cool" colors. The minimal color contrast combined with the muted quality of both colors creates visual comfort.

667F99	33667F	B2CCCC
R: 102 G: 127 B: 153	R: 051 G: 102 B: 127	R: 178 G: 204 B: 204

3. Green

The green color family is the largest color group discernible to the human eye. Since the lens of the eye focuses green exactly on the retina, it's also the most restful color. Use muted shades in large areas and semi-muted shades in smaller areas. Compare the effects below:

#1



A slightly muted shade of green is used on the navigation bars and a very muted shade in the central content area.

66B266	CCE5CC
R: 102	R: 204
G: 178	G: 229
B: 102	B: 204

#2



A dark green and a medium muted green are used at the top of the page. A very light green occupies the background.

004C33	B2E5CC	E5FFE5
R: 000	R: 178	R: 229
G: 076	G: 229	G: 255
B: 051	B: 204	B: 229

Note: Don't use green if it isn't associated (symbolically or literally) with the web site's products or services.

In spite of the fact that appropriate shades of green are very restful, sufficient contrast is still required for readability. Notice the differences in the black text on two different green backgrounds:

Loren ipsum dolor sit amet, consectetur adipiscing elit sed diam nonummy nibh euismod tincidunt

Smaller fonts are readable on very light backgrounds.

E5FFE5

**R: 229
G: 255
B: 229**

Poor contrast with this font size
Loren ipsum dolor sit amet, consectetur adipiscing elit sed diam nonummy nibh euismod tincidunt

Loren Ipsum

Larger and bolder fonts are required for darker backgrounds.

B2CCB2

**R: 178
G: 204
B: 178**

4. Good design



When the human eye sees something horrible, it contracts 50%. If it sees something pleasant, it relaxes 50%. Consequently, an attractive interior space makes people feel relaxed and comfortable. Likewise, an attractive electronic space relaxes the eyes and makes the customer feel welcome. On the other hand, a chaotic, unsightly web page jolts the eye and makes the customer feel edgy and on guard. Therefore, every page of an web site must meet the highest standards of the same design principles that apply to architecture and interior design — or any other design practice.

Color Accessibility and Vision

All web site visitors are not created equal. People land on a site with varying degrees of color vision. Aside from computer-generated color variables, up to 30% of a web site's visitors may have some form of a physical visual disability. This group includes the color-blind and aging population.

Regardless of the site's target audience, designers must be aware of these variables and design accordingly. This section presents guidelines for accessible colors.

Color-Blindness

One out of twelve web site visitors is color-blind — 8 percent of men and 0.5 percent of women have some form of color-blindness. It's important to understand that the color-blind eye is insensitive to a specific color range and instead sees different colors; it is not an inability to see color at all. The red-green perception deficiency is the most commonly recognized form of "color-blindness."

Although there are many forms of color-blindness—and therefore many variables—the following guidelines apply to the most common conditions.

Unsafe Colors

1. Red
2. Green

Unsafe Color Combinations

1. Red and green is the worst combination. Both colors may look grey.

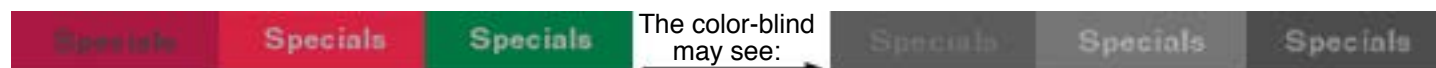
Normal color vision



The color-blind may see the greys below

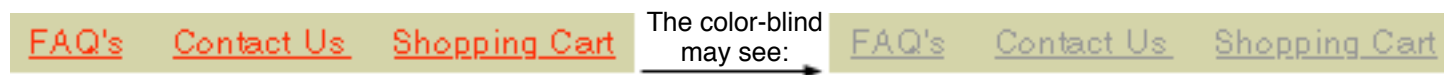


2. Grey and red or green is extremely difficult to see for the same reasons.



3. Colors for linked text on a colored background may not be visible.

Color may not be a cue which the color-blind can see. Since the underline beneath the linked text may be the only cue, style sheets should not be used to remove it. The same may apply to rollovers with changing color. The color-blind will not see the color change and will not know that the link is clickable.



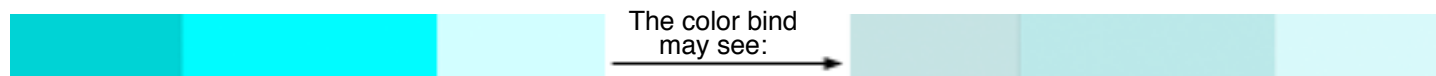
4. Colored text on any mixed-color background may be difficult to distinguish.



The color-blind may see:



5. Combinations of several shades of one color may also be difficult to distinguish. For example, all shades of blue-green may appear quite light.



Safe Colors

1. Black and white are the safest.
2. All shades of yellow and blue are relatively safe.

Safe Color Combinations

1. White on black and black on white are the safest.
2. Yellow on black is fairly safe.
3. Less safe colors may appear more visible if placed against an appropriately colored background.
For example, red on white, green on black, and turquoise on black are relatively safe for visibility.
If any of these colors combinations are used for text, something other than color should be provided as an additional cue.

Miscellany

1. Bright colors are more distinct and easier to tell apart than muted colors.
2. Supply text descriptions to specify the actual color of the merchandise.

Tools

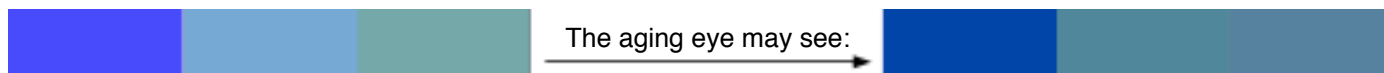
Insight (from Colorfield Digital Media) is a color-blindness simulator that allows designers to preview the effects of color- blindness on their designs. It's an easy-to-install, easy-to-use Adobe Photoshop plug-in.

The Aging Eye

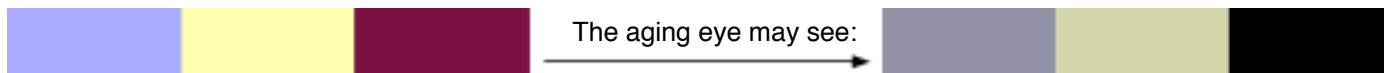
A significant percentage of the population is the elderly. In the United States, 12% of the population is 65 years of age or older and 25% (in the 50+ age group) is beginning to experience visual decline. This substantial—and booming—population see colors quite differently from the young. The cornea begins to yellow and darken, and short wavelengths are selectively blocked. Furthermore, less light reaches the photoreceptors.¹

Examples

1. Blues look darker and blue-based hues may be difficult to discriminate. For example, blue-green and blue-grey may appear very similar.



2. All colors may appear more muted and darker. For example, a moderately bright yellow may appear brownish and dimmer and all dark colors may appear black.



Solutions

As a general rule, bright colors and high contrast compensate for age-related vision deficiencies.

THE PSYCHOLOGICAL EFFECTS OF COLOR

About Color and Psychological Associations

Color associations are a powerful component of all visual information. From the palest tints to the most vibrant hues, every color of the spectrum delivers powerful associations and reactions ranging from the obvious to the sublime.

An excellent example is the reaction to the coloring of food: Appetite will be dulled or heightened by the colors (and the saturation of the colors). Likewise, a doctor's office painted bright red would cause a negative reaction; an office painted light blue, a positive reaction.

In all sales environments, color associations will either work for or against the product or service. Consider the effects of color on toothpaste packaging:



Toothpaste is associated with healthy white teeth. The implications of yellow are obvious.

The right colors make communications more credible and inviting. Compare the effects of color on a site for sun tan products in the two examples below:

#1



Purples are associated with bruising. They work against the implied results of tanning products.

#2



Golden hues are associated with tanned skin. They reinforce the benefits of the products.

The right colors—when combined with professional artistic design, appropriate user-interface, and content—are a primary source of subliminal power and persuasion. The wrong colors can be an irreversible mistake and may keep people from exploring a web site long before they consider purchasing a product or pursuing more information about a service.

Color preferences and associations vary from individual to individual and must be acknowledged and handled accordingly. Many people are not well informed about color. Preferences are frequently based on television and magazine advertising. Many of these color combinations are extremely saturated and are intended to catch the viewer's attention. A web site is extremely different both in terms of sustained viewing time and intended results. Many colors may not be successful when applied to page after page of a site.

Aside from general preferences, many people have very strong feelings about color, especially those they dislike. For example, a person may detest grey. Maybe it was the color of a claustrophobic dentist's office or the decrepit car that caused a collision, or perhaps it's just a general distaste for the color. Regardless of the source, personal preferences must never interfere with the selection of critically symbolic colors for business. Web site designers must subject their color choices to objectivity and instruct their clients to do the same.

Although no one can guarantee that any color or combination of colors will produce a perfect response in all customers, the colors used on web sites will be the most successful when designers analyze the products or services offered, examine the competition, define the target market, and research color symbolism. Following these steps defines an ideal psychological infrastructure for the web site, one which maximizes the power of visual communication and taps the full power of color. The following section defines these steps in detail.

Guidelines for Selecting Symbolic Colors

1. Product analysis

An analysis of how similar products or services are presented in other media (magazines, trade publications, television spots, and billboards) provides valuable information. Packaging, labels, corporate logos, stationery, signage, books, competitors' web sites, and other visual images should also be examined. This might reveal that one set of colors is used more frequently than others. Furthermore, this may be an indication that a favorable response results from familiar associations.

Consider the case of laundry detergent. A display on any supermarket shelf provides clues.



The packaging color used for the majority of detergents in the U.S. is a combination of blue and orange. An analysis of the symbolism reveals the logic: blue is associated with cleanliness and orange with dynamic energy. The combination signifies "industrial strength" cleaning power.

Also, as is the case in automobile advertising, one set of colors may be used for the manufacturer's logo, another for a magazine ad, and yet another set for a television spot. Although blue may predominate in automotive brand identity, other colors are found in advertising spots.

Established color schemes may be the result of persistent marketing. Consequently, a product may benefit from an eye-catching, unique color identity. For example, a leading soft drink brand such as Coca-Cola® has a very established color scheme. Seven-Up®'s green and Pepsi®'s blue contrast successfully with the competition; likewise, Fuji®'s green with Kodak®'s yellow. In the final analysis, the deciding factor is whether a color scheme has withstood the test of time.

Innovative, eye-catching color is not free license for color selections. There must be an underlying logic. First, it is essential that colors bear some relationship—either symbolic or literal—to the product or service. Second, colors must function within the web site medium. A color that grabs attention on a supermarket shelf may be a garish failure if used excessively on a web site. When making a case for breaking with tradition, the context must be considered.

2. Demographics

The age, sex, and nationality of the web site's typical visitor/customer must be defined. For example, are they more likely to be young, technologically savvy, European males or well-educated businesswomen regardless of age or nationality?

Similar products targeting these demographic profiles provide significant information. For example, an ad for sunglasses may incorporate one set of colors in a magazine for a mature audience and yet another set for a younger audience.

Stereotypical color associations must be avoided. For example, pink is not the default color for women. In fact, many professional women take offense when this color is used symbolically for their gender. In spite of pink's associations with breast cancer awareness, it all depends on the context. Women now constitute the major buying power on the web and they are extremely sensitive to color. Other demographic groups are equally sensitive to stereotypes.

Assuming that there are "universal" associations of a color can be lethal on yet another level. The symbolism of a color may take on different meanings in different cultures. For example, the color green is associated with currency and monetary matters in the United States. This symbolism is not global because the color of currency of other nations varies widely.

Likewise, other generalizations must be avoided. While it may be true that bright colors are very attractive to the younger generation, if these are used in the wrong way on a web site, they may make it look like a carnival.

3. Symbolism Analysis

As a preliminary step in determining the most appropriate colors for a web site, the following attributes of colors provide valuable insights:

1. Bright vivid colors, such as pure red and blue, are energizing and outward-focused.
2. Extremely bright, electrifying colors, such as lime green and fuschia, are festive, "hip" and dynamic.
3. Muted, gray-based colors, such as taupe and blue-gray, are sophisticated and reserved.
4. Dark shades, such as deep forest green and navy blue, are dignified and professional.
5. Light shades of most colors, such as pink and light blue, are delicate and ethereal.

The "temperature" of a color provides additional information. Cool colors, such as deep blue and emerald green, work well with medical, automotive and technological businesses. Warm colors, such as golden tan and brick red, work well with food-related, social, and service-oriented businesses such as restaurants and clubs.

Some color associations may be relevant. Colors not commonly occurring in nature, such as purple, are associated with other-worldliness and creativity. Consequently, they work well for artistic and spiritual endeavors. Metallics add an aura of luxury and high technology. Bright colors appeal to youth; complex colors (those that require three or more words to describe, such as dark grayish blue-purple) appeal to higher socio-economic groups.

Note: These generalizations are departure points for further investigation and should not be considered to be absolutes.

Successful web design requires an in-depth analysis of all colors used in substantial quantities at the site. These associations can be quite conspicuous, such as those found in nature. For example, red is the color of blazing fire and blood; blue the color of cooling waters and the sky. Colors also have many other meanings which are not universal. A comprehensive examination must include the following:

1. Natural associations: occurrences of the color in nature
(usually universal and timeless)
2. Psychological generalizations: the associations generated by the color in the mind
(not typically universal)
3. Cultural associations: the color of currency, traditions, celebrations, geography, etc.
(not universal)
4. Political and historical associations: the color of flags, political parties, royalty, etc.
(not universal)
5. Religious and mythical associations: the colors associated with spiritual beliefs
(not universal)
6. Linguistic associations: color terminology within individual languages
(not universal)
7. Contemporary usage and fads: current color applications to objects, sports, and associations generated by modern conventions and trends
(not universal)

Using green as an example, a list might include some of the following relevant (but by no means complete) information:

1. Natural associations: (usually universal and timeless):
leaves, grass, lettuce, apples, grapes, emeralds, jade, lakes and other inland waters, mold
2. Psychological generalizations (not typically universal):
growth, fruitfulness, freshness, ecology, good luck, jealousy, immaturity, sickness
3. Cultural associations (not universal):
heaven (Muslims), luck (U.S. and Ireland)
4. Political and historical associations (not universal):
Libya's flag, the favorite color of Emperor Hirohito and "Green Day" in Japan, the Green Party (U.S.)
5. Religious and mythical associations (not universal):
Celtic myths (the Green man was the God of fertility), alien beings (U.S.)
6. Linguistic associations: (not universal):
South Pacific languages refer to shades of green by comparison to plants in various stages of growth. In Scottish Gaelic the word for blue ('gorm') is also the word used for the color of grass.
7. Contemporary usage and fads (not universal):
traffic lights signifying "go," currency (U.S.), a popular color in Scandinavia for many decades, avocado green appliances (U.S. - 1960's), lime green as a hip and trendy color (U.S. - 1996-200?)

4. Analysis of the symbolism of the specific shade of a color

Many color associations are generalizations that don't pinpoint the precise shade of a color. For example, red is commonly defined as symbolic of power, energy, strength and passion. Nevertheless, two reds, one a yellow-based red, the other a blue-based red, will deliver different meanings.

Yellow-based red

CC0000	FF0000
R: 204	R: 255
G: 000	G: 000
B: 000	B: 000
HEX & RGB	HEX & RGB

Blue-based red

CC0066	993366
R: 204	R: 153
G: 000	G: 051
B: 102	B: 102
HEX & RGB	HEX & RGB

Current research suggests that yellow-based reds, such as tomato, appeal to males and blue-based reds, such as raspberry, appeal to females.⁴ This is precisely why Ford used a yellow-based red for its Mustang GT, targeted toward men, and a blue-based red in its Probe line, targeted for women.

Dark and pastel shades of any color convey completely different meanings. For example, pink loses all of red's associations with energy and takes on new connotations of tenderness and sweetness. Dark blue is dignified and trustworthy in comparison with sky blue's ethereal quality.

Designers should research symbolism in books that provide color-accurate swatches of hues and accurate color descriptions. (A bibliography is provided at the end of this eBook.)

Factors that Influence Symbolism

1. The quantity of the color

The quantity of a color within the total composition affects the amount of symbolism it delivers. A small area of a color on a web page may enliven the overall design or call attention to a different area. Symbolism may have no effect in this capacity. The dominant hues on the page will communicate the primary symbolic associations.

2. The web context

Many will argue that interface designers (including web designers) must copy the visual characteristics of real-world devices. Consequently, since red means "STOP," some people emphatically state that red should only be used in this context and that it should not be used as an unvisited or active link color or in any context that does not imply stopping.

On the contrary, all symbolic color usage is subject to cross-examination based on scientific optical effects. In the case of link colors, red advances, blue recedes. Also, pure red contrasts more than blue with black text on a white background. Therefore, red text catches the eye faster than blue. Consequently, translating the colors of real-world phenomena may not be a reliable standard.

3. The shape the color occupies

Symbolism becomes more complex when specific shades of a color are used in combination with a basic shape. Although this factor may only apply to smaller details on a web page, it is worthy of consideration.

As a rule, circles are associated with softness, connection, wholeness, warmth, comfort and love; rectangles with solidity, containment, order, logic, certainty and hardness; triangles with power, excitement, aggression, force and mystery. Compare the shape, color and text combinations in the illustrations below:



A pink circle evokes a psychological response of warmth and femininity; a dark red rectangle, logic and solidity; a bright red triangle, dynamic energy and aggression. Combined with the phrase, "Order Now," the pink circle is too soft to convey taking action (unless the merchandise is pink bubble bath); the red triangle, too forceful (unless the merchandise is cutlery), and the dark rectangle, the most appropriate.

4. The object

When colors are combined with specific objects, the symbolism is even more complex — and especially so on a global level. A worthy example is the symbolism of a green hat. In the western world, it may conjure up visions of Irish leprechauns and good luck. It would seem to be safe to wear a jazzy green hat in a booth at a trade show. An unexpected reaction occurred when the men who staffed a booth in a technology exposition in China did precisely that. They were horrified to find out why the crowd was laughing and avoiding their booth — when Chinese say that "a man is wearing a green hat," it means that his wife is having an affair.



Another example is a white carnation, an extremely innocent symbol in many cultures. Nevertheless, it takes on quite a different meaning in Japanese culture. An interesting story relates the repercussions at a gala welcoming party in Japan, when the employees of a major airline placed white carnations in their lapels as a means of identifying themselves. They were not aware that, in Japanese culture, a white carnation symbolizes that one's mother has recently passed away. The event turned into an embarrassing disaster.

5. The color combination

When a color is combined with another color or colors, new associations emerge. A classic example is red and green, the symbolic hues of Christmas in the western world. When combined with white, these are also the colors of the Mexican, Italian and Iranian flags (as well as others). Many other bright color combinations carry powerful associations with national flags and prominent sports teams. Cross-referencing a site's thematic color palette with those that are prominent in the target visitor's culture is an absolute requirement.

Other color associations may be automatically generated by high-profile products, such as Kodak's yellow and black. Consequently, a web site designed in these colors might find itself in a case of mistaken identity. Likewise, if certain color combinations are commonly used for a particular genre of products (such as the previous example of blue and orange for laundry detergents), these colors might not work for a site that requires different associations. For example, if an estate planning law firm used this bright color combination as the thematic color palette for its web site, it might convey "industrial strength legal power," but certainly not the professionalism and seriousness of the law practice.

COLOR AND COMPUTER TECHNOLOGY

Introduction

Structures (such as offices and stores) are designed by licensed architects and engineers who must follow city, state and national regulations. Compliance with these standards not only guarantees the safety of the building and its occupants but also ensures that the site is accessible to everyone.

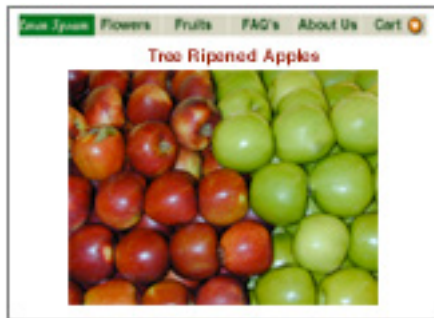
Physical accessibility can be resolved with a high degree of certainty when a structure is constructed of solid building materials. Dimensions are clearly defined in inches or centimeters. In direct contrast, a web site exists in the intangible world generated by computers and web browsers. Consequently, it assumes many different physical dimensions due to several factors interacting simultaneously—the user's operating system, monitor size and capabilities, the web browser, the user's preference settings, and the programming code of the web pages.

"Real world" environments also benefit from a stable color environment. Appropriate lighting ensures that walls, floor coverings, decorative fixtures, signage and the merchandise exist within a relatively stable world of color constancy.

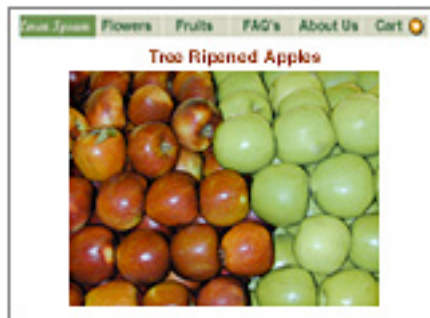
On the other hand, web sites must deal with serious technical challenges in this area. The colors of graphics, backgrounds, and text are transmitted through a computer – or digital device – and a display (screen). Therefore, colors may not result in true fidelity to the original colors—even if they are "web-safe" colors. The web is not alone in this dilemma — there's also a wide degree of color variation from TV set to TV set. In fact, broadcasting professionals joke that NTSC (National Television Systems Committee) stands for "Never The Same Color." Anyone who has ever gazed at a row of television sets in a store has witnessed these variables first hand.

Color Technology

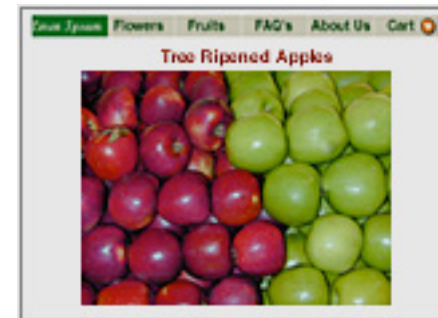
Understanding the underlying technology of computer-generated color is a requirement for color design for the web. As a first step, note the color variables of the same web page shown below*:



Colors are true to the natural hues of the fruit.



Colors are lighter.
Reds have an orange cast.



Colors are darker.
Reds are purplish, whites are greyish.

Web sites distribute images to many different types of computers or digital devices. Each user's device consists of different components and different configurations of these components: the user's operating system, video/graphic cards or the absence thereof, color bit depth, gamma correction, display (screen) capabilities, and utilities. Color variations are caused by this variety of inter-related components that must work together simultaneously. Unfortunately, it's impossible to isolate any singular component and/or prescribe a general formula that would deliver accurate color to all customers. Therefore, this section covers the technical issues of computer-generated color and provides tools for rendering colors as accurately as possible on the web.

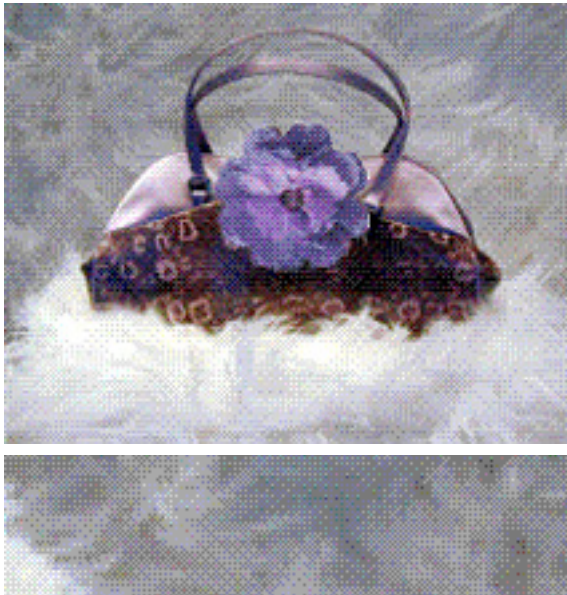
** 16-bit color and fully corrected gamma is required for the most accurate viewing of these images.*

Color Bit Depth

Although the human eye can see 10 million colors, not all computers have a wide range of color vision. Most computers are equipped with 64,000 colors (16-bit) or more. Many mobile devices have 24-bit color or higher. However, some older computers are limited to 256 colors (8-bit). Therefore, it's worth noting how this affects graphics.

Compare the effects of bit depth in the images below*:

256 colors (8-bit)



64,000 colors (16-bit)



** 16-bit color and fully corrected gamma is required for the most accurate viewing of these images.*

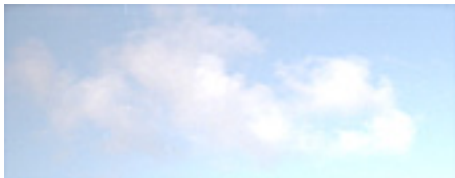
Gamma

Gamma is the key to fully understanding the primary source of color variables on the web. Unfortunately it is one of the most difficult computer terms to define—even experienced computer technicians have a difficult time understanding it. The following provides some basics:

1. Gamma is a qualitative measurement, such as gigabytes, megahertz or bandwidth. Computer gamma measurements generally range from 1.0 to 3.0. The typical gamma on Macintosh and PCs today is 2.2. However, it's 1.8 on older Macs and may range from 2.2 to 3.0 on some PCs.
2. Gamma is also a mathematical formula. It reflects a relationship between input and output. In computer equipment, gamma describes a critical relationship between electricity and what is generated on the monitor screen. In the final analysis, it describes the relationship between the voltage input and the brightness of the image on a monitor screen. This relationship affects the lightness and darkness of colors as well as contrast in the mid-tones of images.
3. The most significant aspect of gamma, as it relates to computer-generated images, is whether the actual gamma is fully corrected. For example, on a PC a gamma of 2.5 may represent fully corrected or uncorrected gamma. Some PCs do not have built-in hardware correction on the motherboard. Consequently, gamma must be fully corrected by the addition of a graphic or video card for the best display of true colors and a good range of light, middle, and dark tones. The Macintosh operating system contains a built-in graphic card that automatically corrects the gamma. Note: Calibration applications and devices can be used to target other gammas on computers.

Also, it's not necessarily a case of one gamma measurement, such as 1.8, being better or worse than another. What matters is whether the gamma is fully corrected. Different computers do different things and many systems have different configurations of the critical elements. The monitor plays a key role but it is still part of a larger picture. Compare the differences in the images below*:

Gamma 1.4 - uncorrected



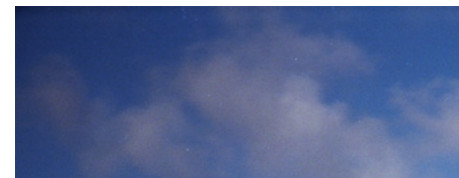
Colors are extremely light.
The pink area is bleached out.

Gamma 1.8 - fully corrected



Colors are accurate.
A wide range of tones can be seen
in the car's grill and fender.

Gamma 2.2 - uncorrected



Colors are very dark.
Tonal differences in the car's grill
and fender are poor.

** 16-bit color and fully corrected gamma is required for the most accurate viewing of these images.*

General Color Variations

Colors may vary regardless of corrected gamma and sufficient bit depth. These mutations may be non-linear in nature. For example, reds may have more of a blue cast and greens may have more of a yellow cast—in the same image. Inexpensive monitors and lack of appropriate calibration of the monitor are sometimes the culprit.

Possible variations of the same 6 colors are illustrated below.



Keys to Color Accuracy for Web Design

In spite of the challenges posed by today's technologies, web designers can employ many techniques that deliver the highest degree of color accuracy—in other words, the most accessible colors.

The degree of color accuracy required for a web site depends on the content. For example, food, clothing, cosmetics and home furnishings require the highest degree of fidelity. Sites that offer professional services or content such as software, computers, books, travel (for example) may be less dependent on color accuracy, but will still benefit from color optimization.

Web designers can maximize the accessibility of colors and stabilize the infrastructure of all sites, regardless of the content, by employing techniques that create the most stable and attractive hues as well as the smallest file sizes. This section presents the tools and techniques for optimizing color.

Color-Accurate Equipment

The highest degree of color accuracy in web design begins on a computer system that generates the most accurate colors. If a designer's system does not meet the highest standards, everything else is in vain.

As a comparison, consider this: In the physical world of commercial design, architects and interior designers must have perfect color vision in order to select colors and materials for an environment. The same requirement applies to the person as well as the equipment used in web design. Web designers must work on computer systems that have sufficient gamma correction and high quality displays. If this equipment is faulty, they are designing with a degree of color-blindness. The disastrous results affect every aspect of the web site.

A simple test will diagnose the equipment used for viewing this publication. The illustration below contains seven "web-safe" colors. Each of these colors is a distinct dark hue. If any of these colors appears the same as the black horizontal strip at the base of the swatches, the computer system needs full gamma correction and/or a better quality display.



Another test will confirm if the computer can generate a pure white pixel. Place a sheet of white paper perpendicular to a blank white document on the display, as shown in the illustration below.



If the "white" on the display appears light gray or any pale color other than white, the system cannot create a pure white pixel. This means that everything viewed on the monitor will have the "sunglass" effect and appear darker and duller.

Before making any final judgments, check to see that the control panels are set to the maximum possible. (The system or the video card may be defaulting to a lower color range.) Adjust the brightness and intensity controls for the display to the higher levels. If it still doesn't generate white, this is a sure sign that the gamma needs full correction, or that the monitor is inadequate, or that both are faulty.

The web designer must have highest quality components and they must also work in perfect unison to deliver the most accurate colors. A high quality display will improve the colors on all computers and especially on a Windows PC. Color quality will be better and brighter. Nevertheless, the display will not compensate for gamma deficiencies in some PC operating systems. A graphics or video card which works in tandem with the operating system and the monitor may also be required. Macintosh designers must also check the quality of their monitors. In spite of Macintosh's built-in gamma correction, an older monitor or a low quality monitor adversely affects color accuracy.

All designers should be aware that most anti-glare screens result in darker and duller colors.

Once a designer has the highest quality equipment, calibration on a regular basis is required. For example, Adobe Gamma can be used to calibrate the monitor.* This tool creates a profile, which is further characterized to match the monitor's particular characteristics. Other calibration devices are available from third-party sources.

Accessible Web Colors

Once the best equipment is in place, the task is to create web colors that are technologically accessible to everyone.

The range of variables that may exist within the color capabilities of a user's computer system determine the degree of color vision. For example, graphic design customers typically have sophisticated computers equipped at least 24-bit color and fully corrected gamma. In direct contrast is the minority of computer users on 8-bit systems. When gamma, bit depth and all other variables are taken into consideration, a significant percentage of average web site visitors have computer systems with varying degrees of color limitations. Regardless of the color capabilities of viewers' computers, successful web design requires stable colors, appropriate file formats and minimum file sizes.

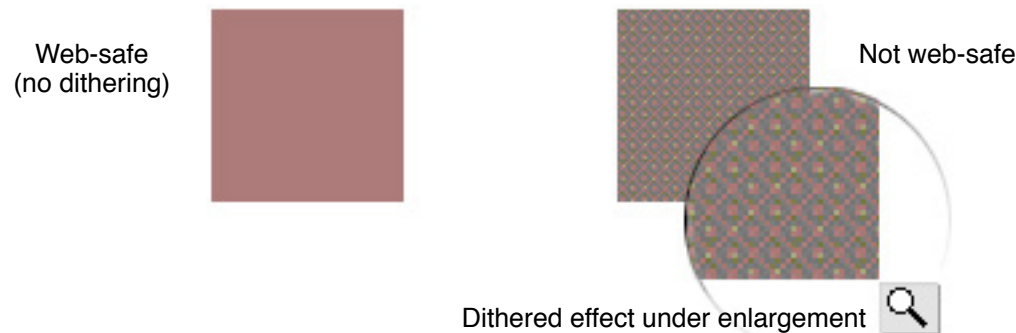
Web designers can employ cross-platform web-safe palettes, hybrid palettes, universal file formats, alternative (alt) tags, and server-based technologies for delivering the most accurate colors possible, regardless of what kind of equipment the customers are using. Furthermore, these steps also ensure the fastest possible download of the images, thereby delivering optimum accessibility to all customers regardless of bandwidth. Detailed descriptions and illustrations of these steps follow.

1. Web-safe colors

There are 216 colors that are common to all computers and browsers. These colors are commonly referred to as the "web-safe" or browser-safe palette. They are a common set of colors that display, without dithering, on all computers. Web-safe colors don't guarantee the same colors on all machines but they do ensure that the "palette" matches the basic colors built into all Windows and Macintosh computers.

Although the majority of computers are equipped with a minimum of 64,000 colors (16-bit) designers should be aware that the color stability of "web-safe" colors is a conservative approach.

Using this palette also solves the problem for the minority of 8-bit systems that can only display 256 colors on the screen at any one time. In this situation, if a color exists outside of the system's palette, the color may shift to a noticeably different color, or the computer may attempt to simulate the color by patching together tiny dots of colors. This "dithering" is illustrated below.

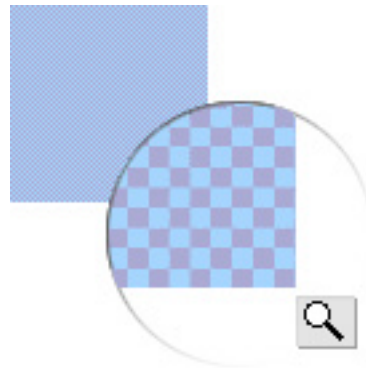


The Most Conservative Approach

"Hybrid" web-safe color combinations for 8-bit systems

It's possible to make over 10 million other combinations by mixing two or three web-safe colors. These hybrid colors can be generated by mathematically combining and dividing the RGB formulas or by plug-in tools,

A hybrid color



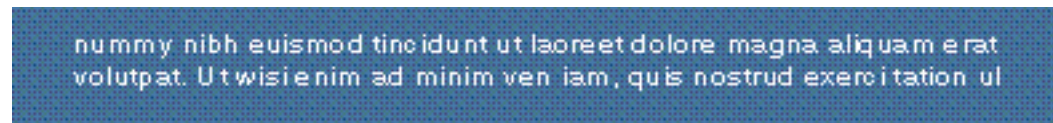
The checkerboard pattern (dithering) in these combinations is noticeable only under magnification. In this controlled situation, the dithering is limited to two or three web-safe colors. It achieves desirable effects, creates a stable color, and does not affect the readability of text. On the other hand, randomly generated dithered colors, as presented in the preceding pages, may consist of dozens of colored speckles and may cause adverse effects.

About 8-bit distortions and text

On 8-bit computer systems, "unsafe" colors (those that can only be generated by computers with 16-bit capabilities) may negatively affect color accuracy and legibility of text. Compare the differences in the illustrations below:



When the "16-bit" blue is used as the background on a web page this is the effect on computers limited to 8-bit colors:



Although this issue affects a minority, web designers must be aware that text and background colors based on colors outside the "web-safe" palette may have adverse effects.

About 8-bit color distortions and graphics

Colors in line drawings are subject to distortions in the gif conversion process.
Compare these three examples:



Original graphic image
before gif conversion

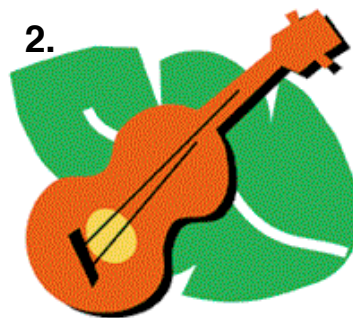


Image converted to gif
using web-safe colors
and dithering



Image converted to gif with
web-safe colors
no dithering

In example #2, the colors are closer to the original but the dithered effects may be undesirable on 8-bit systems. In image #3, the color of the guitar has shifted in the conversion to the "web-safe" palette.

Dedicated gif conversion tools allow the designer to select other color palettes for dithered and non-dithered options in graphics for computers with 16-bit color capabilities. Compare the effects in the maps below:

**GIF - "Web-safe" colors
dithered**



**GIF - "Web-safe" colors
not dithered**



**GIF - "Adaptive colors"
dithered (diffusion)**



Newer versions of Photoshop include a "Save for Web & Devices" function that includes gif conversion options for a wide range of effects. For example, the GIF image at the far right was generated with the GIF **adaptive** dithered option (which incorporates 16-bit colors) and the dithering was set to the diffusion algorithm. The colors do not have the "speckled" effects seen in the "basic" dithered GIF at the far left (which was restricted to web safe colors with the dithered option).

2. File formats for color accuracy

Converting images to the correct file format not only delivers the best colors and the best images possible but it also lowers file sizes and shortens the download time. The two most commonly used file formats are GIF and JPEG. Each one deals with color in a different way.

GIF (Graphic Interchange Format) is best suited for line art and solid colors. JPEG (Joint Photographic Expert Group) format is best suited for photographic and other “continuous tone” images on the Web.

GIF



JPEG



Regardless of the user's operating system, gif files are limited to 256 colors (8-bits) and are automatically compressed when they are saved. Lowering the bit depth to 6 or 4 will decrease the number of colors as well as the file size. Compare the gif and jpeg file formats and file sizes of the line drawings below:

GIF - 4K



Gif images contain 256 colors (regardless of whether they are web-safe colors or others). The effect is usually a solid color area. Other colors may be simulated by patching together these colors. The enlargement of the olive demonstrates the limited range of colors generated when an image is converted to a gif. This file format is best suited to line drawings.

JPEG - 15K



JPEGs can contain up to 16,000,000 colors. The enlargement of the olive clearly demonstrates the wide range of greens that are generated when an image is converted to a jpeg. The jpeg file format can not create the crisp, solid color effects required by line drawings.

Note: Use the zoom tool on the tool bar to see details.

JPEG is a “true” color graphic that takes advantage of the full gamut of RGB colors. It is referred to as a 24-bit color image. Each pixel of the image can be one of any of possible 16,777,216 colors (2 bits to the 24th power). Therefore, it is “true” in the sense that it can contain the widest range of colors possible. The compression process analyzes the image to see how frequently each color is used. Colors that are used infrequently are changed to the next closest color that appears more frequently in the image. Dedicated software, such as Photoshop 5.0 and higher, enable the designer to choose the quality of compression and the lowest possible file size.

Compare these examples of photographs in gif and jpeg file formats:

JPEG - 12K



The jpeg image contains millions of colors. Notice how the gif patches together a limited number of hues from its 256 color vocabulary to simulate a full color effect. The enlargements of the olive demonstrate the differences.

GIF - 34K



3. Color compatibility and file formats

Placing a jpeg on top of a solid color background on a web page can cause unexpected effects. Even if the background of the jpeg appears to be the same color as the web page background, the final result may be quite different on all computer systems.

The effects of a jpeg graphic on top of a blue web page background are illustrated below.

The original graphic in the jpeg file format



The same graphic placed on top of a blue background.



The background of the "Blue Jpeg" image is a slightly different blue than the background blue. The jpeg format draws from millions of colors to create any single color. The solid web page background is using only one color.

Photographic jpeg images can also cause problems. For example, a photograph containing a black background placed on top of a black background web page may create a confusing "figure ground" relationship. Since the JPEG file format creates a wider range of colors, photographs should be framed by a one-point line or other technique. Once framed, the color differences between the image and page background will not be as noticeable.

The effects of a gif graphic on top of a blue web page background are illustrated below.
Compare these effects with the jpeg graphics on the previous page.

The graphic is placed on a blue background.

The original graphic in a gif format



The background of the "Blue Gif" image is the same blue as the background. Both are #3366CC, a web-safe blue.

Line art, or even text with a drop shadow, should be created on the same background that it will eventually be placed upon and the transparency option should be used for the background color.

4. Previewing

Previewing the images on a wide variety of other platforms and browsers is the best way to understand and predict color variations. There is no better technique than developing an eye for how certain colors may shift under numerous conditions. Furthermore, the designer will build an invaluable vocabulary of color nuances. For example, knowing that a dark blue (#000033) may look black on 15% of PCs, will help the designer take remedial steps.

There are also several tools that display the gamma differences in graphic images. The best way to do this is with Photoshop (which has a feature most other apps don't have). Here's how it works:

Open the graphic document in Photoshop and select View/Proof Setup. Choose any of the options.

Alternatively, some graphic applications allow you to change the gamma settings for viewing an image in the application's settings or preferences options.

As a rule, if images look good at gamma ranging from 1.8 - 2.2, they will be acceptable on both Macintosh and Windows platforms.

5. Alternative (alt) tags for color information

Alt tags can be used to define the colors (as a preventive measure for viewers using computers with limited color capabilities). For example, describing the color as “bright tomato red” will add the necessary information. This is especially significant for merchandise such as clothing and interior design products.

Unfortunately, the English language does not provide an accurate color vocabulary. While Eskimos have over 100 specific terms for white— their survival depends on detecting the differences between variations in their snowy terrain—very few English speaking people can define and agree upon the difference between bone white, antique white, champagne white, and off-white. As a rule, natural materials such as plants and minerals provide definitive color terms. Sticking to commonly used color terms such as light and dark, bright and muted, are also safe — for example, “light muted blue.” Do not use meaningless poetic terms such as “Riviera blue.” Furthermore, descriptive words that are peculiar to a specific country, such as “school bus yellow” should also be avoided.

6. Server-based technologies

Although downloading plug-ins and other time-consuming steps should not be required for any store, sometimes a customer may be willing to sacrifice some time for color accuracy. As long as it is offered as an option, sites may benefit from these tools.

The Future of Color on the Web

Currently, web browser software can't perform gamma and chromaticity correction. In the future, both the graphic file and the browser may be able to compensate for these differences. Once this function is fully developed, the browser will be able to adjust the graphic to the user's gamma.

PNG (Portable Network Graphics) file format is now available as a reliable and time-tested solution. Graphics created as PNG (pronounced ping) store gamma and chromaticity data for improved color matching and will work on all computer systems—and on 95% of browsers.

Another option, the sRGB color space, has provoked considerable debate in the past. Some say “Keep everything in sRGB and the color will be ‘good enough’ for consumers.” In truth, it was never designed as a solution to color accuracy on the web. Furthermore, sRGB is a very limited color space which represents the “average” PC display – a \$100 VGA screen at best. Today's monitors offer far greater capabilities. The web designer must decide whether images should include profiles for the lowest common denominator or for a wider color space.

As preparation for any new developments in the future, designers should save high-quality versions of graphics in an uncompressed, lossless format (such as Adobe Photoshop PSD or TIFF). When new tools become available, these graphic files can be recalibrated without loss of image quality.

APPENDIX

Footnotes

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About the author

Jill Morton is one of the foremost color experts and researchers in the world today. She holds the highest academic credentials, a Masters Degree in Art, and has served as faculty at the School of Architecture, University of Hawaii and Chaminade University and has served as faculty at several universities.

In her primary work as a color consultant, she brings the highest level of technical and professional knowledge about color to a wide range of projects. Psychological color impact, innovative color combinations, attractive color harmonies, visual ergonomics and marketing trends are the critical factors she addresses in prescribing successful solutions for her global clients. Her portfolio includes projects for Nokia, Dow Chemical and Eastman Kodak as well as many others in almost every industry sector.

Ms. Morton's opinions and research have been quoted and featured in major publications such as Fortune, USA Today, American Demographics, The Chicago Tribune, and House and Garden.

As director of the International Color Research Institute, she manages the demographic data in the Global Color Database, a one-of-a-kind compilation of information about color preferences and associations gathered from over 120,000 people worldwide, since 1997.

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