

CMPT 165

INTRODUCTION TO THE INTERNET AND THE WORLD WIDE WEB



Special Topic I

The Visual System and Colour

Topics

1. The Visual System

2. Colour Theory

3. Colour Choice, Palettes, Tools

4. Colours in HTML/CSS

5. Positioning Elements

6. Steps in Webpage Creation

Lecture 1

Lecture 2

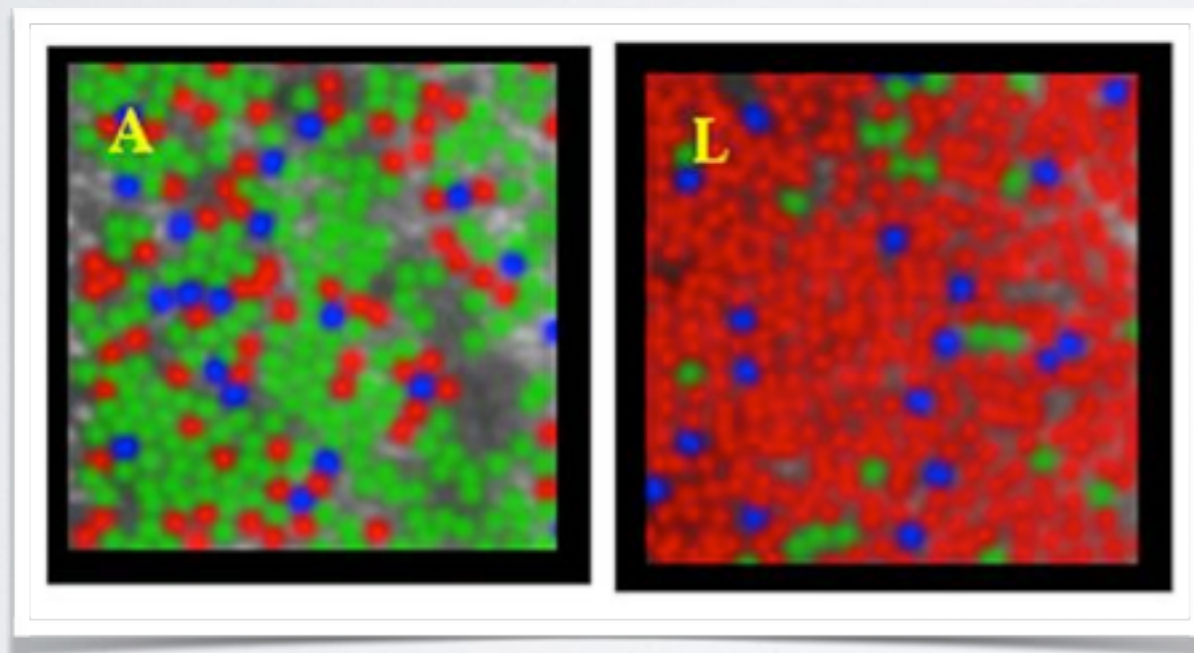
Questions to Ponder

- How do we process or perceive colour?
- What is colour theory?
- How does colour blindness affect colour choice?
- How can we use colour to create illusions?
- How can colour affect readability/like-ability?
- What is a colour palette/scheme?
- Do colours have cultural meaning?
- How can I use a palette to help design a webpage?

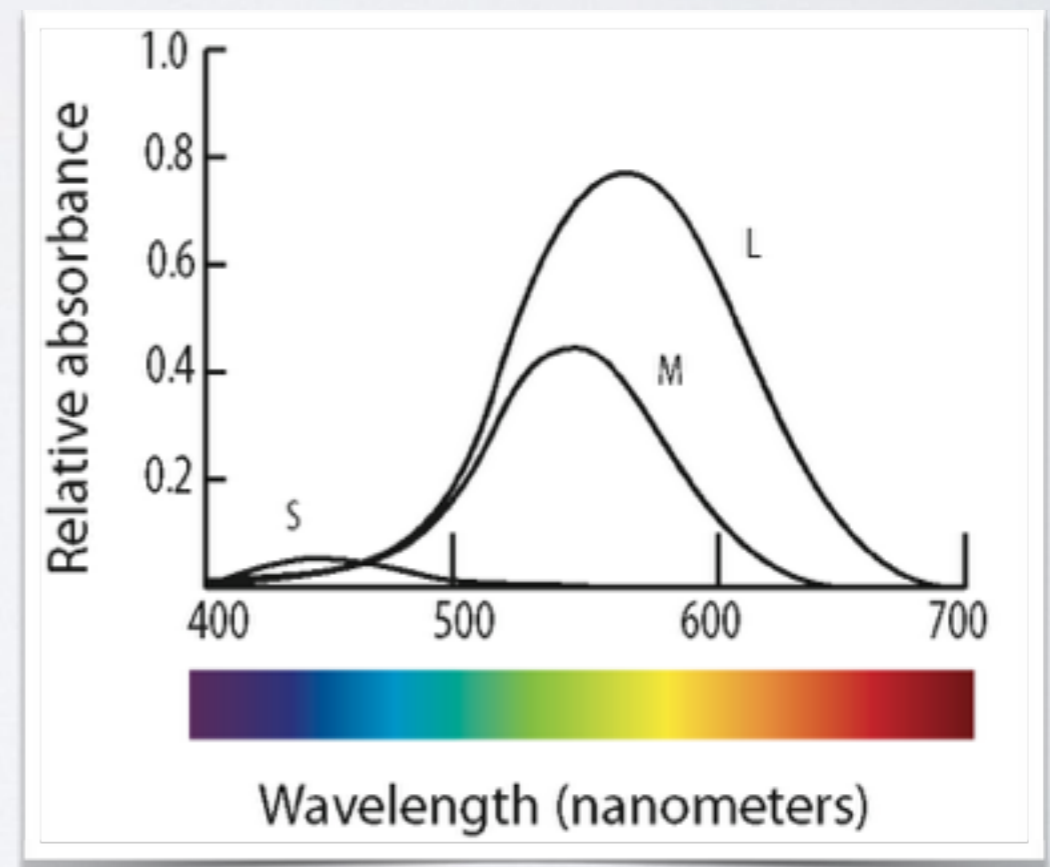
The Visual System

A simplistic view, **our eyes** have cones and rods.

- **Cones** used for our daylight vision (photopic vision)
- **Rods** used for low-light / night (scotopic vision)



Cones in the fovea of the eye.
Not very many S cones.



S = blue, M = green, L = red

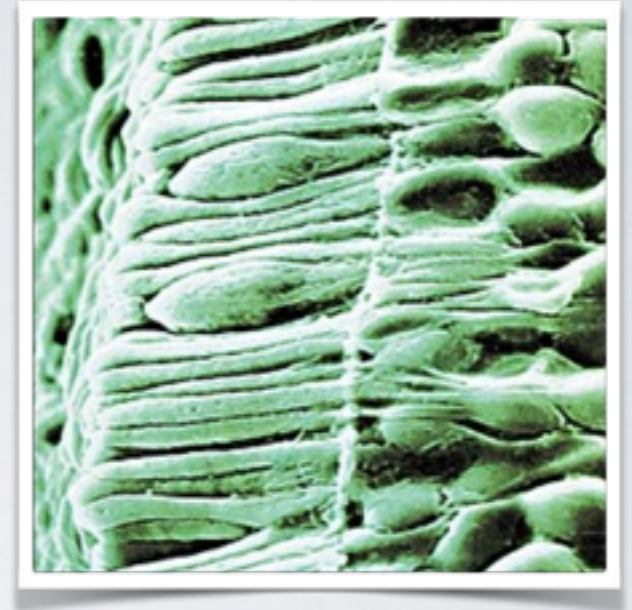
Rods and Cones

- **Rods**

- active at low-light levels (night vision)
- only one wavelength sensitivity function
- 100 million rod receptors

- **Cones**

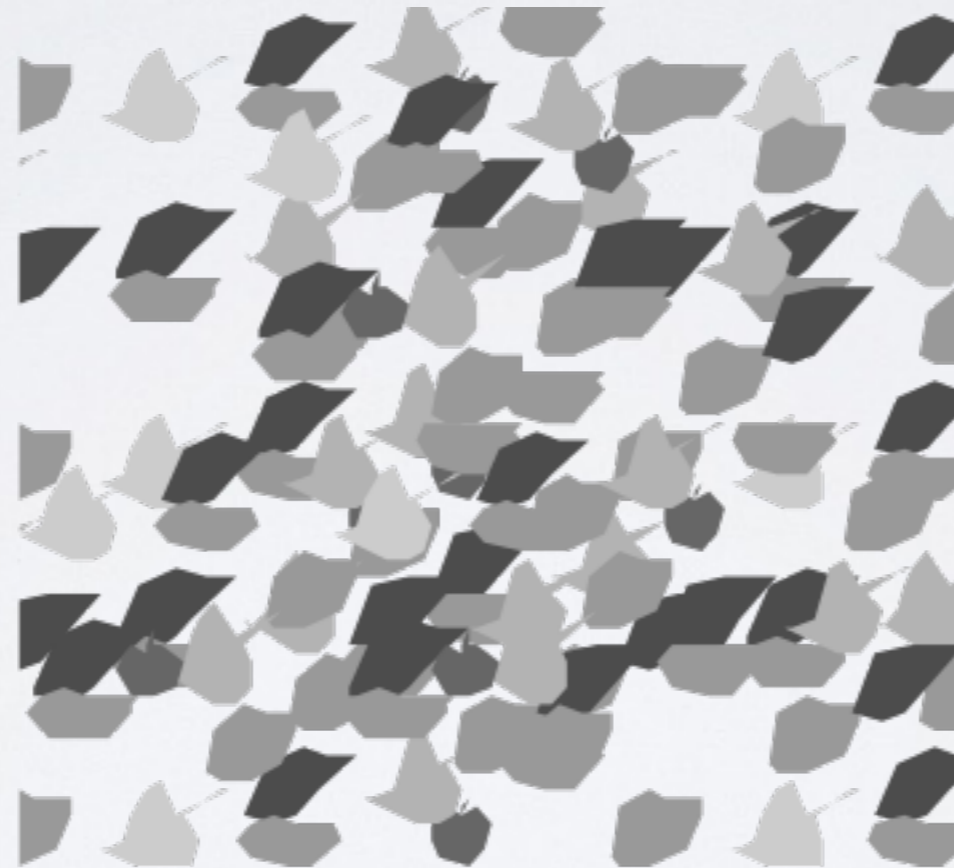
- active at normal light levels
- three types: sensitivity functions peaks at different wavelengths (red, green, blue)
- 6 million cone receptors
- Focused in the centre of vision (fovea)
- The signals for many rods are bundled together into the optic nerve fibres that carry signals to the brain.



Is colour important?

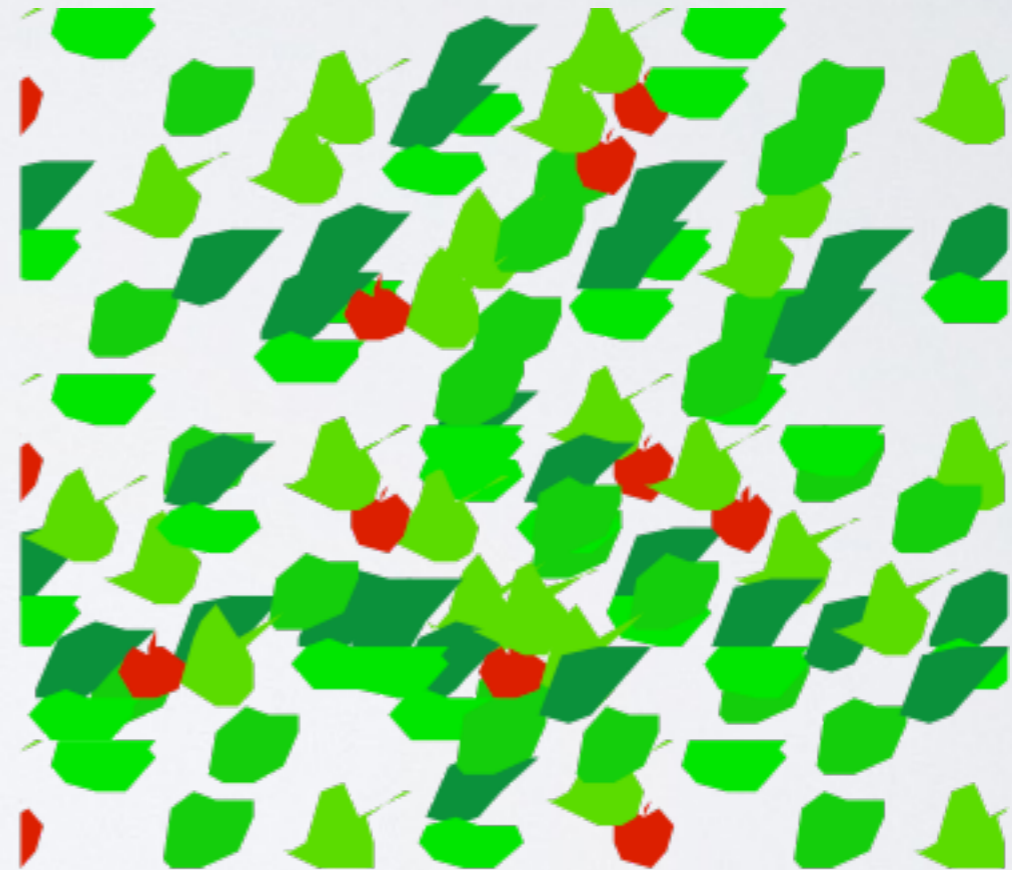
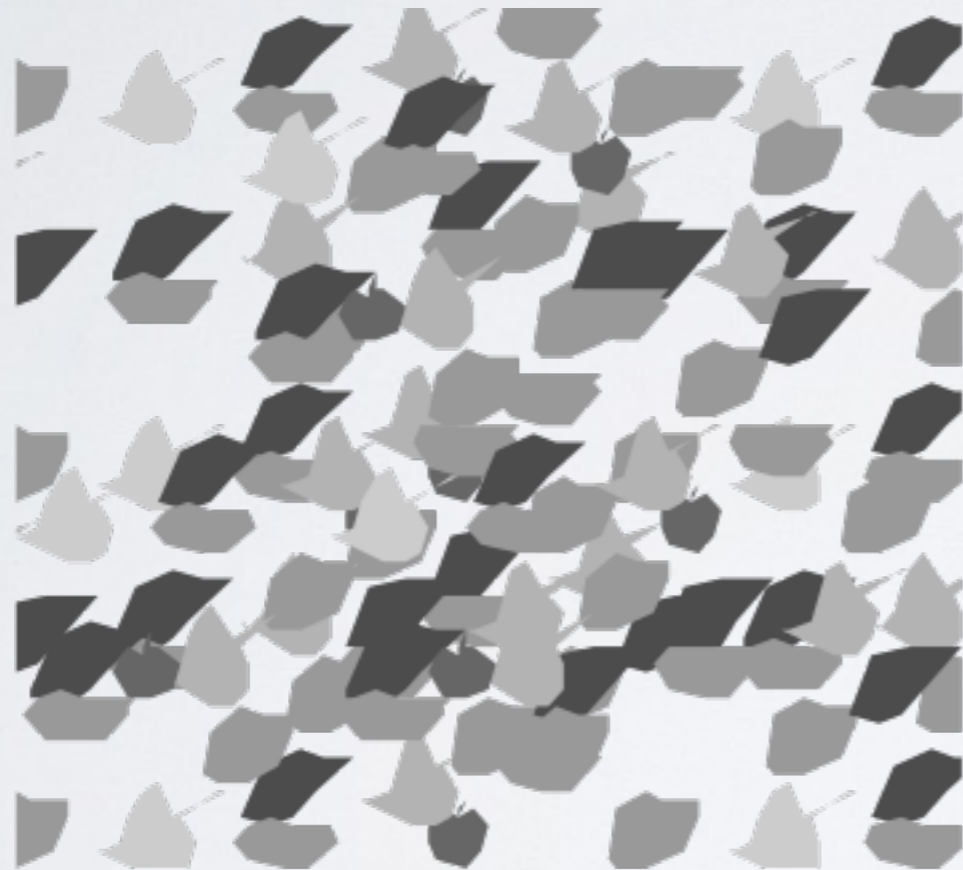
Where are the apples?

huh?



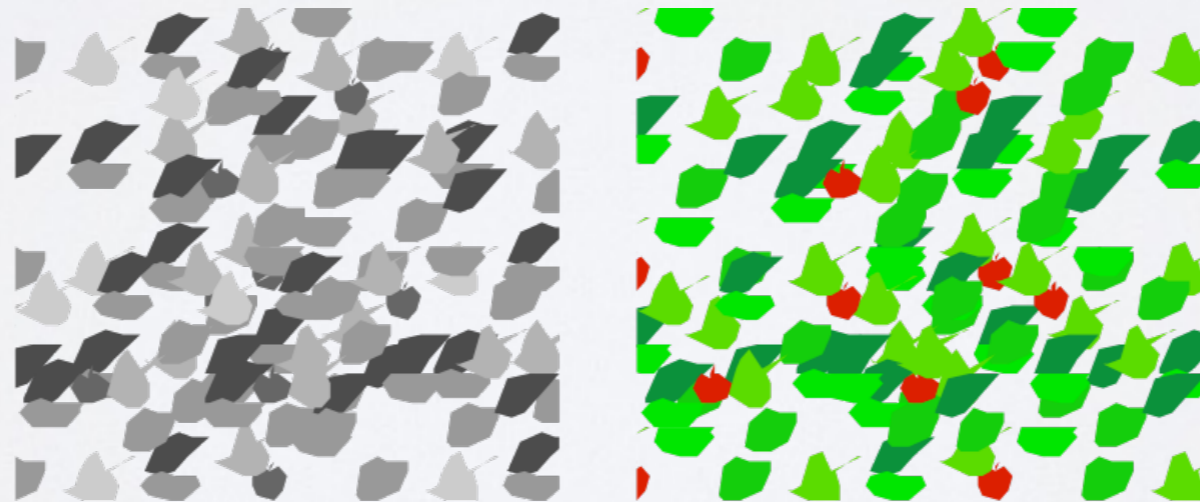
Where are the apples?

Colour is Important ...to humans!



Colour is Critical

- To help us break camouflage.
- To judge the condition of objects (food).
- To determine material types.
- Extremely useful for coding information, visual queuing.

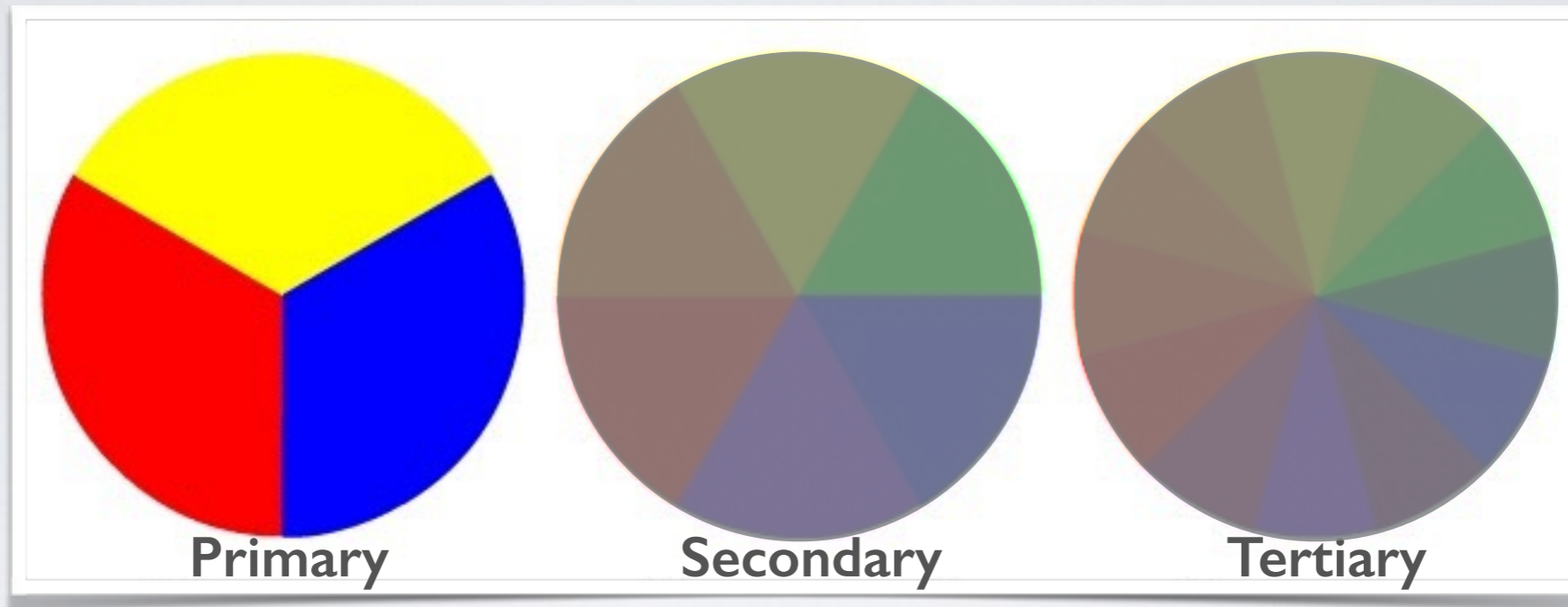


Colour Theory

- Big complex conglomerate of theories.
- Creates a logical structure for colour and shows how colours relate to each other.
- 3 basic categories of in colour theory:
 - Colour wheel — logical arrangement.
 - Color harmony — aesthetics.
 - Colour context and use.

Colour Wheel

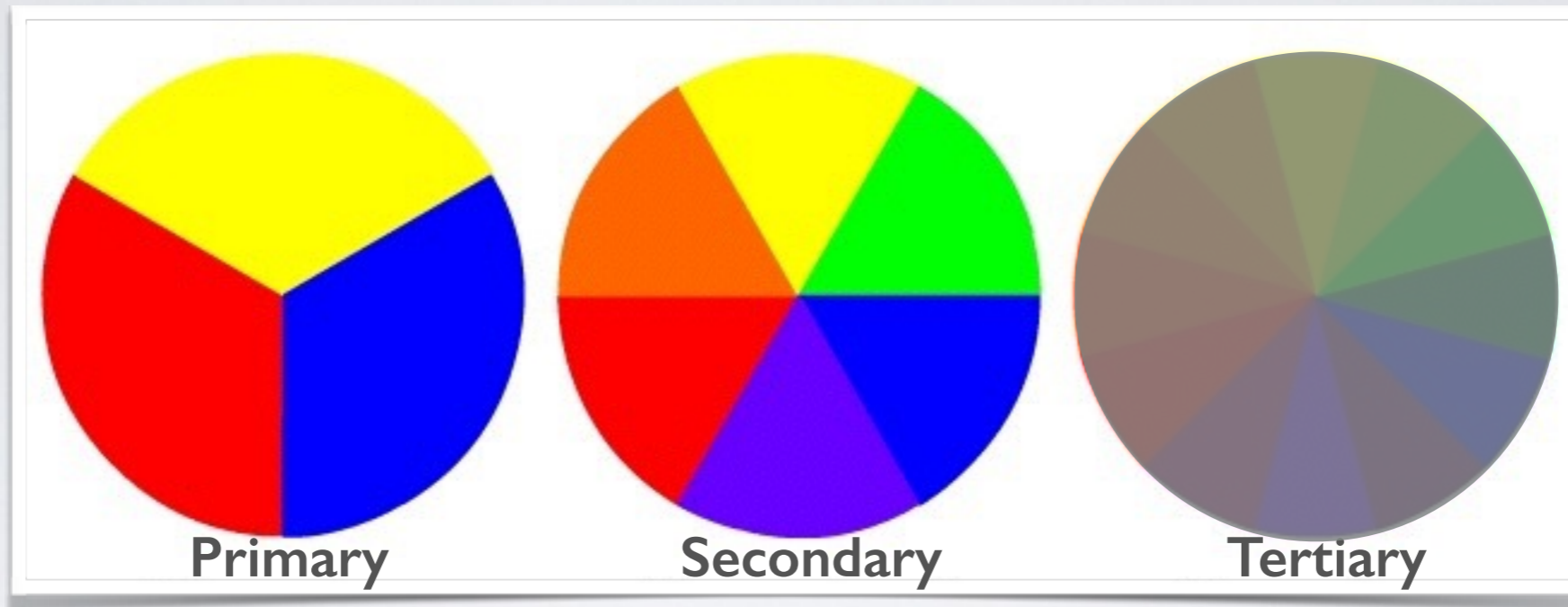
(Primary Colours)



- Colours: red, yellow, and blue
- Traditional colour theory (paint and pigments).
- Can not be created from combining any other colours.
- All other colours are created by combining these 3 colours.

Colour Wheel

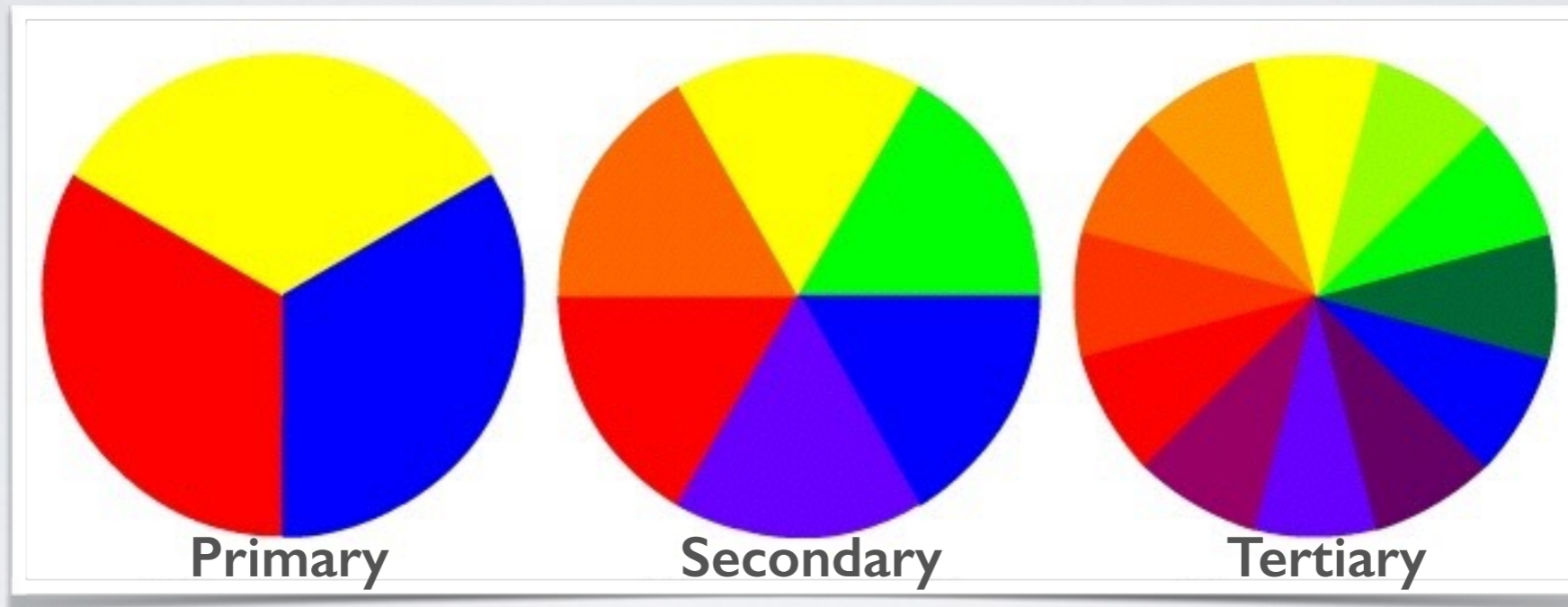
(Secondary Colours)



- Colours: green, orange and purple
- by mixing the 2 adjacent primary colours

Colour Wheel

(Tertiary Colours)



- Colours: yellow-orange, red-orange, red-purple, blue-purple, blue-green & yellow-green
- Mixed from a primary and a secondary colour.
- Hence the two word name, e.g. blue-green, red-violet.

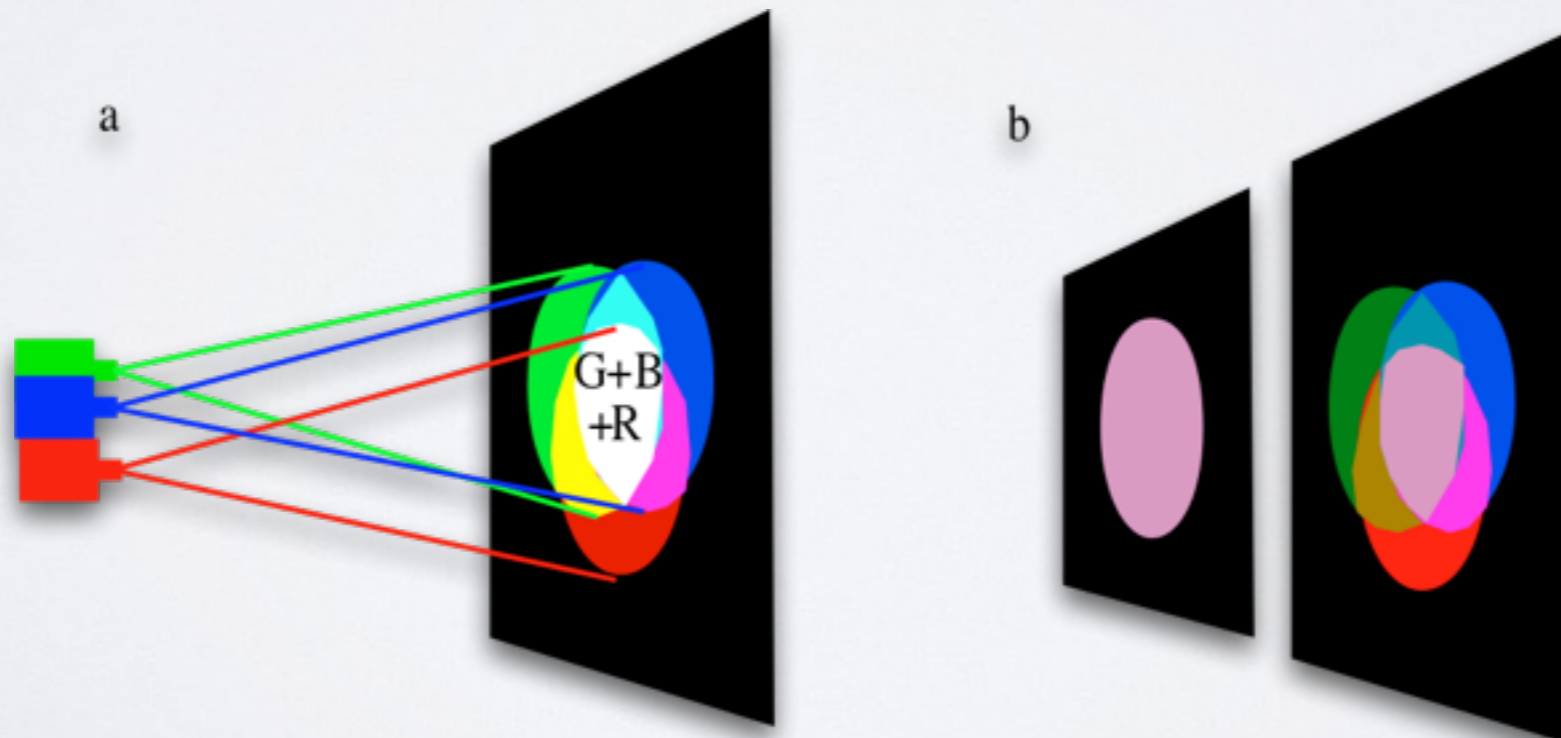
Warm and Cool

- Colours have **temperature**:
 - **Warm** colours have more yellow undertones
 - **Cool** colours have more blue undertones.
- Warm and cold are on opposite sides of the wheel.
- Colours in the middle have an equal balance of yellow and blue.

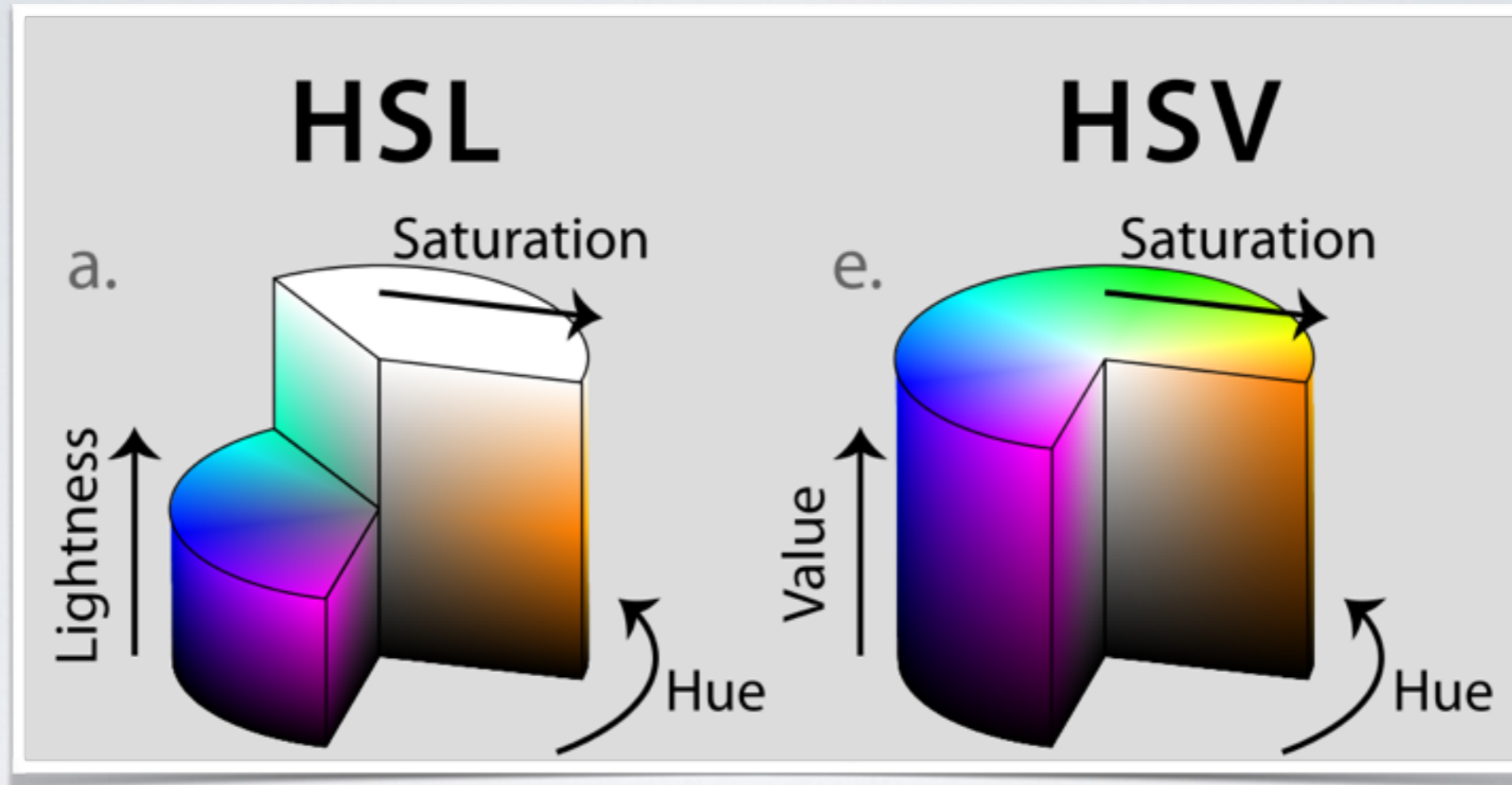


Monitors and TVs

- Computer Monitors and TVs:
 - uses colour like our visual system.
 - RGB (red, green, blue)
- Think of it like 3 coloured lamps shining out at you:



Selecting/Defining Colours



Hue is the colour.

Saturation is the strength or vividness.

Lightness is the tone or perceived reflectance. Sometimes called **Value** used in computer graphics.

Describing Light

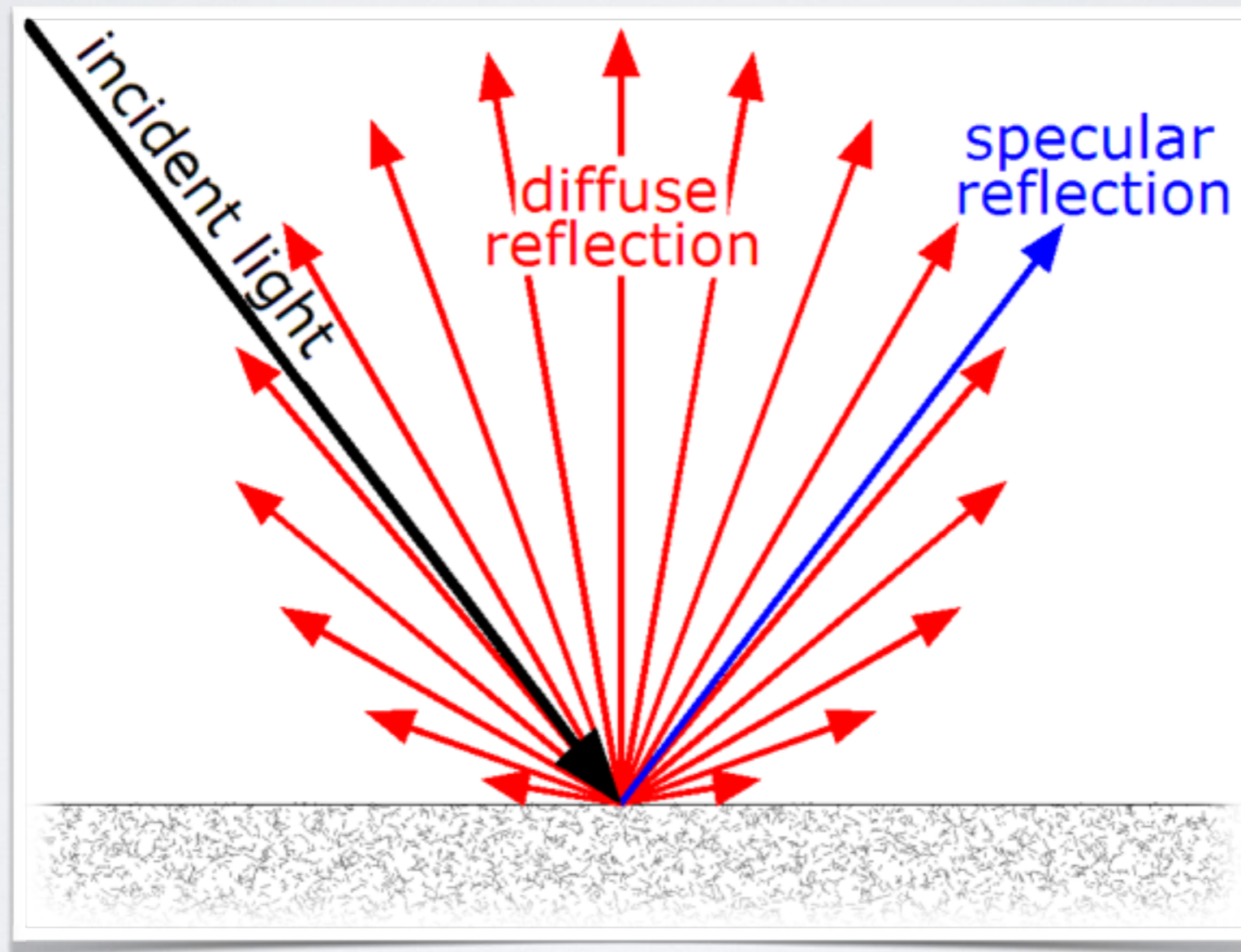
Luminance is the physical amount of light emitted. Amount of light emitted/reflected from a flat, diffuse surfaces.

Brightness is the perceived amount of light. The appearance of radiating or reflecting light, e.g. in a photo.

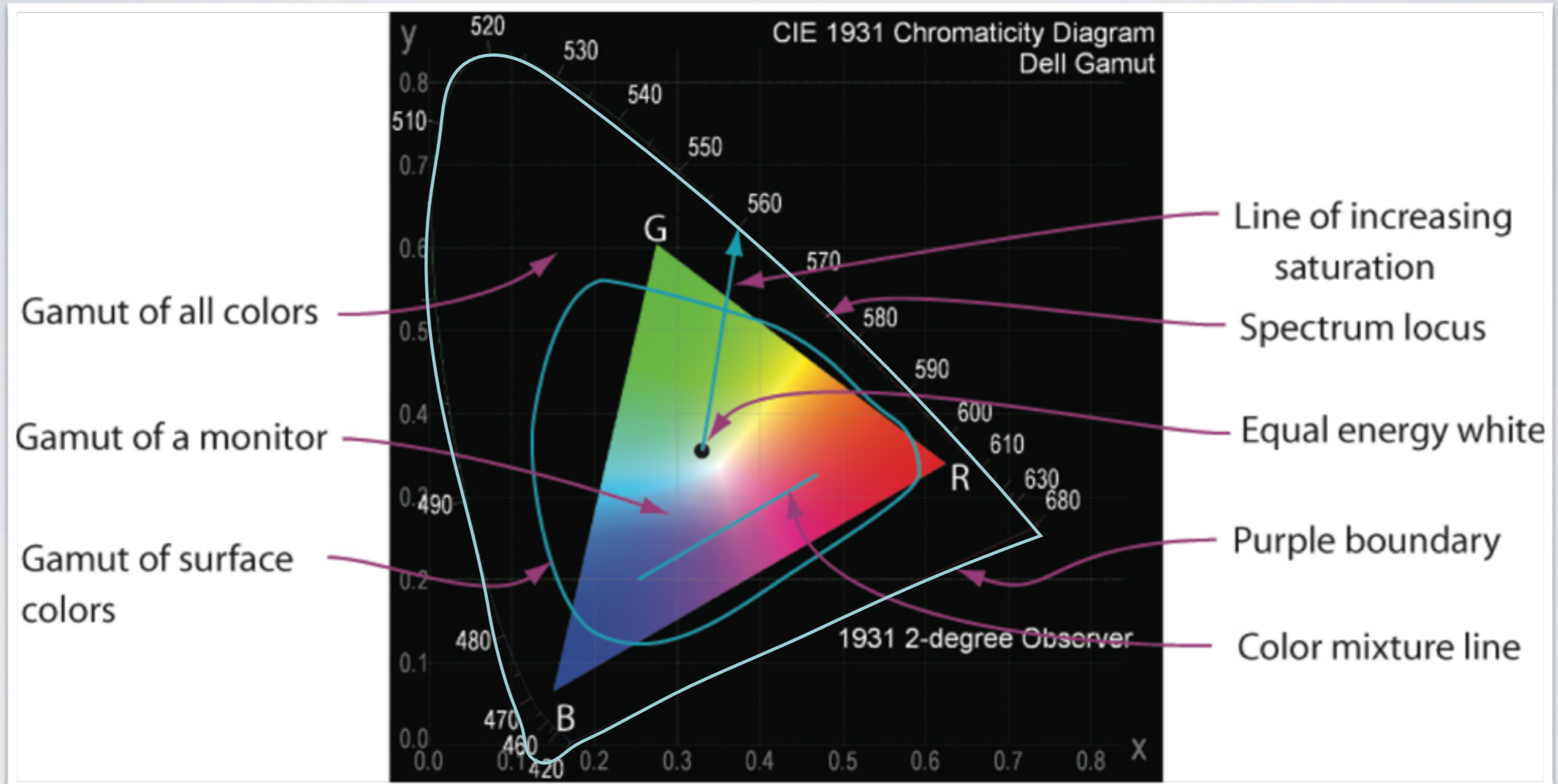


Describing Surfaces

Diffuse surfaces reflect light at many angles, not one angle as a mirror-like surface (**specular surface**) would.



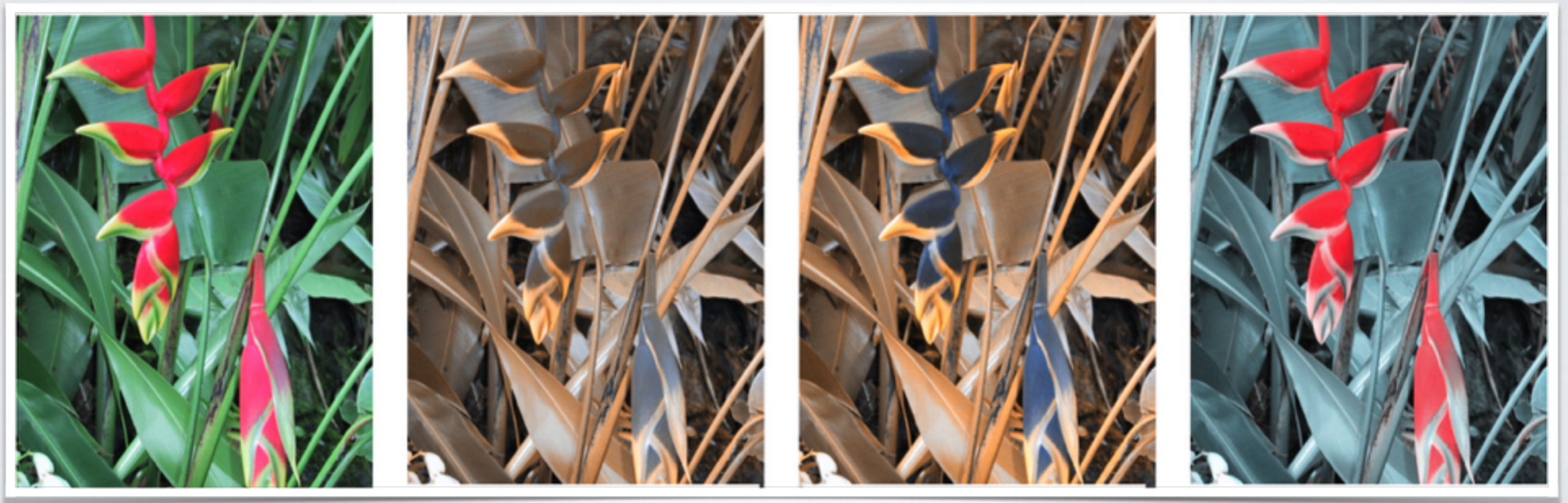
Colour Gamut/Range



RGB is a small subset of a much wider range of colours.

Colour Blindness

- 8% of males are colour blind, no applicable to females.
- We can use [Vischeck](#) to test colour choices.
- Important if colour has meaning on your webpage!



Deuteranope

Protanope

Tritanope

Protanopia



Deuteranope

Protanope

Tritanope

Resulting from insensitivity to red light, causing confusion of greens, reds, and yellows. It is hereditary and is the most common form of colour-blindness.

Deuteranopia



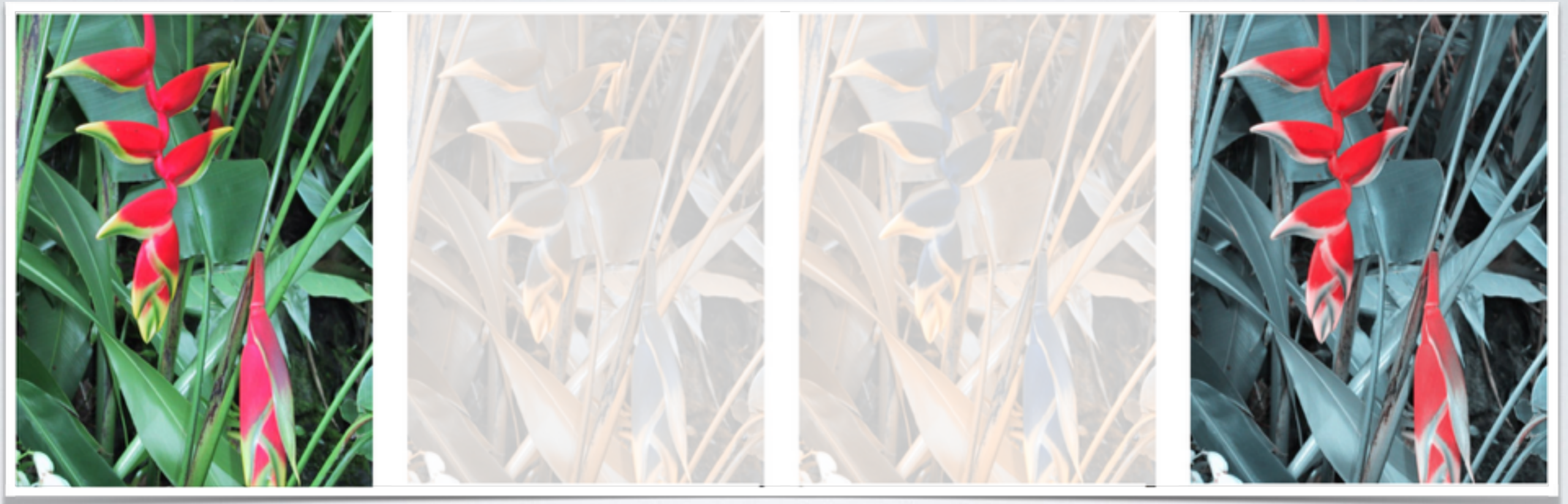
Deuteranope

Protanope

Tritanope

Resulting from insensitivity to green light, causing confusion of greens, reds, and yellows.

Tritanopia



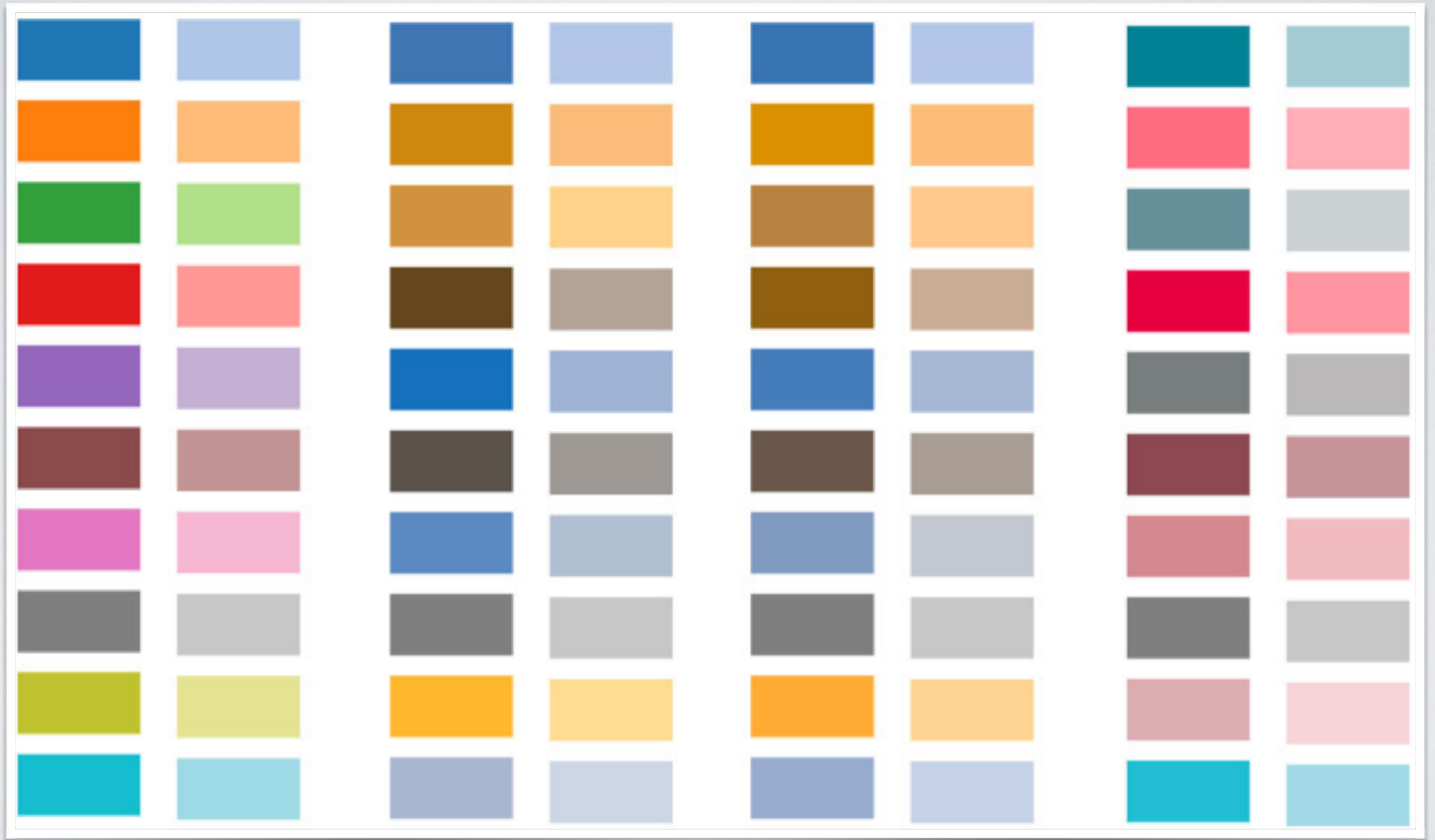
Deuteranope

Protanope

Tritanope

A rare form of colour-blindness. Resulting from insensitivity to blue light, causing confusion of greens and blues.

Watch that palette!



Deuteranope

Protanope

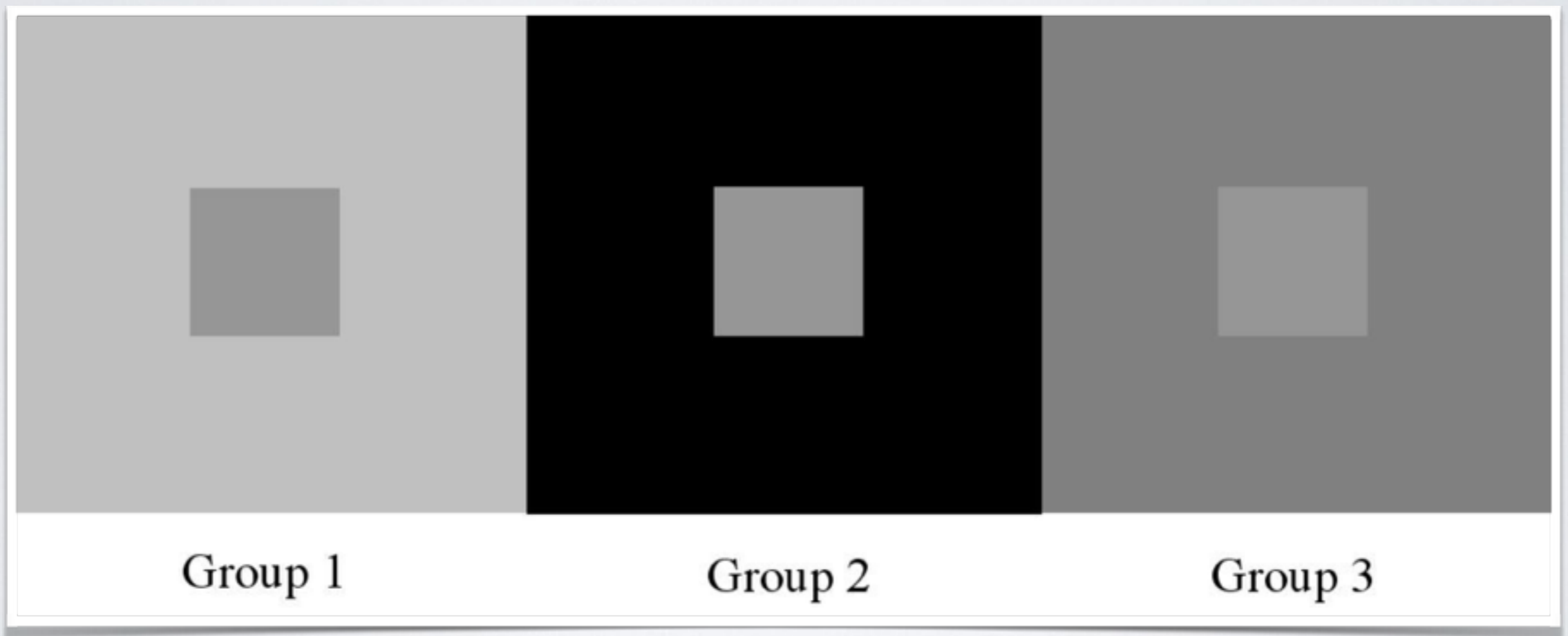
Tritanope

Colour



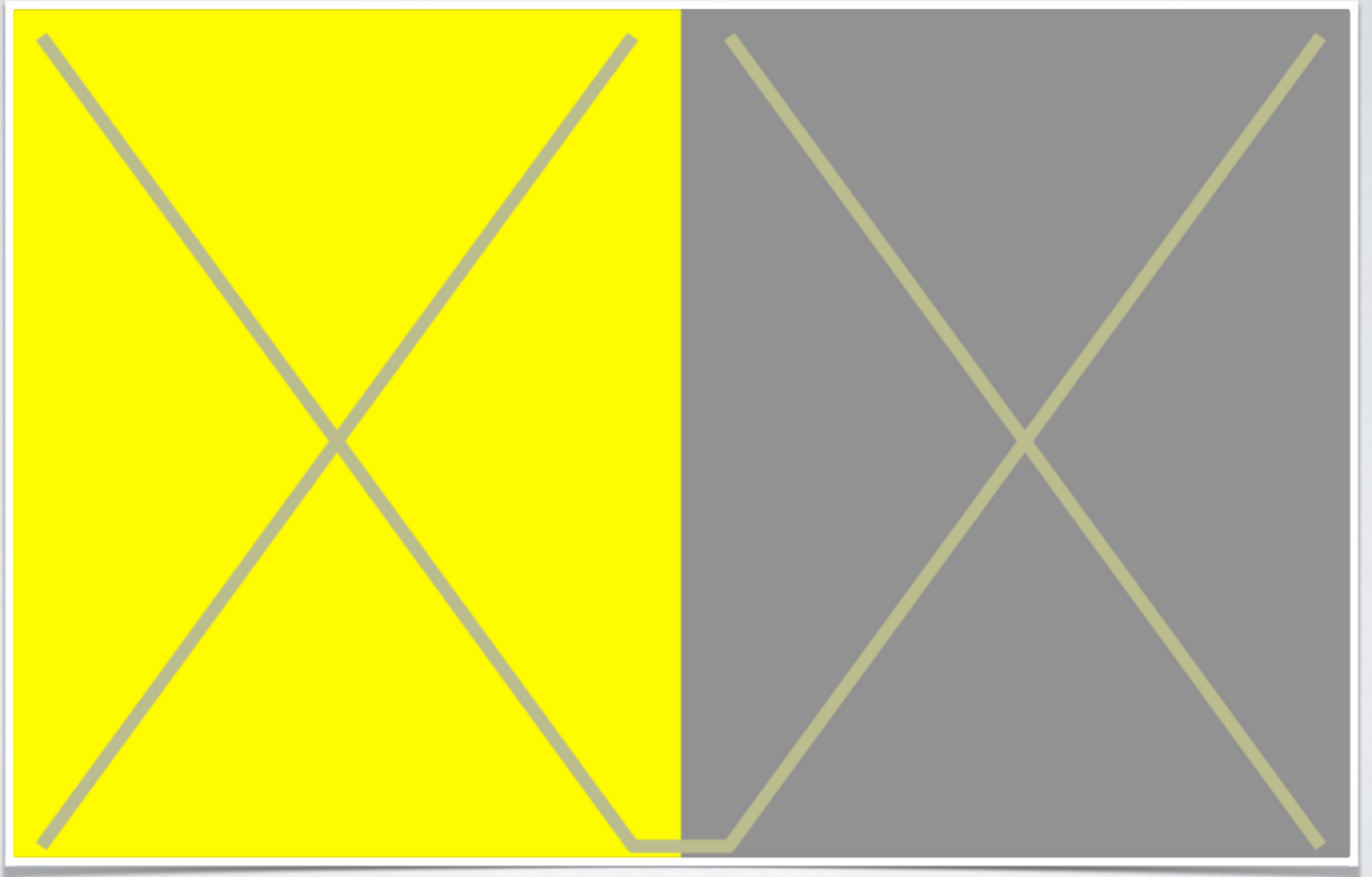
Contrast Effects

True or False? A grey patch placed on a dark background looks lighter than the same grey patch on a light background.



http://www.michaelbach.de/ot/lum_dynsimcontrast/index.html

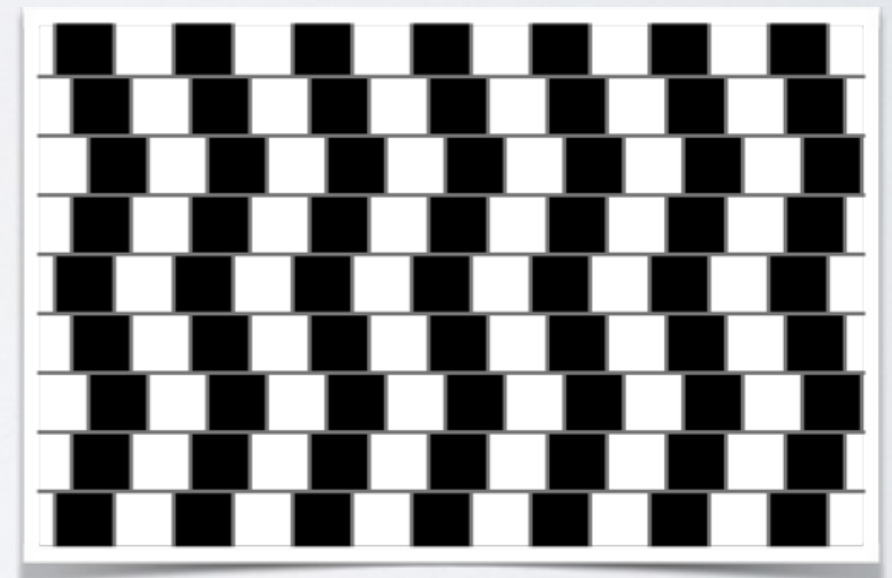
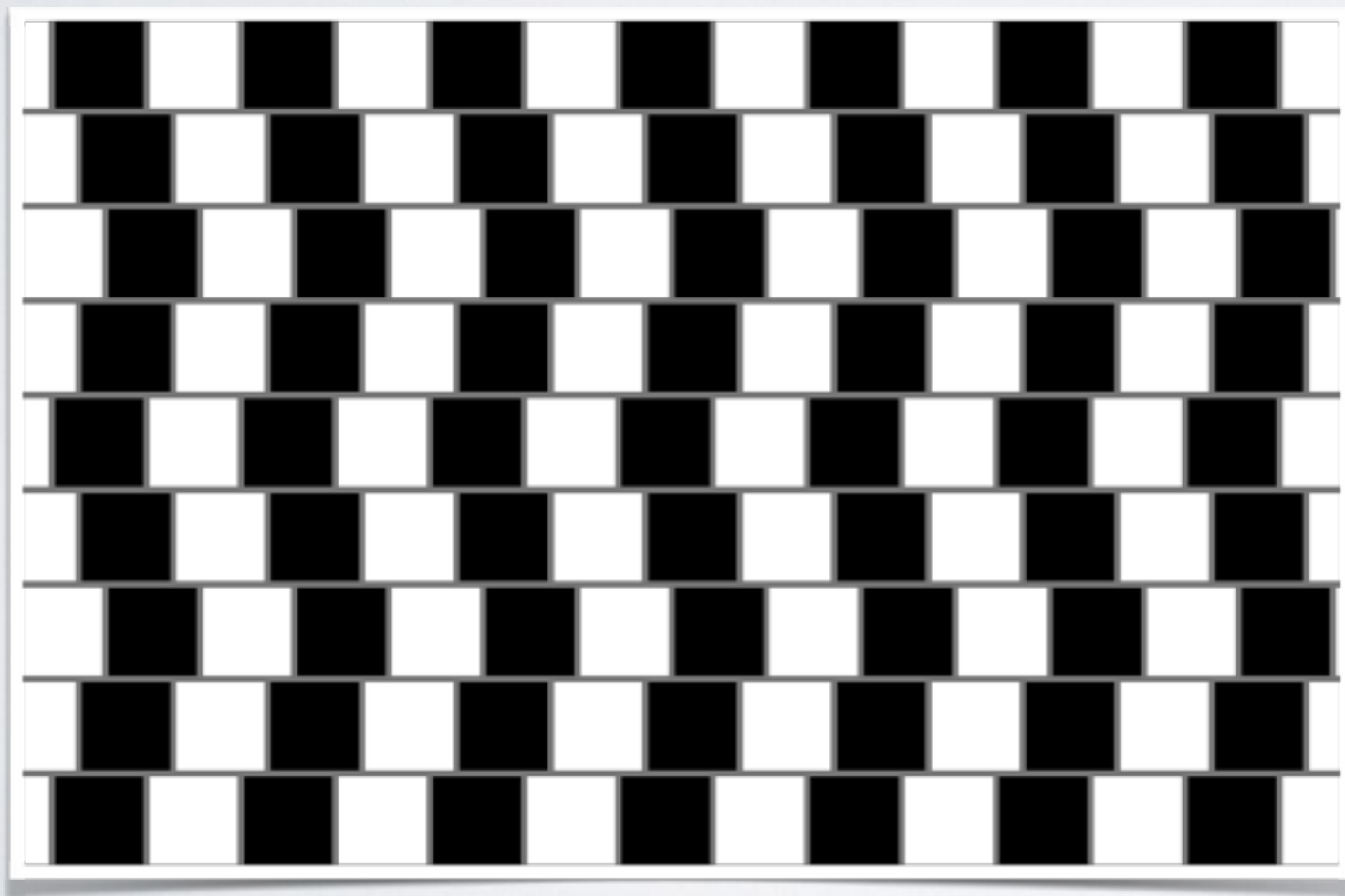
Grey X and Yellow X?



Café Wall Illusion

The horizontal lines are parallel, but visually the lines appearing to be lines curved and tiles wedge shaped.

Is this the effect you wanted?



See [http://en.wikipedia.org/wiki/Café wall illusion](http://en.wikipedia.org/wiki/Café_wall_illusion)

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Dynamic Luminance

Changes in apparent brightness with quick changes in viewing distance.

Move your head forward and backward.

What happens?



Breathing Light Illusion

Change in apparent brightness as you move closer in and farther away quickly.

Move you head forward and backward.

What happens?

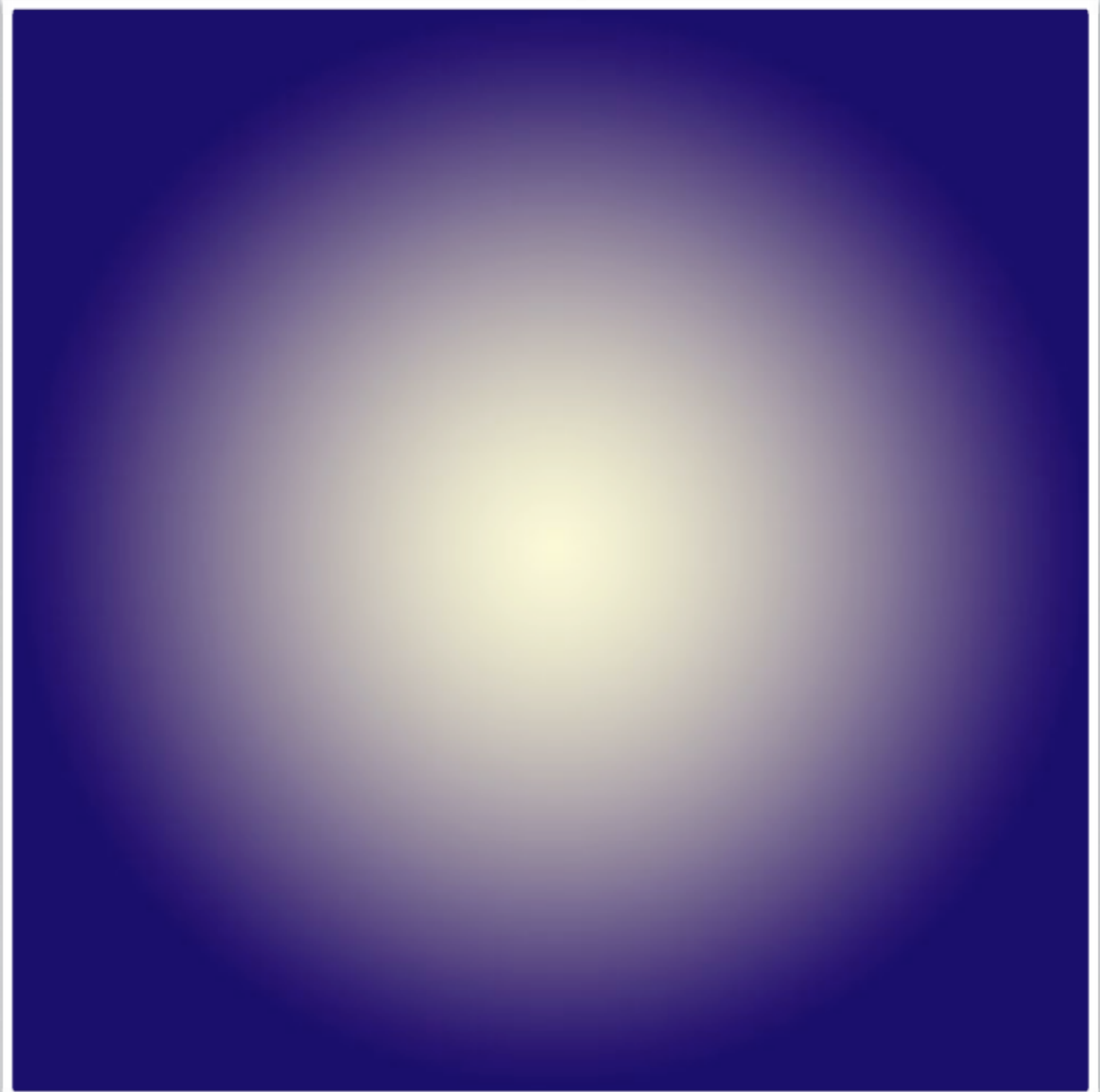


Image from perceptualstuff.org Slide from Lyn Bartram

Gori, S. & Stubbs, D. A. (2006). A new set of illusions - The Dynamic Luminance-Gradient Illusion and the Breathing Light Illusion. Perception. 35, 1573-15771.

Color Harmony

- Selecting colours that are **pleasing** to the eye.
- Selecting colours that **balance** in the visual experience.
- The wrong choice of colours can:
 - can break focus and concentration.
 - can appear to be chaotic and create displeasure.
 - loose the observer and the message being conveyed.

...more next lecture.



QUESTIONS?

Color Palette/Scheme

def. as colour combinations that work together and used

For your website or webpage:

- Pick 2, 3, or 4 colours that will be used
- Can be in addition to black, white, or a shade of grey
- Colours to appear dominant in both the style and images used thought out your website
- The right choice brings a sense of harmony
- Make your site appealing to look at, allows a person to focus on the content and understand your message.

How can we pick colours
to create a harmonious
colour scheme?

Creating a Scheme

We **do not** pick colours randomly!

- There are 2 overarching methods:
 - Dark-On-Light Scheme
 - Light-On-Dark Scheme
- And 7 popular (and algorithmic) selection methods:
 - Monochromatic Scheme
 - Complementary Scheme
 - Analogous Scheme
 - Triadic Scheme
 - Split-Complementary Scheme
 - Rectangle (Tetradic) Scheme
 - Square Scheme

Dark-On-Light Scheme

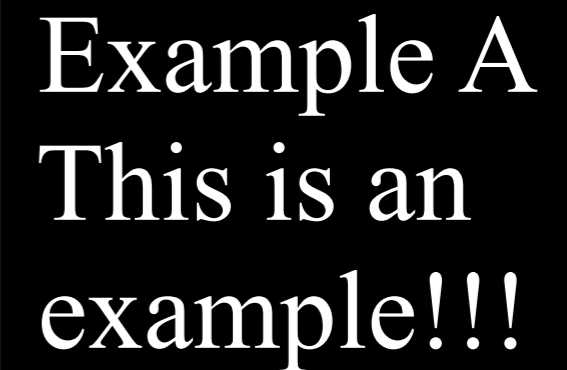
- Dark-coloured text on a light background
- Introduced in graphical (WYSIWYG) word processors
- Simple and most popular
- Used more energy to display
- Can have a *blazing white* effect:
 - Paper reflects light
 - Monitors emit light
 - Causes eye fatigue/strain

Example A
**This is an
example!!!**

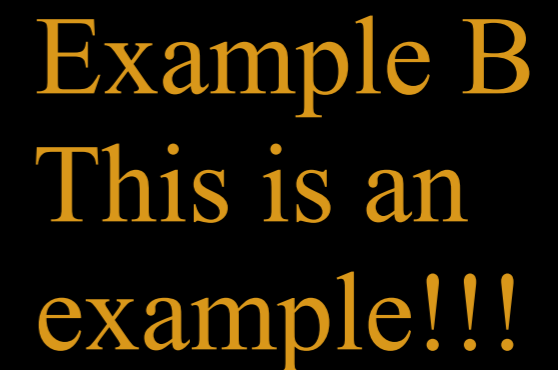
Example B
**This is an
example!!!**

Light-On-Dark Scheme

- Light-coloured text on a dark background (**opposite**)
- Less energy to display, impacting battery life
- Easier to read on the screen:
 - Lower brightness, less eyestrain
- The issue is image transparency:
 - Causes a choppy unsmooth edge
 - Some anti-aliasing assumes white



Example A
This is an
example!!!




Example B
This is an
example!!!

The Text Blues

Blue text on a dark background is to be avoided. We have very few short-wavelength sensitive cones in the retina and they are not very sensitive

Blue text on dark background is to be avoided. We have very few short-wavelength sensitive cones in the retina and they are not very sensitive

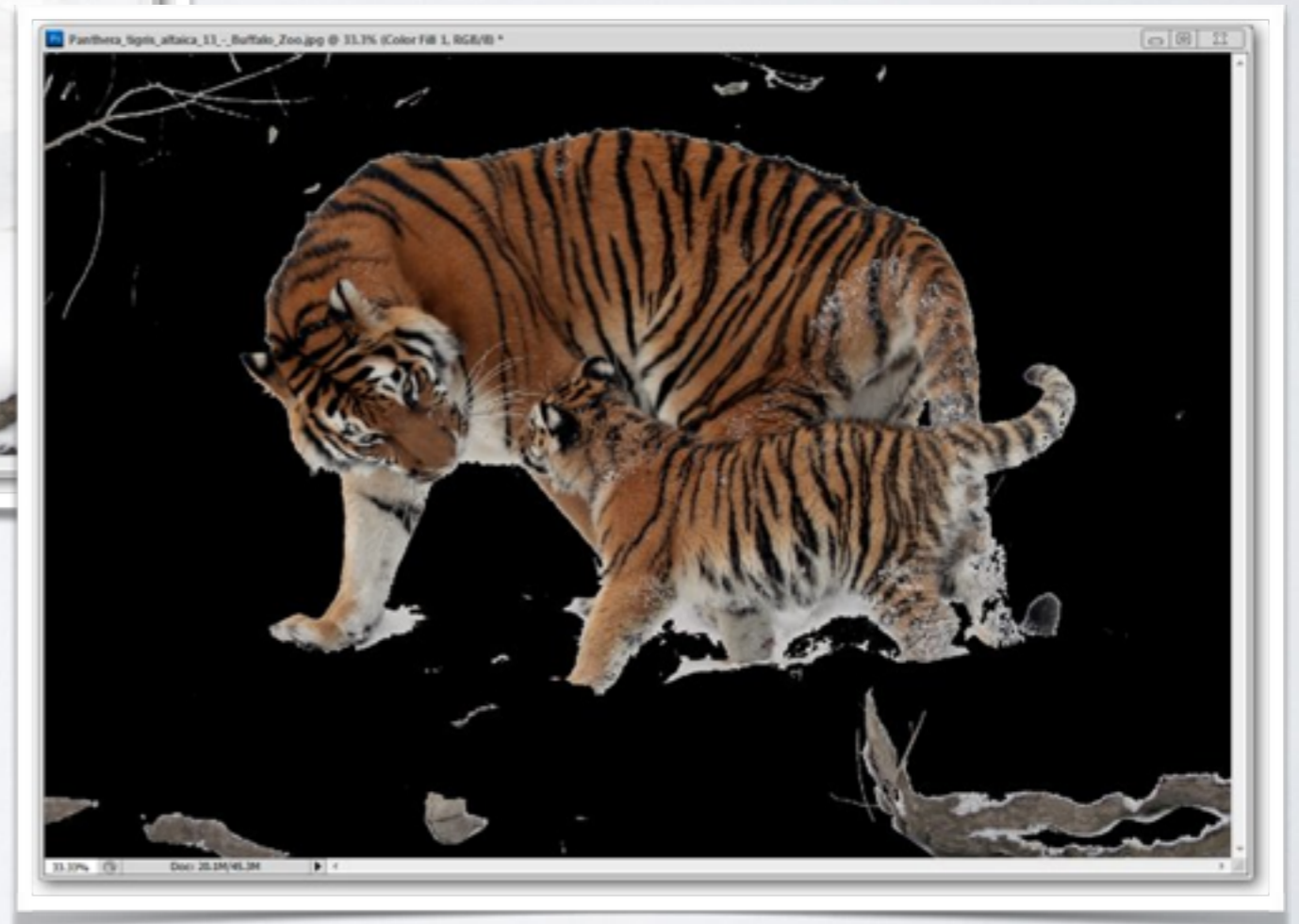


Blue text on a dark background is to be avoided. We have very few short-wavelength sensitive cones in the retina and they are not very sensitive.

Chromatic aberration in the eye is also a problem

Blue text on a dark background is to be avoided. We have very few short-wavelength sensitive cones in the retina and they are not very sensitive

Feeling Edgy?



Images from <http://www.howtogeek.com/76383/3-easy-tips-to-fix-ugly-edges-when-removing-backgrounds/>

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See the white edge?



Monochromatic Scheme

- One colour, many shades
- Varying saturation and lightness/value
- Plays off the subtle differences of shades
- Used to attract attention, create focus
- Strong sense of visual cohesion

Example A
This is an
example!!!

Example B
This is an
example!!!

Palleton Example



Complementary Scheme

- Opposite colours on the colour wheel
- Vibrant with high contrast and full saturation
- Must be managed to avoid harshness, clashing
- Tricky to use in large amounts
- Work well when you want something to stand out
- Not a good choice for text



Palleton Example



Analogous Scheme

- Next to each other on the colour wheel
- They match well, serene and comforting
- Found in nature, are harmonious and pleasing to the eye
- Make sure you have enough contrast when choosing
- 1st colour dominates, a 2nd to supports, the 3rd accents (along with black, white or grey).

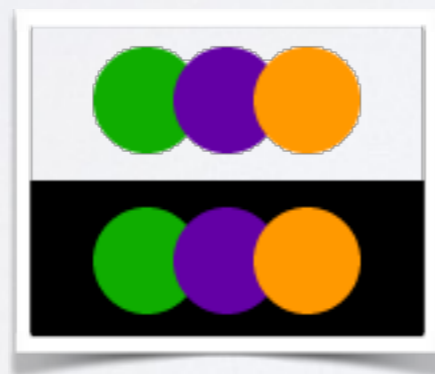
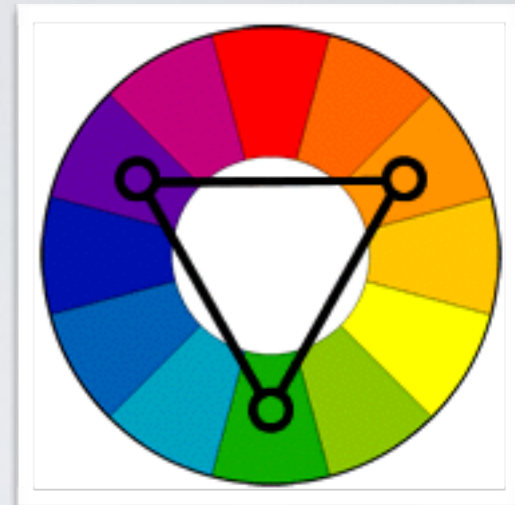


Palette Example



Triadic Scheme

- Evenly spaced around the colour wheel
- Can be quite vibrant, even if you use pale hues
- For success, colours should be carefully balanced
- 1st colour dominates and the other two accent



Palleton Example

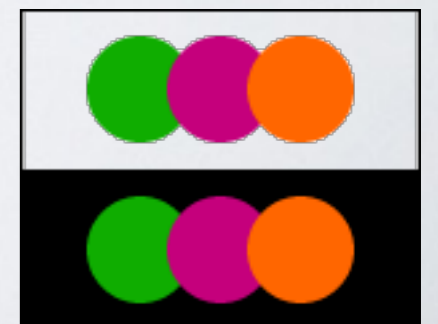


Split-Complementary Scheme

- A variation of the complementary scheme
- A base colour with 2 adjacent colours to complement base colour
- Has the same strong visual contrast as the complementary scheme, but has less tension/harshness
- Often a good choice for beginners, difficult to mess up

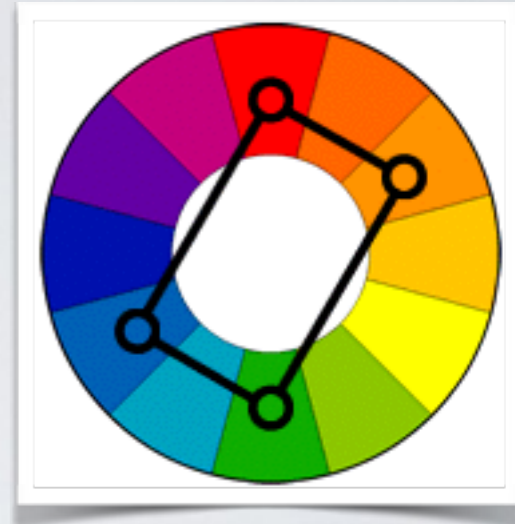


Palette Example

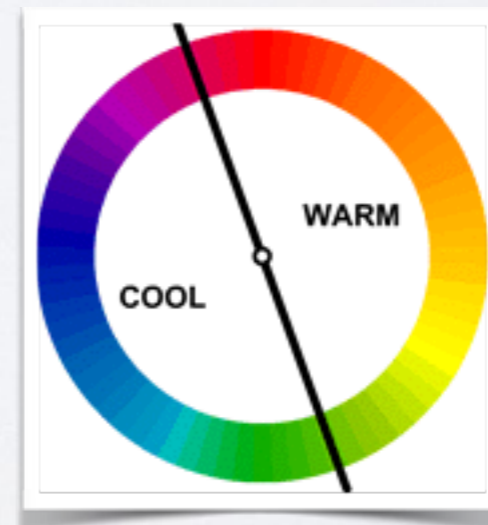


Rectangle (Tetradic) Scheme

- 4 colours arranged into 2 complementary pairs
- Creates rich colour schemes
- Offers plenty of possibilities for variation
- Works best if you let one colour be dominant
- Need to pay attention to the balance between warm and cool colours in your design

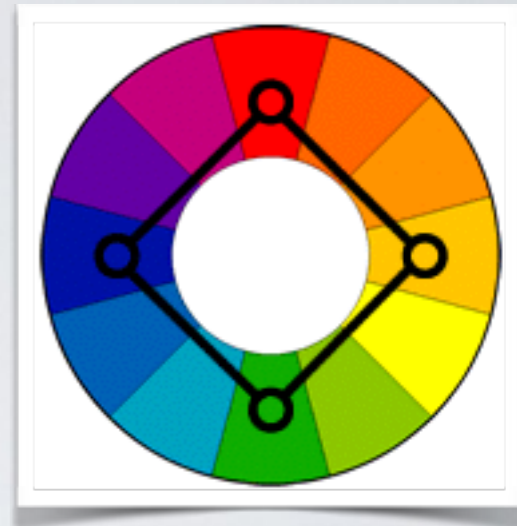


Palette Example

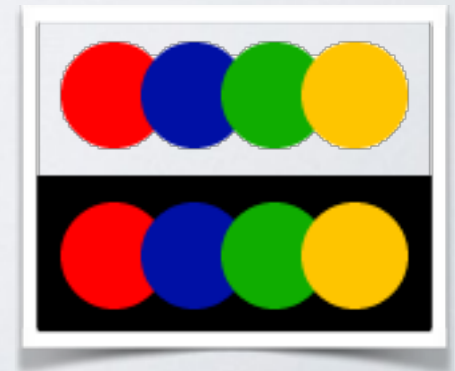
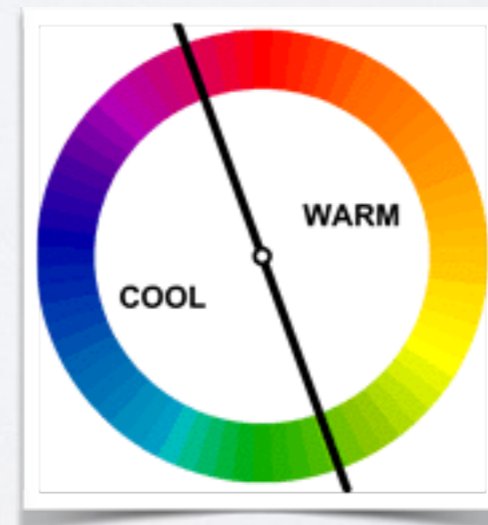


Square Scheme

- Similar to the rectangle but all 4 colours spaced evenly around the colour wheel
- Works best if you let one colour be dominant
- Need to pay attention to the balance between warm and cool colours in your design



Palette Example



Colour Scheme?



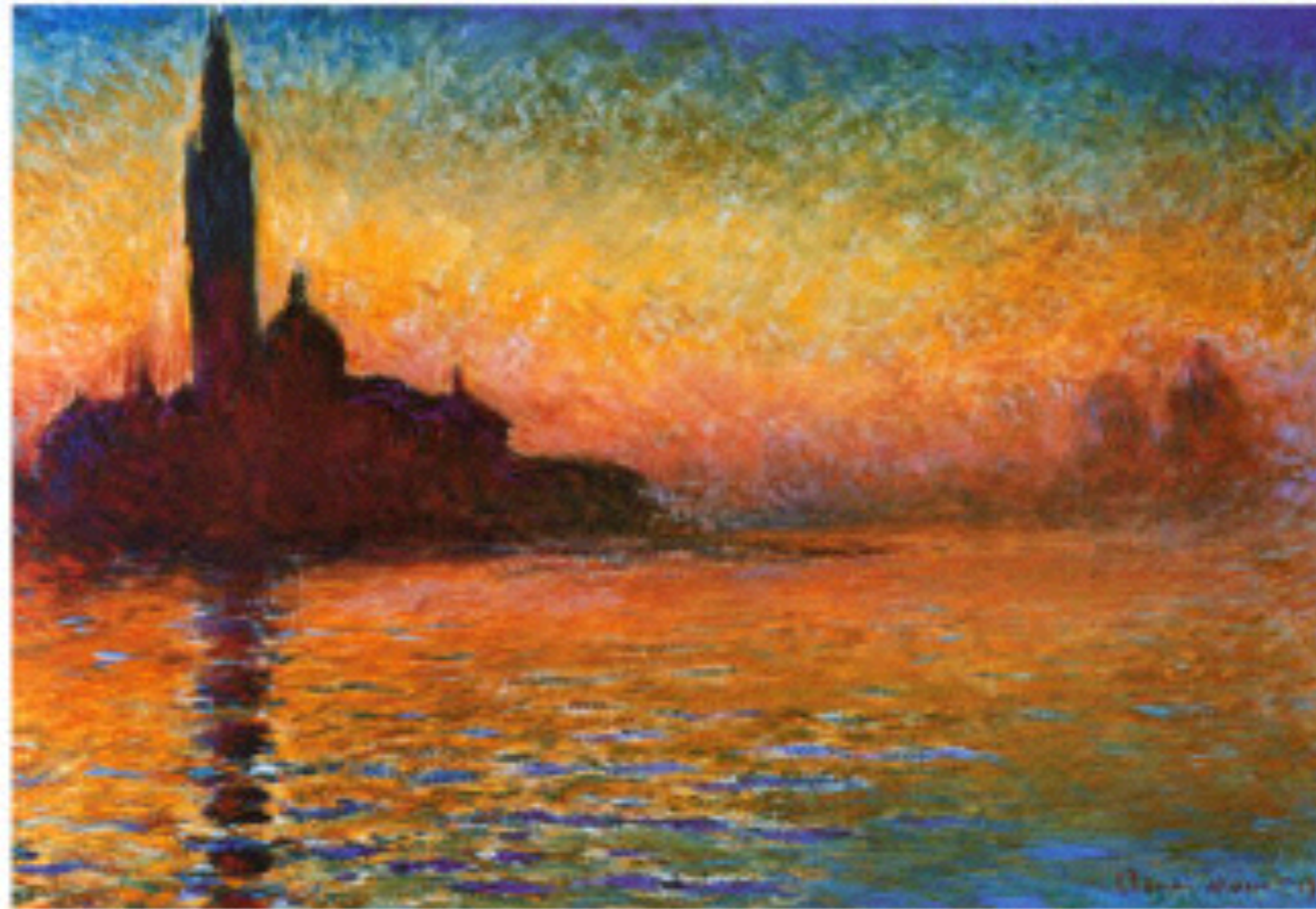
- (A) Monochromatic
- (B) Complementary
- (C) Analogous
- (D) Triadic

- (E) Split-Complementary
- (F) Rectangle (Tetradic)
- (G) Square
- (H) None of the above

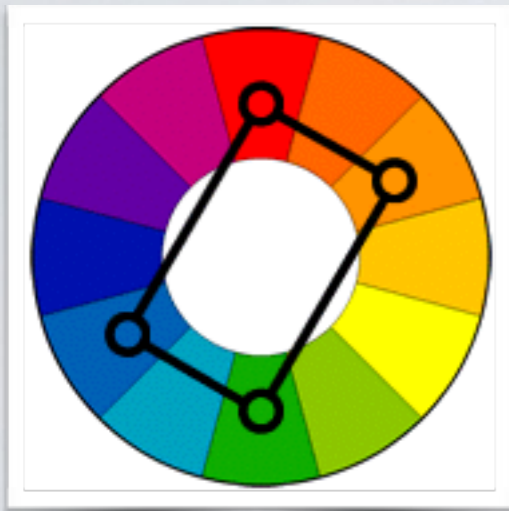
Answer: Complementary



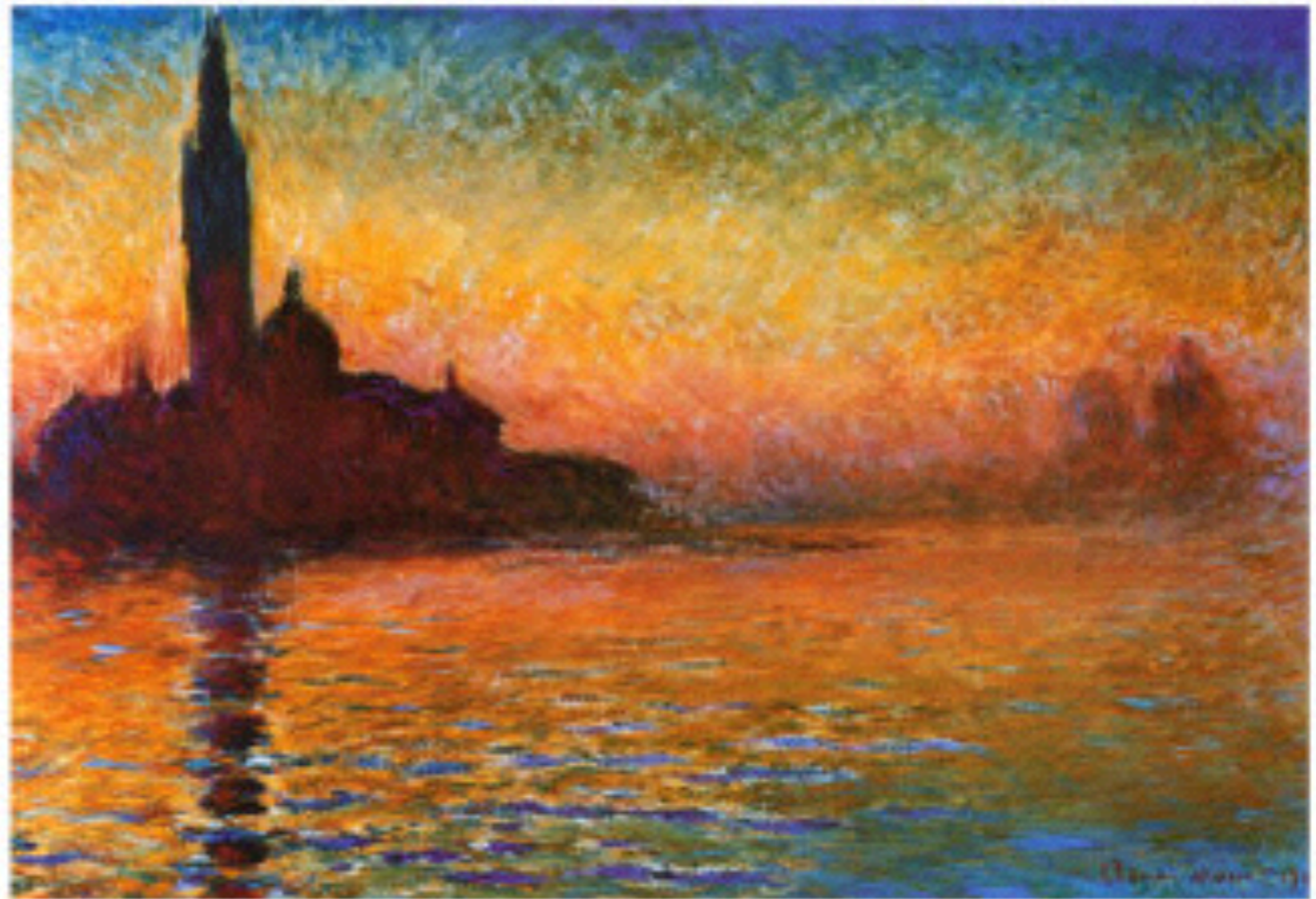
Colour Scheme?



Answer: Rectangle Tetradic



Red as the dominate colour with blue, yellow and green as accents.



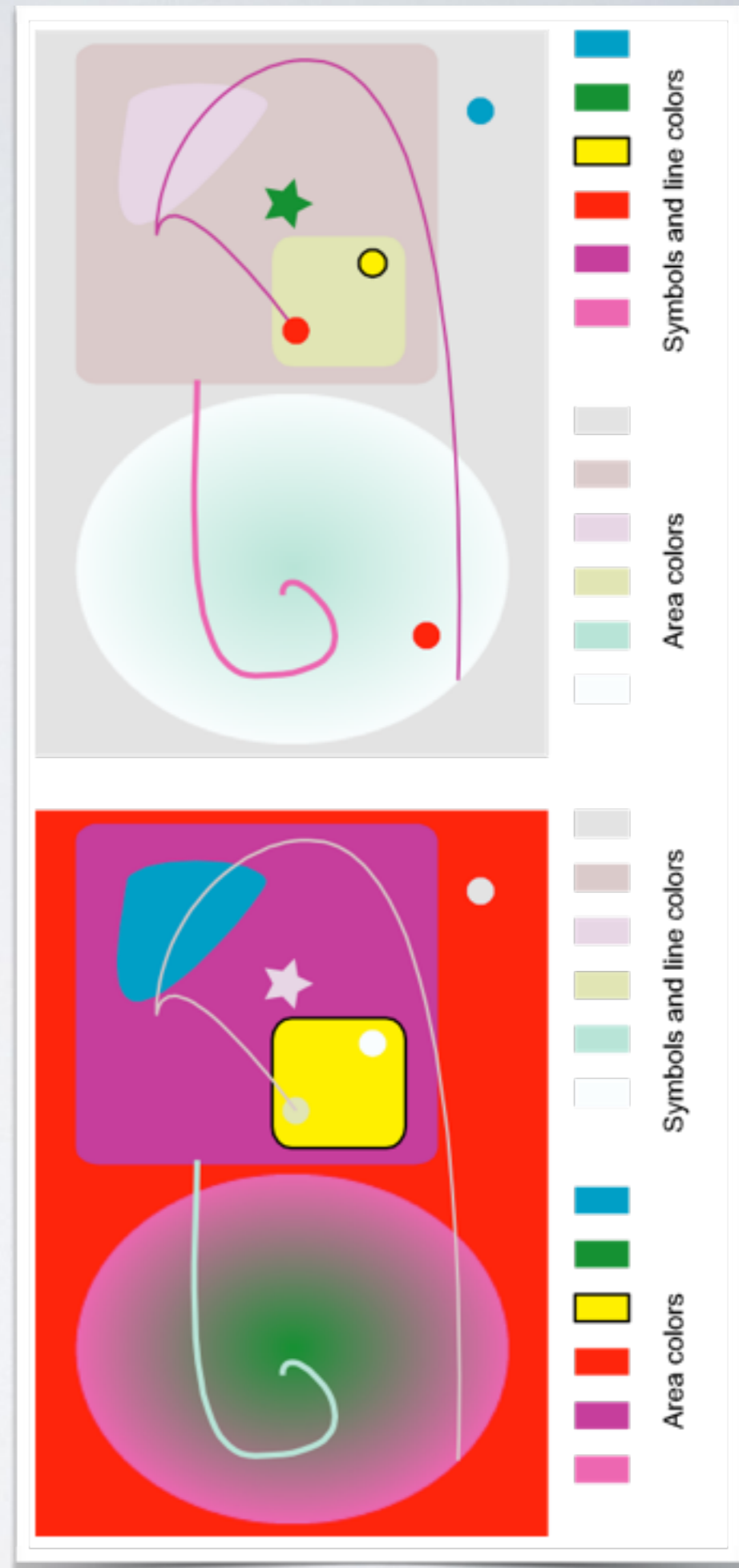
Small Field Tritanopia

Some colours stand out and are **distinguishable in large amounts**. If we use them in **small amounts** they become indistinguishable **vary hard to see and notice**.



Colour Coding

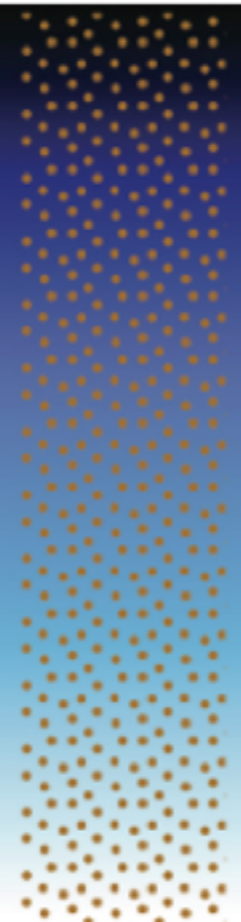
- **Top is good. bottom is bad.**
- Link in Small Field Tritanopia
- Strong colours for small areas
 - e.g. symbols and lines
- Light, low saturation for large areas
 - e.g. background and shapes with in
- Use black border to separate symbols with similar luminance to background



Colour Channel Theory

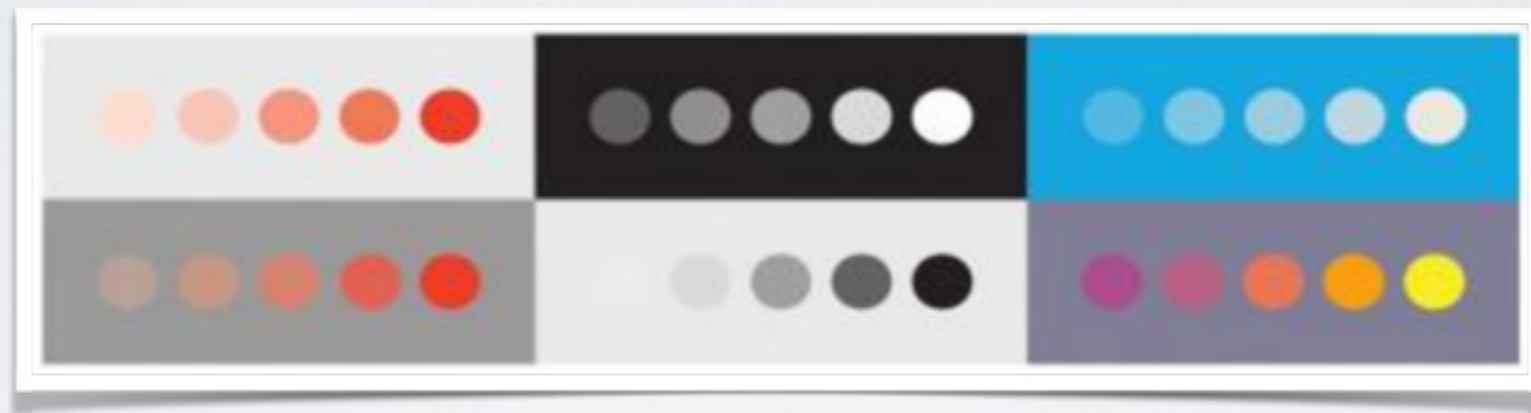
- Luminance contrast is needed to see detail
- The minimum luminance ratio between symbols and background shall be 3:1 (10:1 for small text)
- i.e. the lighter the background the easier it is to read

It is very difficult to read text that is isoluminant with its background color. If clear text material is to be presented it is essential that there be substantial luminance contrast with the background. Color contrast is not enough. This particular example is especially difficult because the chromatic difference is in the yellow blue direction. The only exception to the requirement for luminance contrast is when the purpose is artistic effect and not clarity.



Semantics of Colour

- Colours often used symbolically, code information
- We can show greater quantities for the relative difference in the back ground



- But colour has entrenched cultural meaning, e.g. **RED**
 - In western culture = danger, heat, stop!
 - In China = fortune, renewal
- Mourning death: **white** in Asian, **black** in the West.

Perception of Colour I

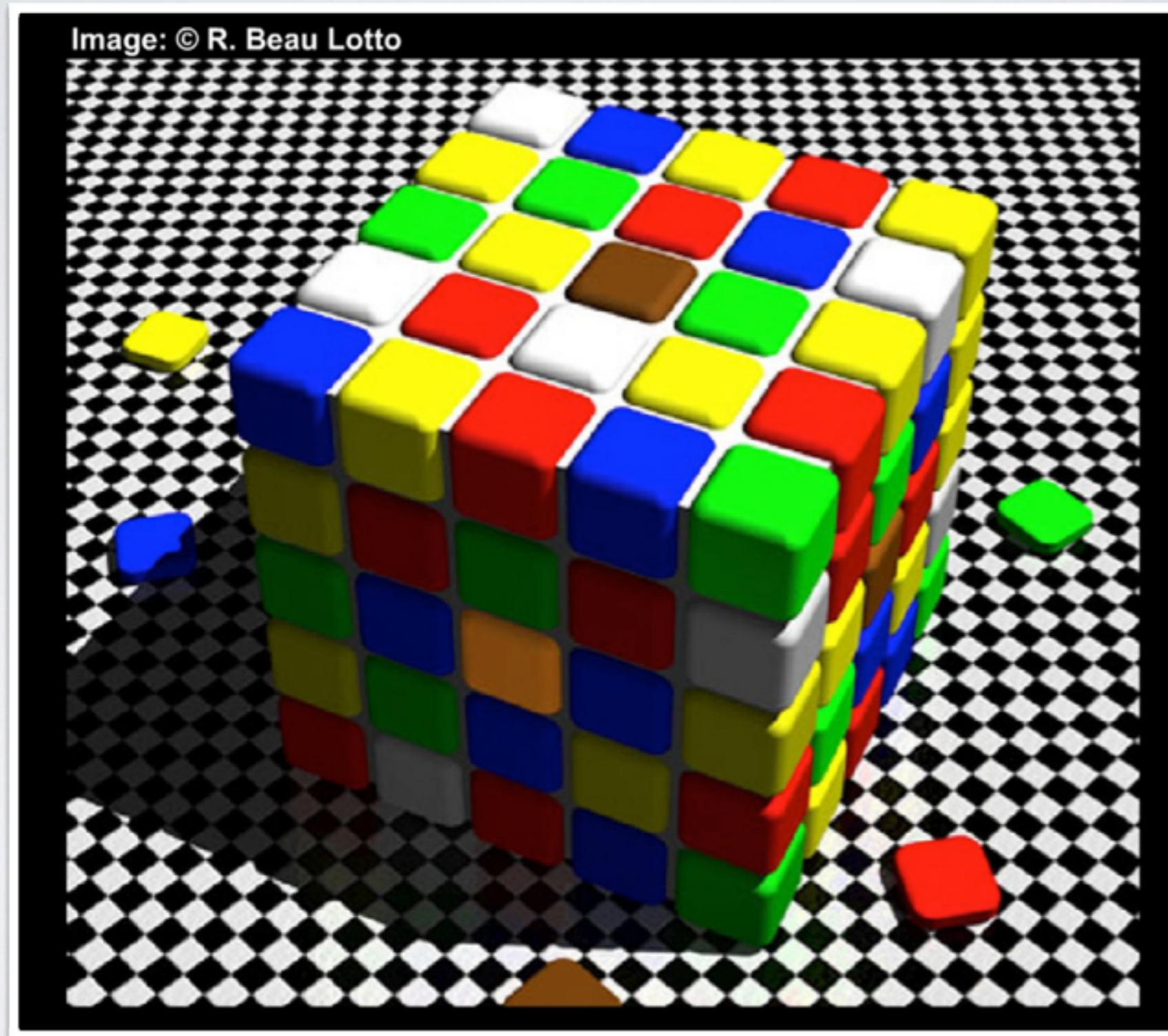


Image from Beau Lotto

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Shadow Effects Ex 1

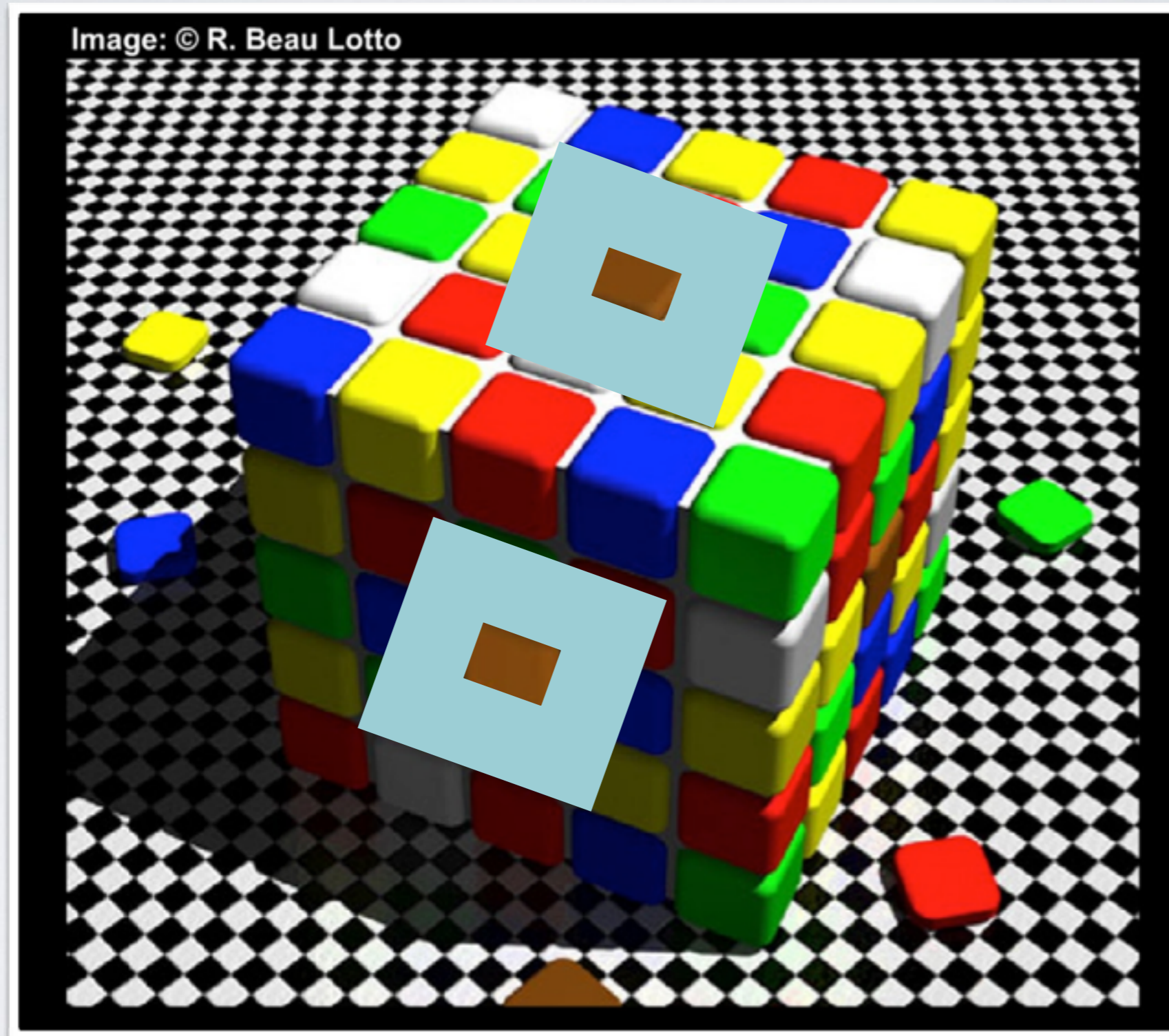
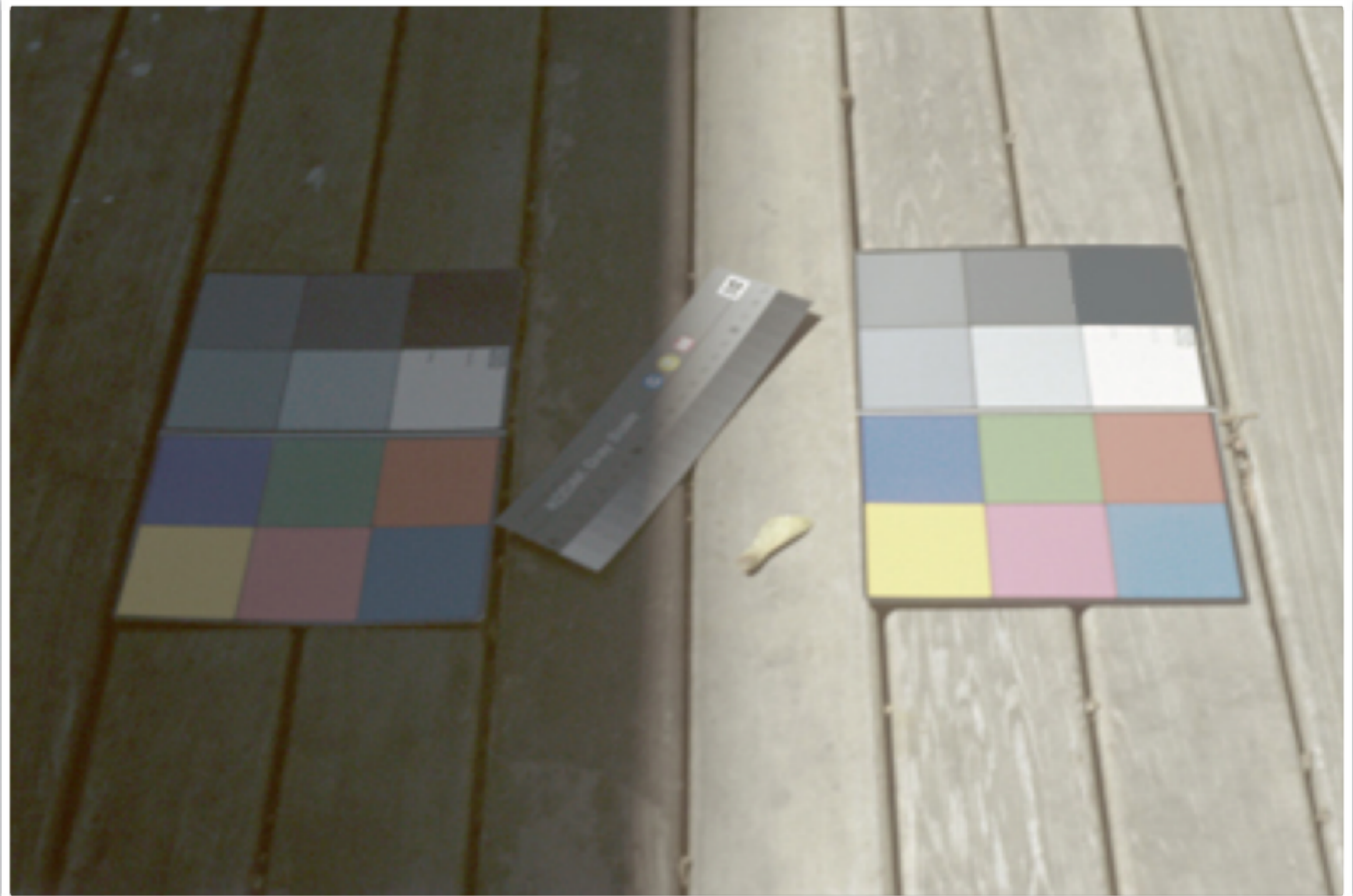


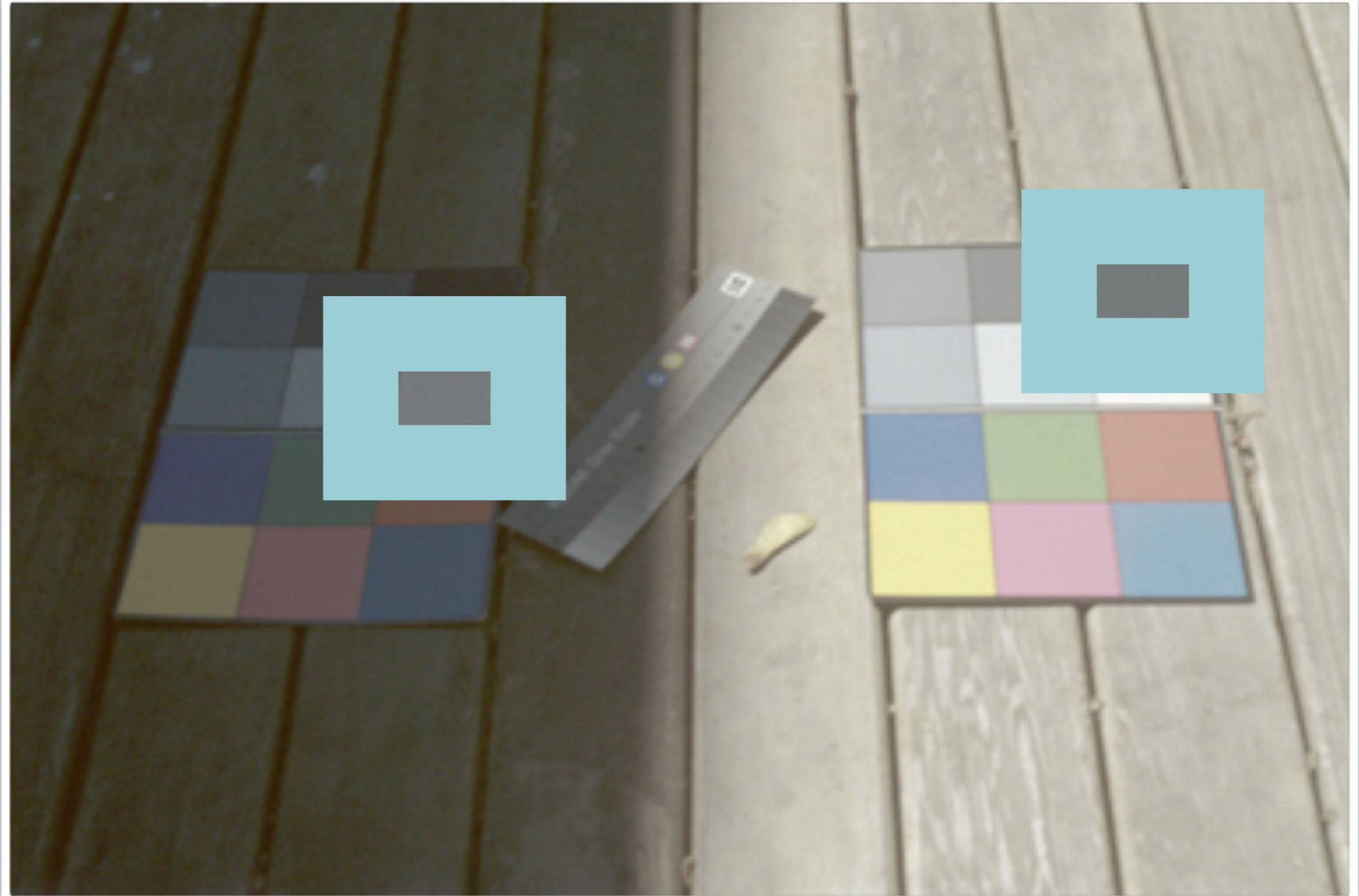
Image from Beau Lotto

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Perception of Colour 2



Shadow Effects Ex 2



The Good, Bad & Ugly



What do you think of these websites?

- <http://fuzzymartian.tripod.com>
- <http://www.angelfire.com/super/badwebs/>
- <http://www.dokimos.org/ajff/>
- <http://1960sailors.net>
- <http://www.fugly.net>

(Cached Screenshots)

Summary

Colour choices and use are important parts of web design.

Good colour design creates an enjoyable web experience and get your message to the reader more effectively.



QUESTIONS?