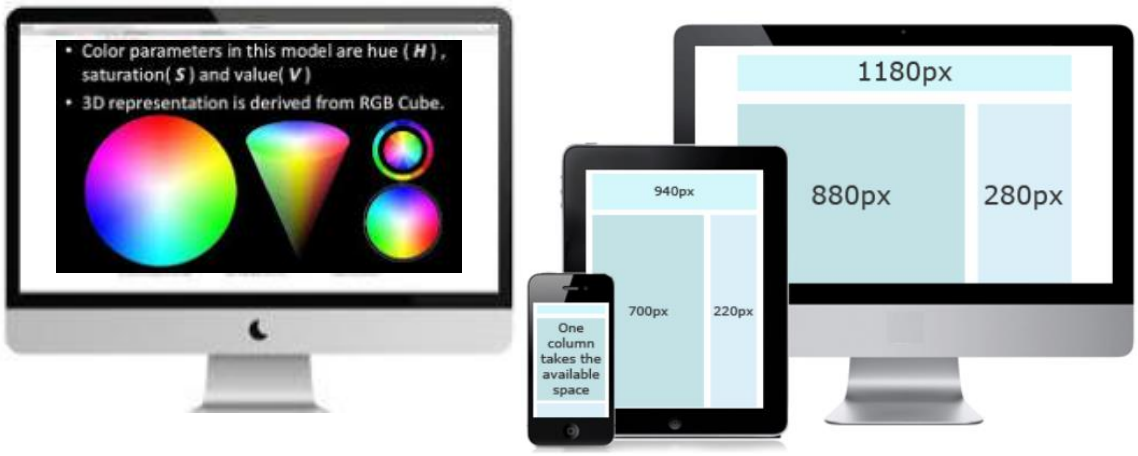
Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática

Screen Layout Design and Color



Beatriz Sousa Santos 2022

- The screen design is an important part of the UI development
- A poor screen design may degrade user performance
- Screen layout must be carefully designed
- There are numerous guidelines (we have seen already some of them)

Screen Layout Guidelines

- Several types:

General layout of information

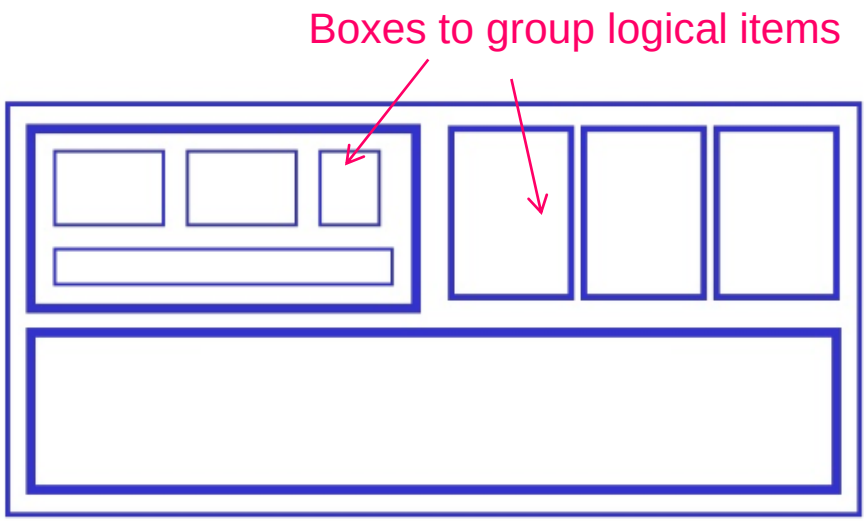
Text
- messages
- instructions

Numbers

Coding techniques (color and others)

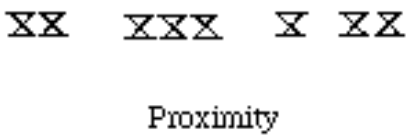
Information layout

- Include only the needed information
- Include all needed information
- Begin at the top left corner and align left (in Western culture)
- Group items according to type
- Leave plenty of white space
- Use leaders in multiple columns
- This is related to how humans analyse an image

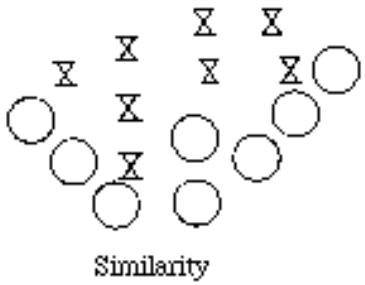


Gestalt Laws

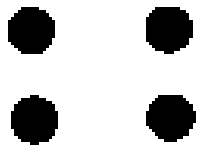
Help understand how visual stimuli in a scene are perceived



Near stimuli are perceived as a group



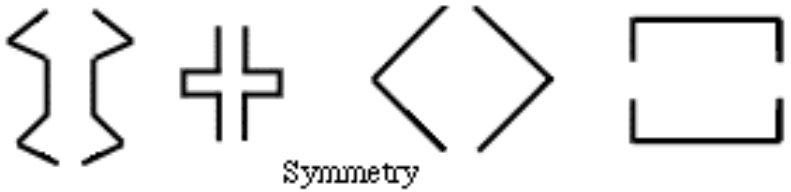
Similar stimuli tend to be grouped (may override proximity)



Stimuli tend to be grouped in complete figures

Ambiguous stimuli tend to be resolved
Using the simplest explanation

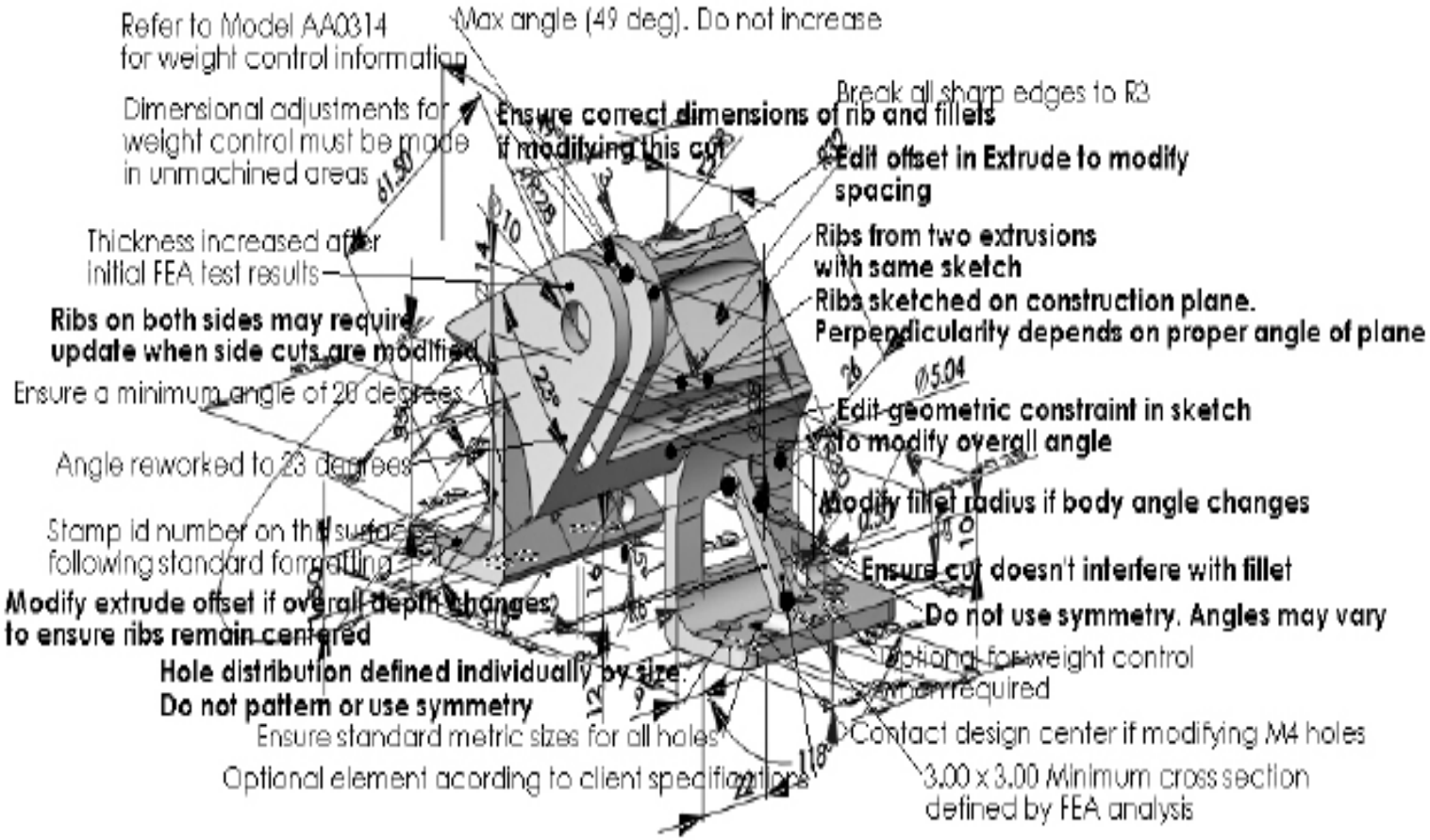
Stimuli tend to be grouped as to minimize variations or discontinuities



Regions delimited by symmetric tend to be perceived as coherent figures

Include only the needed information

Avoid Visual Clutter



Text

- Avoid using only capital letters (are more difficult to read)
- Avoid text with many capital letters
- Do not use too many fonts for emphasis
- In multiple columns use leaders or greying

use fonts for emphasis
(but not too many)

ABCDEF HIJKLM
NOPQRSTUVWXYZ

Alcântara - Terra			12:36			13:06			13:36	
Campolide	12:15		12:41	12:45		13:11	13:15		13:41	13:45
Rossio	12:19			12:49			13:19			13:49
Sete Rios		12:19	12:43		12:49	13:13		13:19	13:43	
Entrecampos		12:22	12:47		12:52	13:17		13:22	13:47	
Roma - Areeiro		12:24	12:49		12:54	13:19		13:24	13:49	

Use greying

In multiple columns it is difficult to read across gaps:

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

use leaders

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

or greying

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

- Messages shall:
  - Have a detail level adequate to user knowledge and experience
  - Be specific and understandable
  - Be brief and concise
  - Be positive
  - Be helpful

Error messages

Too verbose

Too vague

Negative

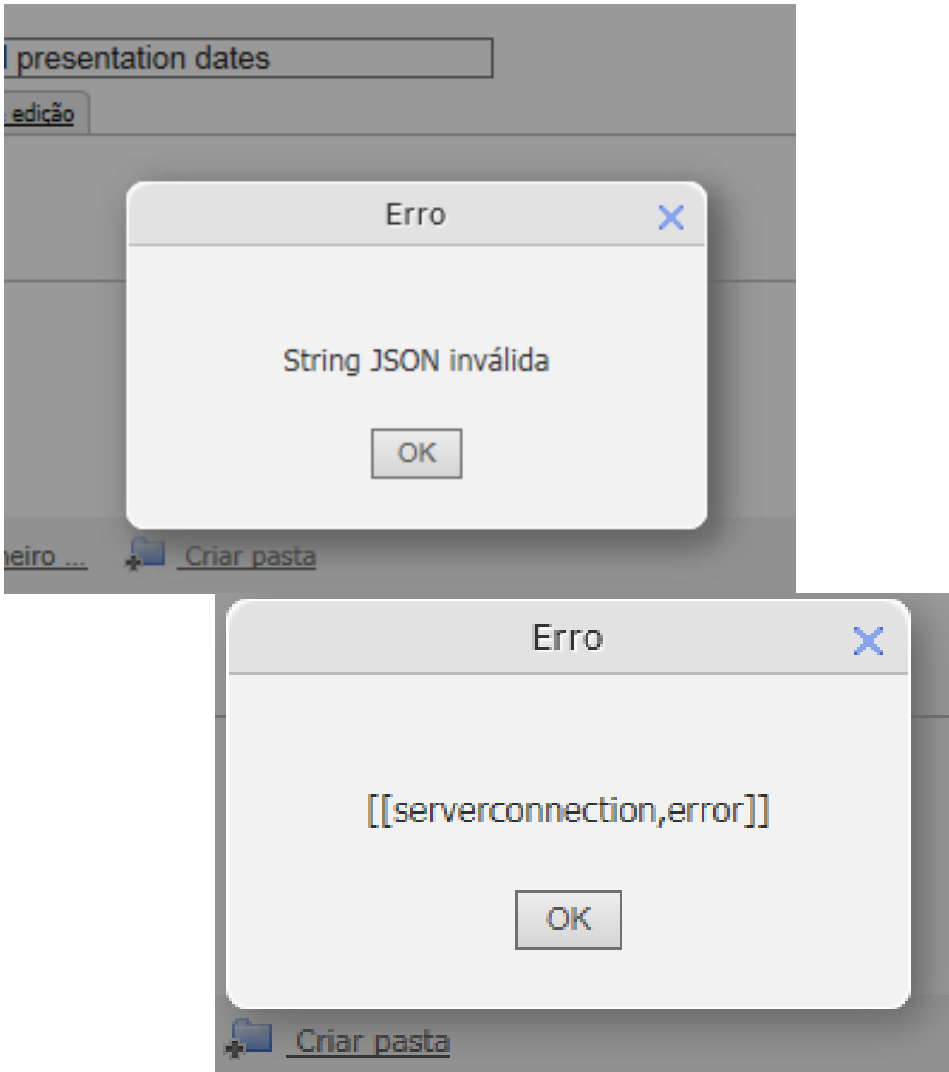
Not helpful

	better
The processing of the text editor yielded 23 pages of output	Output 23 pages
Error in SIZE field	Error: SIZE range is 4 to 16
Cannot exit before saving file	Save file before exiting
Bad/illegal file name	Maximum file name length is 8 chars
Syntax error 1542	Unmatched left parenthesis in line 210

Examples of useless messages for users

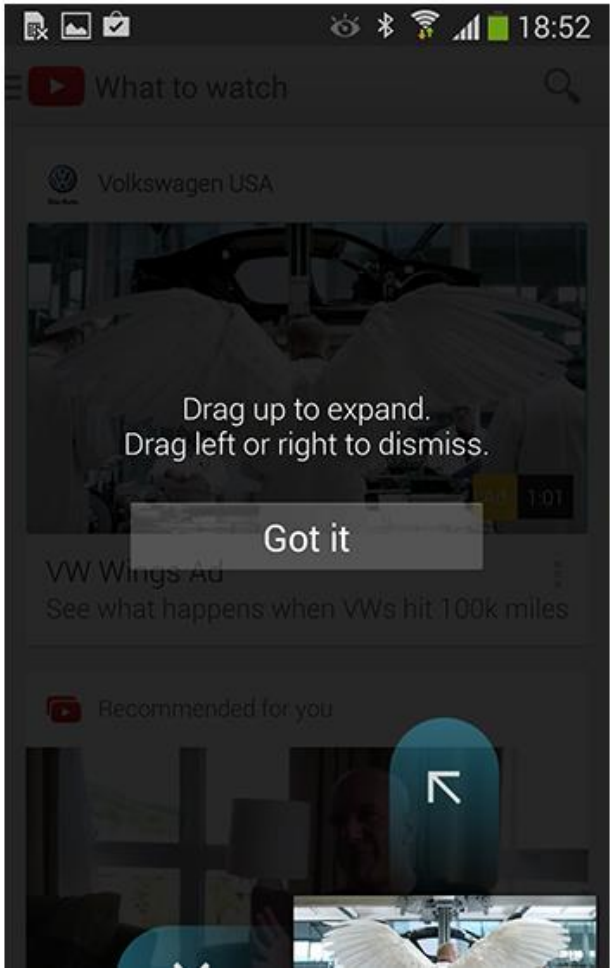
Except (maybe) for Chinese people!

Moodle:



Instructional Overlays and Coach Marks for Mobile Apps

- Instructions in mobile applications must be designed for optimal scannability, as users tend to dismiss them quickly and do not read thoroughly



Main guidelines:

- Short, Focused Tips
- Avoid Chains of Tips
- Use Visuals When Possible
- Keep Tips Sparse

https://www.nngroup.com/articles/mobile-instructional-overlay/

Numbers

- Integers shall be right justified
- Real numbers shall be aligned by the decimal point
- Avoid unnecessary zeros (at left)
- Long numbers shall be divided in groups of 3 or 4

Which is the largest?

532.56
179.3
256.317
15
73.948
1035
3.142
497.6256

627.865
1.005763
382.583
2502.56
432.935
2.0175
652.87
56.34

Align decimal points

75
120
35
27
85

Right align integers

Numbers

	Better
10 100 1000 10000	10 100 1000 10000
100.00 25.365 5432.01 1.45591	100.00 25.365 5432.01 1.45591
10:1 p.m. 002	10:02 p.m. 2
6173954686	617-395-4686

Coding techniques

- Blinking
- Bold
- Size
- Font
- Underlining
- Shape
- Special characters and icons
- Proximity
- Borders
- Sound
- Colour

Main guideline: use parsimoniously any coding technique!

Specific problems for different platforms: mobile

- Many guidelines are similar for mobile and desktop design, but their mobile interpretation is much more unforgiving
  - Context of use
  - Size of screen
  - Platform limitations

http://www.nngroup.com/articles/mobile-sharpens-usability-guidelines/

https://developer.android.com/design/index.html

Links on tablet and mobile usability

Raluca Budiu, The State of Mobile User Experience, NNGroup, March, 2015
http://www.nngroup.com/articles/mobile-usability-update/

https://developer.apple.com/library/ios/documentation/UserExperience/Conceptual/MobileHIG/

https://developer.android.com/design/index.html

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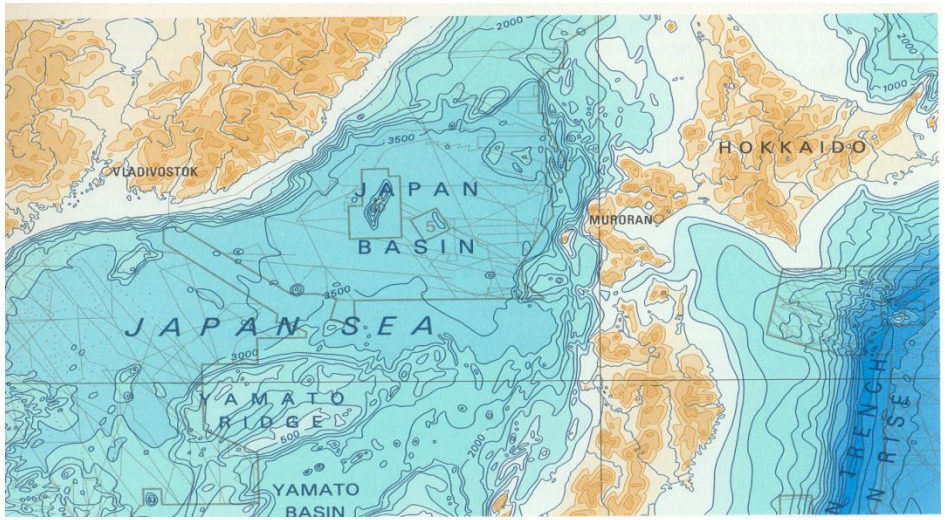
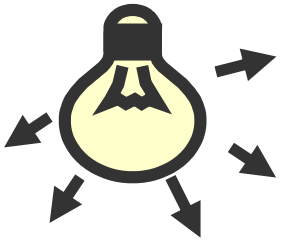
Color usage

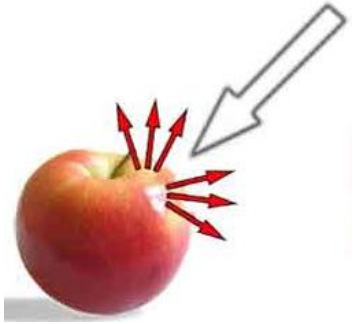


Color

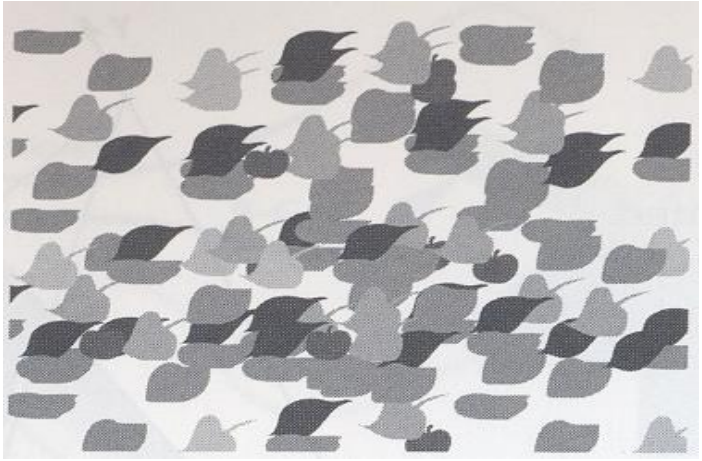
- Color is a complex and multidisciplinary subject:
  - Physics
  - Physiology and psychology
  - Art and graphic design
  - Interactive systems design

- The perceived color of an object depends on the:
  - Material characteristics
  - Illumination
  - Ambient color
  - Human visual system



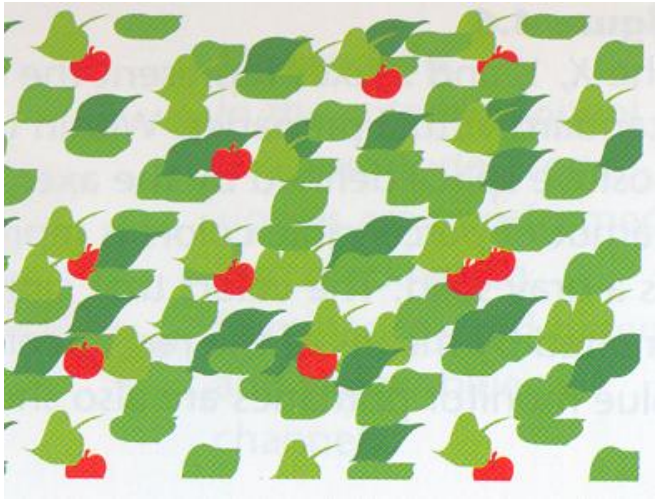


How many cherries?



(Ware, 2004)

How many cherries?



Color may support users in many tasks!
(yet, if not properly used may make them more difficult!)

Using color

Besides increasing realism, it may have the following **advantages**:

It may:

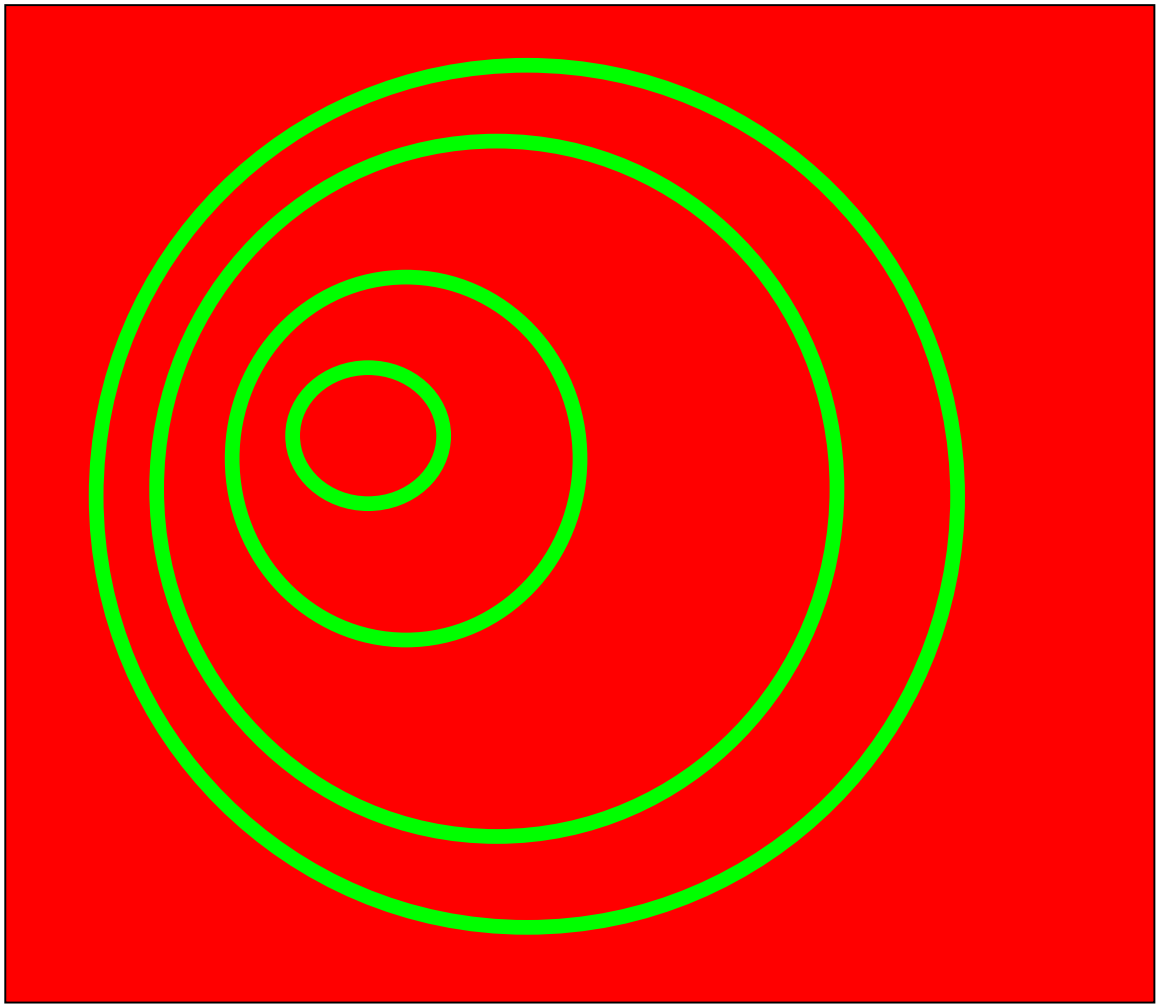
- Show the logical organization of the information displayed
- Represent approximate values
- Catch the attention
- Increase satisfaction
- Ease the search in complex displays
- Trigger emotions

…

However, **it may degrade user's performance** if not used properly

Guidelines for using color

- **Use color parsimoniously**
- Use a limited number of colors
- Firstly make it work without color
- Use color coherently
- Avoid using simultaneously several saturated colors
- Do not convey information solely through color
- Make color coding support the user task
- Make the color coding as obvious as possible
- Allow the user to control the color code
- Take into account the cultural meaning of colors …



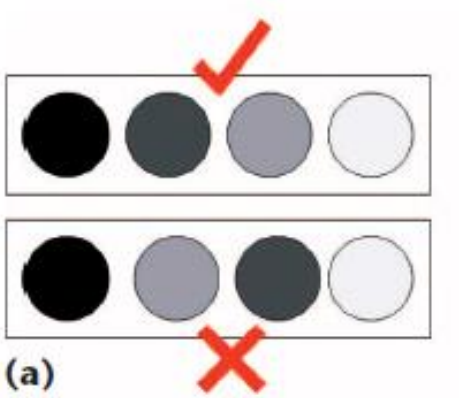
Saturated complementary colors should not be used simultaneously

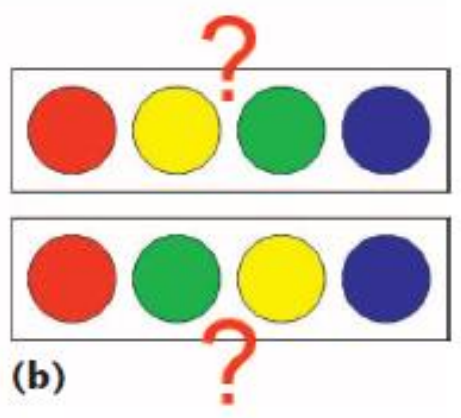
Small spots of color on a neutral background enhance relevant information

(Tufte, 1990)

- Do not expect to easily perceive order from color

(Borland, Taylor II, 2007)

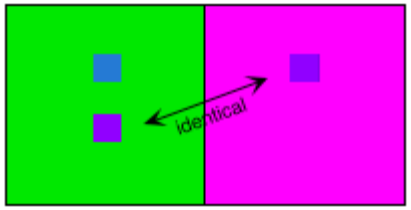


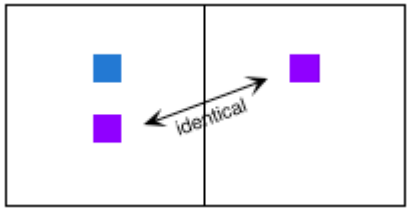


The elements within these sets look identical to deuteranopes, the most common kind of dichromat:

These can be discriminated on the basis of non-color differences:

Don’t use colour coding on small elements





Use neutral gray surrounds where color judgments are critical.

Color Vision deficiencies

- ≈ 8% of men and 1% of women have some type of color vision deficiency
- Generally it is genetic (associated to the X chromosome)
- Common deficiencies are explained by the lack of cones (color sensor cells in the retina) sensitive to the long and medium λ (dicromacies)):
  - Protanopia (LW – "Red" cone)
  - Deuteranopia (MW – "Green" cone) (Daltonism)
- There are three types of inherited deficiencies:
  - Monocromacy (disorder or lack of all color sensitivity)
  - Dicromacy (disorder or lack of one type of cone)
  - Anomalous Tricromacy (disorder in cones)

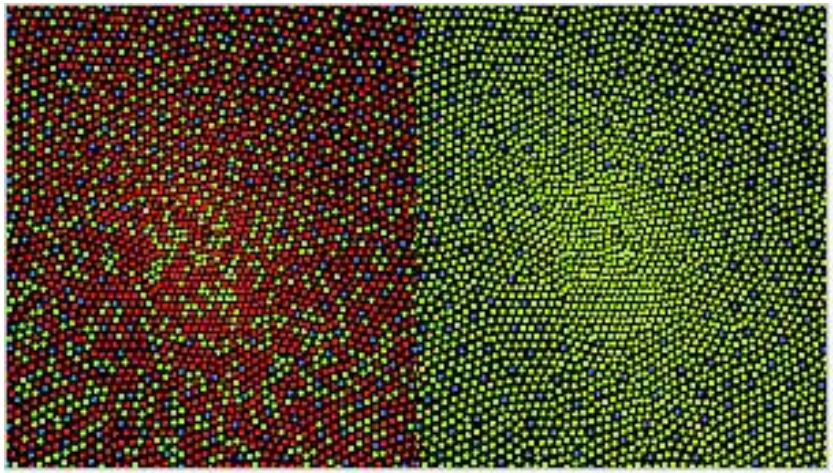


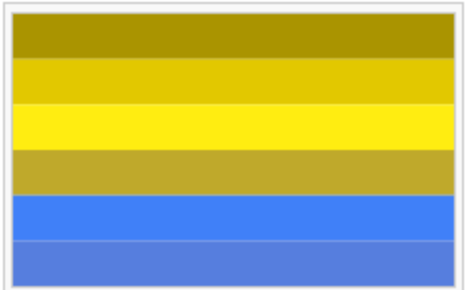
Illustration of the distribution of cone cells in the fovea of an individual with normal color vision (left), and a color blind (protanopic) retina. Note that the center of the fovea holds very few blue-sensitive cones.

http://en.wikipedia.org/wiki/Photoreceptor_cell

Rainbow colors as viewed by people suffering from color vision deficeiencies

The colors of the rainbow as viewed by a person with no color vision deficiencies.

The colors of the rainbow as viewed by a person with protanopia.



The colors of the rainbow as viewed by a person with deuteranopia.

The colors of the rainbow as viewed by a person with tritanopia.

http://en.wikipedia.org/wiki/Color_blindness

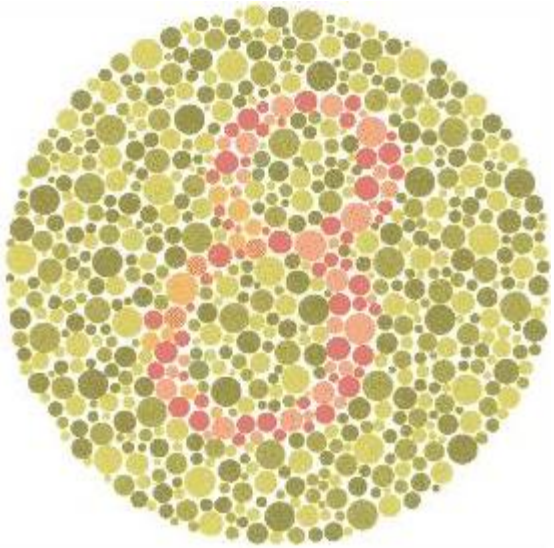
Simulating color vision deficiencies

Original image as seen by a normal observer

As seen by a deuteranope (daltonic)

http://www.daltonize.org/

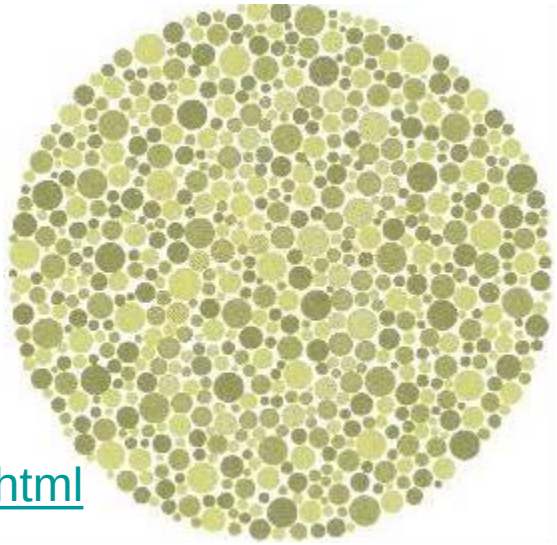
Simulating color vision deficiencies Ishihara-2



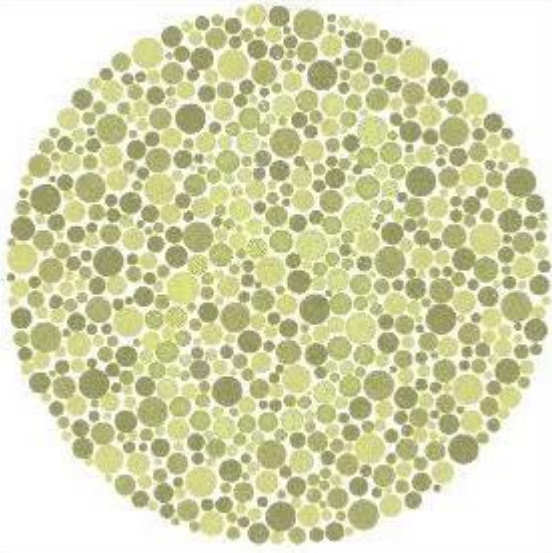
Original image as seen by a normal observer

As seen by an observer with a color vision deficiency:

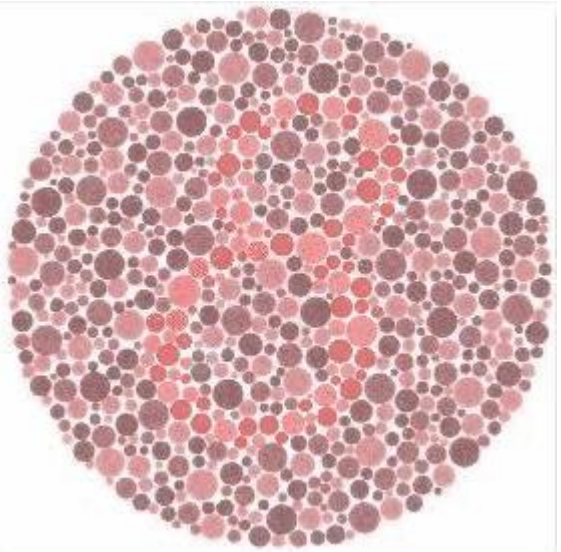
Red-Blind/Protanopia



Green-Blind/Deuteranopia



Blue-Blind/Tritanopia



http://www.color-blindness.com/coblis/coblis.html

How can we describe color experience?

- Color perception happens in the mind due to light properties
- Different color descriptions are necessary for:

light stimuli		**color sensations**
external (physical)	⟶	subjective (mental)
photometry, colorimetry		color attributes

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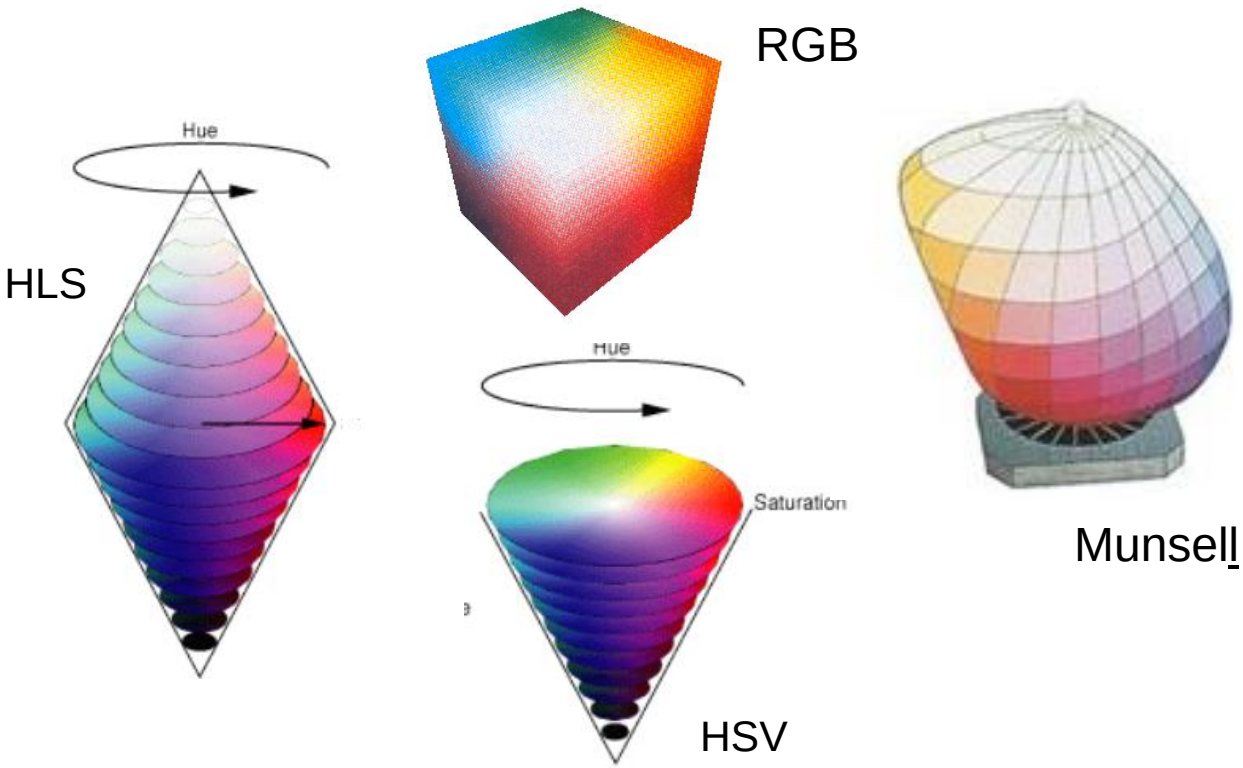
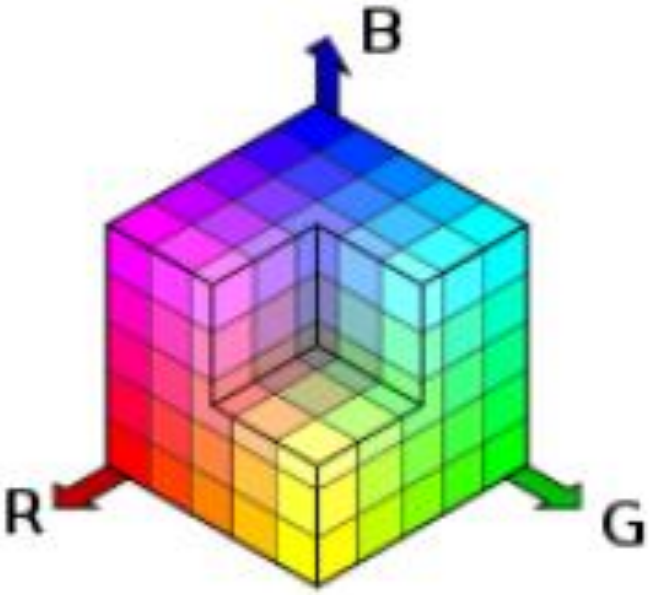
Color Models



- Objects are perceived as having a color depending on the spectrum of the reflected light (or emitted)
- But different spectra may induce similar color sensations
- It is important to be able to describe color objectively
- There are to types of color production systems:
    - Additive (eg.: monitors, TV sets, projectors) $\rightarrow$ RGB
    - Subtractive (e.g.: printers) $\rightarrow$ CMY
- RGB and CMY are H/W oriented color models not adequate for users
- There are more color models …

The RGB color model:

The **RGB color model** is an additive color model in which red, green, and blue light (the primary colors) are added to reproduce a broad array of colors.

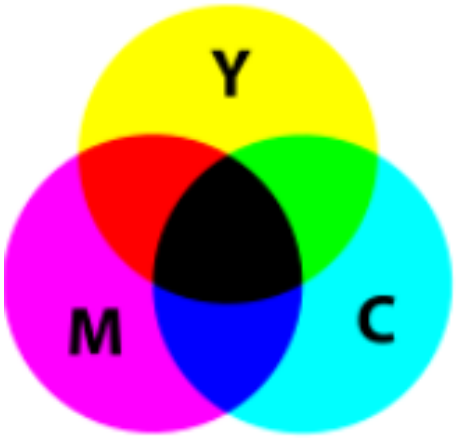


The color space is a cube in a Cartesian coordinate system

White -> 1, 1, 1

Black -> 0, 0, 0

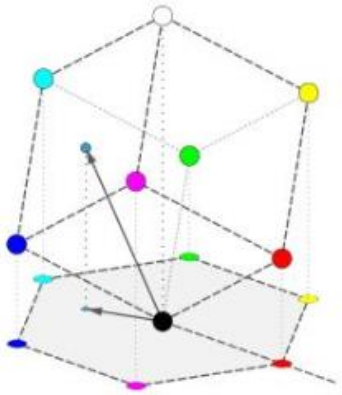
https://en.wikipedia.org/wiki/RGB_color_model

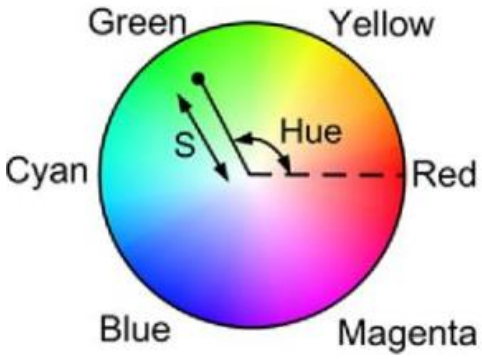


The **CMY color model** is a subtractive color model in which cyan, magenta, and yellow (the primary colors) are subtracted from white to reproduce a broad array of colors.

The color space is also a cube in a Cartesian coordinate system

White -> 0, 0, 0
Black -> 1, 1, 1



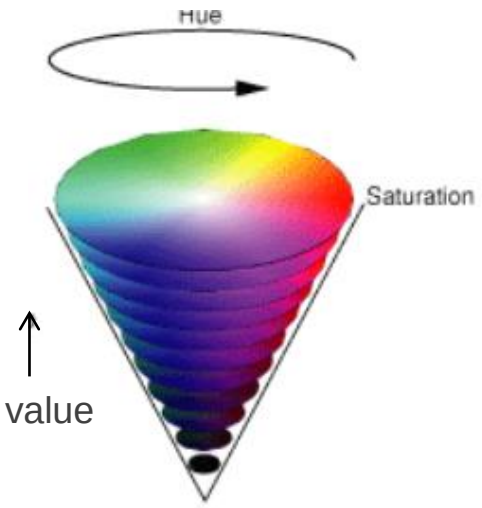


There are other models more adequate to color specification by the users:

- HSV
- HLS

- Humans describe color based on 4 psychophysical variables related to physical variables:
  - Hue – the degree to which is similar to or different from stimuli that are described as red, green, blue, and yellow
  - Saturation – related to the amount of achromatic light
  - Lightness – related to the objects reflectance (for reflecting objects)
  - Brightness – for light emitting objects

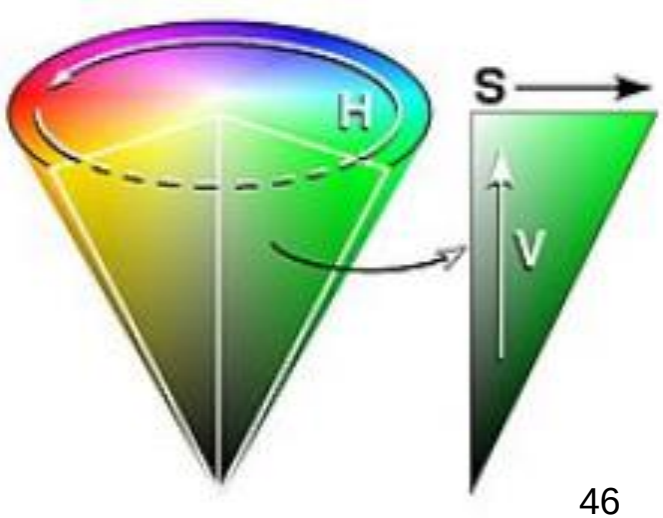
https://en.wikipedia.org/wiki/Hue



- HSV color model:
  - Hue

  - Saturation – related to the amount of achromatic light
  - Value - controls the brightness: 0% - pure black 100% - pure white

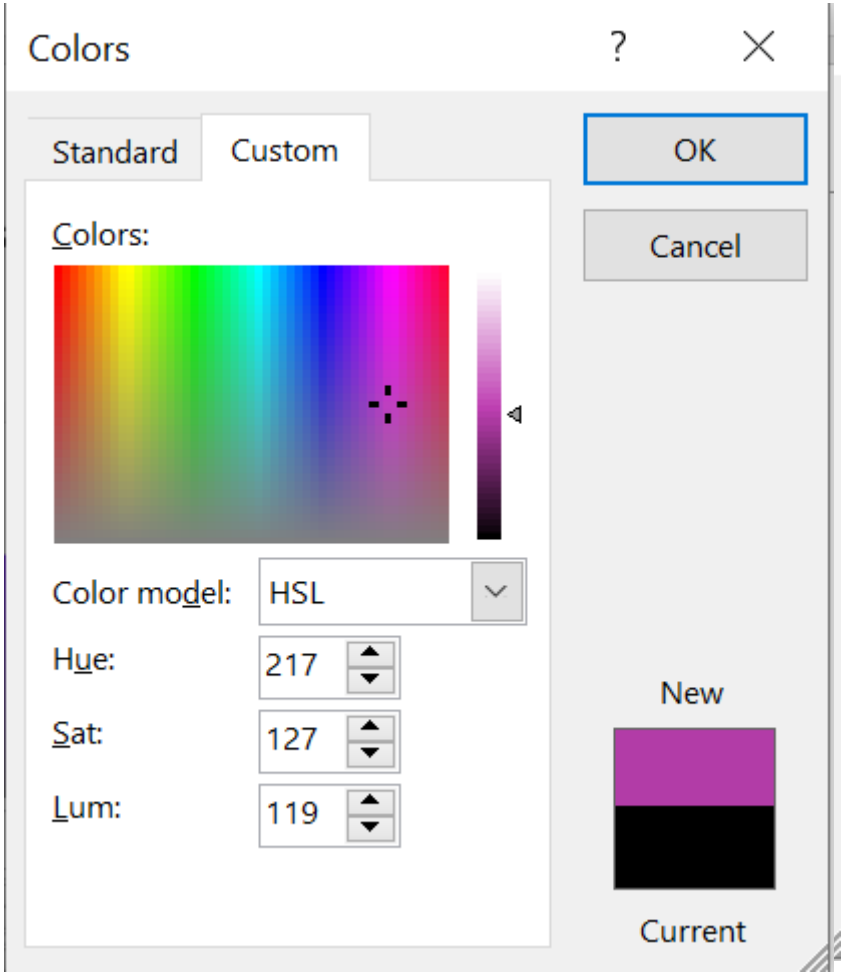
Uses cylindrical coordinates



https://www.khanacademy.org/partner-content/pixar/color/color-101/v/color-3

https://programmingdesignsystems.com/color/color-models-and-color-spaces/index.html

- Let the user select a color:



Interesting Links

- Introduction to color guidelines and standards (NASA)

http://colorusage.arc.nasa.gov/guidelines_0.php