

# Interacção Humana com o Computador

## Aula 8



Departamento de Informática  
UBI 2024/2025

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# Aesthetic, size and proportion

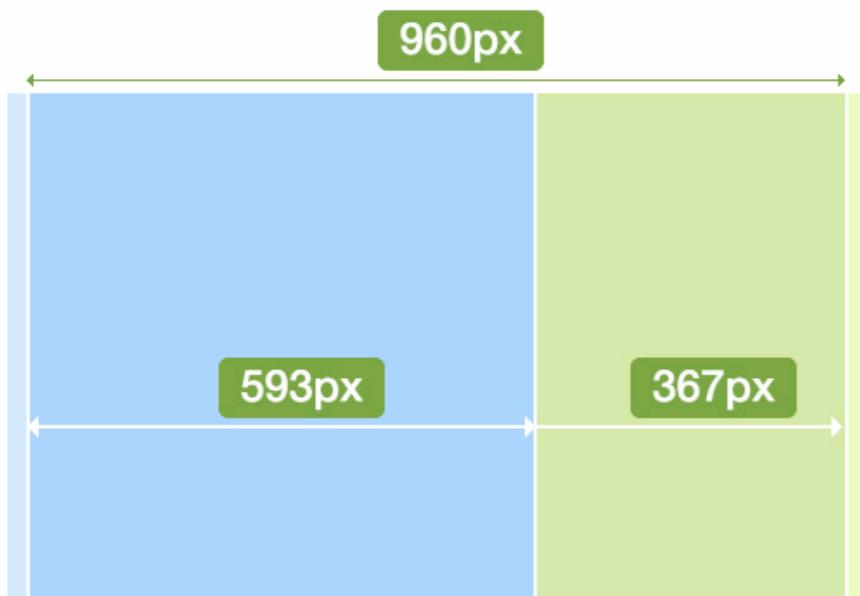




# The Golden Ratio

## Application in the design of GUI:

Divine Proportion: 1.618



$$960\text{px} : 1.618 = 593\text{px}$$

$$960\text{px} - 593\text{px} = 367\text{px}$$

404 USER EXPERIENCE DESIGN

EMC.com | About 404 Archives Subscribe SEARCH

STICKY FEATURED ARTICLE

Wednesday May 7, 2008

Welcome to 404.

by Jared Christensen

Yeah, we're at it again.

404UXD, formerly [The Geniant Blog](#), is the new home of our Dallas-based user experience group. For those of you following along at home, you'll know that in the latest episode of our little telenovela we ([Geniant](#)) were acquired by [EMC](#) last July. And prior to that, in 2006, Geniant acquired [Bright Corner](#), which company was more or less the humble genesis of our UX group.

[Continue reading...](#)

13 MIN READ Article posted by Jared Christensen in Culture, Design . Comments (3)

Tuesday May 27, 2008

Virtual Cable™ Car Navigation →

This is too cool: a thin red "cable" sits above the road, in your peripheral vision, tracing the route to your destination. It shows you the path you need to take far ahead of you, even in the dark. What a great visualization idea!

13 MIN READ Link posted by Jared Christensen in Interface, Visualization . Comments (1)

Friday May 23, 2008

Retro Cosmic

404 UXD is a team of user experience professionals working in Room 404 (literally) of our Dallas, TX office. We are part of EMC's User Experience Design competency.

[Learn more...](#)

On Our Calendar... View all

Jun 23, 2008: An Event Apart at Boston Marriott Copley

In late 2005, two internationally recognized web authorities—web standards godfather Jeffrey Zeldman...

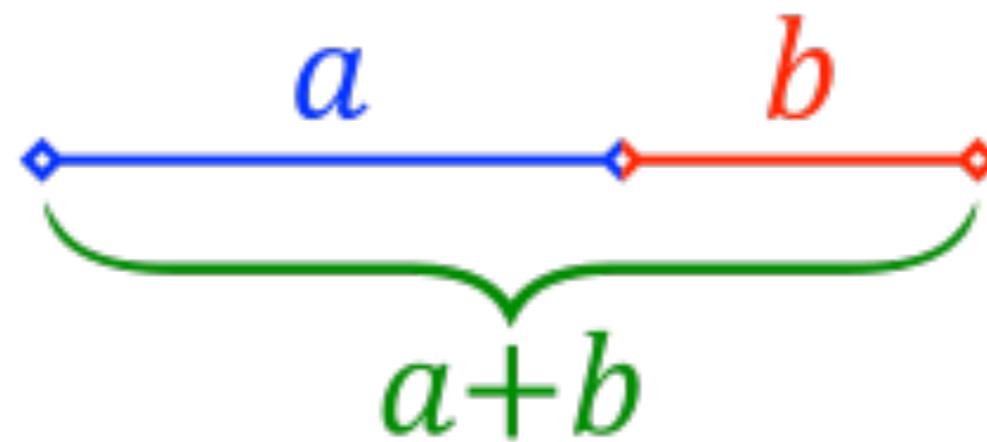
Aug 12, 2008: User Experience Week 2008 at The Palace Hotel

UX Week is the premier user experience conference, and in 2008 we consider what it takes to create g...



# The "Golden Ratio"

**Concept and definition:**



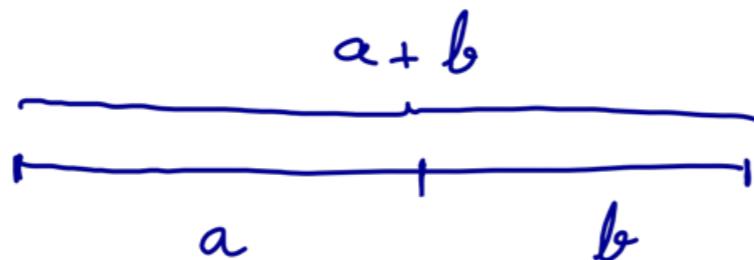
$a+b$  is to  $a$  as  $a$  is to  $b$

**Number  $\Phi$**

$$\Phi = \frac{1 + \sqrt{5}}{2} \approx 1.6180339887\dots$$



# The "Golden Ratio"



Golden Ratio

$$\frac{a}{b} = \frac{a+b}{a} \Leftrightarrow a^2 = ab + b^2 \Leftrightarrow$$

$$\Leftrightarrow a^2 - ba - b^2 = 0 \Leftrightarrow a = \frac{b \pm \sqrt{b^2 + 4b^2}}{2} \Leftrightarrow$$

$$\Leftrightarrow a = \frac{b \pm \sqrt{5b^2}}{2} \Leftrightarrow a = \frac{1 \pm \sqrt{5}}{2} b \Rightarrow$$

$$\Rightarrow \frac{a}{b} = \frac{1}{2} + \frac{\sqrt{5}}{2} \approx 1.61... (\varphi)$$

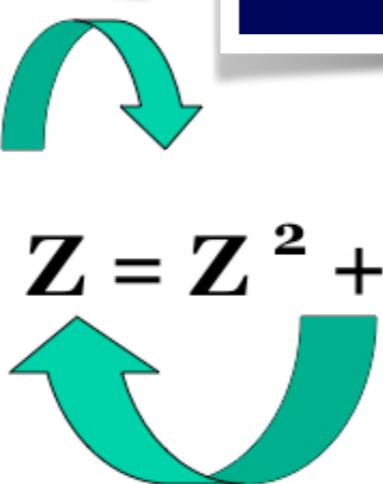


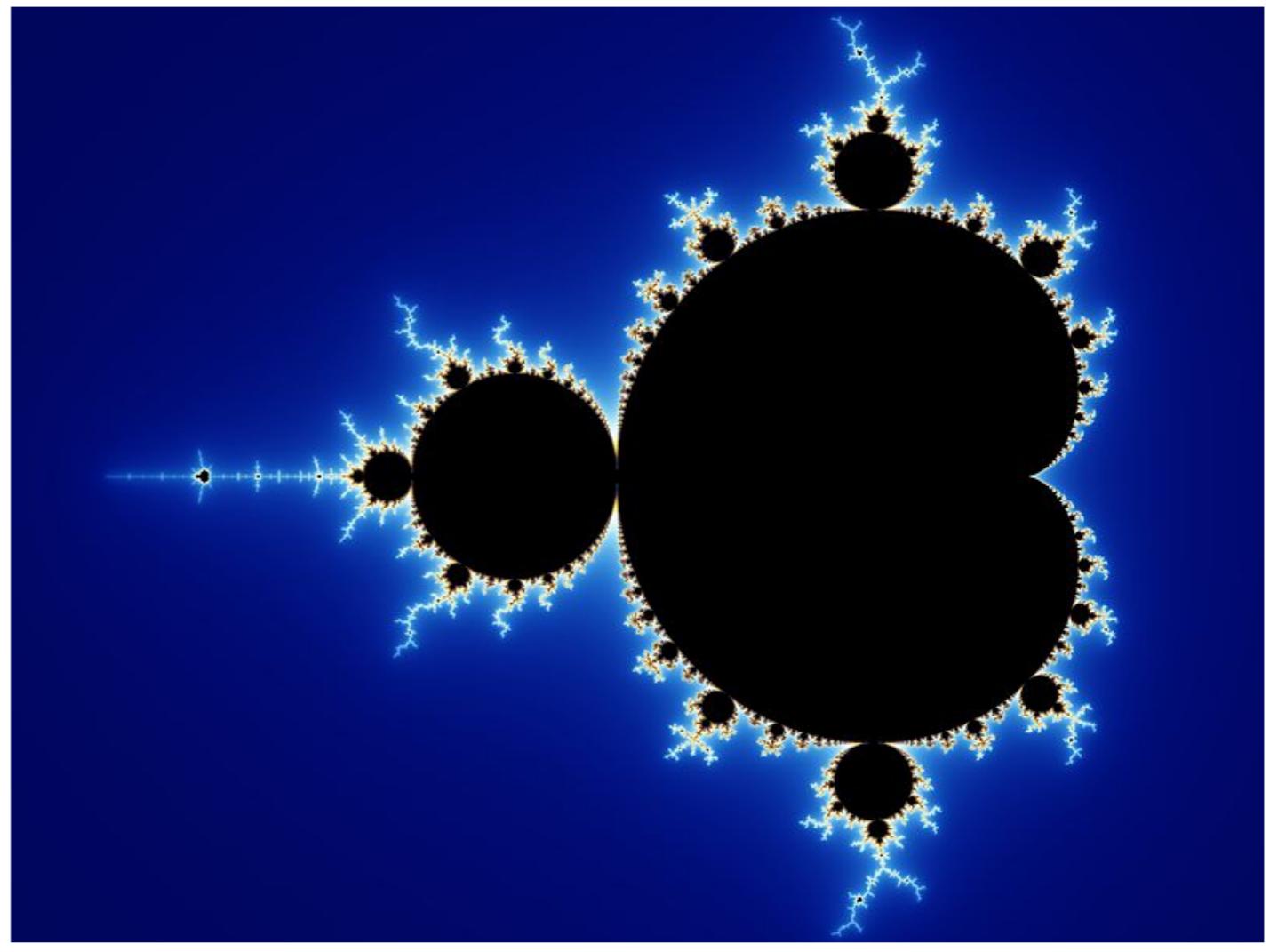
# Self-Similarity and Fractals

## Benoît Mandelbrot



1924 – 2010


$$Z = Z^2 + C$$



The Mandelbrot Set



# Fractals and Beauty





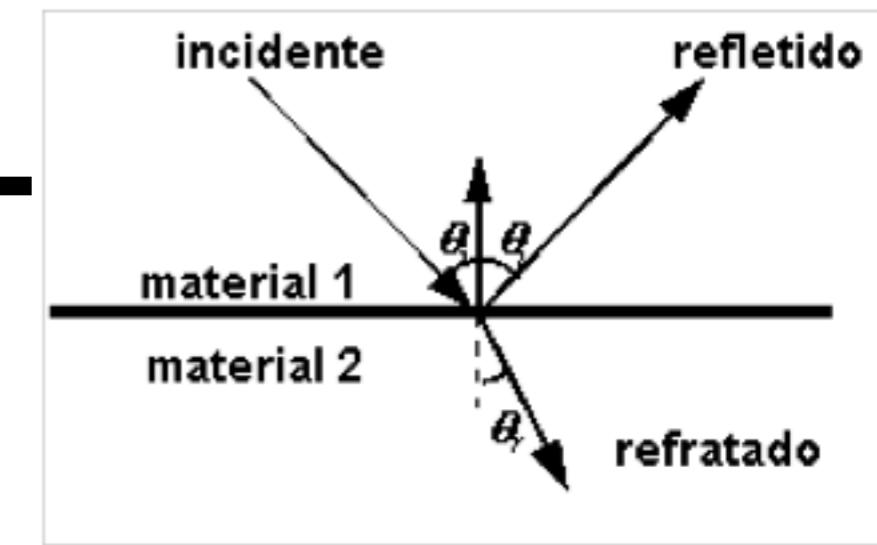
# Light, Vision, and Color

Fiat Lux



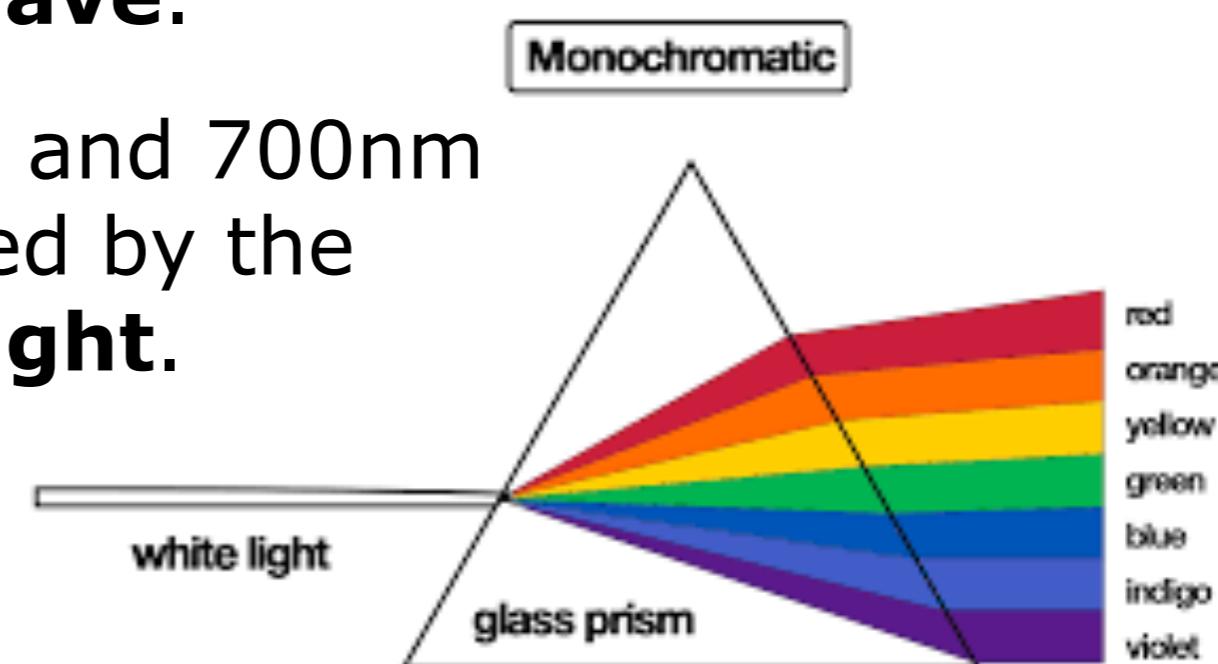


# Light, Vision, and Color



## The light - a few concepts

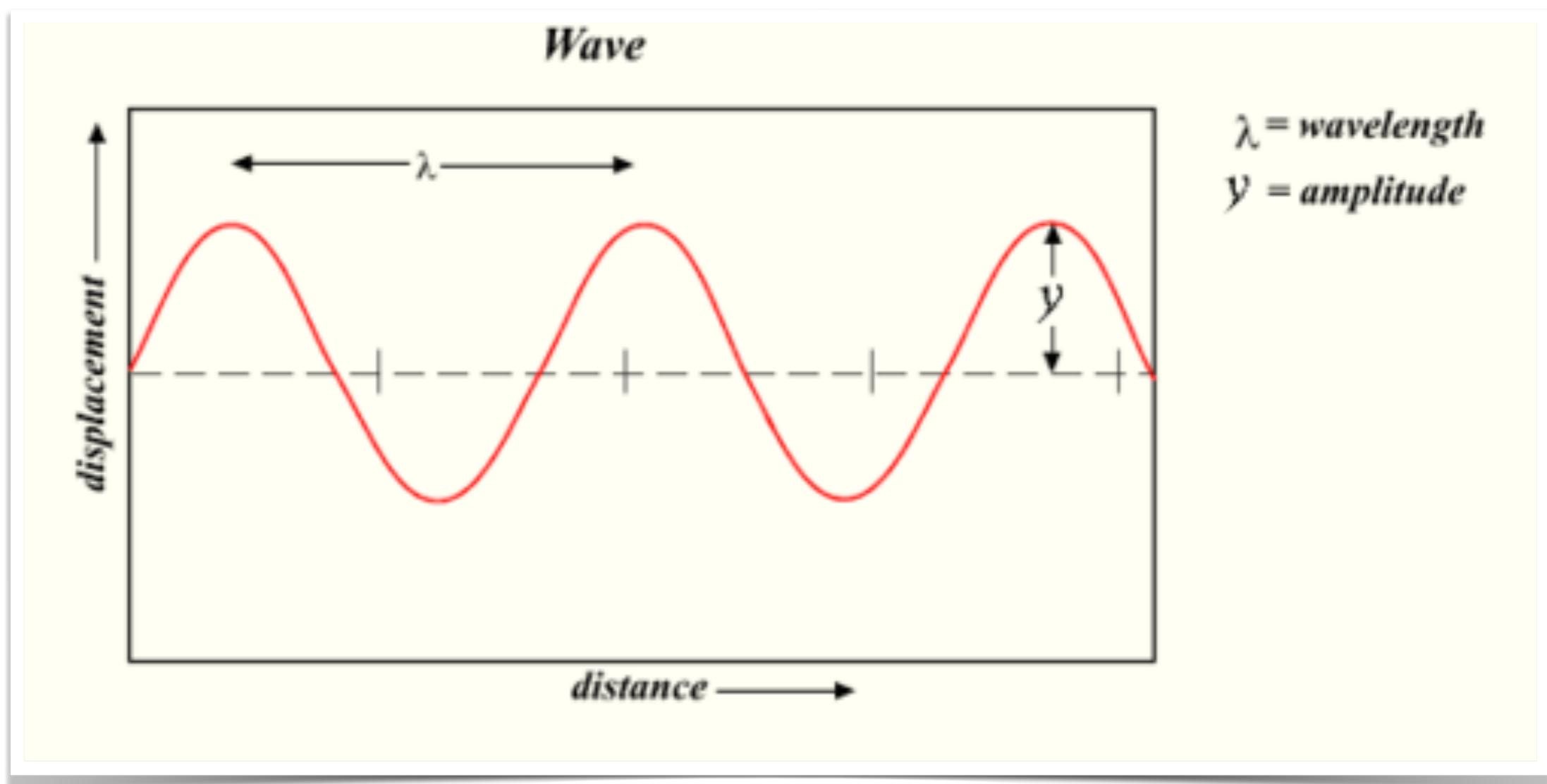
- Light is **essential** for color visualisation. Without it, nothing would be seen.
- In fact, what do we see? We do not see the objects themselves, but just the light that is **emitted** or **reflected** by them.
- Light is an electromagnetic **wave**.
- Wavelengths between 400nm and 700nm (visible spectrum) are detected by the human — **monochromatic light**.





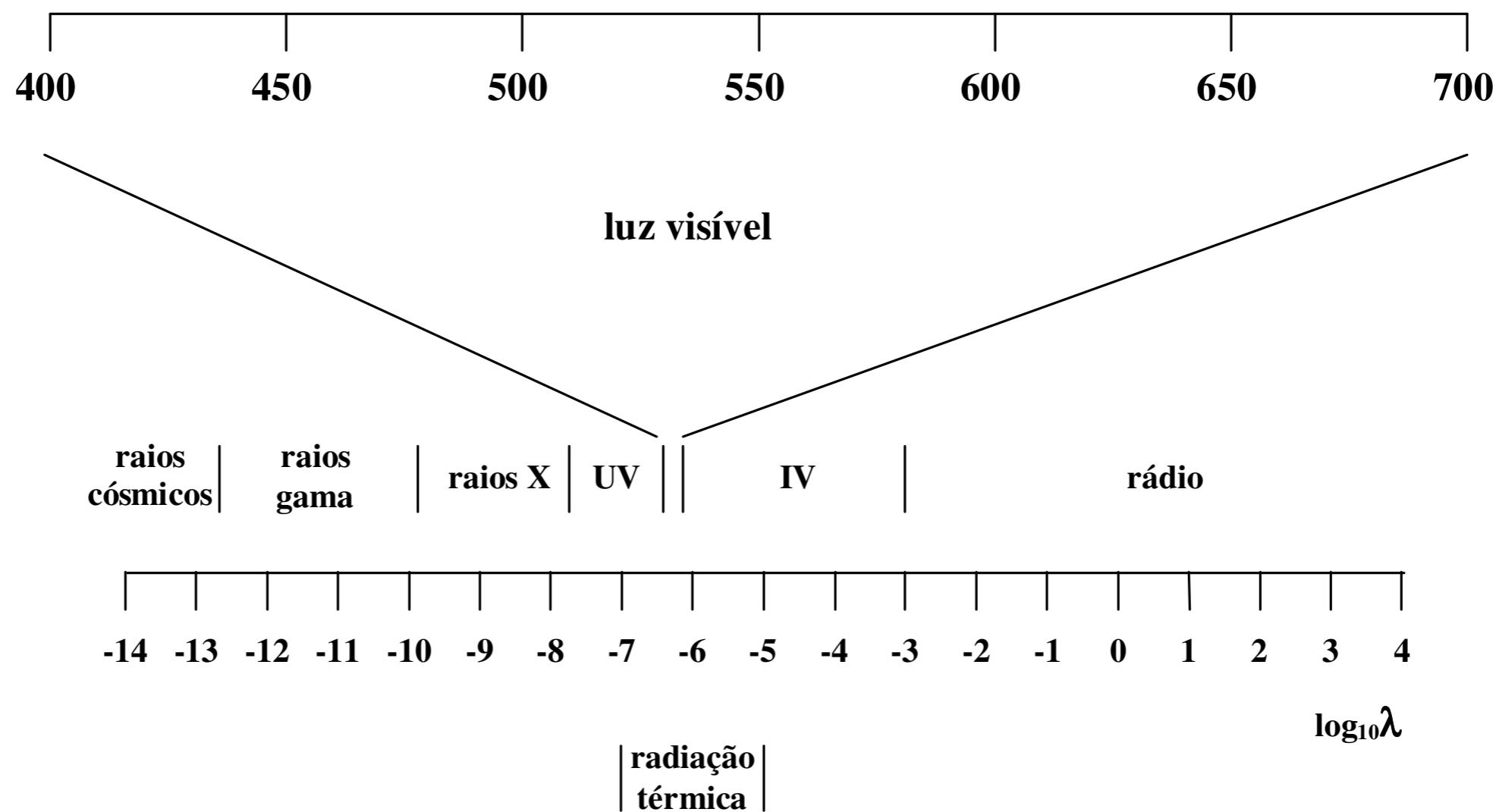
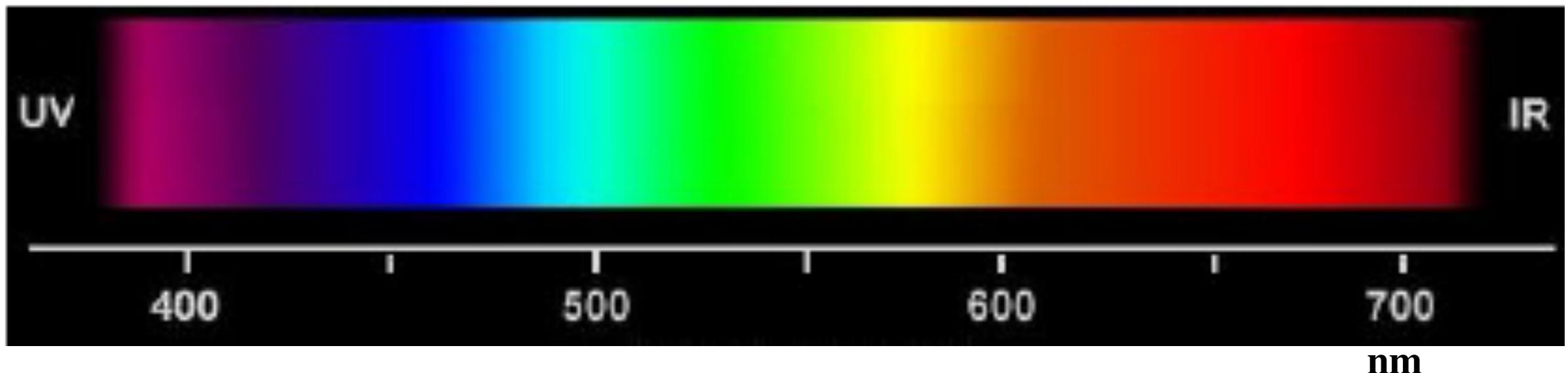
# The nature of light

What we call light is an **electromagnetic wave**, with a given length and amplitude.





# The nature of light





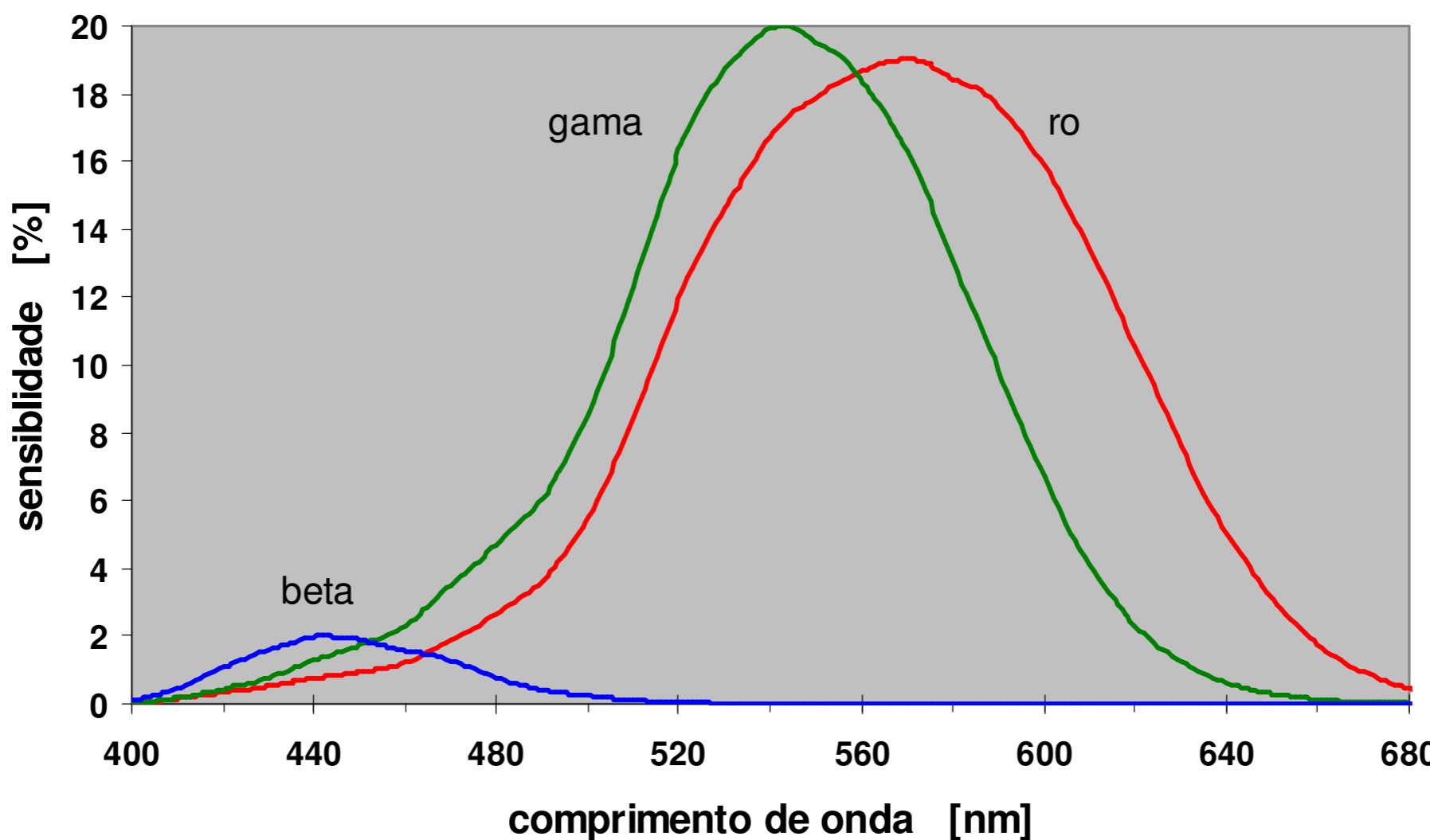
# The nature of light

## Spectral characteristics of human eye sensors

### The two types of sensors:

- **cone** (color sensitivity)
- **rod** (brightness sensitivity)

- The 3 kinds of cones:
  - vermelhos (**red**)
  - verdes (**green**)
  - azuis (**blue**)





# Light, color and human vision

## Spectral characteristics of human eye sensors

### The two types of sensors:

- **cone** (color sensitivity)
- **rod** (brightness sensitivity)

- The 3 kinds of cones:
  - vermelhos (**red**)
  - verdes (**green**)
  - azuis (**blue**)

Tipo de cone	Cor principal	Distribuição relativa [%]	Gama detectada [nm]	$\lambda$ da maior sensibilidade [nm]	Fracção de luz absorvida a $\lambda_{max}$ [%]
$\beta$	azul	4	350-550	440	2
$\gamma$	verde	32	400-660	540	20
$\rho$	vermelho	64	400-700	580	19



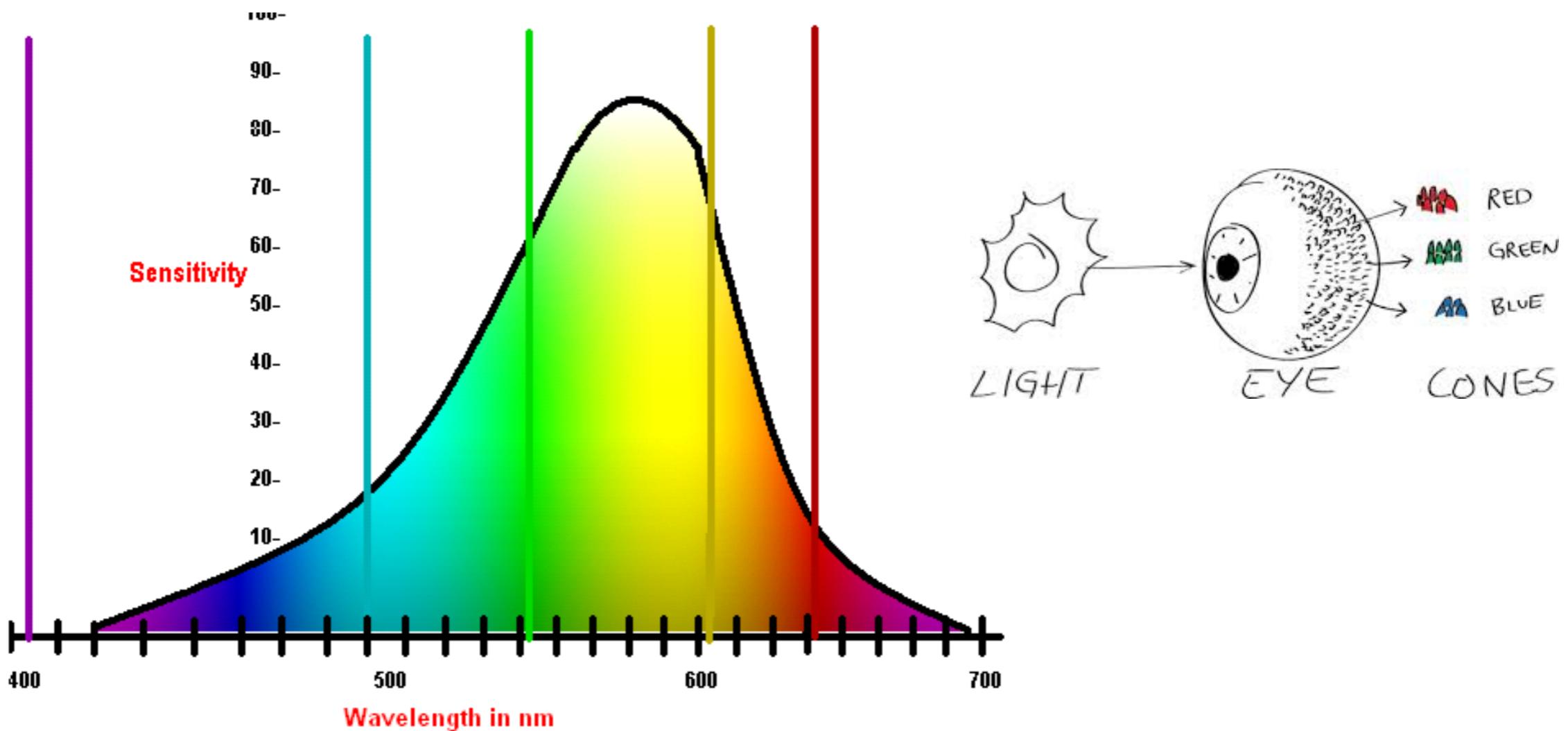
# Light and human vision

## Spectral characteristics of human eye sensors

### The two types of sensors:

- **cone** (color sensitivity)
- **rod** (brightness sensitivity)

- The 3 kinds of cones:
  - vermelhos (**red**)
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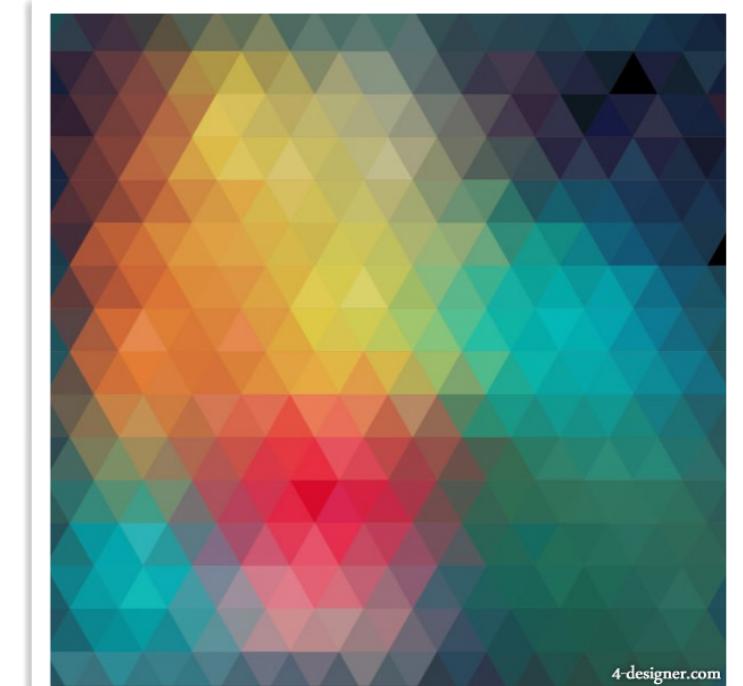
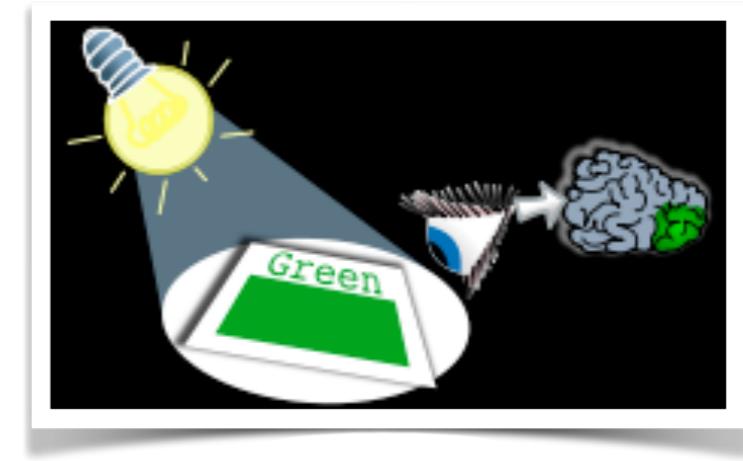


# What is color? Subjective view

"(...) **Impressão** que produz a luz na retina do olho ao ser emitida, difundida ou reflectida pelos corpos (...)"

"(...) **Sensação fisiológica** que, afora em **fenómeno** do tipo alucinatório, é provocada pela acção da luz incidente numa região da retina sobre os pigmentos dos cones dessa região (...)"

"(...) **Conjunto das características da luz** distintas das suas heterogeneidades espaciais e temporais – sendo a luz o aspecto da energia da radiação que o observador humano é capaz de perceber pelo estímulo que produz na sua retina (...)"



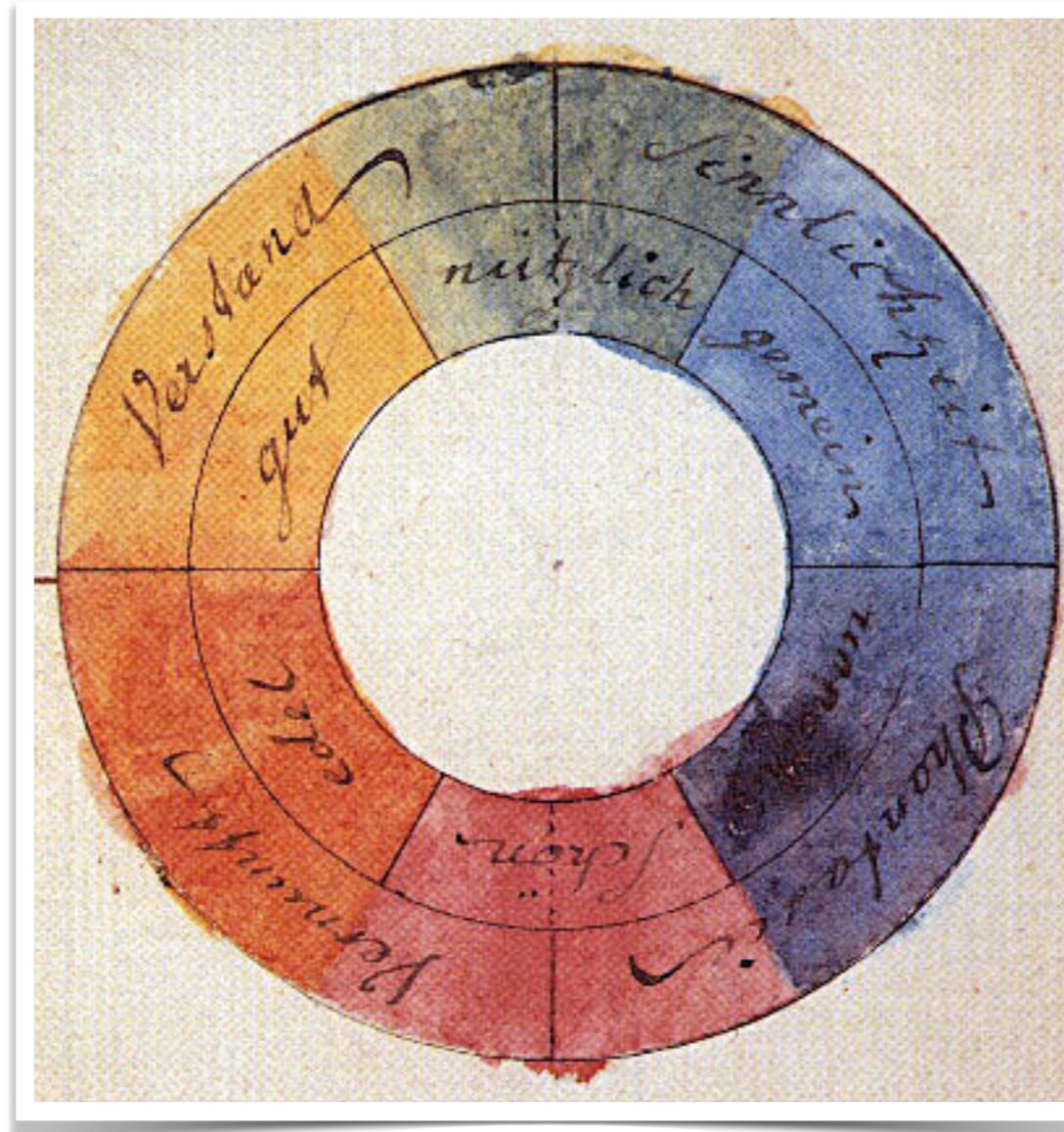


# Color Theory

## The **RYB** system



Goethe 1810



**Red**

**Yellow**

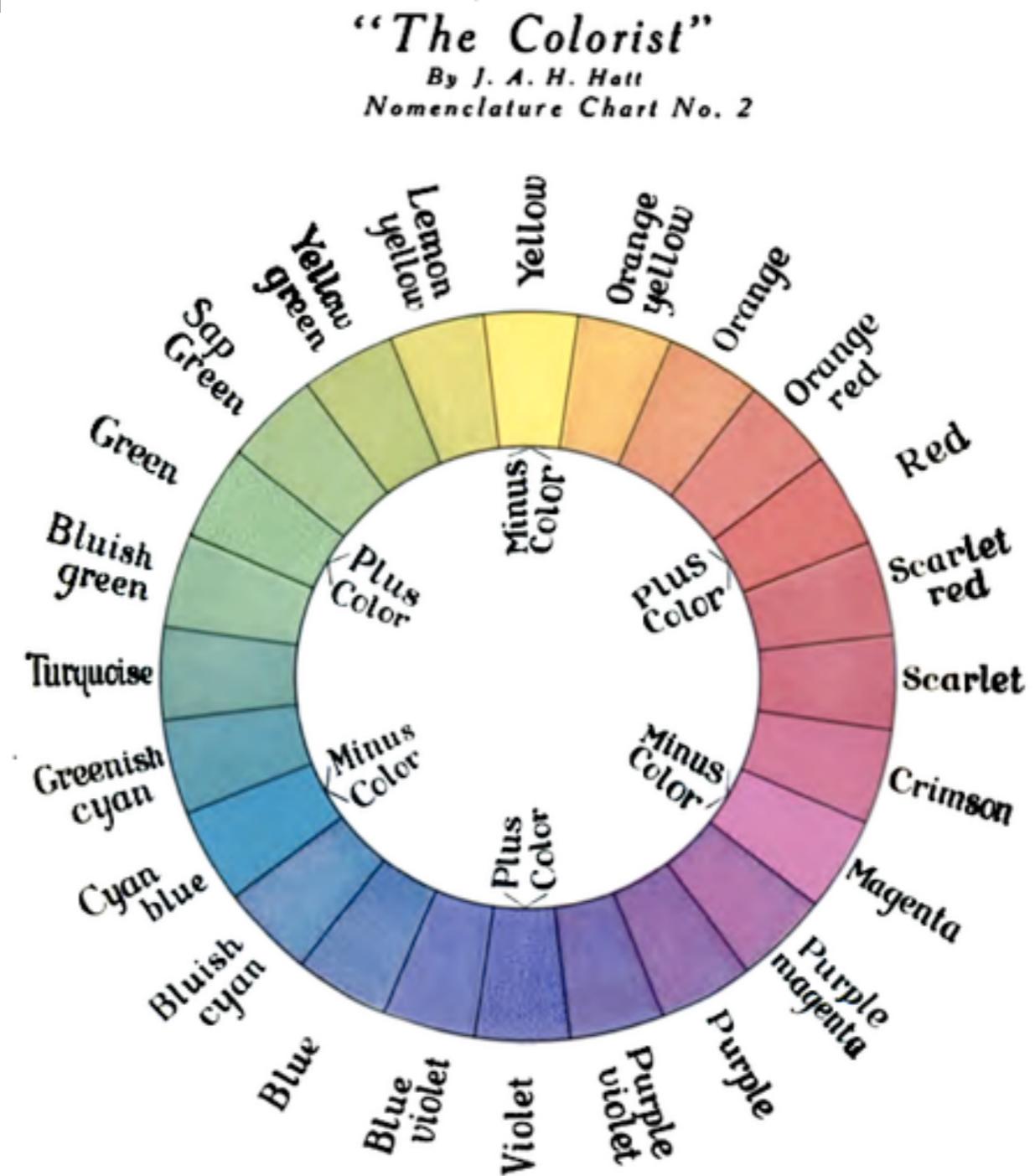
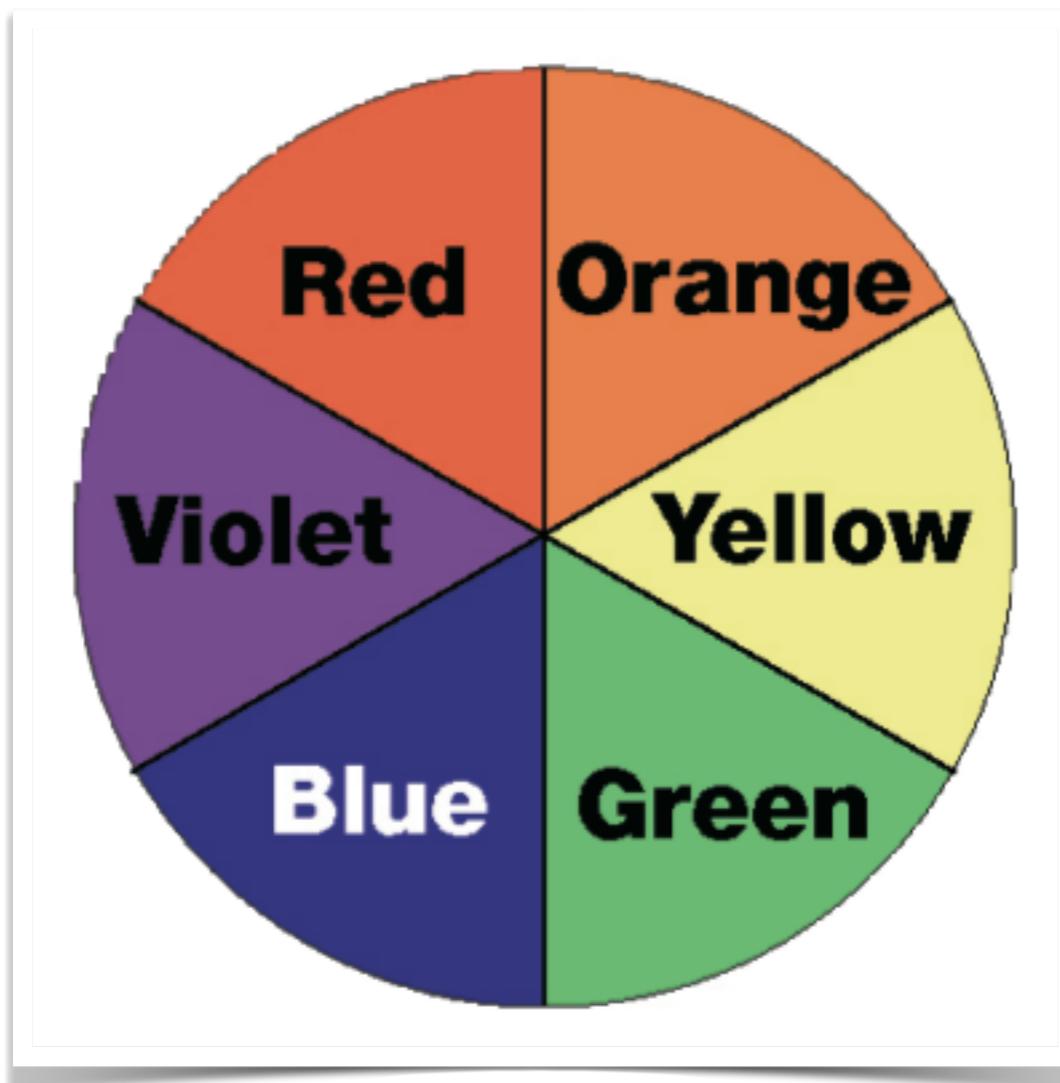
**Blue**

The color wheel



# Color Theory

## The RYB system



Showing proposed names for hues 15° apart.  
Colors opposite each other are complimentary.

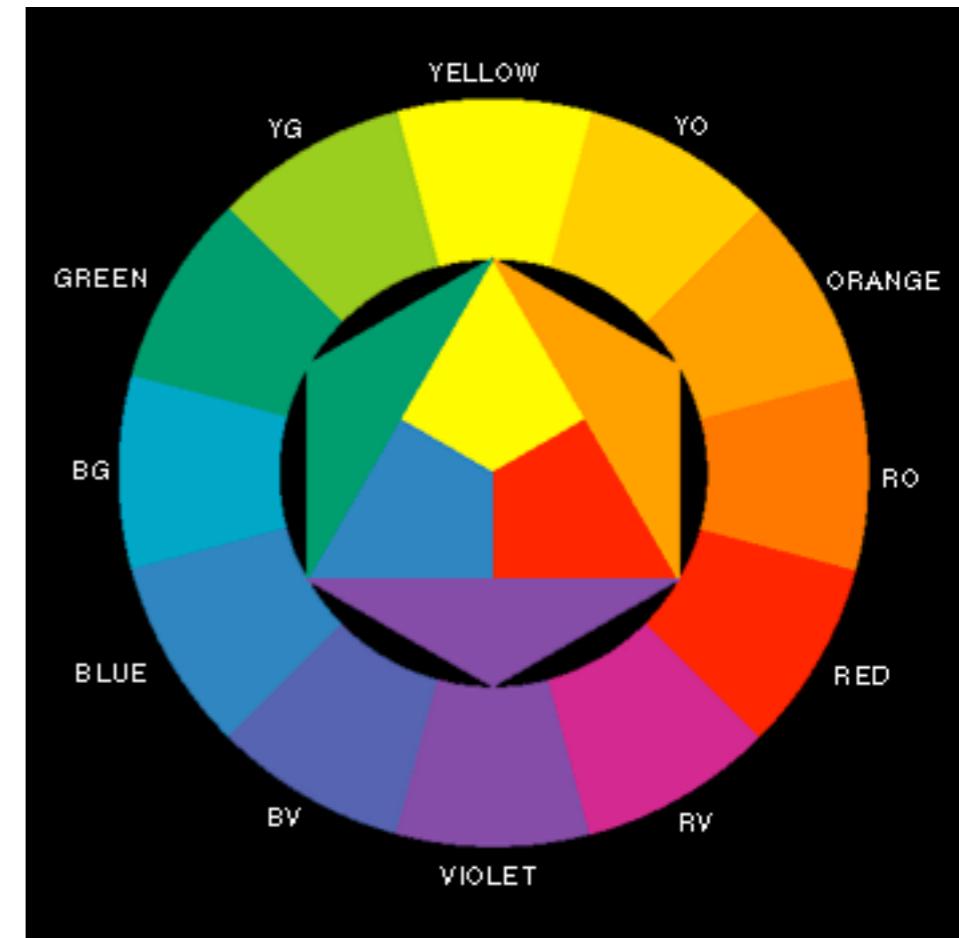


# Color Theory

How can we generate a color wheel?



**RGB ou CMY**



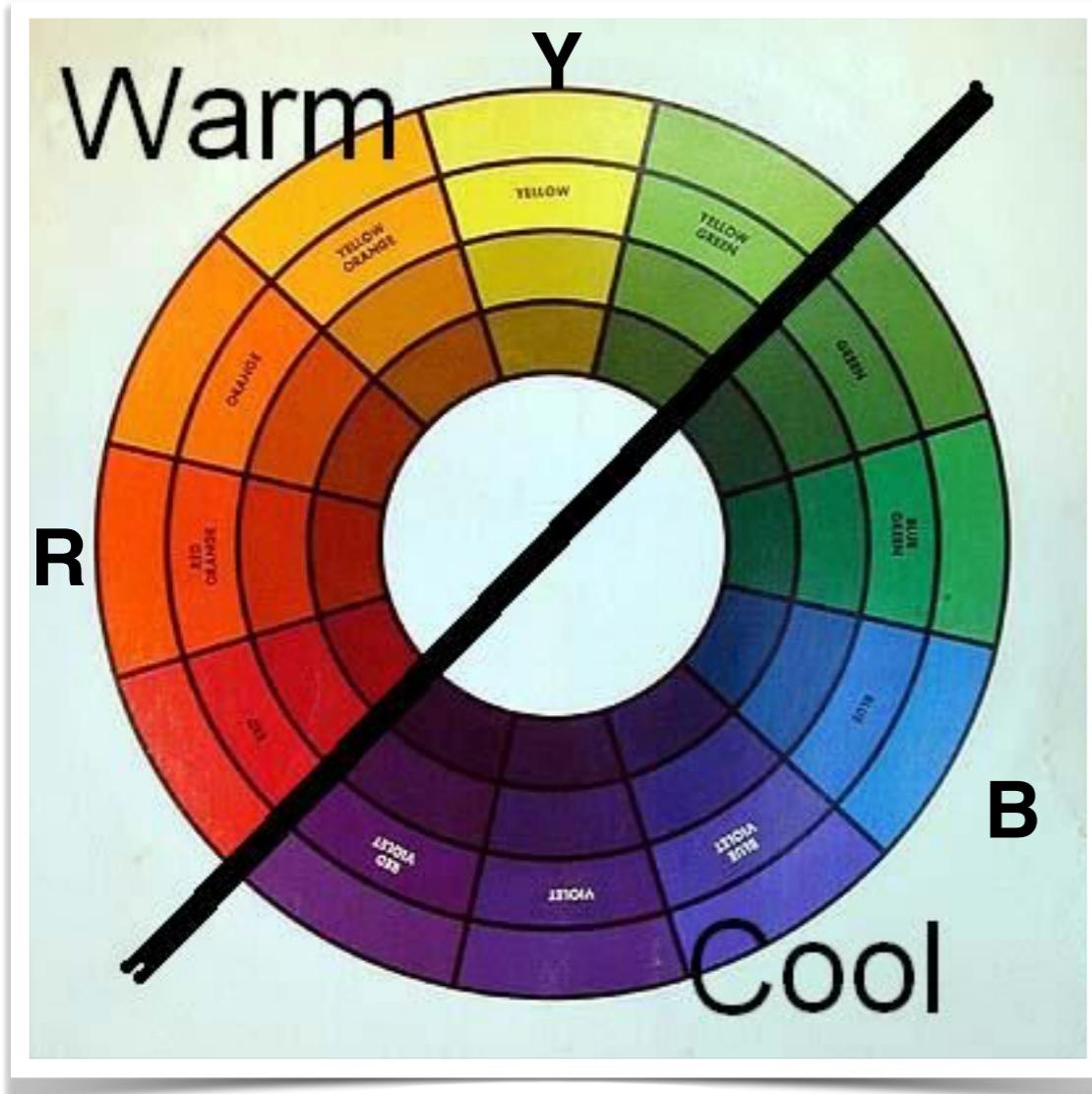
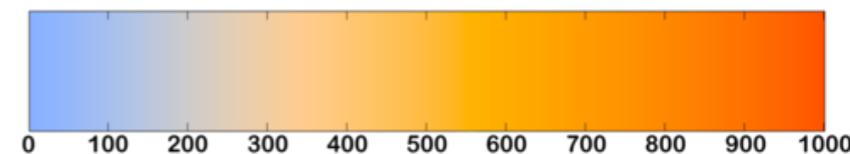
Johannes Itten,  
*Bauhaus School*

1. Start from a RYB base
2. Complete the wheel with "Chromatic Gradation"



# Color Theory

## Warm and cold colors



COOL	LIGHT COOL	WARM	LIGHT WARM
black	dark gray	dark brown	brown
charcoal	gray	brown	camel
gray	light gray	beige	beige
white	bone	cream	cream
pink	light pink	peach	peach
fuchsia	pink	coral	coral
red	red	red	red
plum	mauve	rust	orange
purple	plum	orange	copper
cobalt	violet	mustard	yellow
navy	periwinkle	banana	banana
blue	light blue	green	chartreuse
blue-green	sea foam	olive	green
turquoise	turquoise	hunter	celery
emerald	emerald	teal	teal



# Color Theory

**Warm Colors** ~ Energy and adrenaline



“*Impressão do Sol Nascente*” - Claude Monet,  
1873



# Color Theory

**Cold Colors** ~ Freezing, immobility, tranquility

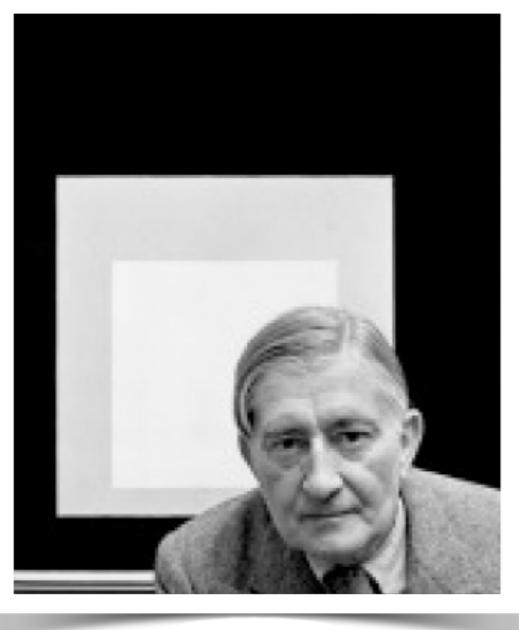


“*The Gare Saint-Lazare*” - Claude Monet, 1877



# Color Theory

## Color and Context



**Joseph Albers**  
**1888 - 1976**



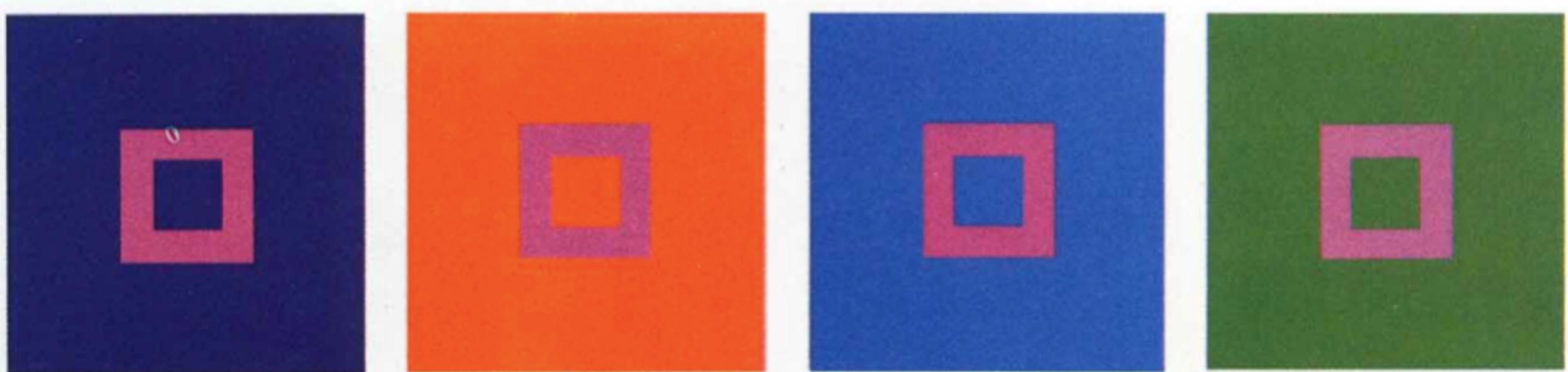
**Untitled, 1921**



# Color Theory

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## Color and Context



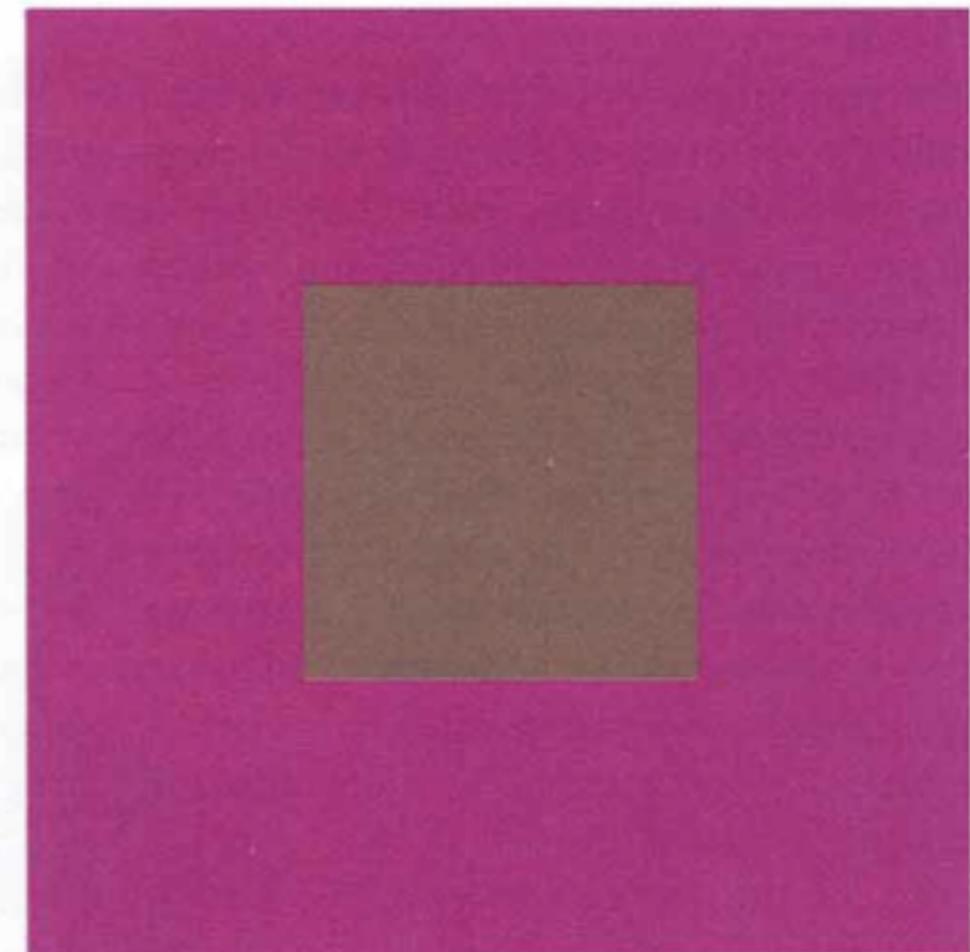
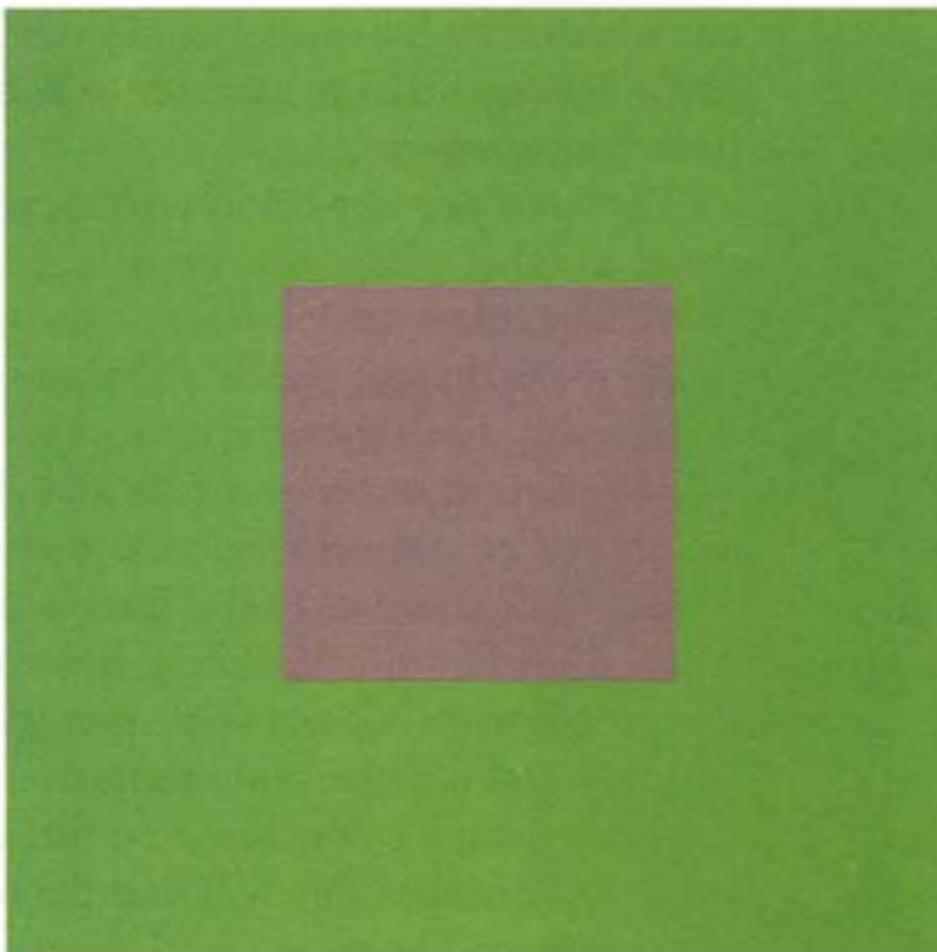
**A**

The red-purple squares, although seemingly different, are identical.



# Color Theory

## Color and Context



C

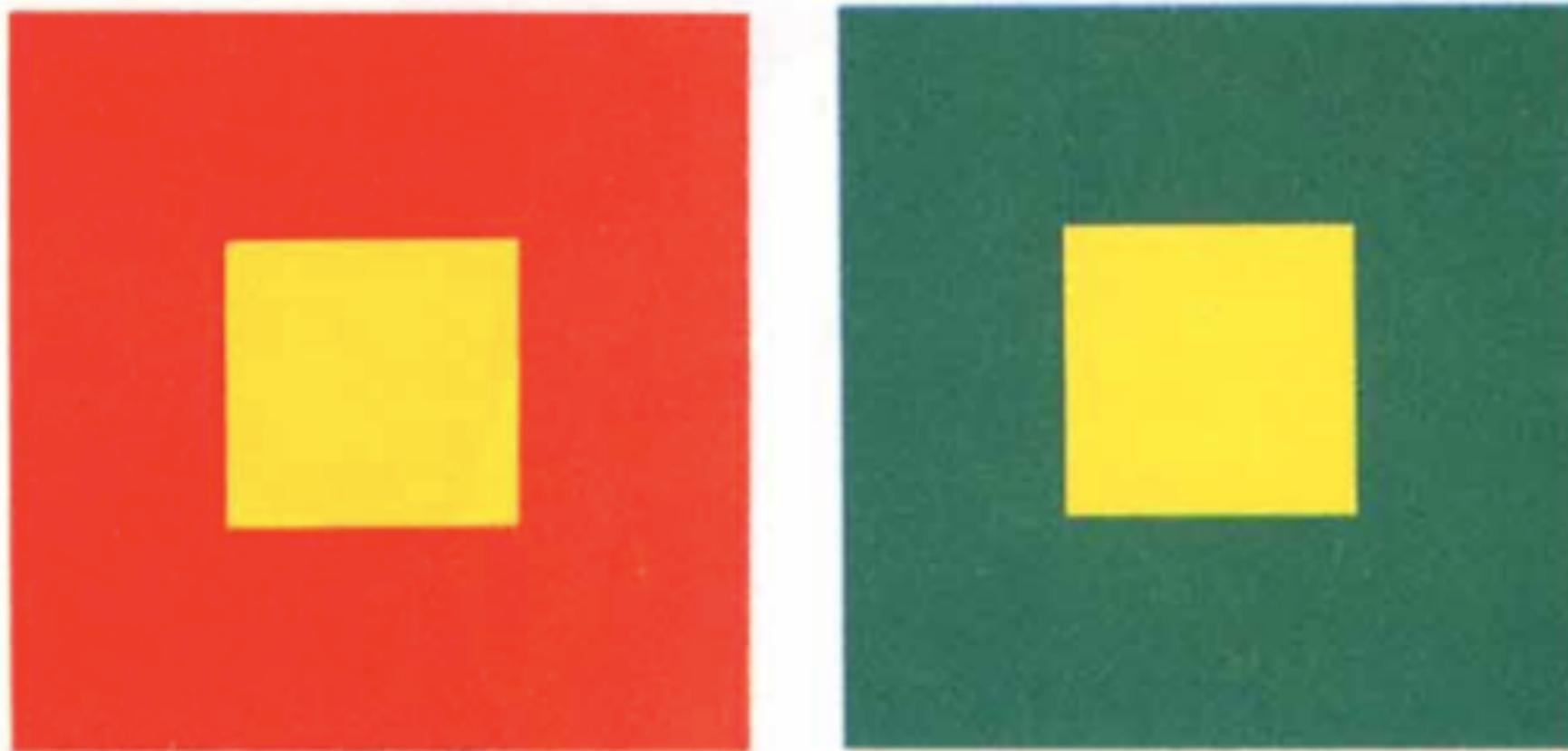
The gray sample looks different against the two background colors.



# Color Theory

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## Color and Context



**B**

A brilliant, vibrant color will not show much change despite different surroundings.

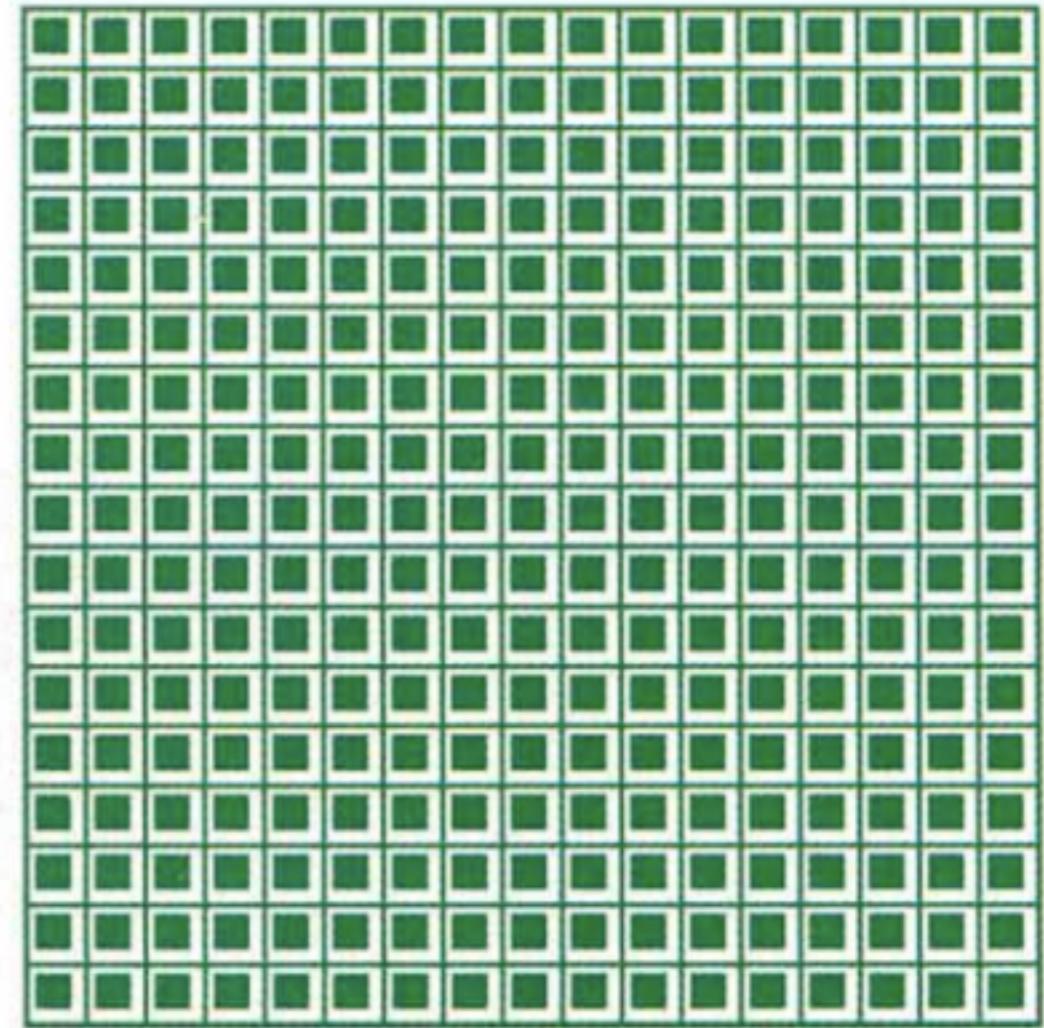
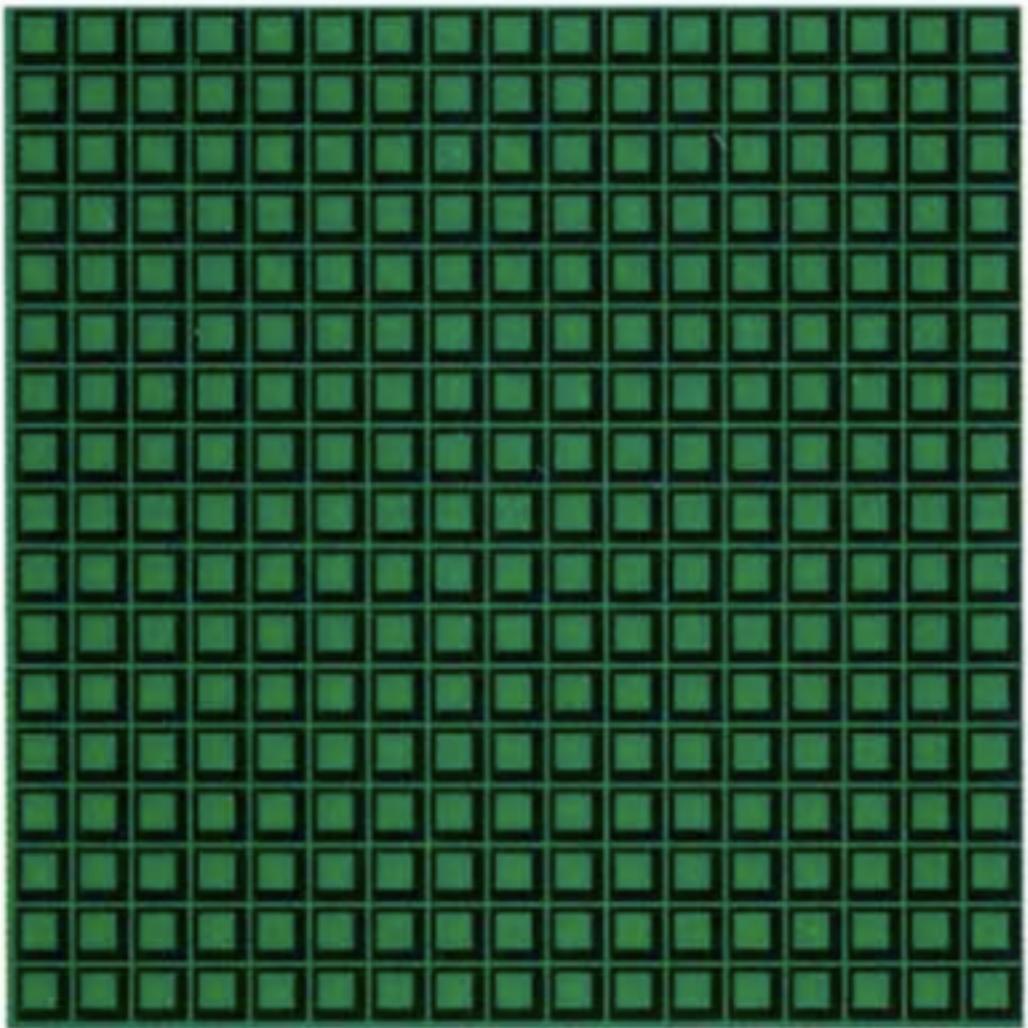


# Color Theory

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## Color and Context

**Contexts with different brightness**



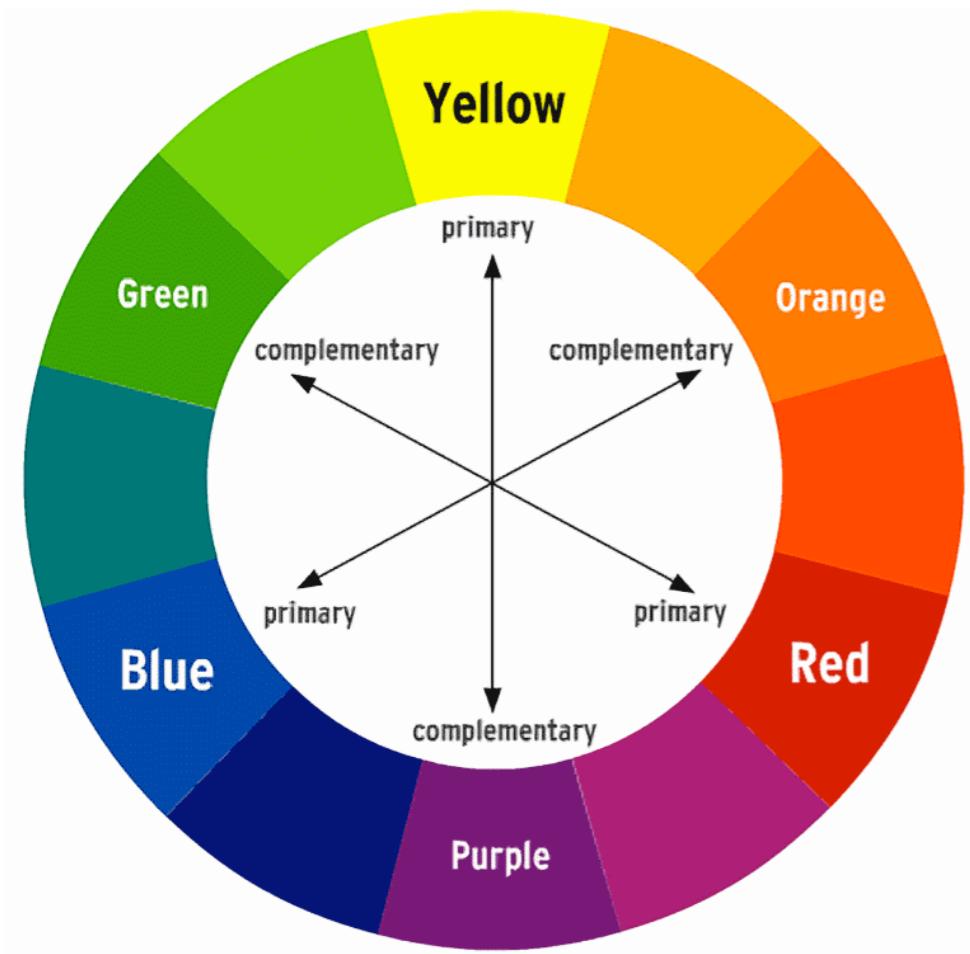
C

The visual mixture of green with black and white.



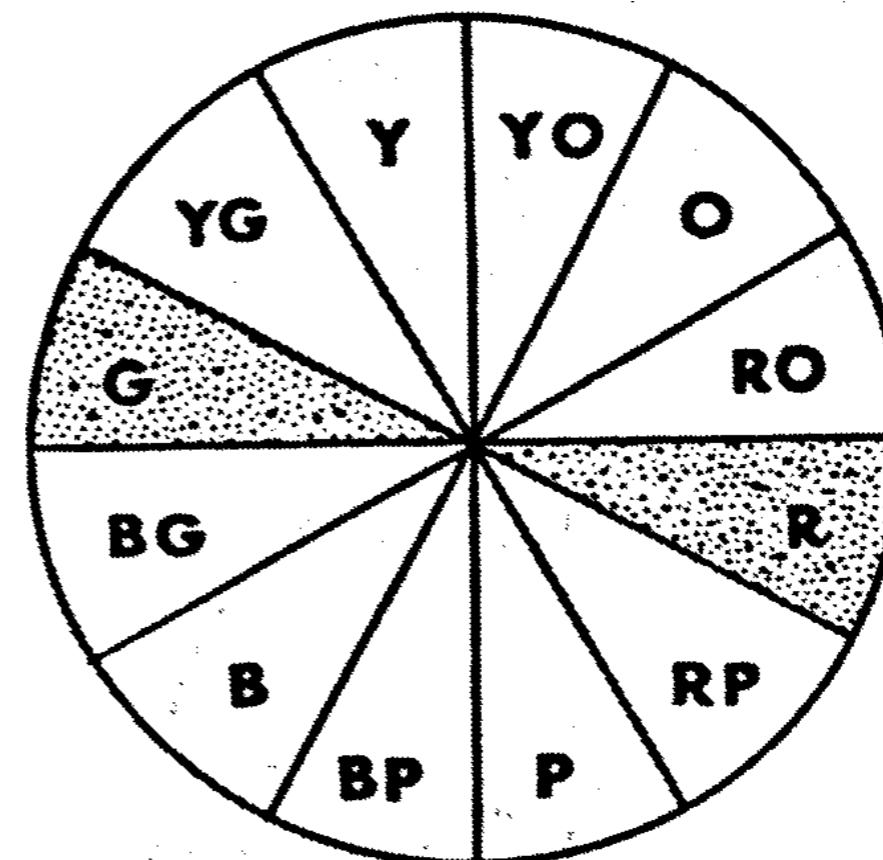
# Color Theory

## Color and Combinations



### *Complementary*

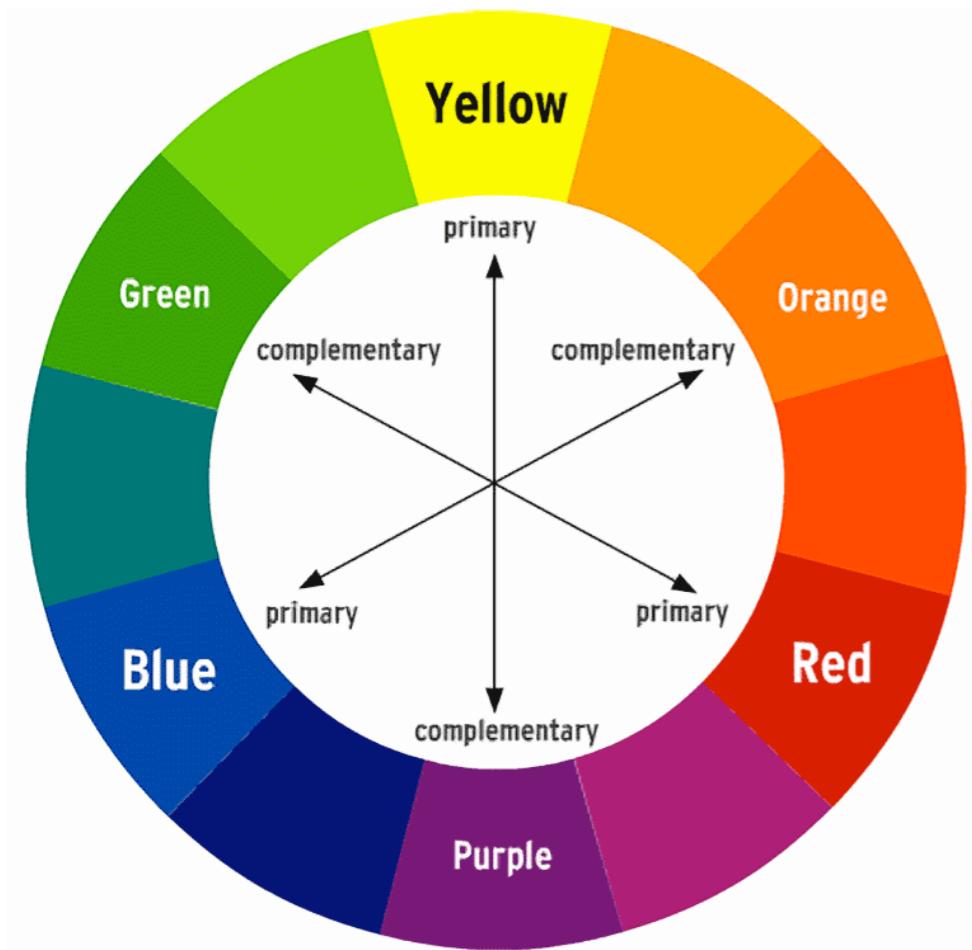
- Two colors opposite each other on the color wheel
- Reddish hues are hardest to handle
- One of the complements used should be dull, light or dark, or in small amount





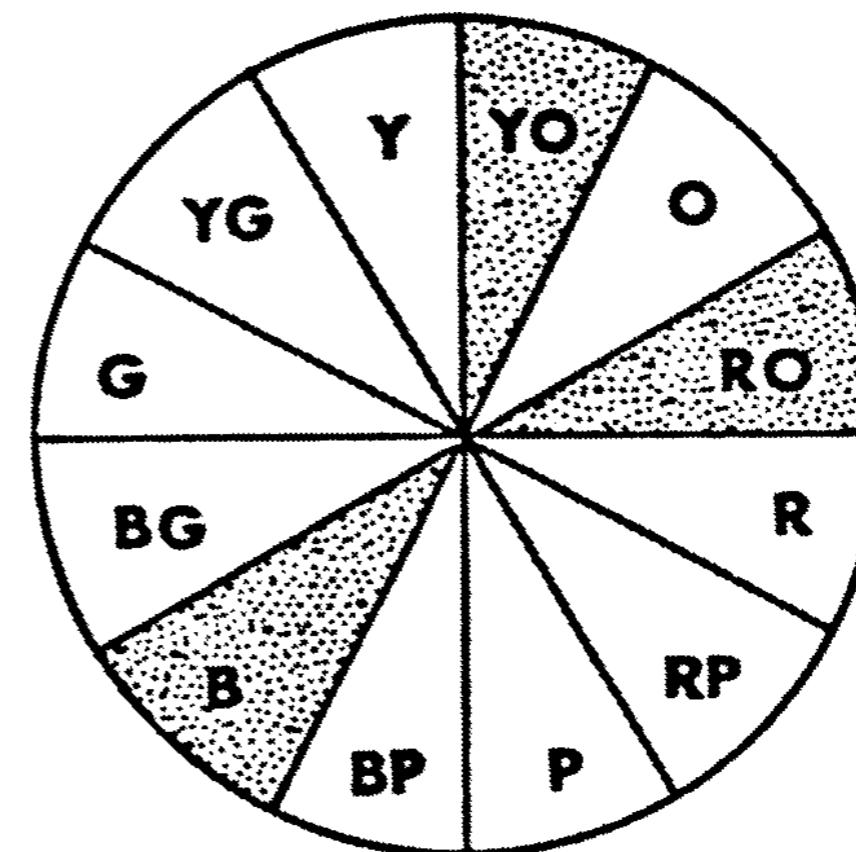
# Color Theory

## Color and Combinations



### *Split Complementary*

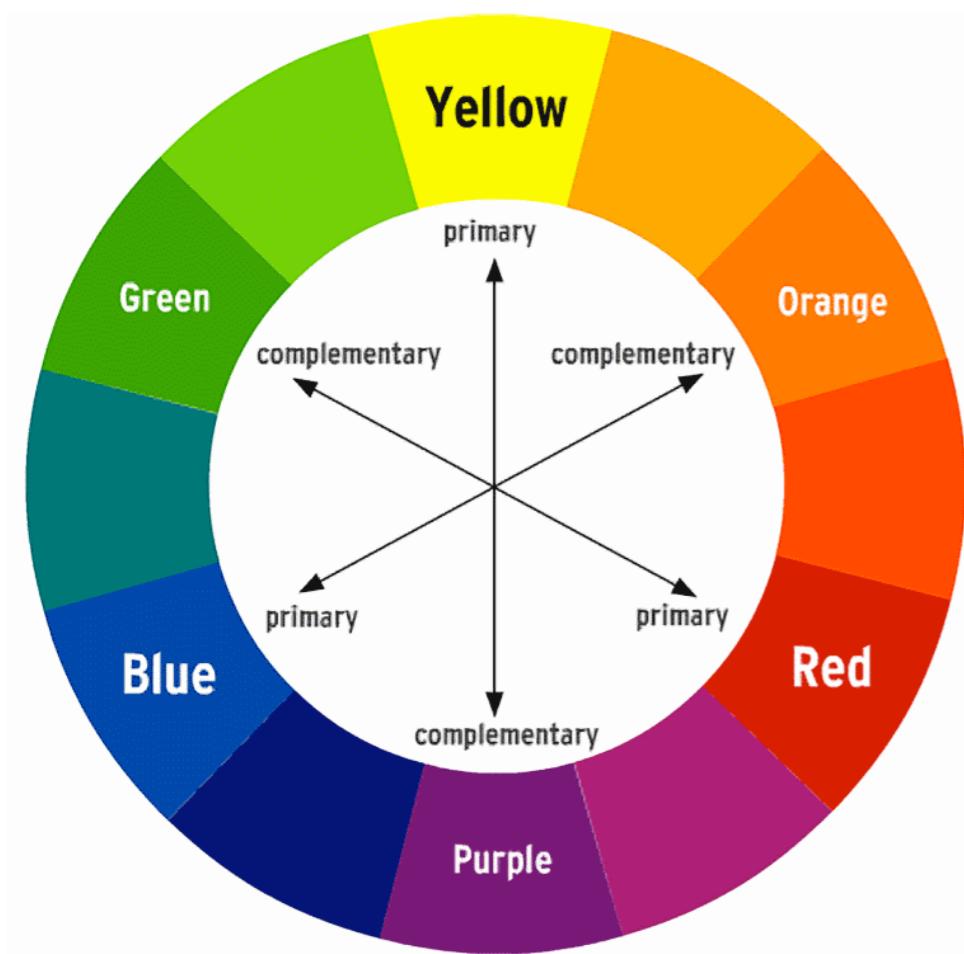
- Combines a primary color with colors on either side of its complement
- Cannot start with a secondary color because its complement, a primary, cannot be split
- Adjust amounts of different values and intensities





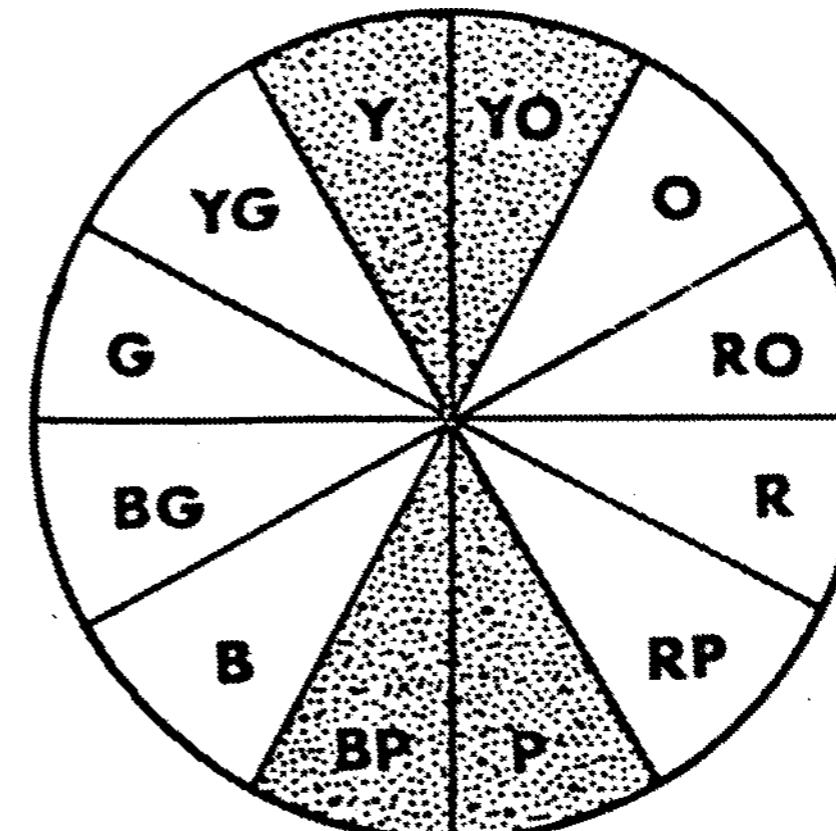
# Teoria da Cor

## Color and Combinations



### ***Double Complementary***

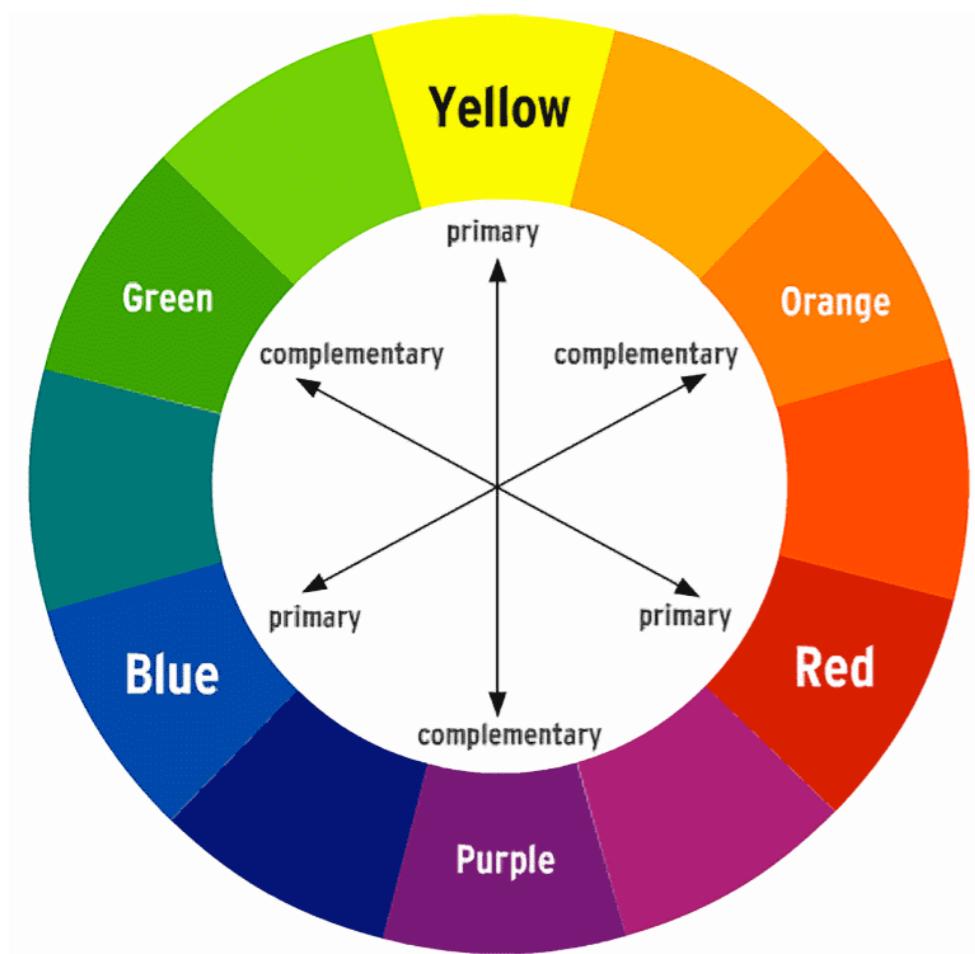
- Two directly adjacent colors and their complements used together
- Pick only one hue to be outstanding and used in largest account (dulled)
- Vary intensities and values of other hues, as well as amounts





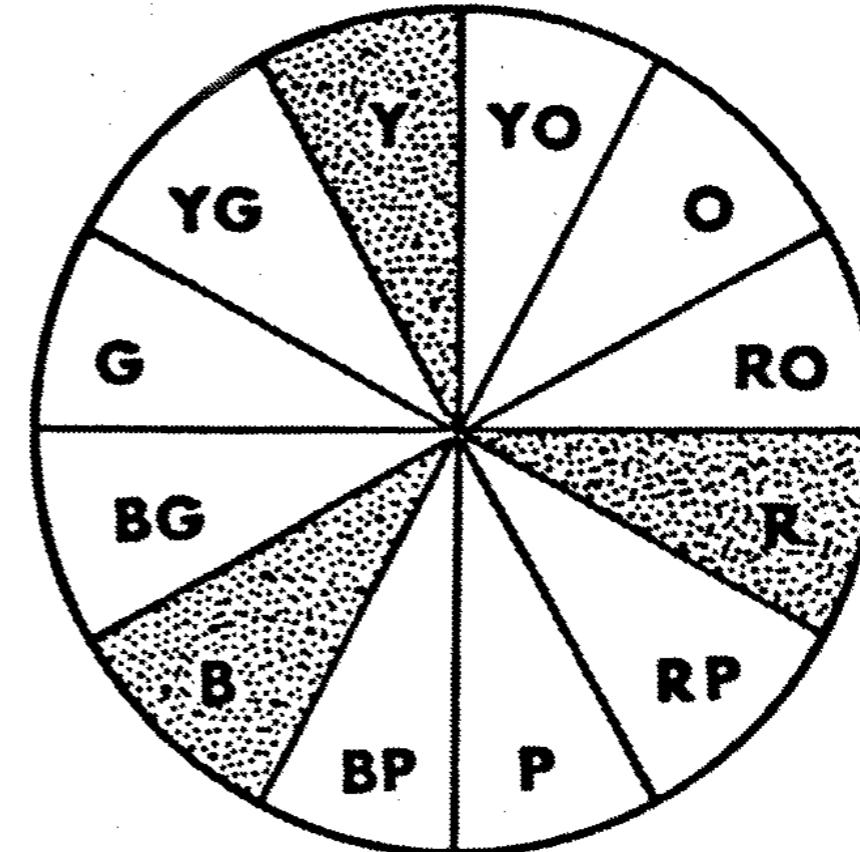
# Teoria da Cor

## Color and Combinations



### *Triad*

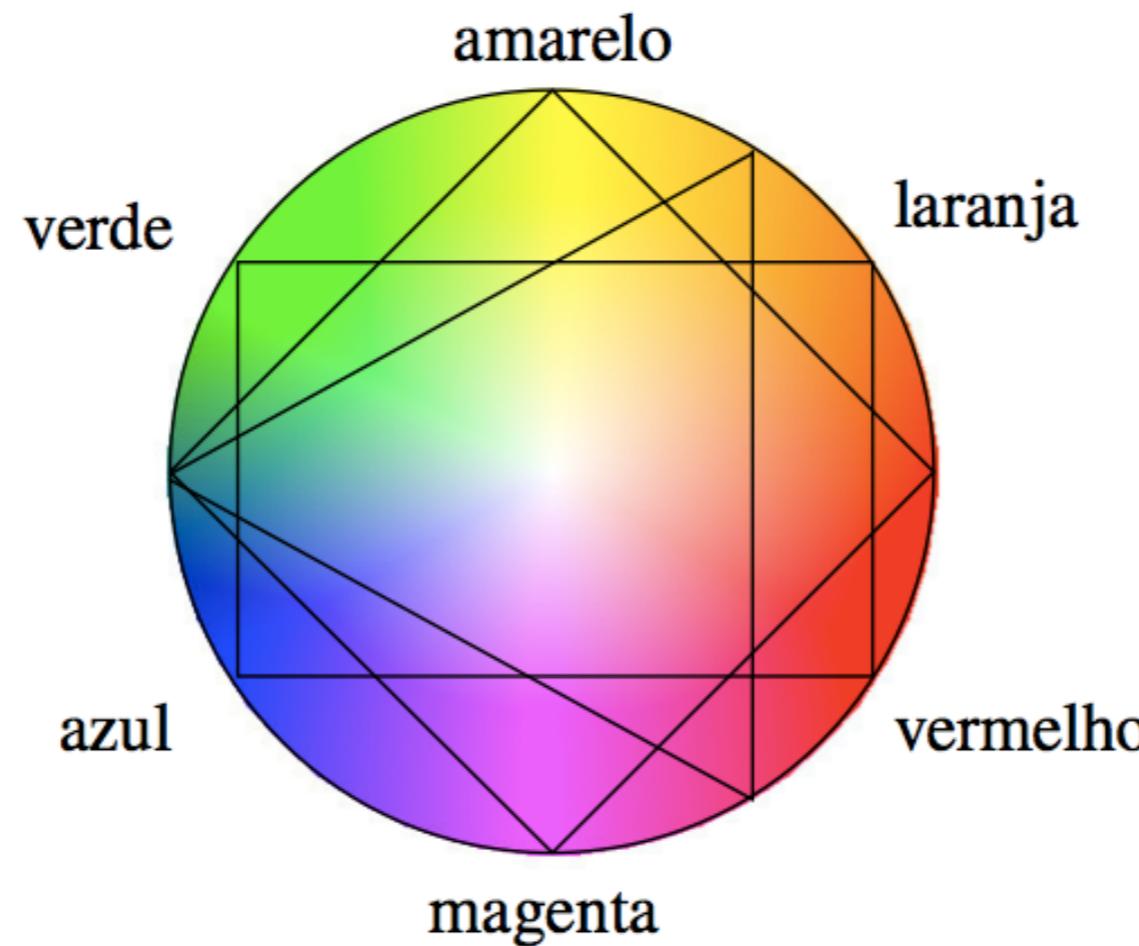
- Richest harmony if well-used
- Equilateral triangles create triads such as Red, Blue, Yellow; Green, Orange, purple; Yellow-Purple, Blue-Green, Red-Purple; AND Yellow-Green, Blue-Purple, Red- Orange.





# Color Theory

## Circle for the choice of colors:



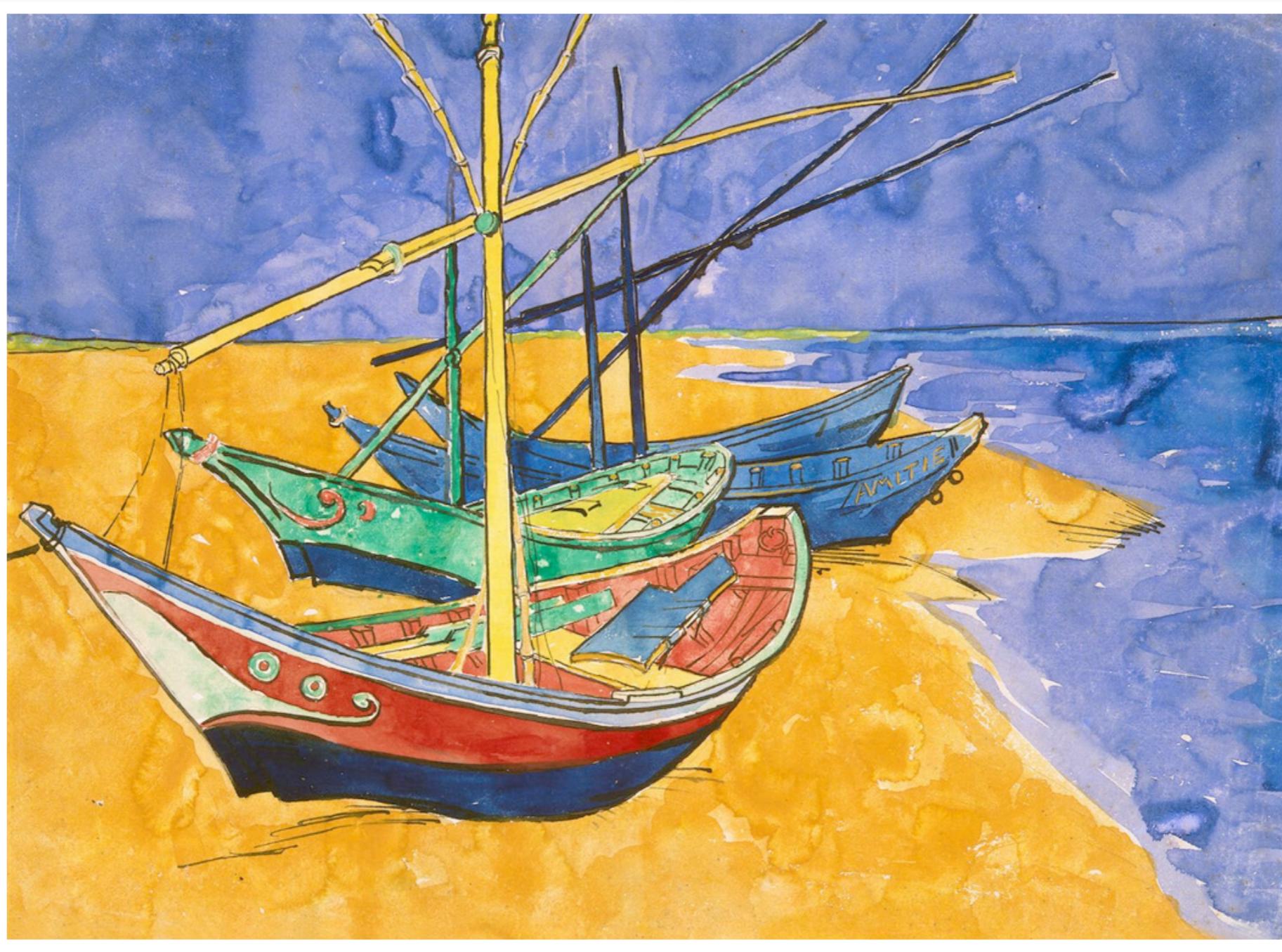
Polygons inscribed in the color circle

**Resource example:** The “Paletton” Web App



# Color Theory

## Use of complementary colors



“Boats” - Van Gogh



# Color Theory

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## Without Complementar Colors



“*Boats Alt.*” - Van Gogh



# Color Resources

The screenshot shows the homepage of coolors.co. At the top, there's a navigation bar with icons for back, forward, home, and search, followed by the URL "coolors.co". Below the bar is a horizontal menu with categories like AUBI, Minha UBI, UBI, Google, R&D, OO, Clouds, NLP, CWork, News, T, F, Y, GRM, Prt, Sci, \$, Midia, etc, UP, and Sat. The main content area features a large, multi-colored grid of vertical bars. A tooltip above the grid says "Press the spacebar to generate color schemes!". To the right of the grid are several icons: a question mark, a gear, a camera, a left arrow, a right arrow, a square, a grid, and a circular icon. In the bottom right corner of the grid, there's a small green square containing a white lowercase 'v'. At the bottom of the page, there's a link to "https://coolors.co/".

<https://coolors.co/>



# Color Resources

Color Hunt Palettes > New ▾

Palette Type	Color Scheme	Likes	Last Updated
Today	Dark Grey, Teal, Light Green	97	Today
Yesterday	Light Grey, Teal, Dark Teal, Dark Purple	188	Yesterday
2 days	Dark Purple, Red, Orange	208	2 days
3 days	Cyan, Orange, Red	203	3 days
4 days	Teal, Light Green, Pink, Yellow	257	4 days
5 days	Red, Orange, Yellow	285	5 days

<https://colorhunt.co/>



# Color Resources

The screenshot shows the Paletton.com website interface. At the top, there's a navigation bar with links for "English", "Browse 1 Million Design Assets (NEW)", "Like it?", "Paletton Live Colorizer", "Mobile [scheduled]", and "More apps [scheduled]". Below the navigation is the main header "paletton.com" with a "paletton" logo. To the right of the logo are buttons for "< UNDO", "REDO >", "RESET", "RANDOMIZE...", and "MORE INFO". Below the header are several buttons: "AdChoices", "Build a Color Palette", "Create My Color Palette", "Color Combinations", and a yellow "Donate" button.

In the center, there's a large color wheel with various color swatches. A specific color is selected, indicated by a larger circle on the wheel. The text "Hue: 304°" and "opposite" are displayed near the wheel. Below the wheel, the "Base RGB" value is listed as "5D2971". There are also "Fine Tune..." and "Monochromatic (2-colors)" buttons. A radio button labeled "add complementary" is also present.

To the right of the color wheel is a preview area titled "My Palette:" showing a horizontal color bar with purple and green segments. Below this is a "Share palette" button. Further down, there's a "Simulation active: Web Colors (legacy 216-color palette)" message with a warning icon.

At the bottom of the interface, there are tabs for "COLORS", "PRESETS", "PREVIEW", "EXAMPLES...", and "TABLES / EXPORT...".

The “Paletton” Web App



# Color Resources

## 7 Rules for Website Color Schemes

Best website colour schemes + inspiration



NICK SCHÄFERHOFF

Editor in Chief

Last updated: Sep 5, 2019. [2 Comments](#)



In branding and website design, colors really matter.

Why?

Research shows that [90% of snap purchase decisions](#) are driven purely by the perception of colors.

Choosing the right website color scheme is what makes it memorable, trustworthy, attractive, and profitable. The first impression is everything.

When building a site, you should consider carefully which colors to add to your color scheme and why. Different colors will send different messages to your visitors, changing their understanding of your website, even when it wasn't intended.



7 Rules for Creating  
**Website  
Color Schemes**

<https://websitesetup.org/website-color-schemes/>



# Color Resources



Inside  
Design

by InVision

INVISIONAPP.COM



Design Resources

Process

Videos

Inspiration

Teams

Design



TRY INVISION FREE

SUBSCRIBE



DESIGN

## Website color schemes that are changing the way we design

11 min read



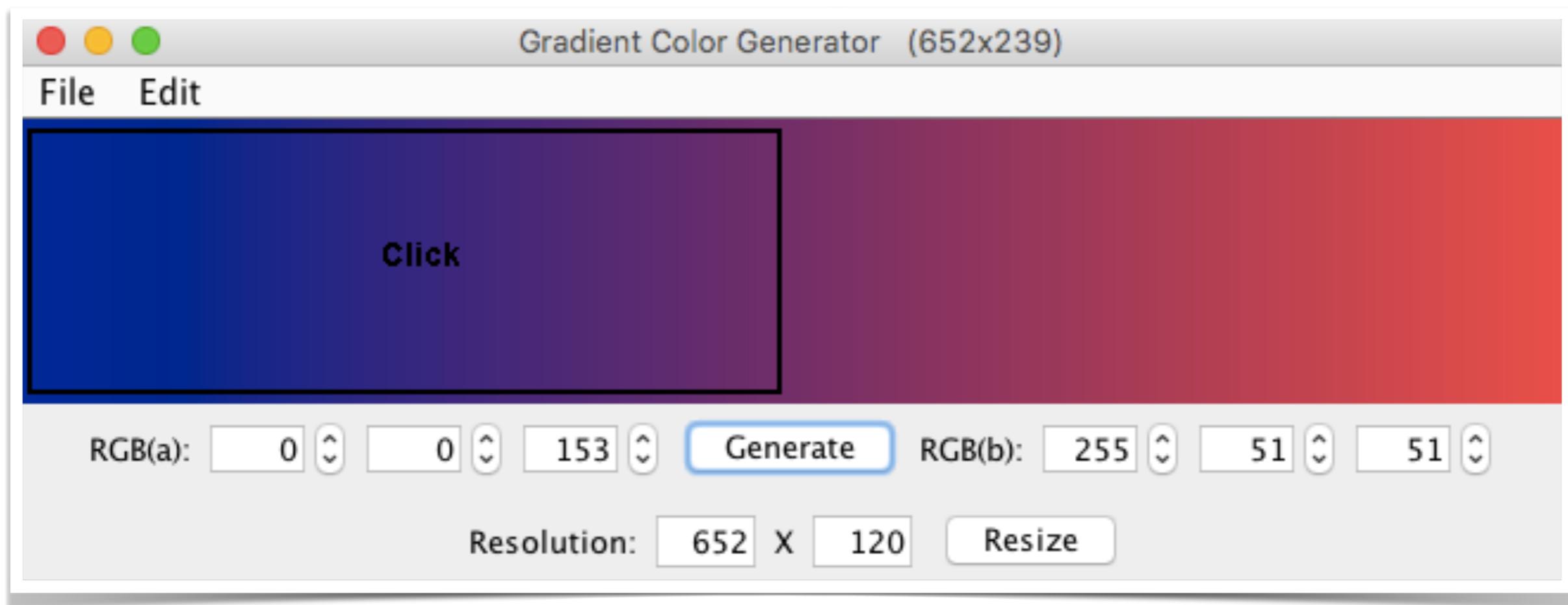
Jess Thoms • Aug 15, 2019

**W**ebsite design has seen endless trends, from the first ever website as text on a white background, to



# Color Theory

## The use of color gradient





# Color Theory

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## Seven General Principles:

- Harmony
- Contrast
- Rhythm
- Repetition
- Gradation
- Balance
- Dominium



# Color Theory – Harmony



Combination of similar elements, colors with close tint or with slight variations in brightness and intensity.

Serenity, tranquility ... or melancholy!



# Color Theory – Harmony



Edgar Degas (1834-1917) "Interior" (1868 or 1869)

Degas has used what appears to be a fairly limited palette to give this painting a tight color harmony. The color temperature is predominantly warm with dominating browns and reds, but woven through some of these fields of warm are subtly contrasting areas of cool green/grey.

In the wallpaper background, small patches of juxtaposed green and red blend to produce an animated field of warm. This sounds like a recipe for strong color contrast, but the visual blending Degas color arrangement creates a **tight and very rich color harmony**.



# Color Theory – Contrast



Combination of opposing colors and/or different levels of saturation.

Action, movement, ... rhythm, excitement



# Color Theory – Contrast



Ernst Ludwig Kirchner (1880-1930)  
Artistin Marcella (1910)

The strong composition and dramatic tonal **contrast** in Ernst Kirchner's painting immediately grab your attention. The striped dress against the dark sofa establish a strong focal point, but the thing that really gives this work life and vibrancy is Kirchner's use of raw, contrasting red in the large expanse of green that dominates the painting. Without this color contrast the painting would lack the vitality that brings it to life.

Source: <http://johnlovett.com/design/color-contrast/>



# Color Theory – Repetition



Shapes and hues are repeated following well defined patterns.

Order, Logic, Structure, ...



# Color Theory – Repetition



Gustave Klimt (1862-1918) "Attersee" (1900)

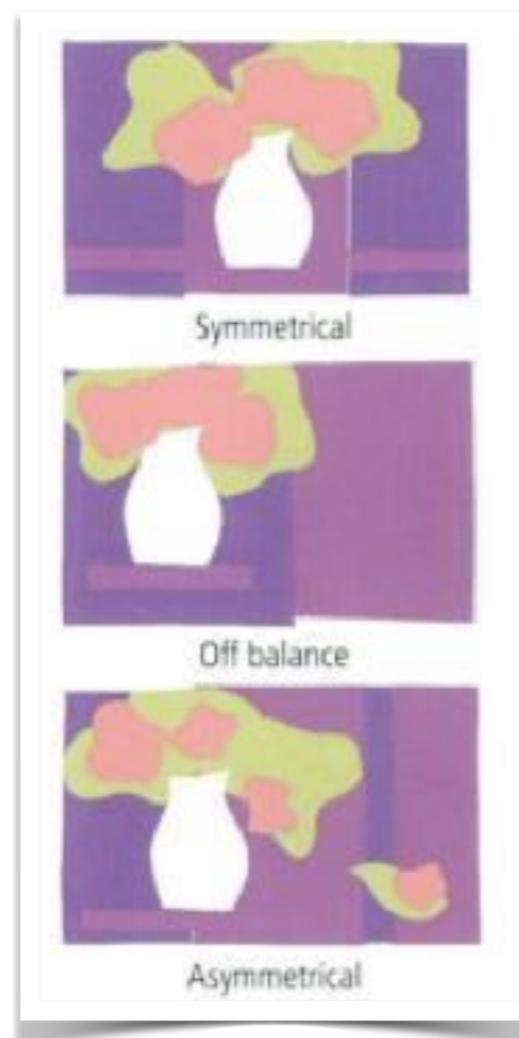
This simple composition relies on the repeating patches of blue and green to give it vitality and depth. The graduating size of the ripples gives the painting a feeling of perspective, while the contrast between the warm grey underpainting and the similar toned turquoise and blue ripples creates the shimmering effect on the water.



# Color Theory – Balance



Distribution of elements on a symmetrical or asymmetric form. With more elements it become complex and difficulty to perform.



**More asymmetry results in higher emotional response.**



# Color Theory – Balance



Toulouse Lautrec has used an interesting arrangement of warm and cool to balance this painting. The dominating cool, dark mass of the women's dresses and background waiter, are flanked by a pair of horizontal red stripes. The stripes are balanced, on the opposite side of the painting, by the shape of a red jacket. A small flick of red in the collar of one of the women creates a balanced triangular arrangement of reds in a field of predominantly cool blue/greys. The areas of light punctuating the dark masses establish the focal point, but it is the arrangement of reds that keep the painting balanced.

**Henri de Toulouse-Lautrec (1864-1901)"  
At the Moulin Rouge: Two women waltzing" (1892)**



# Color Theory – Dominance



When a color dominates the whole, it can sometimes unify conflicting parts. Setting a context

Unified chromatic blend



# Color Theory – Dominance



Claude Monet (1840-1926) “Impression Sunrise” (1872)

Monet’s painting of a sunrise is dominated by a cool green/grey. This cool color occupies around three quarters of the painting and is relieved, in the upper sky, by a pale warm orange, intensifying as it approaches the rising sun. The sun is the direct complementary color to the surrounding sky, creating a shimmering intensity. By allowing the green/grey to dominate, the red/orange of the sun is injected with maximum intensity.



# Color Theory

## **The Color Psychology**



Color ==> Emotions



# Color Theory

## The Color Psychology

O Vermelho transmite coragem física, força, calor, energia, sobrevivência básica, estímulo, masculinidade e entusiasmo. Mas também, desafio, agressão, impacto visual, perturbação.

Área de Projecto 12ºD: Psicologia das Cores

O Amarelo transmite optimismo, confiança, auto-estima, extroversão, força emocional, simpatia e criatividade. Mas também irracionalidade, medo, fragilidade emocional, depressão, ansiedade e suicídio.

Área de Projecto 12ºD: Psicologia das Cores

O Azul transmite inteligência, comunicação, confiança, eficiência, serenidade, dever, lógica, frescura, reflexão e calma. Mas também frieza, frivolidade, ausência de emoções e ausência de simpatia.

Área de Projecto 12ºD: Psicologia das Cores



Color => Emotions

O Verde transmite harmonia, equilíbrio, frescura, amor universal, recuperação do descanso, segurança, consciencialização ambiental, equilíbrio e paz. Mas também aborrecimento, estagnação, malícia e enervamento.

Área de Projecto 12ºD: Psicologia das Cores



# HUMAN-COMPUTER INTERACTION

THIRD  
EDITION



DIX  
FINLAY  
ABOWD  
BEALE

## chapter 7

# Design Rules



# Design rules

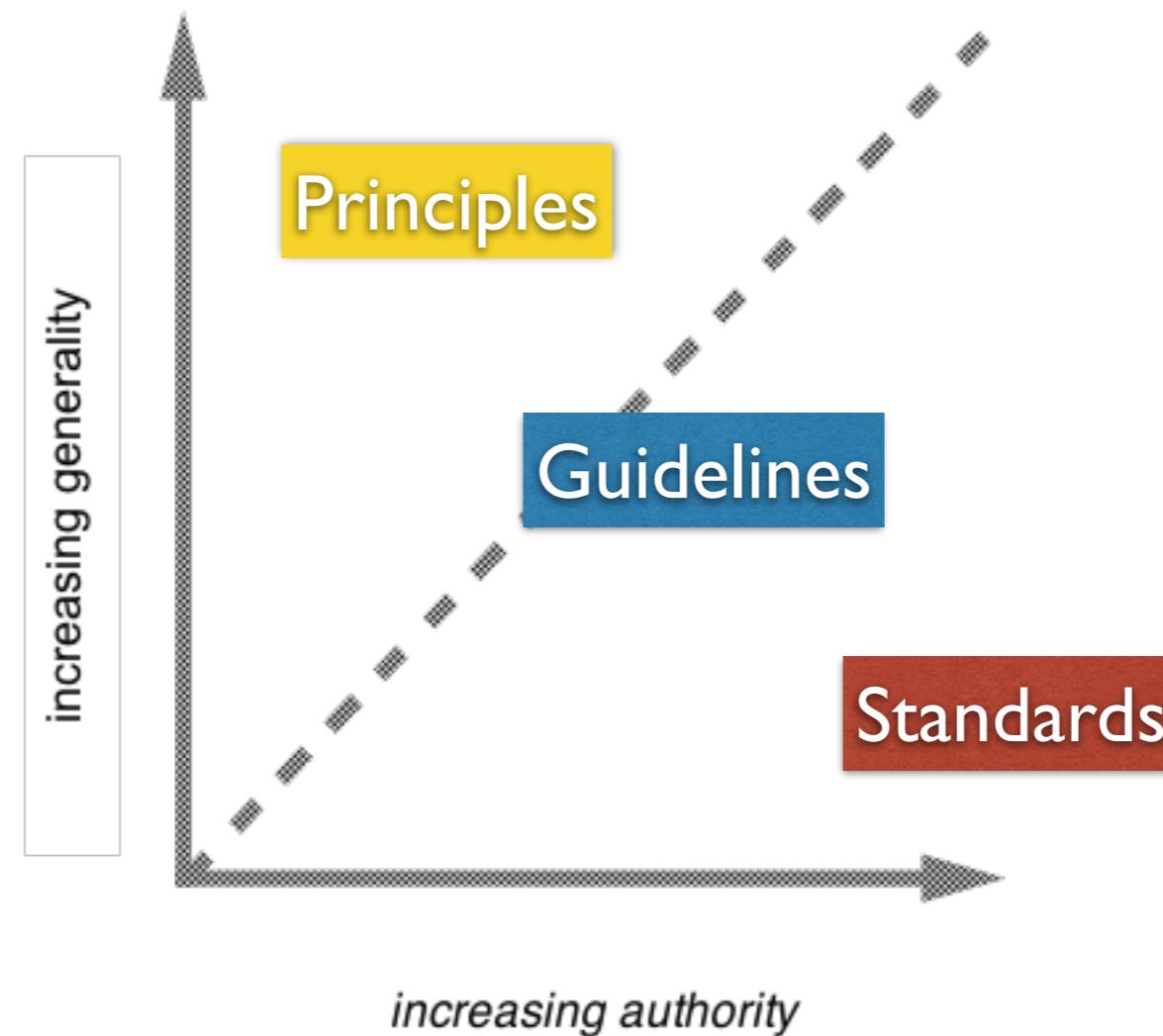
**Designing for maximum usability**  
– the goal of interaction design



- **Principles of usability**
  - general understanding
- **Guidelines and Standards**
  - direction for design
- **Design patterns**
  - capture and reuse design knowledge (gathered from the experience).



# Using design rules



## Design rules

- Suggest how to increase usability
- Different kinds, containing different levels of **generality** and **authority**.



# Types of design rules

## ● Principles

- **abstract** design rules
- **high** generality
- **low** authority

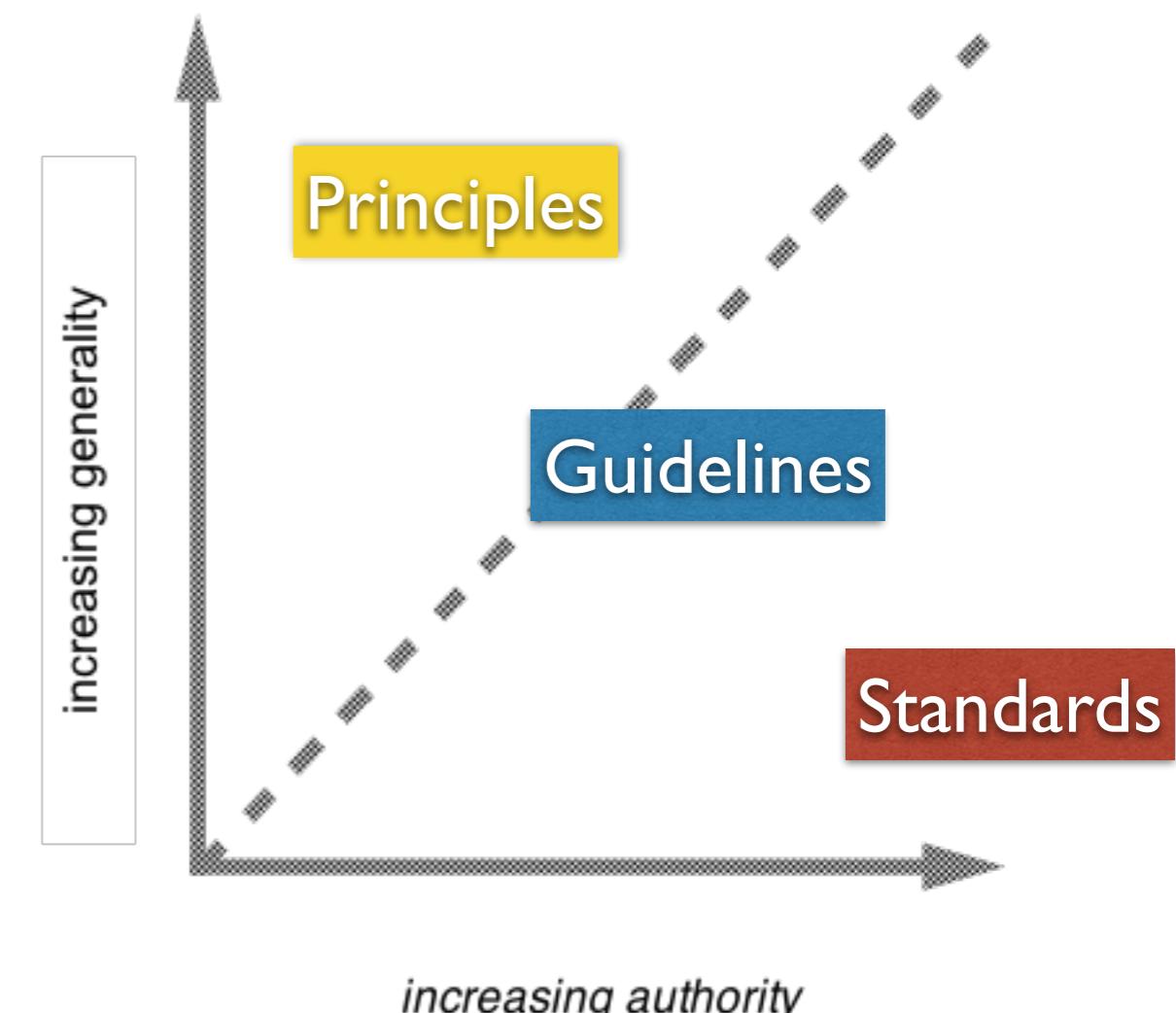
- Psychology
- Sociology
- Comp. Science

## ● Guidelines

- claim **more** authority
- **less** general / more tech.

## ● Standards

- **specific** design rules
- **high** authority
- **limited** application





# Principles to support usability

## **Learnability (Aprendizagem)**



The ease with which new users can begin effective interaction and achieve maximal performance.

## **Flexibility (Flexibilidade)**



The multiplicity of ways the user and system exchange information (ex: OS multiple ways of doing ...).

## **Robustness (Robustez)**



The level of support provided to the user to ensure successful achievement and assessment of goal-directed behaviour.

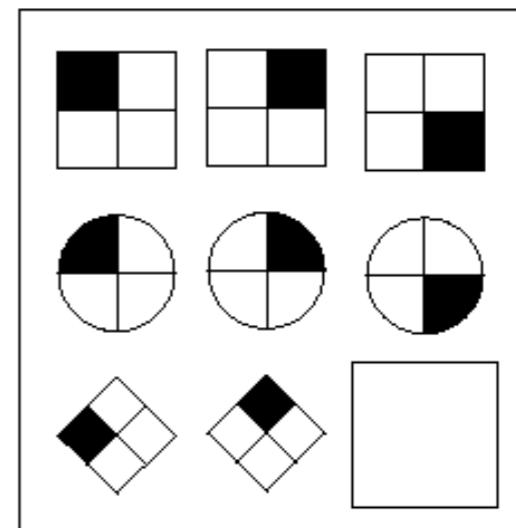


# Principles of learnability



## Predictability (previsão)

- determining effect of **future** actions based on past interaction history (e.g. 123, 234, 345, ?)
- operation visibility (e.g. disabled fields)  
 $F\{\text{recognition}\} > F\{\text{recall}\}$



## Synthesizability (sintetização)

- assessing the effect of **past** actions
- honesty
  - immediate vs. eventual honesty
    - (e.g. Command vs GUI OS; MacOS Finder v7)
    - (e.g. “the the”  
“We will prove the theorem” ...)



# Principles of learnability



## **Familiarity** (familiaridade)

- how prior knowledge applies to the new system
- guessability; affordance (facilitadores)
  - e.g., the typewriter metaphor.



## **Generalizability** (generalização)

- extending specific interaction knowledge to new situations (e.g., the square is a constrained rectangle)
- across applications (e.g., copy/paste)

## **Consistency** (consistência)

- likeness in input/output behavior arising from similar situations or task objectives
- widely mentioned and related to other principles.
- (ex: 'e' 'x' 's' 'f' in a directional keyboard)



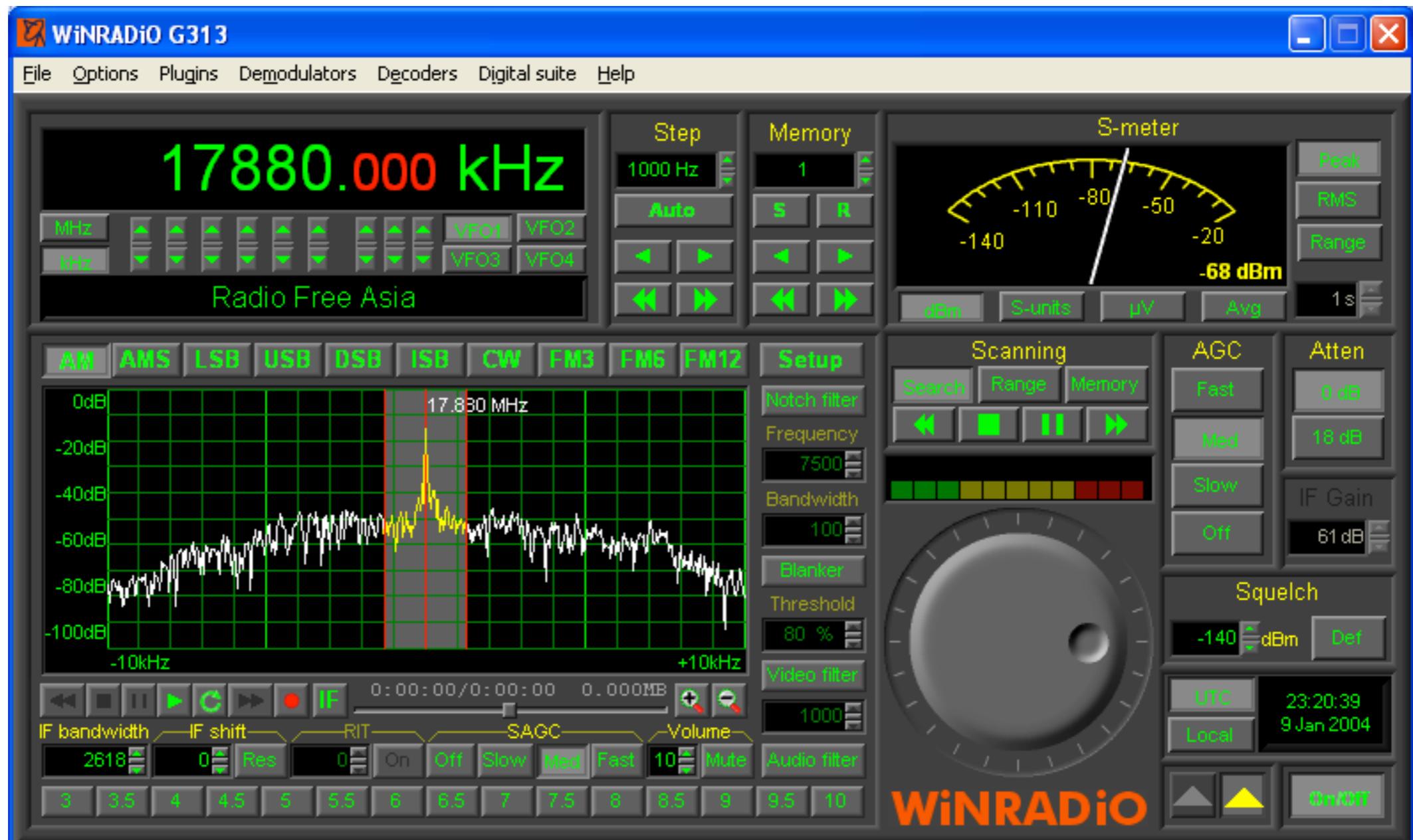


# Principles of learnability



## Familiarity

- how prior knowledge applies to new system
- guessability; **affordance**





# Principles of flexibility



## Dialogue initiative

- freedom from system-imposed constraints on input dialogue

**system** vs. **user** <== pre-emptiveness

- e.g., modal dialog
- e.g., important for security (ex: cooperative editor)

Google docs

## Multithreading (of a dialog)

- the ability of the system to support user interaction for more than one task at a time
- concurrent vs. interleaving (multiple but one each time)

## Task migrability

- passing responsibility for task execution between **user** and **system** (ex: spell checker; automation aviation)



# Principles of flexibility

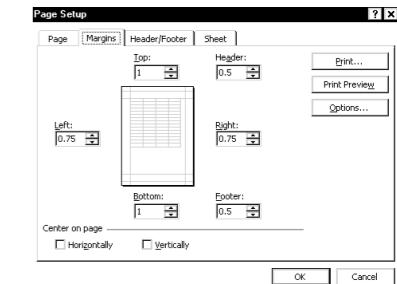


## Substitutivity (Equivalência)

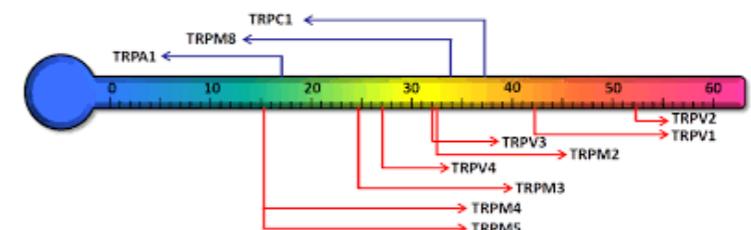
-allowing equivalent values of input and output to be substituted for each other

–e.g. margin definition. “ $=2/3 * (8.5-6.5)$ ”

–e.g. temperature readings.



–With respect to output: representation multiplicity; equal opportunity (ex: spreadsheet)



## Customizability (Parametrização)

- User modifies/parametrizes the system: **adaptability**
- System automatically adjusts itself: **adaptivity**



# Principles of robustness

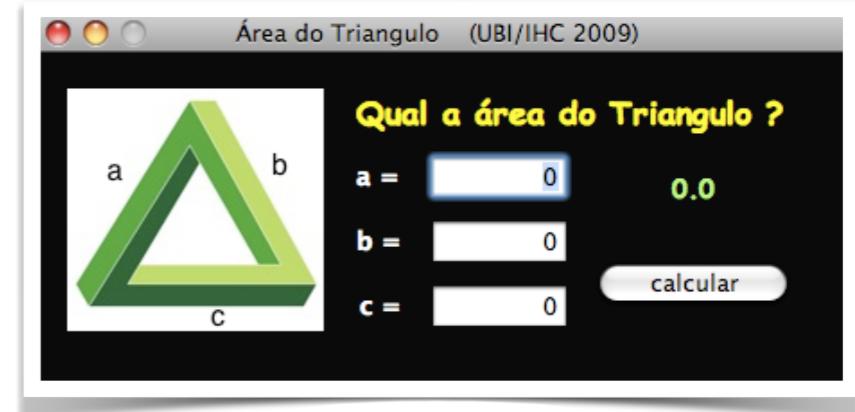


## Observability

- ability of user to evaluate the internal state of the system from its perceivable representation
- 5 other principles: browsability; defaults; reachability; persistence; operation visibility

*Vocal: email beep*

*Visual: signal persists*



## Recoverability

- ability of user to take corrective action once an error has been recognised
- **forward/backward recovery**; commensurate effort

*delete > rename*





# Principles of robustness



by TOM TOMORROW

## THIS MODERN WORLD

### AMERICA: A BRIEF PARABLE

LOOK OUT! WE'RE HEADED  
RIGHT FOR THAT CLIFF!

THERE'S NO  
CLIFF.

IT'S RIGHT THERE  
AHEAD OF US! FOR  
GOD'S SAKE, STOP  
THE CAR!

RELAX! I'VE GOT A  
MAP--AND THERE'S  
NO CLIFF!

DEAD  
END

AIIIEEEEEEEEEE

YOU DIDN'T REALLY  
HAVE A MAP, DID  
YOU?

THIS IS ALL YOUR  
FAULT, YOU WANTED  
US TO FAIL.



# Principles of robustness



Impressão e Digitalização

Pesquisa

Impressoras

FollowMePreto

- Alterar nome da impressora...
- Definir como predefinida
- Rapor sistema de impressão...**

Faxes

HP Officejet 4630 seri...

FollowMePreto

- Abrir fila de impressão...
- Opções e acessórios...

Local:

Tipo: Xerox WorkCentre 7835, 4.22.2

Estado: Disponível

Partilhar esta impressora na rede

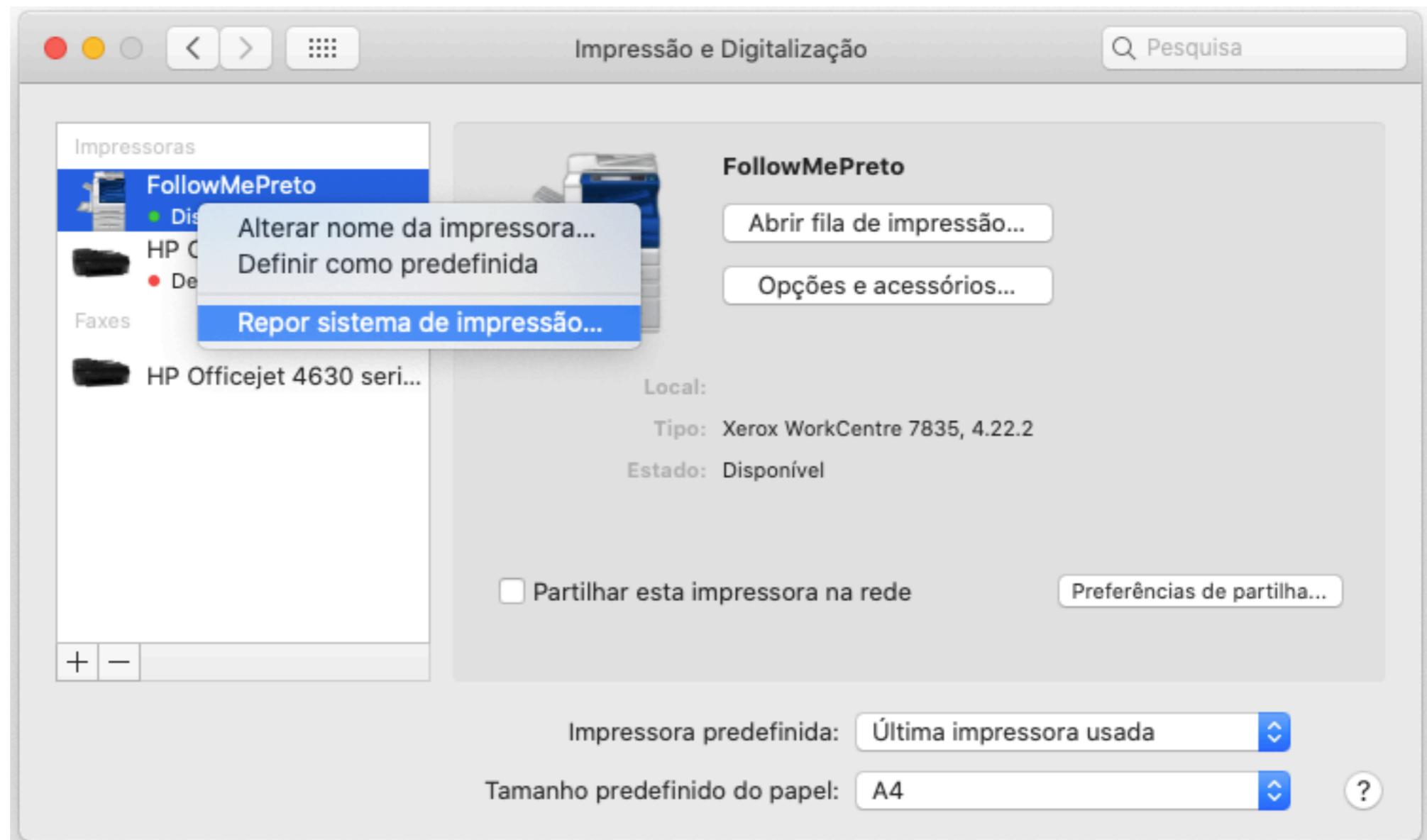
Preferências de partilha...

Impressora predefinida: Última impressora usada

Tamanho predefinido do papel: A4

?

DEAD END



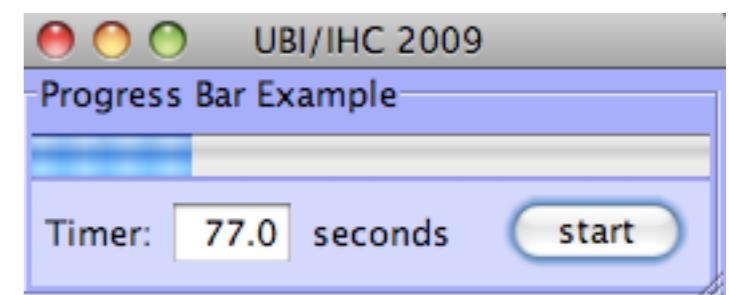
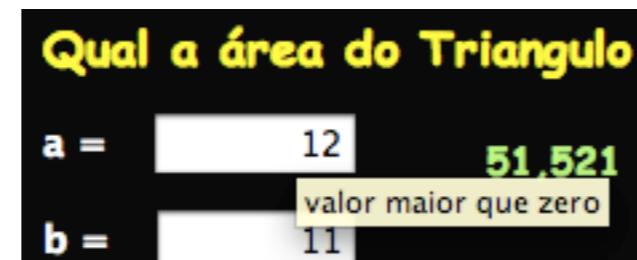


# Principles of robustness



## Responsiveness (Reatividade)

- How the user perceives the rate of communication with the system
  - Time Stability
- Response time (system)
- Anticipation



## Task conformance (Adequação)

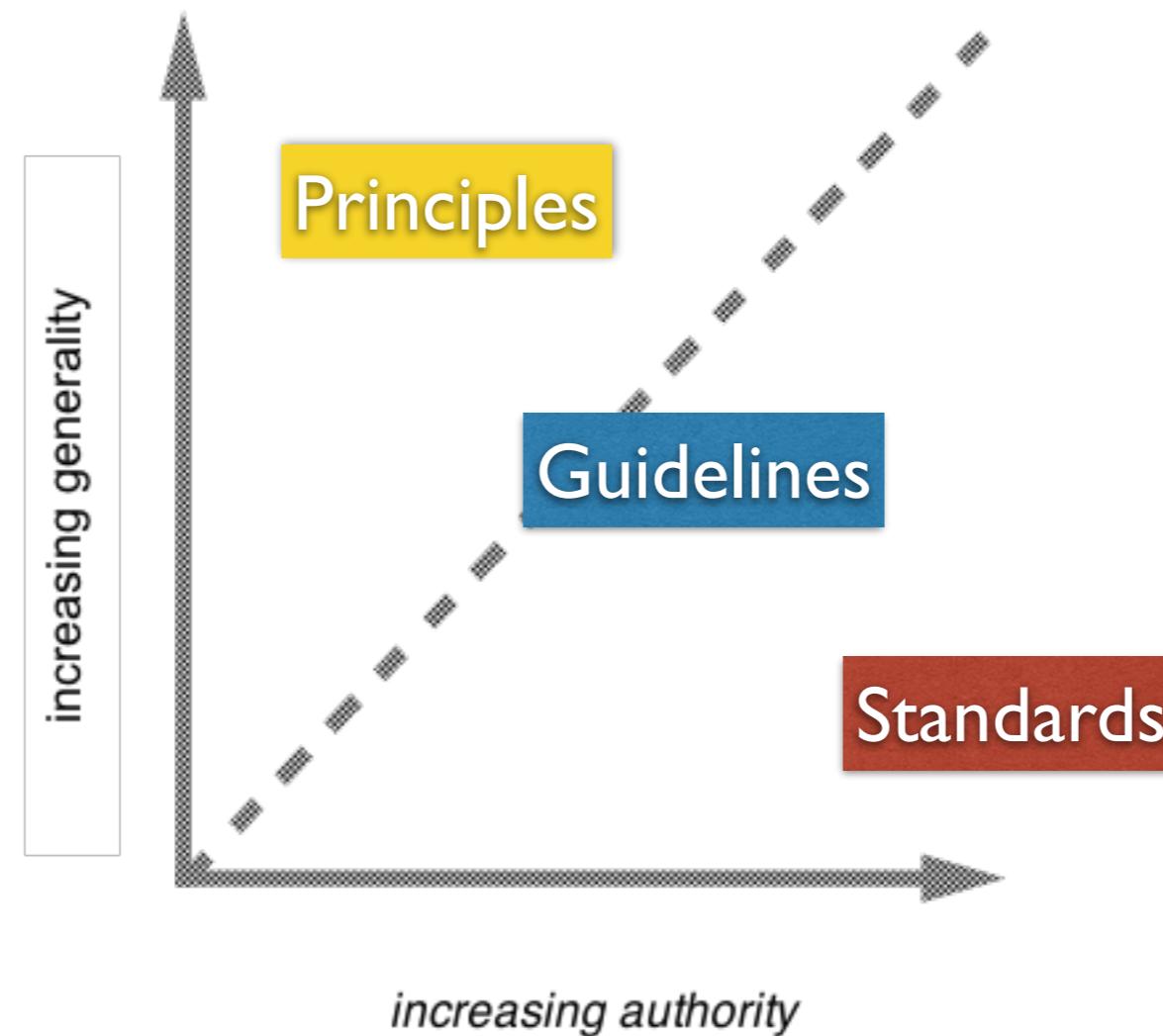
- Degree to which system services support all of the user's tasks
- Task **completeness**; task **adequacy**

Remember Norman's Gulfs !

coverage  
user understanding  
the model world metaphor



# Using design rules



## Design rules

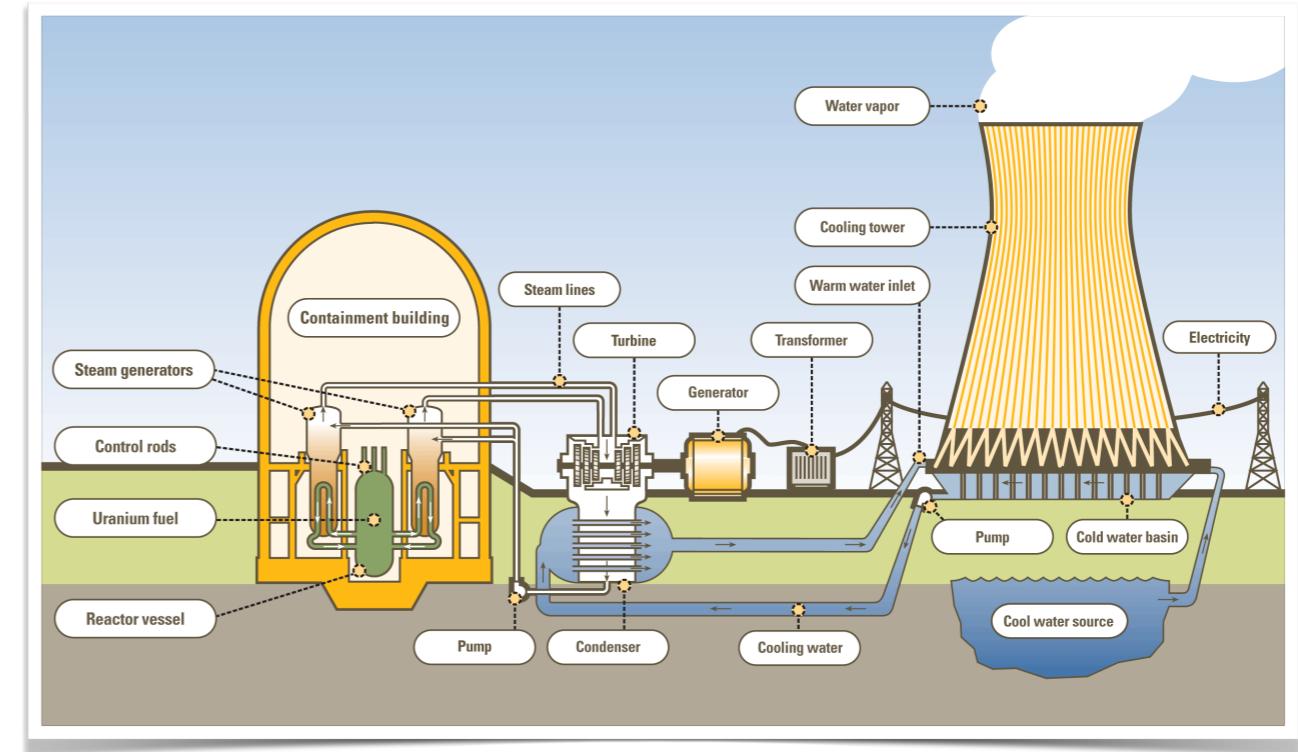
- Suggest how to increase usability
- Different kinds, containing different levels of **generality** and **authority**.



# Standards (ISO ...)

- Set by **national or international bodies** to ensure compliance by a large community of designers. Standards require sound underlying theory and slowly changing technology.

- Longer history on **safety-critical** domains



- **Hardware** — More common  
Ergonomics and physiology
- **Software** — With authority but low level of detail  
Cognitive Sciences