

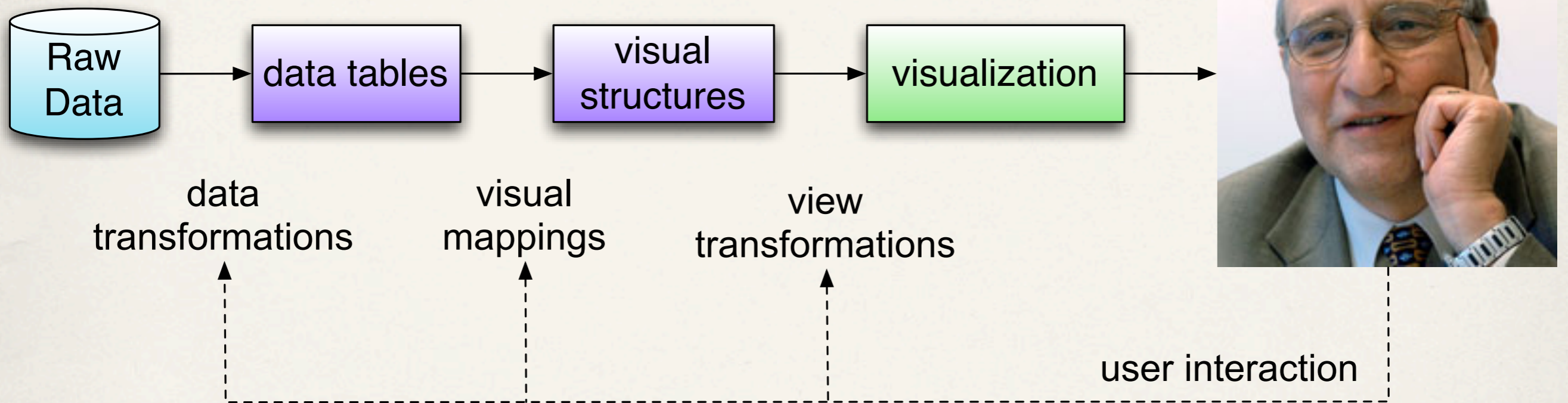
# Perception to visualization I

C. Andrews

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2014-02-25

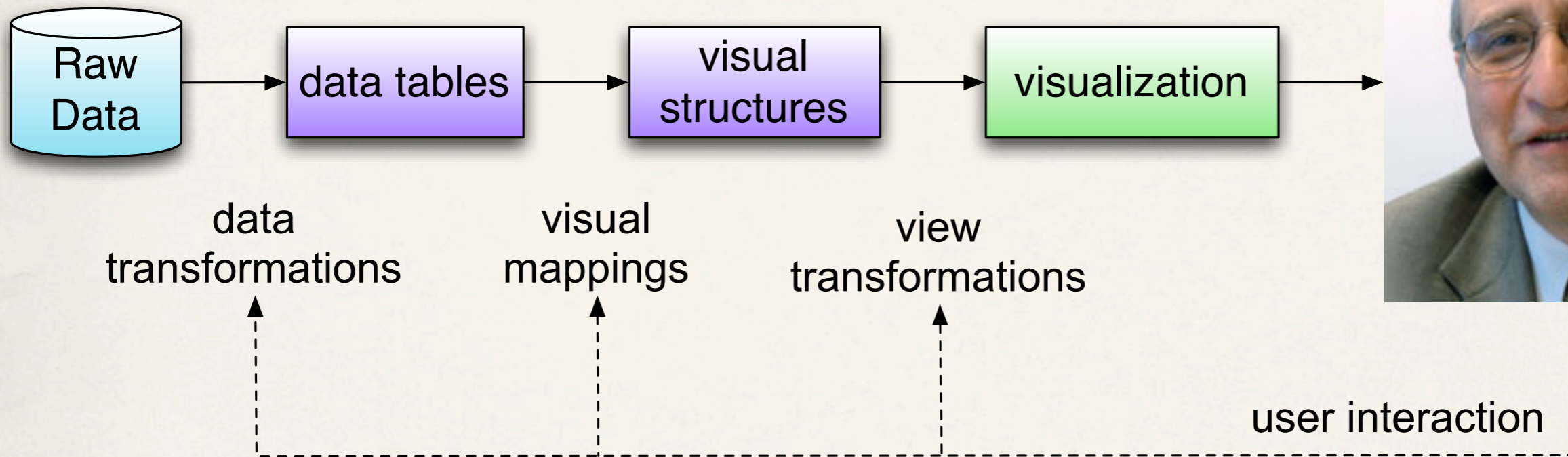
# Visualization Pipeline





# Visualization Pipeline

**Insight!**

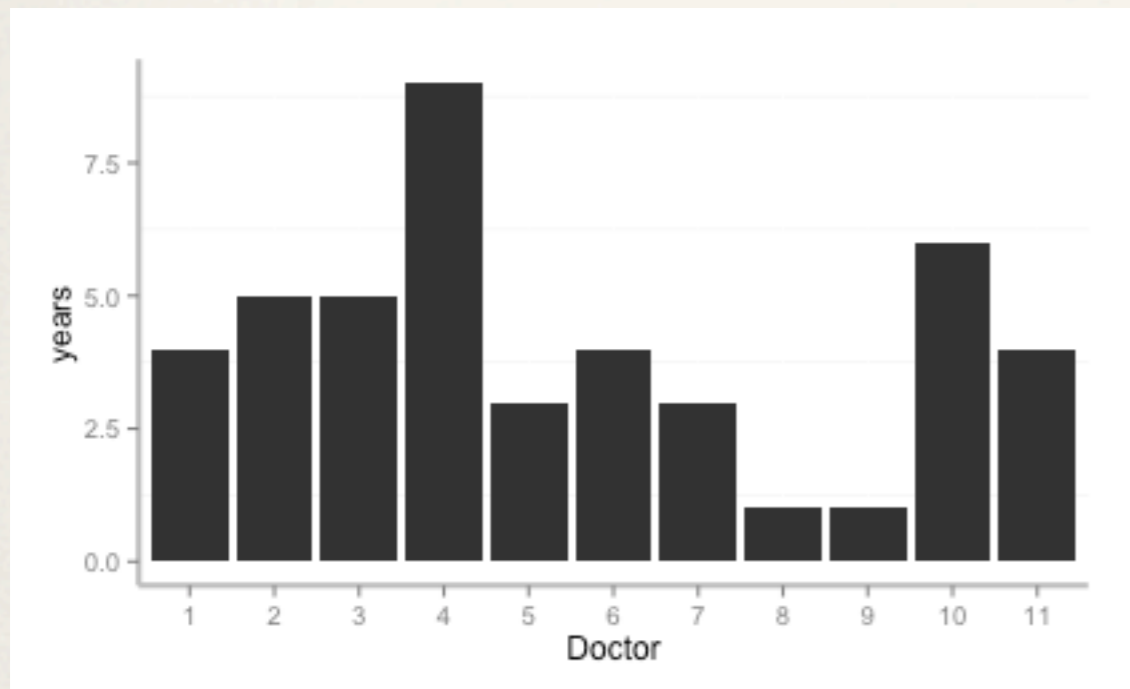


# Visual mapping

doctor	name	companions	start	end	episodes	duration
1	William Hartnell	10	1963	1966	135	3288
2	Patrick Troughton	5	1966	1970	127	3183
3	Jon Pertwee	3	1970	1974	129	3206
4	Tom Baker	8	1974	1982	174	4248
5	Peter Davidson	6	1982	1984	69	1800
6	Colin Baker	2	1984	1987	31	1029
7	Sylvester McCoy	2	1987	1989	42	1025
8	Paul McGann	1	1996	1996	1	84
9	Christopher Eccleston	3	2005	2005	13	568
10	David Tennant	5	2005	2010	48	2368
11	Matt Smith	4	2010	2013	44	2083



visual mapping



**Computable** (math)

$$\text{visual} = f(\text{data})$$

**Comprehensible** (invertible)

$$\text{data} = f^{-1}(\text{visual})$$

**Creative**



# Eight Visual Variables

**Position**

**Mark** or **Glyph** or **Shape**

**Size** (length, area, volume)

**Brightness** or **Luminance**

**Color**

**Orientation**

**Texture**

**Motion**

# Characteristics of visual variables

## **Selective**

is a change in just this variable enough to make a mark distinct?

## **Associative**

can marks sharing this attribute be grouped despite other variables?

## **Quantitative**

if two marks differ in this variable, can we extract a numerical relationship?

## **Order**

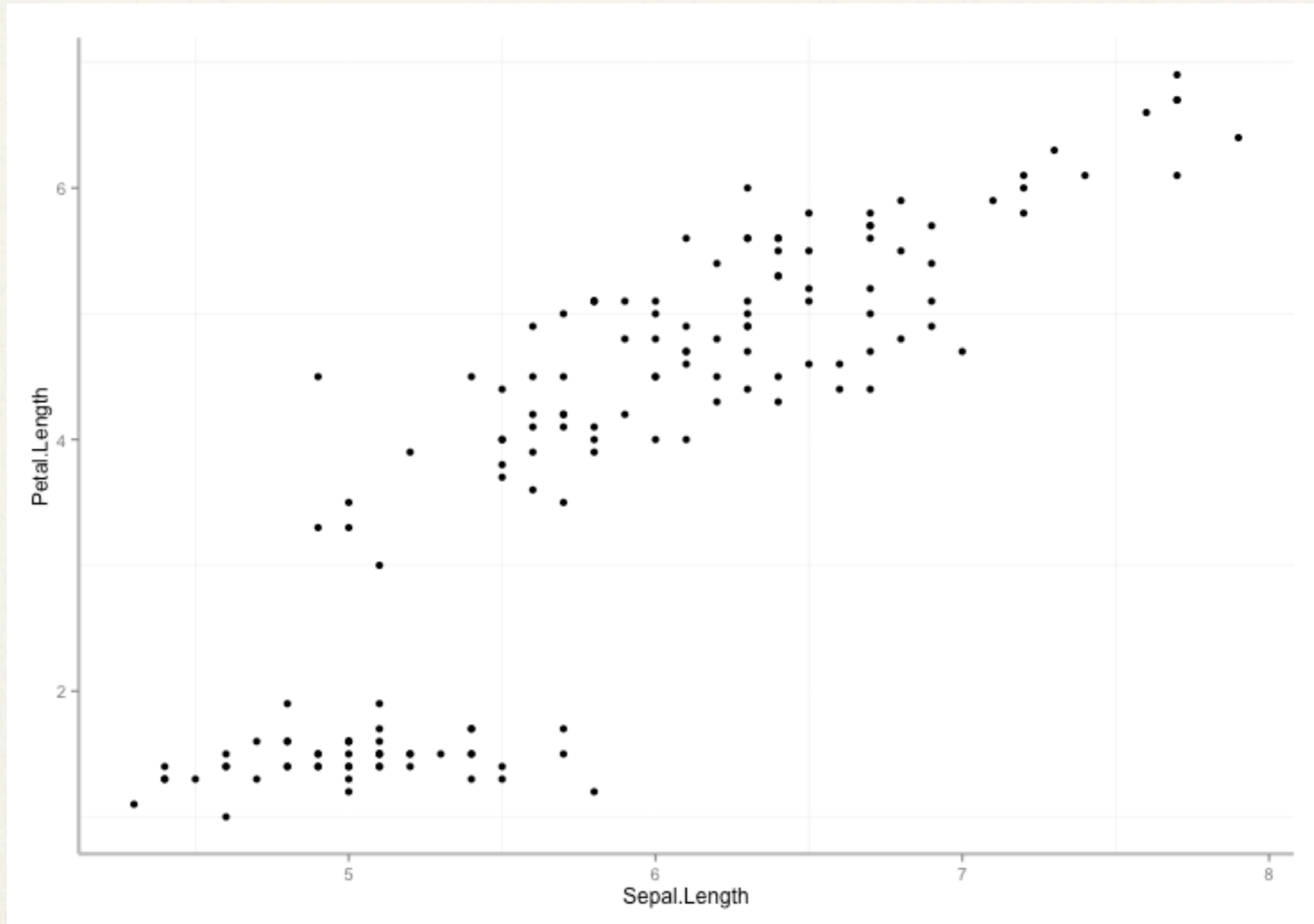
can we order marks based on the values of this variable

## **Length**

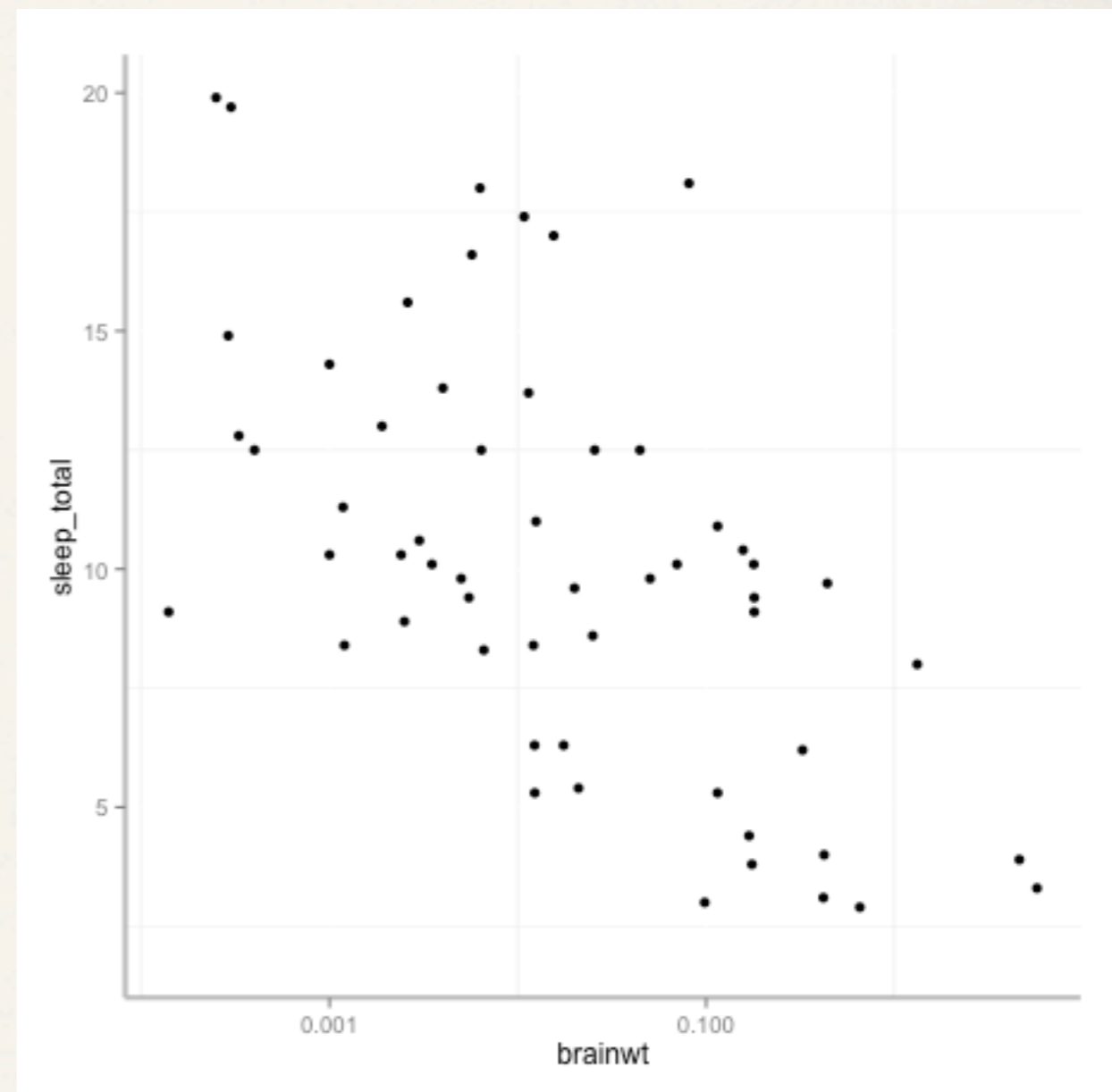
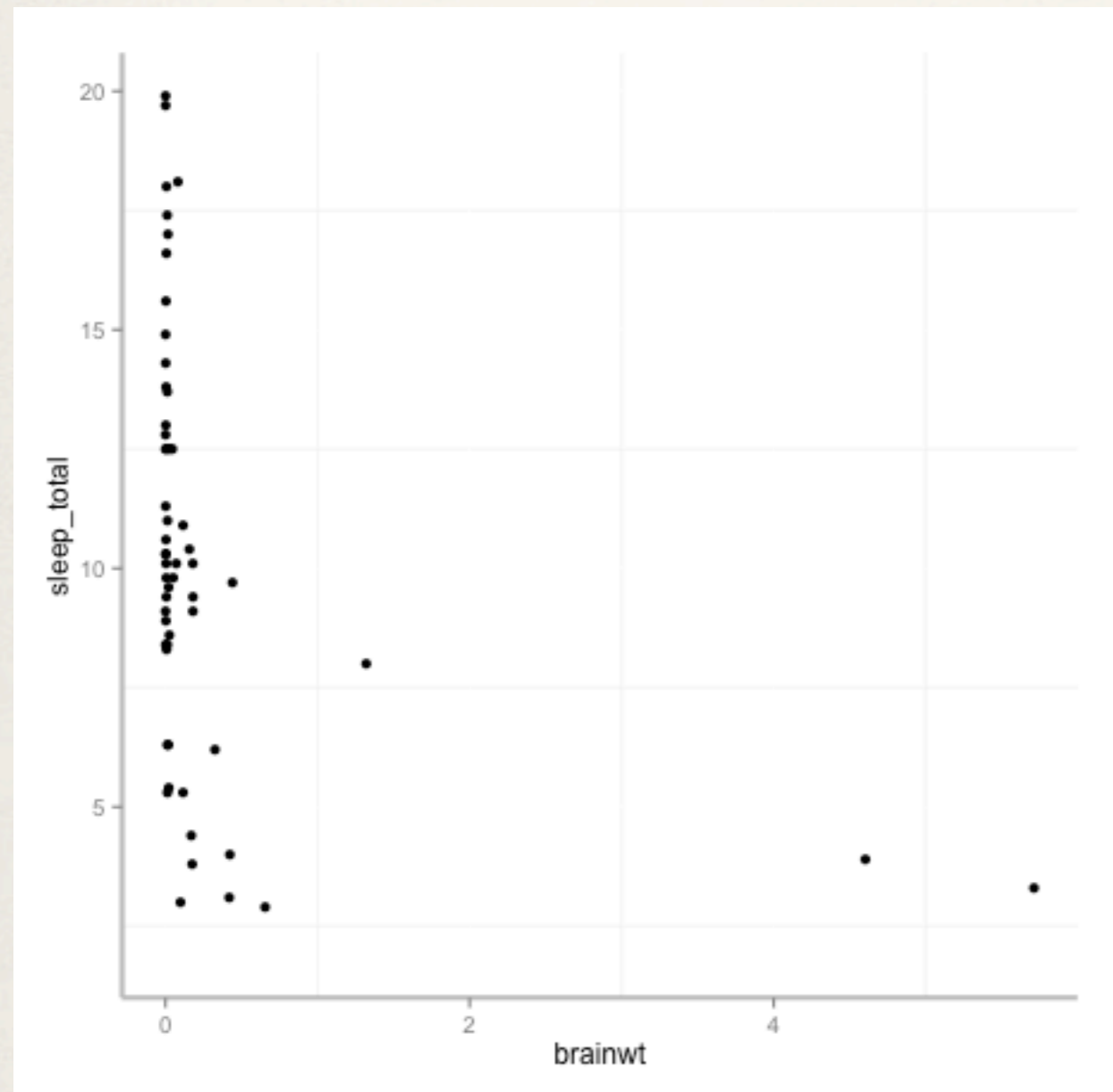
across how many changes in this variable are distinctions recognizable?



# Position

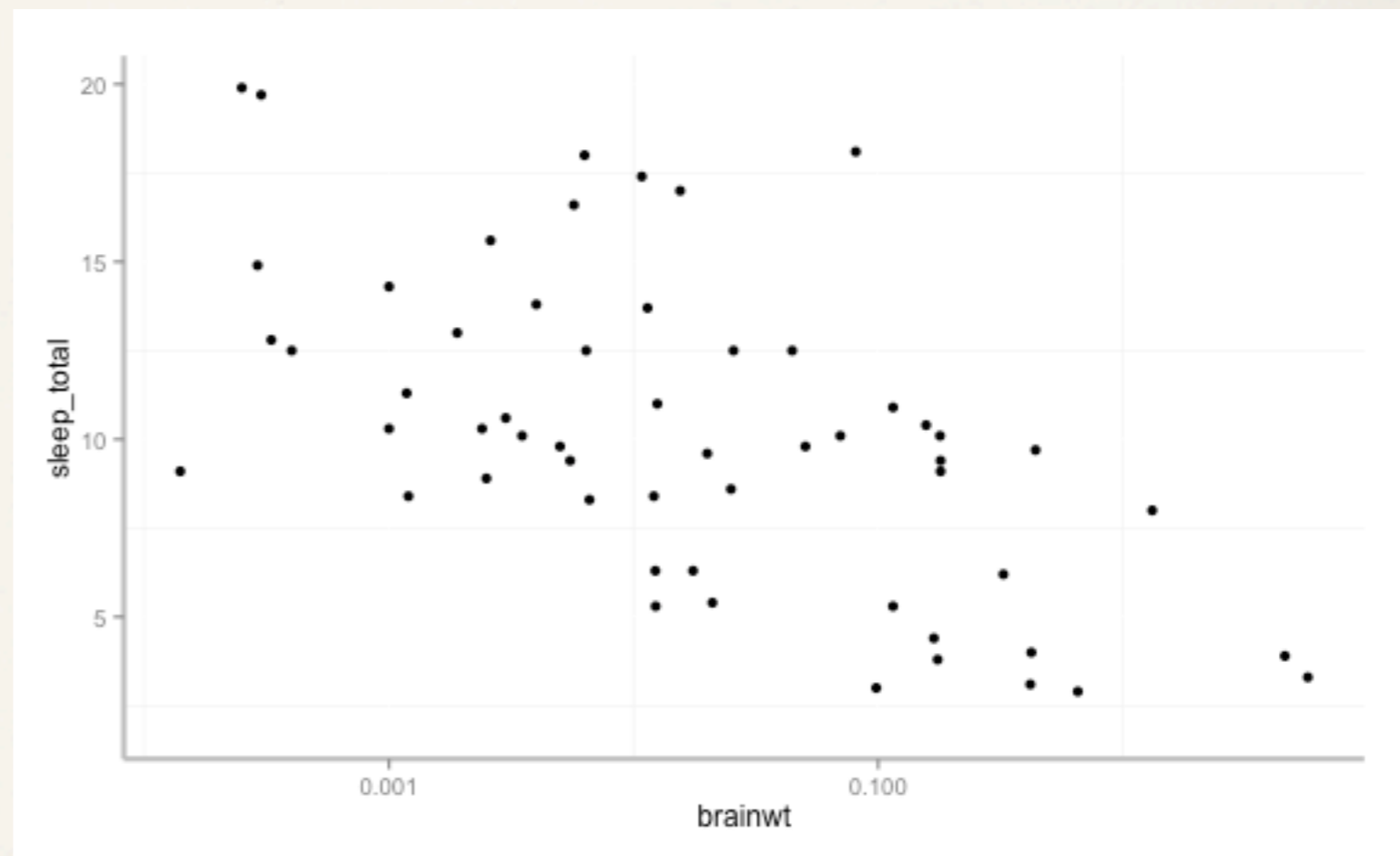
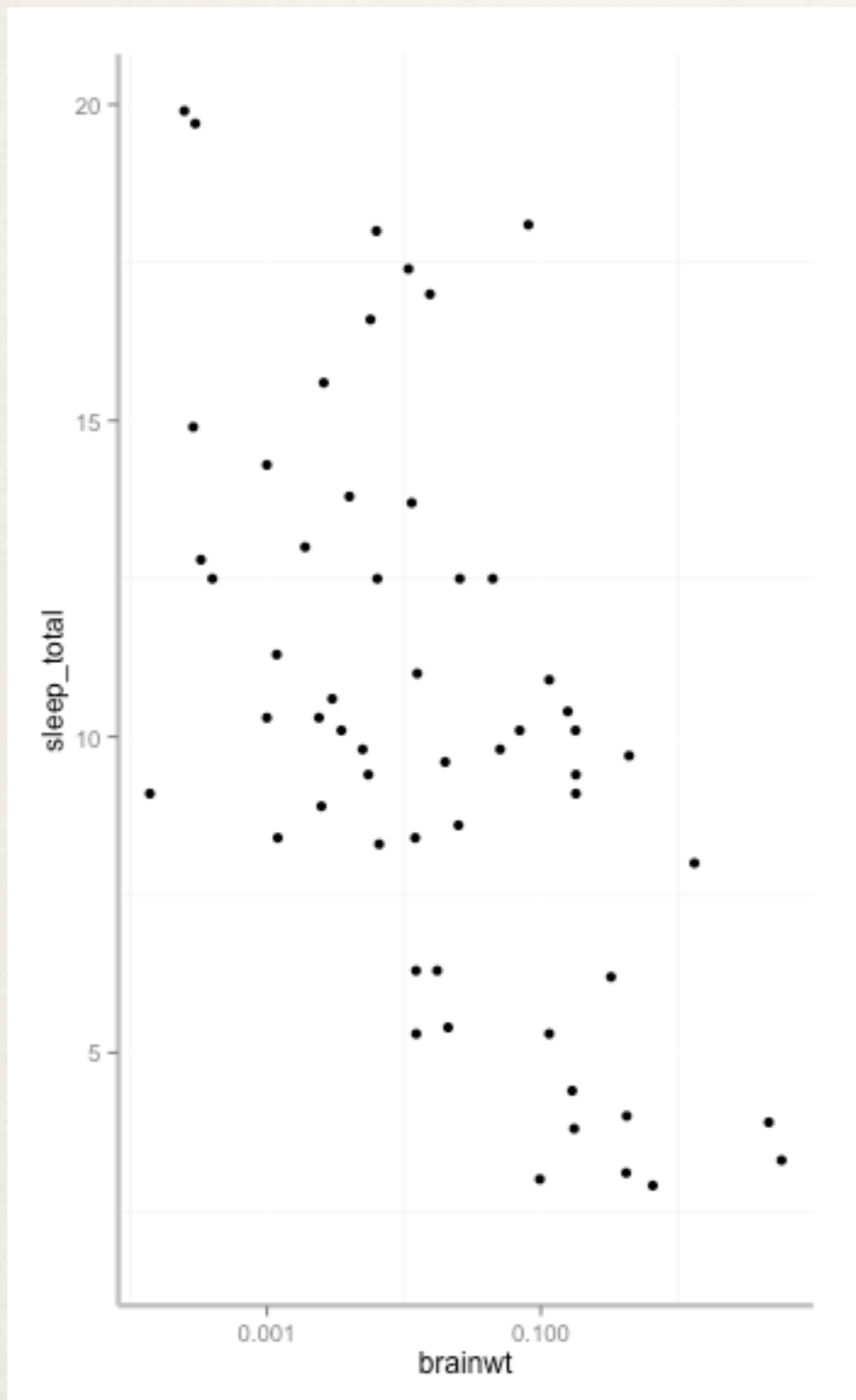


# Position

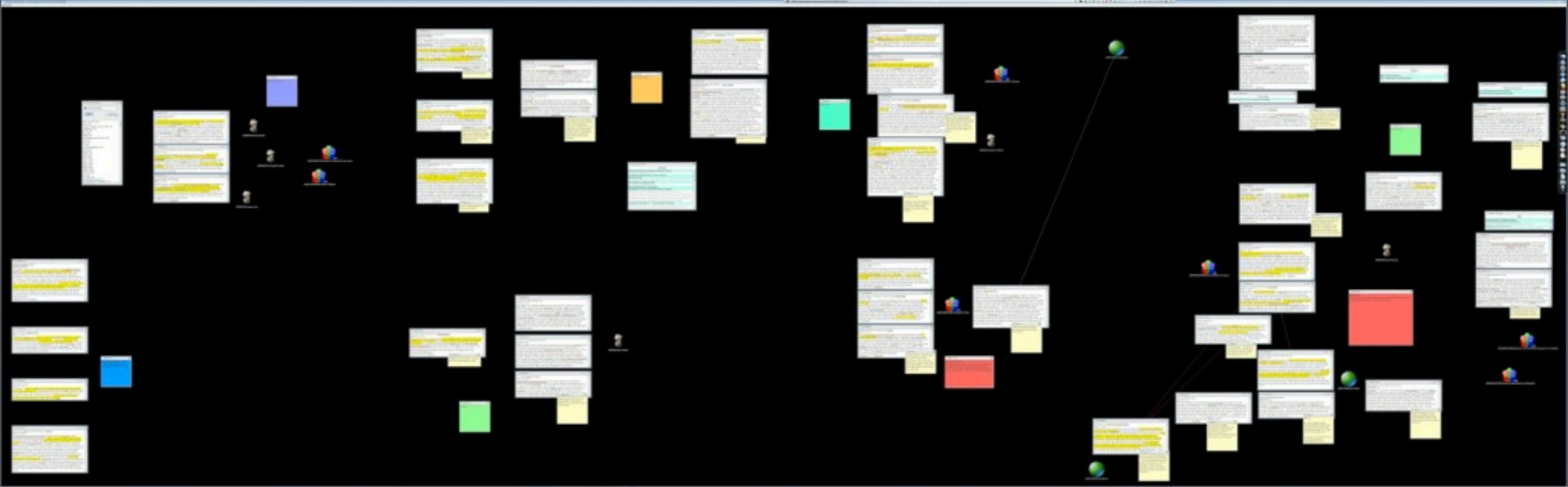




# Position

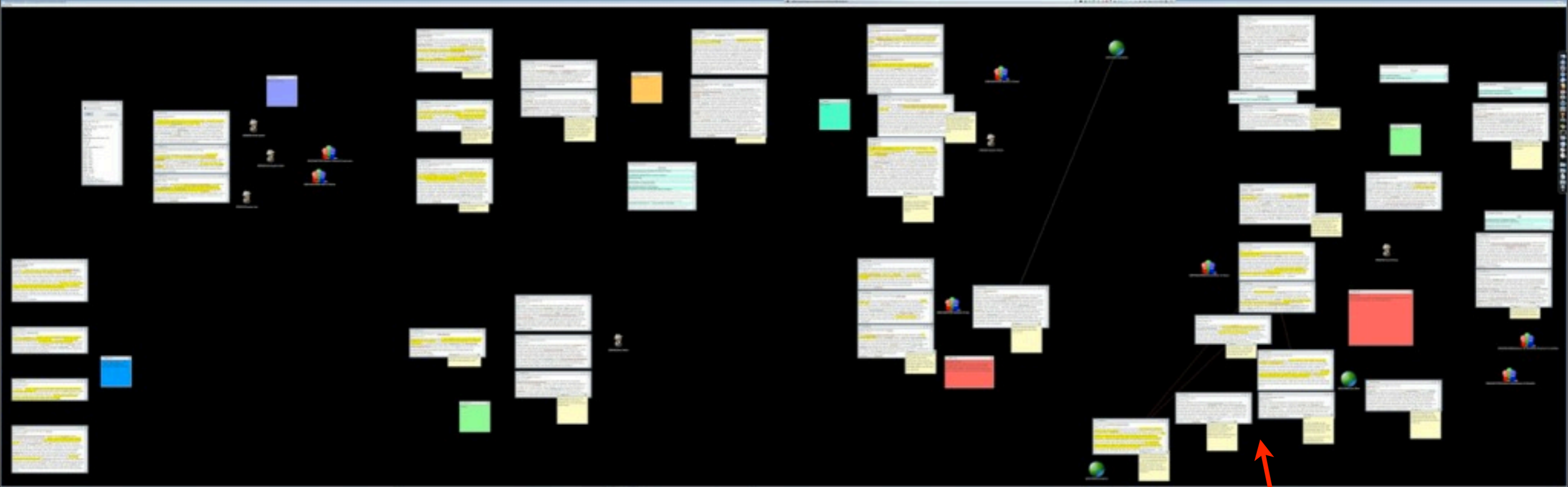


# Position



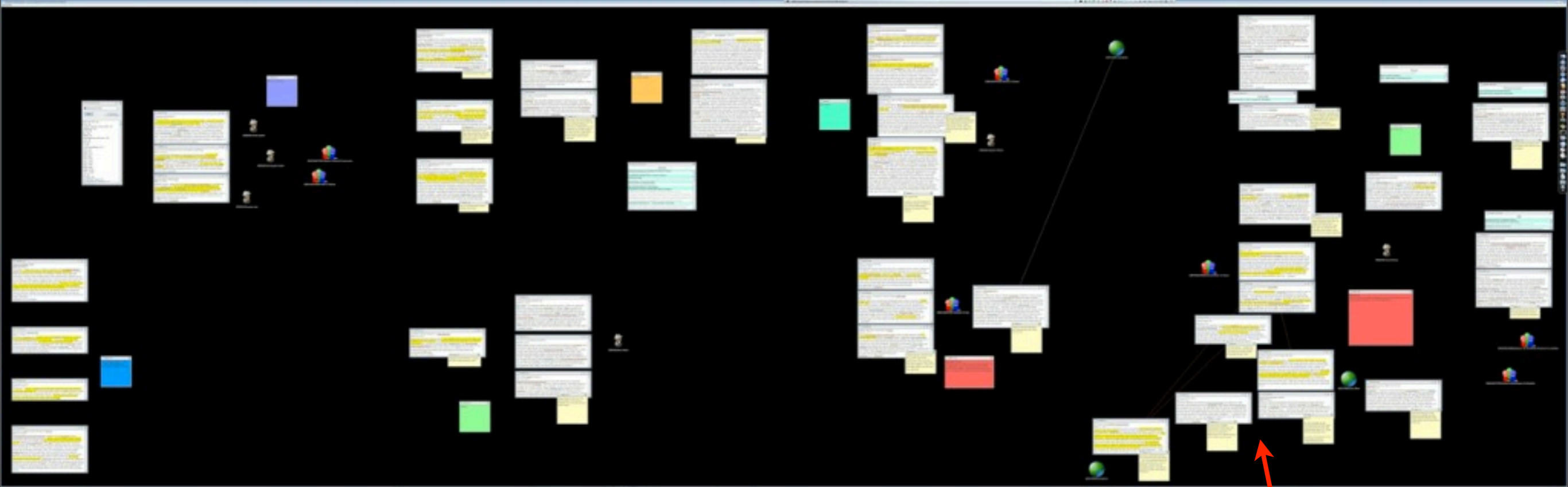


# Position



main threat

# Position


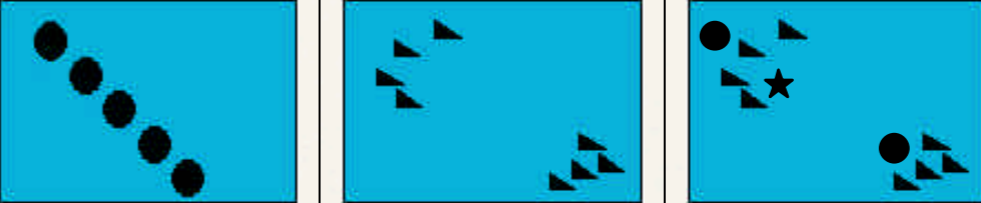
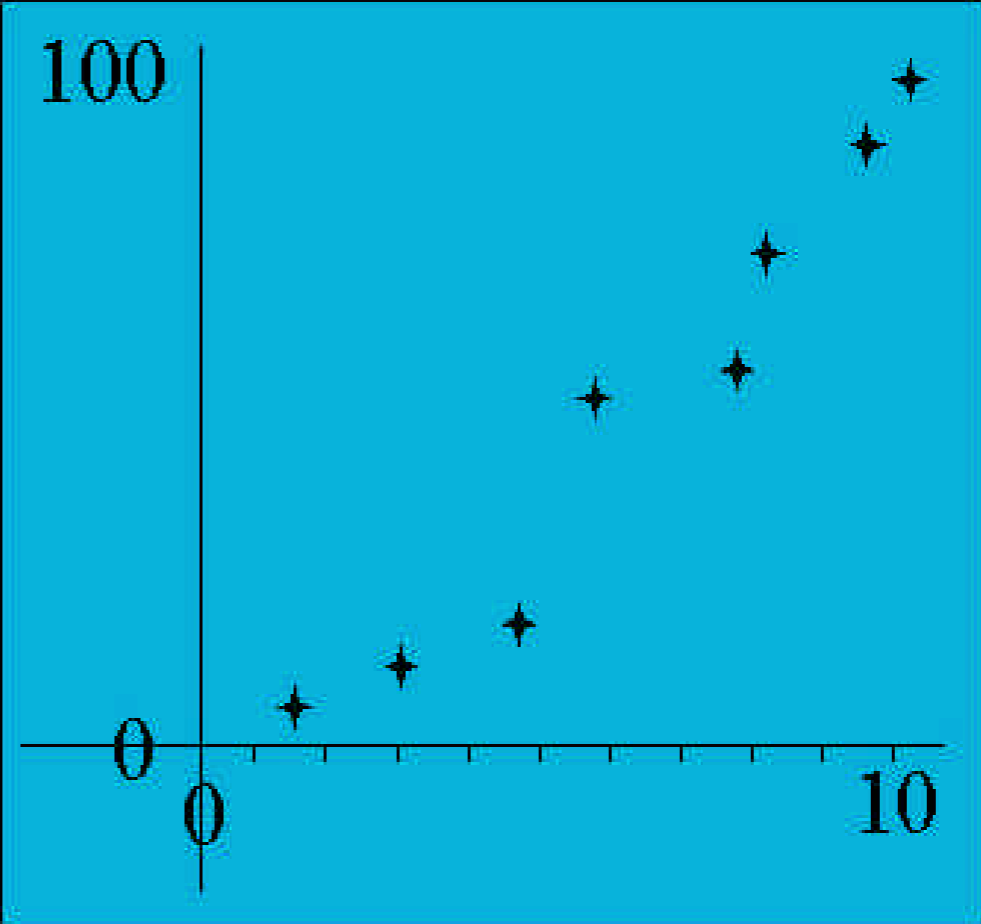


← decreasing threat level

↑ main threat

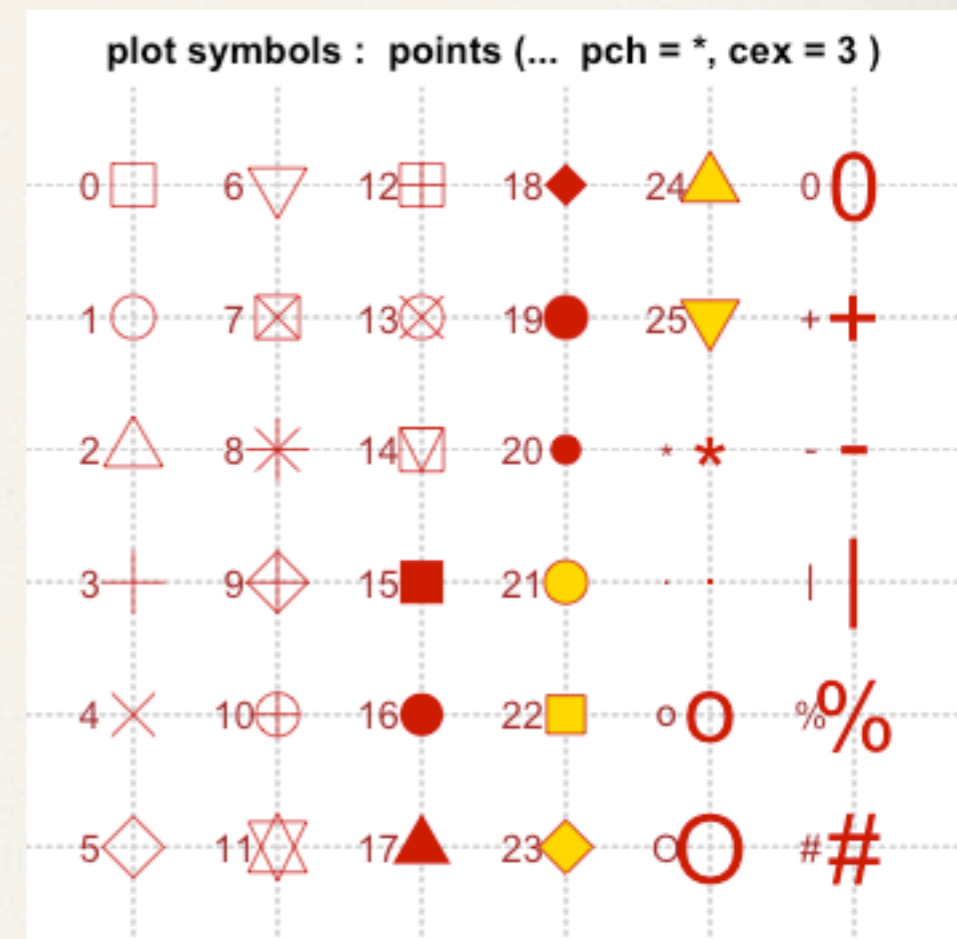
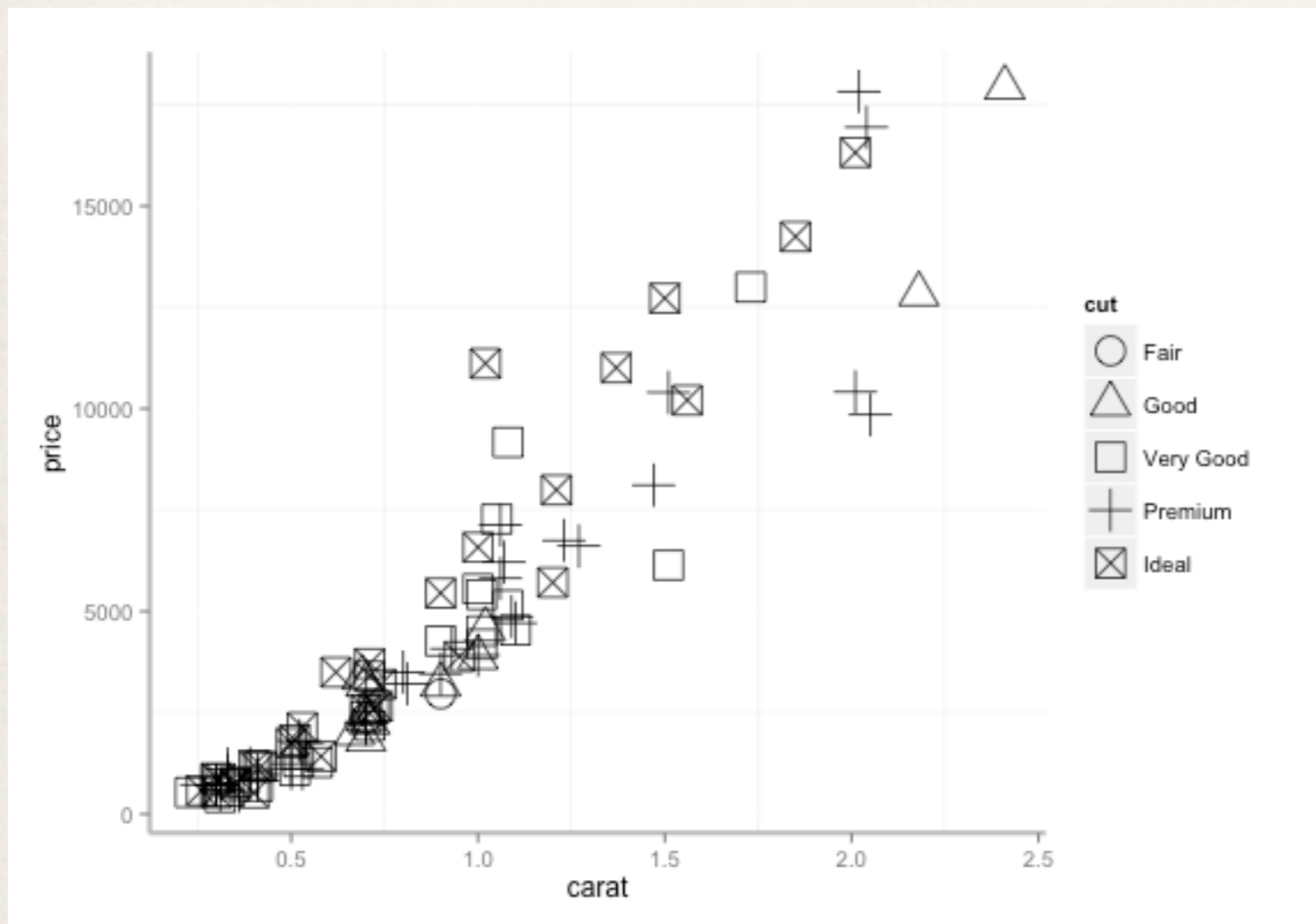


# Position characteristics

Visual Variable: Position		
✓	selective	
✓	associative	
✓	quantitative	
✓	order	
✓	length	


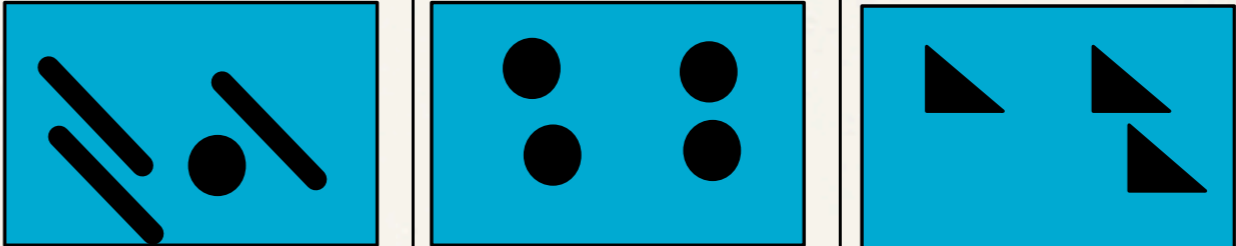

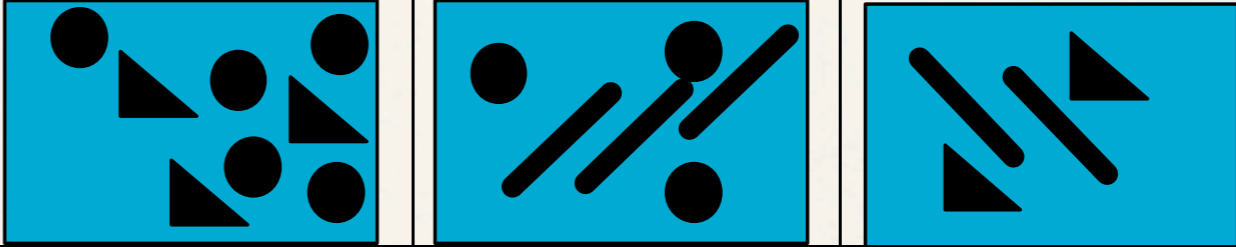





Carpendale, "Considering Visual Variables as a basis for Information Visualization."

# Marks or Glyphs

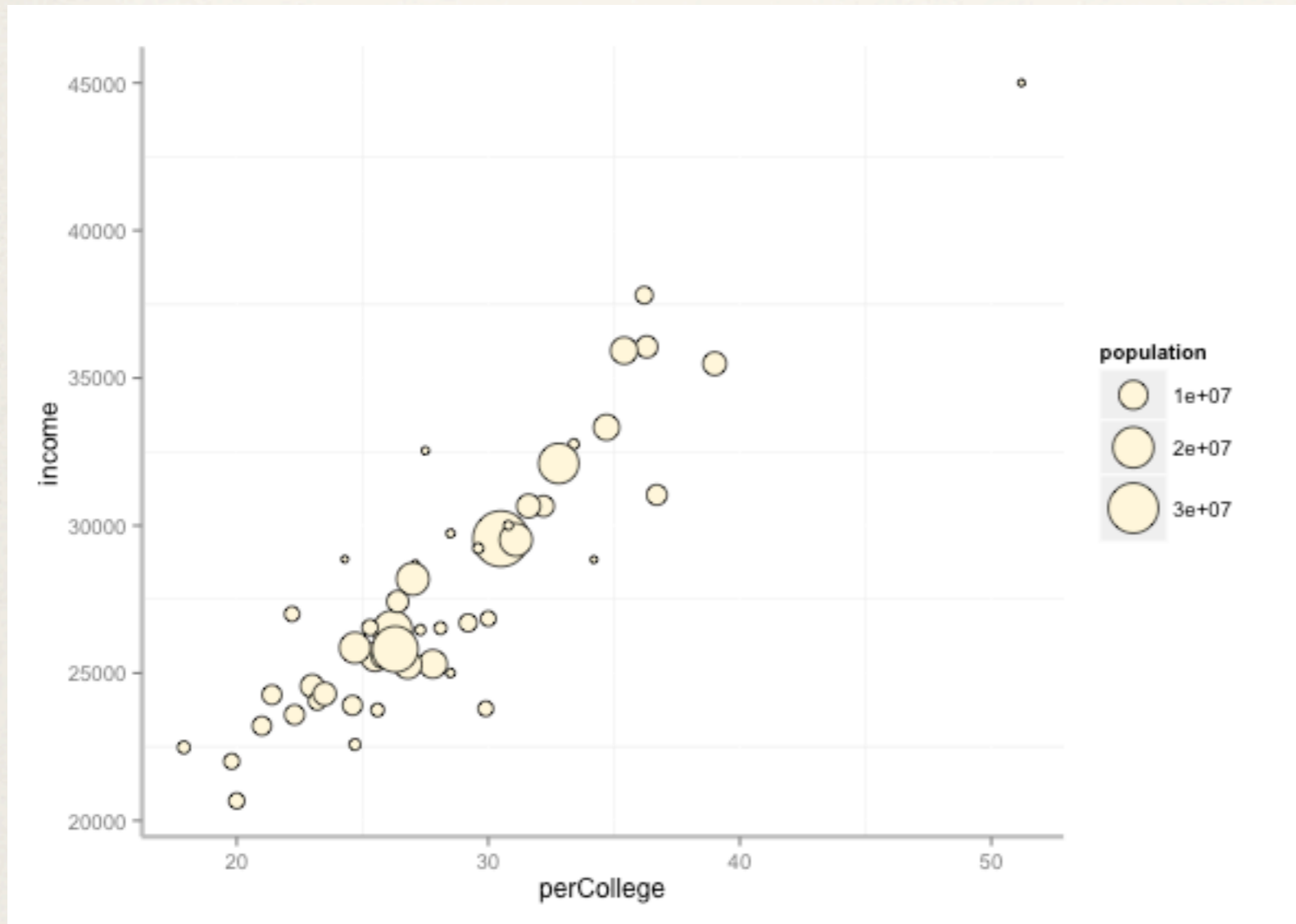




# Shape characteristics

Visual Variable: Shape		
	selective	
	associative	
	quantitative	
	order	
	length	 <p>theoretically infinite</p>

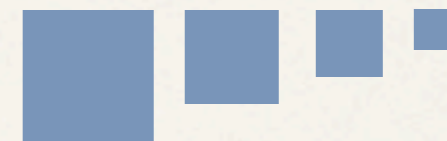
# Size



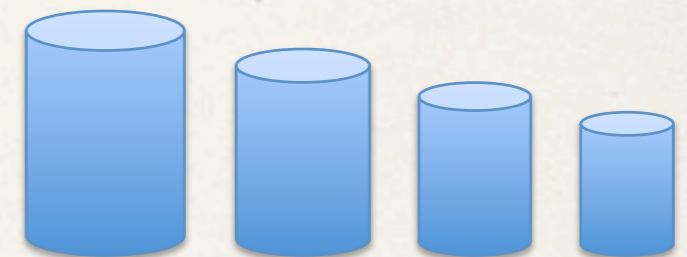
## Length



## Area



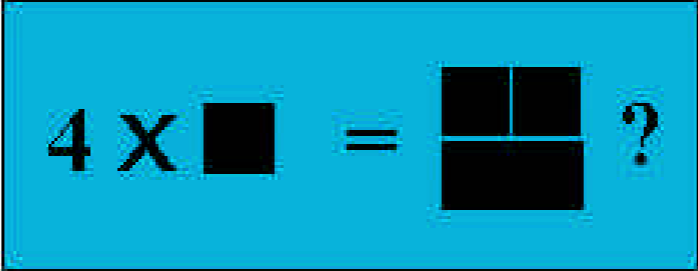
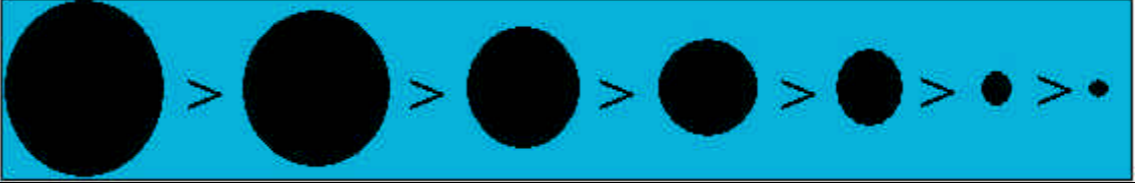


## Volume

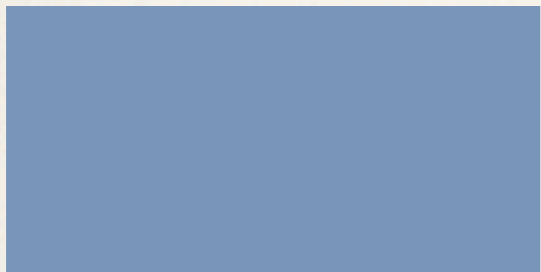




# Size characteristics

Visual Variable: Size		
✓	selective	
✓	associative	
≈ 	quantitative	
✓	order	
✓	Length	<ul style="list-style-type: none"> <li>• theoretically infinite but practically limited</li> <li>• association and selection ~ 5 and distinction ~ 20</li> </ul>

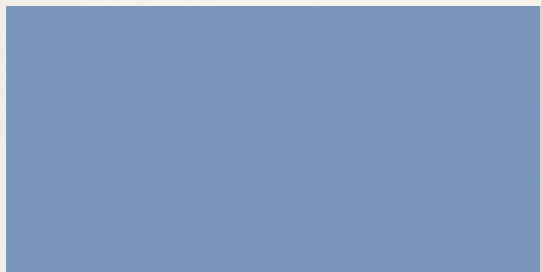
# Quantitative values



compare the length of the bars



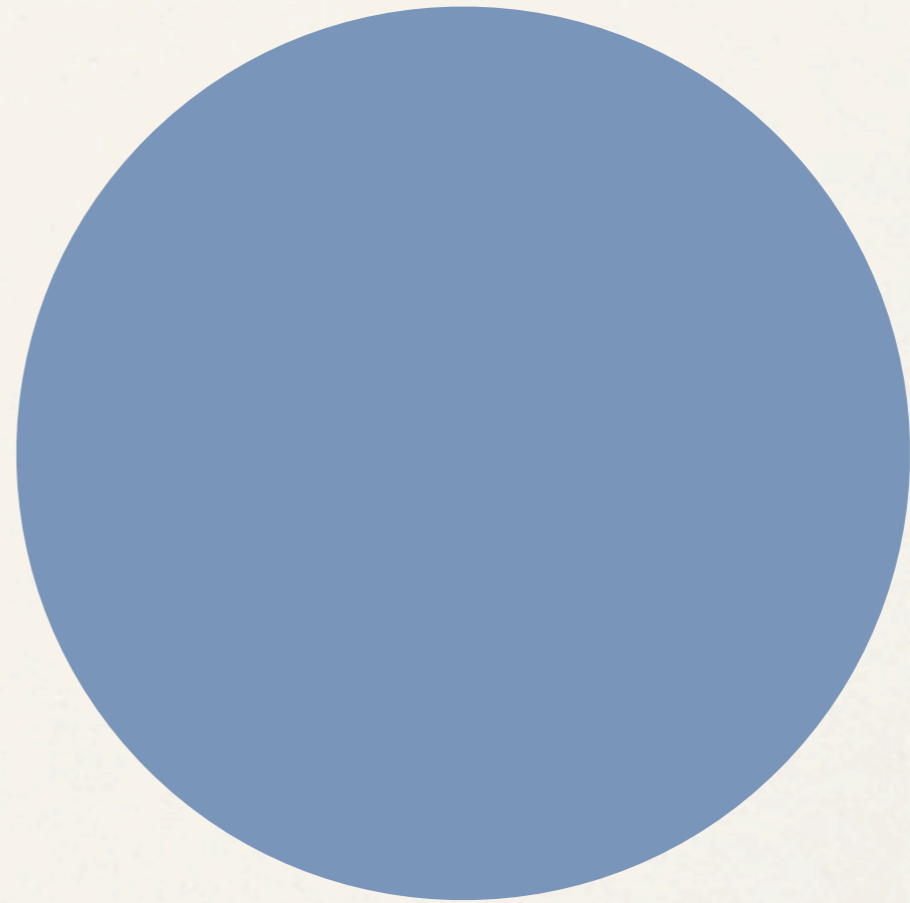
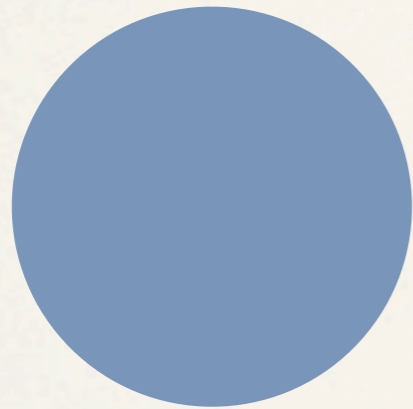
# Quantitative values



compare the length of the bars

4 x longer

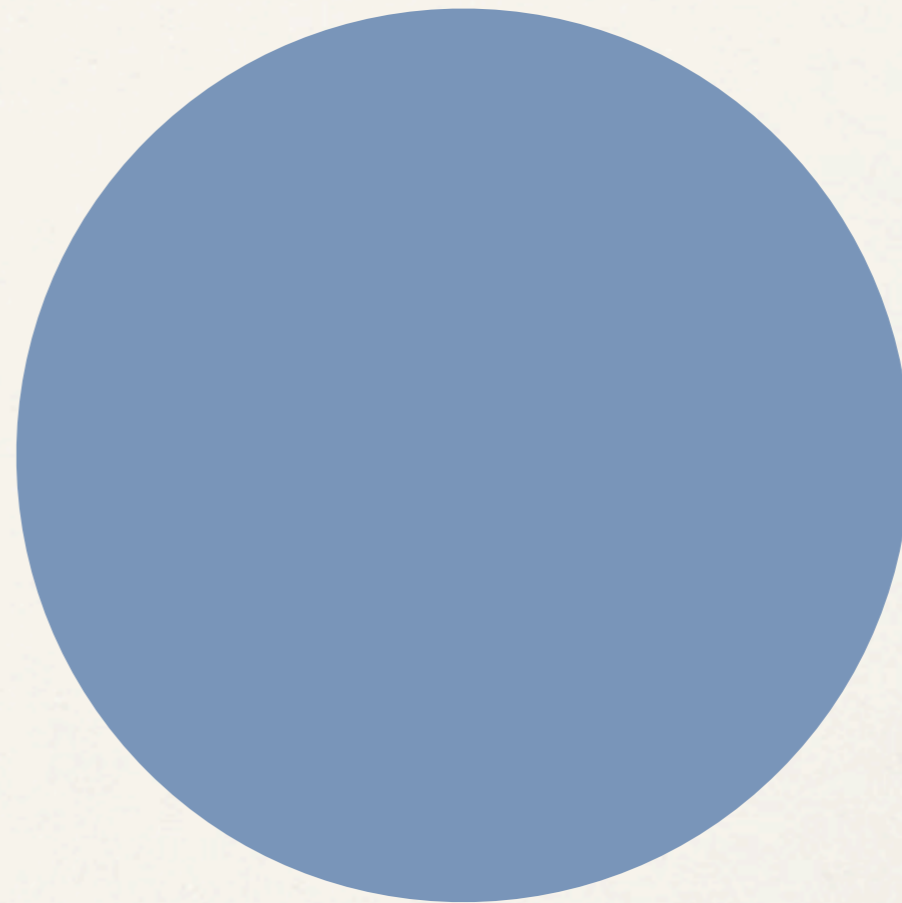
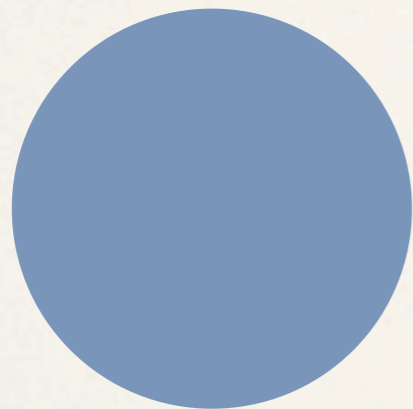
# Quantitative values



compare the area of the circles



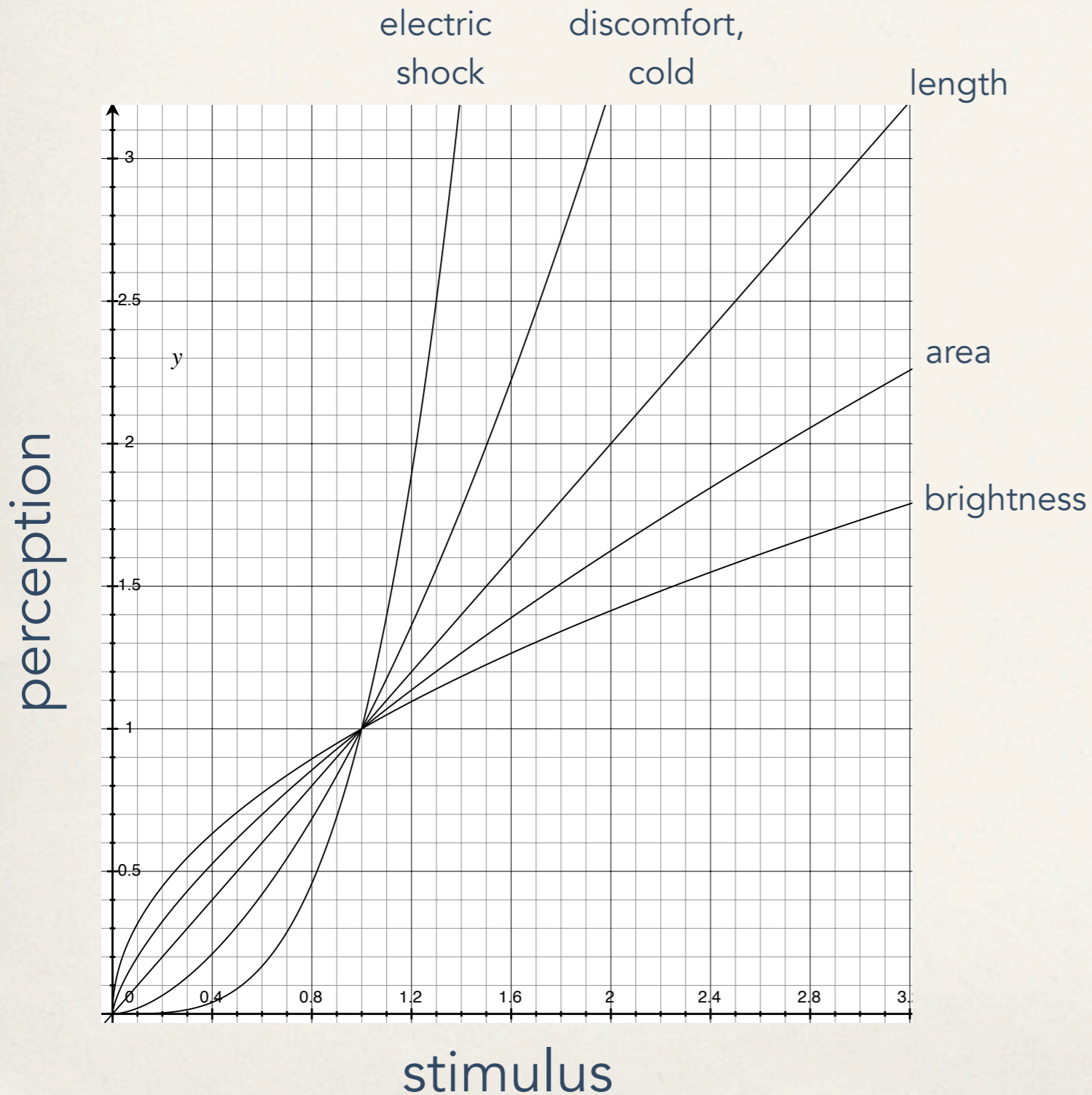
# Quantitative values



compare the area of the circles

5 x longer

# Steven's power law



$$\psi(I) = kI^a$$

sensation	exponent
shock	3.5
discomfort, cold	1.7
length	1
area	0.7
brightness	0.5

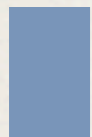


# Weber's Law

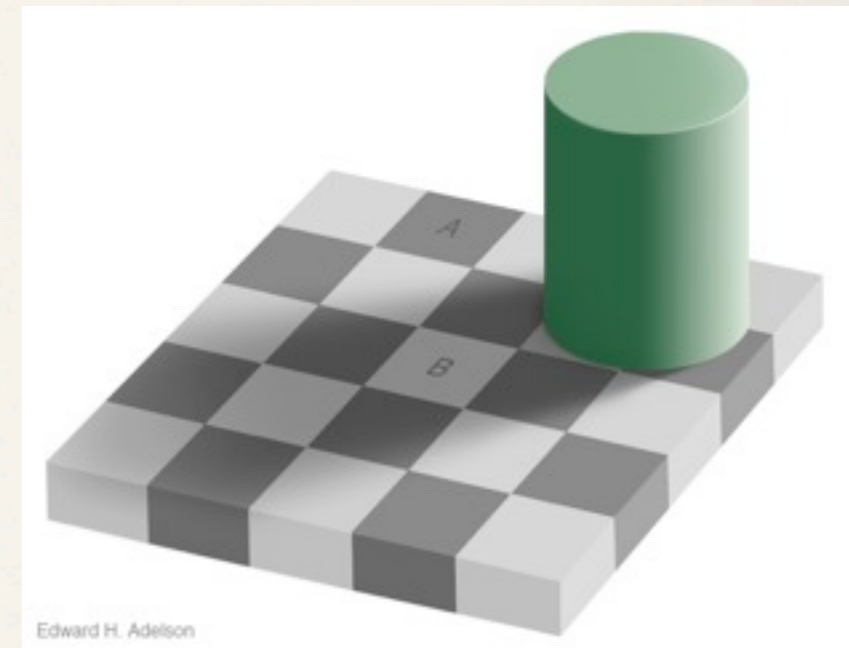
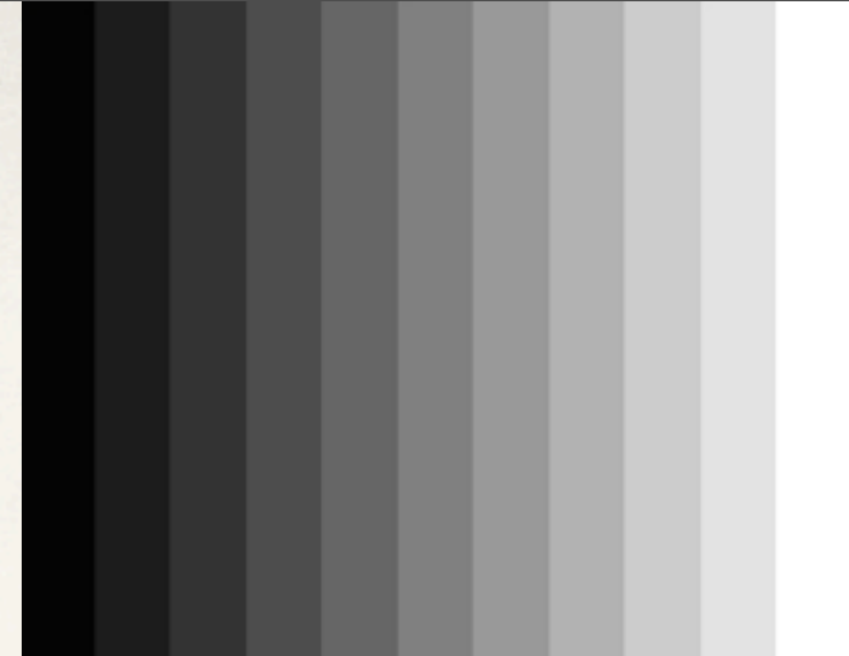
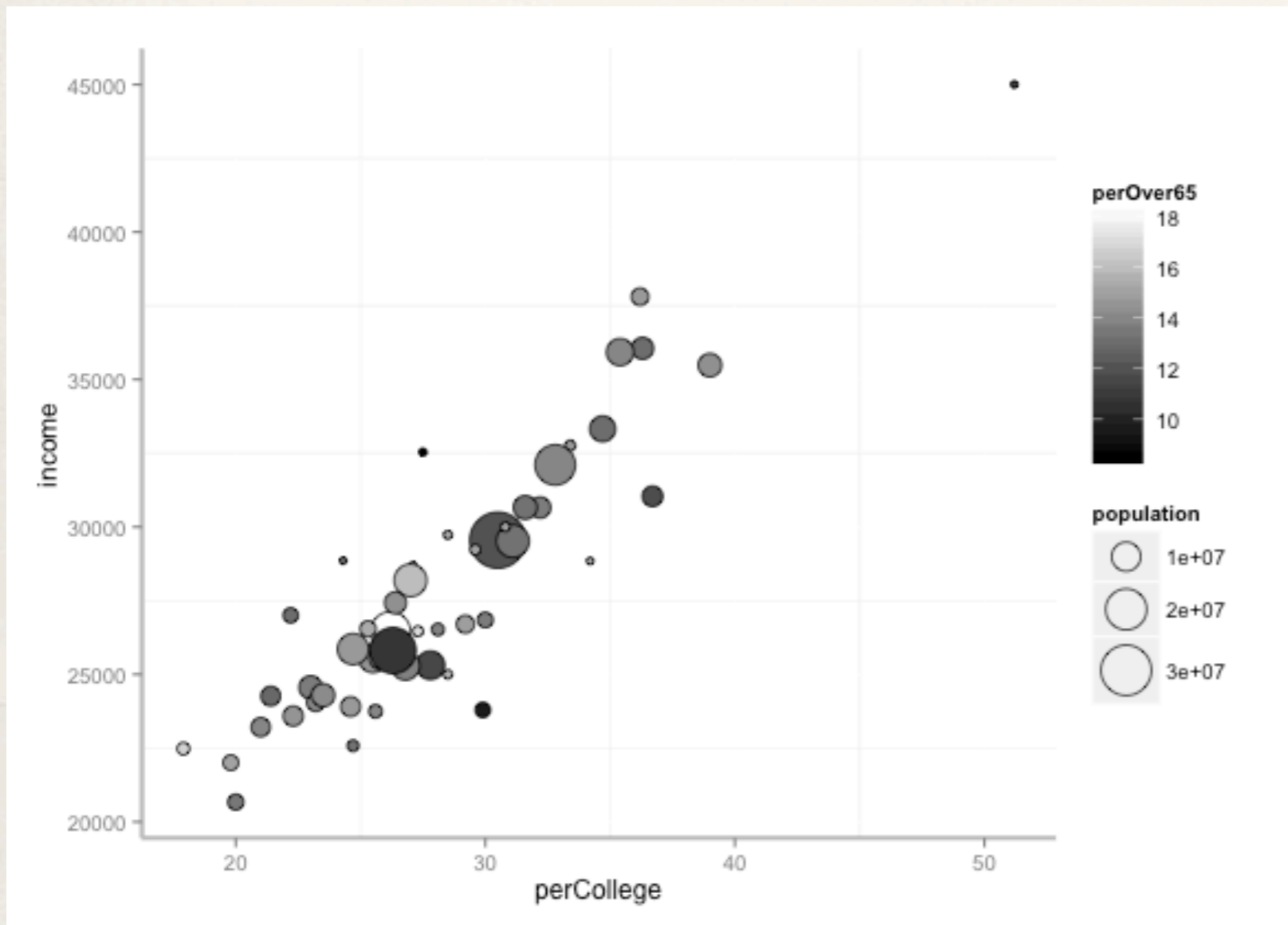
JNB - Just Noticeable Difference

$$dp = k \frac{dS}{S}$$

The perceptible difference proportional to the ratio of the difference in stimulus and the current stimulus

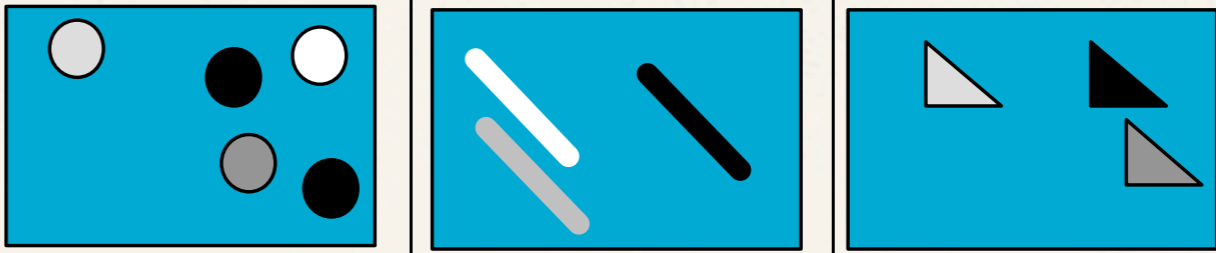
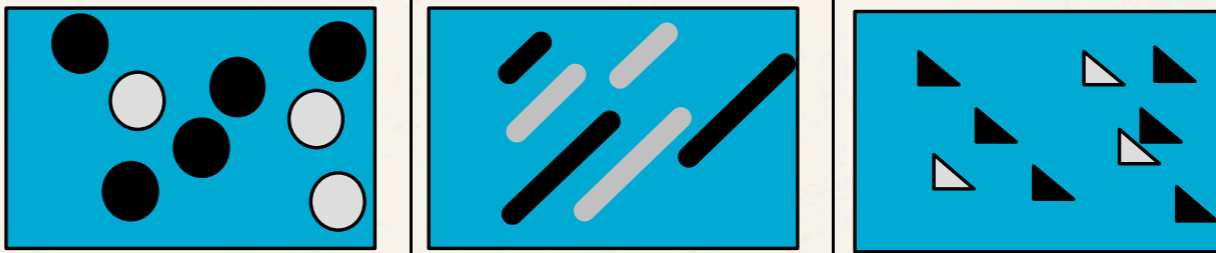
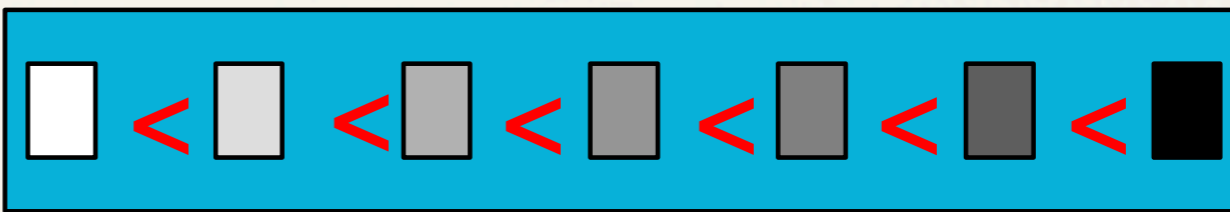


# Brightness or Luminance

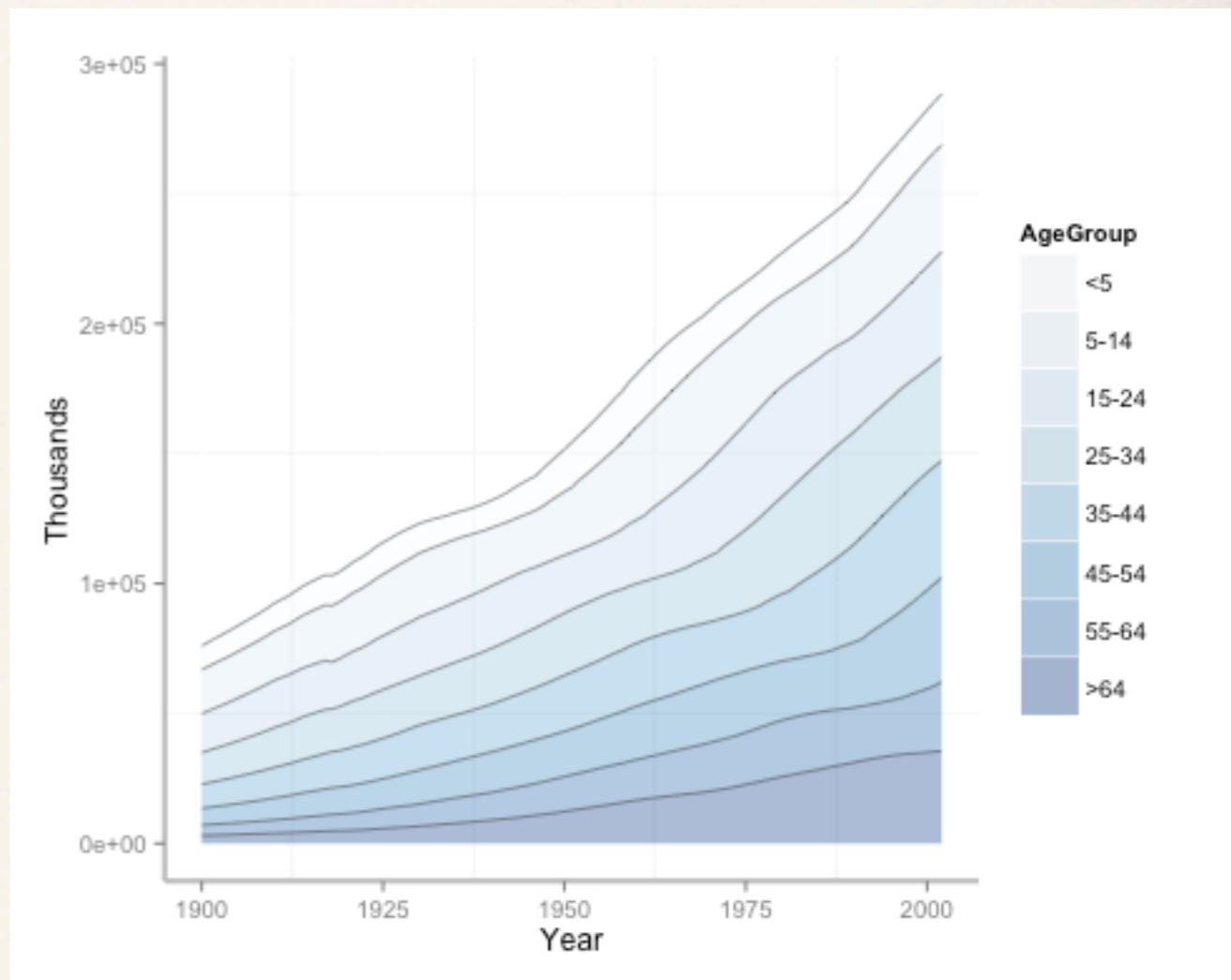
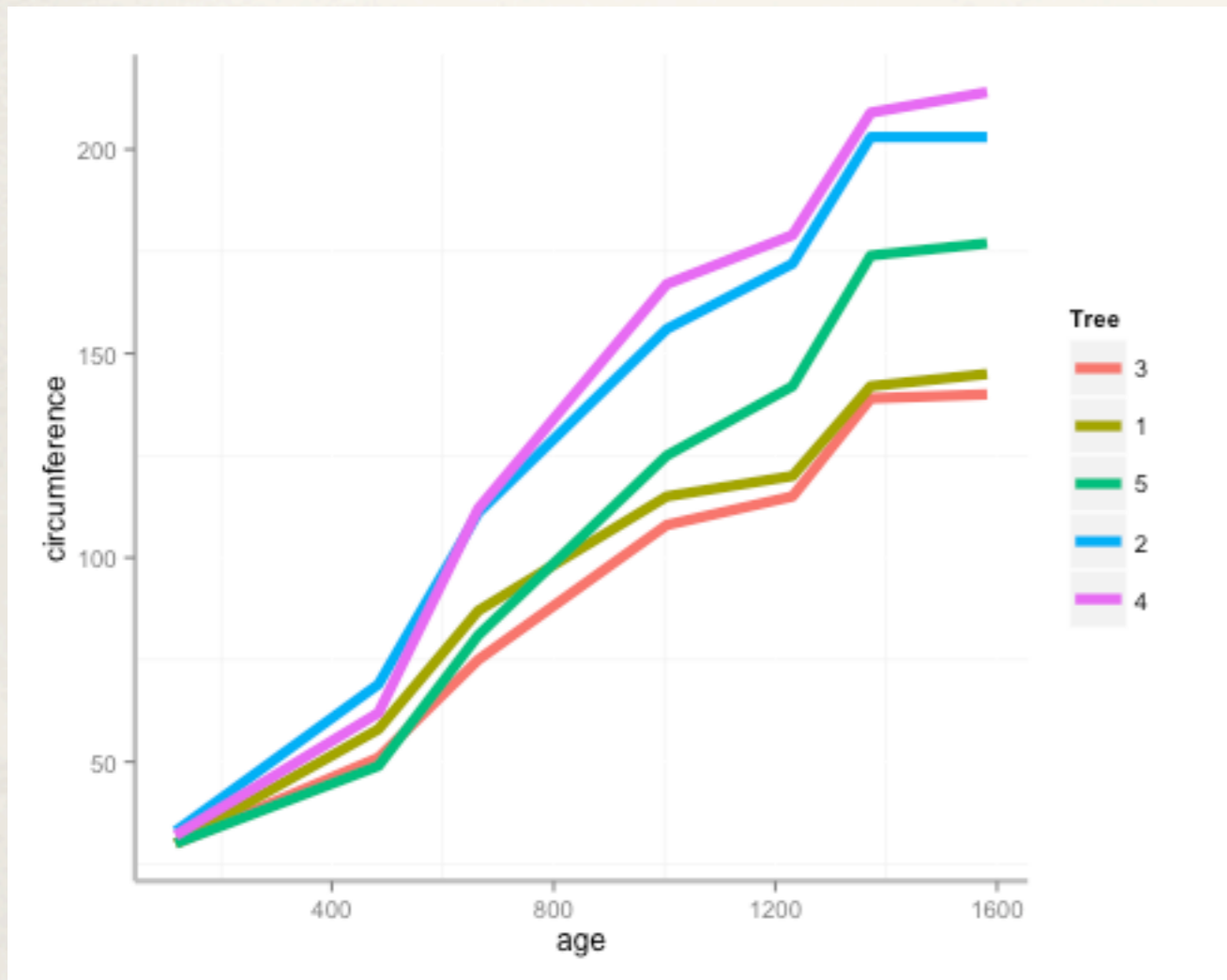




# Luminance characteristics

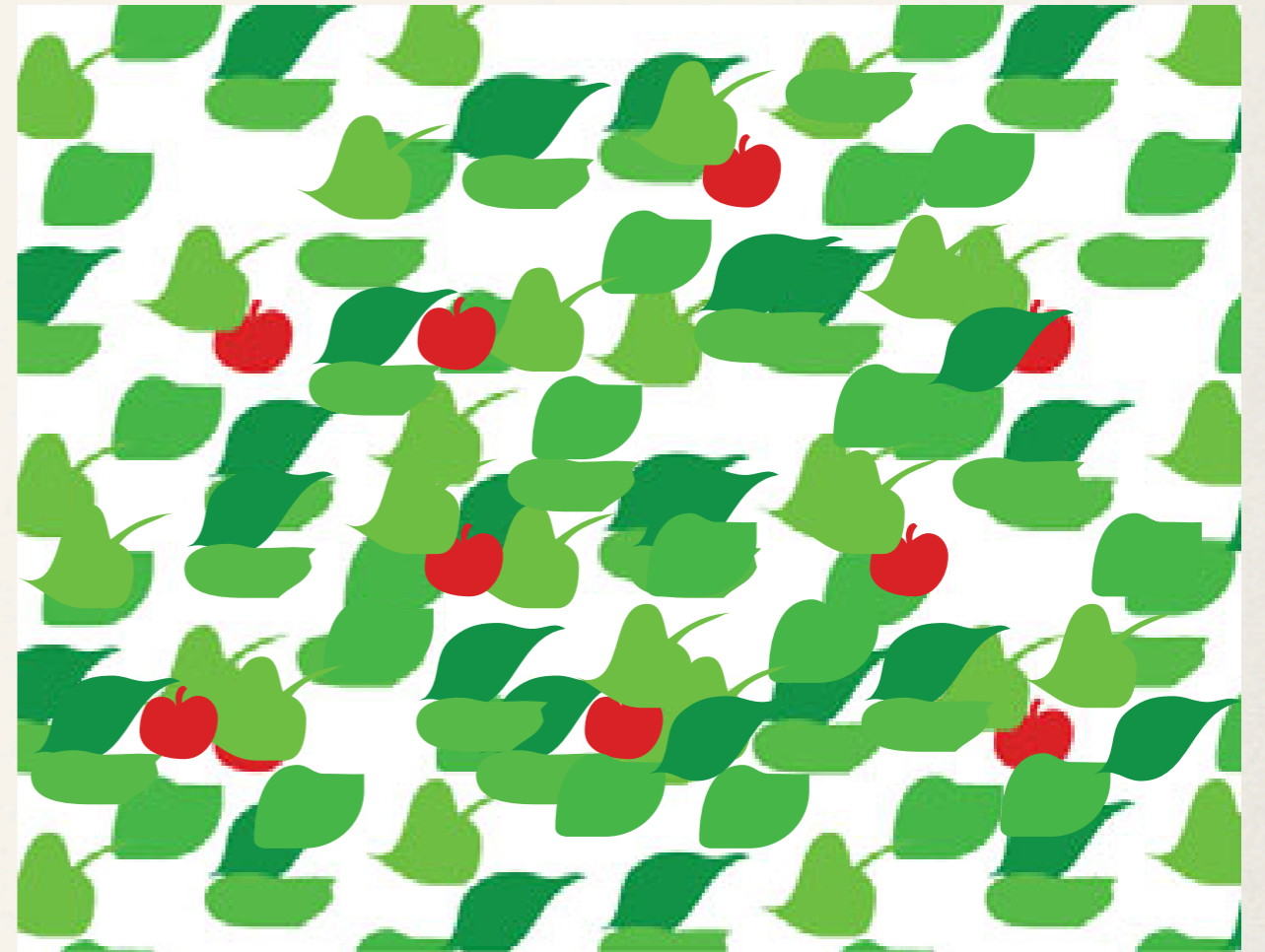
Visual Variable: Value		
✓	selective	
✓	associative	
≠	quantitative	
✓	order	
✓	length	<ul style="list-style-type: none"> <li>• theoretically infinite but practically limited</li> <li>• association and selection ~ &lt; 7 and distinction ~ 10</li> </ul>

# Color



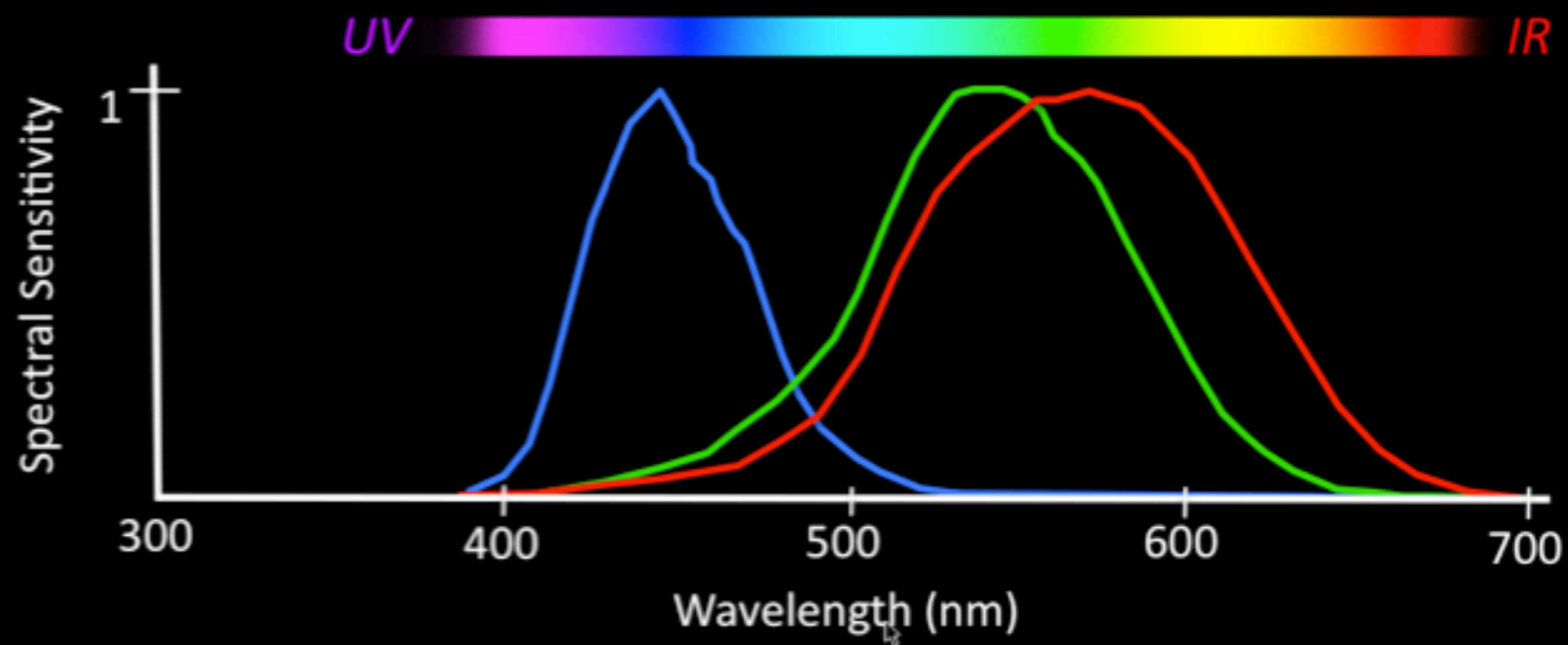


# Color



# Visual perception

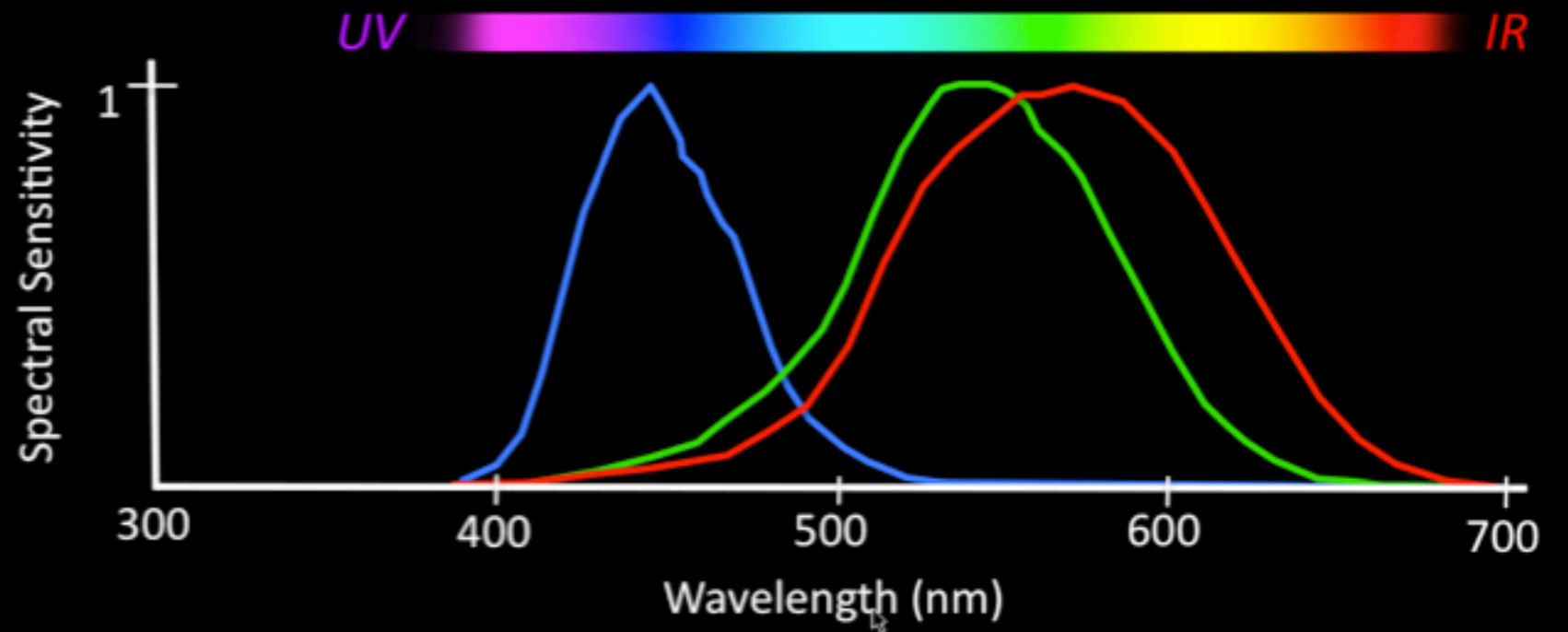
*Homo sapiens*



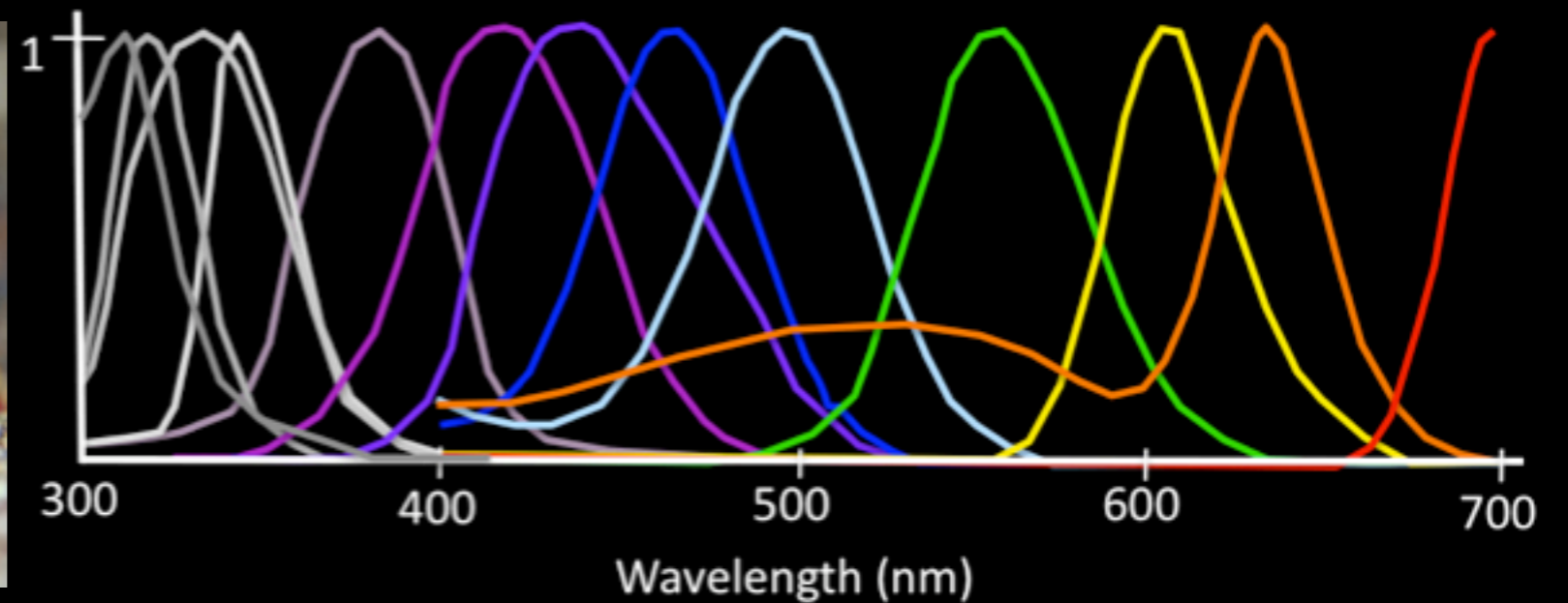


# Visual perception

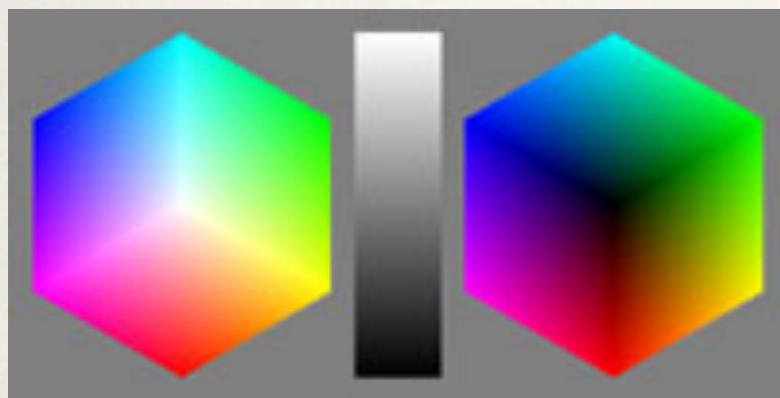
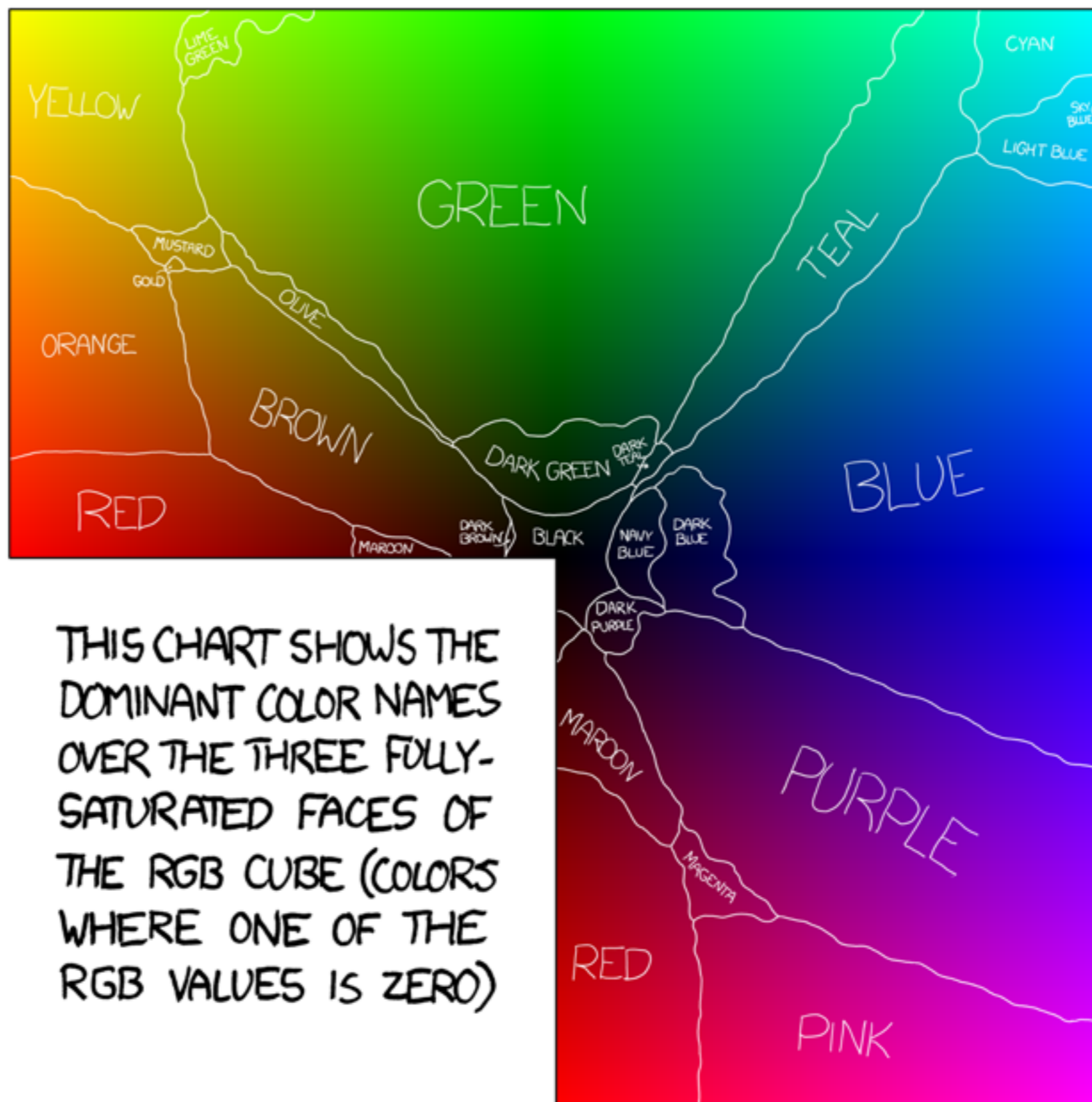
*Homo sapiens*



*Neogonodactylus oestedii*



# Color names: XKCD survey

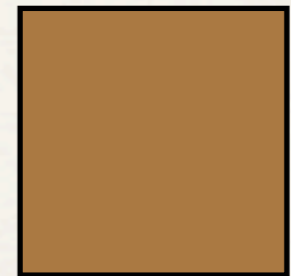
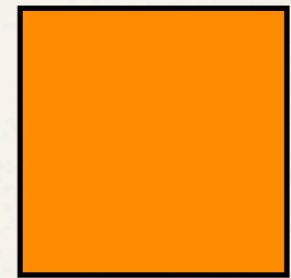
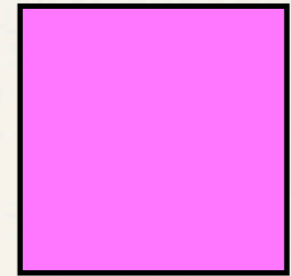
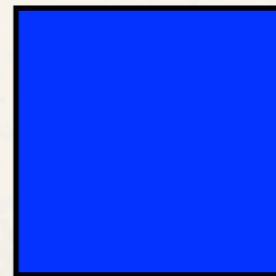
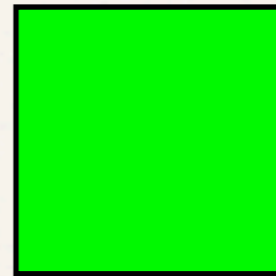
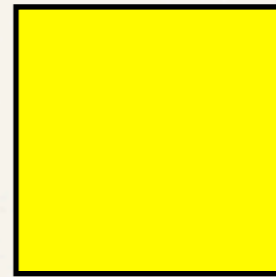
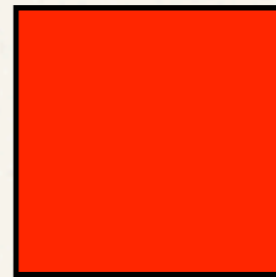
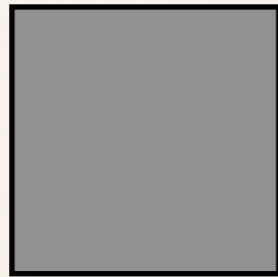
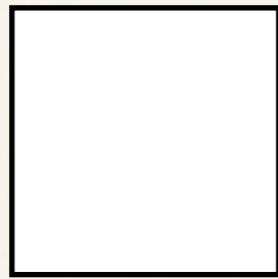


RGB cube from <http://www.argyllcms.com/doc/timage.html>

<http://blog.xkcd.com/2010/05/03/color-survey-results/>

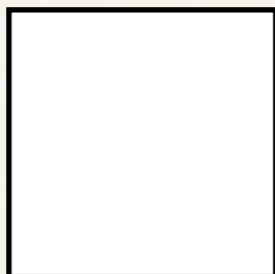


# Universal (?) colors

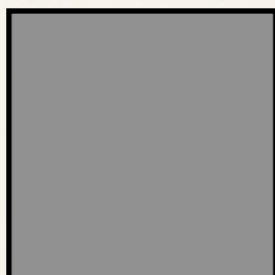


# Universal (?) colors

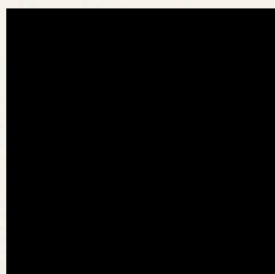
white



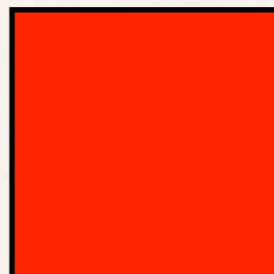
grey



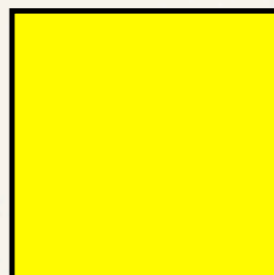
black



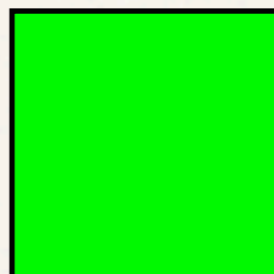
red



yellow



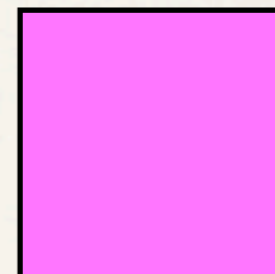
green



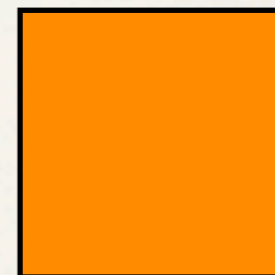
blue



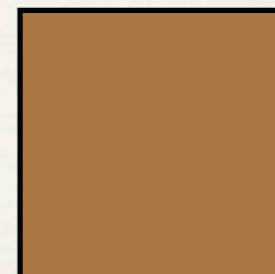
pink



orange



brown



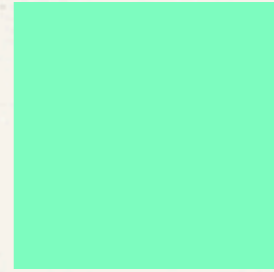
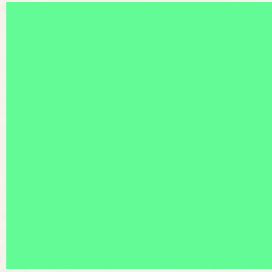
purple





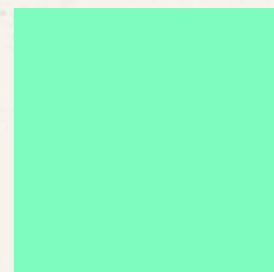
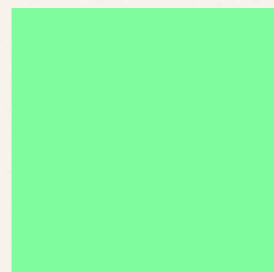
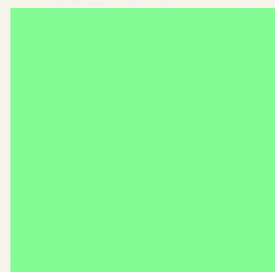
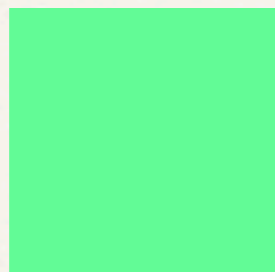
# Color names

Greens

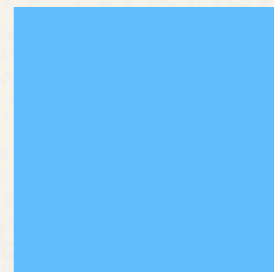
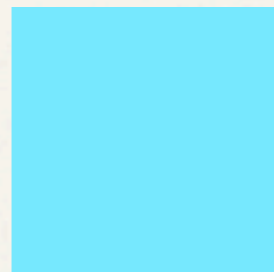
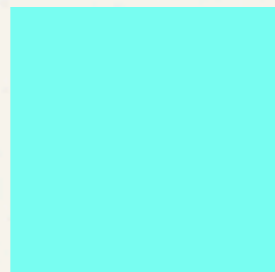
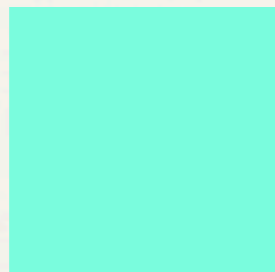


# Color names

Greens

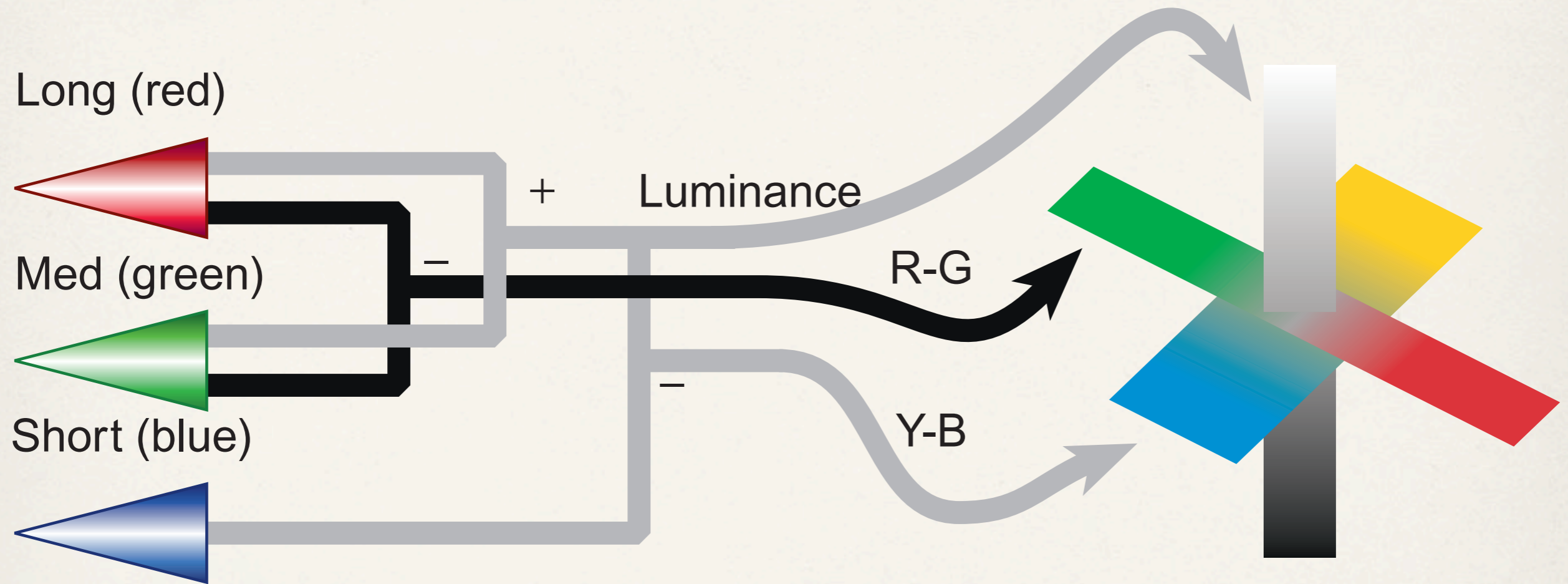


Blues



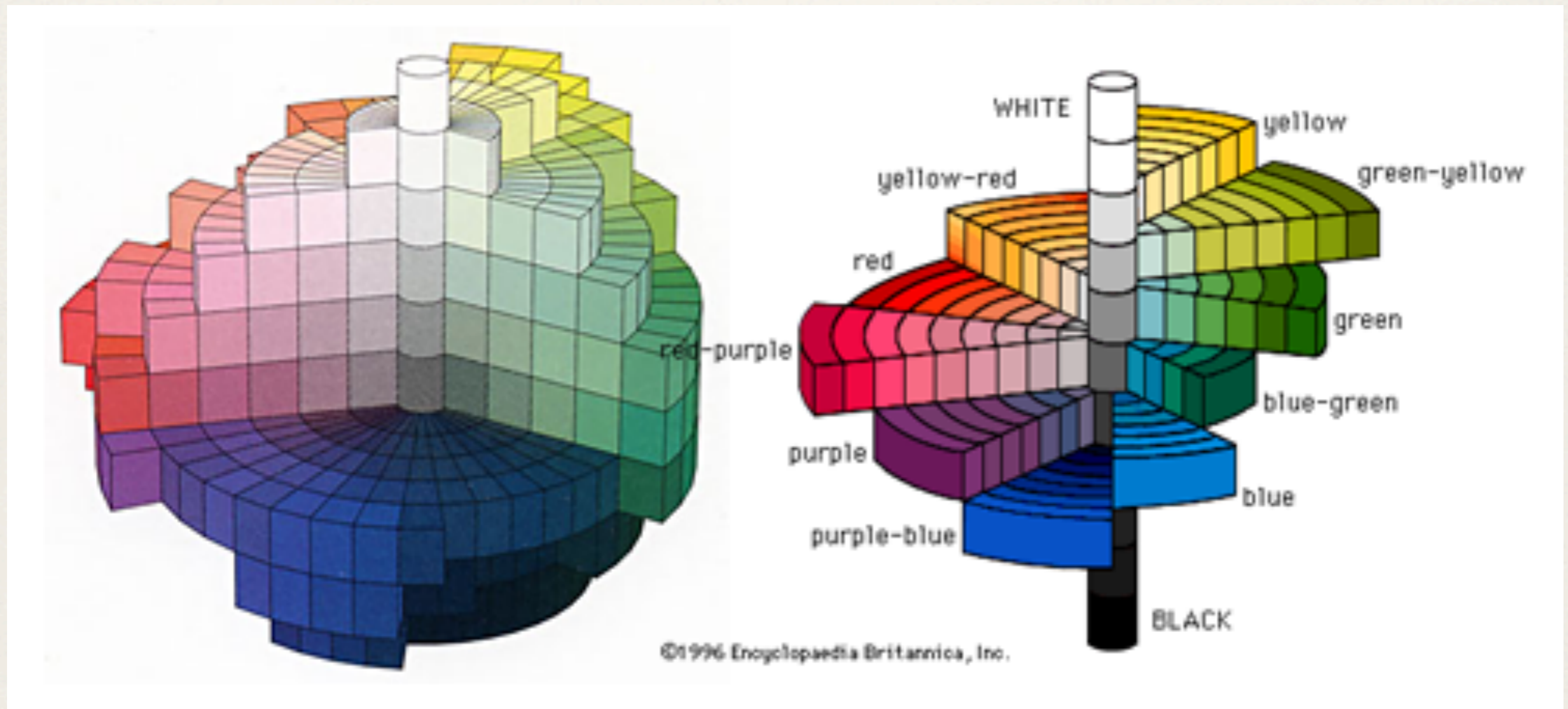


# Opponent Process model



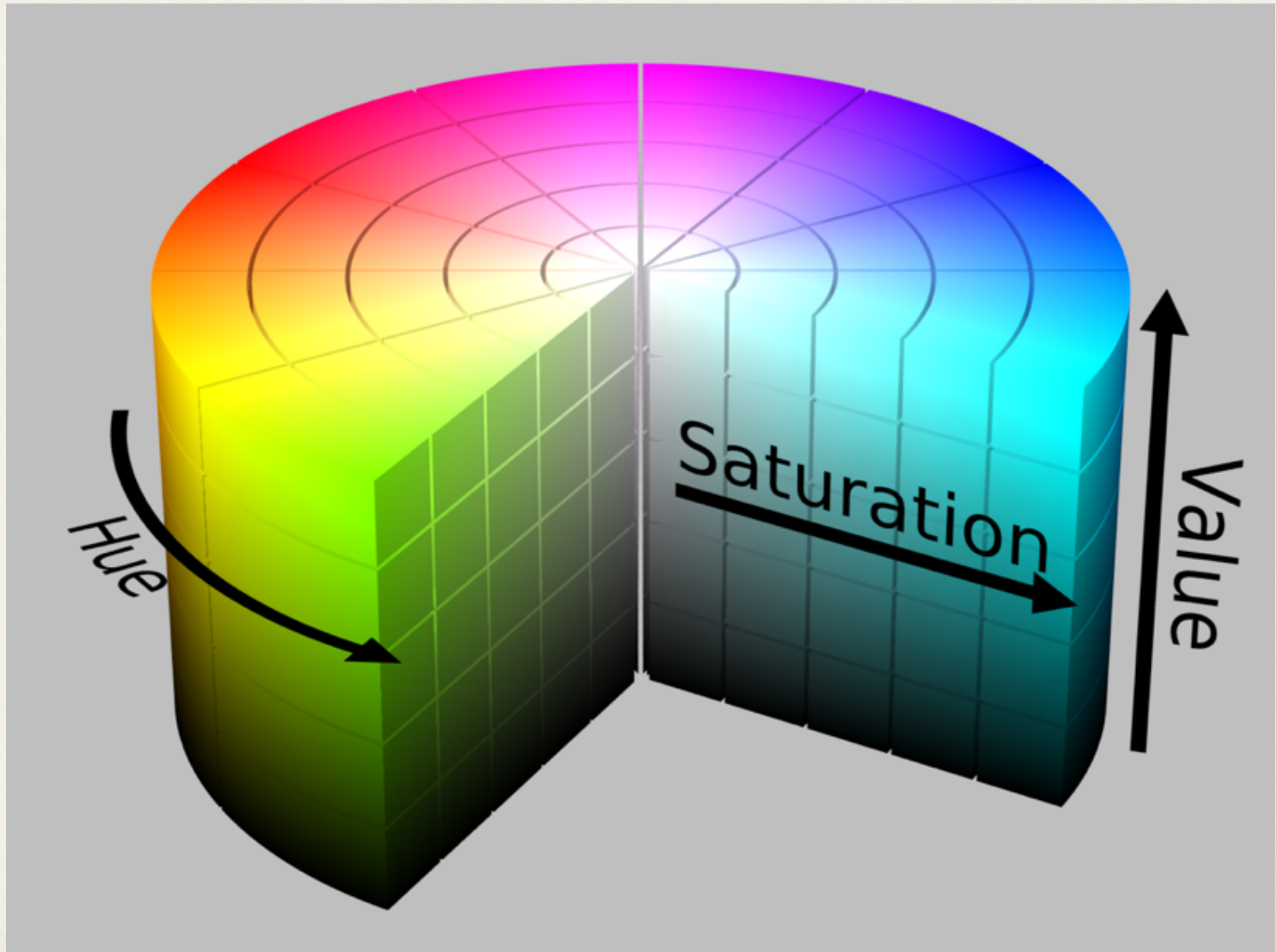
no "reddish-green" or "bluish-yellow"

# Munsell's color system



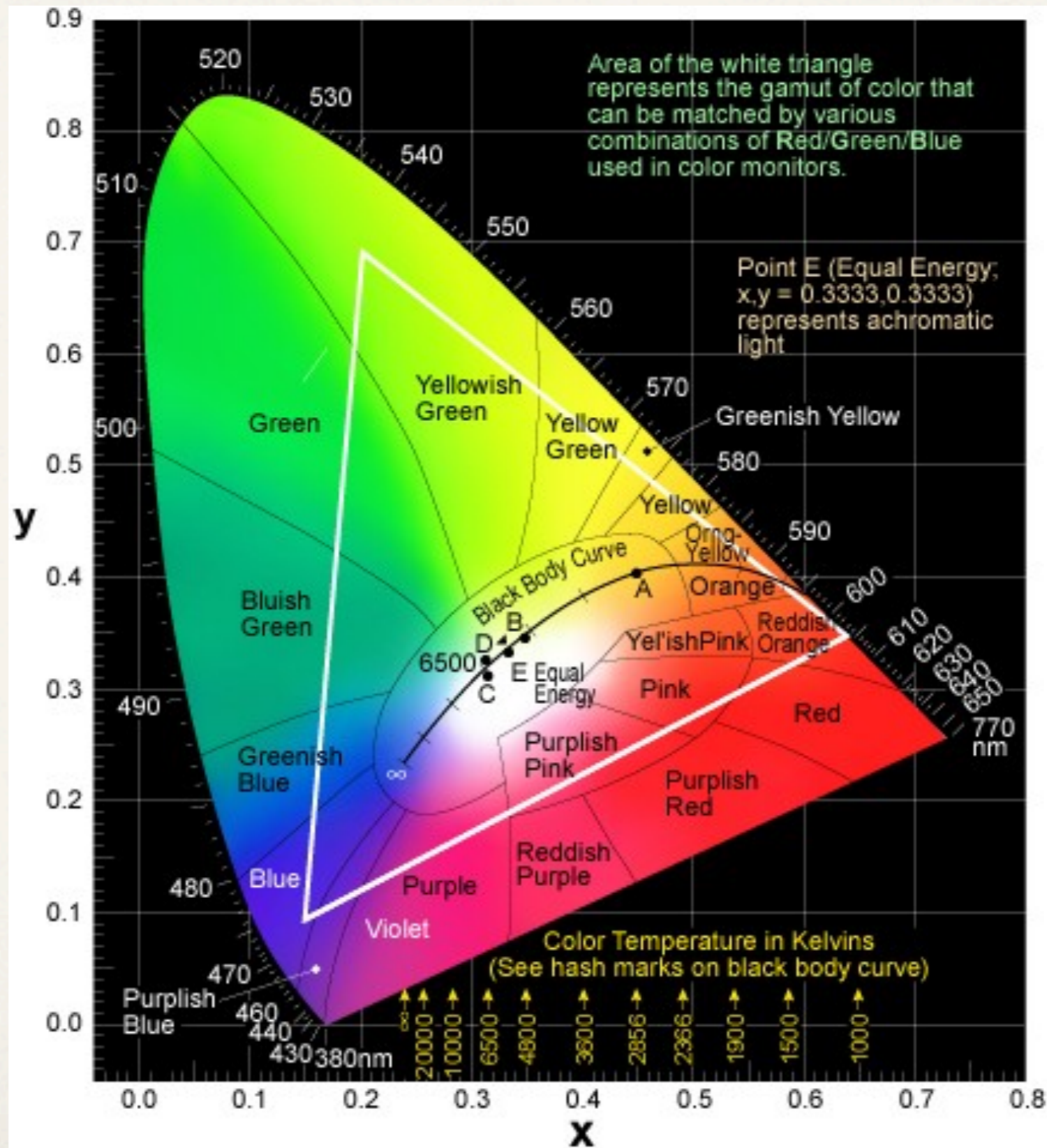


# Hue, saturation, brightness/value/intensity



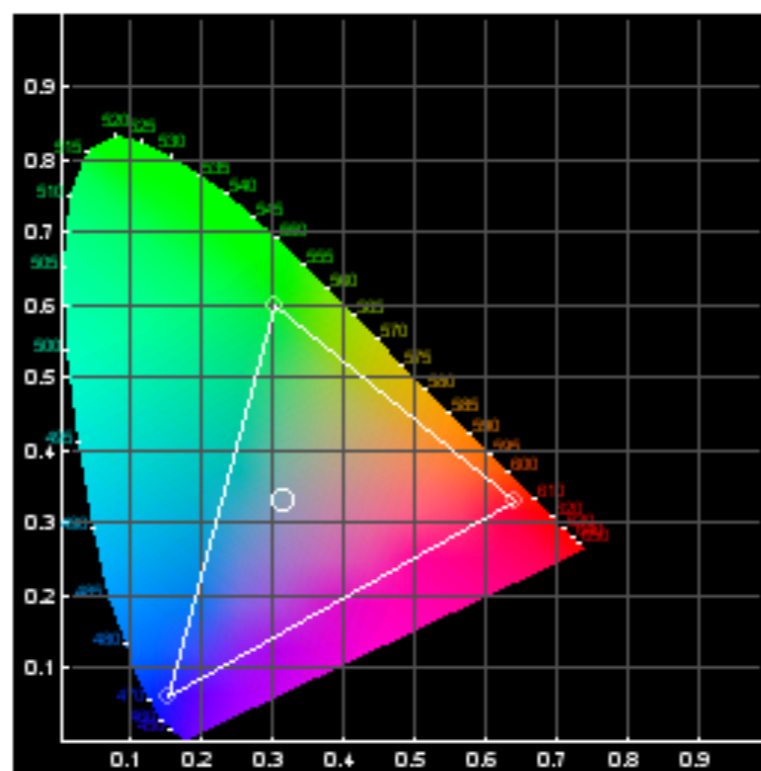


# CIE XYZ

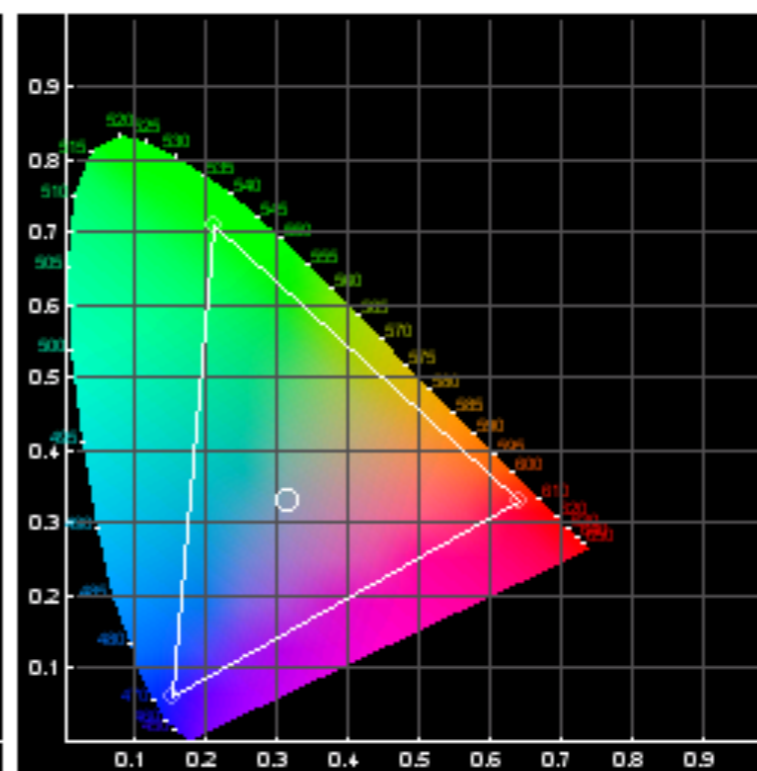




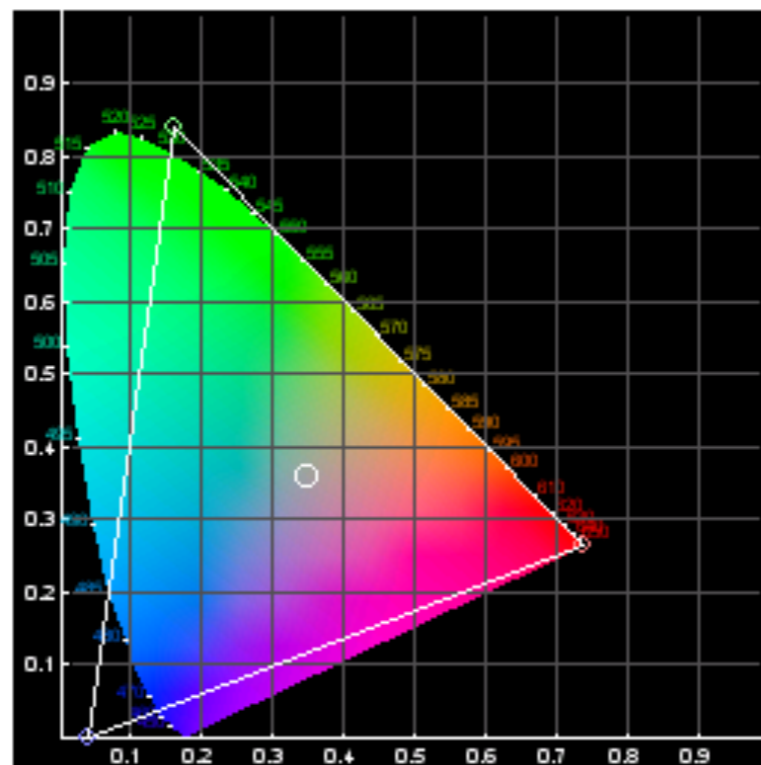
# Color gamut



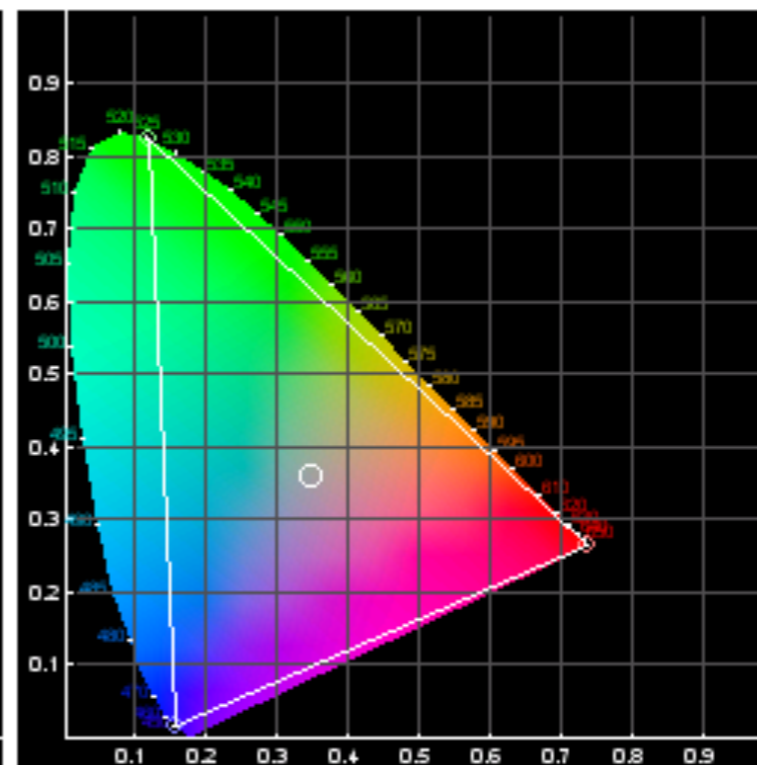
sRGB



AdobeRGB



ProPhotoRGB



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