

Designing Effective Visualizations. Practical guidelines

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Outline

- Effective Visualizations
- Use of color
- Comparison
- Copy & labels
- Ordering & aligning data

Outline

- **Effective Visualizations**
- Use of color
- Comparison
- Copy & labels
- Ordering & aligning data

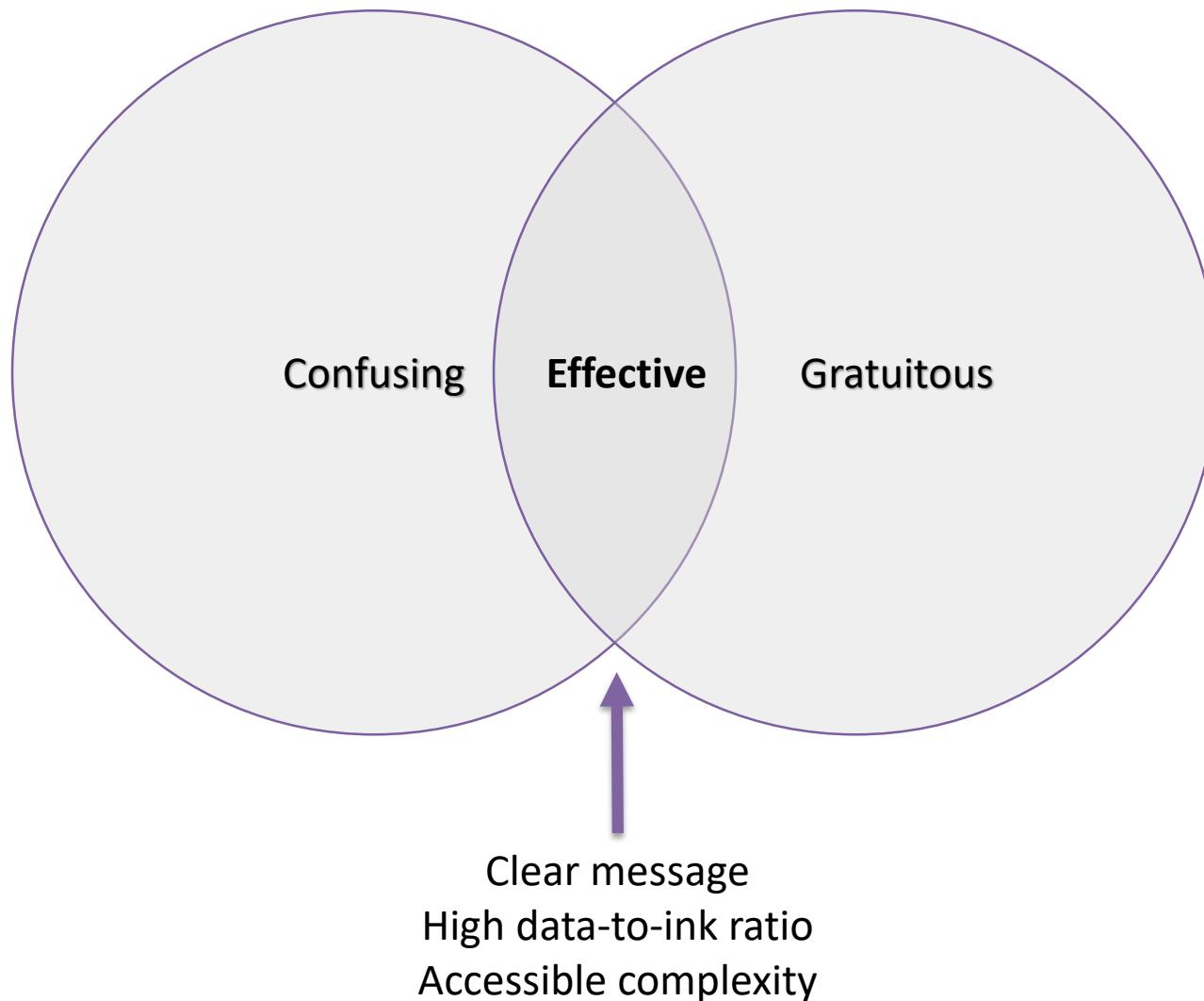
Effective Visualizations

- Main goal of visualization:
 - Communicate [a message/data...]
- Visualization will be **effective** if:
 - Message has been transmitted
 - Data has been properly understood
- Visualization will be **ineffective** if:
 - Visualization is too complex: user is unable to get the message
 - Visualization is misleading: user is unable to grasp the data

Effective Visualizations

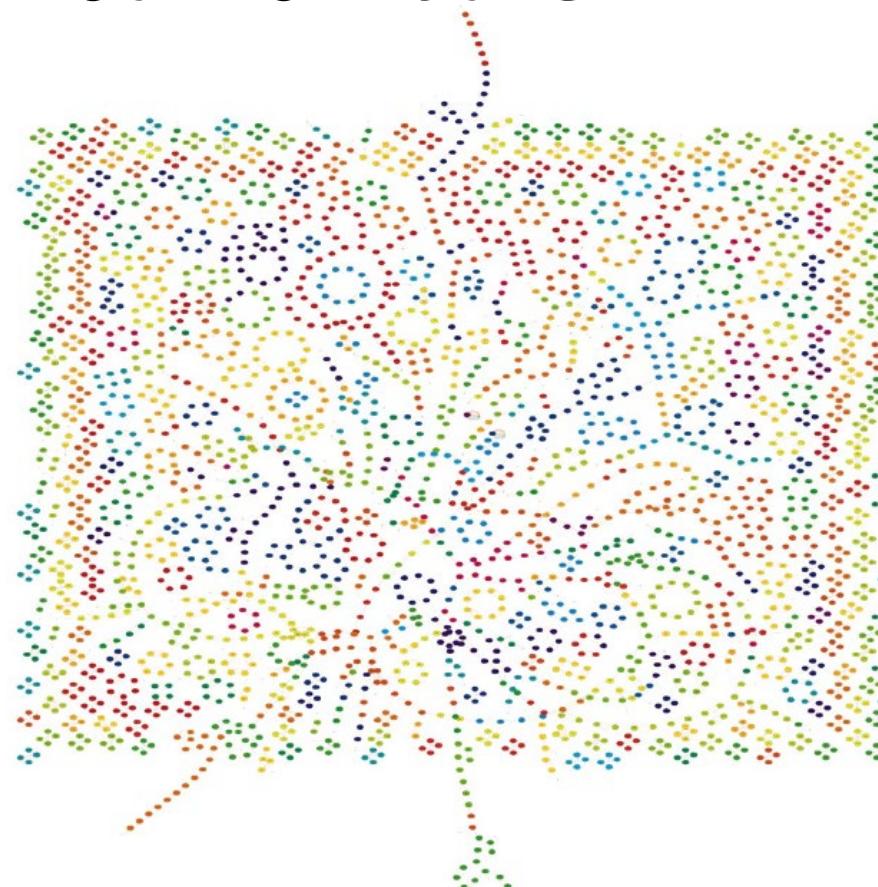
- Effective visualization. Elements to consider
 - Data density
 - We want information-rich visualizations
 - Visual mappings
 - Observers must understand the depiction without effort
 - Amount of information
 - Keys, labels [grids, legends, ticks...] help understanding the data
 - Color usage
 - Influences perception and attention

Effective Visualizations



Effective Visualizations

- Information rich, not informative

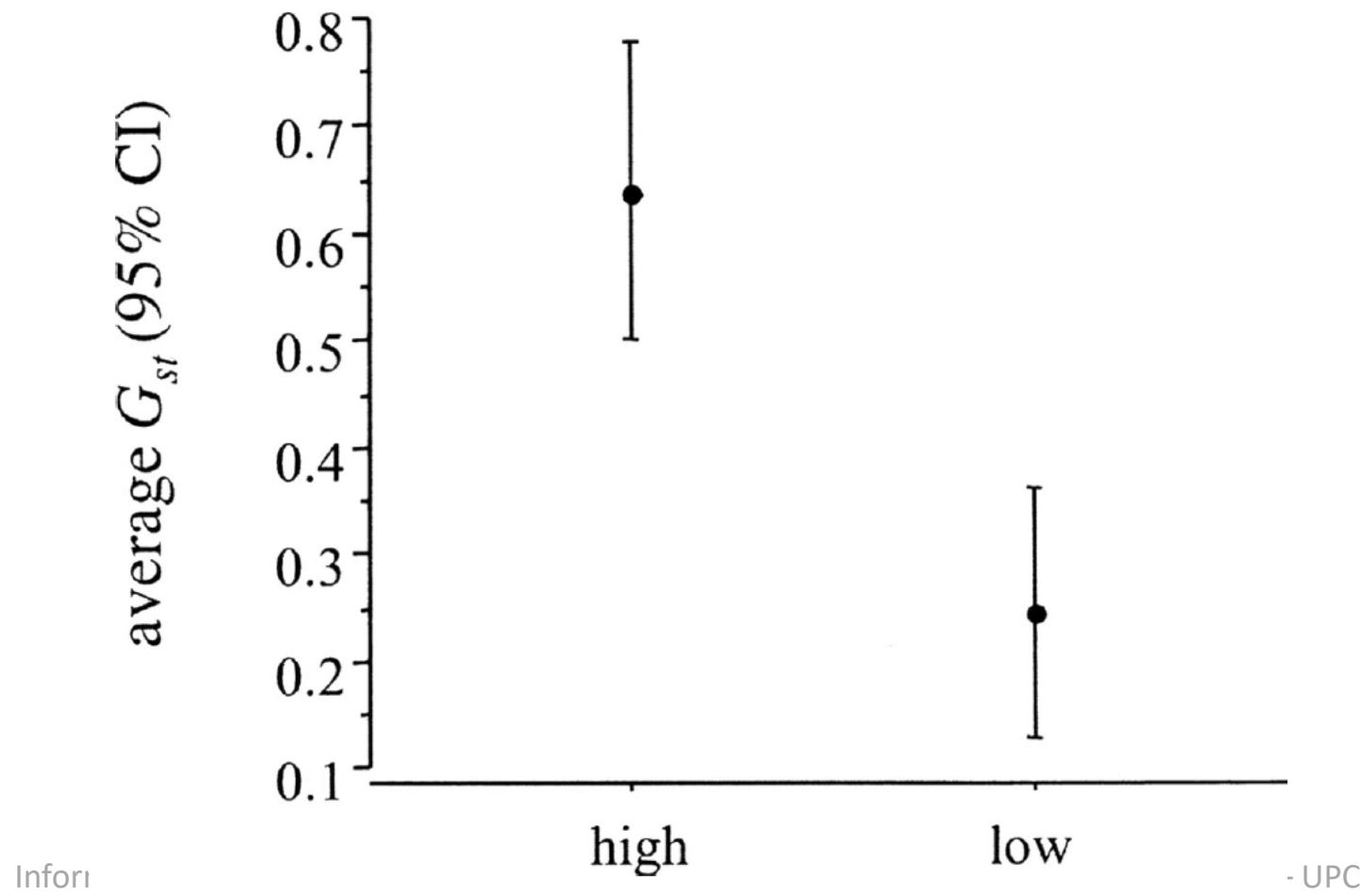


Chromosome colors:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X
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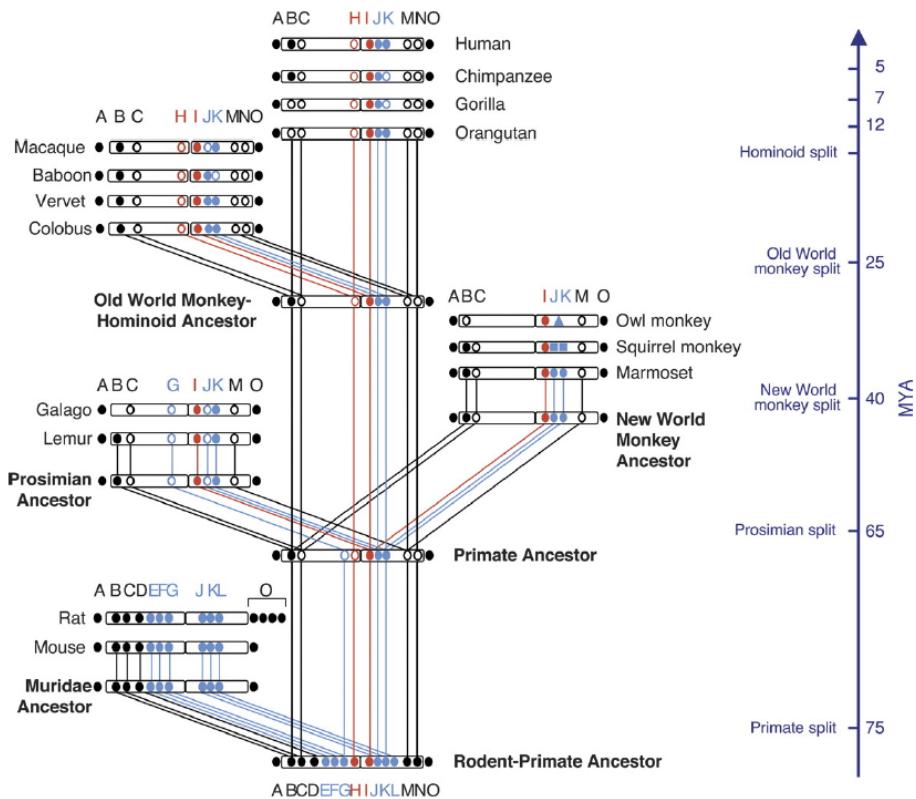
Effective Visualizations

- Informative, not information-rich



Effective Visualizations

- Information-rich and Informative



Information

A	WFDC5/Wfdc5	D	WFDC15a/Wfdc15a	M	WFDC15c/Wfdc15c
B	WFDC12/Wfdc12	E, F, G, J, K, L	SEMG/Svs family	N	WFDC15d/Wfdc15d
C	WFDC15b/Wfdc15b	H, I	Trappin (PI3) family	O	SLPI/Sipi family

science – UPC

Effective Visualizations

- Very general principle

**strive to give your viewer
the greatest number of useful ideas
in the shortest time
with the least ink
in the smallest space**

Tufte, E. The Visual Display of Quantitative Information (Graphic Press, Cheshire, Connecticut, USA, 2007).

Effective Visualizations

- Specific principles
 - Create visuals when necessary
 - Accuracy isn't everything
 - Don't merely display data, explain it
 - Know your message
 - Strive for clear communication
 - Satisfy your audience, not yourself
 - Respect human visual limitations

Use visuals only when necessary

- The desire for a figure is not always proportional to its utility



Accuracy isn't everything

- Accuracy does not always add to utility



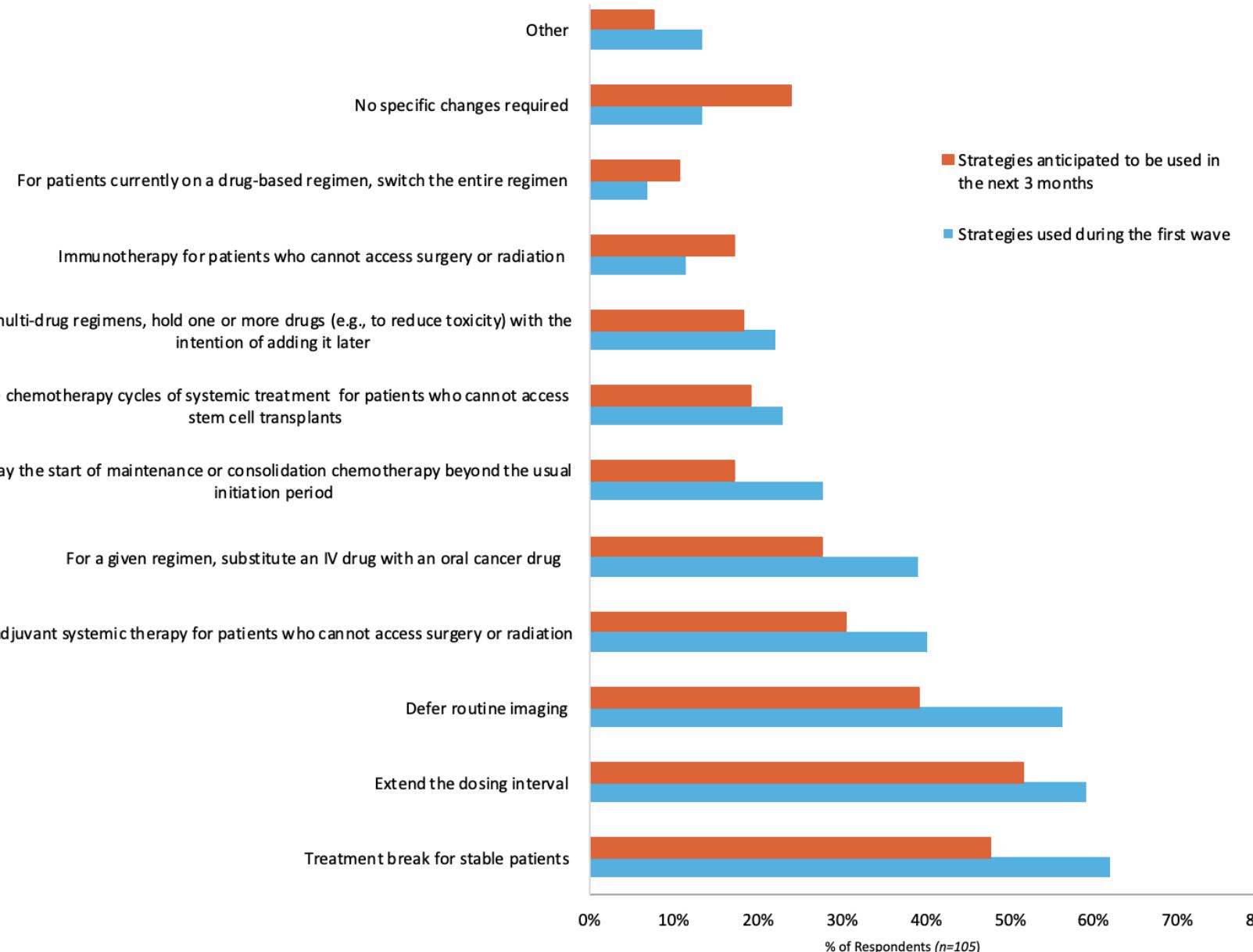
Accuracy isn't everything

- Accuracy does not always add to utility



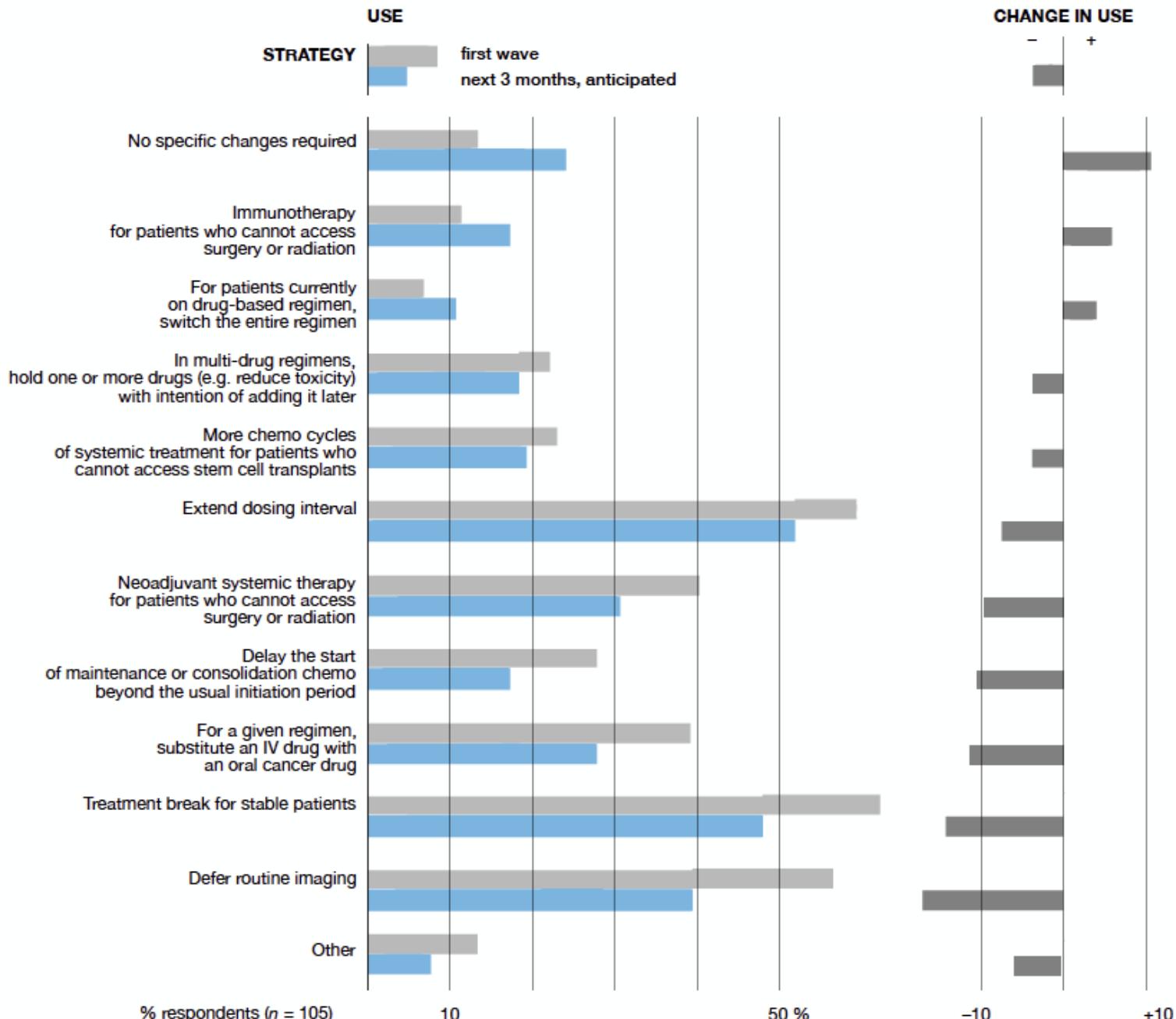
Explain your data

If we want to communicate data change ...

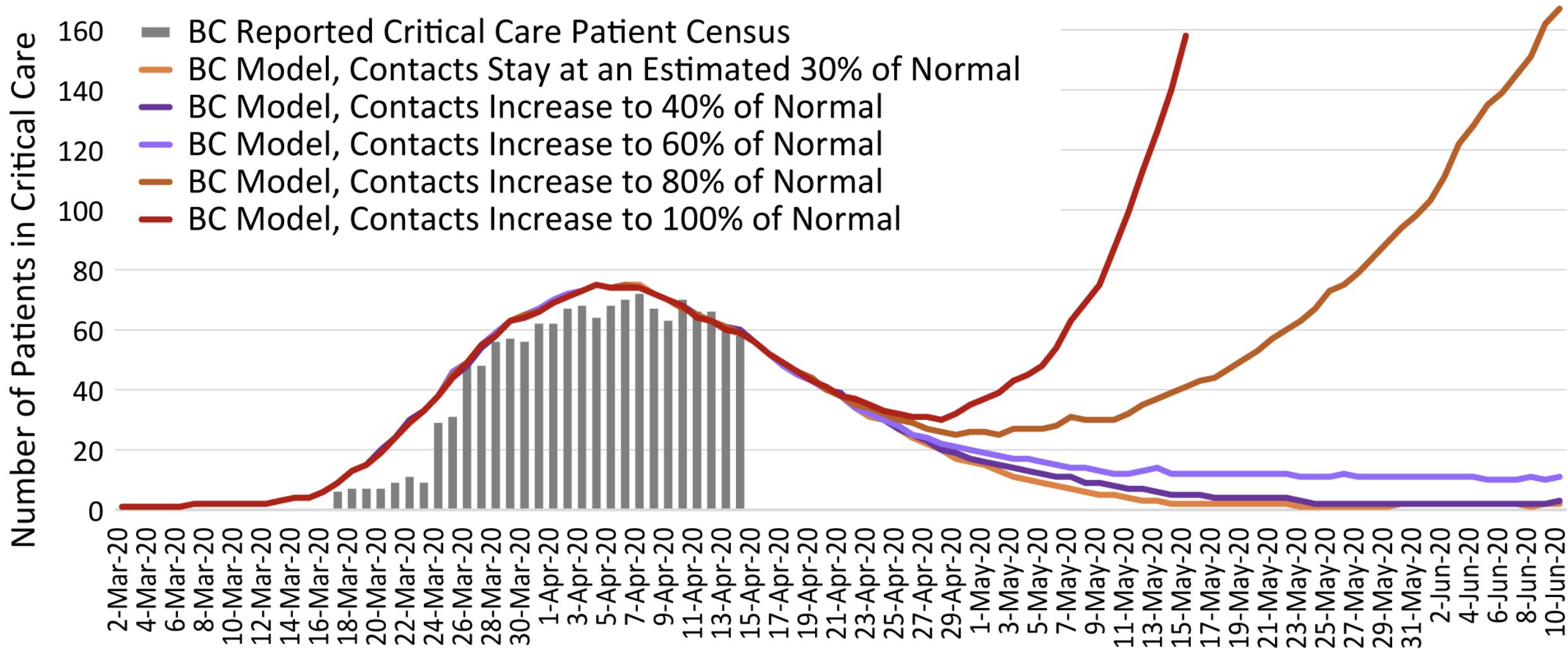


Explain your data

... we can show it

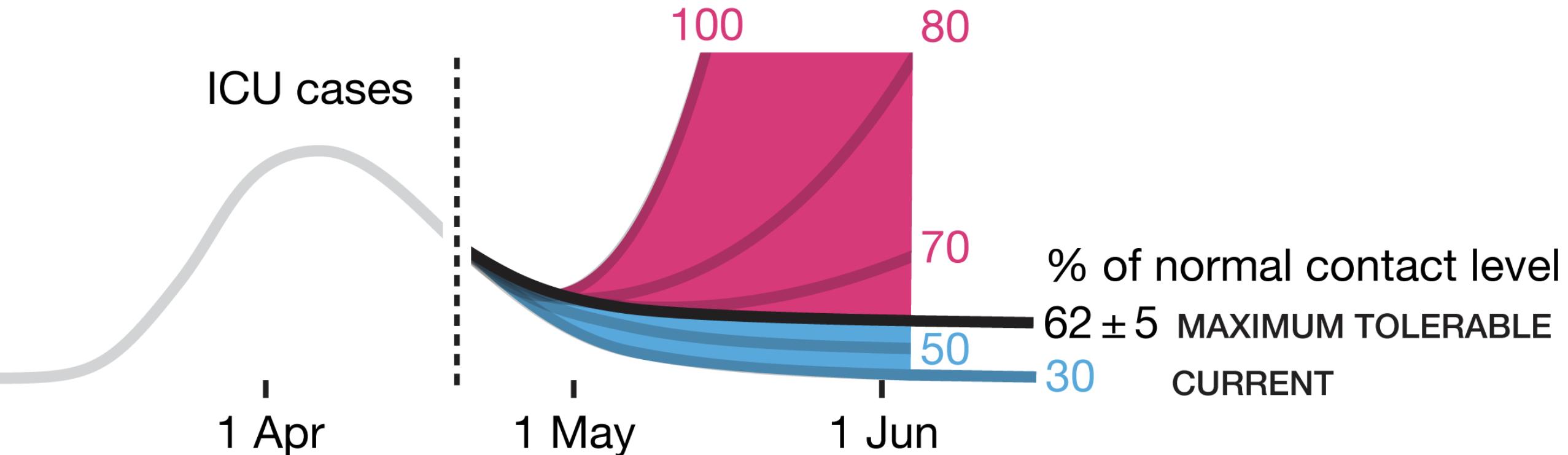


Example: critical care implications of dynamic model in BC's context



Explain your data

Critical care admission rate remains acceptable if restrictions are relaxed up to 60% of normal



Know your message

WHAT IS SHOWN?

RAW DATA

12 54 82 29 25 22 67 61 23 79

WHAT IS COMMUNICATED?

NO CLEAR MESSAGE.

WHAT IS INTERPRETED?

UNKNOWN. READER IS
ON THEIR OWN.

Know your message

WHAT IS SHOWN?

RAW DATA

12 54 82 29 25 22 67 61 23 79

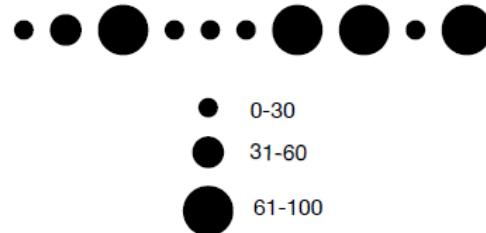
WHAT IS COMMUNICATED?

NO CLEAR MESSAGE.

WHAT IS INTERPRETED?

UNKNOWN. READER IS
ON THEIR OWN.

DISCRETIZED



SCALE

THREE RANGES ARE IMPORTANT.
INDIVIDUAL VALUES WITHIN A
RANGE ARE NOT.

Know your message

WHAT IS SHOWN?

RAW DATA

12 54 82 29 25 22 67 61 23 79

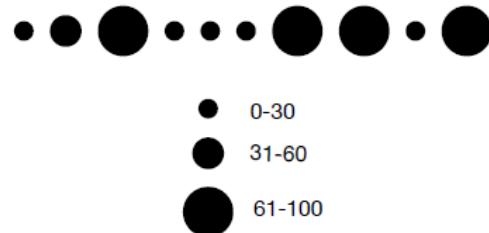
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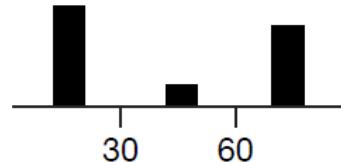
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DISTRIBUTION

THERE ARE FEWER
MEDIUM-SIZED VALUES.

Know your message

WHAT IS SHOWN?

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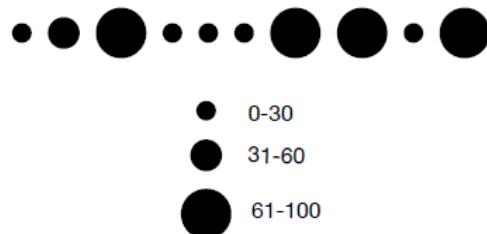
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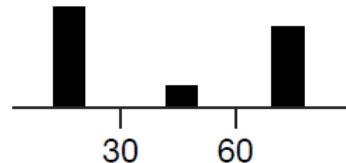
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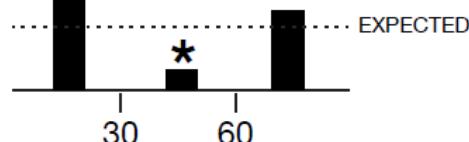
BINNED



DISTRIBUTION

THERE ARE FEWER
MEDIUM-SIZED VALUES.

TREND

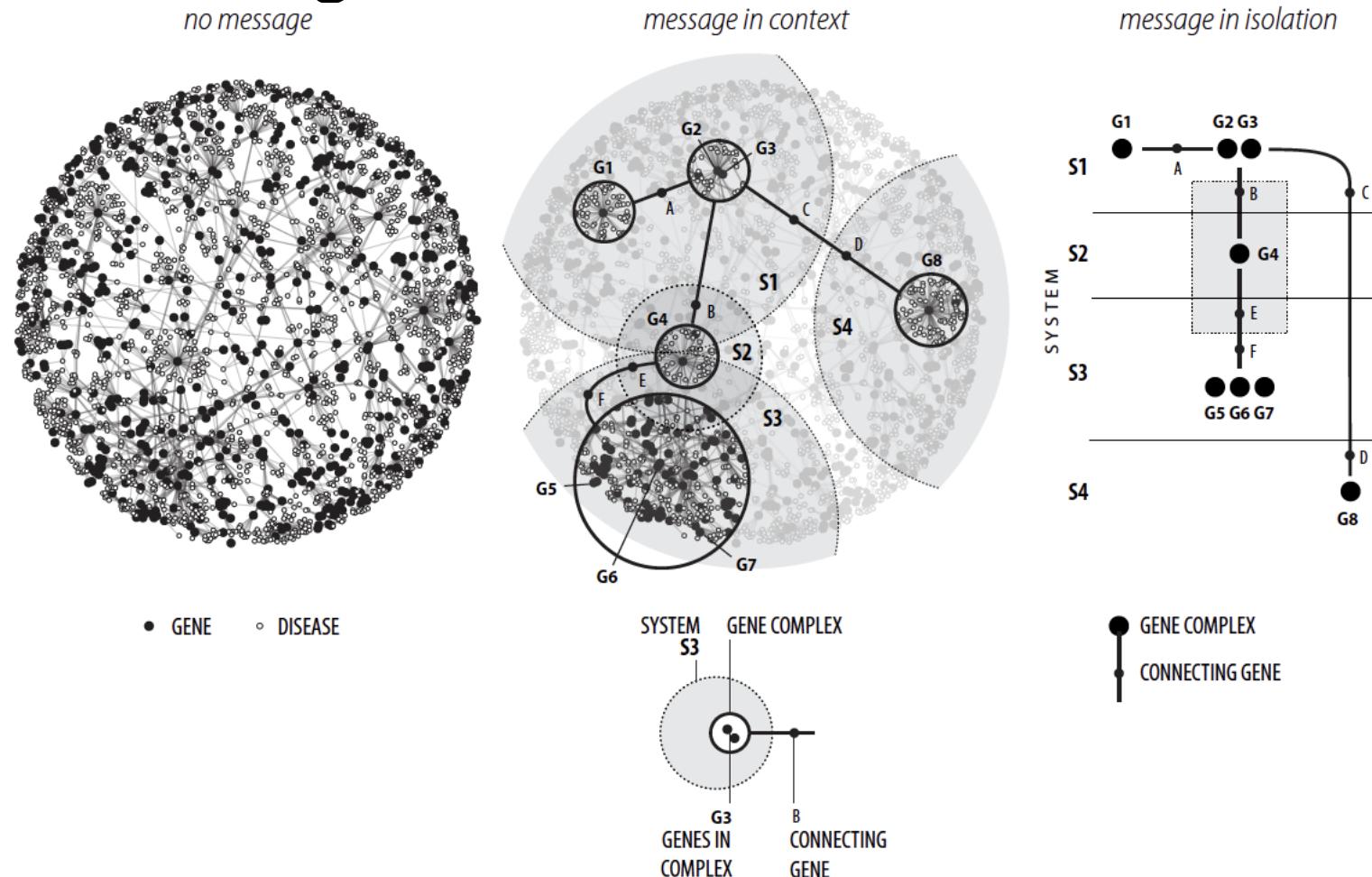


SIGNIFICANCE

THERE ARE SIGNIFICANTLY
FEWER MEDIUM-SIZED VALUES.

Strive for clear communication

- Don't hide message with context

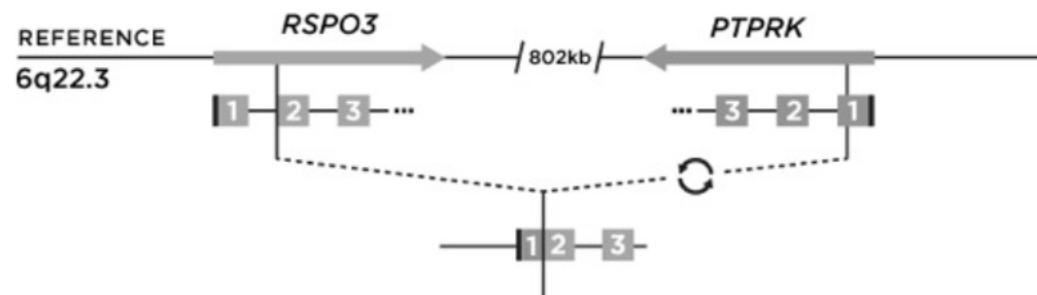


Strive for clear communication

- Revise and redraw
- To explore data, achieve effective encoding



- To communicate concepts, use effective design



Satisfy your audience, not yourself

- Be aware of bias in evaluating effectiveness of visual forms

Satisfy your audience, not yourself

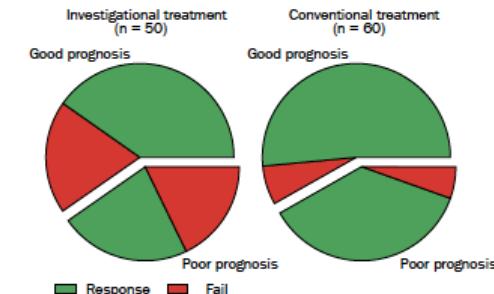
Influence of data display formats on physician investigators' decisions to stop clinical trials: prospective trial with repeated measures

Linda S Elting, Charles G Martin, Scott B Cantor, Edward B Rubenstein

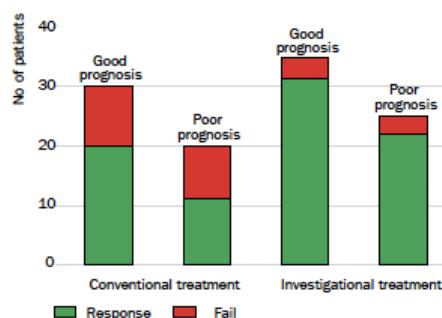
table

	Conventional treatment		Investigational treatment	
	Total no	% Fail	Total no	% Fail
Good prognosis	30	30	35	11
Poor prognosis	20	45	25	12
Total	50	38	60	12

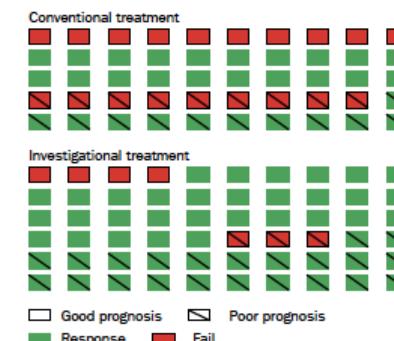
pie chart



bar graph



icon graph



Satisfy your audience, not yourself

Influence of data display formats on physician investigators' decisions to stop clinical trials: prospective trial with repeated measures

Linda S Elting, Charles G Martin, Scott B Cantor, Edward B Rubenstein

*“...eight voiced
considerable contempt
for the [icon] display.”*



% accuracy % preference

82 0

30 30 35 11
20 45 25 12
50 38 60 12

68 62

*“... icon displays were often
preferred by nurses, students,
... but were considered
unacceptable by physicians.”*

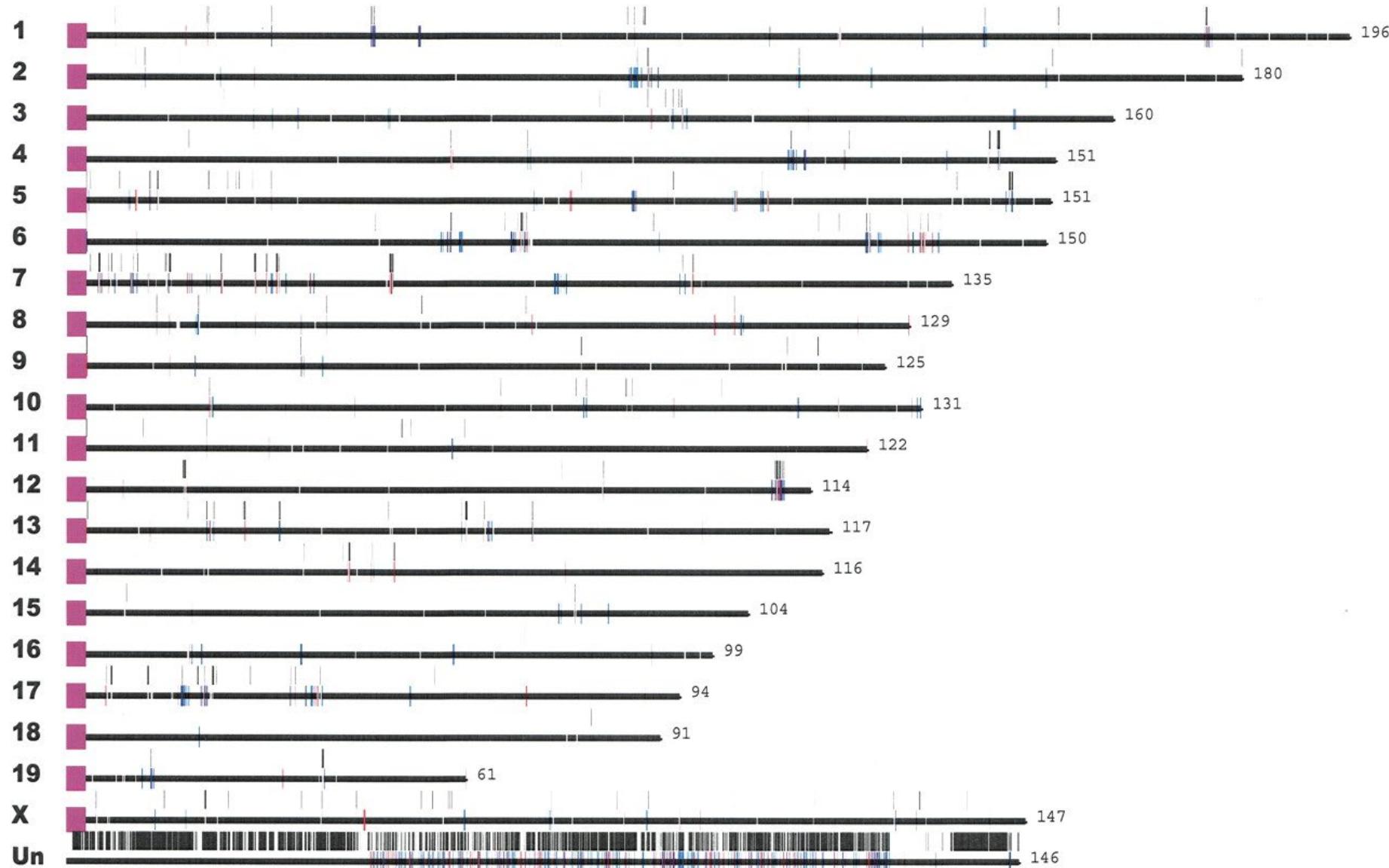


56 24



56 14

Respect human limitations. Legibility



Respect human limitations. Legibility

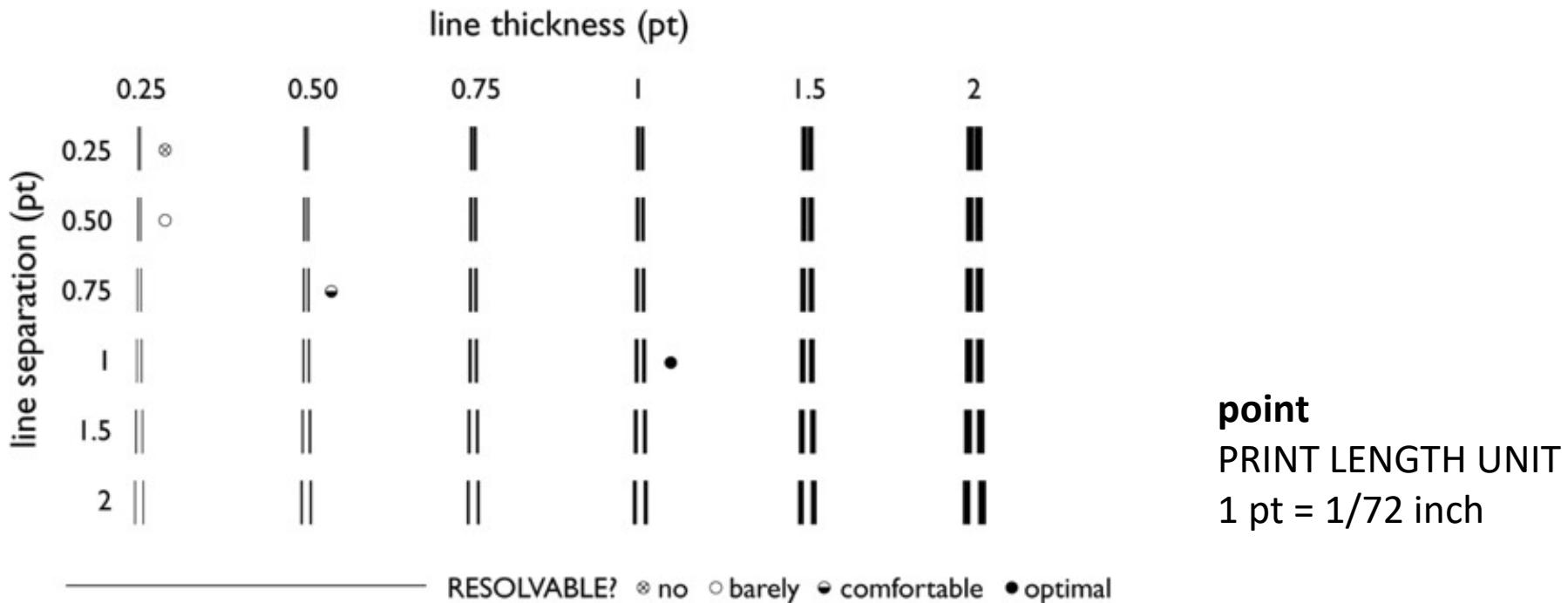
- The resolving power of the eye is approximately 50 cycles per degree (*see next slide*).
 - This limits us from distinguishing features smaller than 0.1 mm at a reading distance of 30 cm.
 - Larger features must be used to maintain legibility and comprehension. 1 point = $1/72$ inch = 0.0353 cm

Respect human limitations. Legibility

- Cycles per degree (aka **acuity**):
 - Spatial resolving capacity of the visual system
 - Ability of the eye to see fine detail
 - Refers to the highest resolution we can see with the fovea
- Each cycle represents an element we can see isolated:
 - Commonly taken as a line pair: a black and white strokes together
- Other acuity limits: <https://entokey.com/visual-acuity-2/>

Respect human limitations. Legibility

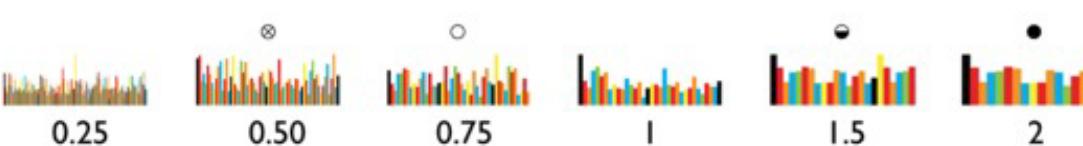
RESOLVING DETAIL



RESOLVING COLOR DIFFERENCES

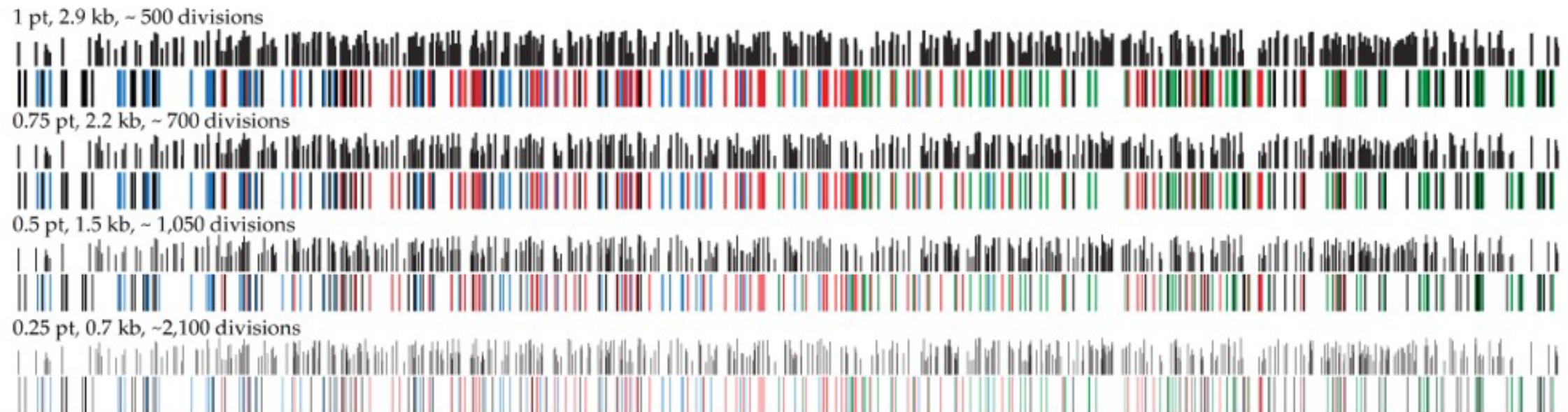


RESOLVING COMPLEX DATA TRACKS

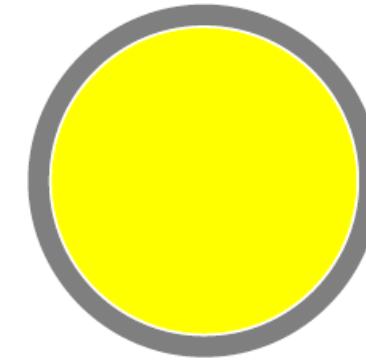
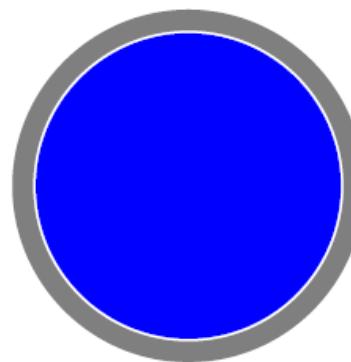


Respect human limitations. Legibility

- As a rule of thumb, do not divide scale into more than 500 intervals per 216mm (US letter size).
 - 1 pt on a 183 mm figure, 4 pixels on a 1920 horizontal resolution display, or 2 pixels on a typical LCD projector



Respect human limitations. Color



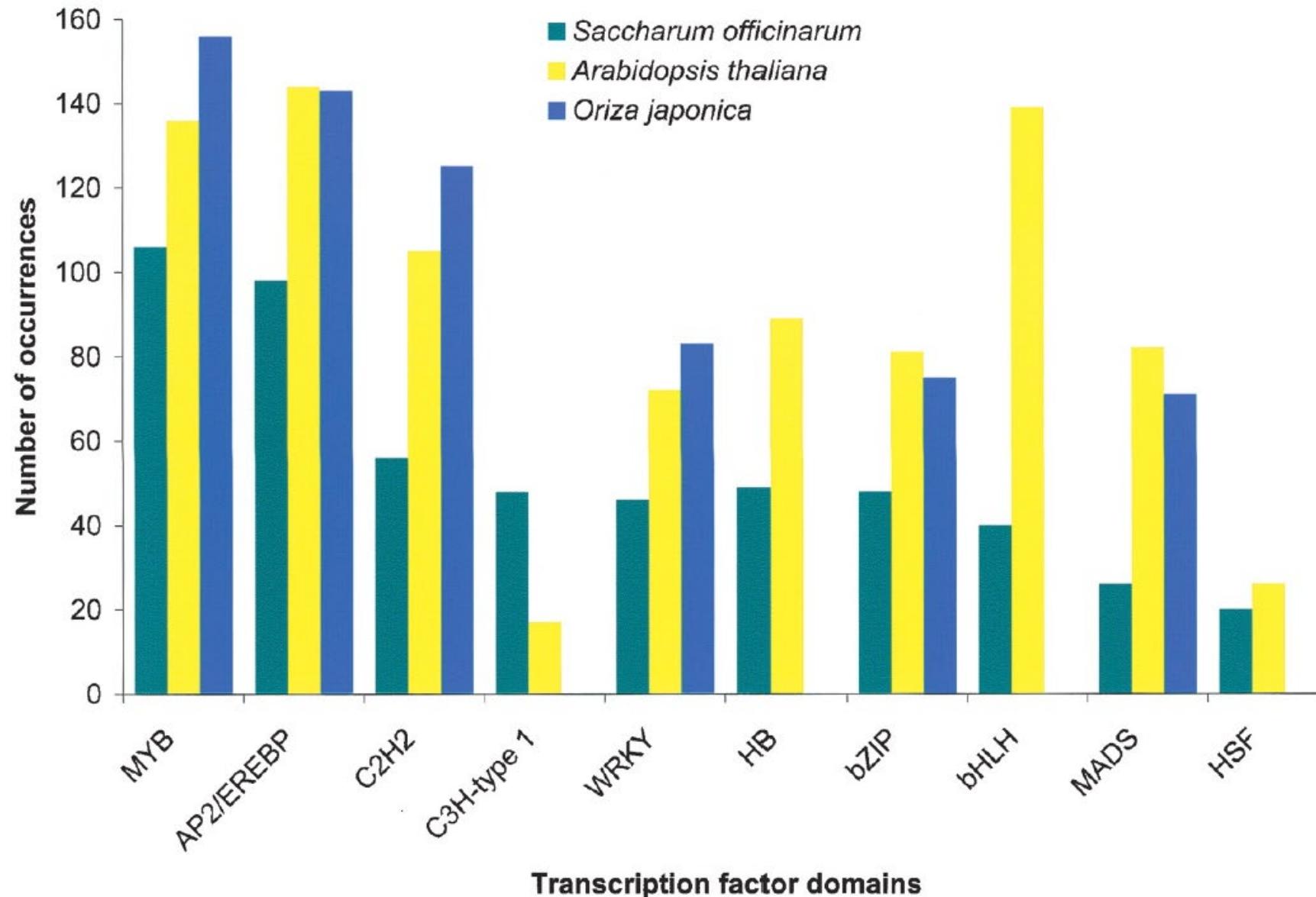
HSB COLOR SPACE

HUE	240	60
SATURATION	1	1
BRIGHTNESS	1	1

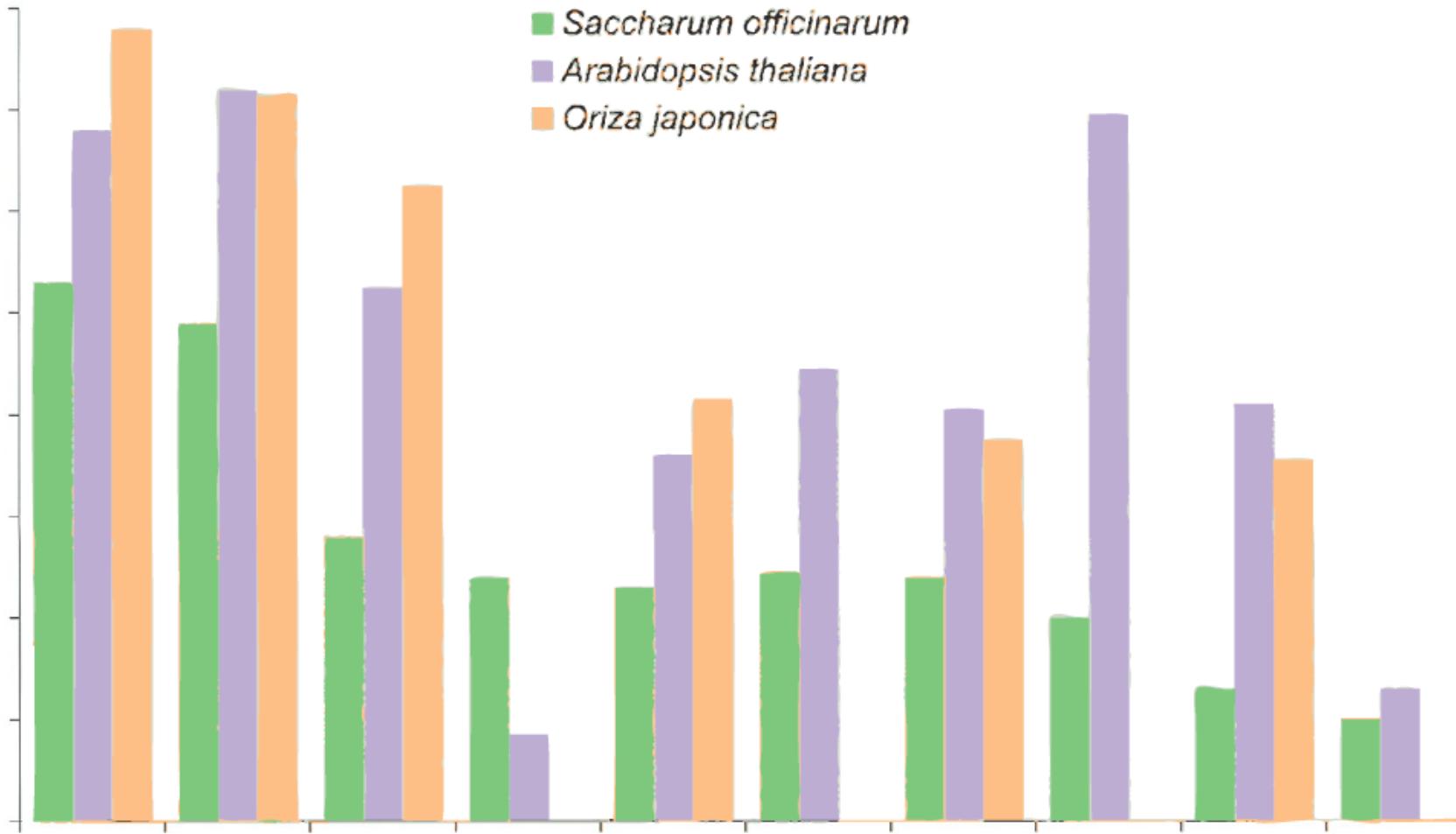
LCH COLOR SPACE

HUE	266	86
CHROMA	130	107
LIGHTNESS	0.32	0.97

Respect human limitations. Color



Respect human limitations. Color

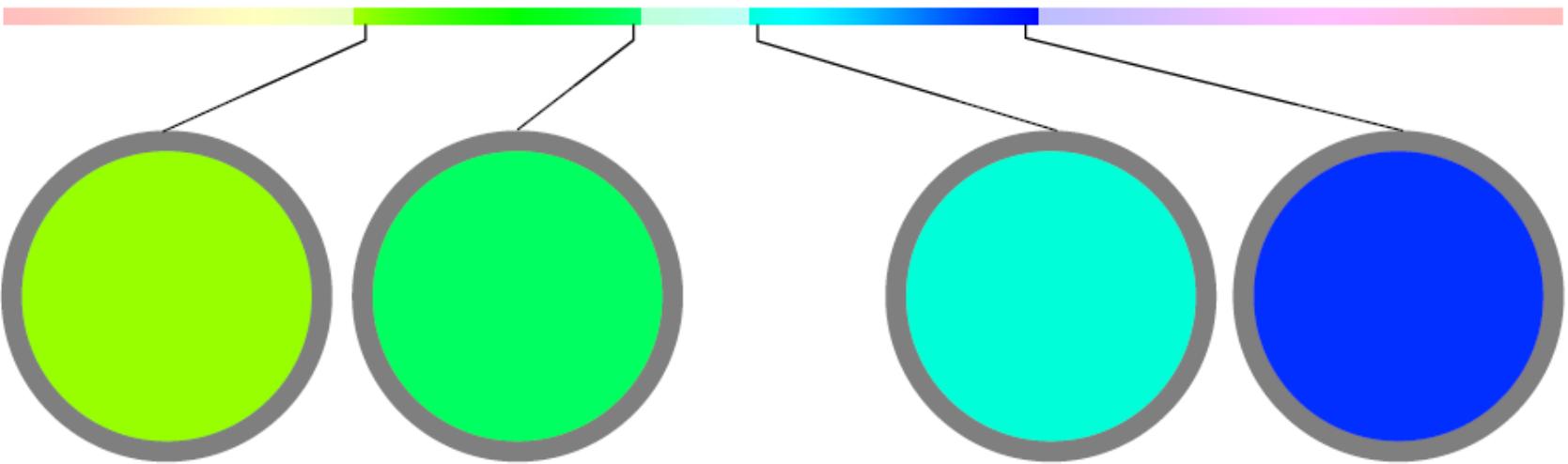


BREWER QUALITATIVE 3-COLOR PALETTES

ACCENT

PASTEL 1

SET 2



HSB COLOR SPACE

$\Delta H = 60$

$\Delta H = 60$

HUE	83	143	171	231
SATURATION	1	1	1	1
BRIGHTNESS	1	1	1	1

Lab COLOR SPACE

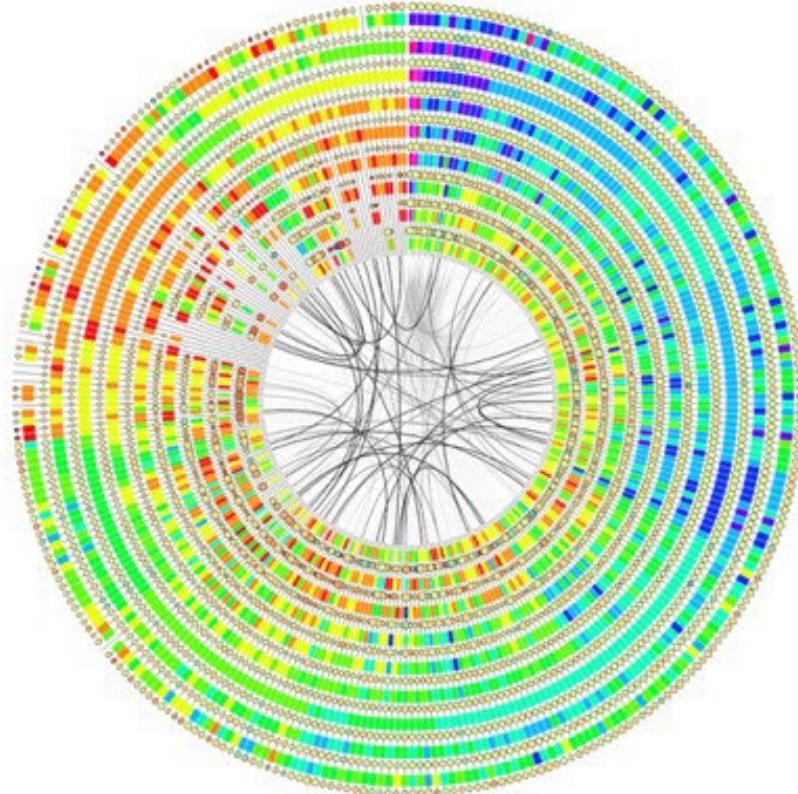
$\Delta E_{ab} = 35$

$\Delta E_{ab} = 176$

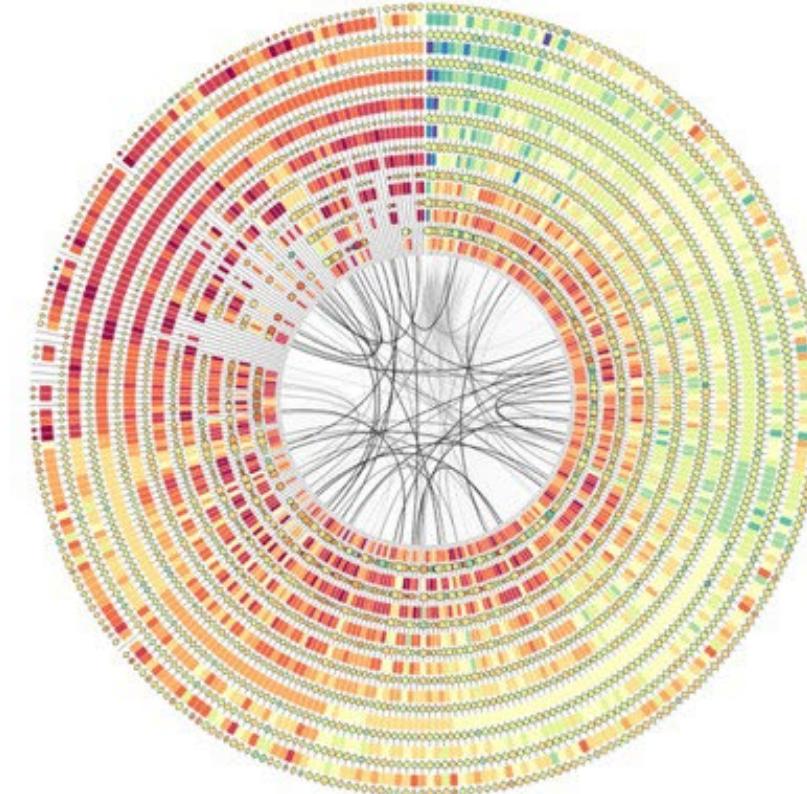
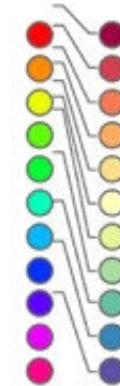
L	91	88	90	35
a	-59	-81	-58	70
b	87	60	4	-102

Respect human limitations. Color

UNIFORM HSB 11 COLOR PALETTE

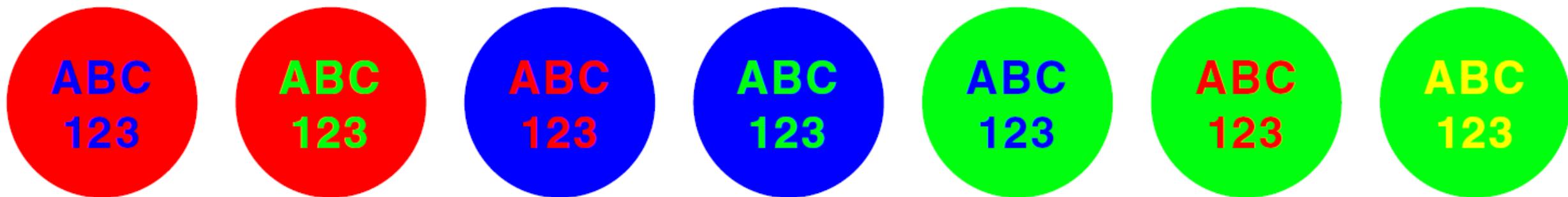


BREWER 11 COLOR SPECTRAL PALETTE



Respect human limitations. Contrast

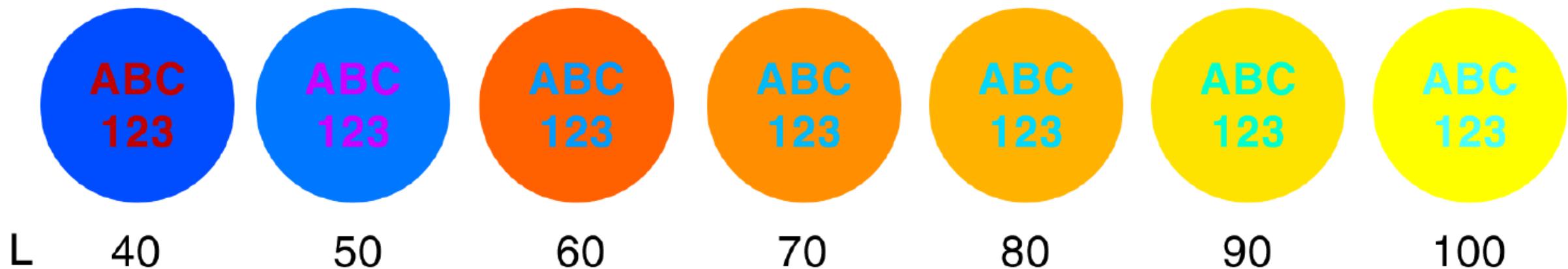
- Simultaneous contrast occurs when two pure colors are adjacent



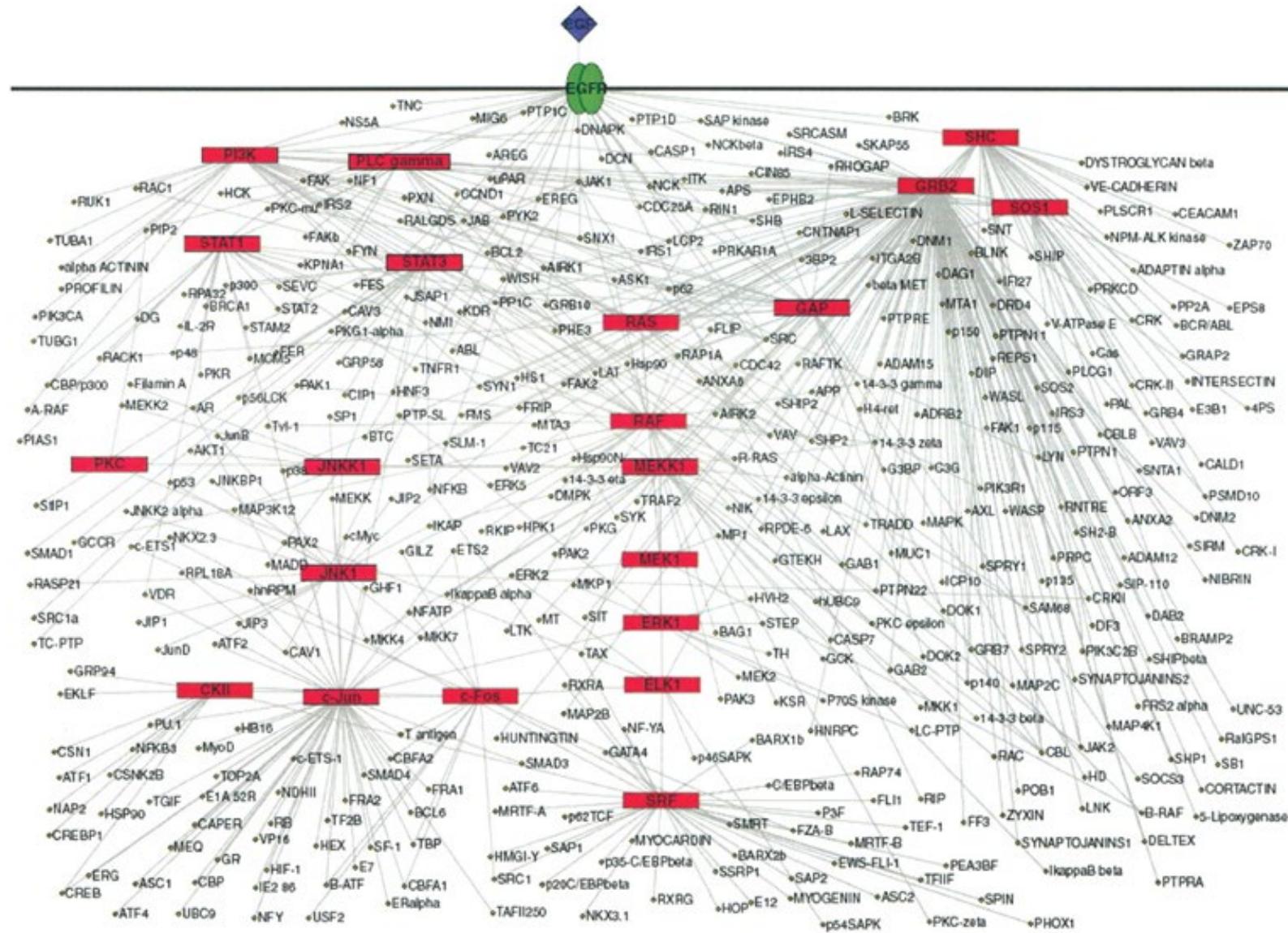
Respect human limitations. Contrast

- Poor contrast occurs when two colors have similar luminance (perceived brightness)

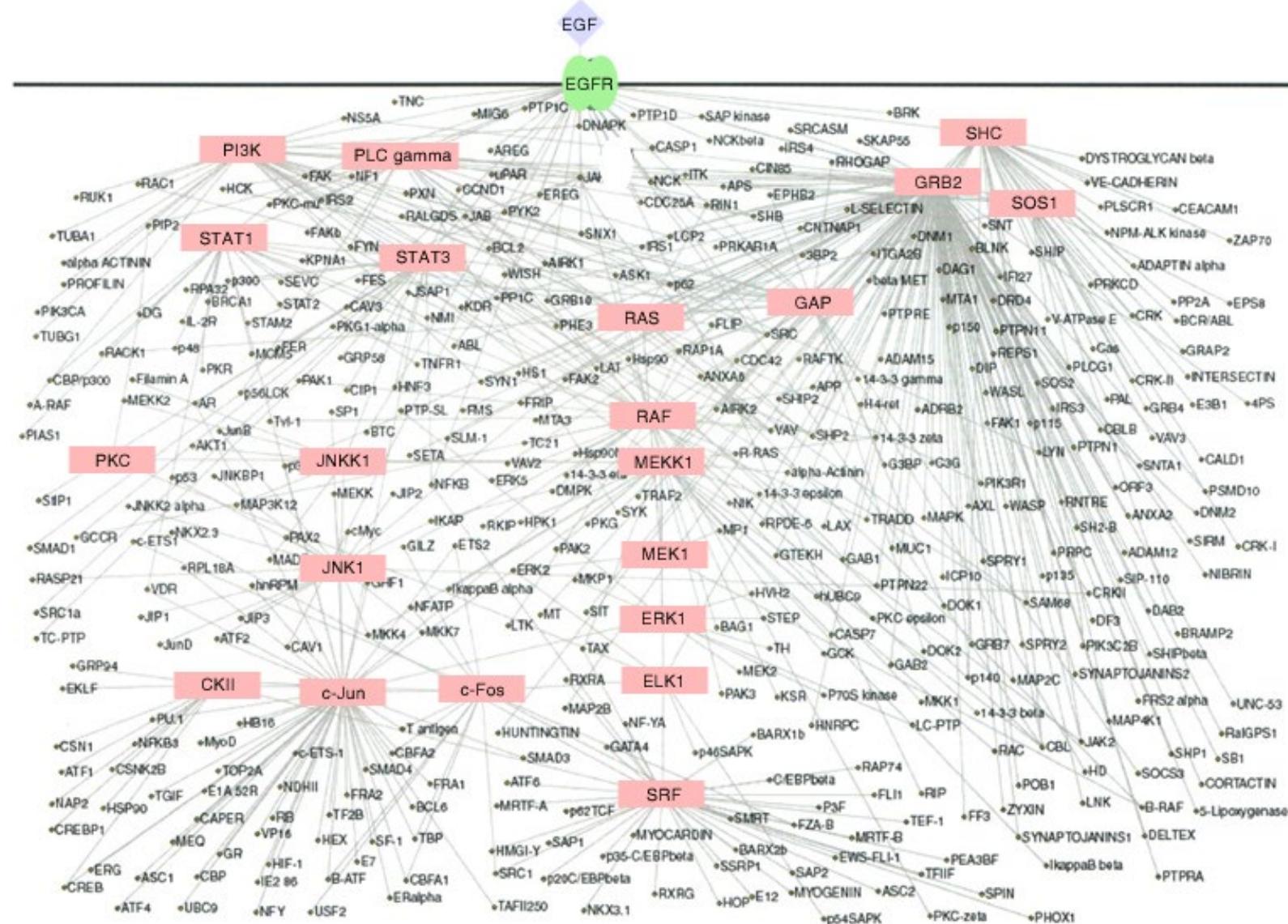
$$\Delta L = 0$$



Respect human limitations. Contrast



Respect human limitations. Contrast



Effective Visualizations

- More specific principles
 - Data informs variation
 - Consistency
 - Avoid redundancy
 - Conciseness
 - Remove to improve
 - Focus & emphasis
 - Attractiveness

Data informs variation

#PactosdelalInfamia

SANT VICENÇ DE CASTELLET



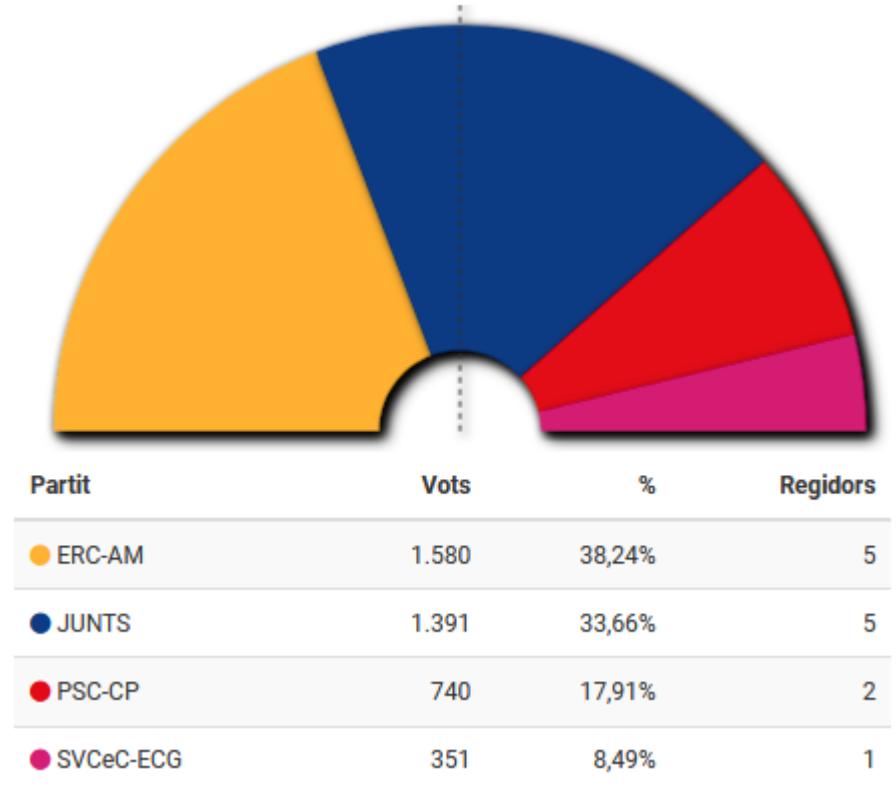
Data informs variation

#PactosdelalInfamia

SANT VICENÇ DE CASTELLET

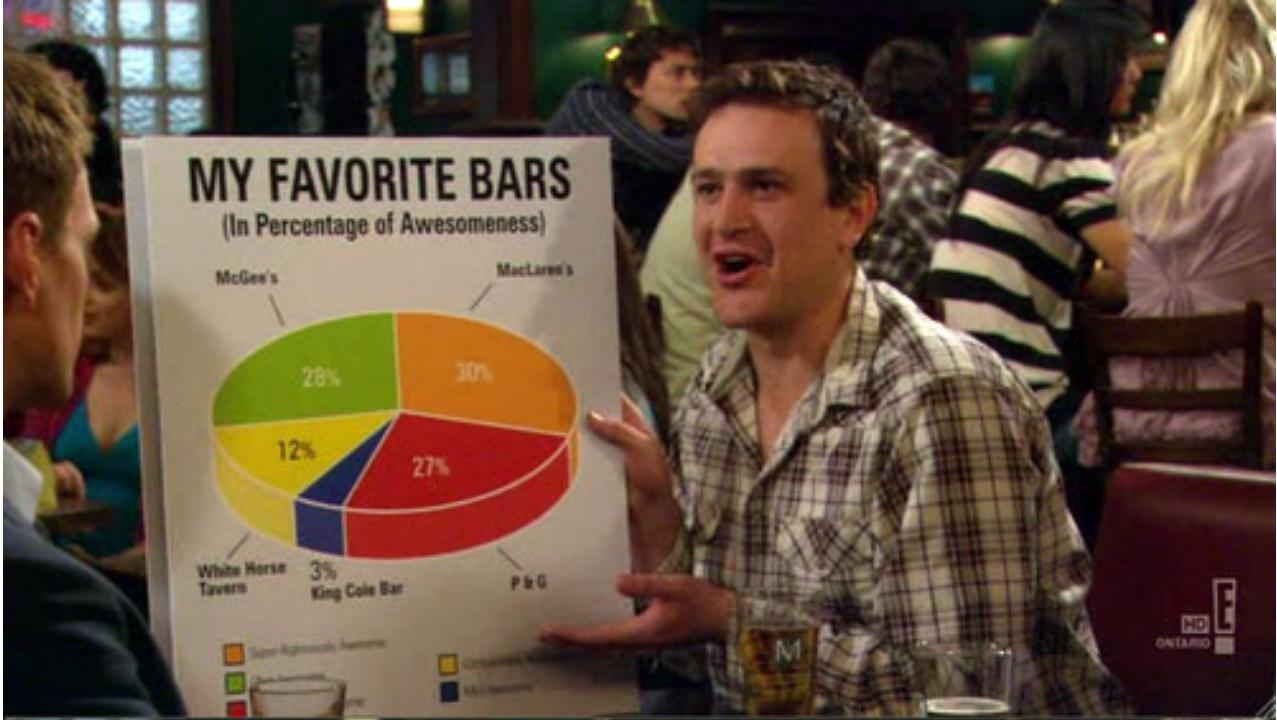


Sant Vicenç de Castellet 2019 (100,00% escrutat)



Consistency

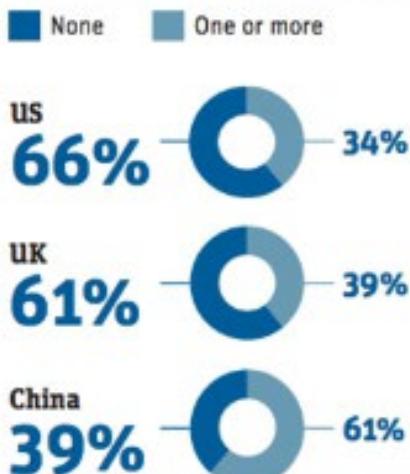
- Consistency implies color, shapes, etc.



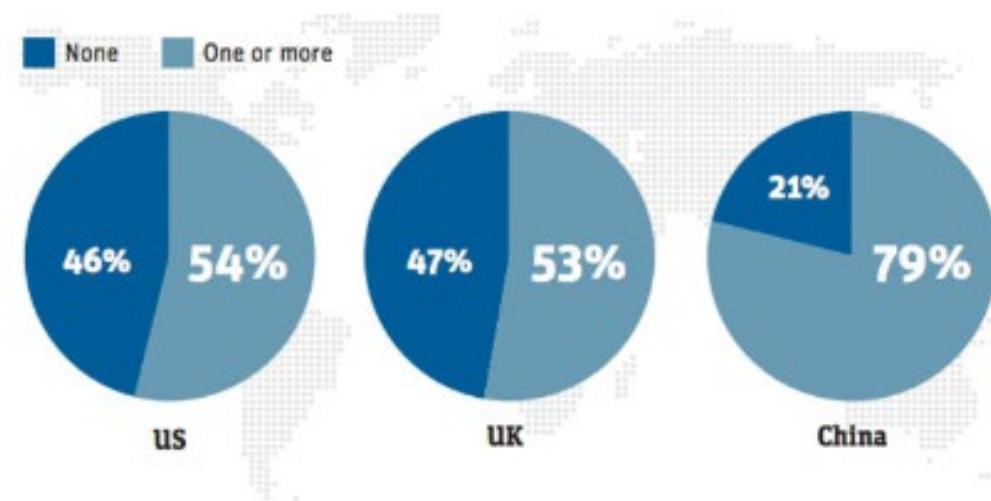
<https://www.webdevelopmentgroup.com/2015/05/data-visualization-best-practices/>

Consistency

How many women are on your board of directors?



How many women are in your C-suite?



Do you have programs in place to increase the number of women in leadership positions?



View the complete Startup Outlook 2016 report at svb.com/leo

<https://www.fastcompany.com/4011394/china-beats-the-u-s-when-it-comes-to-female-startup-leaders>

Consistency

China leads when it comes to female startup leaders with 79% of Chinese startups having one or more women in the C-Suite

How many women directors do you have on the board?

US



UK



CHINA



How many women are in your C-Suite?

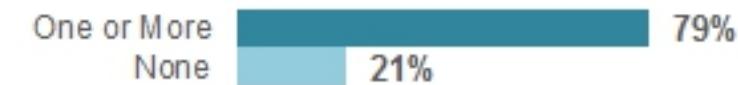
US



UK



CHINA



Do you have programs in place to increase the number of women in leadership positions?

US



UK



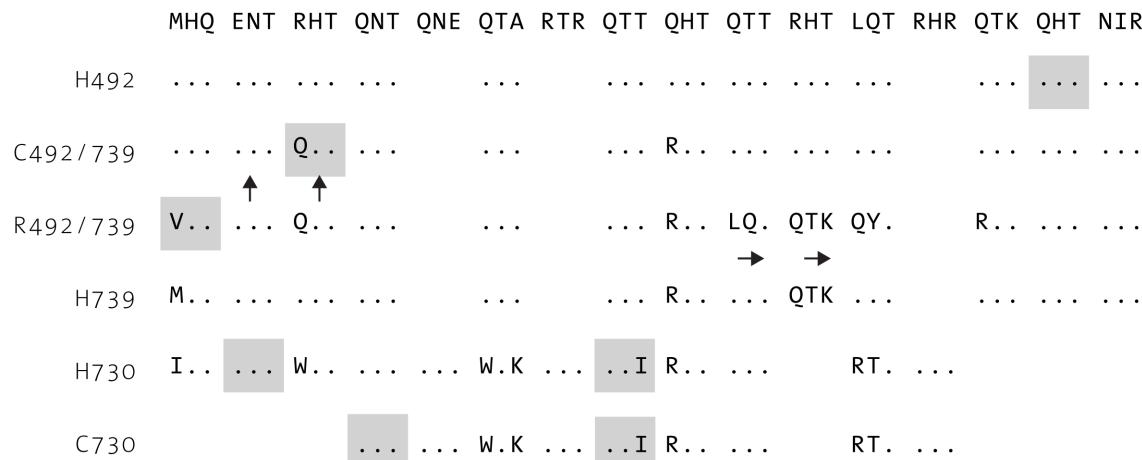
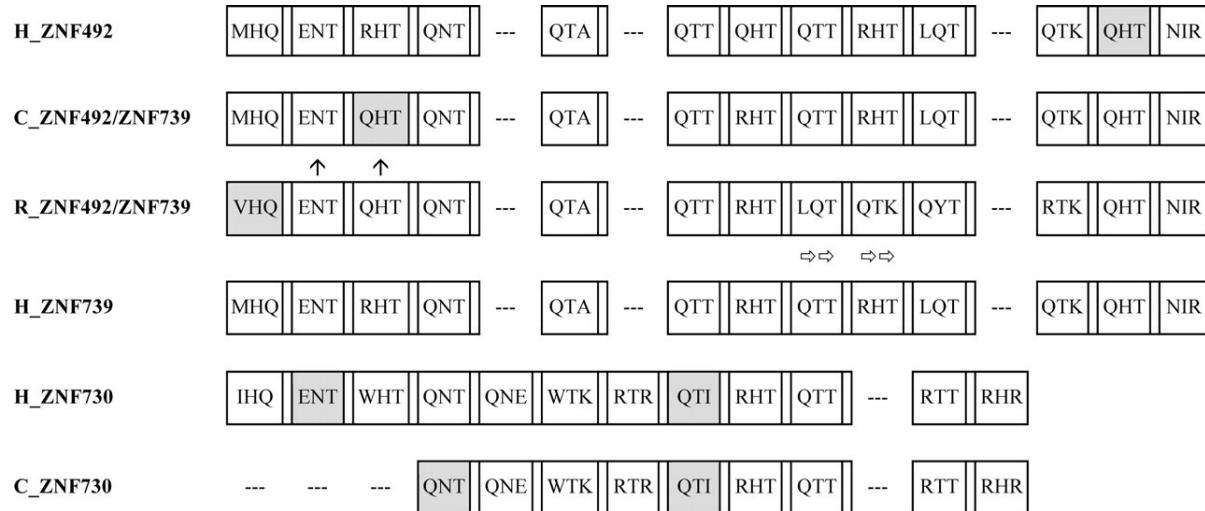
CHINA



Source: Silicon Valley Bank, Startup outlook 2016

<https://daydreamingnumbers.com/blog/consistency-in-charts/>

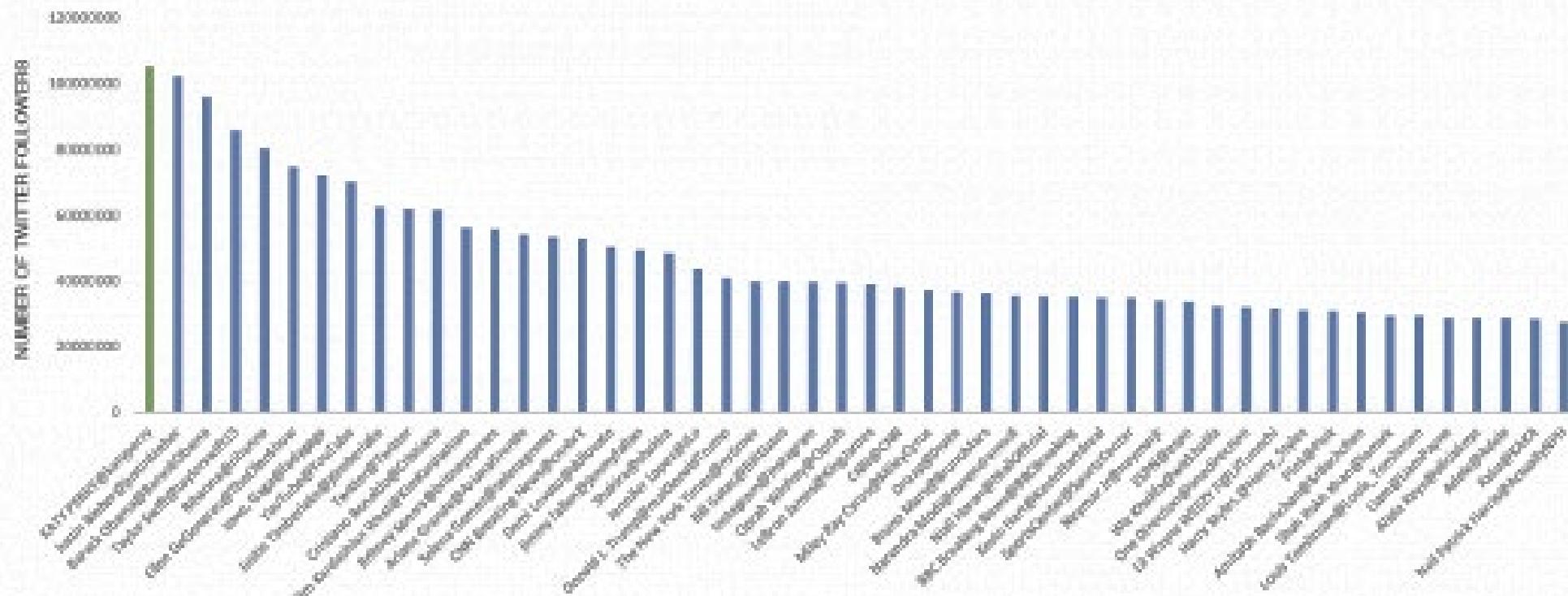
Avoid redundancy



Zinc finger exon analysis for ZNF493 and ZNF738, two divergent genes from the ZNF431 clade. Hamilton, A.T., et al., Evolutionary expansion and divergence in the ZNF91 subfamily of primate-specific zinc finger genes. Genome Res, 2006. 16(5): p. 584-94.

Conciseness

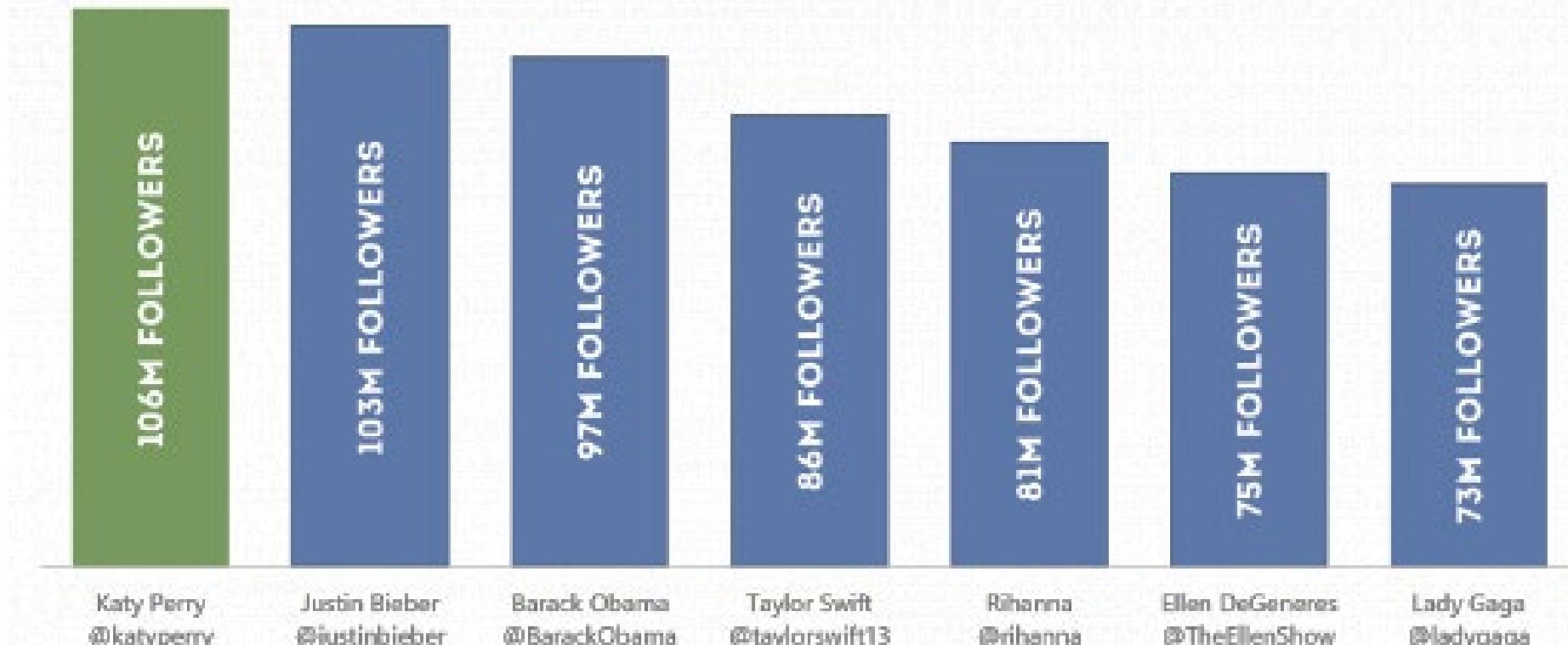
HOW POPULAR IS KATY PERRY ON TWITTER?



<https://www.ellenfinkelstein.com/pptblog/a-simple-4-step-guide-to-beautifully-visualize-data-in-your-presentations/>

Conciseness

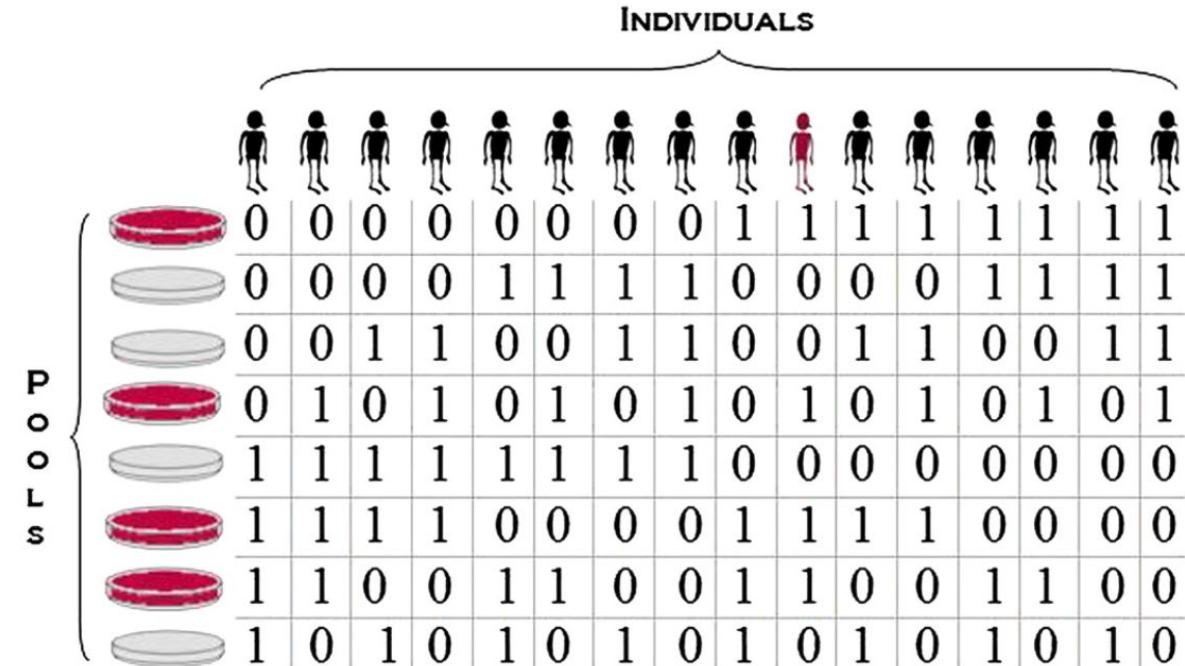
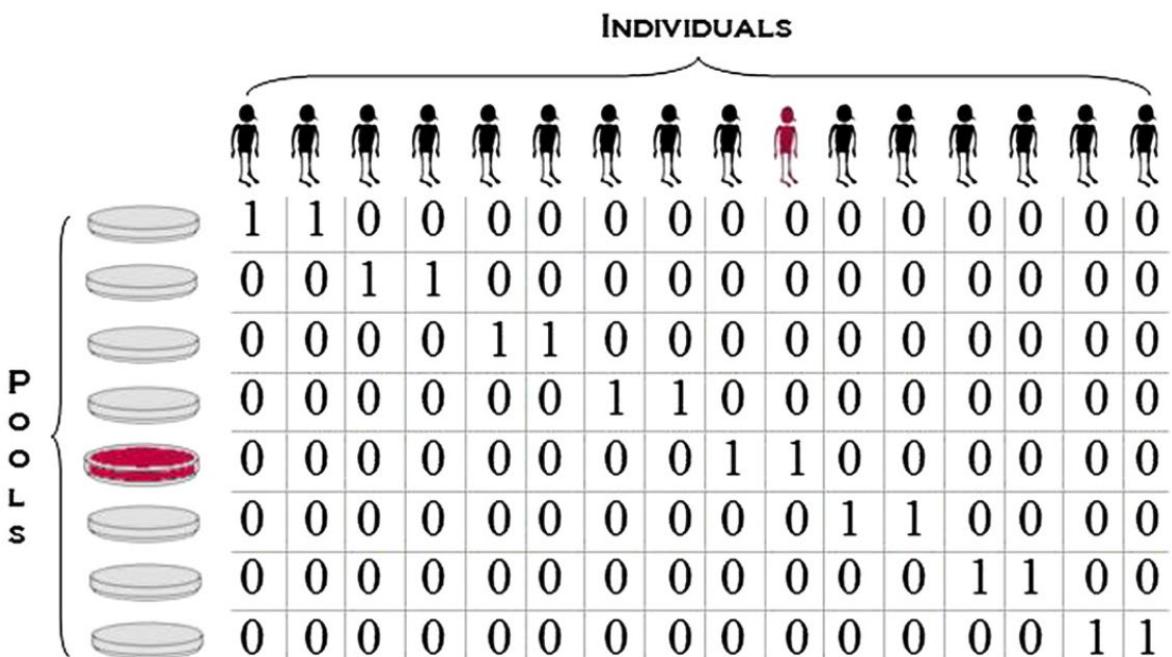
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<https://www.ellenfinkelstein.com/pptblog/a-simple-4-step-guide-to-beautifully-visualize-data-in-your-presentations/>

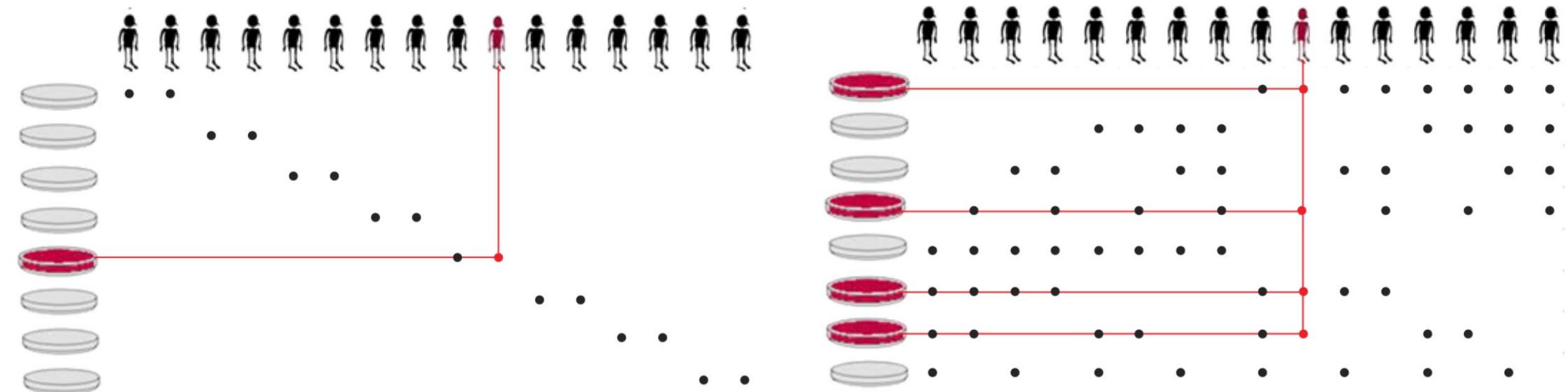
Remove to improve

- Excess ink competes with message



Remove to improve

- Excess ink competes with message

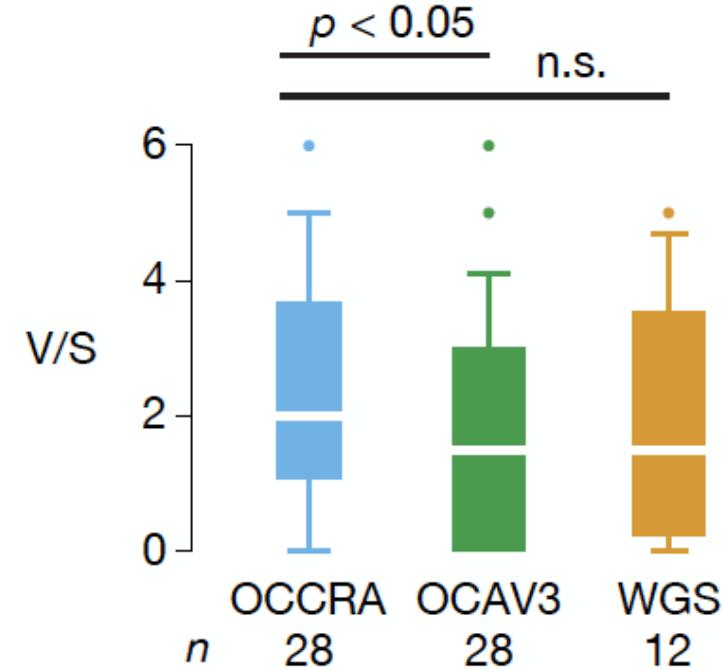
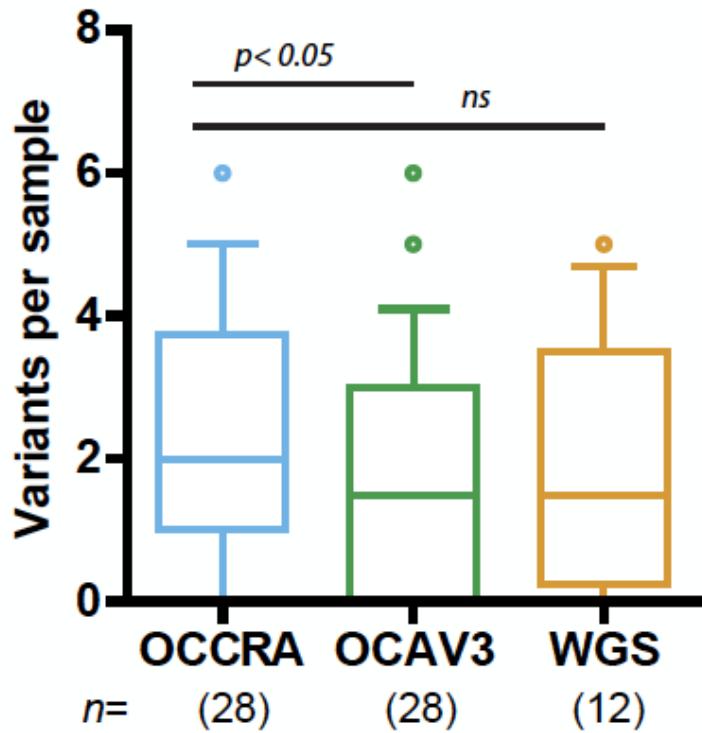


Resequencing with naïve and log pool designs. Prabhu, S. and I. Pe'er, Overlapping pools for high-throughput targeted resequencing. *Genome Res*, 2009. 19 (7): p. 1254-61.

Focus and emphasis

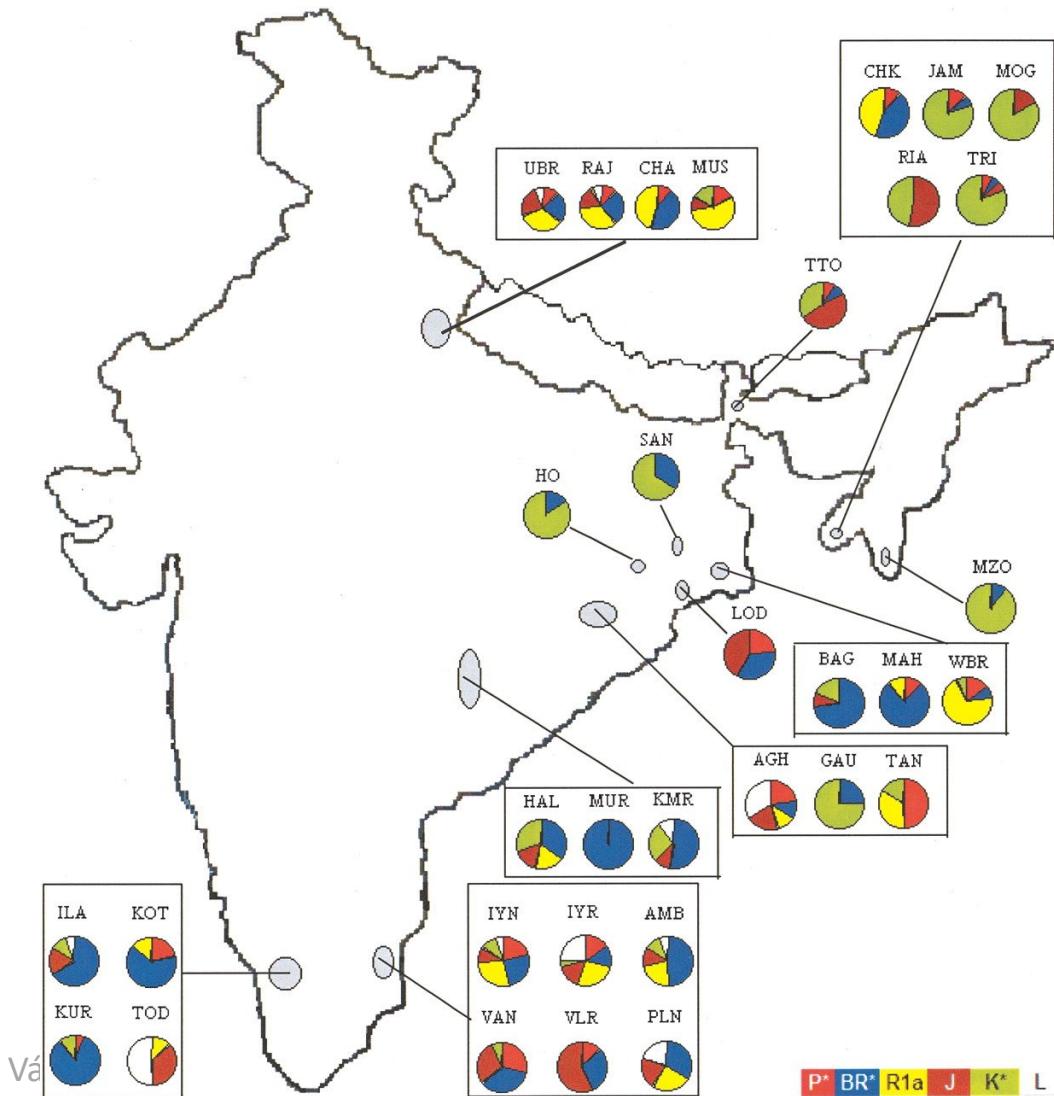
- Match the pertinence of an object with its visual salience
 - Which also means removing salience of non-important elements
- Apply visual organization Gestalt principles

Focus and emphasis



Attractiveness

- The importance of grids



Frequencies (%) of Y-chromosomal haplogroups among ethnic populations. Basu, A., et al., Ethnic India: a genomic view, with special reference to peopling and structure. *Genome Res*, 2003. 13(10): p. 2277-90..

Attractiveness

- The importance of grids
 - Redesign



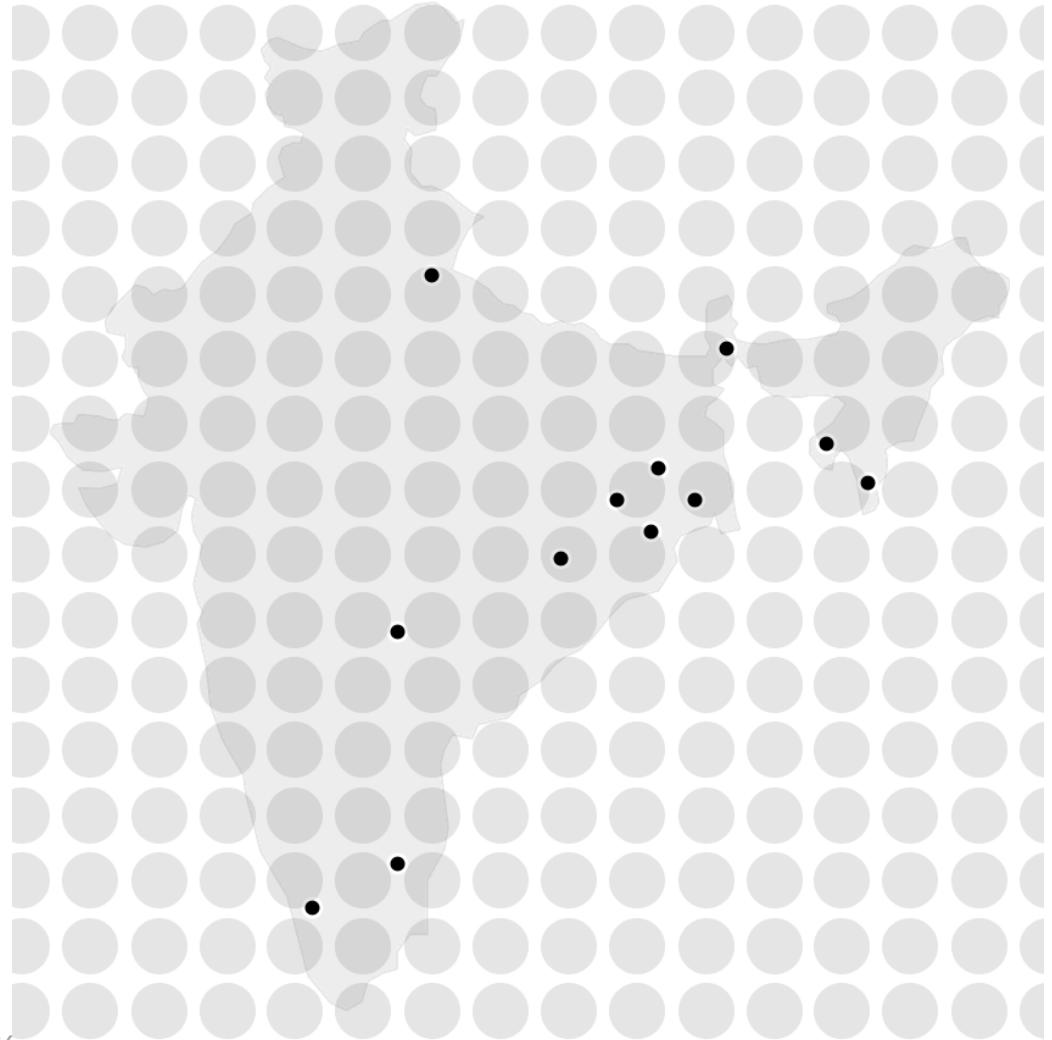
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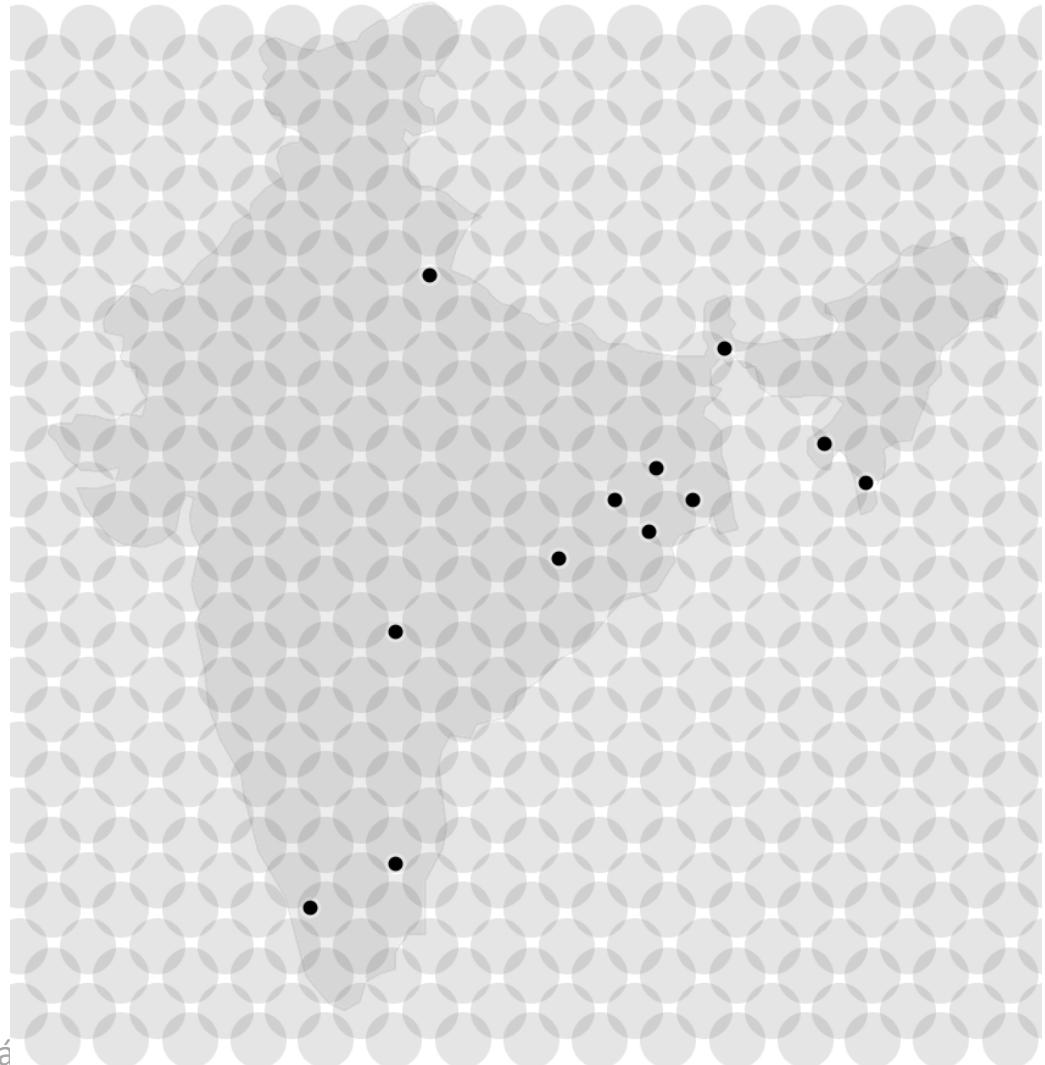
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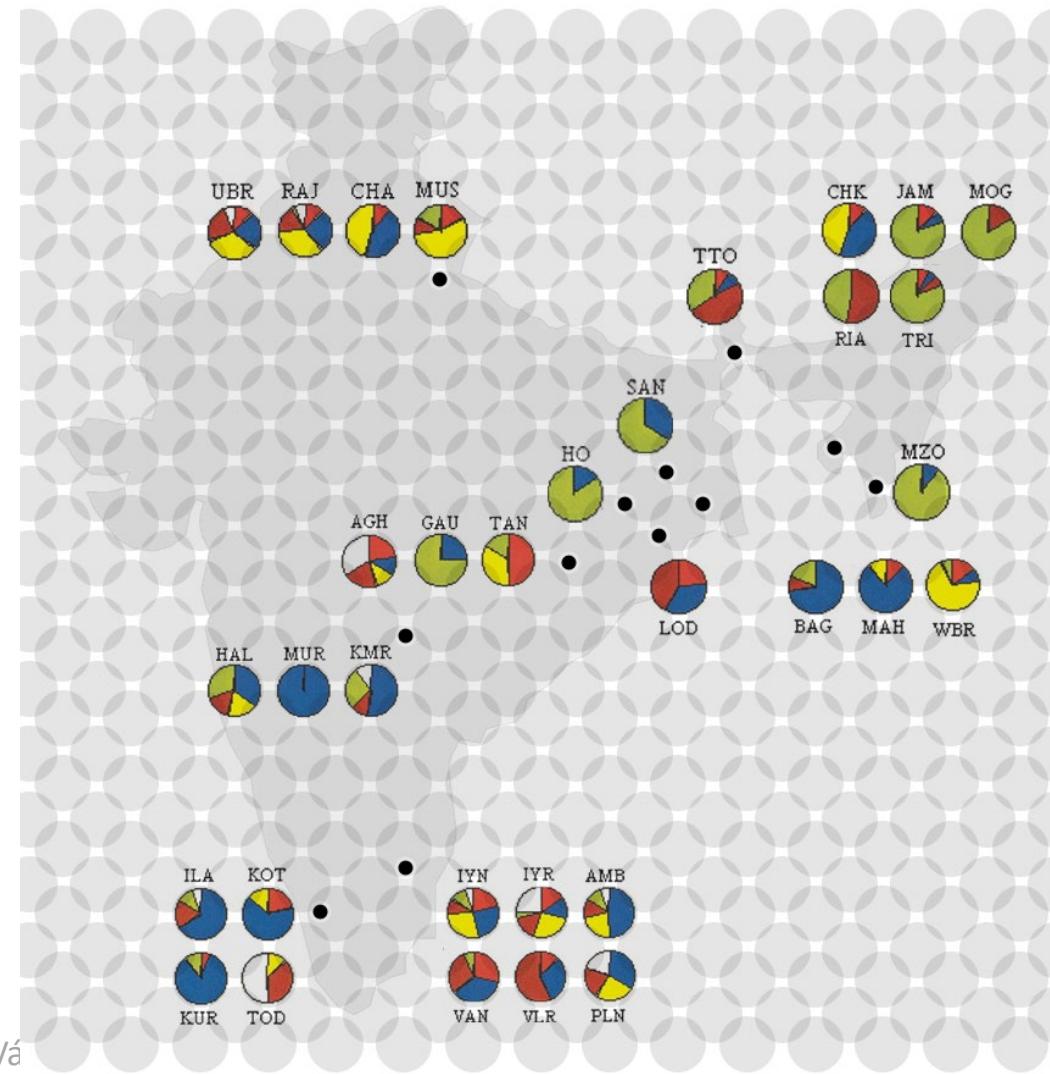
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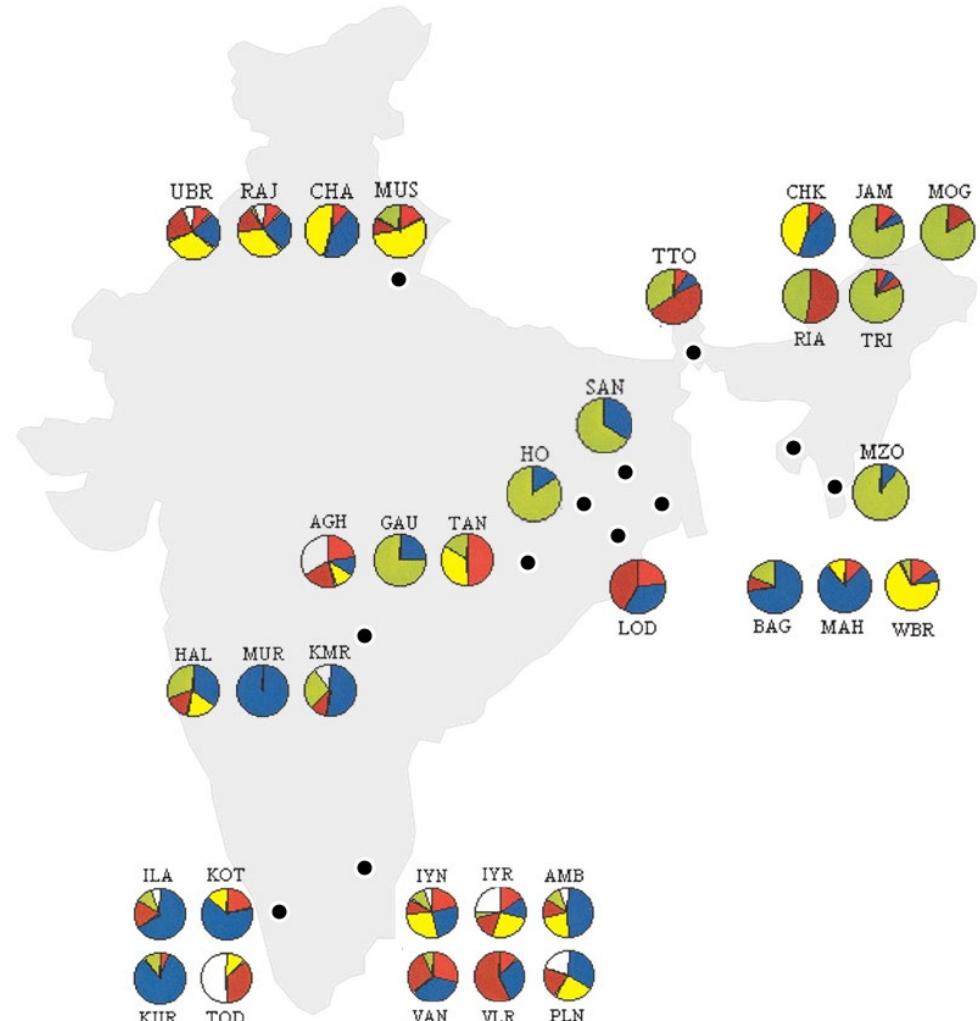
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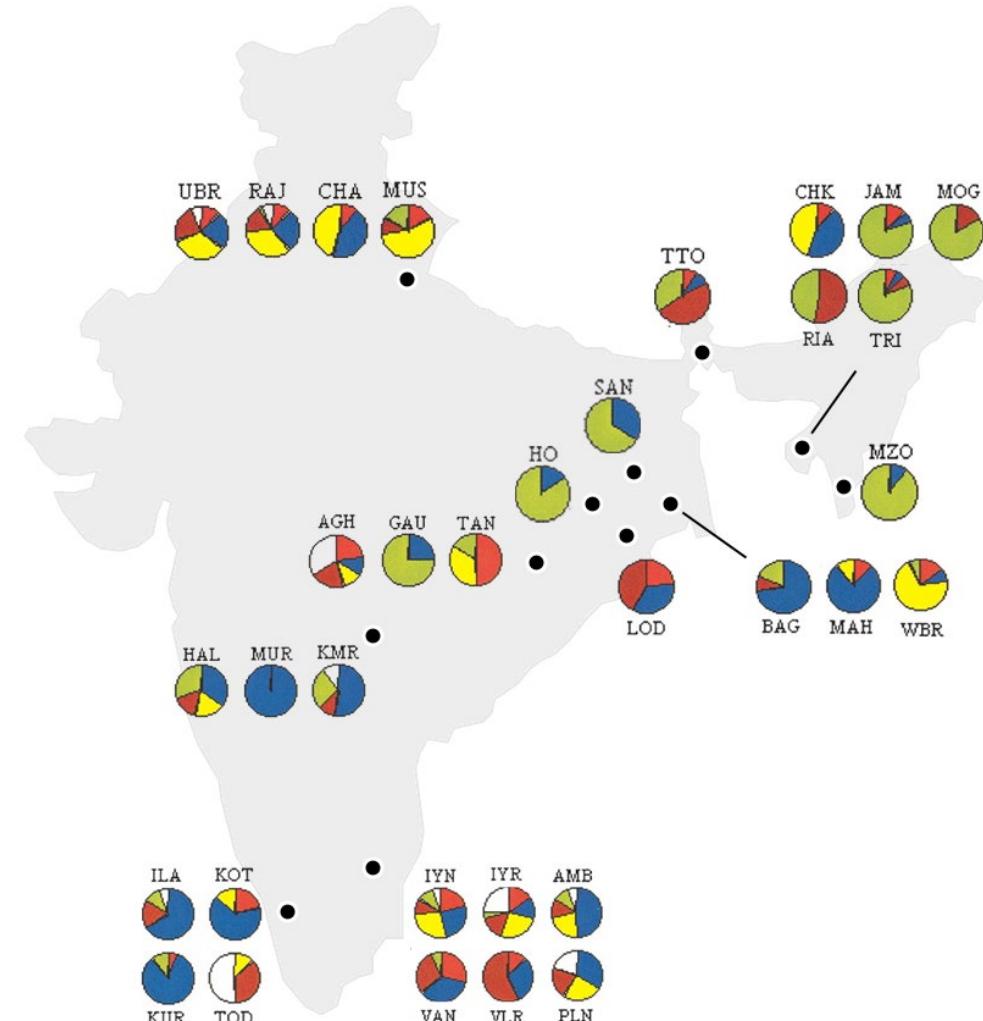
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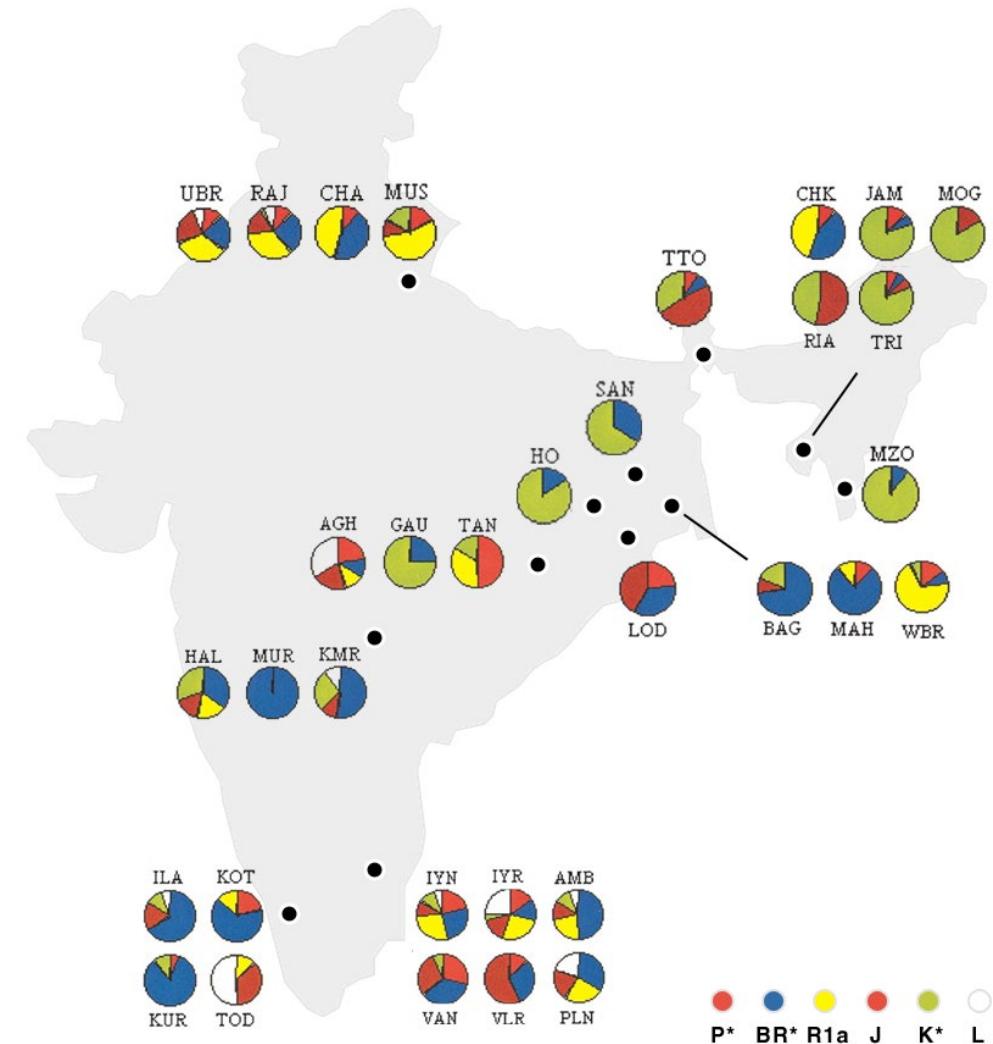
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 - Redesign

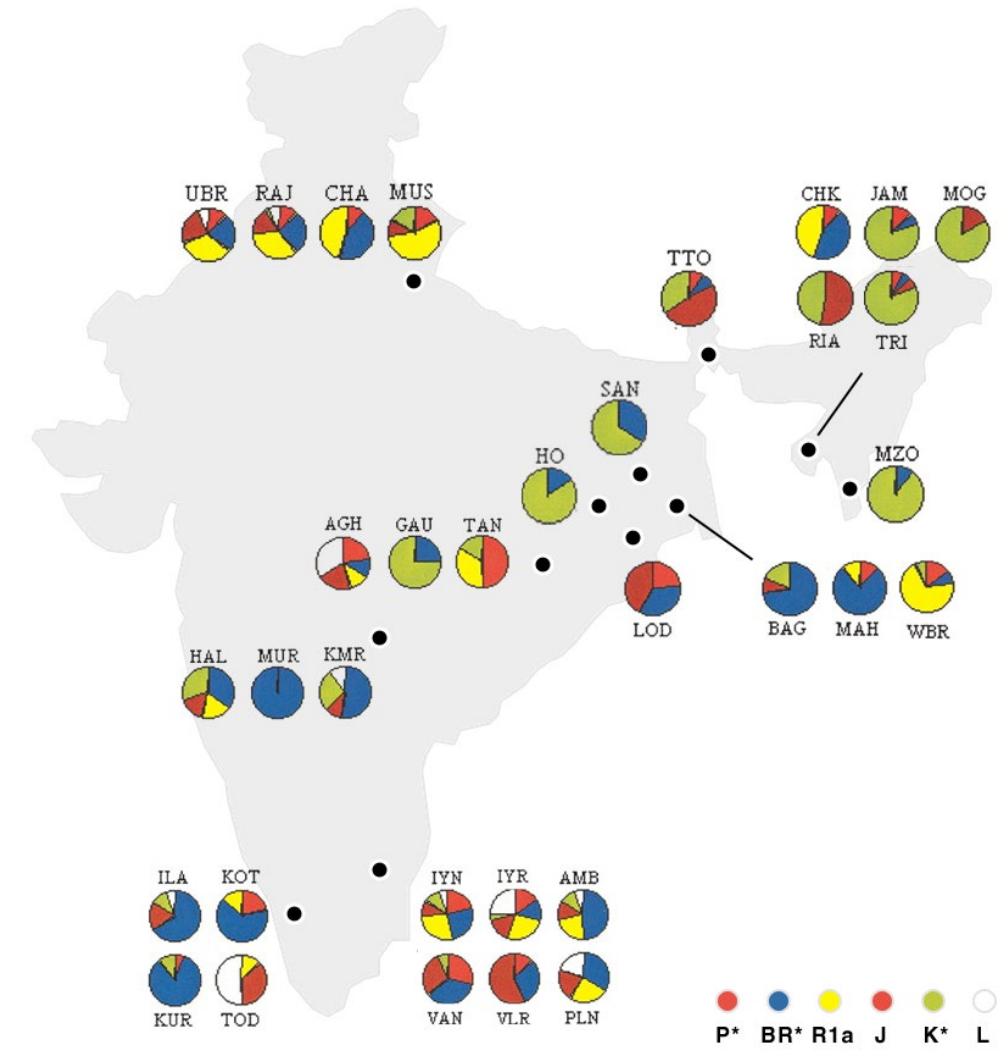
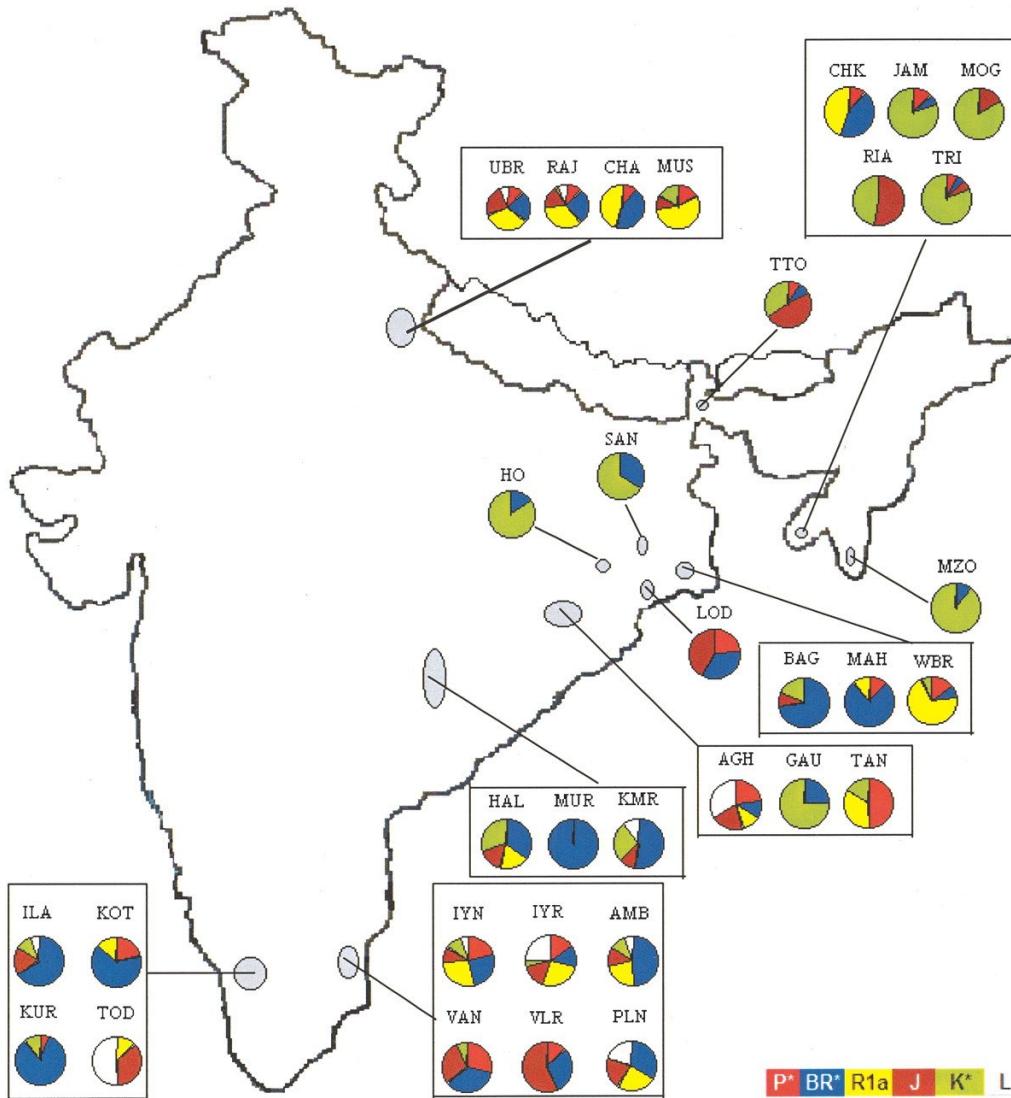


Attractiveness

- The importance of grids
 - Redesign



Attractiveness



Outline

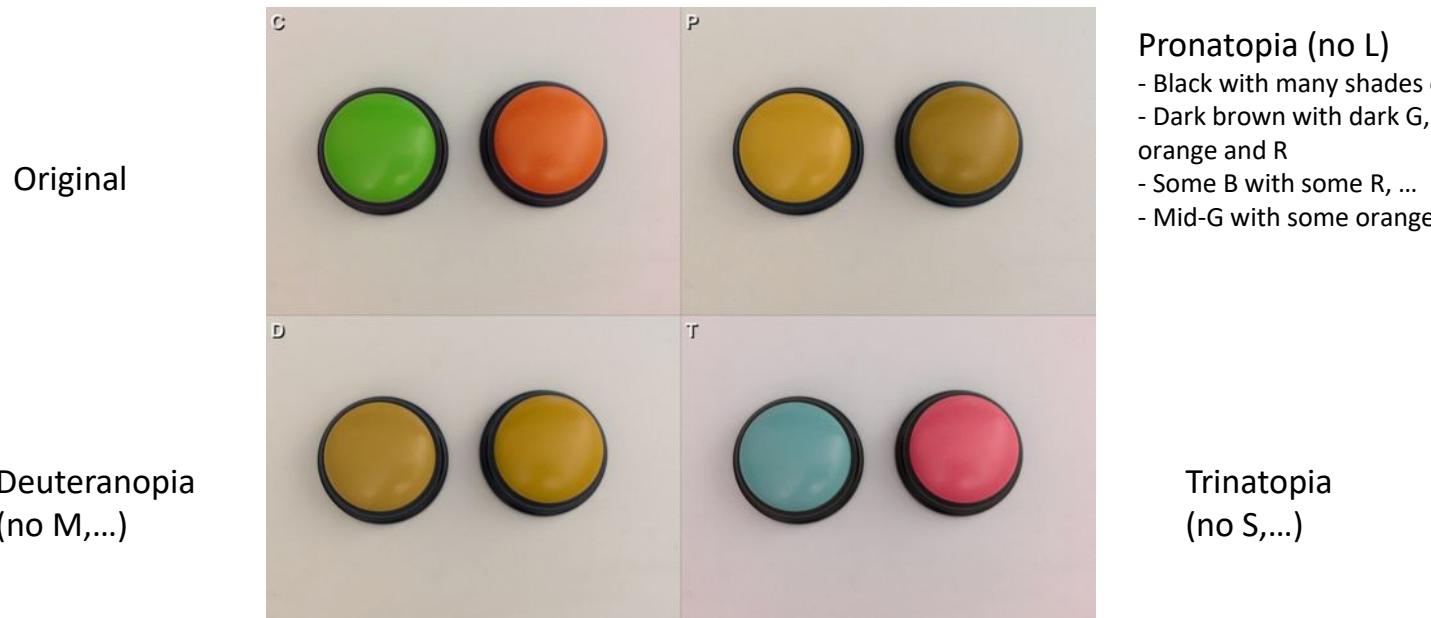
- *Effective Visualizations*
- **Use of color**
- Comparison
- Copy & labels
- Ordering & aligning data

Use of Color. Background

- Color blindness:
 - Inability to distinguish the colors the same way than non-color impaired people
- Most common types of colour blindness are:
 - **Deutanopia (M cones):** Reduced sensitivity to green light.
 - **Protanopia (L cones):** Reduced sensitivity to red light.
 - **Tritanopia (S cones):** Reduced sensitivity to blue light, not very common.
 - **Achromatopsia:** Cannot see any colour at all. Also not very common.

Use of Color. Background

- Color blindness simulation (affects the three channels):

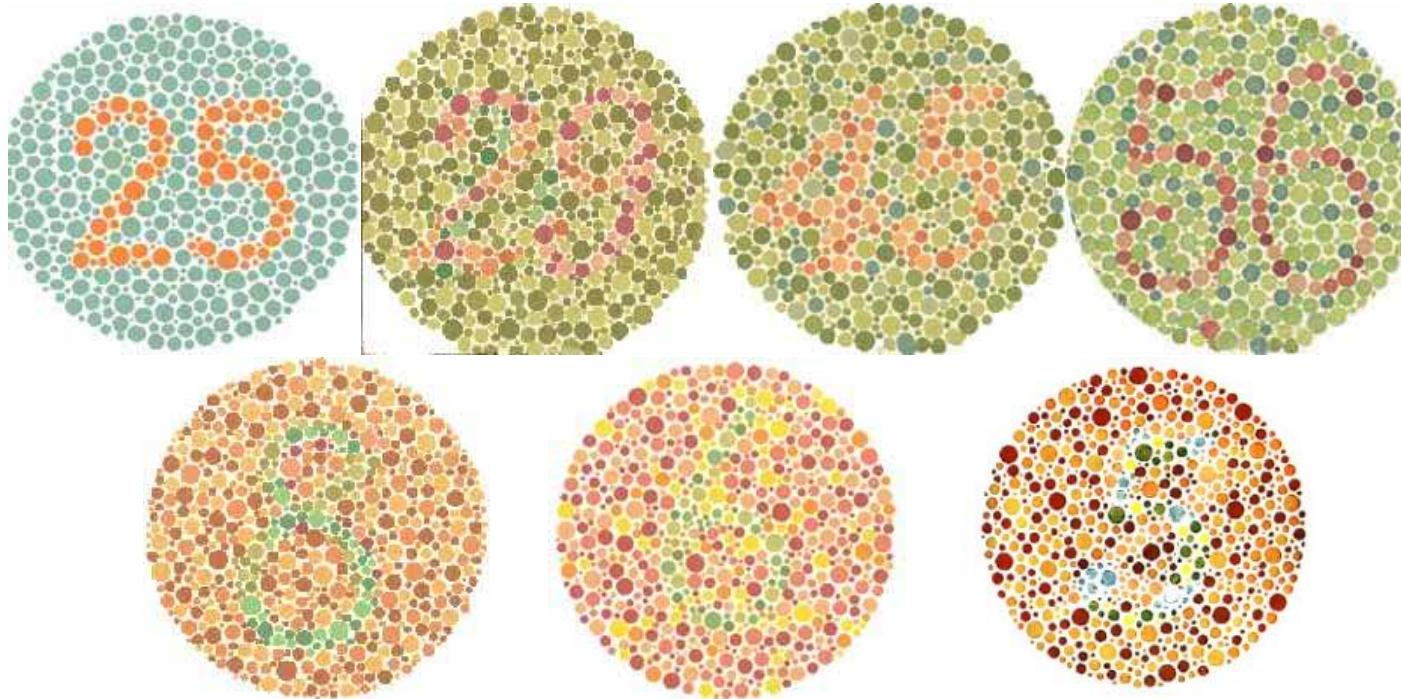


Use of Color. Background

- Color blindness:
 - Inability to distinguish the colors the same way than non-color impaired people
 - 5-10% of men
 - 1-2% of women
 - Relatively easy to detect
 - Ishihara tests

Use of Color. Background

Ishihara test images



Use of Color. Background

- Other vision problems:
 - About 4% of the population have low vision (0.6% are blind)
 - Low-vision conditions increase with age
 - Half of people over 50 have some degree of low-vision condition
 - Worldwide, the fastest-growing population is 60+ years
 - Over 40, almost everyone needs corrected vision to clearly see small objects or text
 - Age-related vision problems include macular degeneration, diabetic retinopathy, cataracts, and retinitis pigmentosa

Use of Color. Background

- Supporting packages and webpages:
 - **Colorblindor:** Color-blindness simulator. <http://www.color-blindness.com/coblis-color-blindness-simulator/>
 - **Chromatic Vision Simulator:** Simulates three forms of colour deficiencies: Protanopia, Deutanopia and Tritanopia.
 - Available for Android and iOS
 - **VisionSim:** Developed by the Braille Institute. It simulates a variety of low-vision conditions.
 - Available for Android and iOS

Use of Color. Background

- Size and spatial frequency are also important in perception
 - The higher the spatial frequency the lower the saturation
 - e.g. chessboard
- Chromatic adaptation:
 - Illumination changes affect the colours dramatically
 - Human perception adapts to changes
 - Does not perceive those changes linearly



Use of Color. Background

- Color friendly design (most concepts based on HSV model):
 - Few colors. Similar colors should infer a similarity among objects
 - p.e. red for error, green for success, yellow for alert, blue information
 - Avoid using adjacent strongly saturated colors
 - Contrast dark colors against light colors
 - Content areas should be monochromatic with the font color and background at the opposite ends of the color saturation poles
 - Elements of navigation, headers and sub-headers, require some extra visual enhancement

Use of Color. Tips for color selection

- Color design rules:
 - Use color only when needed to serve a particular communication goal.

Use of Color. Tips for color selection

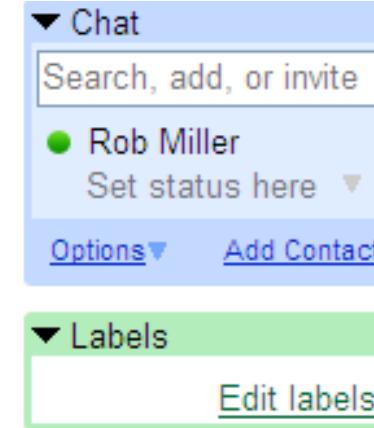
- Use small number of colors (hues). Use color only when needed to serve a particular communication goal.



- Many colors appears more complex
- More difficult perception
- More effective: one hue, weakly saturated and combined with black/white/gray

Use of Color. Tips for color selection

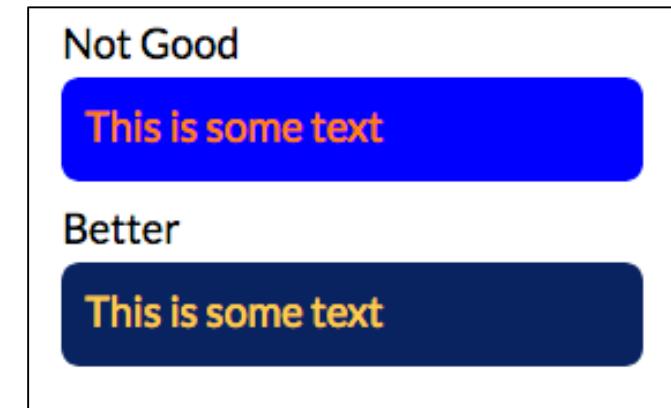
- Avoid strongly saturated colors



- They can cause visual fatigue
- More effective: “pastel” colors

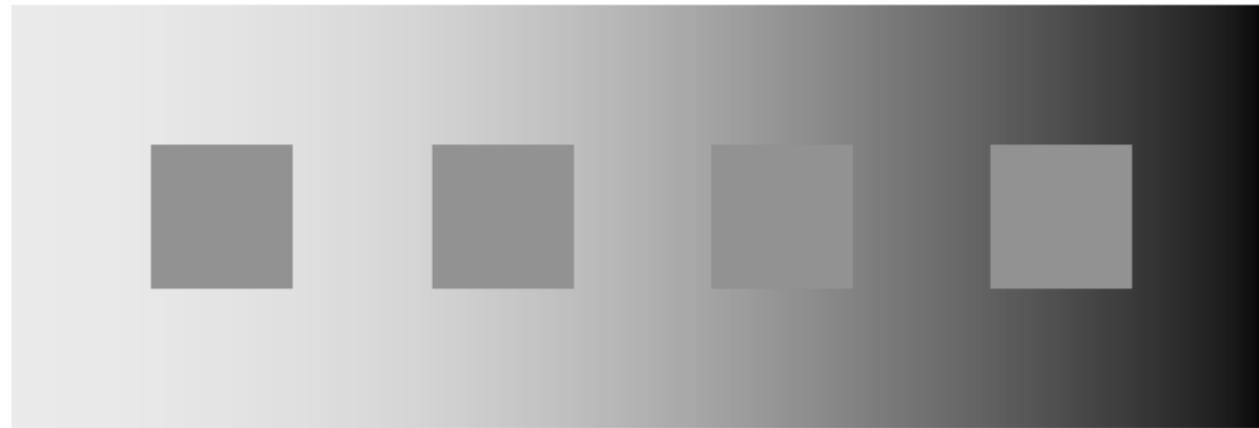
Use of Color. Tips for color selection

- Color usage rules:
 - If you want objects to be easily seen, use a background color that contrasts sufficiently with the object
 - For text is usually needed a combination of contrast of Hue + V & S
 - Contrast “dark” (high S, Low V) with “light” colors (Low S, high V)



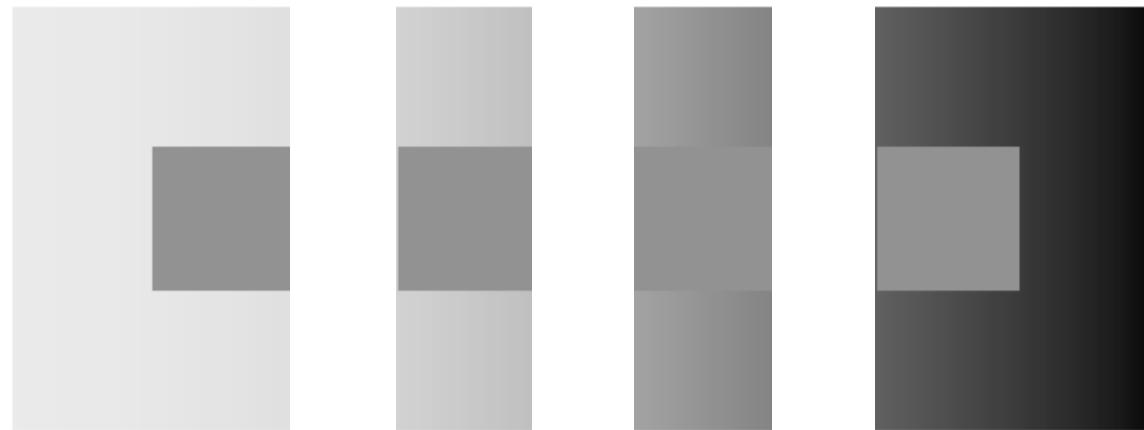
Use of Color. Tips for color selection

- Color usage rules:
 - If you want different objects of the same color to look the same, make sure that the background -the color that surrounds them- is consistent



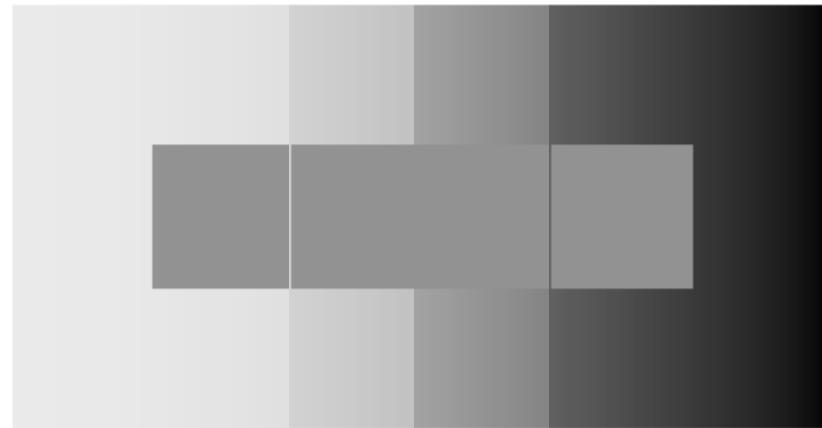
Use of Color. Tips for color selection

- Color usage rules:
 - If you want different objects of the same color to look the same, make sure that the background -the color that surrounds them- is consistent



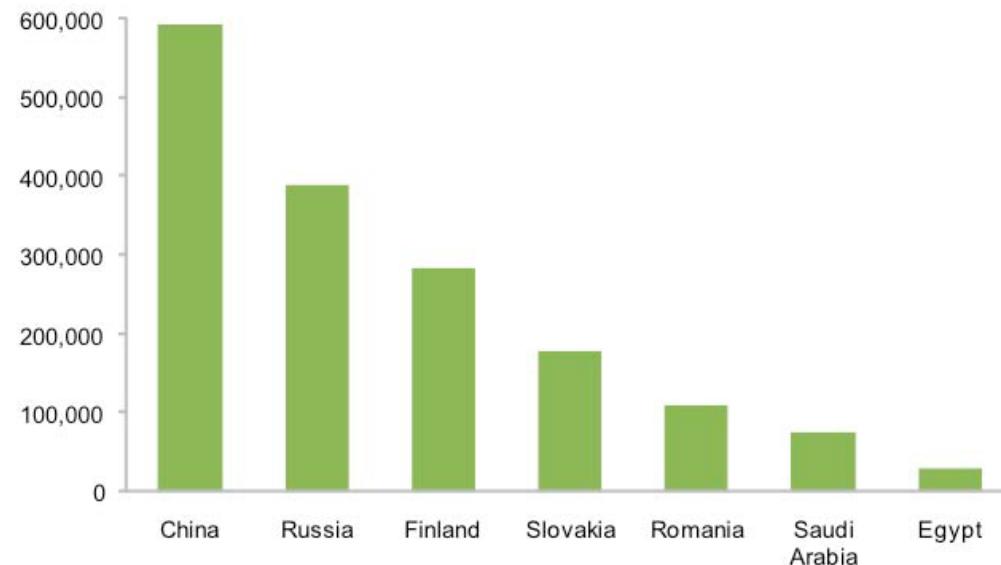
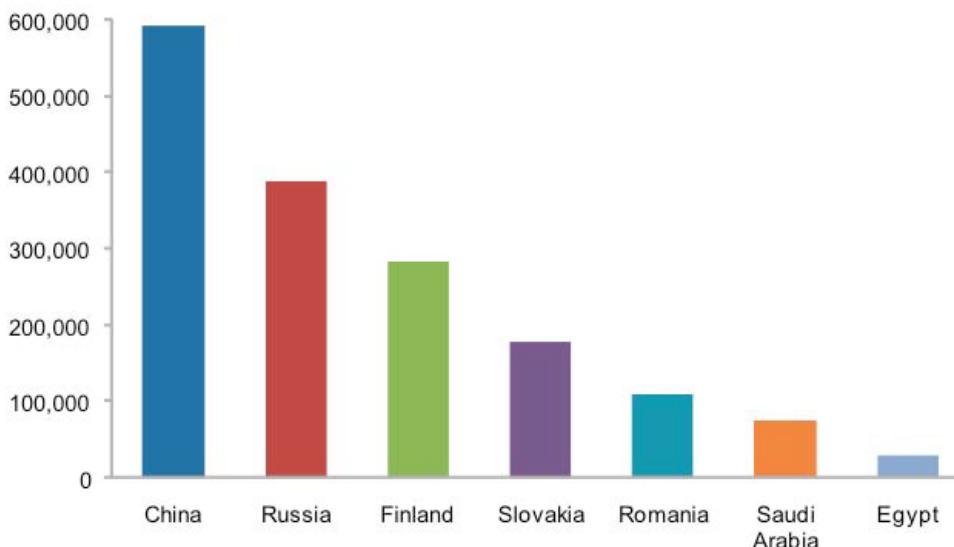
Use of Color. Tips for color selection

- Color usage rules:
 - If you want different objects of the same color to look the same, make sure that the background -the color that surrounds them- is consistent



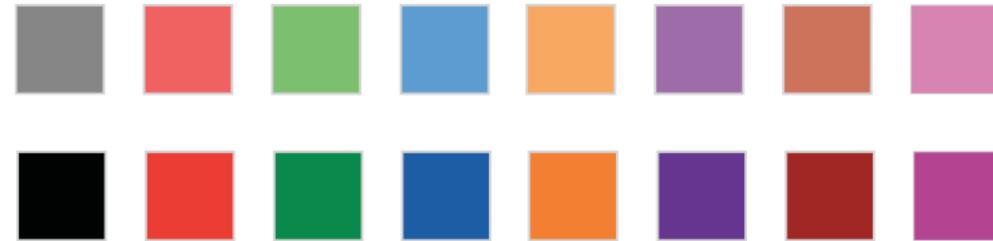
Use of Color. Tips for color selection

- Color usage rules:
 - Use different colors only when they correspond to differences of meaning in the data.
 - Highlight particular data, group items, encode quantitative values...



Use of Color. Tips for color selection

- Color usage rules:
 - Use soft, natural colors to display most information and bright and/or dark colors to highlight information that requires greater attention.



Use of Color. Tips for color selection

- Color usage rules (palette selection):
 - When using color to encode a sequential range of quantitative values:
 - Use a **single hue** (or a small set of closely related hues) and **vary intensity ..**
 - ... from pale colors for low values ...
 - ...to increasingly darker and brighter colors for high values

Use of Color. Tips for color selection

- Color usage rules (palette selection):
 - Use <http://colorbrewer2.org>

Categorical



No order required

Sequential



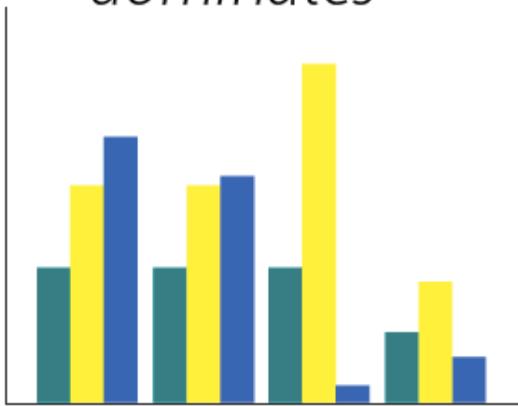
Order required but no neutral value

Diverging

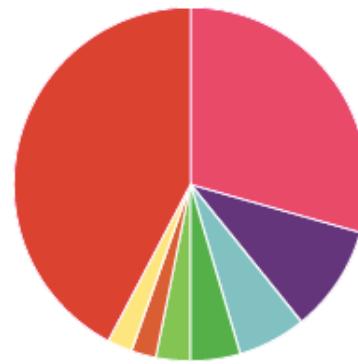


Order required **and** neutral value

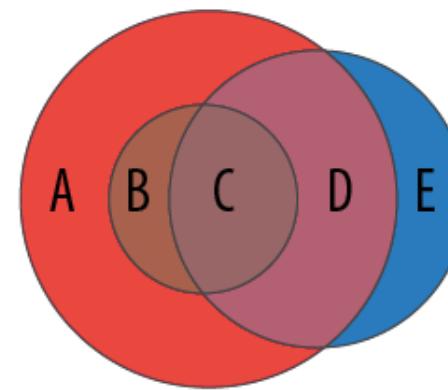
*one color
dominates*



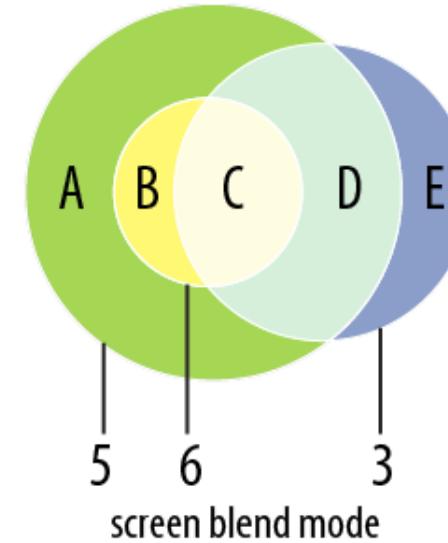
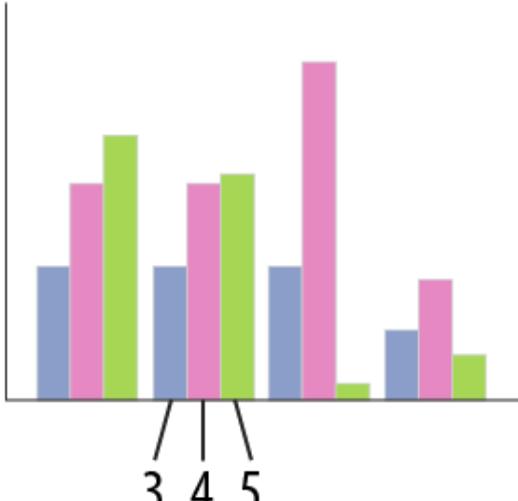
*difficult to
distinguish*



murky



recolored with Brewer palettes

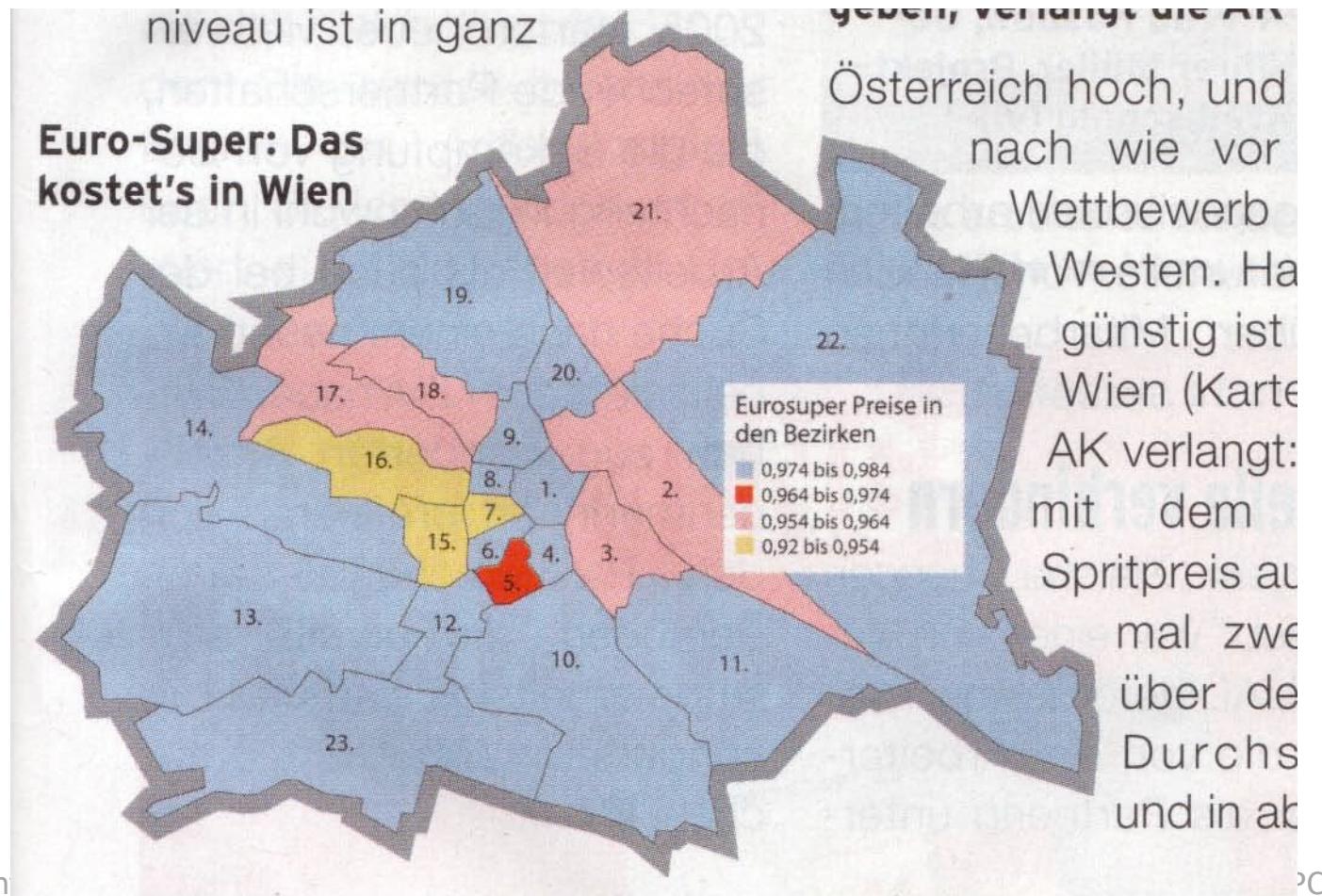


Use of Color. Color design rules

- Color usage rules (in charts/tables):
 - Non-data components of tables and graphs should be displayed just visibly enough to perform their role
 - Excessive salience could cause them to distract attention from the data

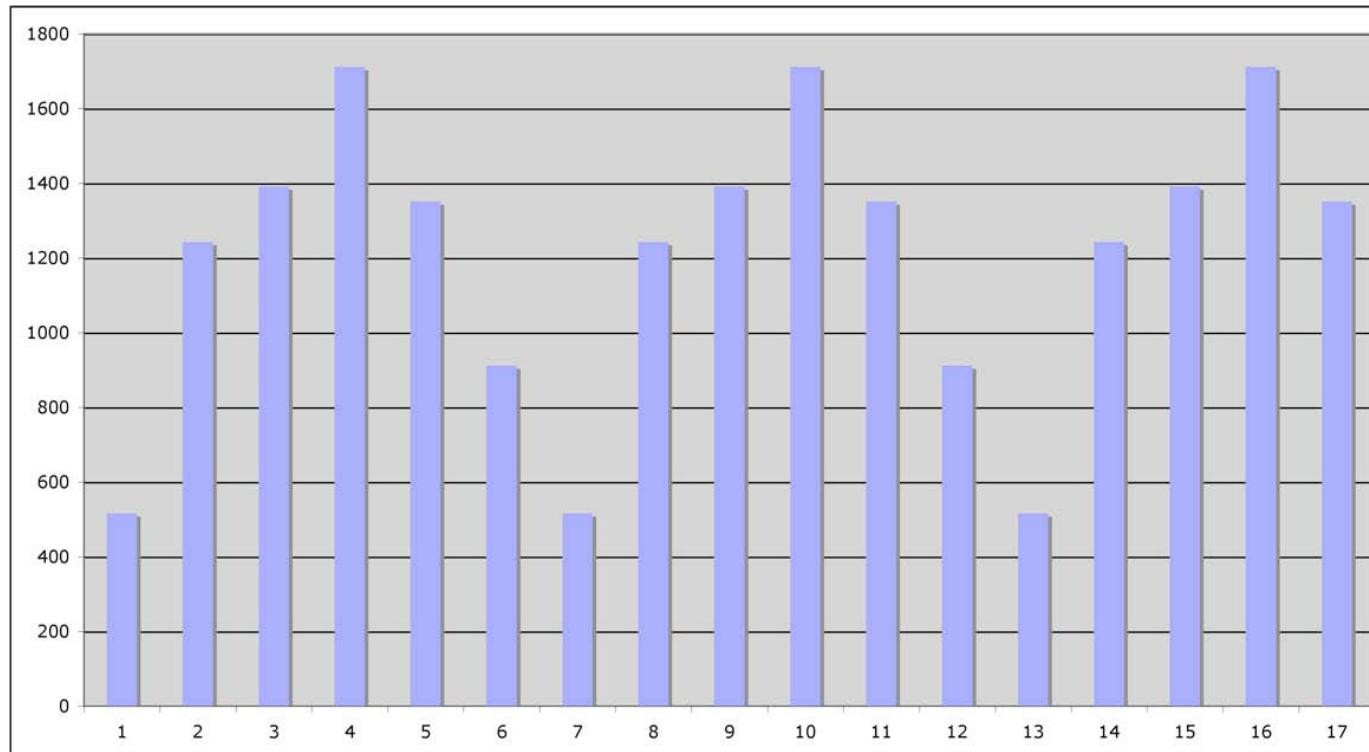
Use of Color. Color design rules

- Color usage rules (in charts/tables). Salience:



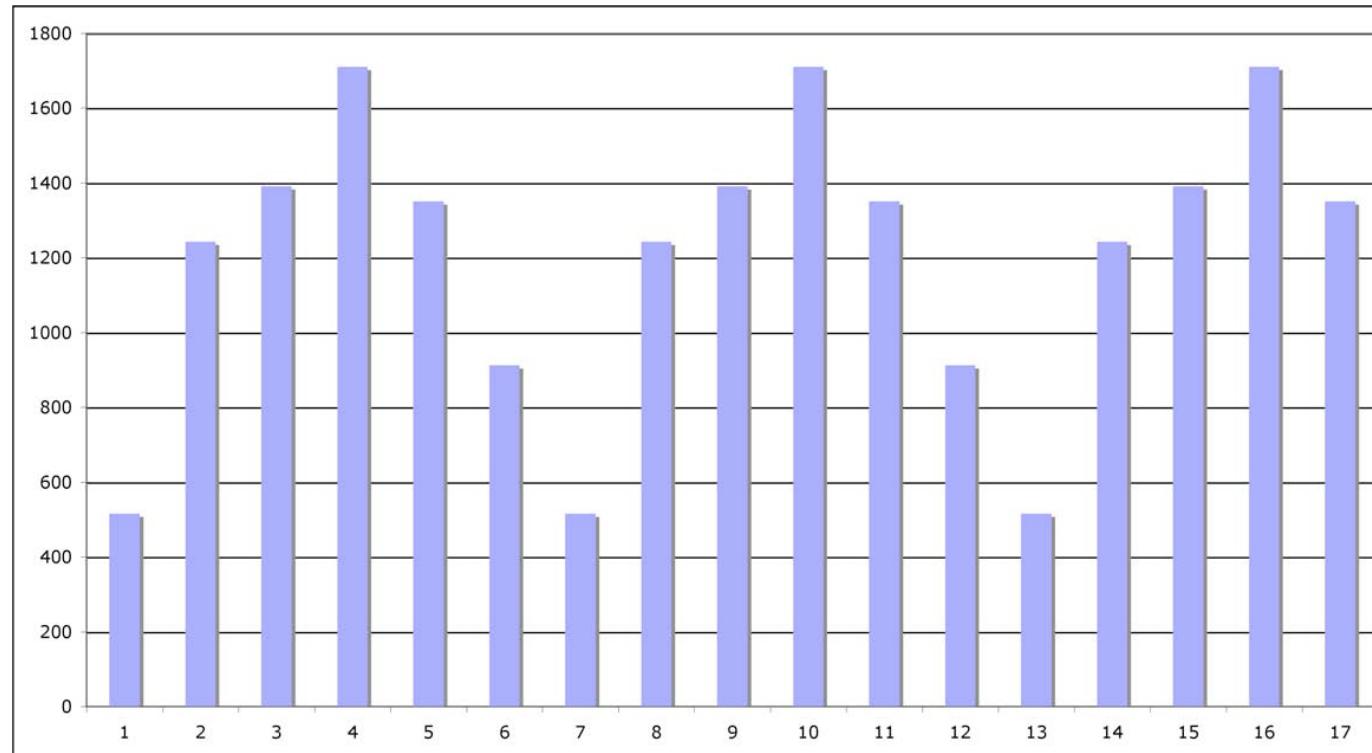
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



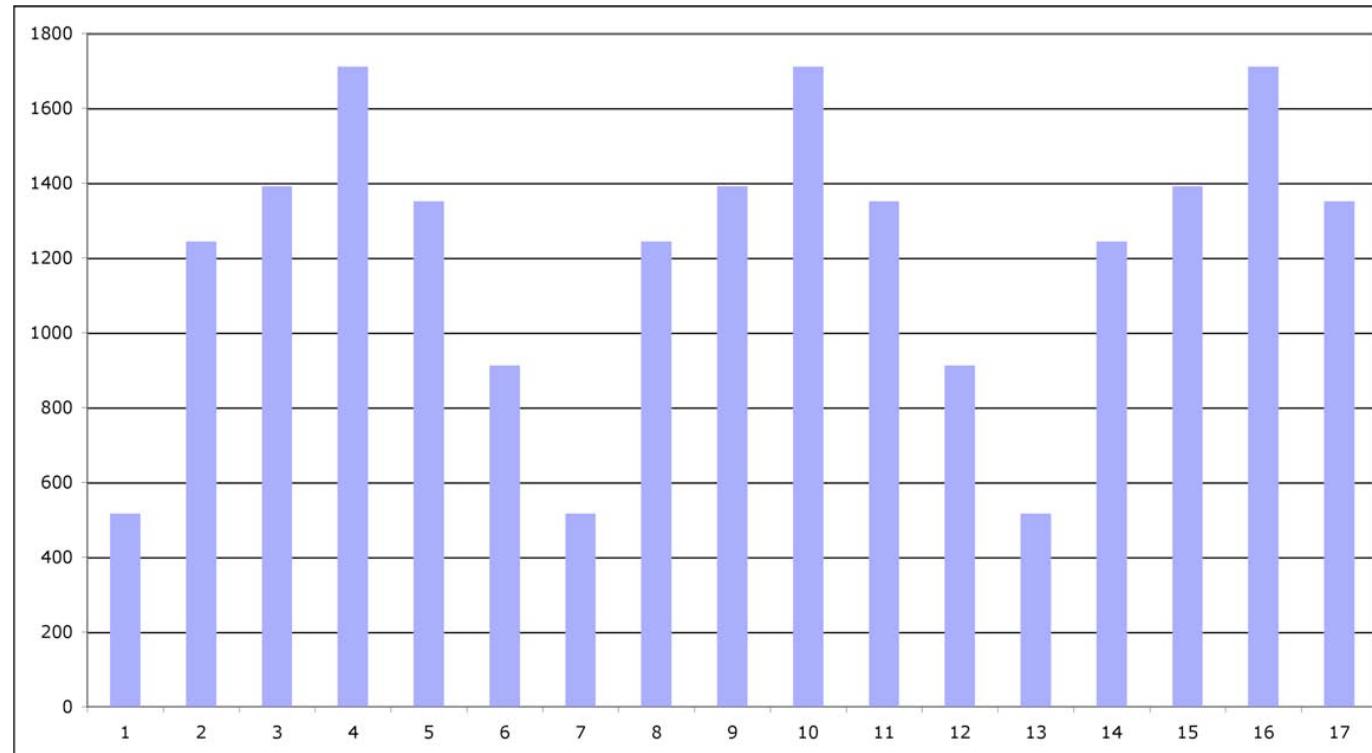
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



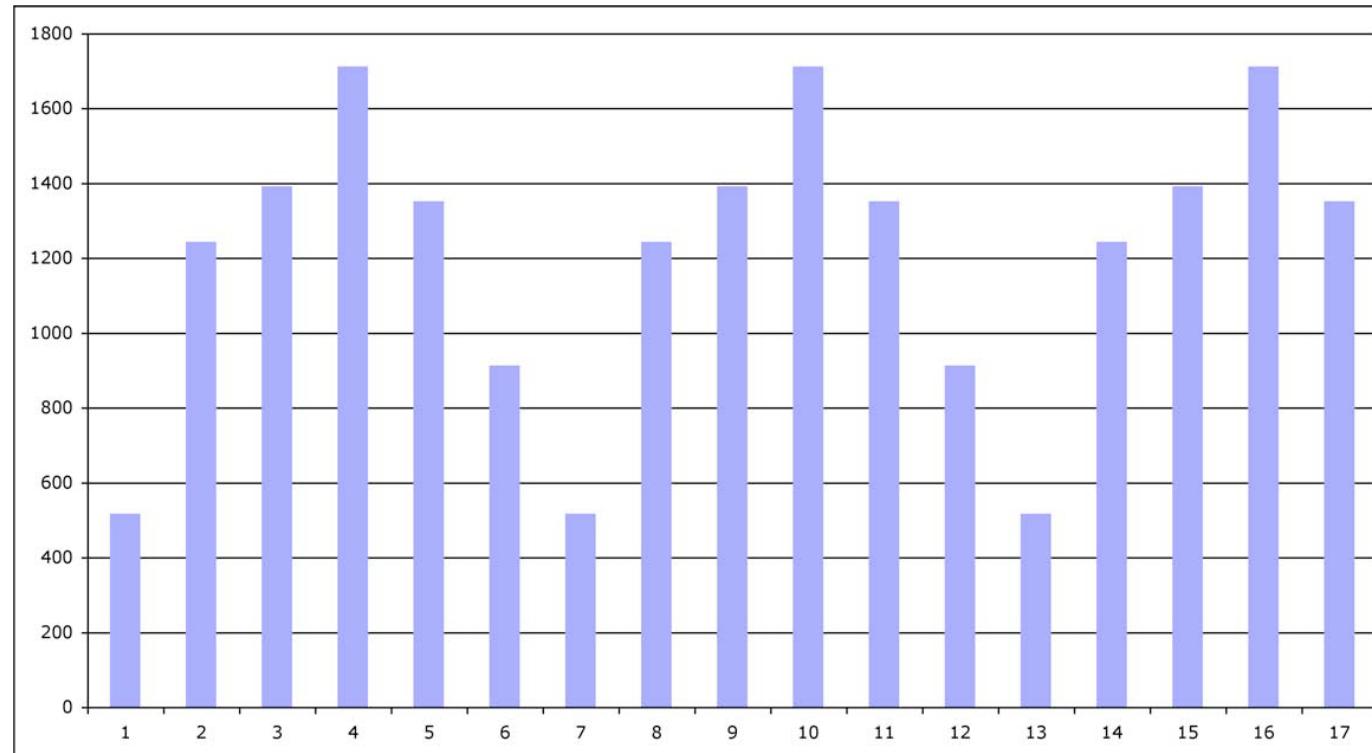
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



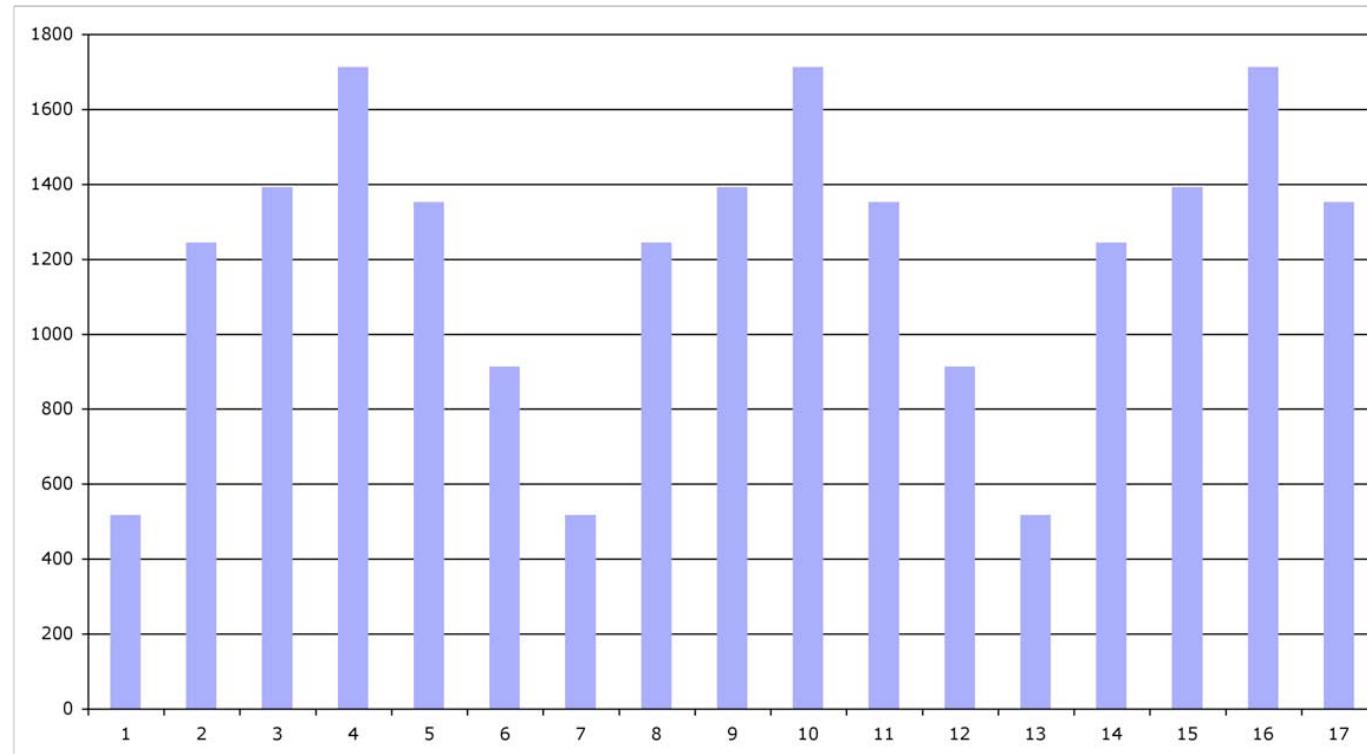
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



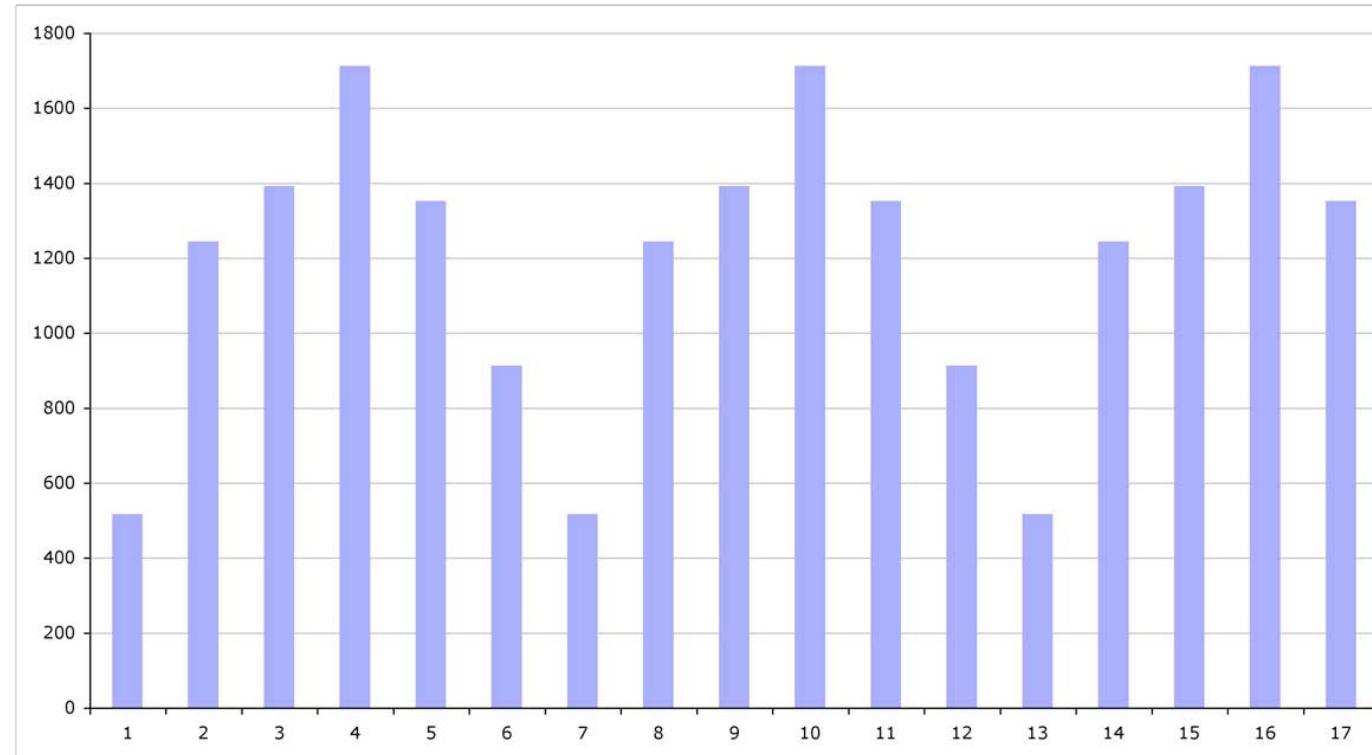
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



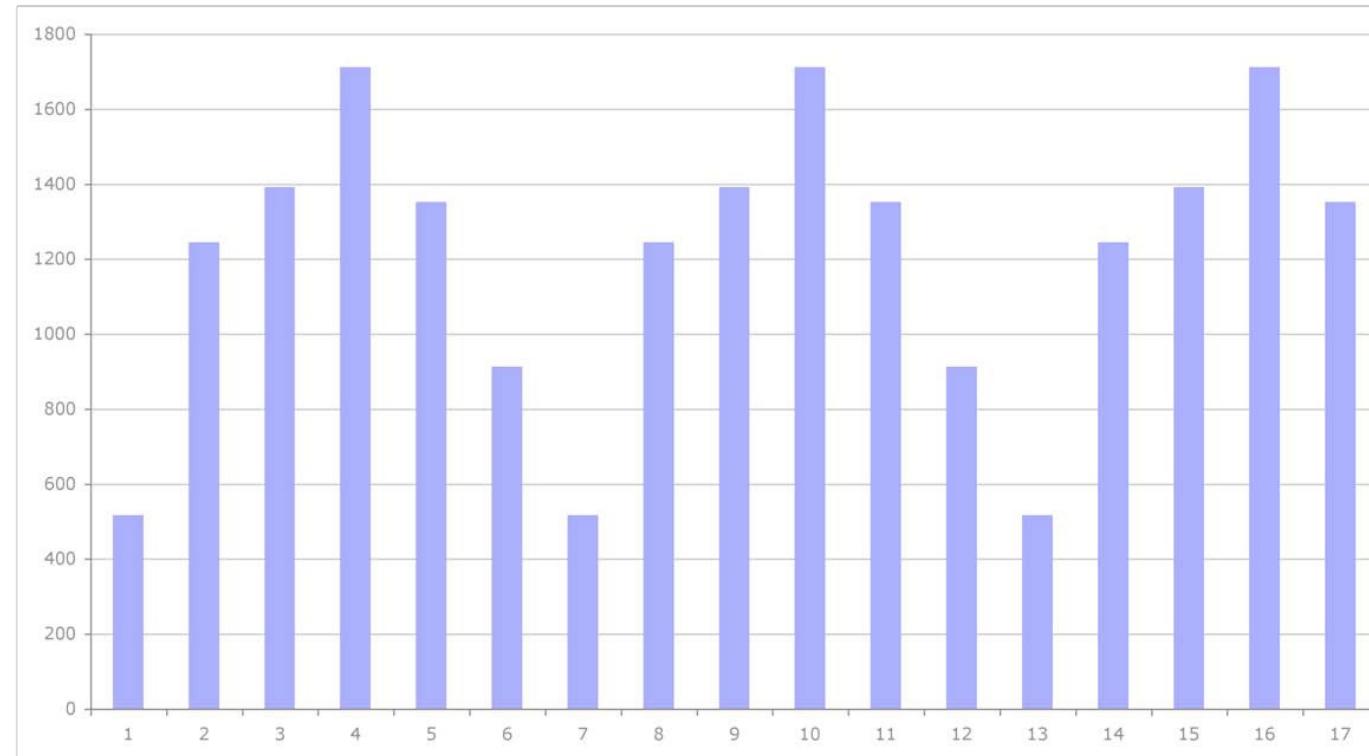
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



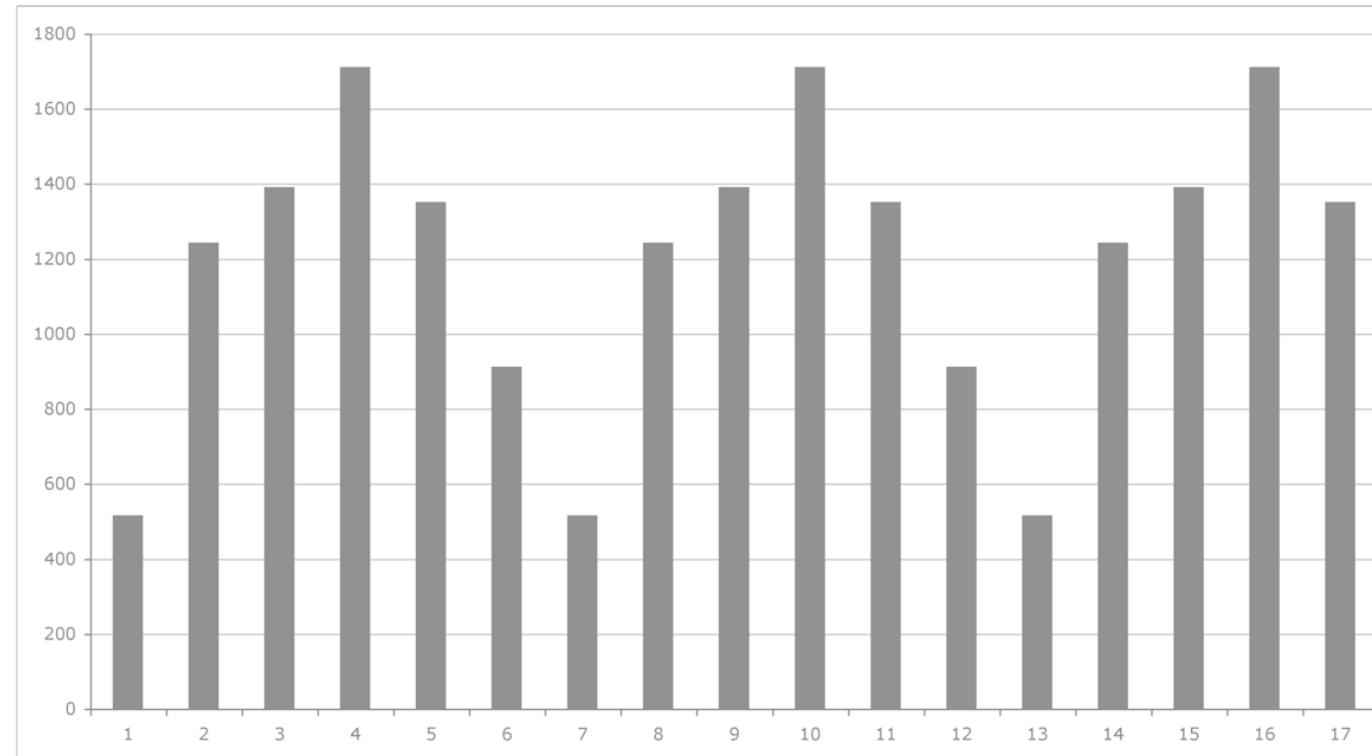
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



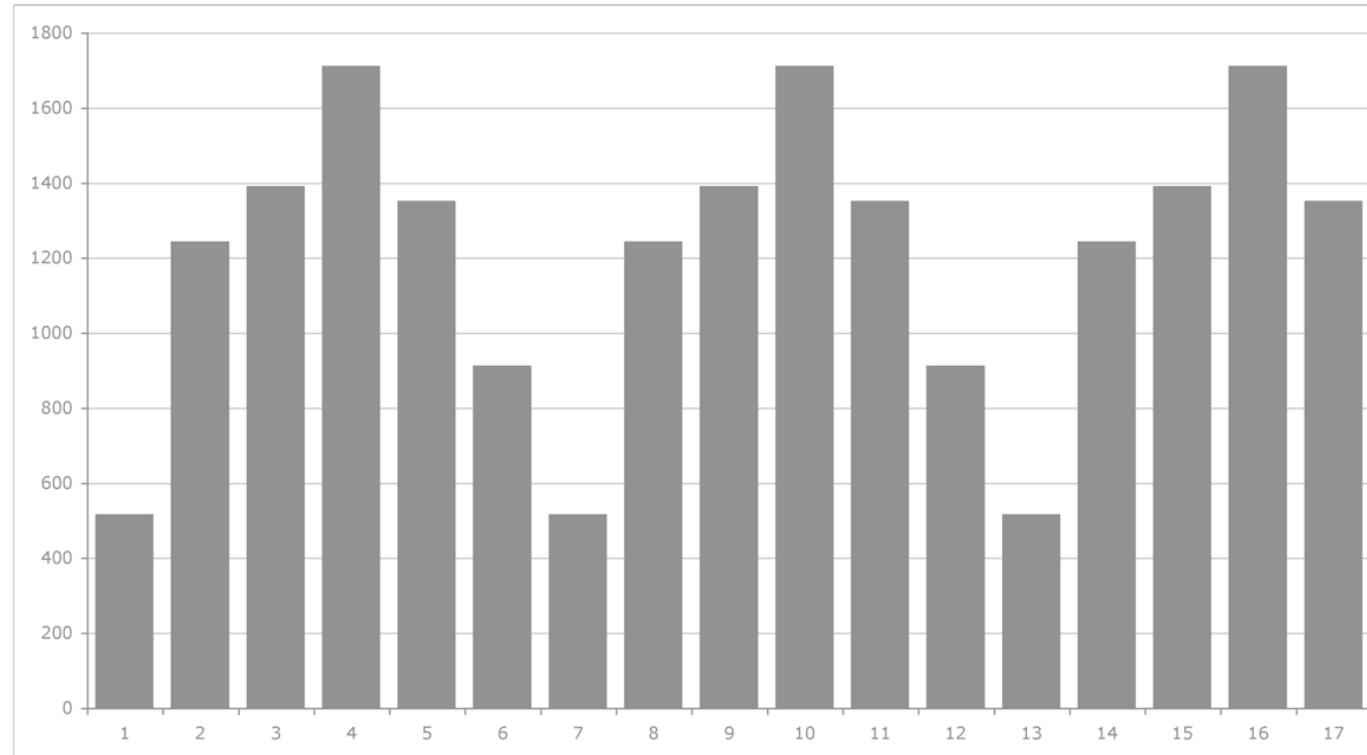
Use of Color. Color design rules

- Color design rules:
 - De-emphasize non-data components



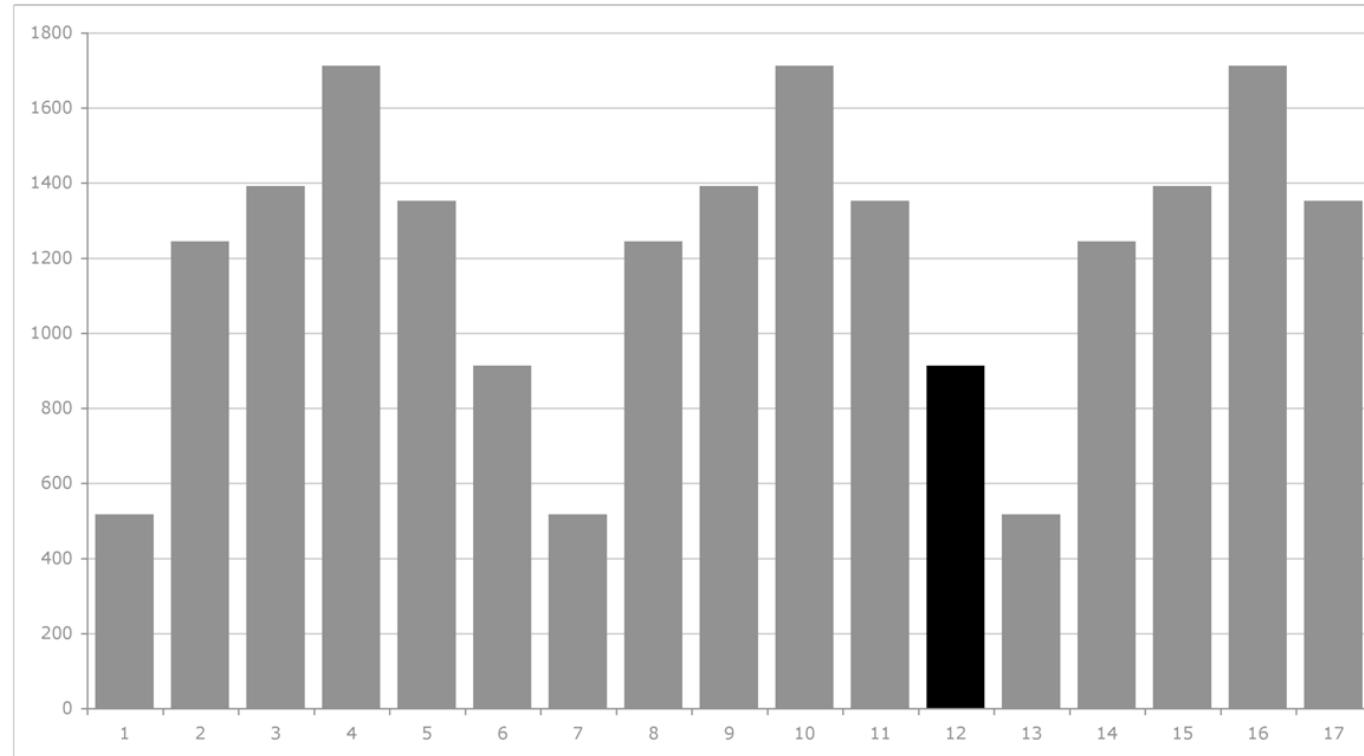
Use of Color. Color design rules

- Color design rules:
 - Improve data components



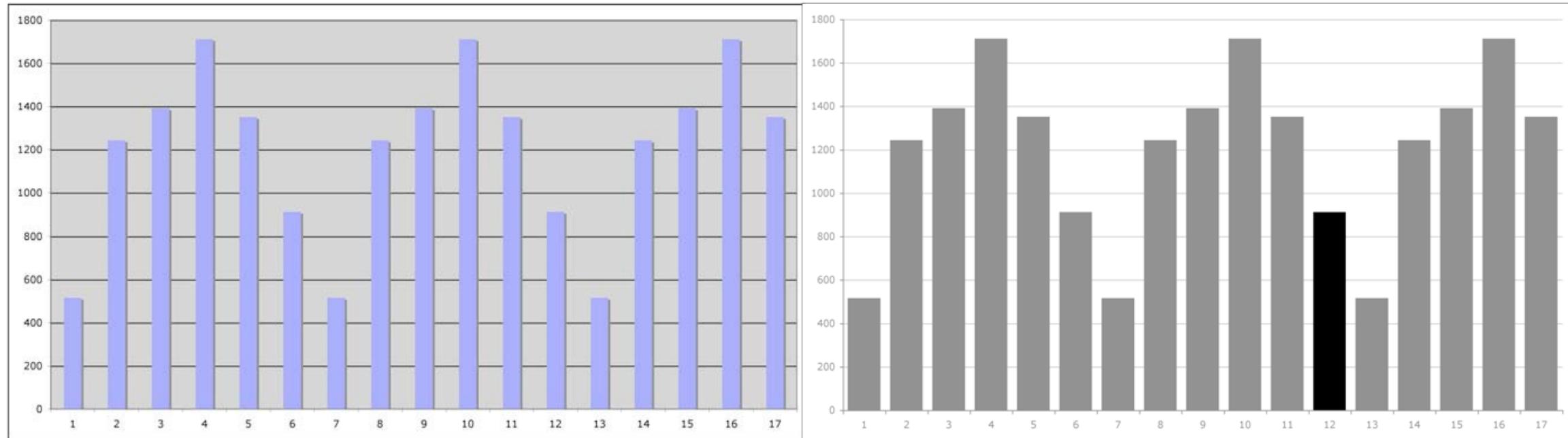
Use of Color. Color design rules

- Color design rules:
 - Improve data components



Use of Color. Color design rules

- Color design rules:
 - Result



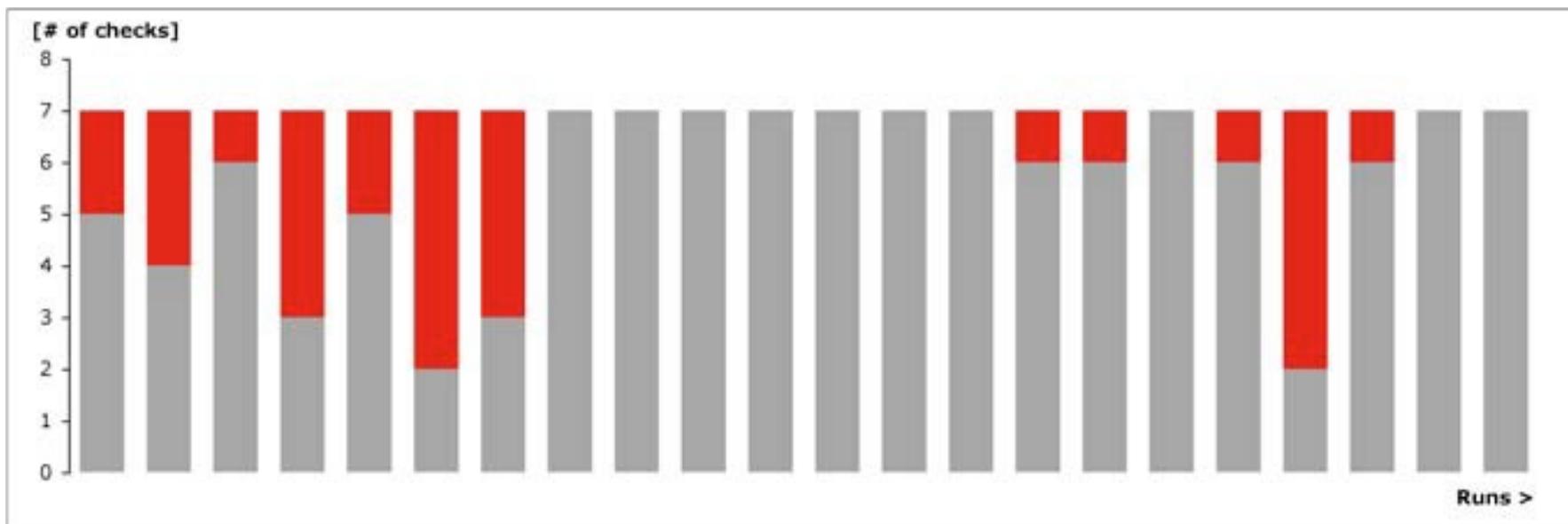
Use of Color. Color design rules

- Color design rules:
 - Avoid using a combination of red and green in the same display
 - Color blind users may have problems



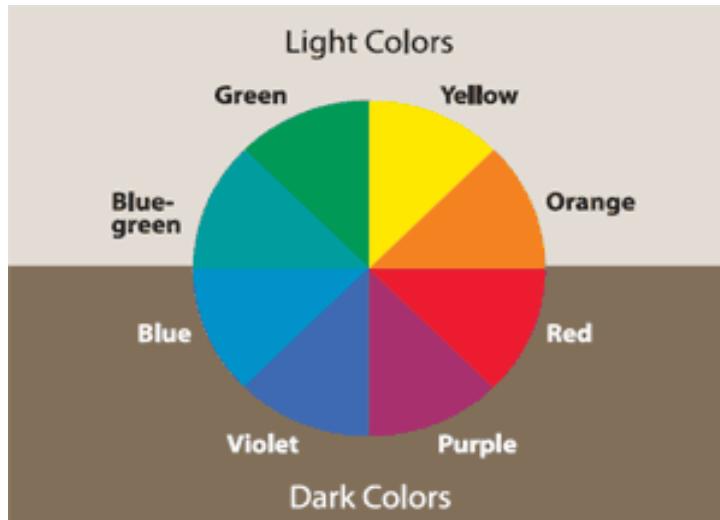
Use of Color. Color design rules

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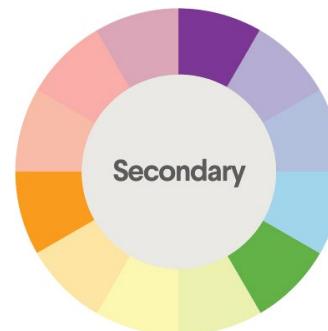
Use of Color. Color palettes

- Use opposite colors



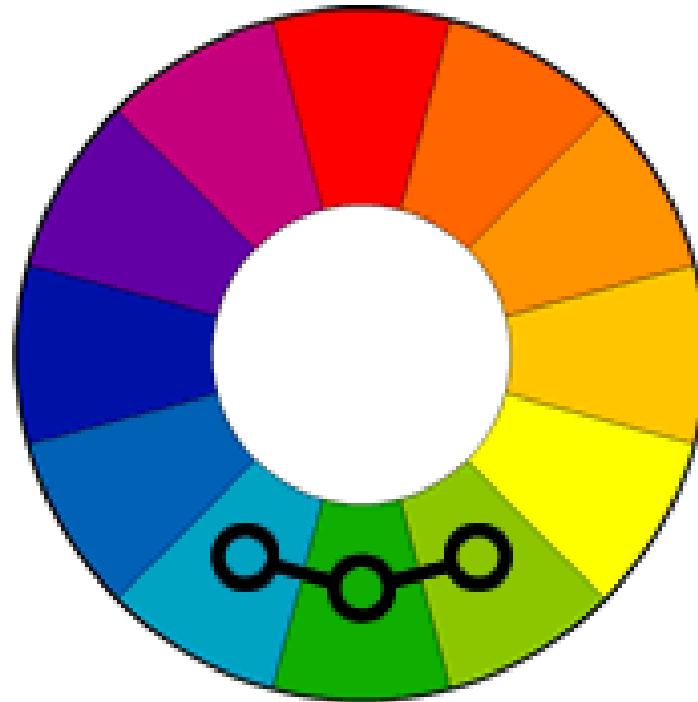
Use of Color. Color palettes

- Color Wheels



Use of Color. Color palettes

- Analogous colors



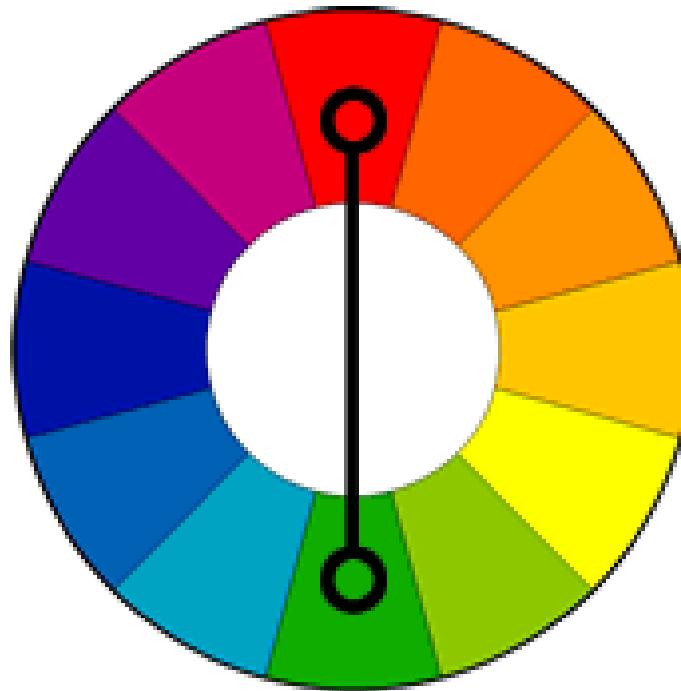
Use of Color. Color palettes

- Analogous colors



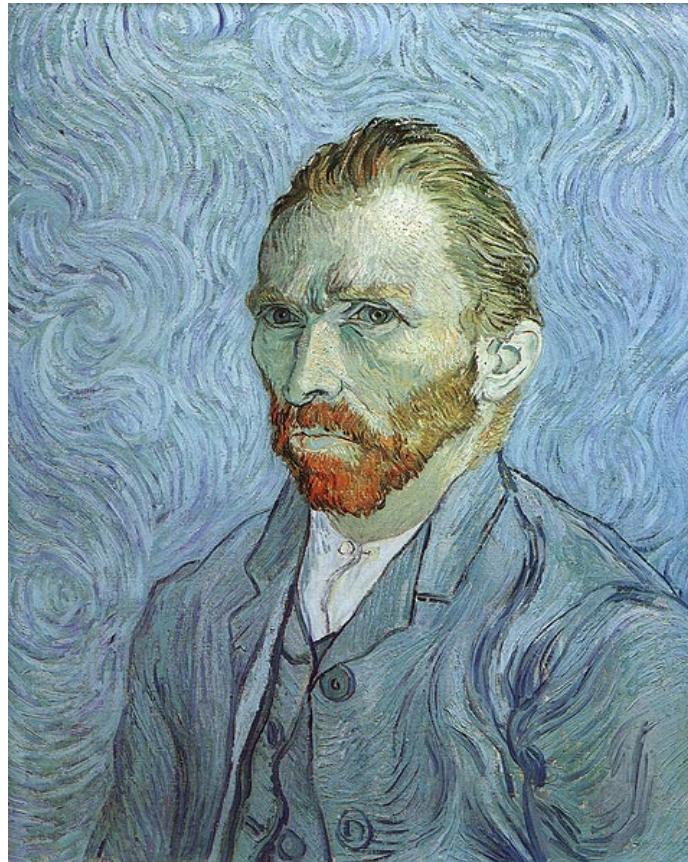
Use of Color. Color palettes

- Complementary colors



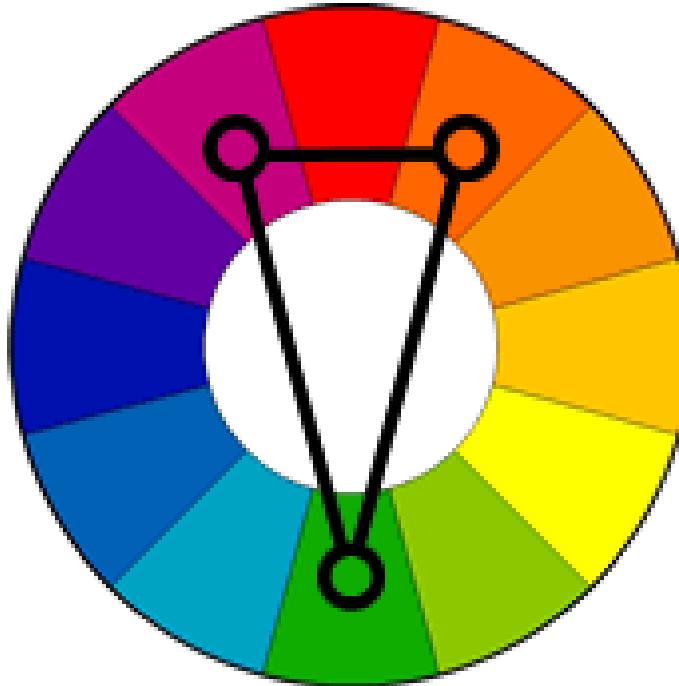
Use of Color. Color palettes

- Complementary colors



Use of Color. Color palettes

- Split-complementary colors



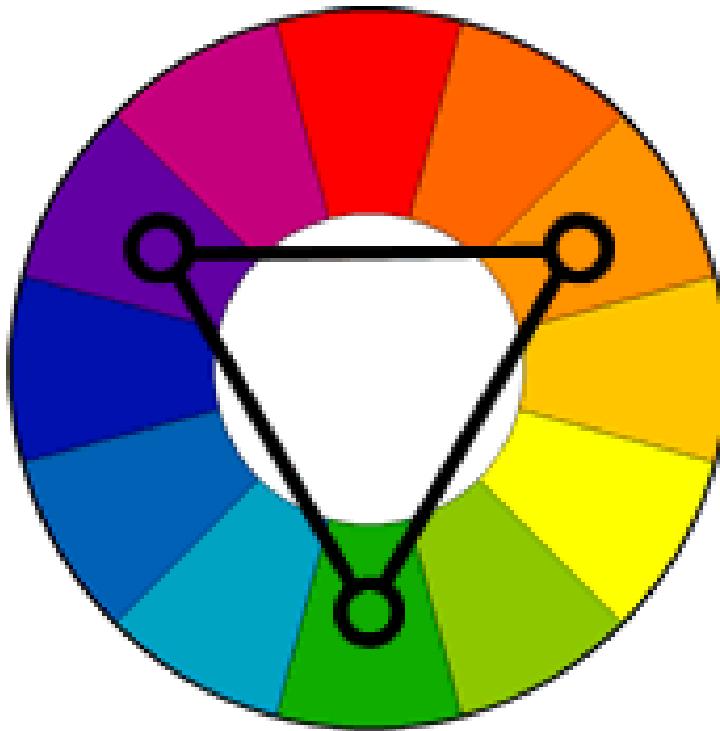
Use of Color. Color palettes

- Complementary colors



Use of Color. Color palettes

- Triad relationship



Use of Color. Color palettes

- Triad relationship



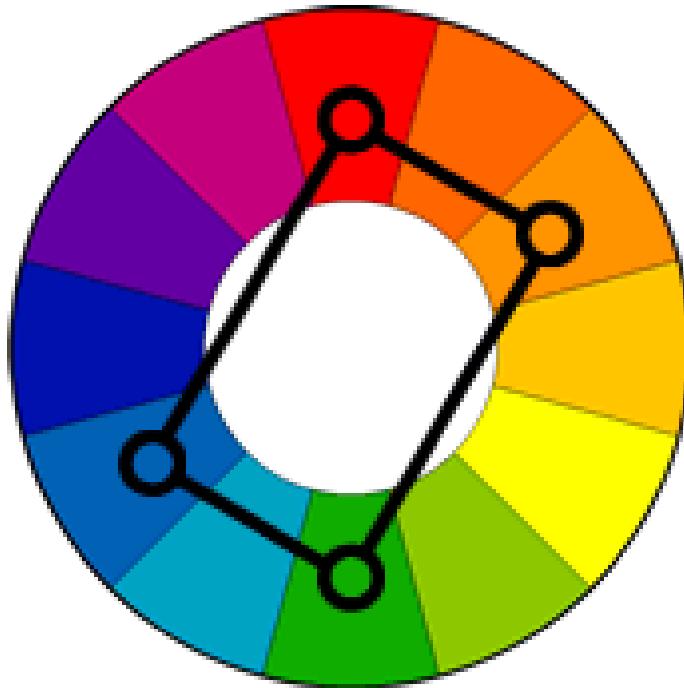
Use of Color. Color palettes

- Triad relationship



Use of Color. Color palettes

- Tetrads relationship



Use of Color. Color palettes

- Tetrads relationship



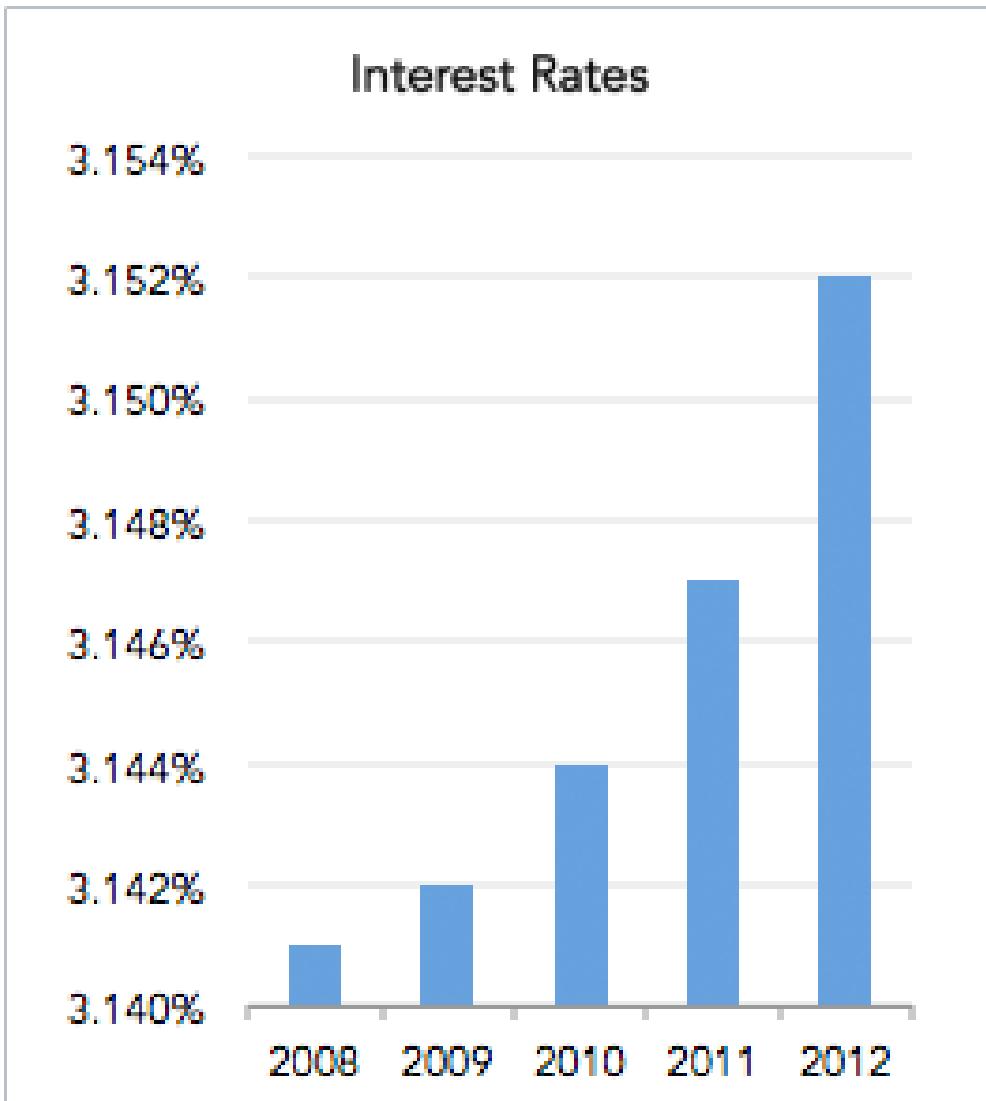
Outline

- *Effective Visualizations*
- *Use of color*
- **Comparison**
- Copy & labels
- Ordering & aligning data

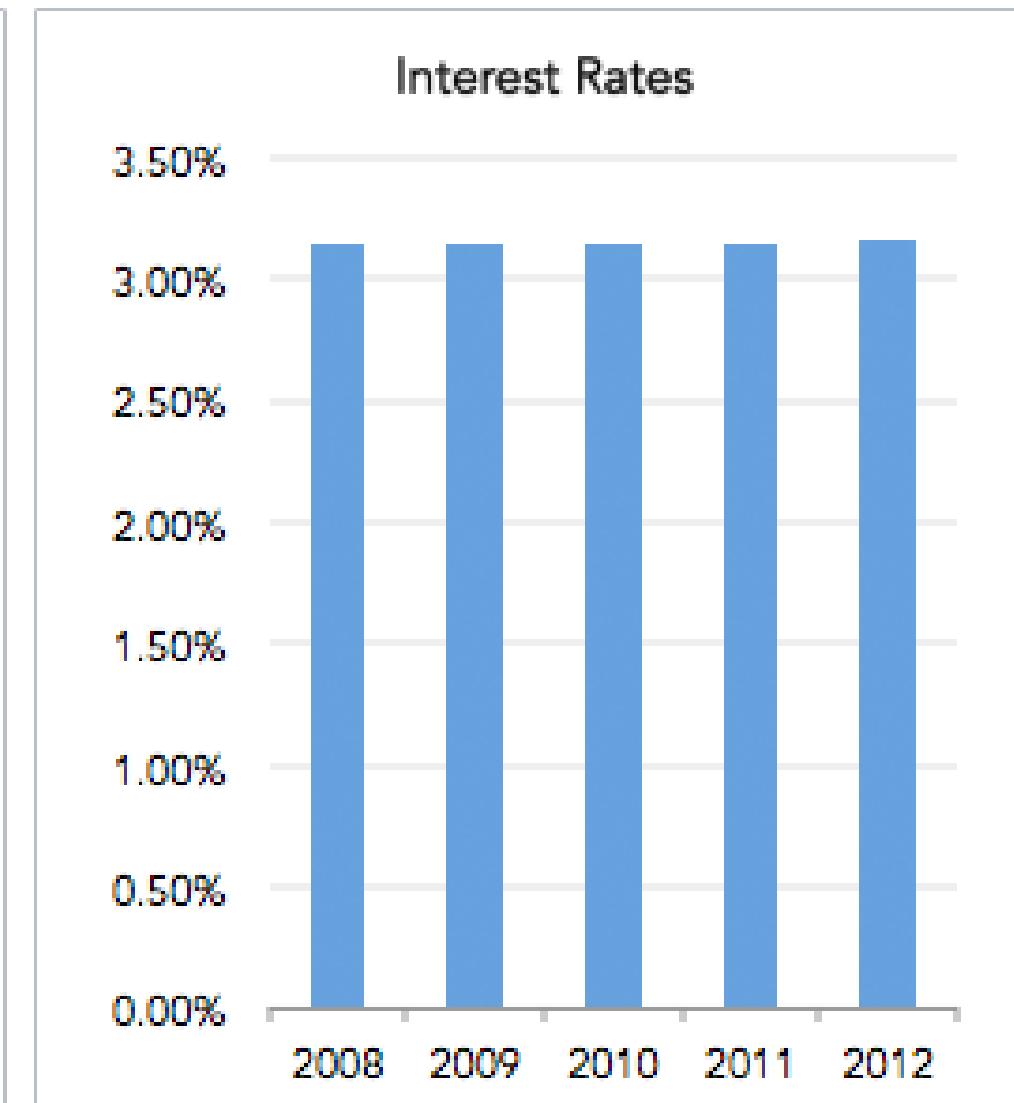
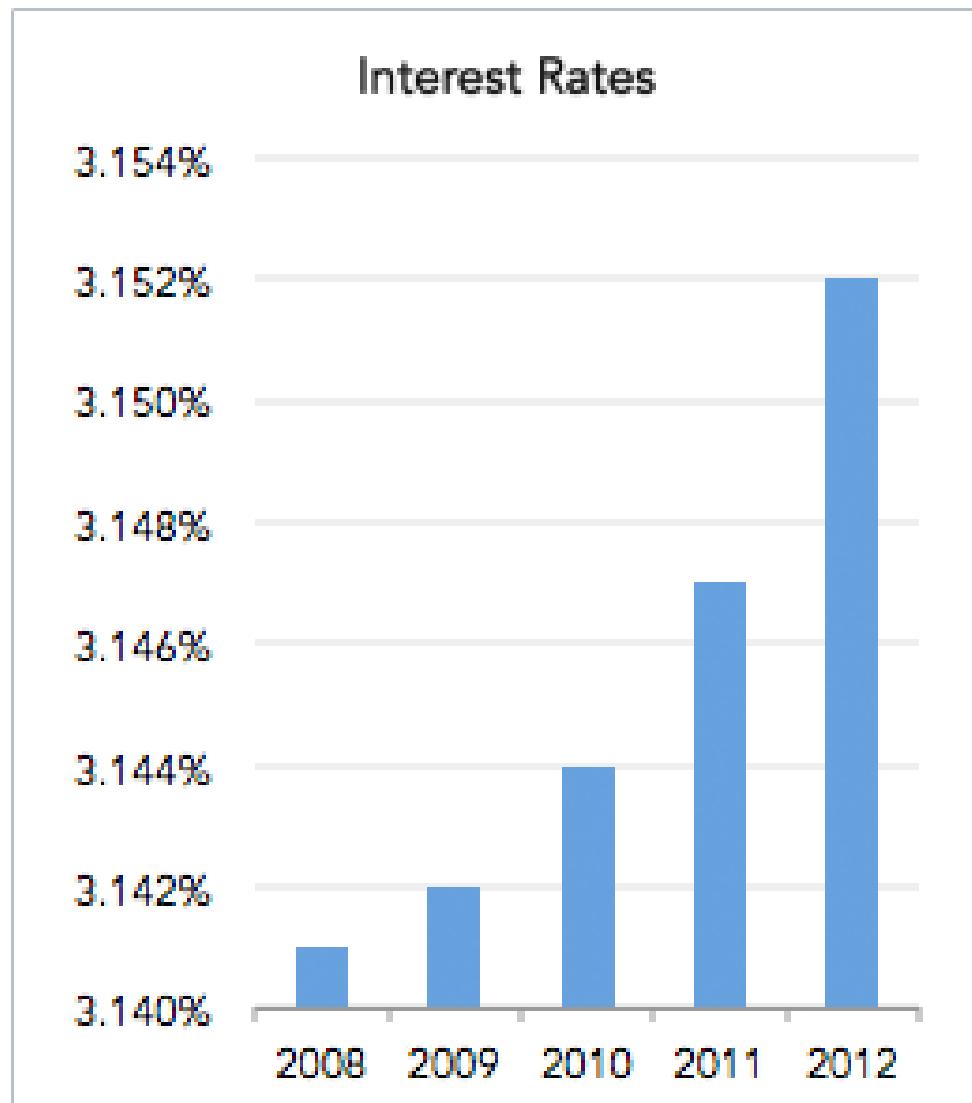
Comparison

- Visual comparison one of most common tasks
- Tips to take into account
 - Zero baseline if possible
 - Choose the most effective visualization
 - Place elements to facilitate comparison
 - Distances, positions matter
 - Tell the whole story

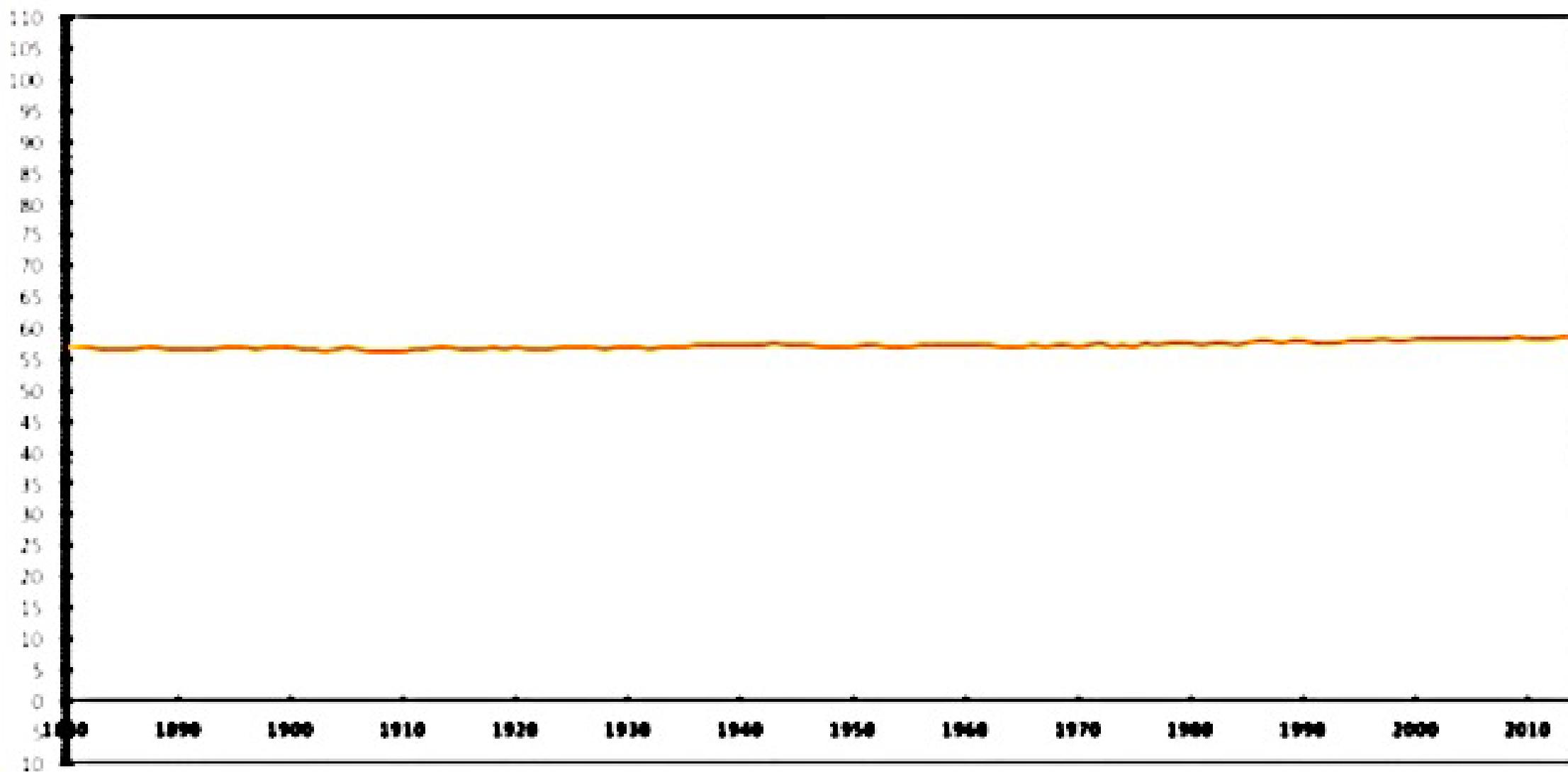
Comparison. Zero baseline

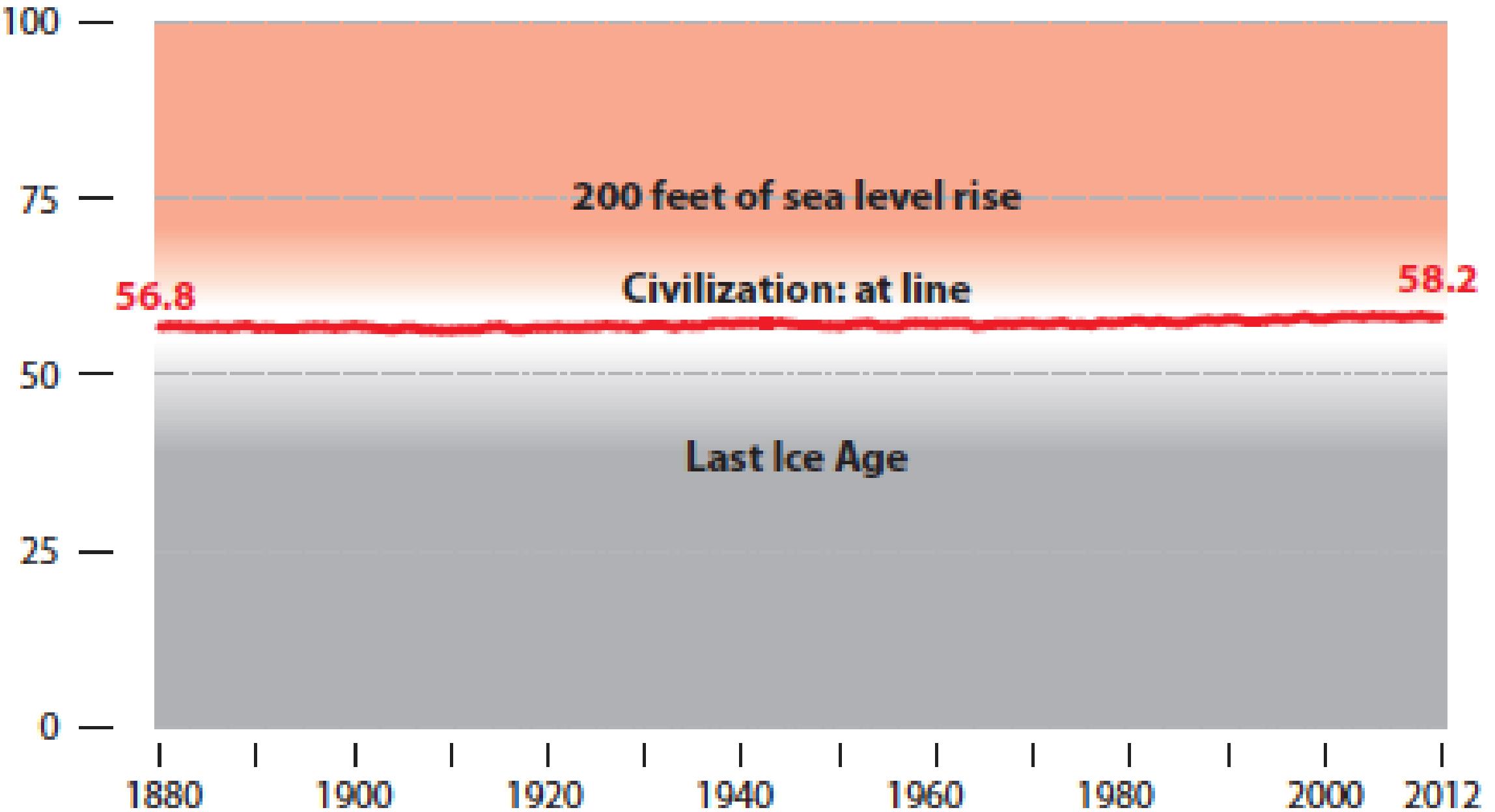


Comparison. Zero baseline

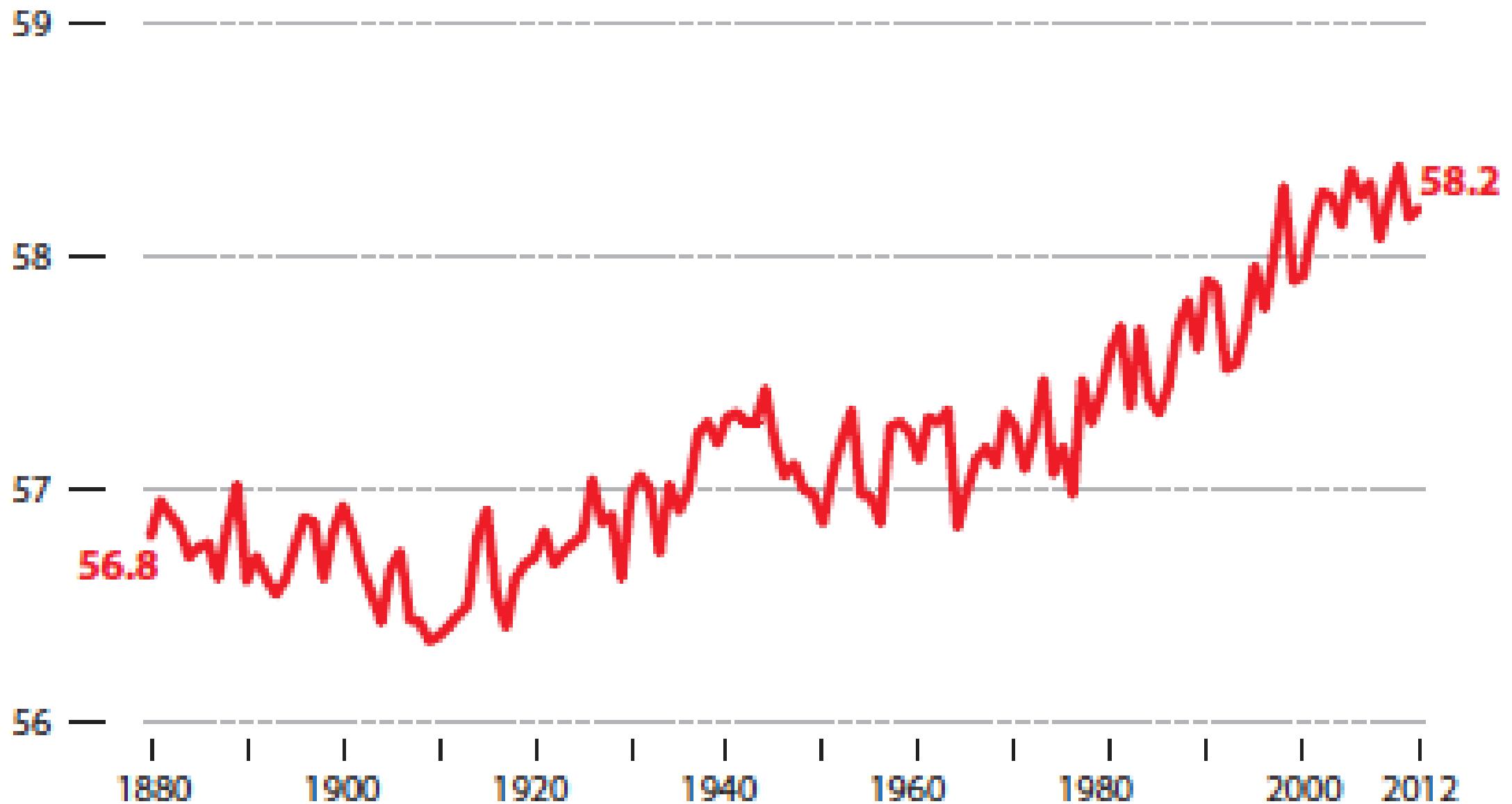


Average Annual Global Temperature in Fahrenheit 1880-2015

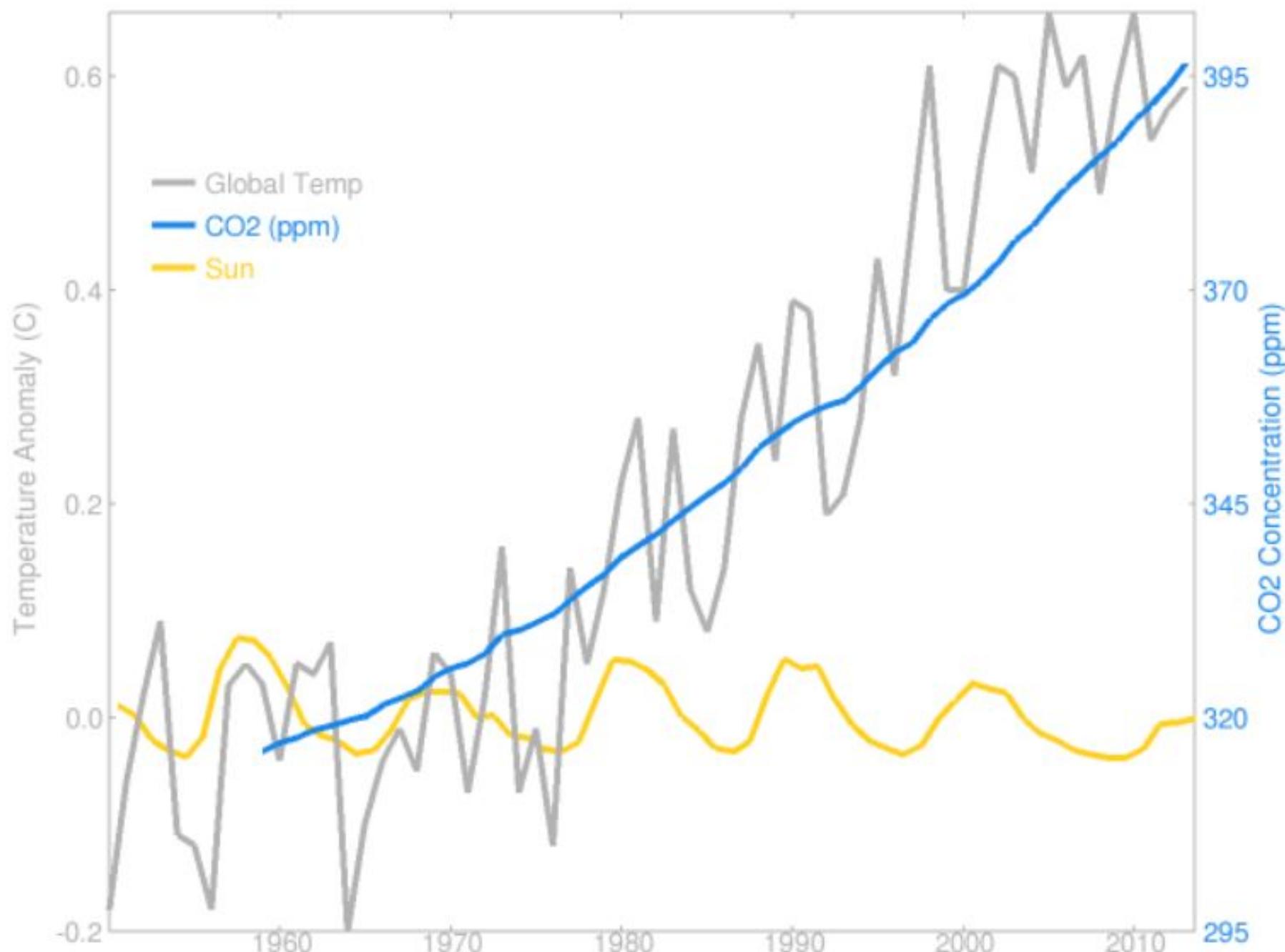




Average annual global temperature in degrees Fahrenheit



World climate Widget





KNUCKLEBALL VELOCITY
R.A. DICKEY

77.3 MPH



2012

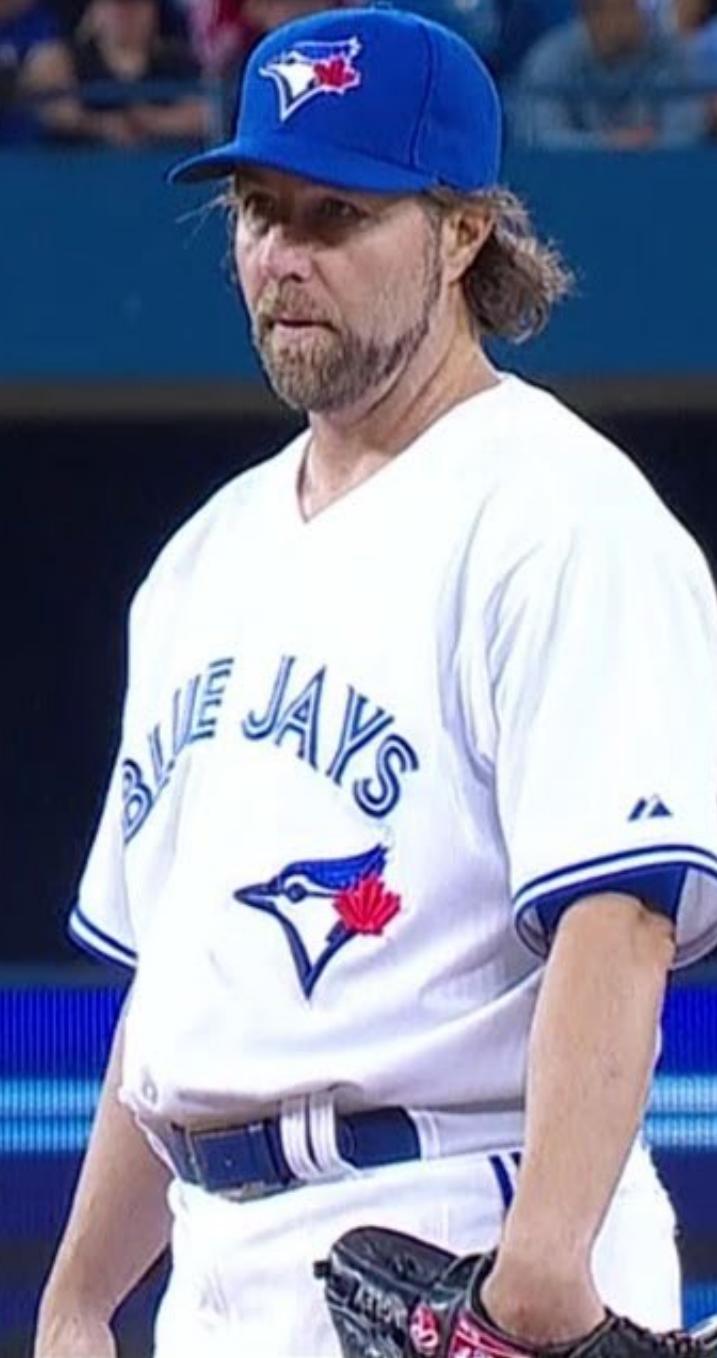
75.3 MPH



2013

BlackBerry

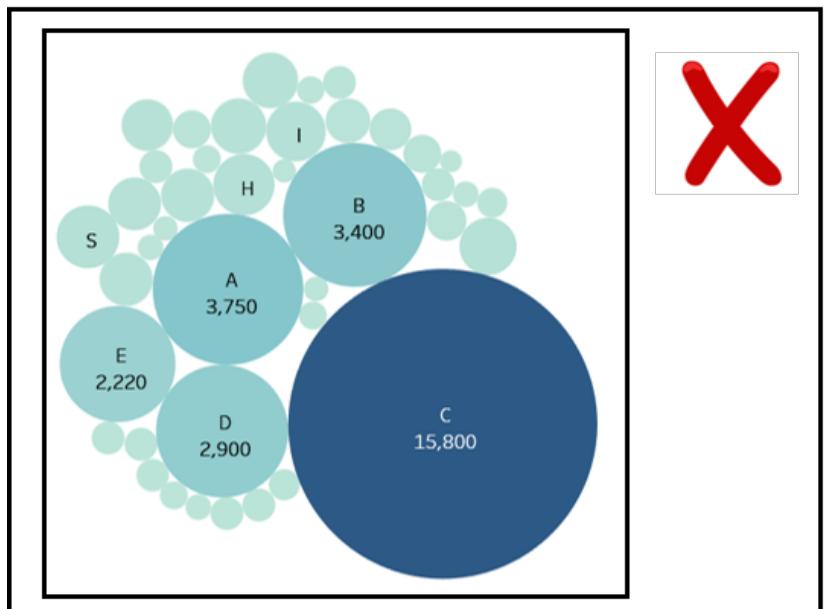
Keep Moving



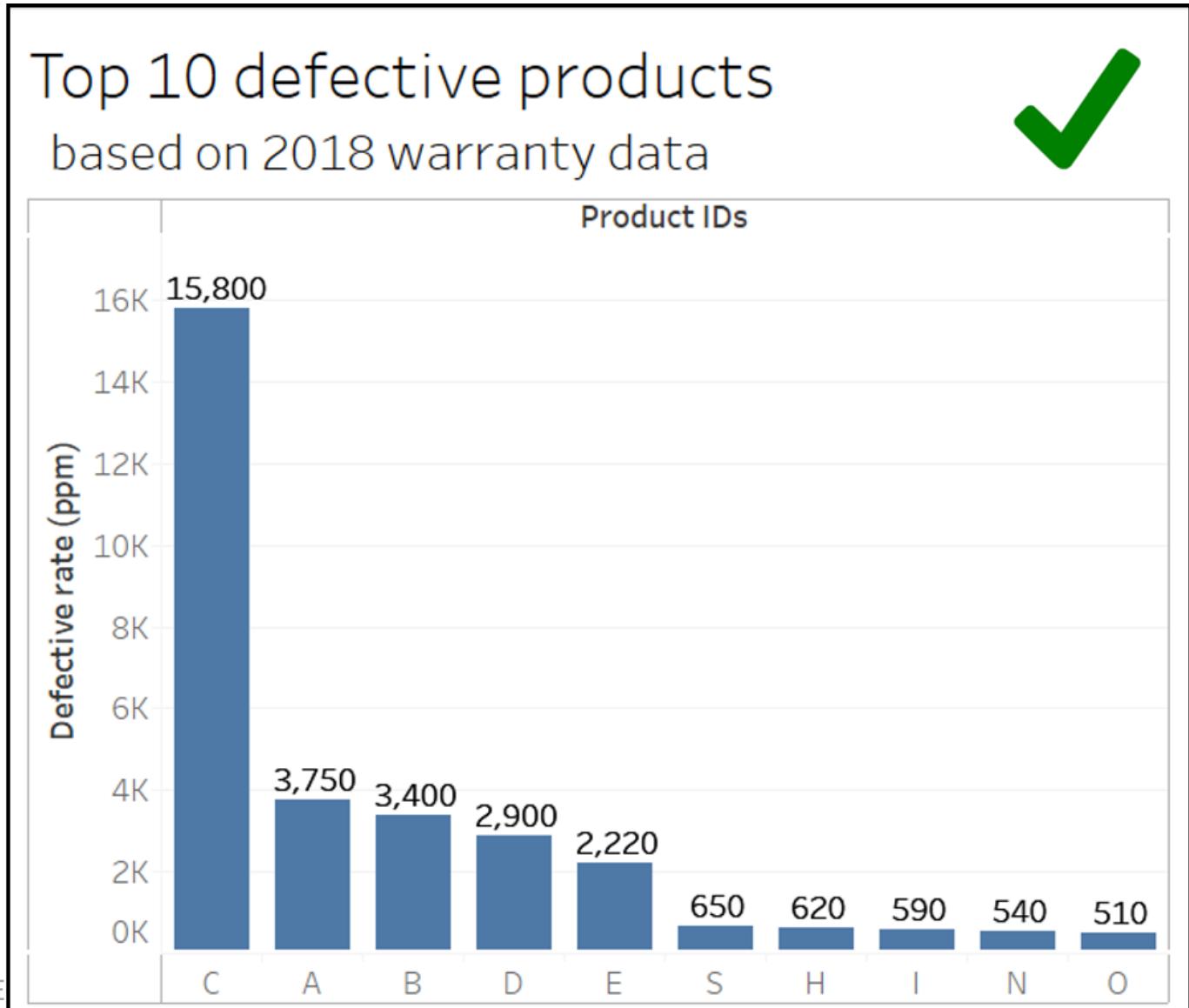
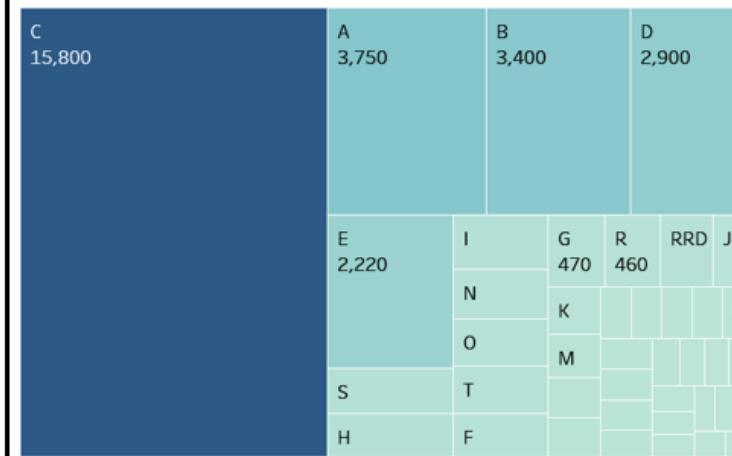
Comparison. Most effective visualization

- Many visual depictions may communicate the same data correctly
 - But some are more difficult to understand than others
 - Need more time/cognitive effort
- Always select the most effective ones
 - In terms of time, space, cognitive effort...

Comparison. Most effective visualization



Total complaints by Product ID



Comparison. Placement

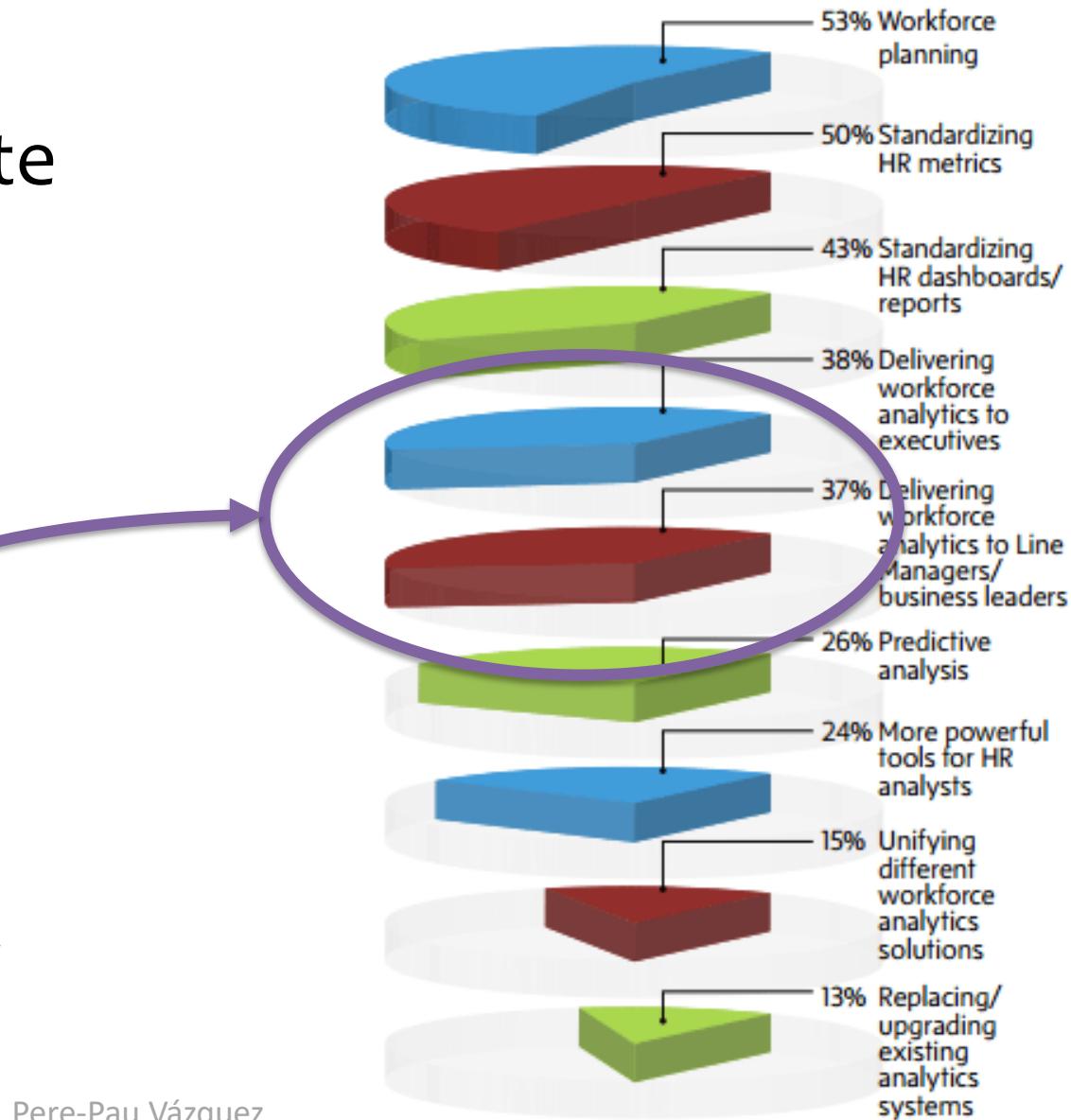
- Place elements to facilitate comparison
 - Distances, positions...

Comparison. Placement

- Place elements to facilitate comparison
 - Distances, positions...

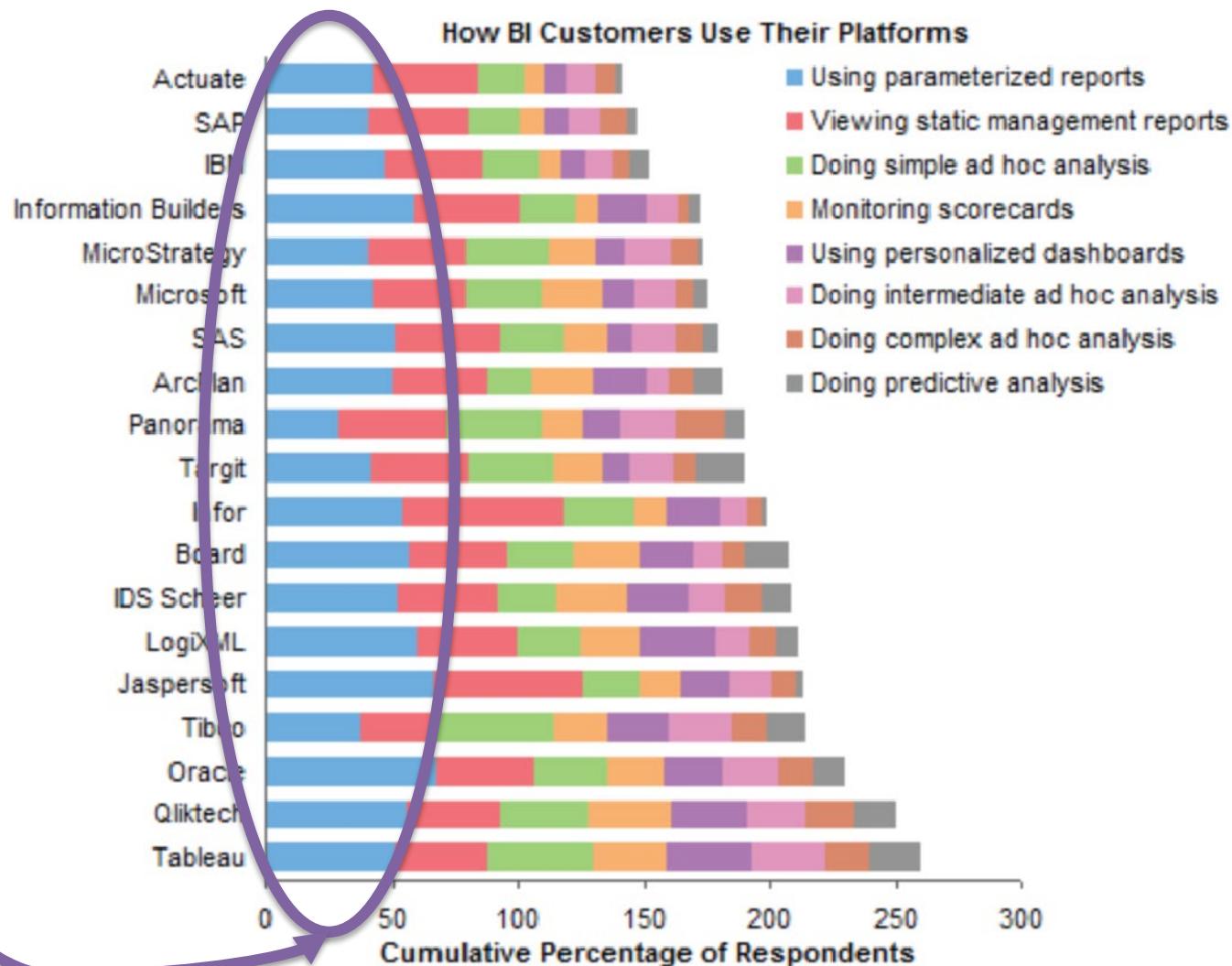
Relative sizes?

<https://flowingdata.com/2013/08/07/piemaster/>



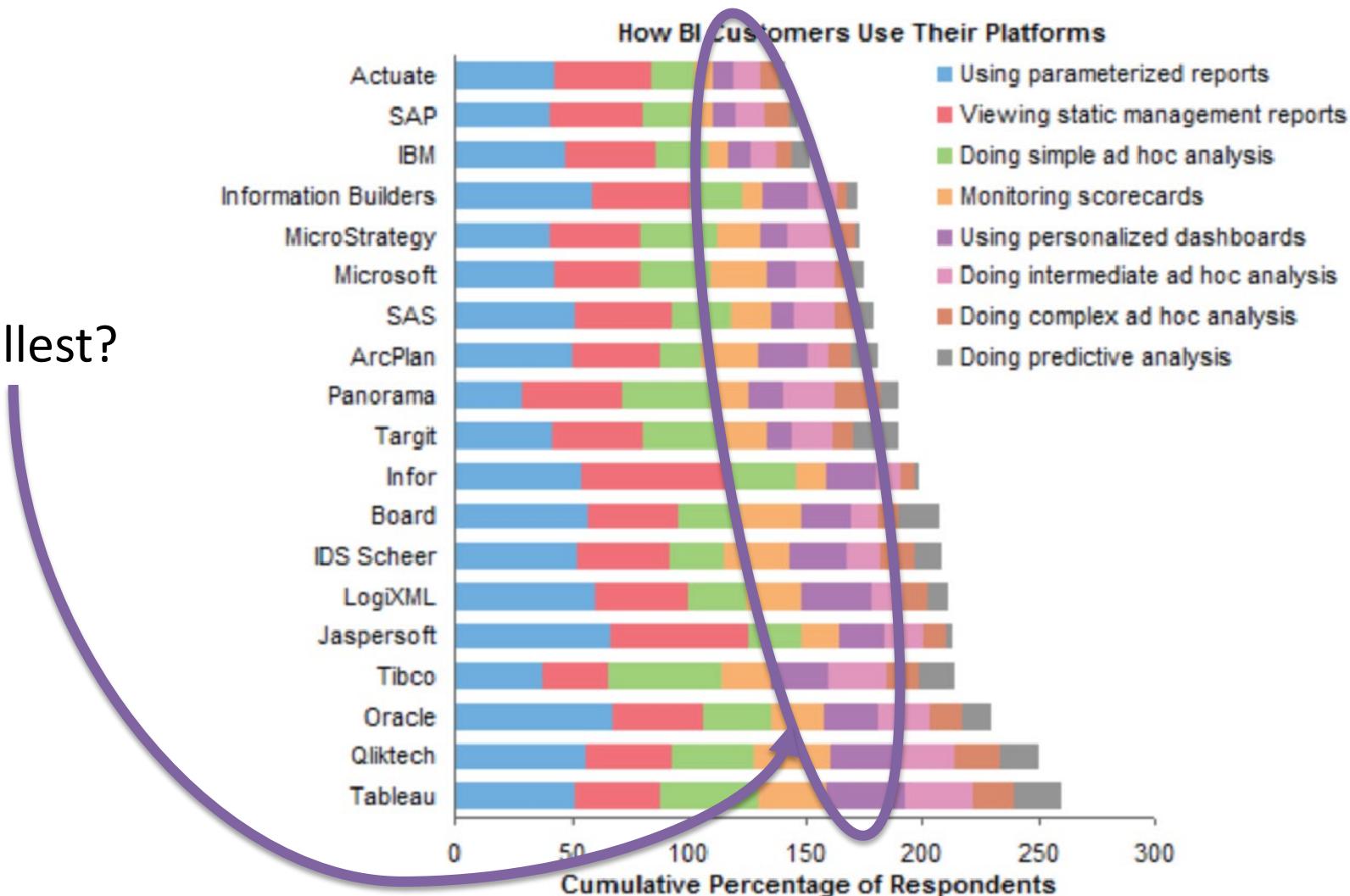
Comparison. Placement

Smallest?



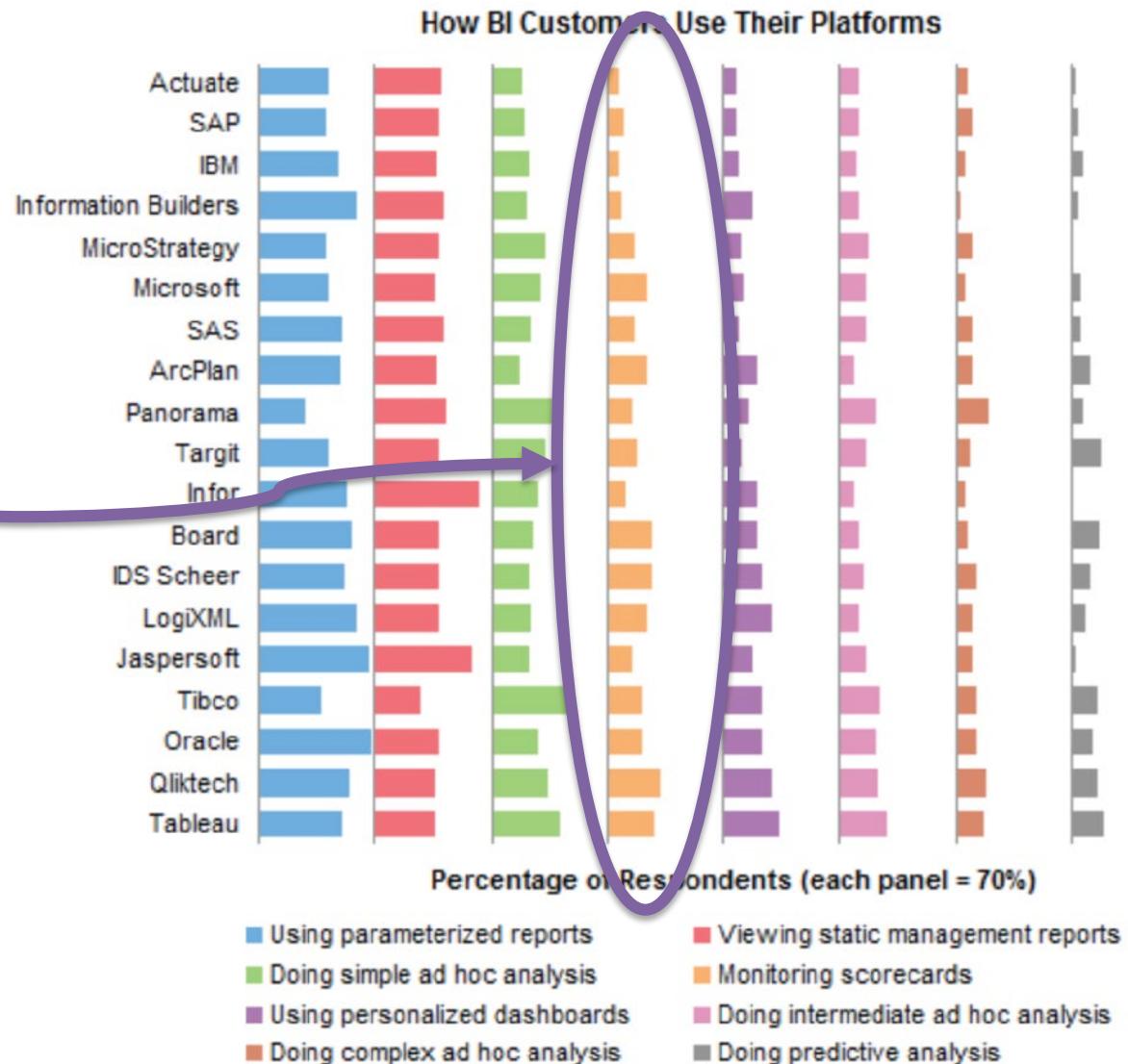
Comparison. Placement

Smallest?



Comparison. Placement

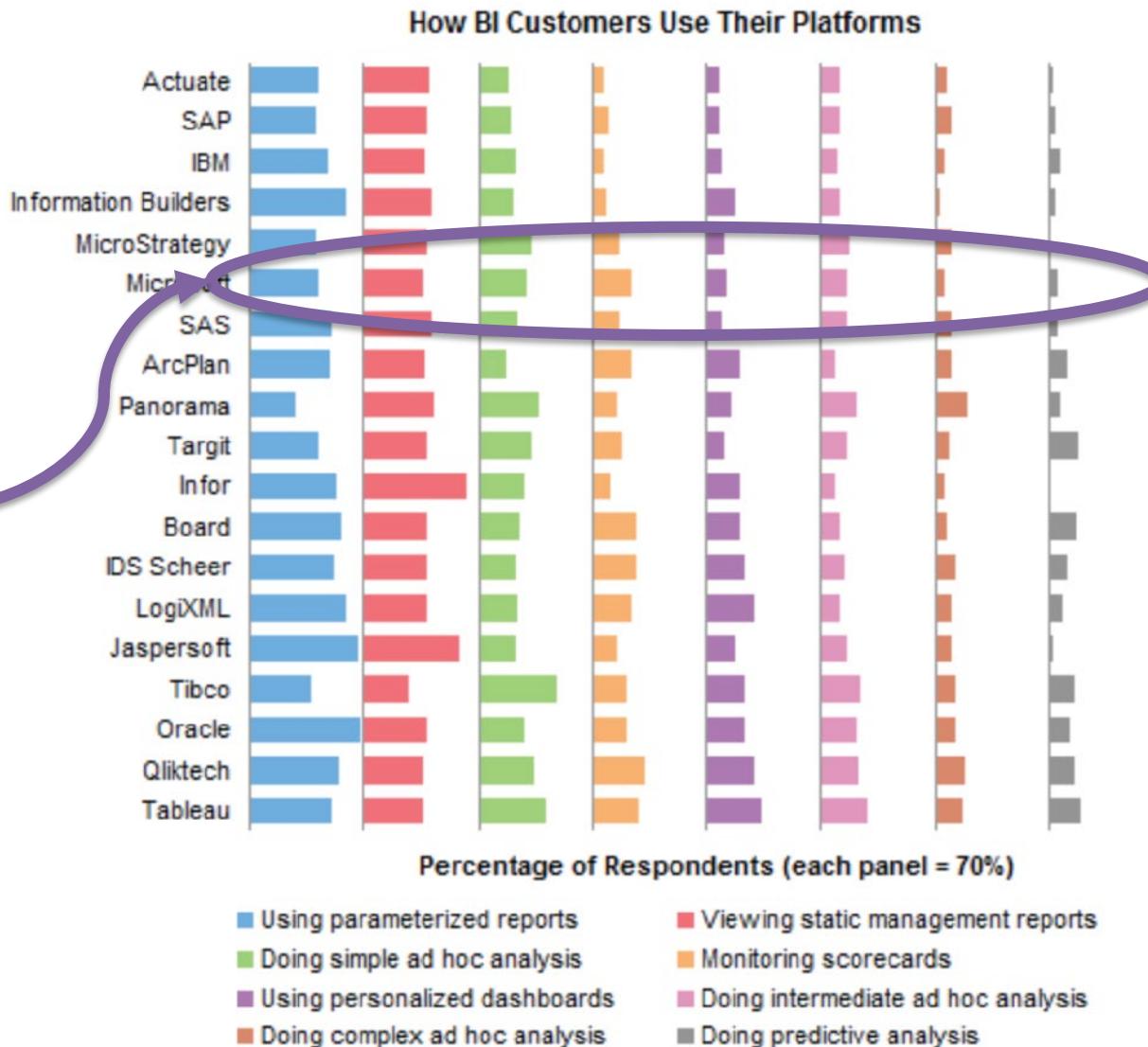
Largest?



<https://venngage.com/blog/how-to-choose-the-best-charts-for-your-infographic/>

Comparison. Placement

Largest?



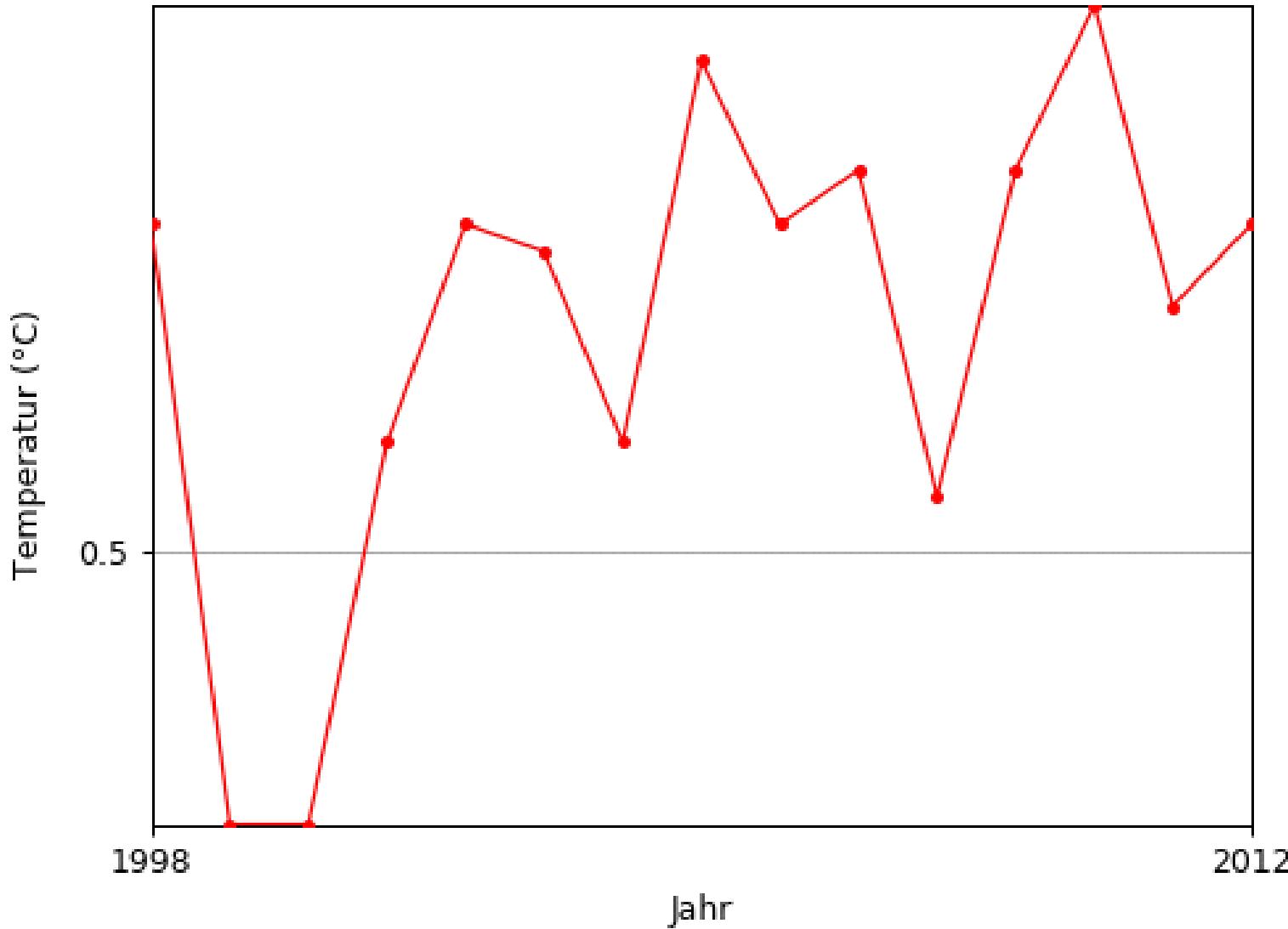
<https://venngage.com/blog/how-to-choose-the-best-charts-for-your-infographic/>

Comparison. Whole story

- Tell the whole story
 - Omitting data may be misleading
 - But extra data can also be misleading

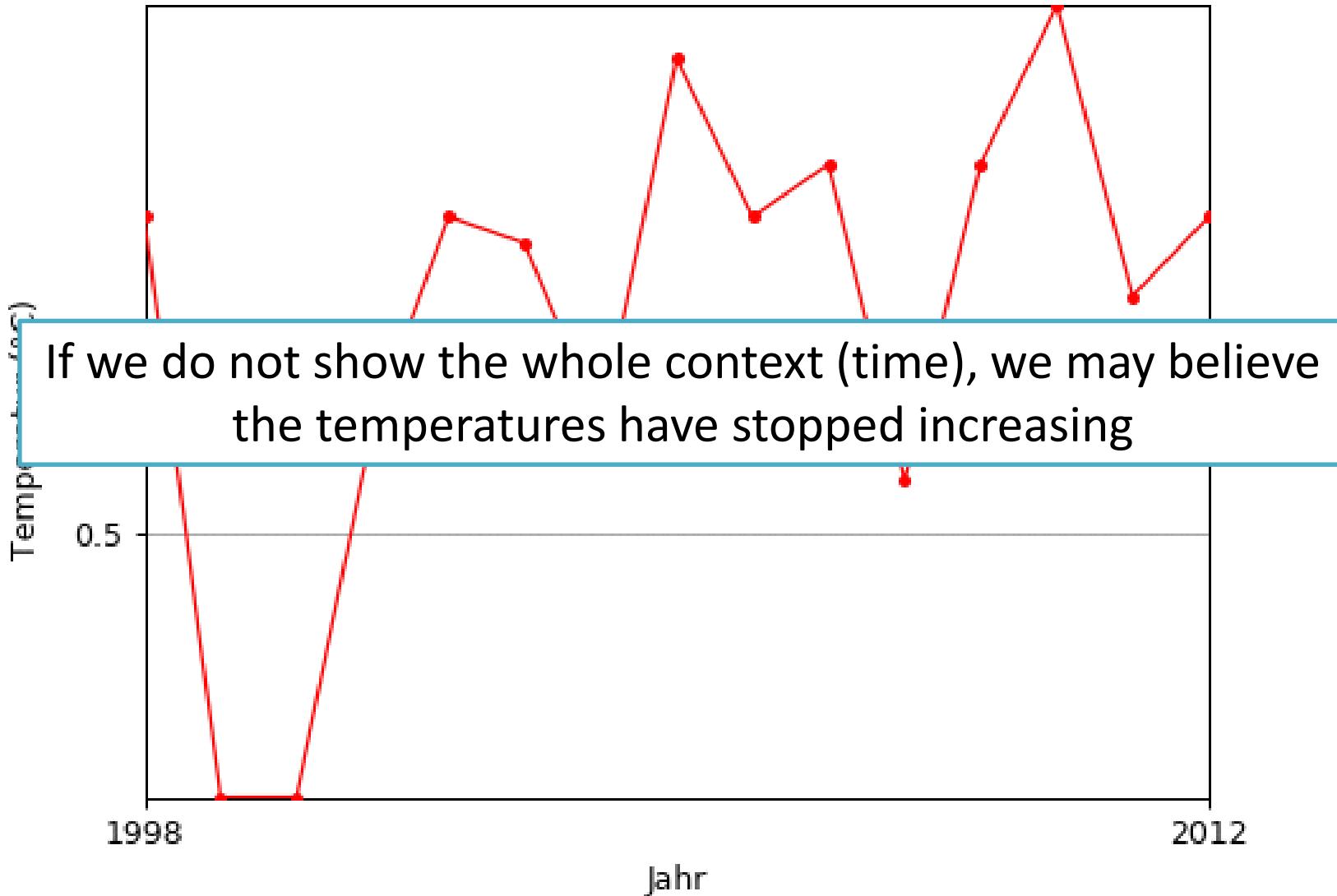
Comparison. Whole story

Vermeintlicher Stillstand der Erwärmung
der Erdoberfläche (1998 - 2012)

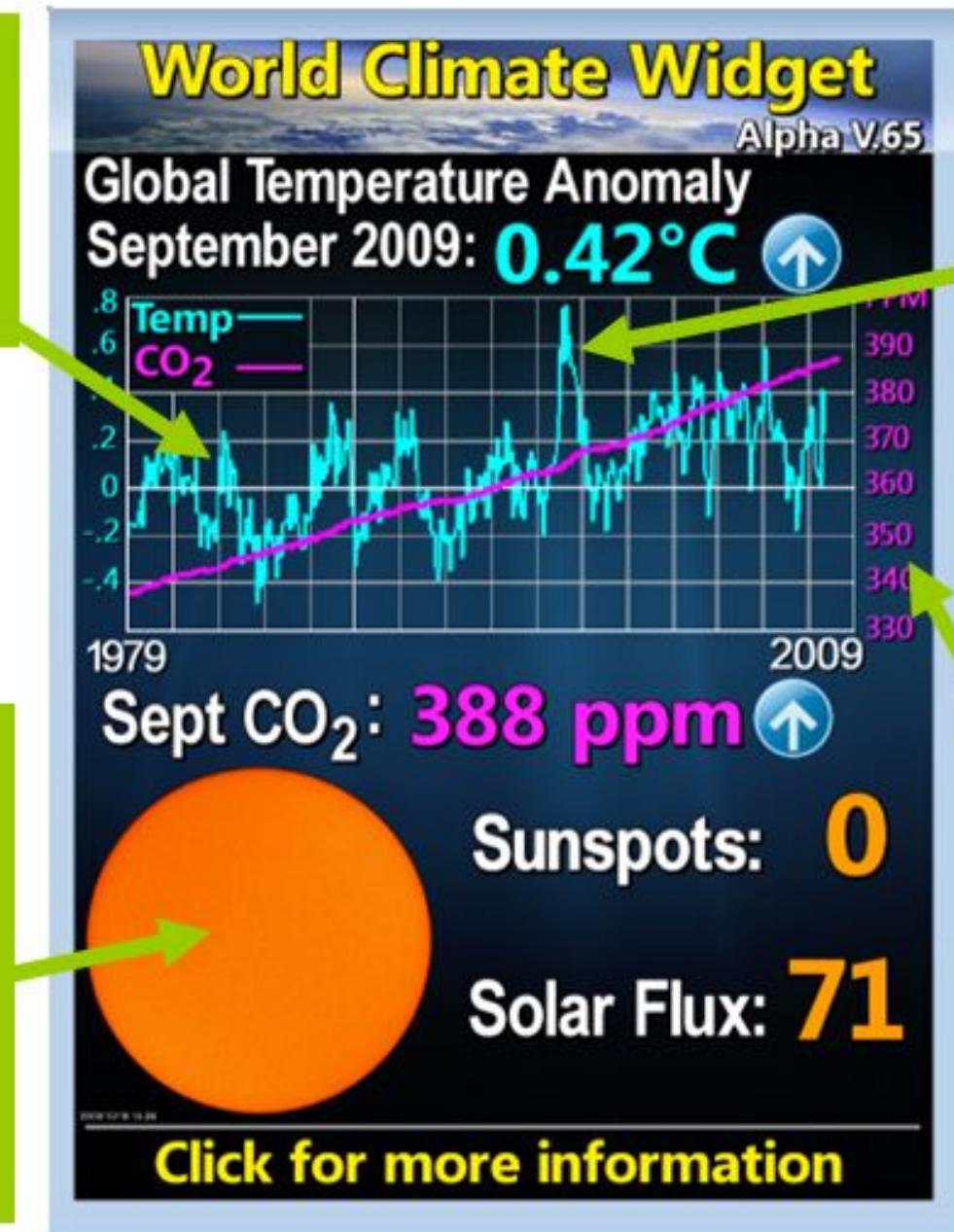


Comparison. Whole story

Vermeintlicher Stillstand der Erwärmung
der Erdoberfläche (1998 - 2012)



Ploy #1: Monthly data are shown. These show large variations due to the weather, so the trend looks relatively small.



Ploy #2: Shown is not the surface temperature but that from several km up in the troposphere. This shows larger variability, e.g. the El Niño peak of 1998 is twice as high as at the surface. This makes the climate trend look smaller.

Ploy #4: A snapshot of the sun and the daily sunspot number suggests an important role of the sun. Not shown is the time series of sunspot numbers which shows it has almost nothing to do with global temperature.

Ploy #3: A scale is chosen where the CO₂ rise appears much too steep. 70 ppm corresponds to 1.4 °C; that is about two and a half times faster than the relation predicted by climate science.

Outline

- *Effective Visualizations*
- *Use of color*
- *Comparison*
- **Copy & labels**
- Ordering & aligning data

Copy & labels

- Copy refers to the text font, size, color...
 - We can use font changes to emphasize information, headings, etc.
- Some tips:
 - Use only the minimum amount of text
 - Don't over explain
 - Keep headers simple
 - Use contrast effectively
 - Don't use distracting fonts/elements

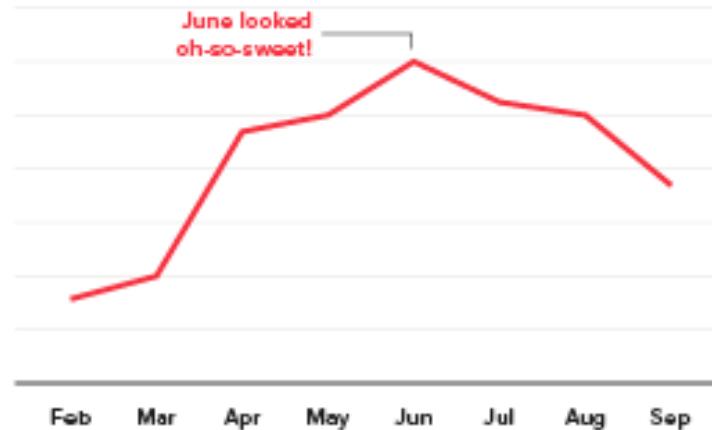
Copy & labels. Minimum amount of text



INCORRECT

A Fruitastic Sales Season

Strawberry season never looked better!



CORRECT

Strawberry Sales, by Month



Copy & labels. Contrast

- Use contrast effectively

Reeder 2

Screenshots

Contact

Overview

Syncing

Offline

Services

Reading

while syncing. Or in more technical terms, Reeder doesn't depend on CoreData anymore by using SQLite directly.

So, there is better performance, what else will make Reeder 2.0 so much better than 1.2? Well, let's start with...

State saving

Finally, Reeder will remember where it was last time you used it. When quitting the app, Reeder will save its state and restore it on relaunch. No need to panic anymore if you get a phone call while reading an article.

Copy & labels. Contrast

- Problems with contrast
 - Elderly users with bad vision
 - Low quality monitors
 - Bad lighting conditions and glare
 - Reading on tiny screens

Copy & labels. Contrast

- Reading on a computer screen is harder than reading printed material (e.g. <https://www.nngroup.com/articles/how-little-do-users-read/>)
 - Reading time is lower when there is high contrast between text and background
 - Mobile is worse (e.g. <https://www.nngroup.com/articles/mobile-content/>)

Copy & labels

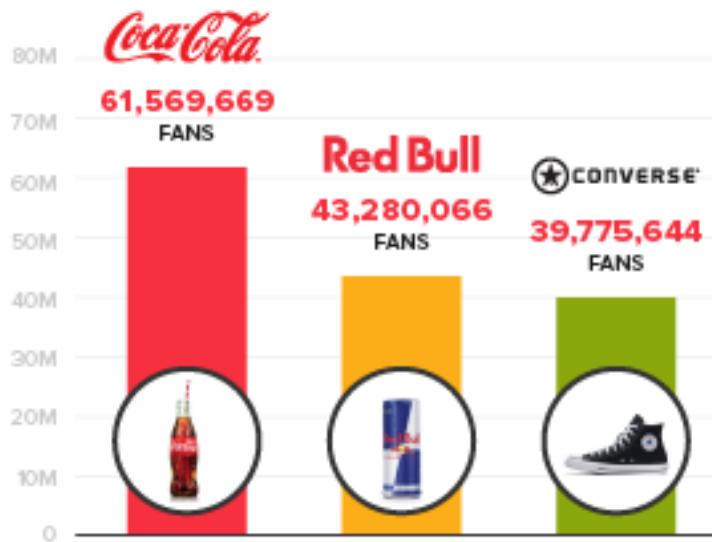
- Labels: Text that identifies elements
- Some tips:
 - Ensure that everything is labeled
 - Ensure labels are visible
 - Label the lines directly
 - Don't over label

Copy & labels. Don't over label



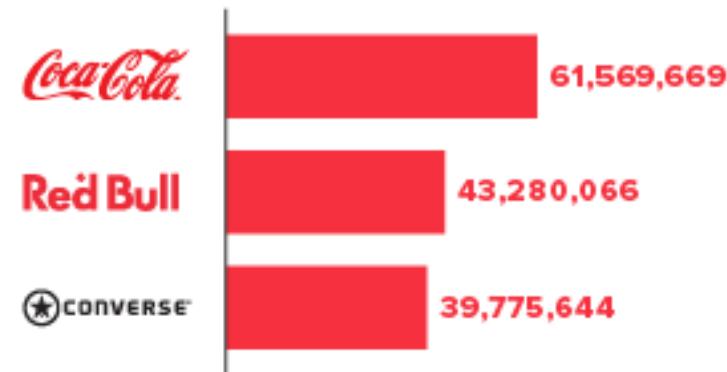
INCORRECT

Top 3 Most Popular Brands on Facebook



CORRECT

Top 3 Most Popular Brands on Facebook



Outline

- *Effective Visualizations*
- *Use of color*
- *Comparison*
- *Copy & labels*
- **Ordering & aligning data**

Ordering data

- LATCH principle. Information organized according to:
 - Location: Information comes from different places (e.g. geographically)
 - Alphabet: Usually for large amounts of data
 - Time: Events with fixed durations
 - Category: To classify goods/elements of similar importance
 - Hierarchy: By magnitude, order of importance

Aligning data

- Correct alignment
 - Elements must be aligned, this creates a sense of unity and cohesion, as well as facilitates reading
 - Incorrect alignment can lead to dramatic consequences...

1
OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

ELECTORS FOR PRESIDENT AND VICE PRESIDENT (A vote for the candidates will actually be a vote for their electors.) (Vote for Group)	(REPUBLICAN)	
	GEORGE W. BUSH - PRESIDENT	3 →
	DICK CHENEY - VICE PRESIDENT	
	(DEMOCRATIC)	
	AL GORE - PRESIDENT	5 →
	JOE LIEBERMAN - VICE PRESIDENT	
	(LIBERTARIAN)	
	HARRY BROWNE - PRESIDENT	7 →
	ART OLIVIER - VICE PRESIDENT	
	(GREEN)	
RALPH NADER - PRESIDENT	9 →	
WINONA LaDUKE - VICE PRESIDENT		
(SOCIALIST WORKERS)		
JAMES HARRIS - PRESIDENT	11 →	
MARGARET TROWE - VICE PRESIDENT		
(NATURAL LAW)		
JOHN HAGELIN - PRESIDENT	13 →	
NAT GOLDHABER - VICE PRESIDENT		



1-8
OFFICIAL BALLOT, GENERAL ELECTION
PALM BEACH COUNTY, FLORIDA
NOVEMBER 7, 2000

(REFORM)	
PAT BUCHANAN - PRESIDENT	
EZOLA FOSTER - VICE PRESIDENT	
(SOCIALIST)	
DAVID McREYNOLDS - PRESIDENT	
MARY CAL HOLLIS - VICE PRESIDENT	
(CONSTITUTION)	
HOWARD PHILLIPS - PRESIDENT	
J. CURTIS FRAZIER - VICE PRESIDENT	
(WORKERS WORLD)	
MONICA MOOREHEAD - PRESIDENT	
GLORIA La RIVA - VICE PRESIDENT	
WRITE-IN CANDIDATE	
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.	

LEGISLATIVE CANDIDATES

CONSTITUTIONAL AMENDMENT & OTHER MEASURES

JUDICIAL CANDIDATES

TURN PAGE TO CONTINUE VOTING

CONSTITUTIONAL AMENDMENT & OTHER MEASURES

JUDICIAL CANDIDATES

CONSTITUTIONAL AMENDMENT & OTHER MEASURES

Confusion at Palm Beach County polls

Some Al Gore supporters may have mistakenly voted for Pat Buchanan because of the ballot's design.

Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.

Punching the second hole casts a vote for the Reform party.

ELECTORS FOR PRESIDENT AND VICE PRESIDENT (A vote for the candidates will actually be a vote for their electors.) (Note for Group)	(REPUBLICAN)	
	GEORGE W. BUSH - PRESIDENT	3 ➔
	DICK CHENEY - VICE PRESIDENT	
	<hr/>	
	(DEMOCRATIC)	
	AL GORE - PRESIDENT	5 ➔
	JOE LIEBERMAN - VICE PRESIDENT	
	<hr/>	
	(LIBERTARIAN)	
	HARRY BROWNE - PRESIDENT	7 ➔
ART OLIVIER - VICE PRESIDENT		
<hr/>		
(GREEN)		
RALPH NADER - PRESIDENT	9 ➔	
WINONA LaDUKE - VICE PRESIDENT		
<hr/>		
(SOCIALIST WORKERS)		
JAMES HARRIS - PRESIDENT	11 ➔	
MARGARET TROWIE - VICE PRESIDENT		
<hr/>		
(NATURAL LAW)		
JOHN HAGELIN - PRESIDENT	13 ➔	
NAT GOLDHABER - VICE PRESIDENT		
<hr/>		
WRITE-IN CANDIDATE		
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Sun-Sentinel graphic

Sources of information

- Information take from slides/webpages/books by: Martin Krzywinski, colorbrewer2.org, towardsdatascience.com, E. Tufte...

Designing Effective Visualizations. Practical guidelines

Pere-Pau Vázquez – Dept.
Computer Science – UPC