

Step 10 Visualisation

Carlos Moura

COIN 2018 - 16th JRC Annual Training on Composite Indicators & Scoreboards
05-07/11/2018, Ispra (IT)

Effective communication through visualization

Why investing on visual information?

Effective communication through visualization

How many P's can you find in the text?

A M C D F G O I S H P O F Q H O P I U O I U L F K S D K
F K F J Z F C P T H B M U G I N D I C A T O R S D H D X
B E W Z C O M P O S I T E A E T F R J L M N O J K P B R
L A D X O G F J E I L K S A P R P U E D G H M X O Q B I

Effective communication through visualization

How many P's can you find in the text?

A M C D F G O I S H **P** O F Q H O **P** I U O I U L F K S D K
F K F J Z F C **P** T H B M U G I N D I C A T O R S D H D X
B E W Z C O M **P** O S I T E A E T F R J L M N O J K **P** B R
L A D X O G F J E I L K S A **P** R **P** U E D G H M X O Q B I

Effective communication through visualization

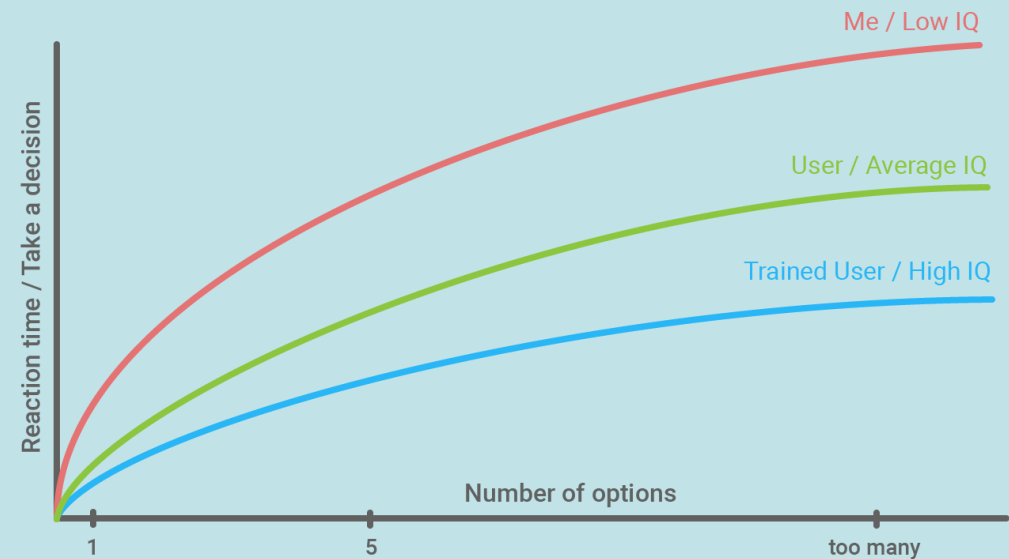
*Visualization uses **perception** to free cognition*

Effective communication through visualization

*Visualization uses **perception** to free cognition*

Effective communication through visualization

- Gestalt psychology
- Miller's law – The number of objects an average person can hold in working memory is about seven [Also known as the magical number Seven, plus or minus two]
- Hick's law – Describes the time it takes for a person to make a decision as a result of the possible choices available: Increasing the number of choices will increase the decision time logarithmically



Gestalt psychology

Set of laws that accounts for how we perceive or intuit patterns and conclusions from the things we see.

It allows for

- Better understanding of human perception
- Achieving better visuals
- Speeding up development by removing trial and error.

Visual perception and the Principles of Gestalt

Emergence – forming complex patterns from simple rules.



Can you see the cow?

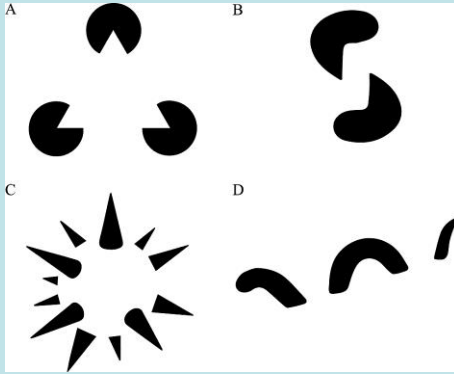
Visual perception and the Principles of Gestalt

Emergence – forming complex patterns from simple rules.

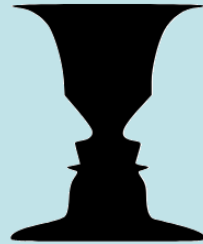
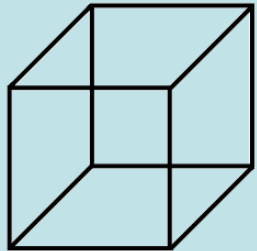


Visual perception and the Principles of Gestalt

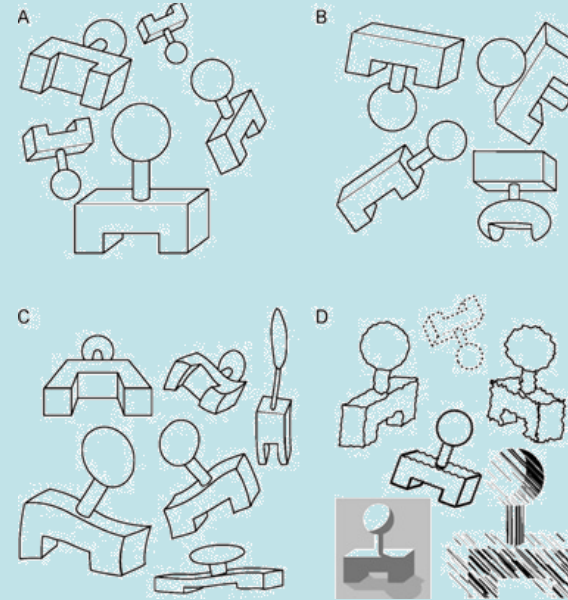
- **Reification** - The perceived experience contains more information than the sensorial stimulus.



- **Multistability** - Ambiguous perceptual experiences to pop back and forth between alternative interpretations.

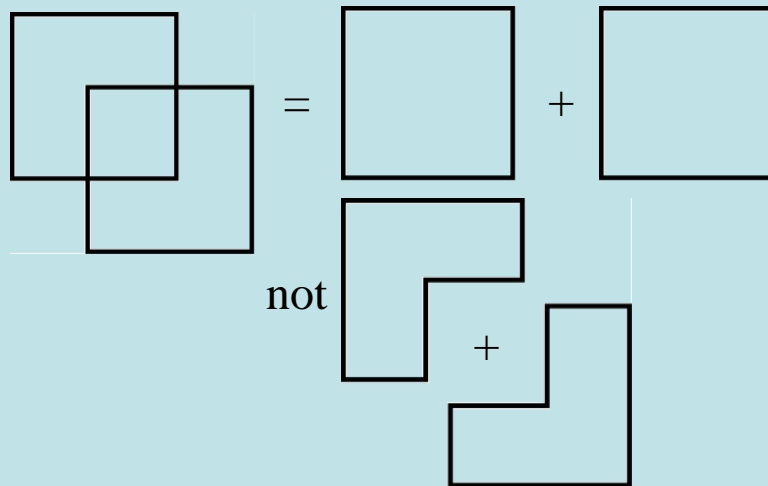


- **Invariance** - Simple objects are recognized independent of rotation, translation and scale.

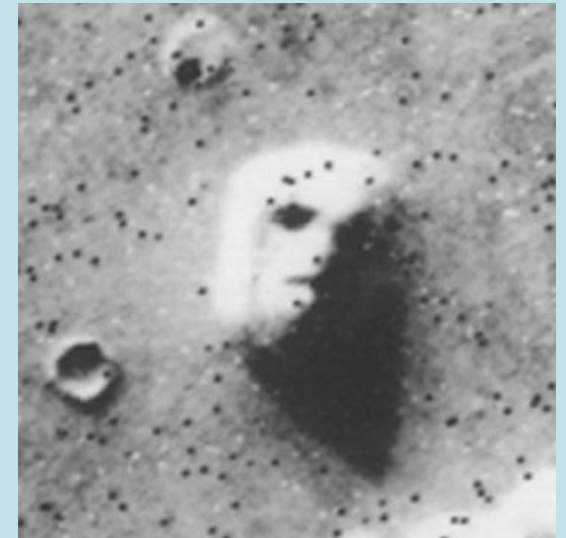
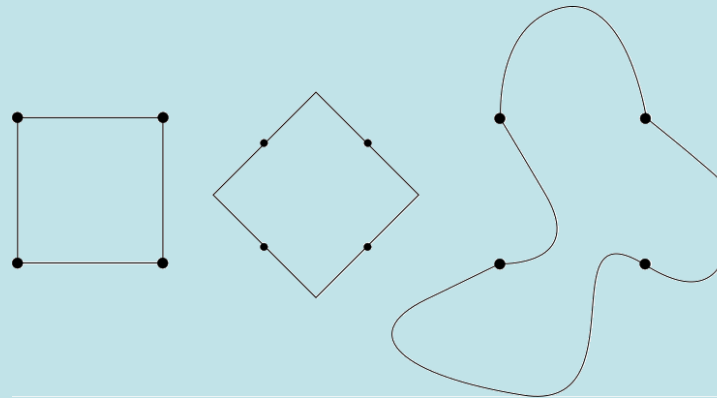


Pragnanz – Simplicity is the key

People will perceive and interpret ambiguous or complex images as the simplest and complete form(s) possible.



Because it's the interpretation that requires the least cognitive effort



Pragnanz – Simplicity is the key

The logo for the original Google search engine, featuring the word "Google!" in a large, colorful, 3D-style font.

Search the web using Google!

10 results

Google Search

I'm feeling lucky

Index contains ~25 million pages (soon to be much bigger)

[About Google!](#)

[Stanford Search](#) [Linux Search](#)

Get Google! updates monthly!

your e-mail

Subscribe

[Archive](#)

Copyright ©1997-8 Stanford University

The modern Google logo, featuring the word "Google" in a clean, sans-serif font with its characteristic colors.

|

Google Search

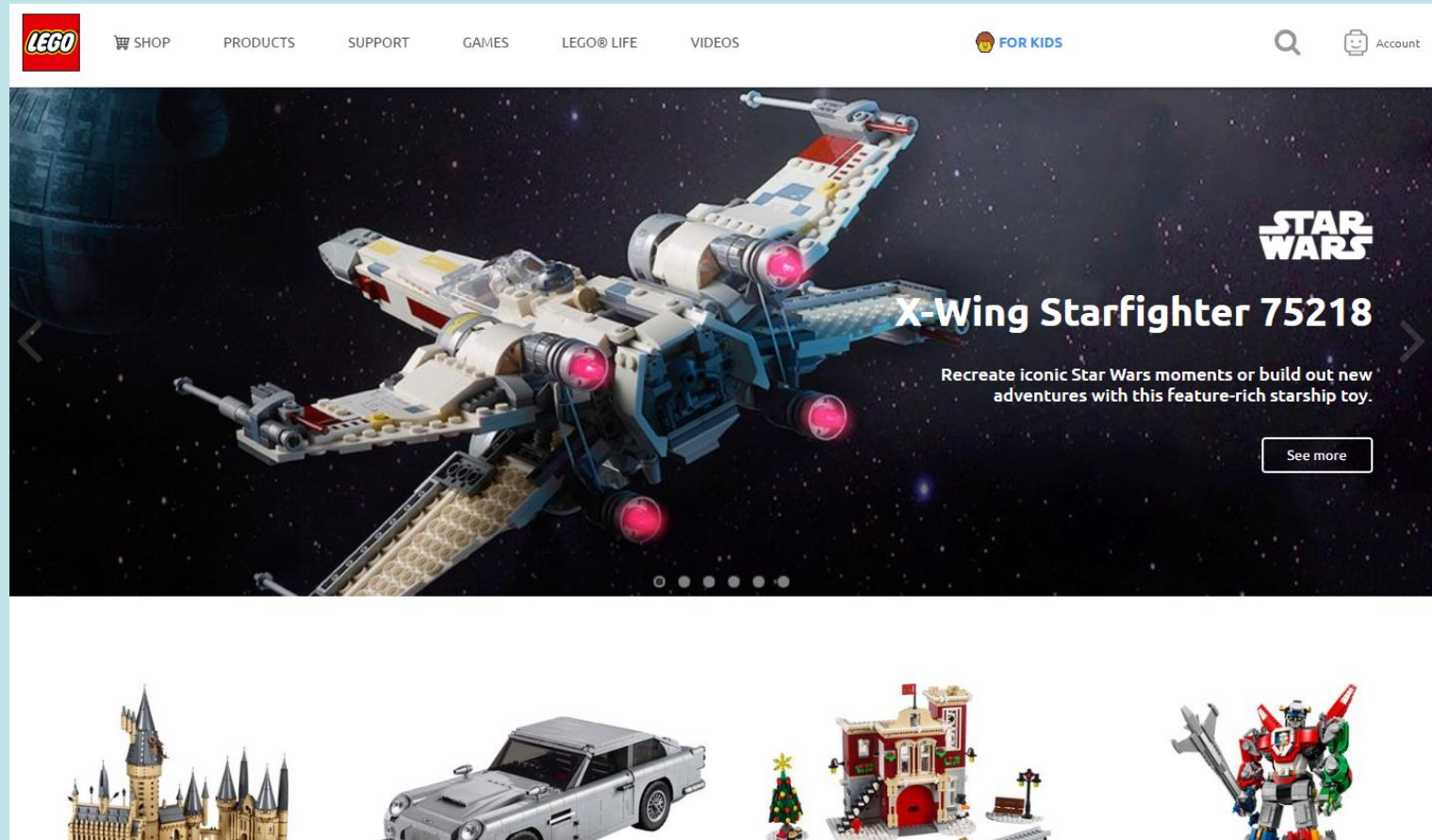
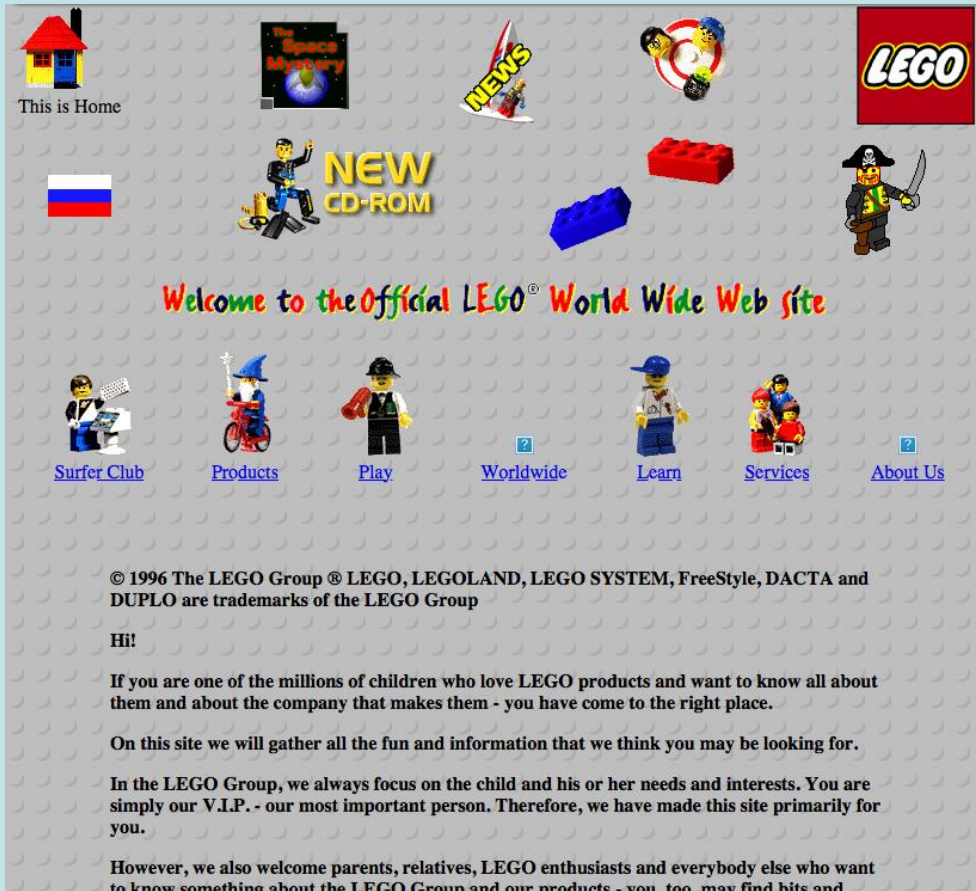
I'm Feeling Lucky

Google offered in: Italiano



European
Commission

Pragnanz – Simplicity is the key



Pragnanz – Simplicity is the key



The screenshot shows the original Apple website from July 1997. The layout is clean and minimalist, with a red sidebar on the left containing navigation links like 'Find It', 'Product Information', 'Customer Support', 'Technology & Research', 'Developer World', 'Groups & Interests', 'Resources Online', 'About Apple', 'Where to Buy', 'Register to Win', 'Software Updates', and 'Home Page Archives'. The main content area features a 'Welcome to Apple' header with the rainbow logo. Below this, there are several promotional banners: 'Introducing CyberDrive' with a CD-ROM image, 'EMATE 300' with a laptop image, 'MOVIES FROM MARS' with a QuickTime VR image, and 'Preorder Mac OS 8' with a text description. A 'What's Hot' section is also visible at the bottom.

Find It

Product Information

Customer Support

Technology & Research

Developer World

Groups & Interests

Resources Online

About Apple

Apple Sites Worldwide

Asia

Australia

Belgium

Canada

Chile

Go

Where to Buy

Register to Win

Software Updates

Home Page Archives

WELCOME TO APPLE

Introducing CyberDrive

Register today for a free CD-ROM.

EMATE 300

Mobile, Affordable, & Smart

MOVIES FROM MARS

QuickTime VR Takes You Out of this World

What's Hot

Preorder Mac OS 8

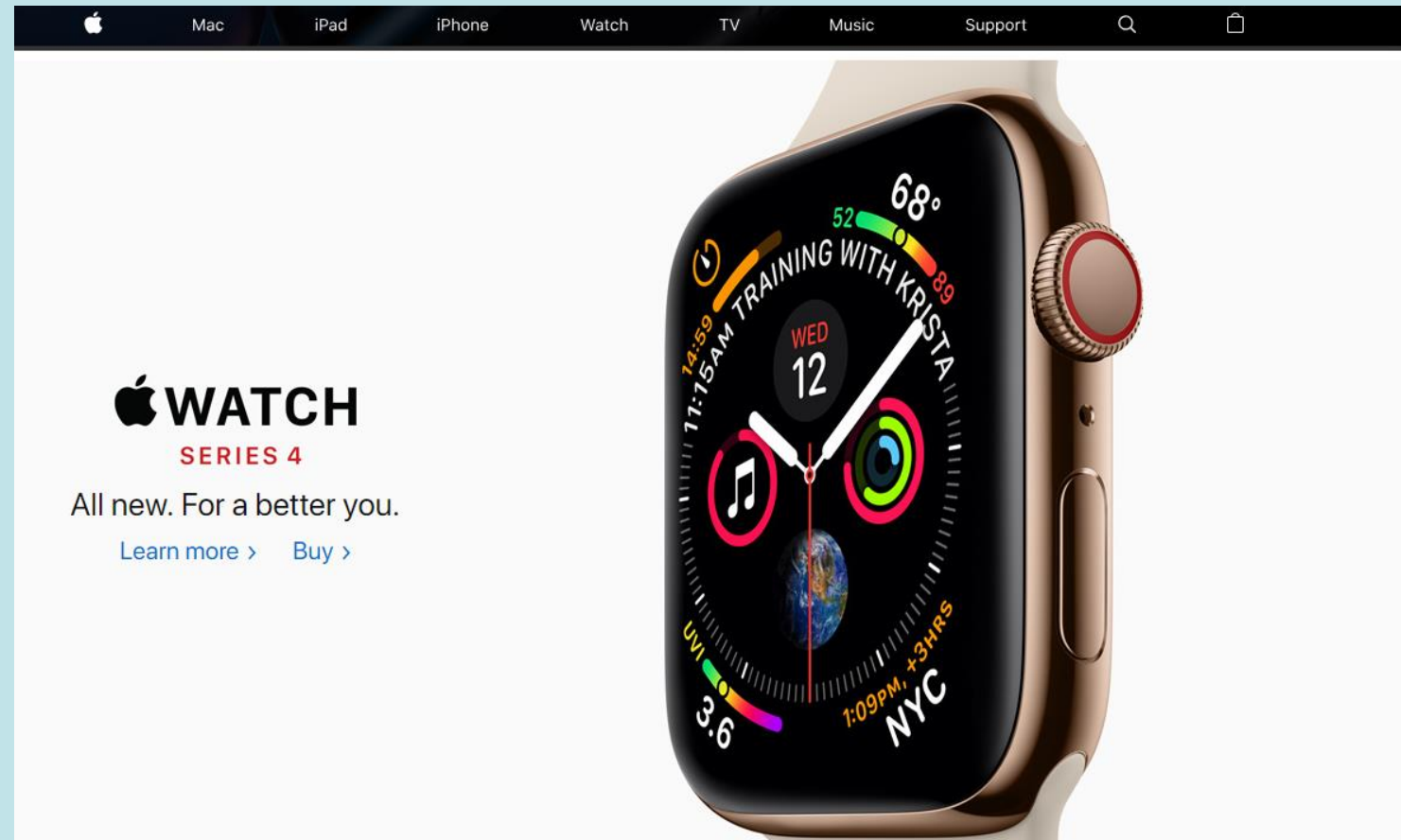
Now you can [preorder Mac OS 8](#), described by Macworld as "the most comprehensive update to the Mac OS in years, sporting a bold new look, a speedier Finder, more shortcuts and integrated Internet functions."

Be the First to Know

Learn about new Macintosh software releases the moment they become available. Check [Hot Mac Products](#) to hear about programs like Speed Demon, ReBirth RB-338 and QuickCRC.

Newton Connects

Newton, Inc., will enhance network connectivity for Newton-based devices this fall via [Newton Internet Enabler 2.0](#). Ethernet capability can connect



The screenshot shows the Apple Watch Series 4 product page. The top navigation bar includes links for Mac, iPad, iPhone, Watch, TV, Music, and Support, along with a search icon and a shopping bag icon. The main content area features a large image of an Apple Watch Series 4 with a black face and a gold case. The watch face displays various complications, including a clock, a weather widget showing 68°F, a music widget, a calendar widget showing 'WED 12', and a world clock widget for NYC. Below the watch image, the text 'Apple WATCH SERIES 4' is displayed, followed by the tagline 'All new. For a better you.' and two links: 'Learn more >' and 'Buy >'.

Mac iPad iPhone Watch TV Music Support

Apple WATCH

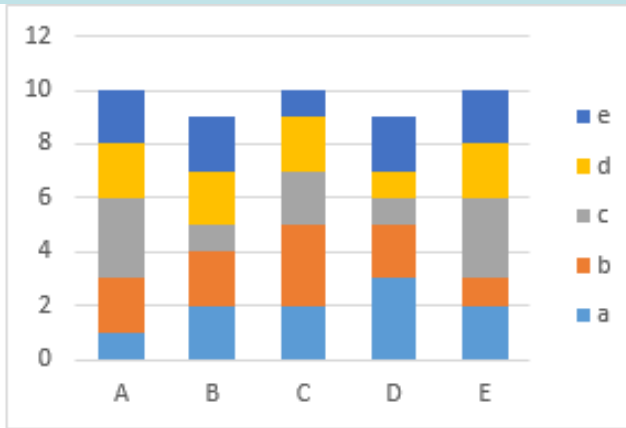
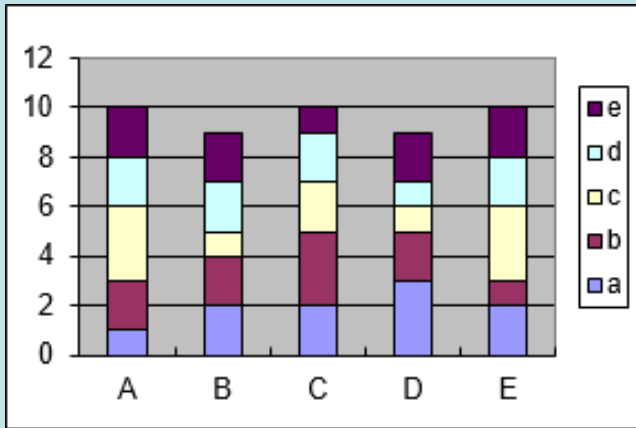
SERIES 4

All new. For a better you.

[Learn more >](#) [Buy >](#)

Pragnanz – Simplicity is the key

Excel 2003 vs Excel 2013



$$\text{Data-Ink ratio} = \frac{\text{data-ink}}{\text{total ink used to make the graphic}}$$

= 1 – proportion of a graphic that can be erased without loss of data-information

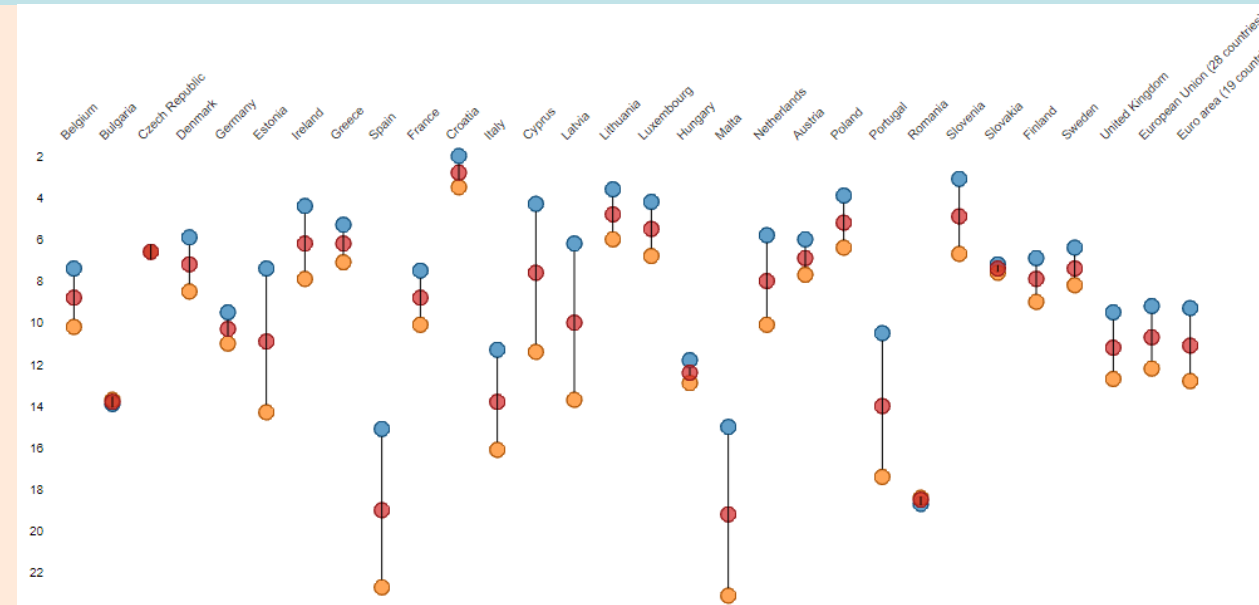
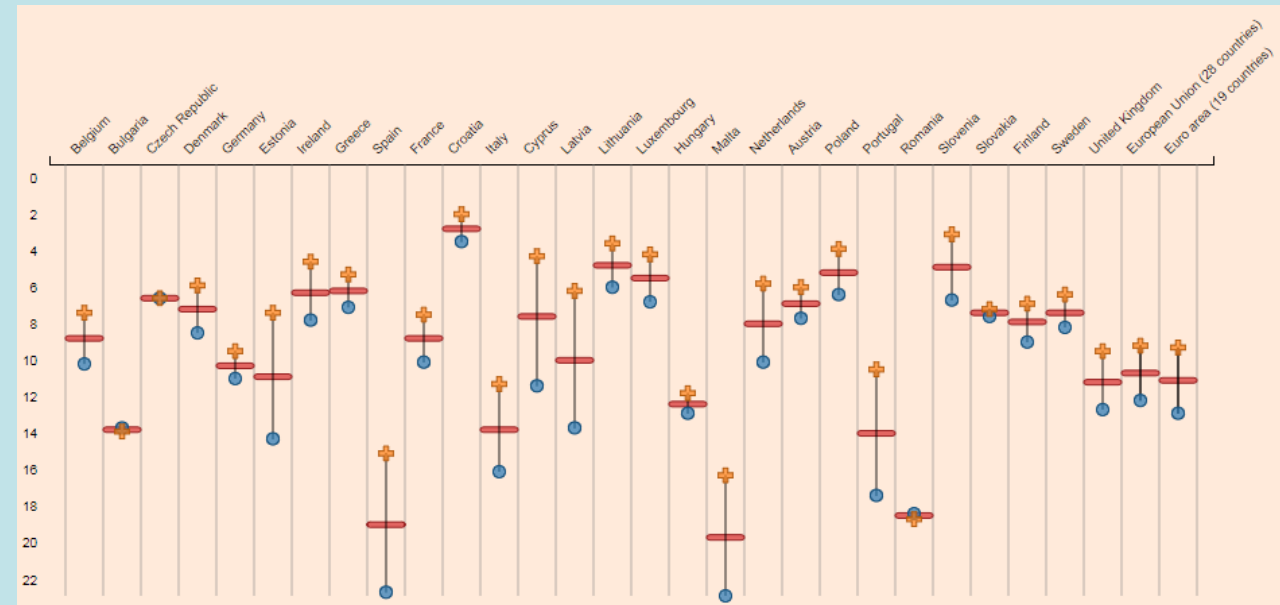
(Tufte, Edward – *The visual display of quantitative information*)

Some suggestions to reduce data-ink ratio:

- No 3d charts
- No backgrounds, shadows or gradients
- Remove gridlines, decoration, borders, fillcolors

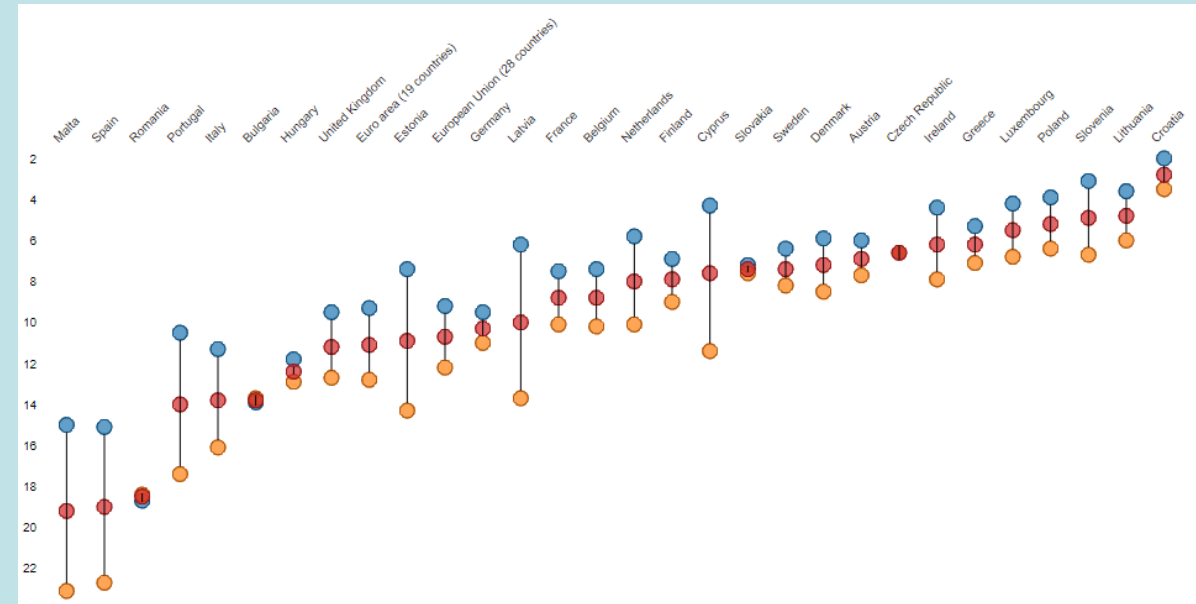
Pragnanz – Simplicity is the key

What can be removed from a chart while keeping the information?



Pragnanz – Simplicity is the key

An ordered chart is easier to read



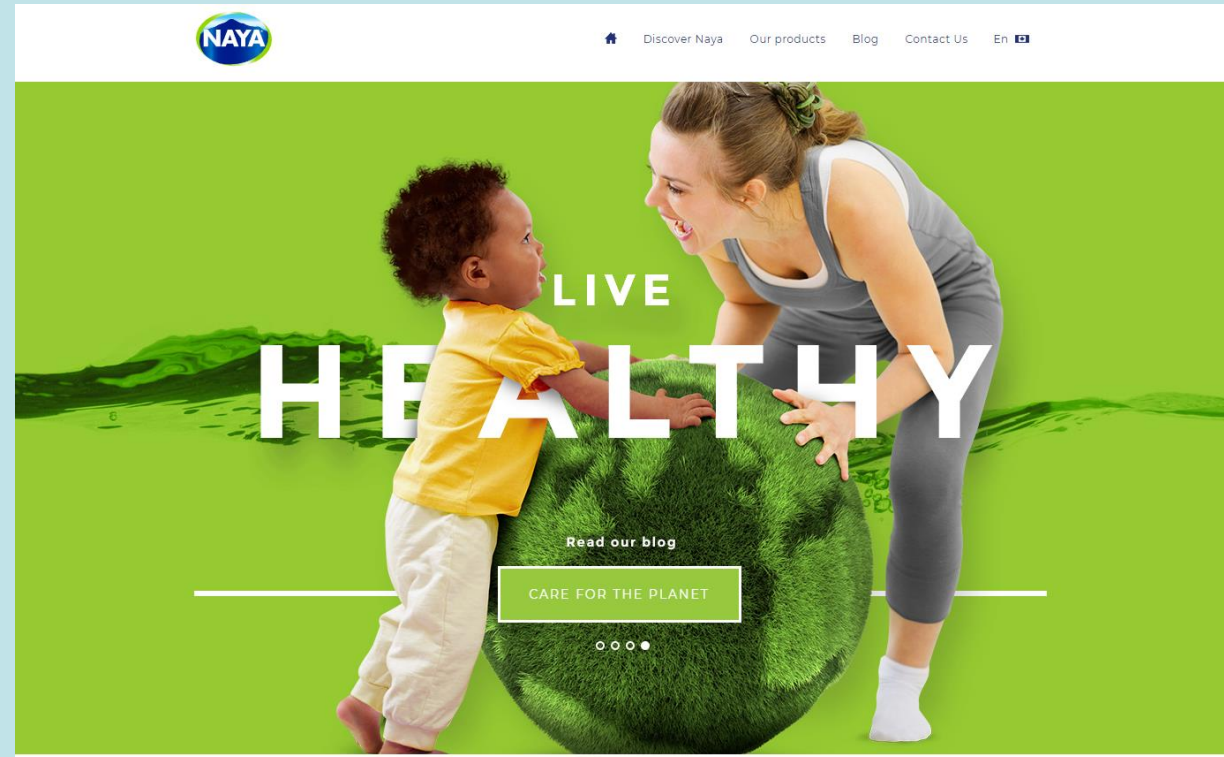
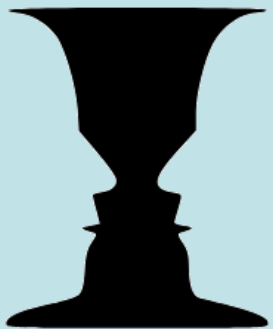
Gestalt principles

Figure-ground organization

The eye differentiates an object from its surroundings.

Objects are either classified as figure or ground.

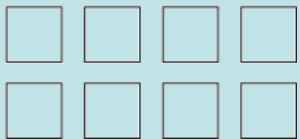
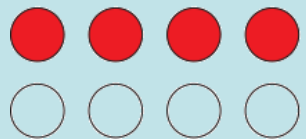
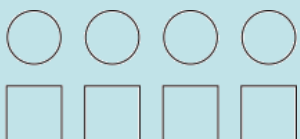
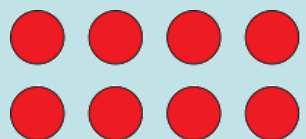
Balancing figure and ground can make the perceived image more clear.



Gestalt principles

Law of Proximity

Objects or shapes that are close to another appear to form groups.



European partners: Austria; Belgium; Bulgaria; Croatia; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; Netherlands; Norway; Poland; Portugal; Romania; Slovakia; Slovenia; Spain; Sweden; Switzerland; United Kingdom.

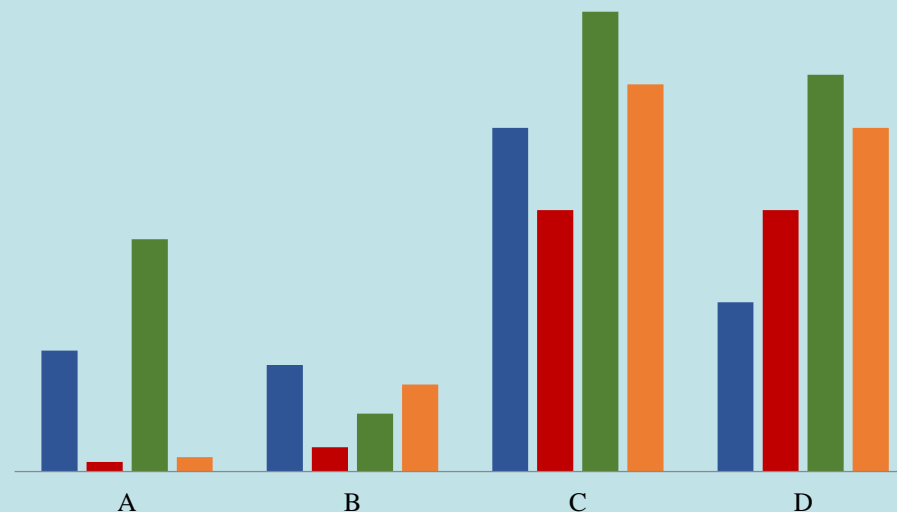
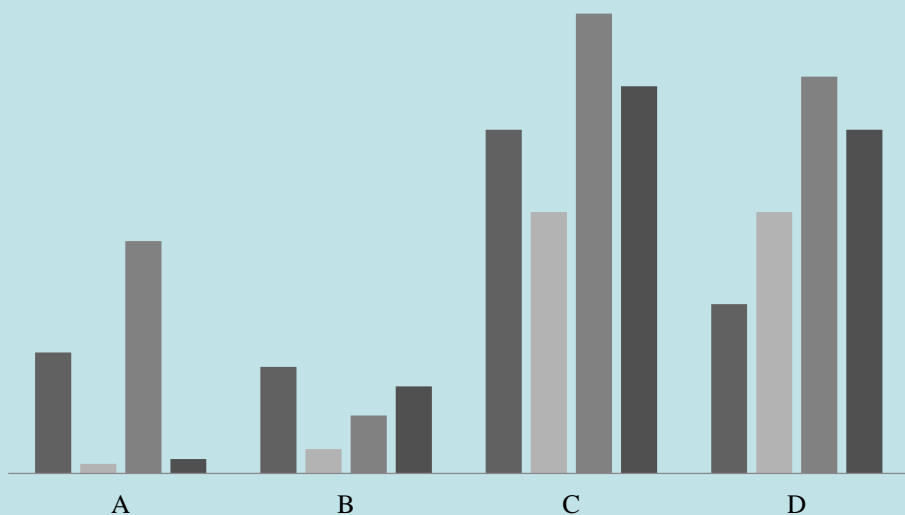
Asian partners: Australia; Bangladesh; Brunei Darussalam; Cambodia; China; India; Indonesia; Japan; Kazakhstan; Korea; Lao PDR; Malaysia; Mongolia; Myanmar; New Zealand; Pakistan; Philippines; Russian Federation; Singapore; Thailand; Vietnam.

ASEM report – p.14

Gestalt principles

Law of Proximity

Objects or shapes that are close to another appear to form groups.

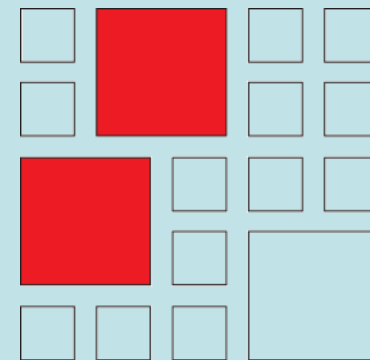
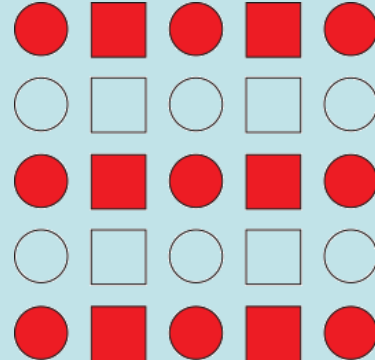
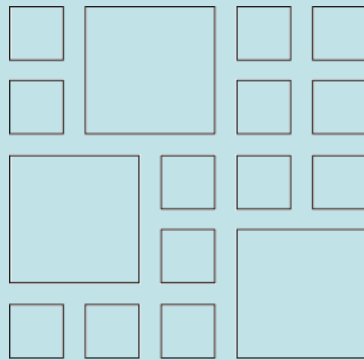
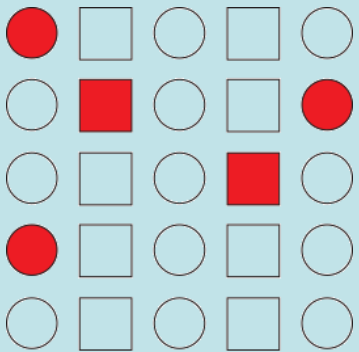


Gestalt principles

Law of Similarity

Elements that share similar characteristics are perceived as more related than elements that don't share those characteristics.

Similarity is particularly affected by color.

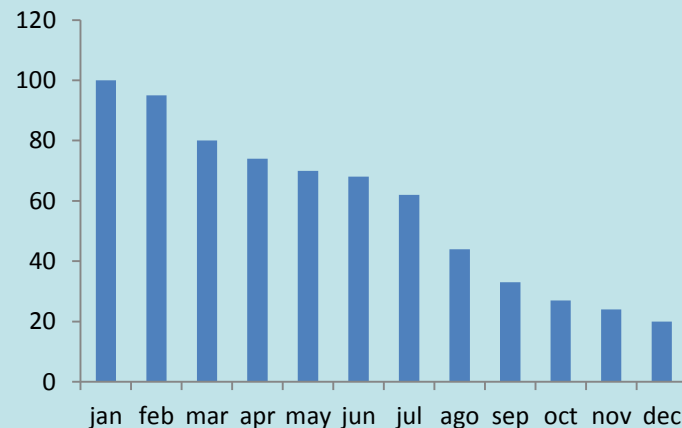
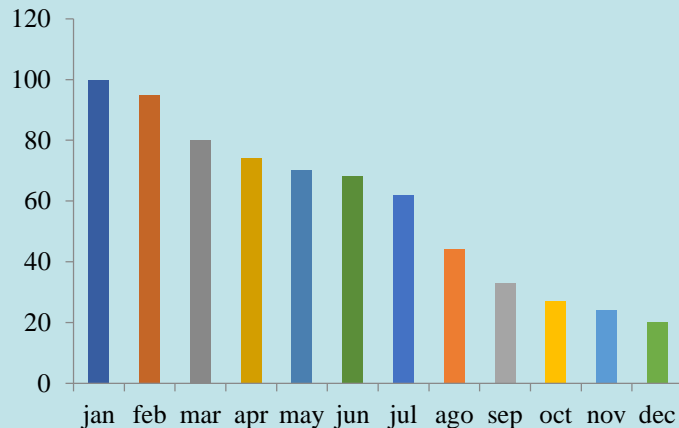


Gestalt principles

Law of Similarity

Elements that share similar characteristics are perceived as more related than elements that don't share those characteristics.

Similarity is particularly affected by color.



Gestalt principles

Law of Closure

The mind's tendency to see complete figures or forms even if a figure is incomplete, partially hidden by other objects or if part of the information is missing.

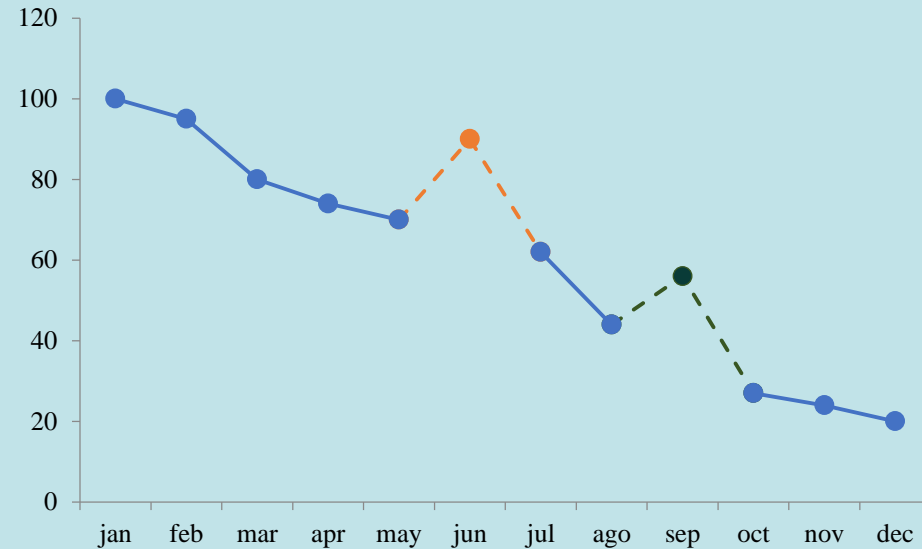
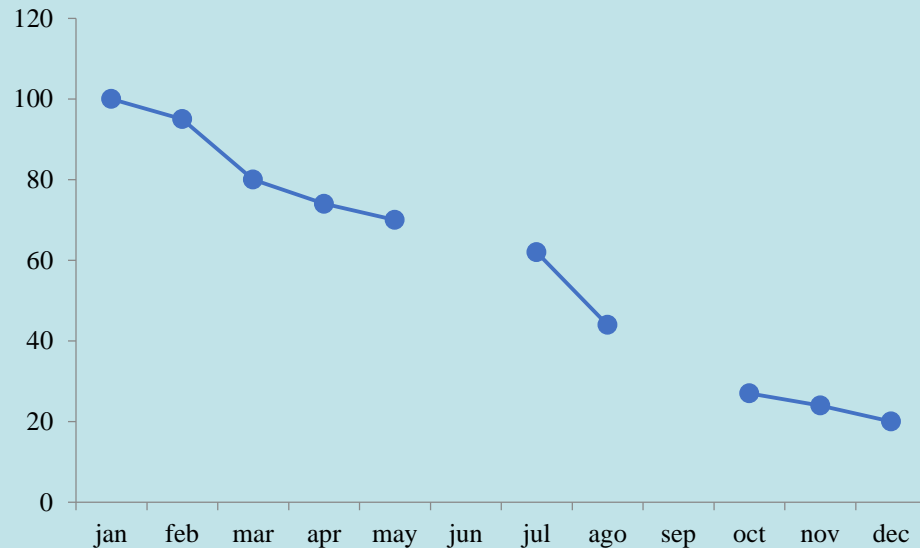


NBC logo 1956 vs 1986

Gestalt principles

Law of Closure

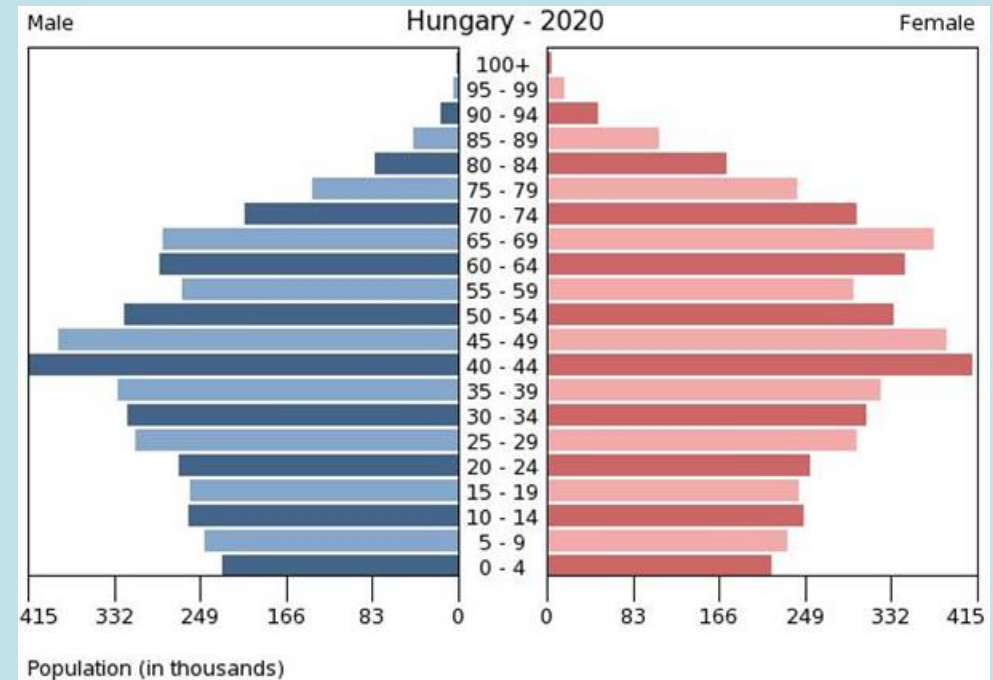
The mind's tendency to see complete figures or forms even if a figure is incomplete, partially hidden by other objects or if part of the information is missing.



Gestalt principles

Law of Symmetry

The mind perceives objects as being symmetrical and forming around a center point. When two symmetrical elements are unconnected the mind perceptually connects them to form a coherent shape.

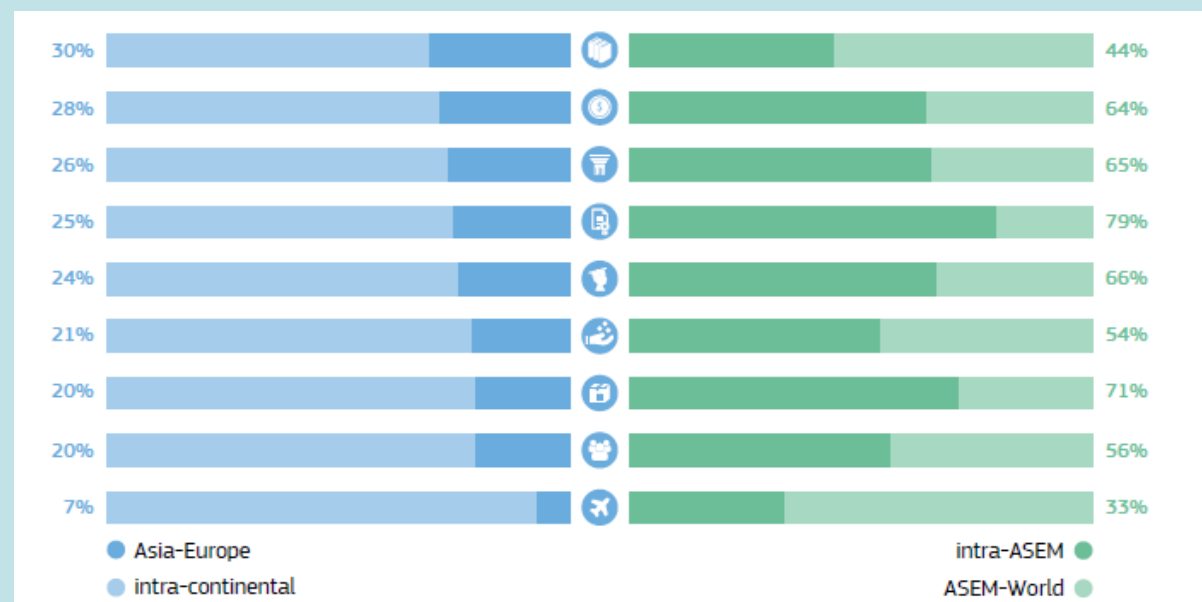


Gestalt principles

Law of Simetry



Cultural and Creative Cities Monitor report, p. 81



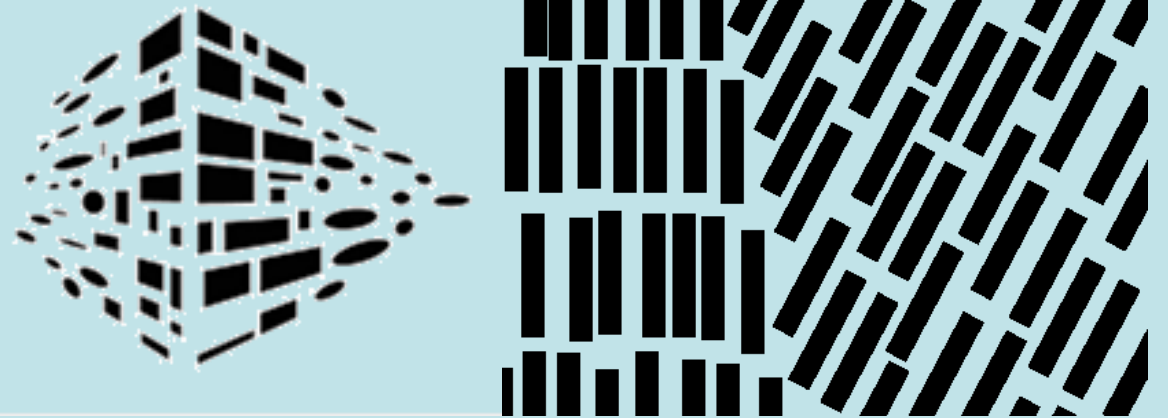
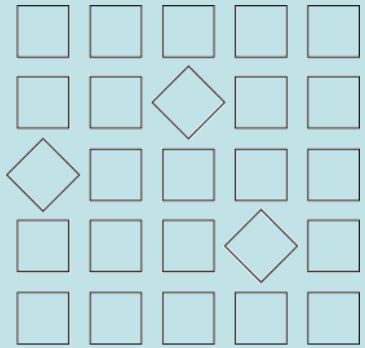
ASEM report – p.12

Gestalt principles

Law of Common fate

Visual elements moving in the same direction are perceived as being related to each other more than being related with others stationary or moving in a different direction.

Images can also relate to similarity by shape.

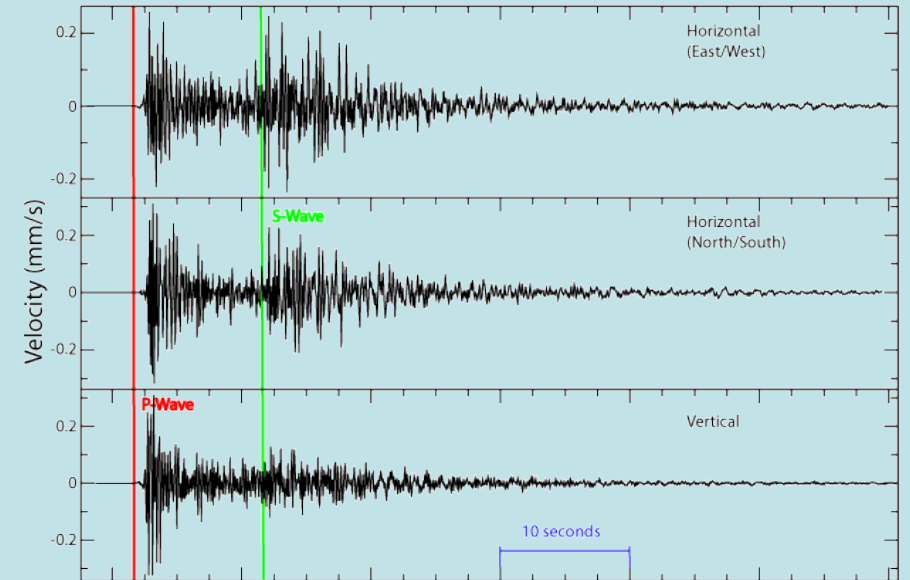
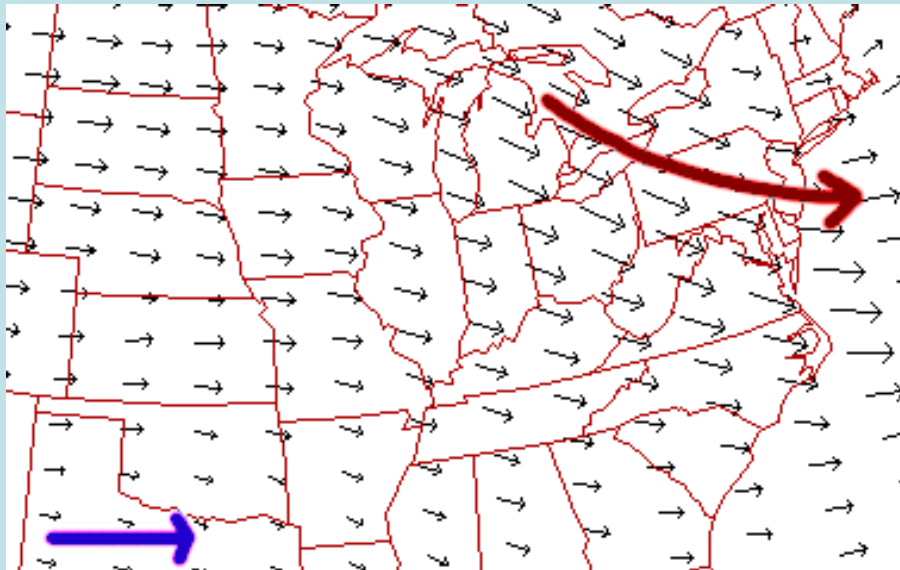


Gestalt principles

Law of Common fate

Visual elements moving in the same direction are perceived as being related to each other more than being related with others stationary or moving in a different direction.

Images can also relate to similarity by shape.



Gestalt principles

Law of Continuity

Elements tend to be grouped together if they are aligned within an object.

CONTENTS

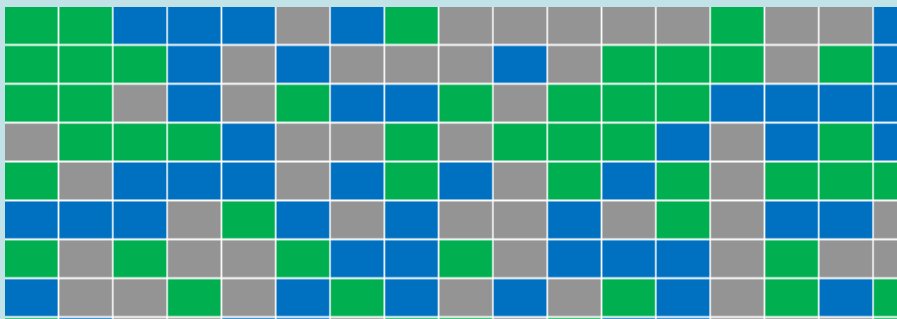
Foreword.....	5
Acknowledgements.....	6
Executive summary.....	7
1 Introduction.....	13
2 Measuring ASEM sustainable connectivity.....	19
2.1 Approach.....	
2.2 Conceptual framework.....	
2.3 Intensive and extensive connectivity.....	
3 The findings.....	
3.1 An interconnected ASEM.....	
3.1.1 Political ties.....	
3.1.2 International trade.....	
3.1.3 International finance.....	
3.1.4 Movement of people.....	
3.1.5 Research and innovation.....	
3.1.6 Energy flows.....	
3.1.7 Cultural trade.....	



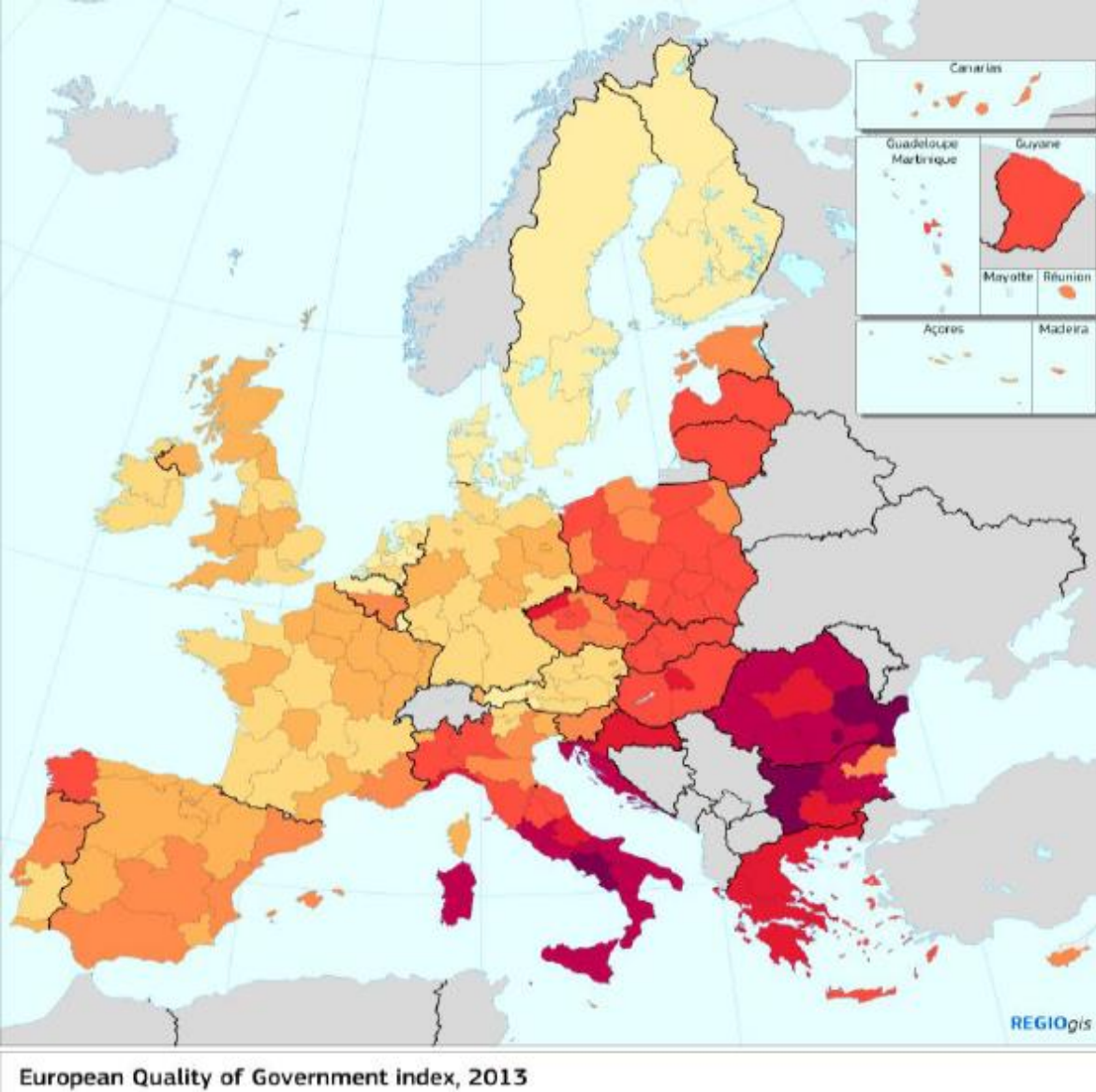
Gestalt principles

Law of Past experience (isomorphic correspondance)

Under some circumstances, visual stimuli are categorized according to past experience



Gestalt principles



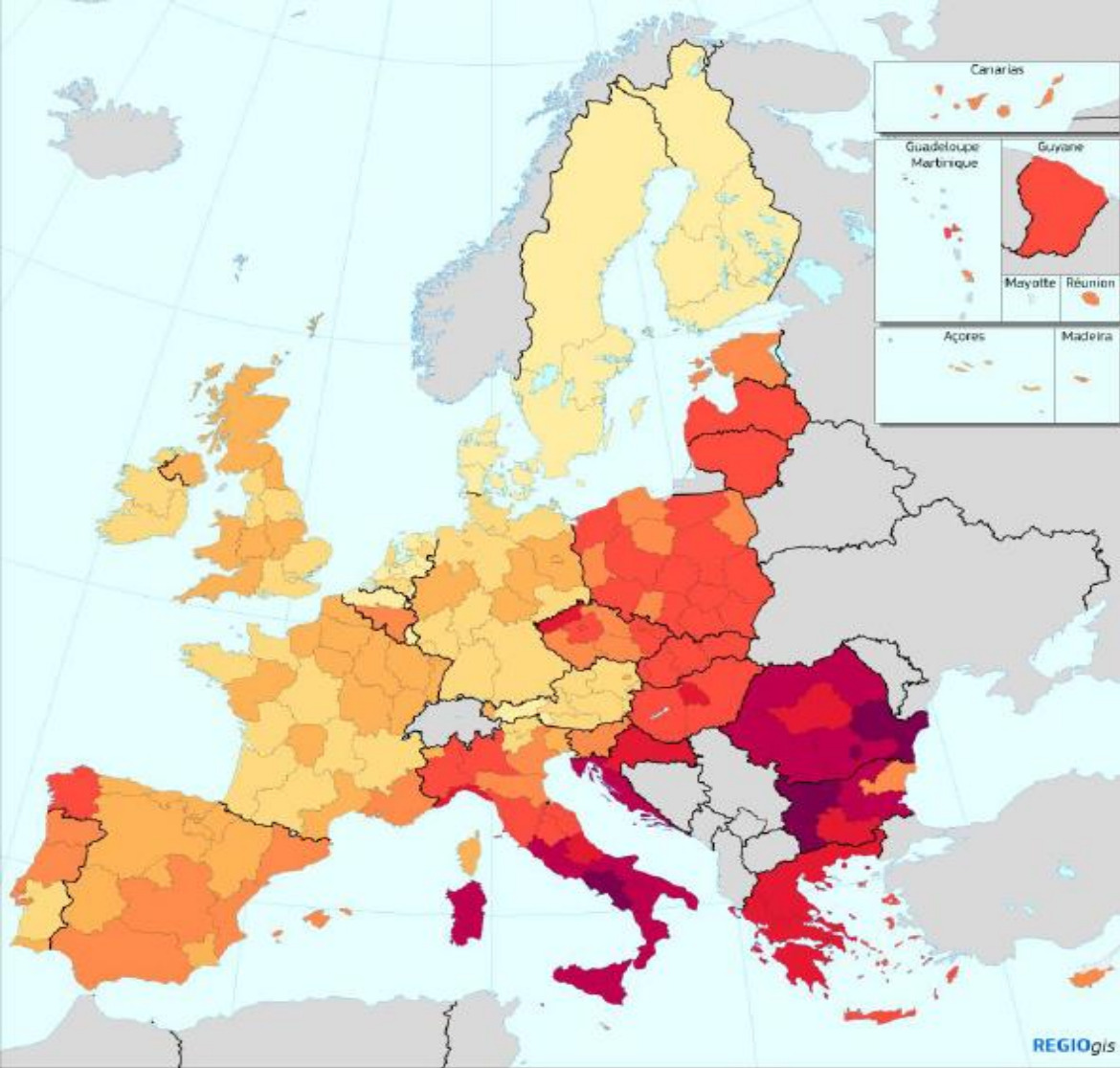
Quality of Government

- *First published in 2010 as a working paper*
- *Picked up by academic research*
- *Financed for 2013 update through FP7*
- *Included in the Cohesion Report*
- *One of the pillars of the Cultural and Creative Cities Monitor*

Gestalt principles

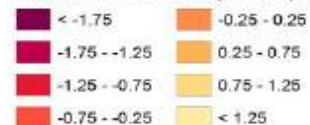
Quality of Government

- *First published in 2010 as a working paper*
- *Picked up by academic research*
- *Financed for 2013 update through FP7*
- *Included in the Cohesion Report*
- *One of the pillars of the Cultural and Creative Cities Monitor*



European Quality of Government index, 2013

Standard deviation, range from poor quality (negative) to high quality (positive)



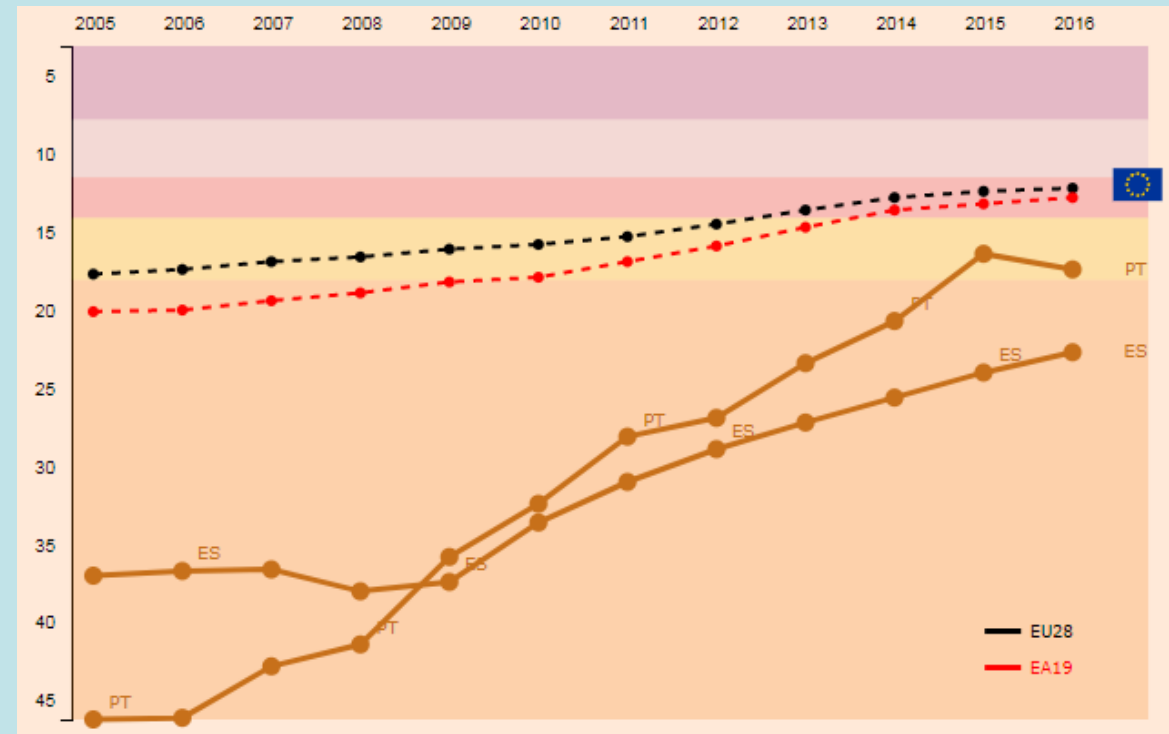
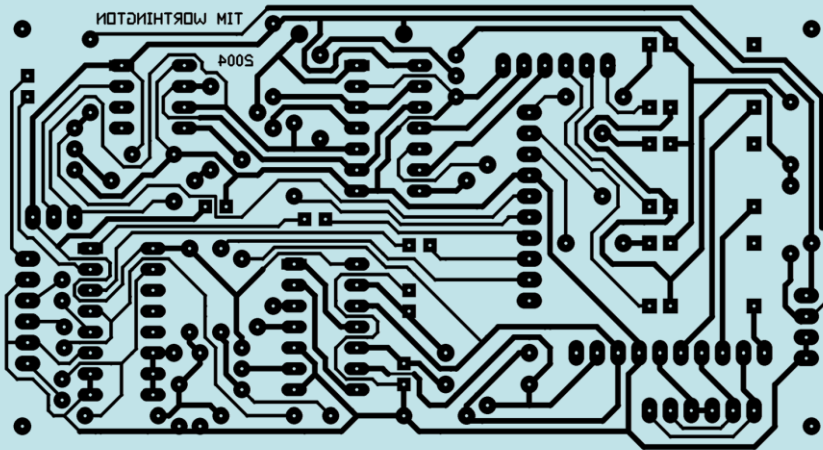
Note: EU = 0
Source: ANTICORRP, based on World Bank data and a regional quality of government survey

0 500 Km

Gestalt principles

Law of Uniform connectedness

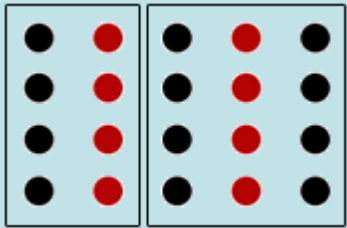
Elements that are visually connected are perceived as more related than elements with no connection.














Gestalt principles

Law of Common regions

Elements are perceived as part of a group if they are located within the same closed region.

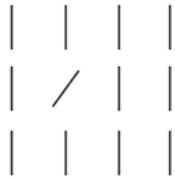


The indicators for each index are presented in Figure 10:

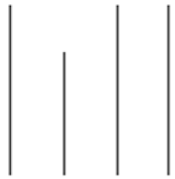
ASEM Connectivity Index framework of indicators	
 Physical	1. Logistics Performance Index
	2.  International flights passenger capacity
	3. Liner Shipping Connectivity Index
	4. Border crossings
	5.  Trade in electricity
	6.  Trade in gas
	7. Average connection speed
	8. Population covered by at least a 4G mobile network
 Economic/Financial	9.  Trade in goods
	10. Trade in services
	11.  Foreign direct investment
	12.  Personal remittances (received and paid)
	13. Foreign portfolio investment liabilities and assets
 Political	14.  Embassies network
	15. Participation in international intergovernmental organisations
	16.  UN voting alignment
	17. Cost to export/import

Preattentive attributes

Form



orientation



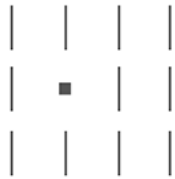
length



width



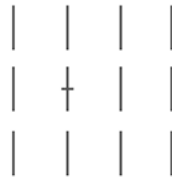
size



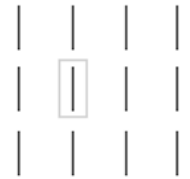
shape



curvature



added marks



enclosure

Color



shade



hue

Spatial Position



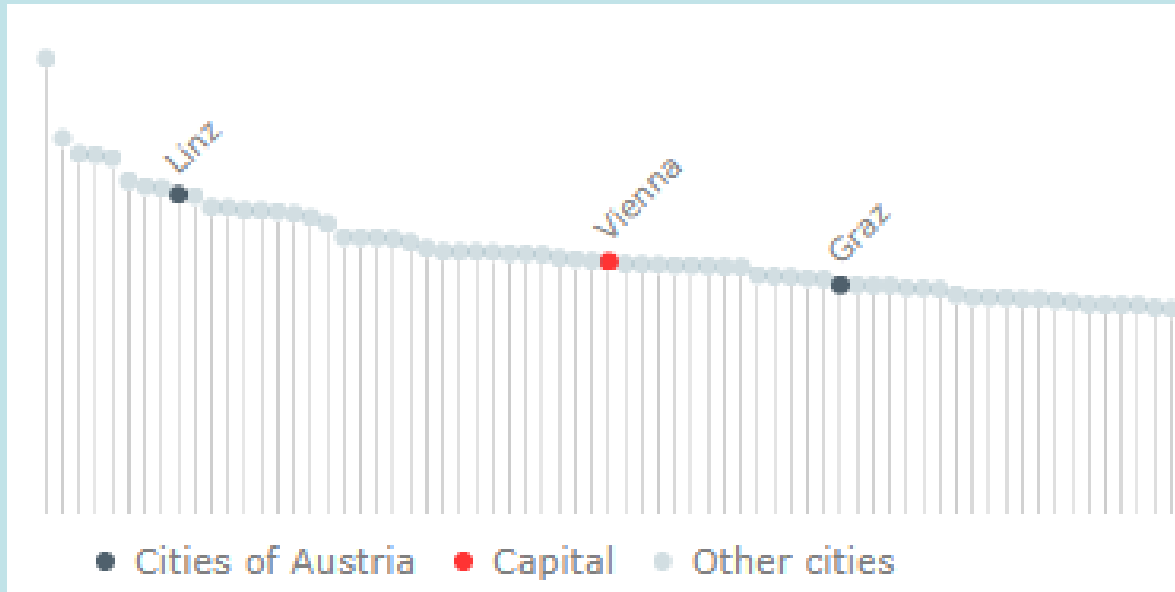
2d position

Used in data visualization to quickly focus the readers view on the most important point of information

Preattentive attributes - examples

Cultural and Creative Cities Monitor Rank – Country page

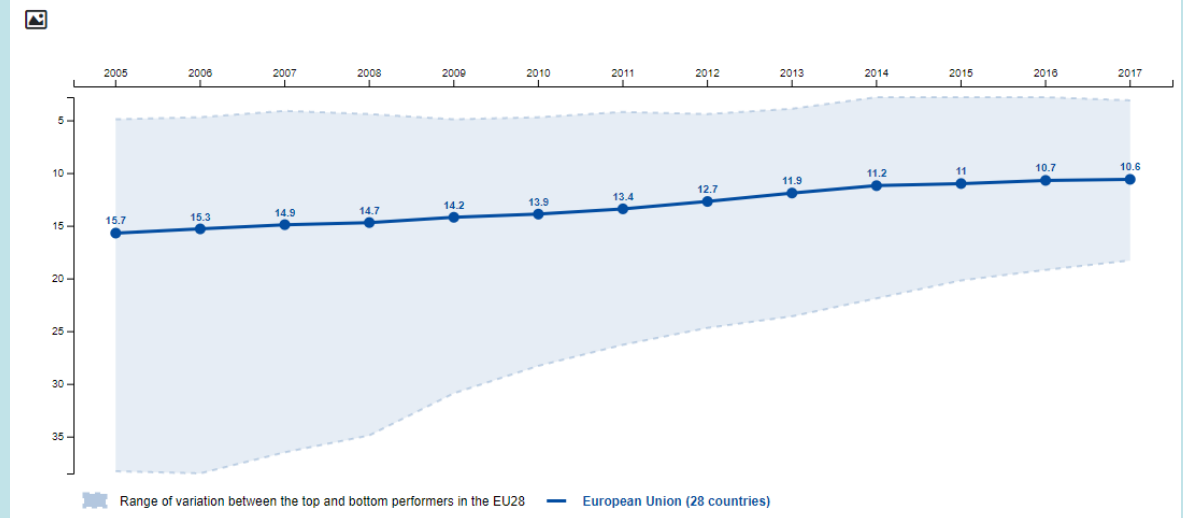
Preattentive attributes: Length/position and hue



Social scoreboard – Country Analysis

Preattentive attributes: Position, connectedness

Early leavers from education and training



Preattentive attributes - examples

OECD Better Life Index

Preattentive attributes: hue

France

→ Learn even more about France at [oecd.org](https://www.oecdbetterlifeindex.org/countries/france/)

How's Life?

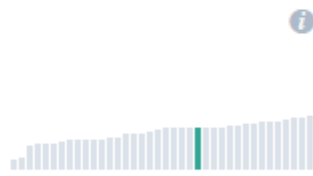
France performs well in many measures of well-being relative to most other countries in the Better Life Index. France ranks above the average in civic engagement, work-life balance and personal security.

Money, while it cannot buy happiness, is an important means to achieving higher living standards. In France, **the average household net-adjusted disposable income per capita is USD 29 759 a year**, more than the OECD average of USD 29 016 a year. But there is a considerable gap between the richest and

Topics

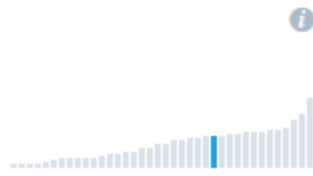
Housing

6.2



Income

4.8



<http://www.oecdbetterlifeindex.org/countries/france/>

Chart examples bad vs good

Highlight what's important

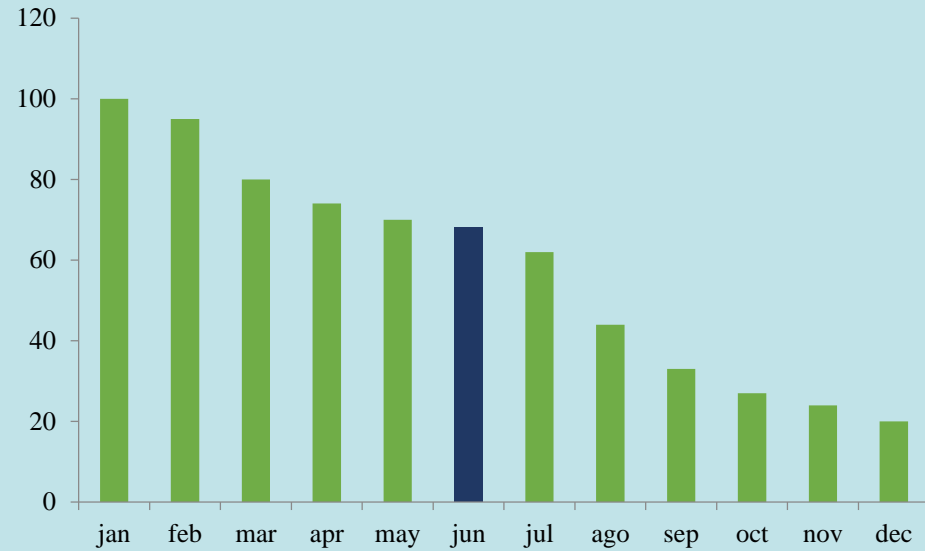
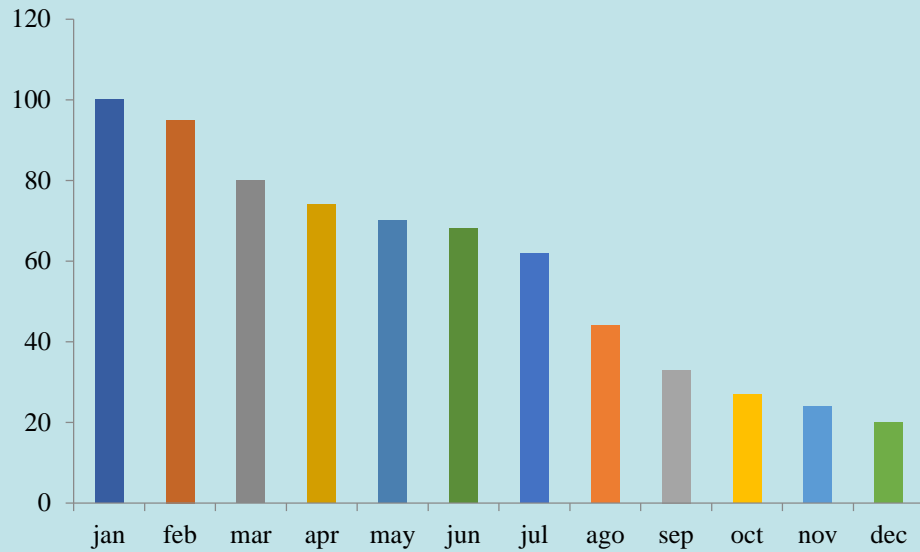
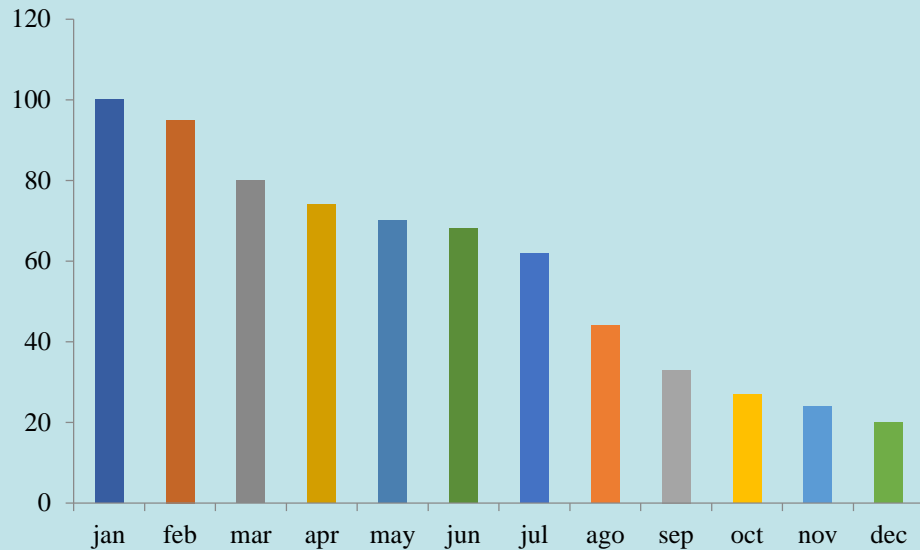


Chart examples bad vs good

Highlight what's important



Is it ok?

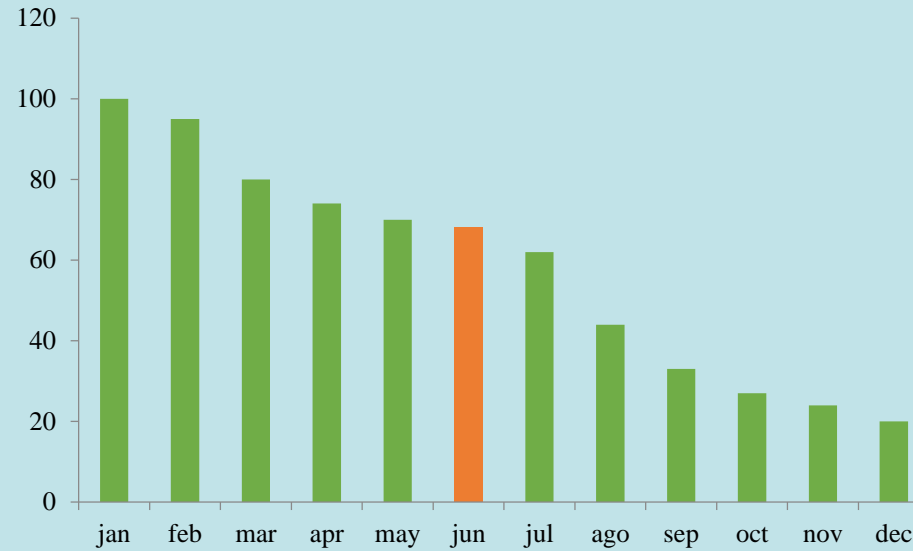
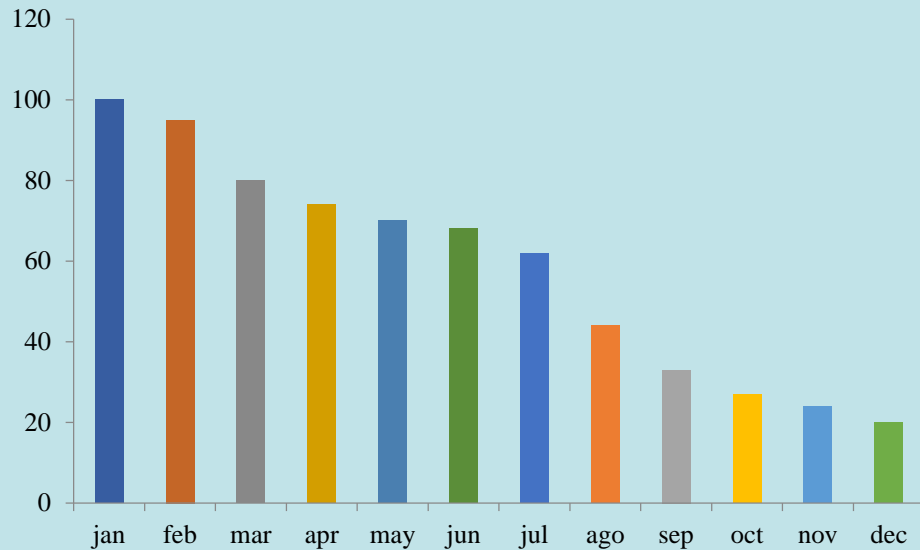


Chart examples bad vs good

Highlight what's important



... not color blind friendly (Red-blind simulation)

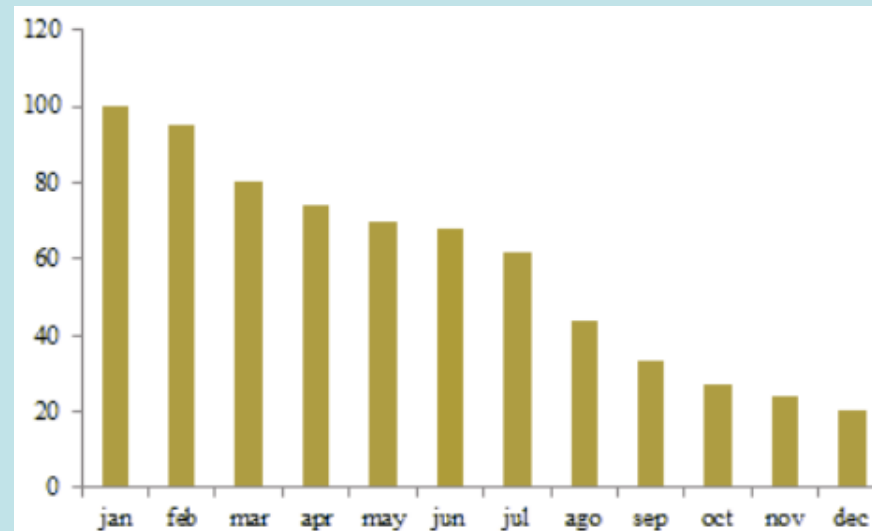
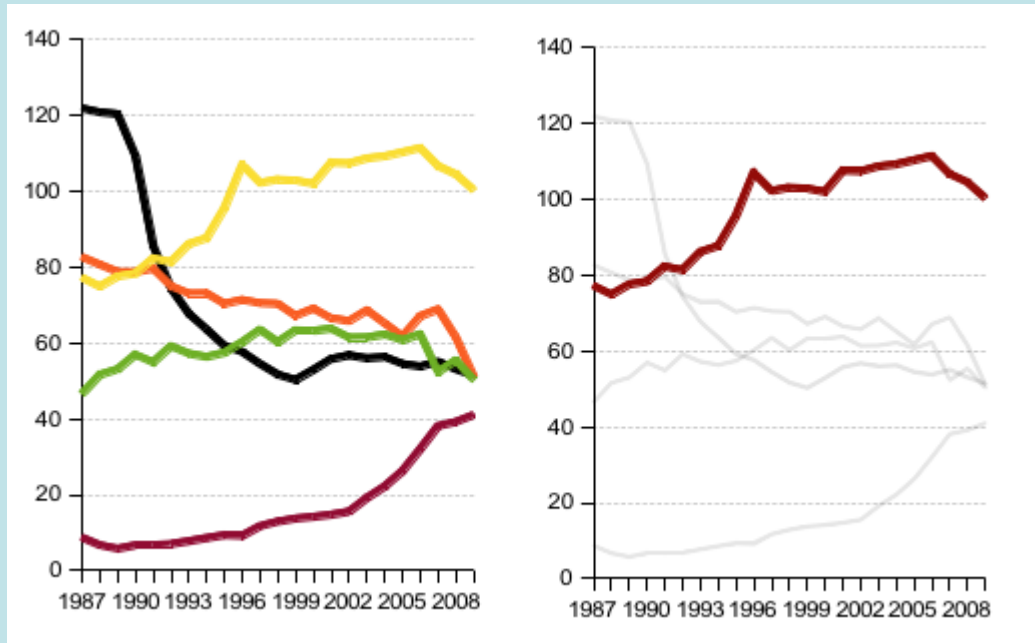
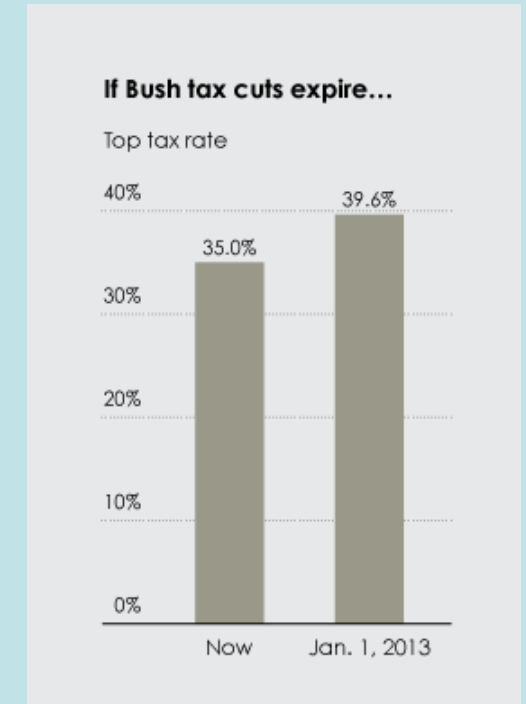
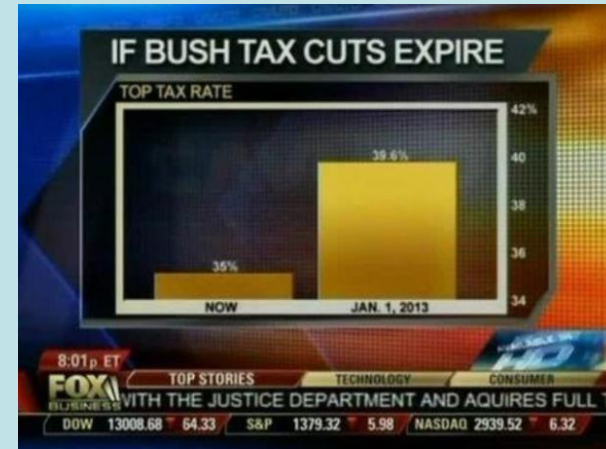


Chart examples bad vs good

Highlight what's important



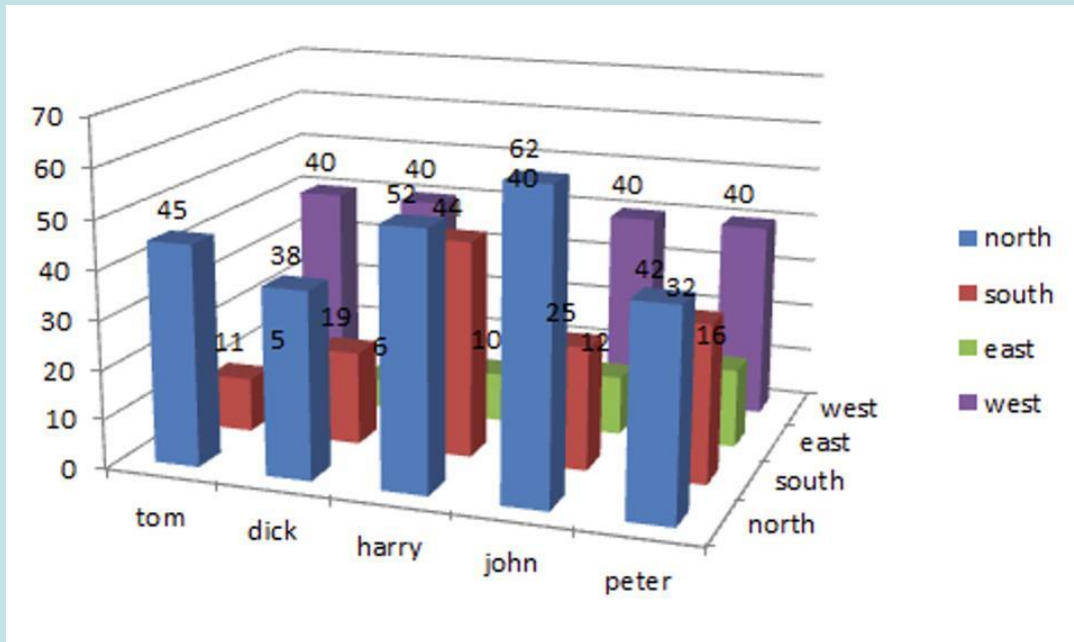
Start from zero (and keep it simple)



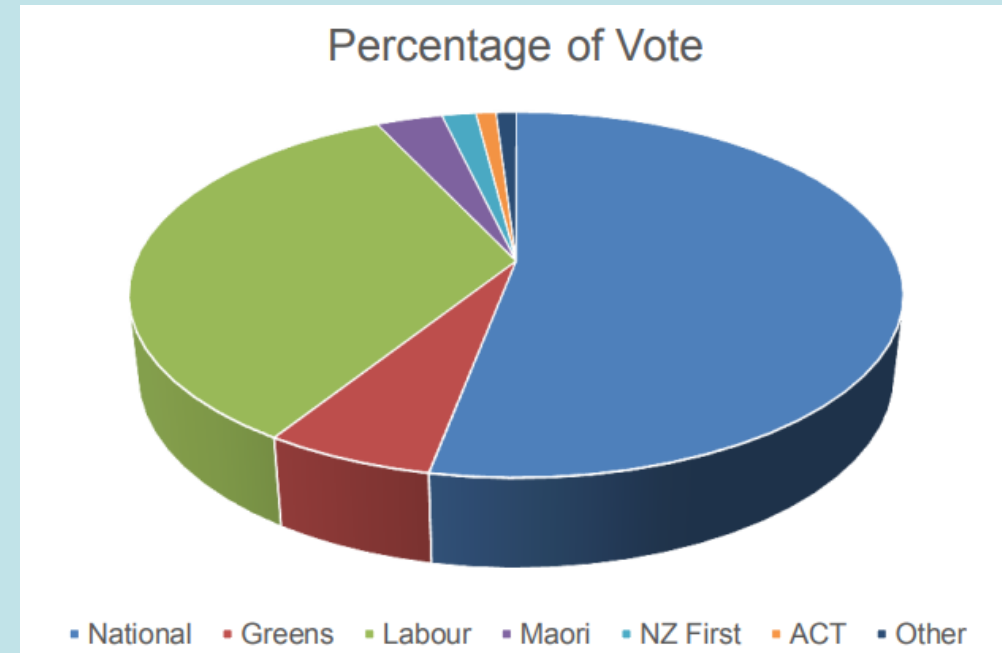
Source: <https://guides.library.duke.edu/datavis/topten>

Chart examples bad vs good

Don't use 3d



Avoid pie charts (specially in 3D)



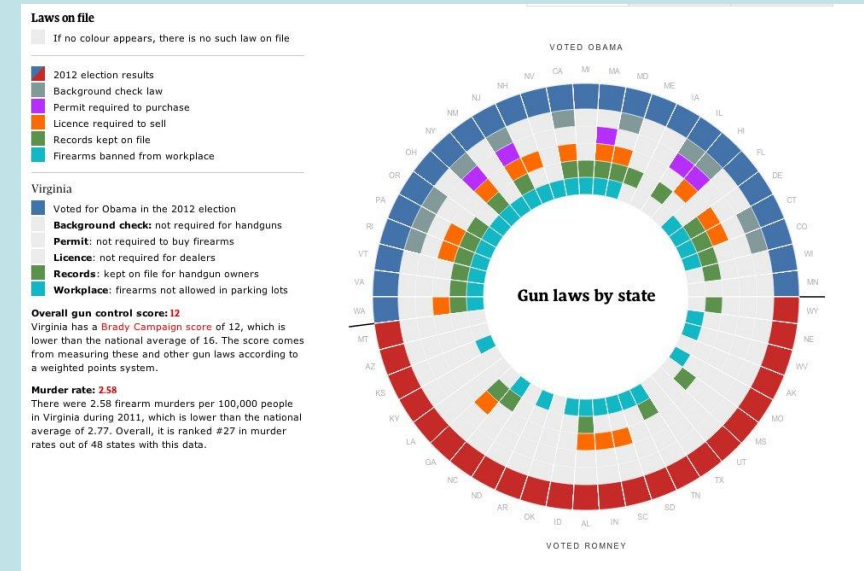
Source: <https://guides.library.duke.edu/datavis/topten>

Chart examples bad vs good

Avoid comparing areas (even when the charts make sense)

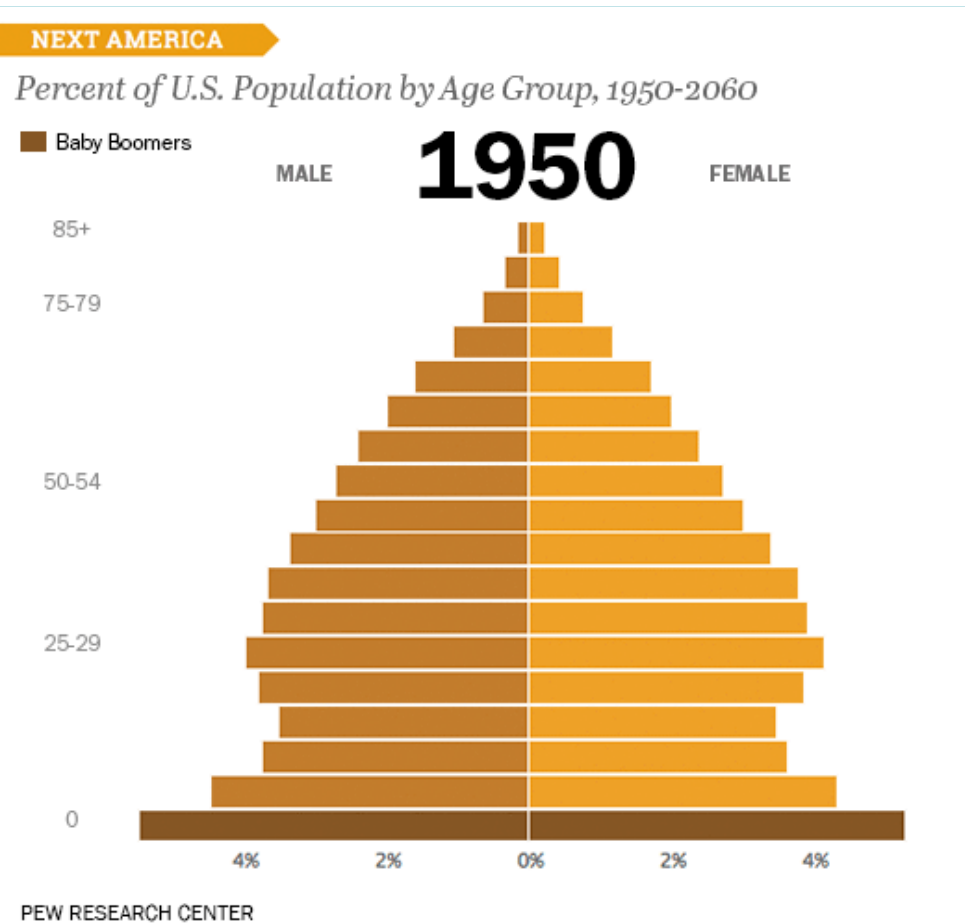


Keep it simple
(sometimes a table is better to convey information)



Source: <https://guides.library.duke.edu/datavis/topten>

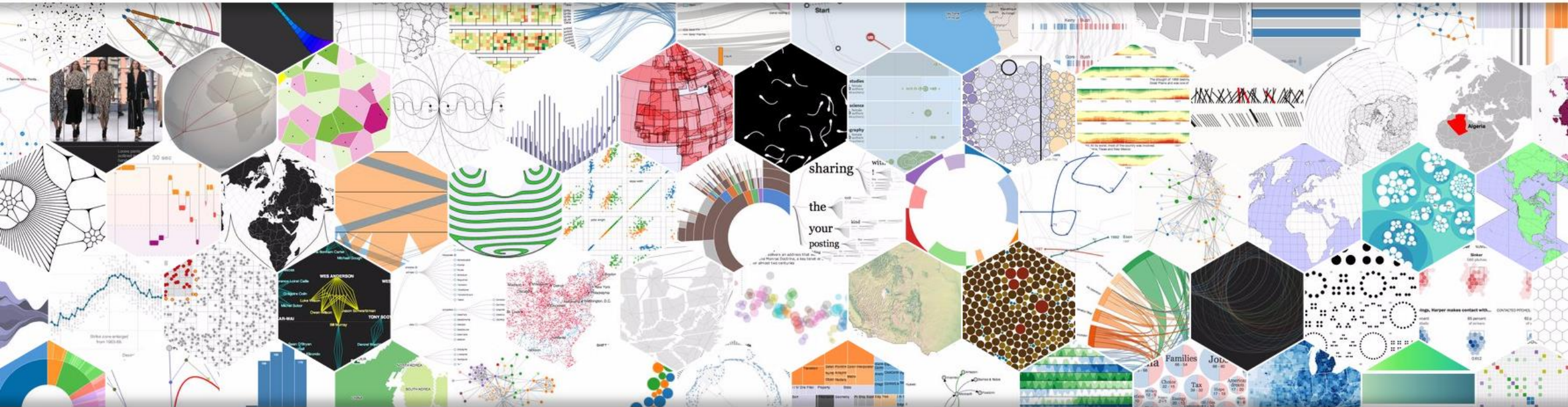
Interactive data visualization



- Attract attention from the public
- Increase engagement
- Increase trust in the data
- The data tells the story
- Hundreds of possible stories
- The user create its own story

Source (image): <http://www.pewresearch.org/fact-tank/2014/12/29/our-favorite-pew-research-center-data-visualizations-from-2014/>

Interactive data visualization



Source: <https://d3js.org/>

COIN interactive platforms

Social Scoreboard

<https://composite-indicators.jrc.ec.europa.eu/social-scoreboard>

Cultural and Creative Cities Monitor

<https://composite-indicators.jrc.ec.europa.eu/cultural-creative-cities-monitor>

ASEM Sustainable Connectivity Portal

<https://composite-indicators.jrc.ec.europa.eu/asem-sustainable-connectivity>



Any questions?

You can find me at jrc-coin@ec.europa.eu