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EUROPEAN MASTER IN OFFICIAL STATISTICS EMOS

Visualization

Presenter: *Mojca Bavdaž (mojca.bavdaz@ef.uni-lj.si)*

Guest: *Jorge Camoes (excelcharts.com)*

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EMOS Webinar, 17 May 2017

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Outline

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Classic examples **Visual processing** **Representation & perception** **Official statistics**

16:30 Break 18:00

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Icon by Giuditta Valentina Gentile from Noun Project

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Classic examples of visualization

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Bar chart & time-series line chart: Price of wheat & wages

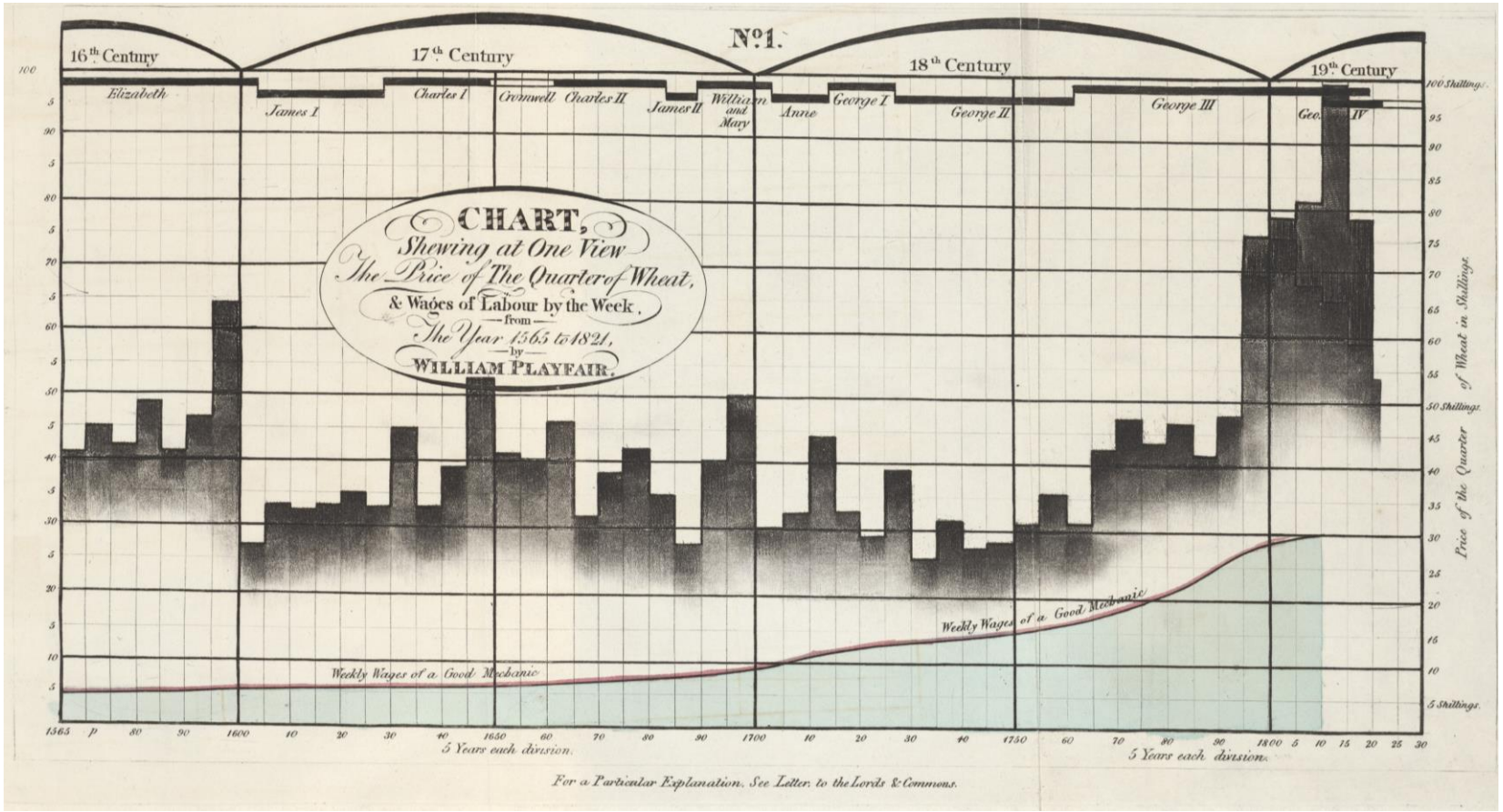
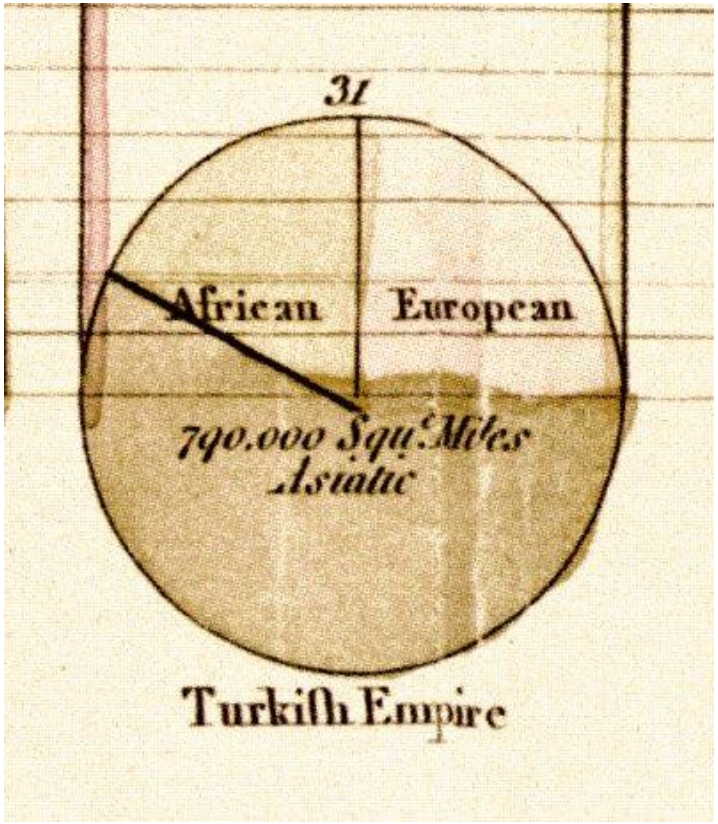


Chart shewing at one view the price of the quarter of wheat, & wages of labour by the week, from the year 1565 to 1821 by William Playfair (1822). (The second edition / with an additional chart.). Retrieved from http://brbl-dl.library.yale.edu/vufind/Record/3566707

Pie chart:
Turkish Empire

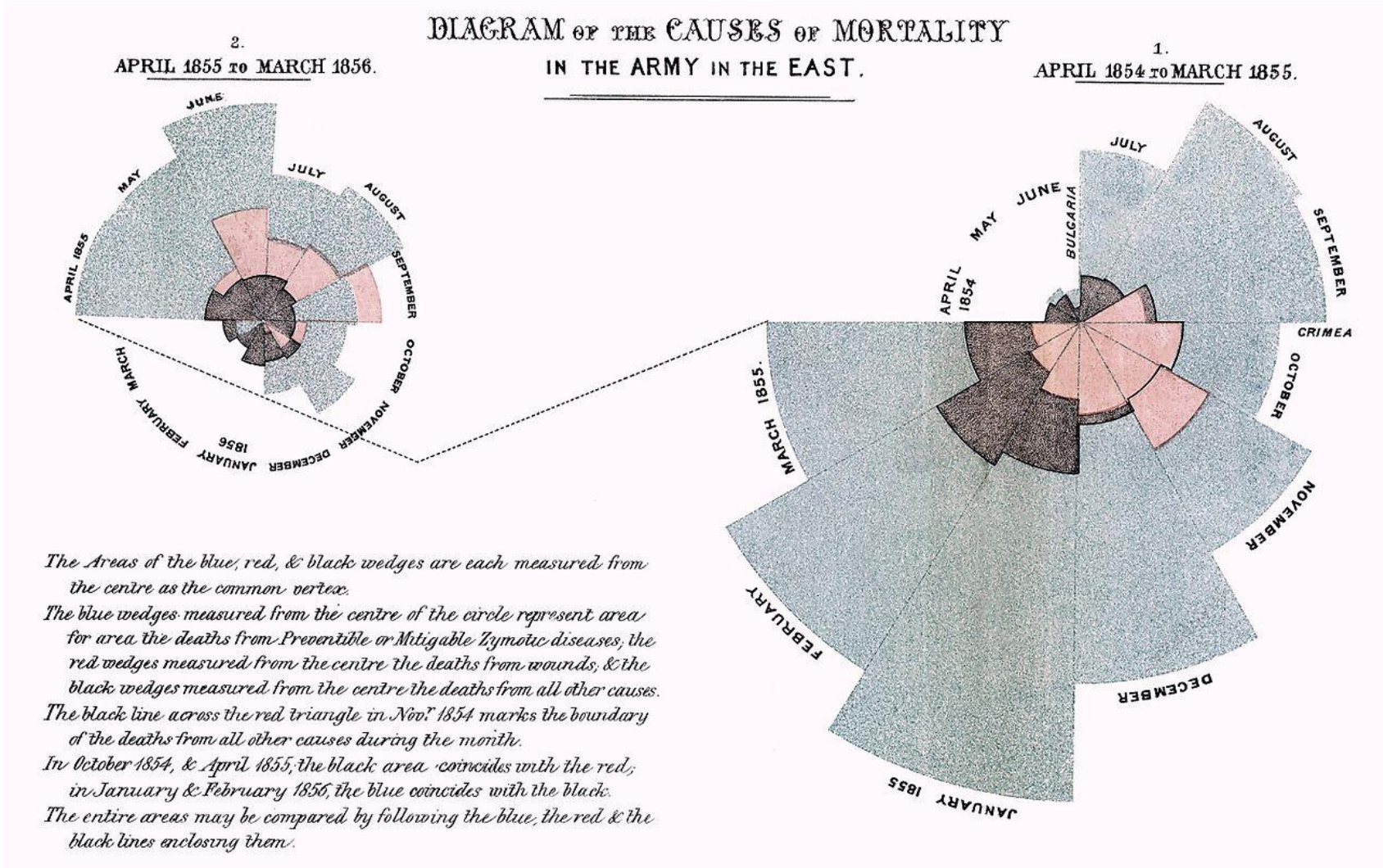


The pie chart Turkish Empire by William Playfair (1801). In *Statistical Breviary*. Retrieved from https://commons.wikimedia.org/wiki/File:Playfair-piechart.jpg

Disease dot map: Cholera in London

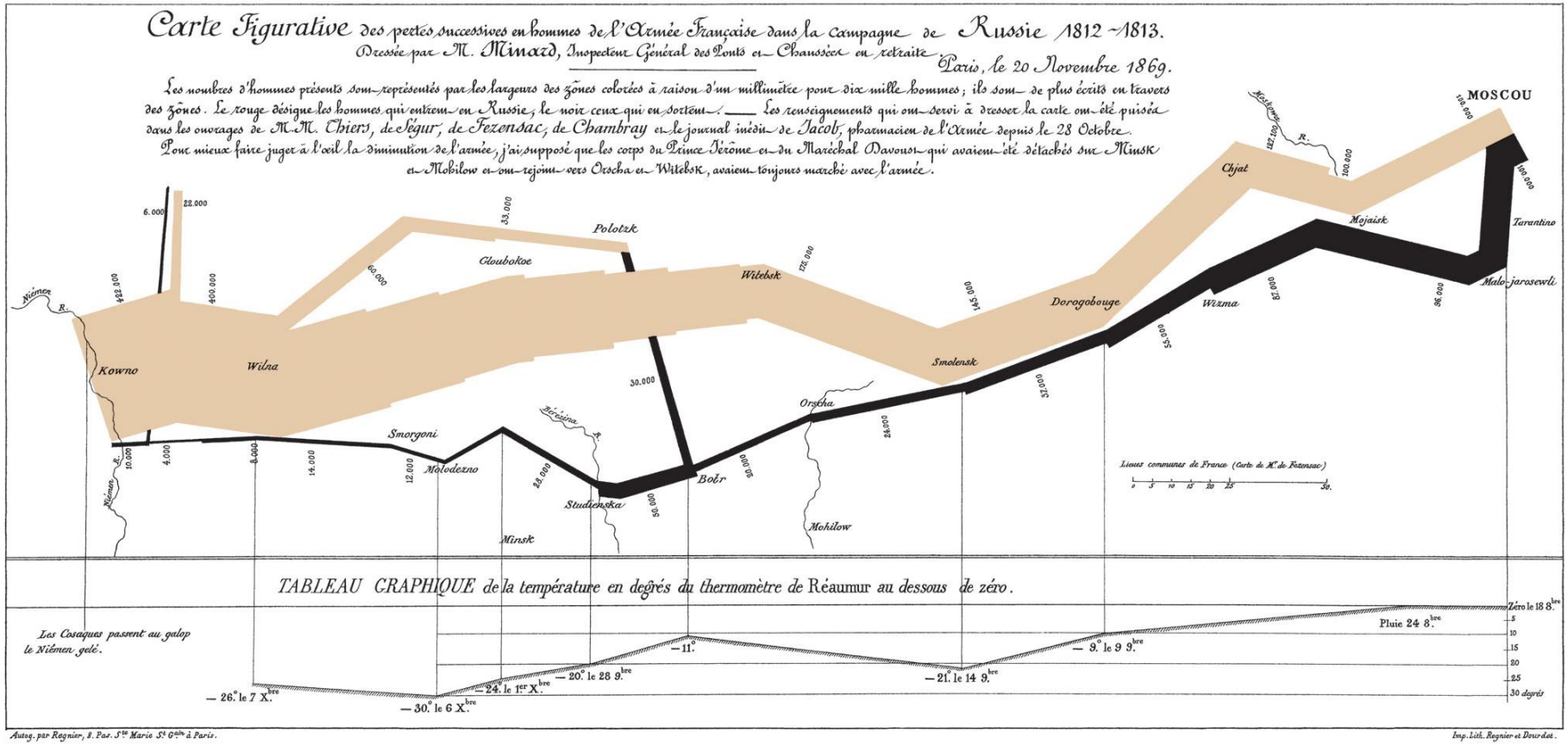
Variant of cholera map by John Snow (1854). In *Wikimedia Commons*, Retrieved from https://commons.wikimedia.org/wiki/File:Snow-cholera-map.jpg

Polar area diagram:
Causes of mortality in Crimean War



Polar area diagram of the causes of mortality by Florence Nightingale (1858). In *Wikimedia Commons*, Retrieved from https://commons.wikimedia.org/wiki/File:Nightingale-mortality.jpg

Flow map:
Napoleon's March on Moscow



Role of design:
London Underground map

By Henry C. Beck (1933). In *Wikipedia,* Retrieved from https://en.wikipedia.org/wiki/File:Beck_Map_1933.jpg

Long list of other contributors

Baron Pierre Charles Dupin (1826): Choropleth map

Charles Joseph Minard (1861): Map with diagrams

Francis Amasa Walker (1874): Population pyramid

Michael George Mulhall (1884): Pictograms

Karl Pearson (1892)(?): Histogram

John W. Tukey (1969): Stem-and-leaf, box-and-whisker plots…

Friendly, M. & Denis, D. J. (2001). Milestones in the history of thematic cartography, statistical graphics, and data visualization. Retrieved on May 12, 2017 from http://datavis.ca/milestones/

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Basics of visual processing

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Role of memory

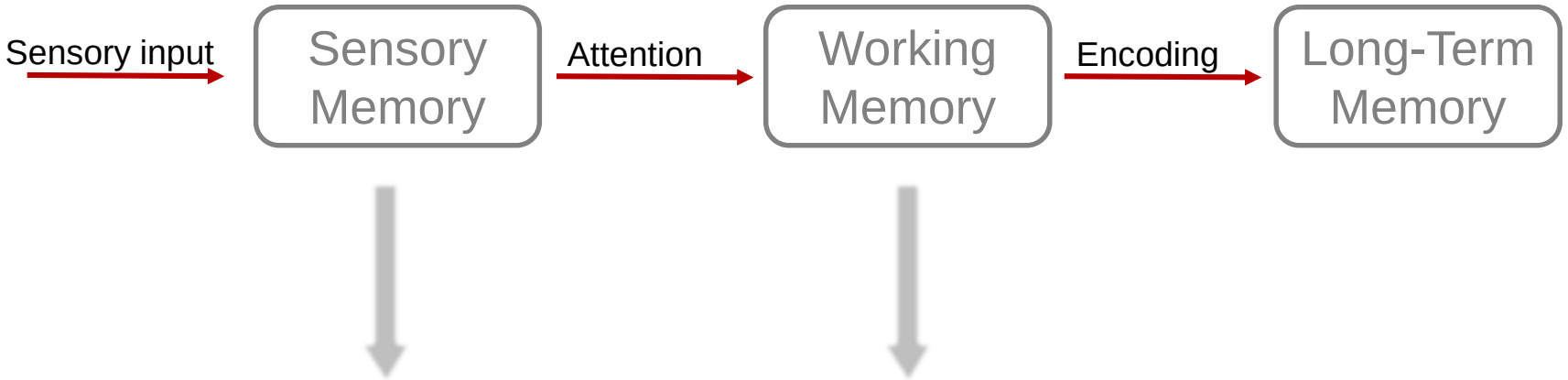
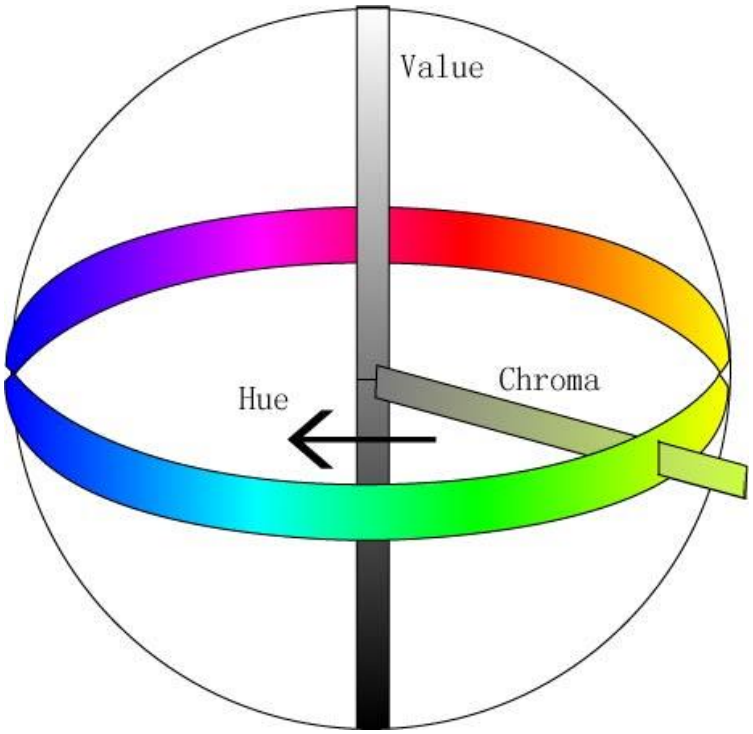


Figure illustrates The Multi-Store Model by Atkinson & Shiffrin (1968),

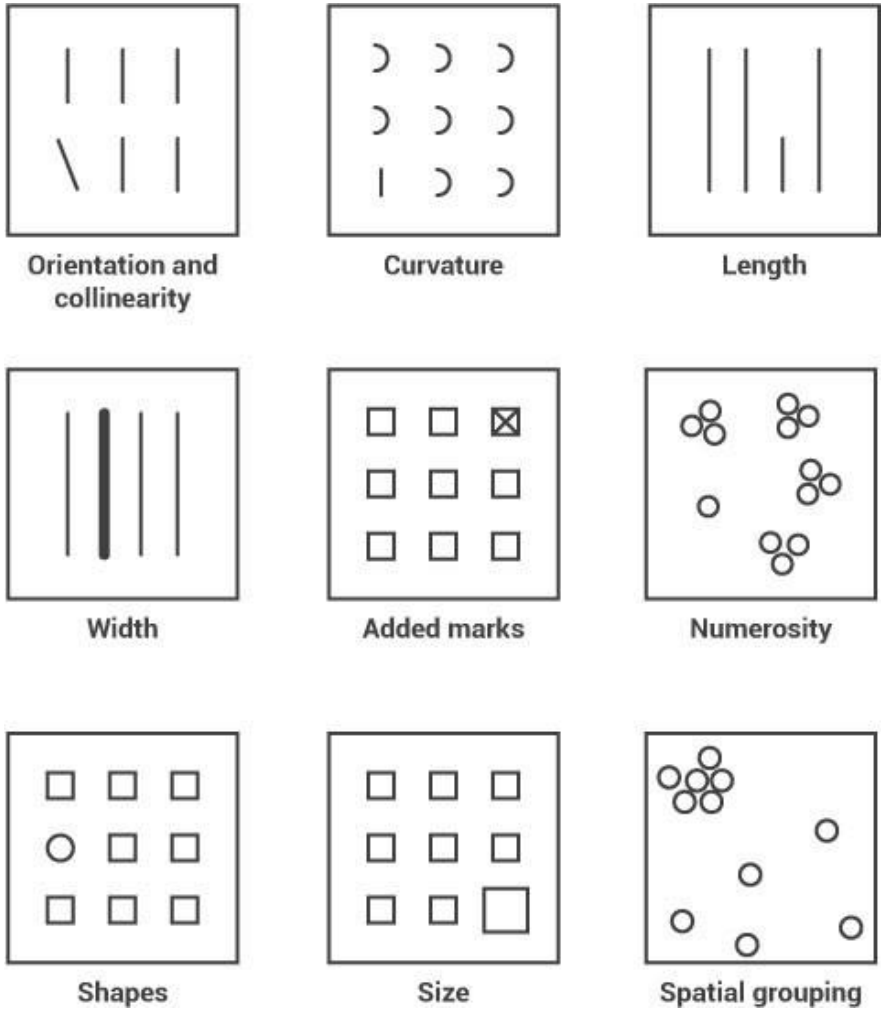
Preattentive attributes

Preattentive attributes: Color



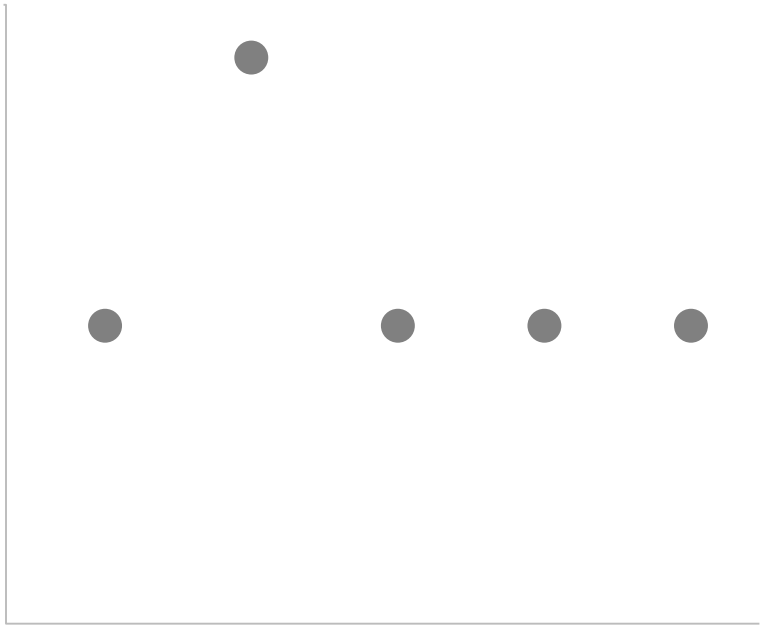
Munsell Color System (2006). In *Wikimedia Commons*, Retrieved from https://commons.wikimedia.org/wiki/File:Munsell_Color.jpg

Preattentive attributes: Form



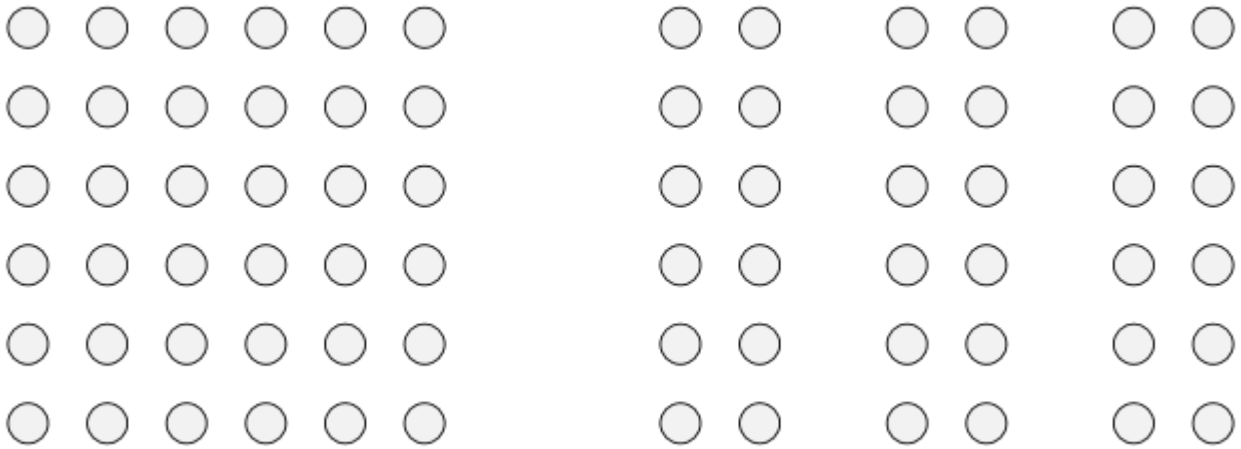
Preattentive Visual Properties and How to Use Them in Information Visualization (2016). *The Interaction Design Foundation,* Retrieved from https://www.interaction-design.org/literature/article/preattentive-visual-properties-and-how-to-use-them-in-information-visualization

Preattentive attributes: Spatial positioning



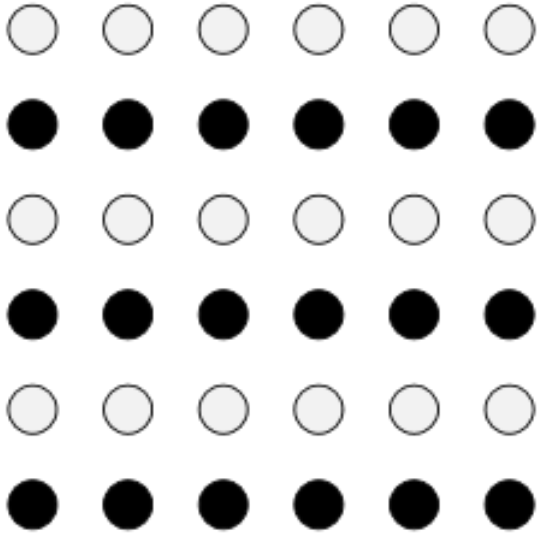
Gestalt principles

Gestalt principles: Proximity



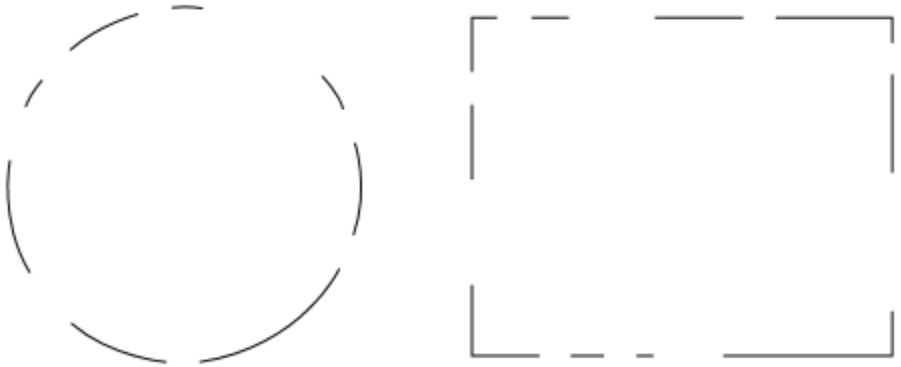
Gestalt Proximity (2008). In *Wikimedia Commons*, Retrieved from https://commons.wikimedia.org/wiki/File:Gestalt_proximity.svg

Gestalt principles: Similarity



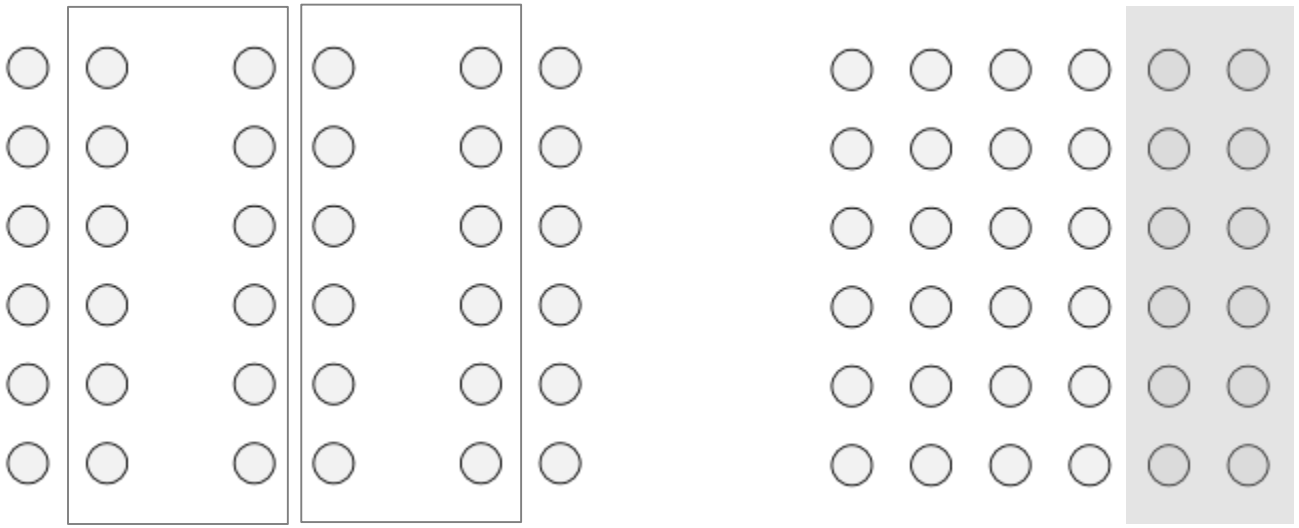
Gestalt Similarity (2008). In *Wikimedia Commons*, Retrieved from https://commons.wikimedia.org/wiki/File:Gestalt_similarity.svg

Gestalt principles: Closure

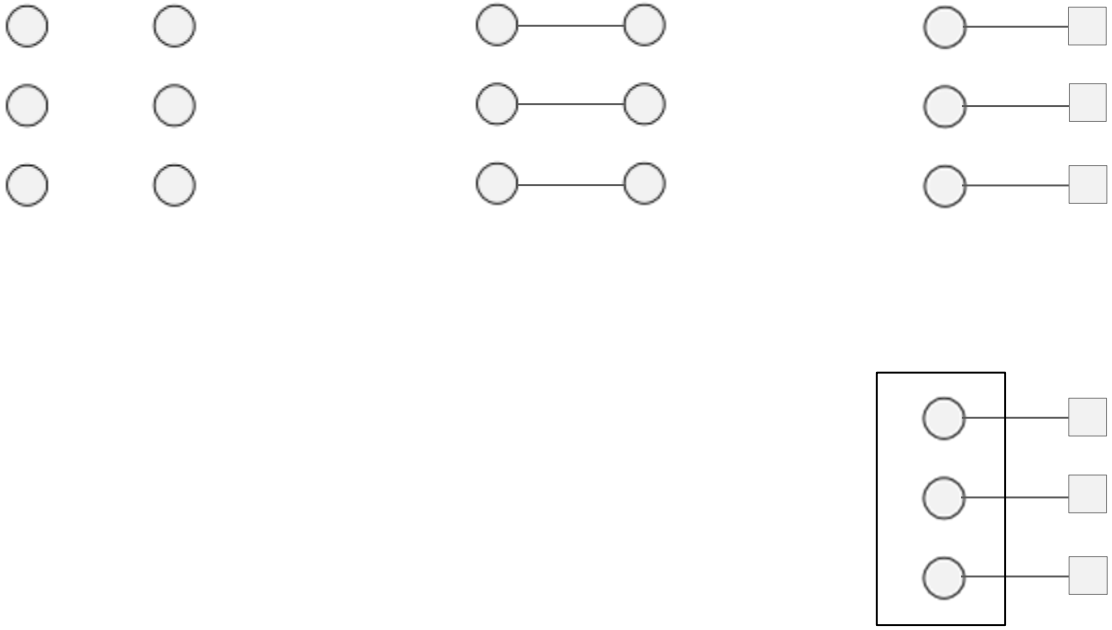


Gestalt Closure (2008). In *Wikimedia Commons,* Retrieved from https://commons.wikimedia.org/wiki/File:Gestalt_closure.svg

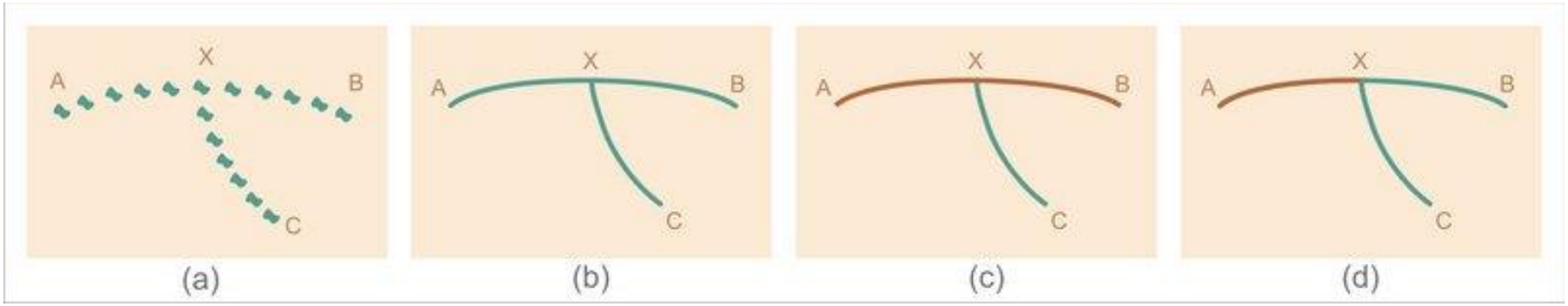
Gestalt principles: Common region/Enclosure



Gestalt principles: Connectedness

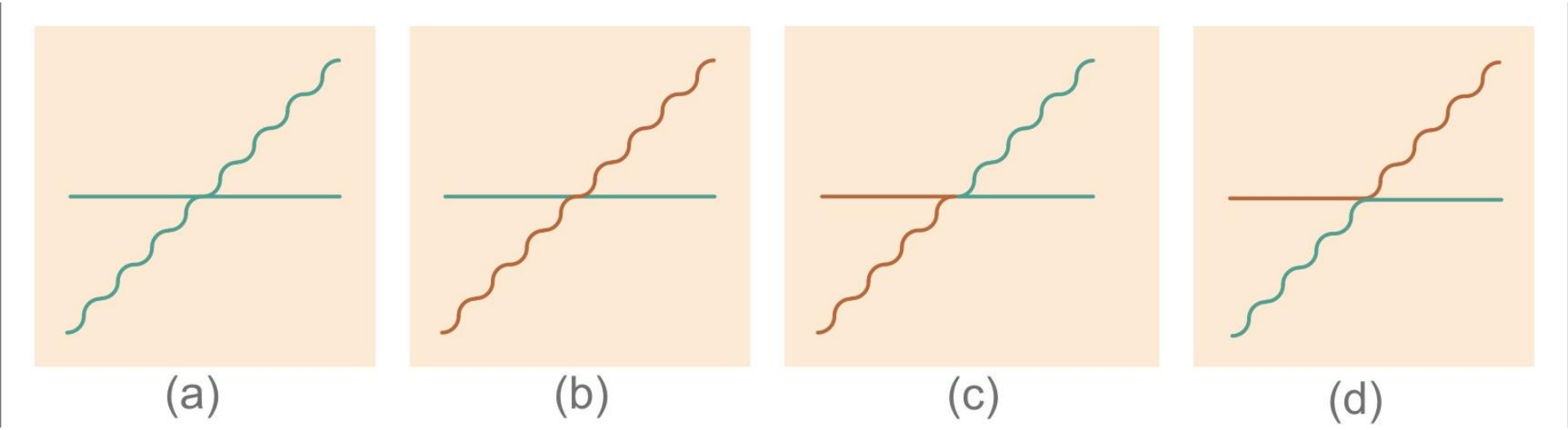


Gestalt principles: Continuity



Dejan Todorovic (2008) Gestalt principles. Scholarpedia, 3(12):5345., revision #91314, Retrieved from http://www.scholarpedia.org/article/Gestalt_principles

Gestalt principles: Good Gestalt



Dejan Todorovic (2008) Gestalt principles. Scholarpedia, 3(12):5345., revision #91314, Retrieved from http://www.scholarpedia.org/article/Gestalt_principles

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Gestalt principles: Good Gestalt

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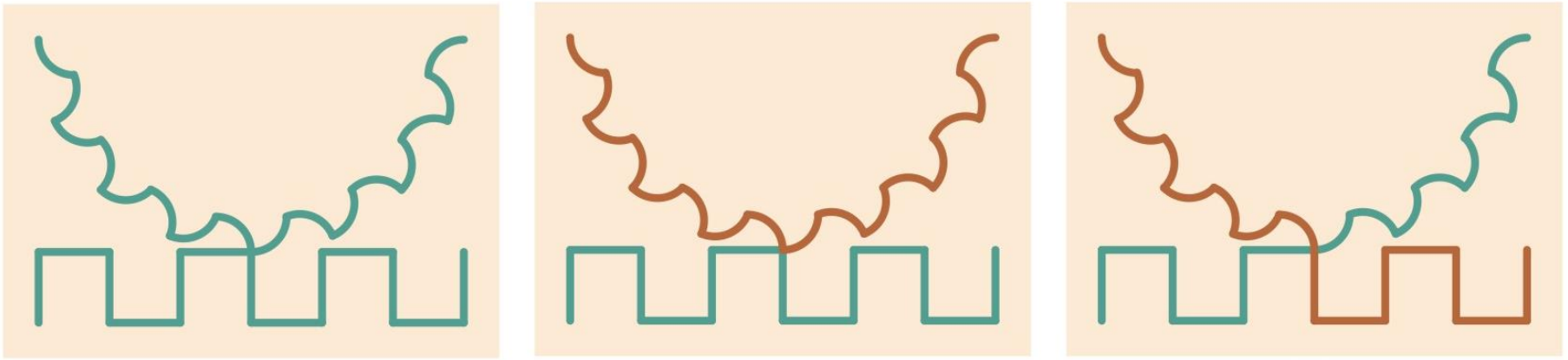

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Dejan Todorovic (2008) Gestalt principles. Scholarpedia, 3(12):5345., revision #91314, Retrieved from http://www.scholarpedia.org/article/Gestalt_principles

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Visual representation of statistical data and perception

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Theory of graphic symbols by Jacques Bertin

Basic visual units (marks): point, line, area.

Visual variables:

- position (position),
- size (taille),
- shape (forme),
- color (couleur),
- brightness (valeur),
- orientation (orientation),
- granularity (grain).

Other visual variables:

- hue
- saturation
- resolution
- crispness
- transparency
- motion

Jacques Bertin in Sémiologie graphique (1967)

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Hans Rosling: Gapminder.org & Moving bubble chart

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Hans Rosling:

The best stats you've ever seen

TED2006 · 19:50 · Filmed Feb 2006

48 subtitle languages

View interactive transcript

11,701,358 Total views

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Perception of graphical elements

Weber. If difference between two lines is relatively

- large ⇒ easy to detect
- small ⇒ hard to detect

Stevens. Bias in judgments

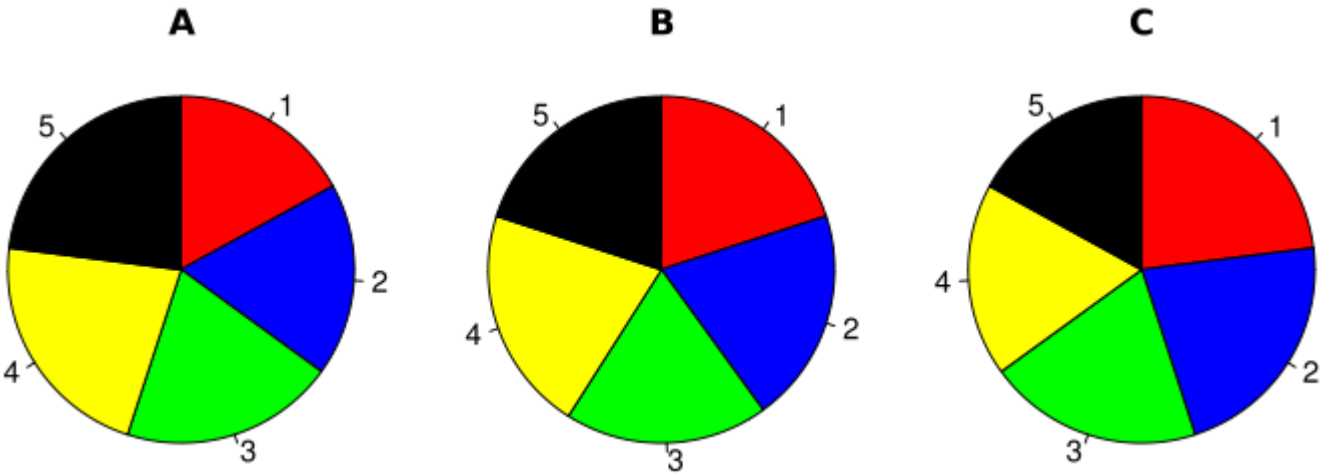
length < area < volume

Cleveland. Perception tasks of decoding quantitative variables from most to least accurate:

Position
Length
Angle, Slope
Area
Volume
Color

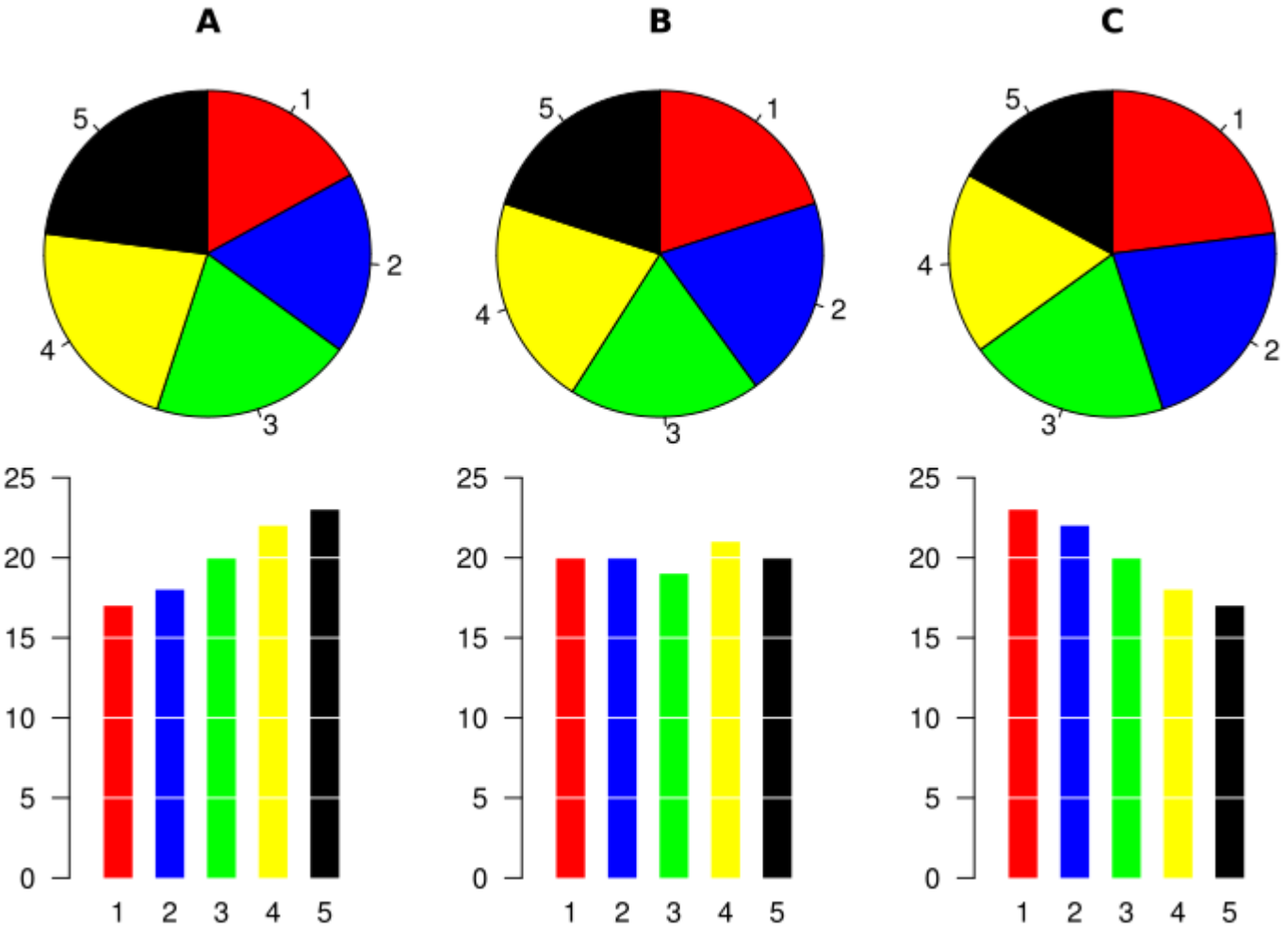
A test ☺

I'll show you three pie charts.
Order the slices of each pie chart
by size from the largest to the smallest.



Pie charts (2007). In *Wikipedia*. Retrieved from http://en.wikipedia.org/wiki/Pie_chart

A test ☺



Pie charts (2007). In *Wikipedia*. Retrieved from http://en.wikipedia.org/wiki/Pie_chart

Theory of data graphics by Edward Tufte

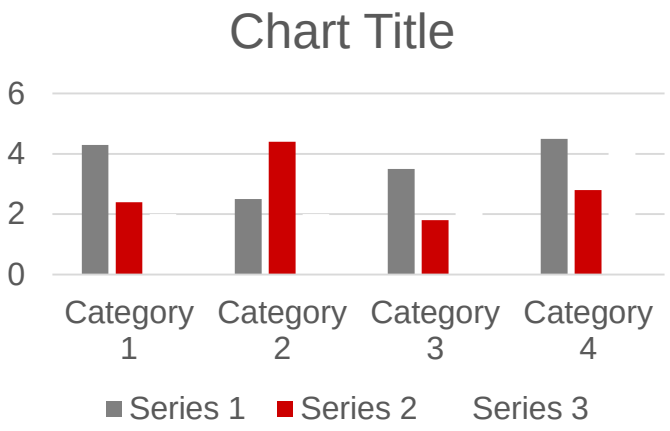
- Above all else show the data.
- Maximize the data-ink ratio.

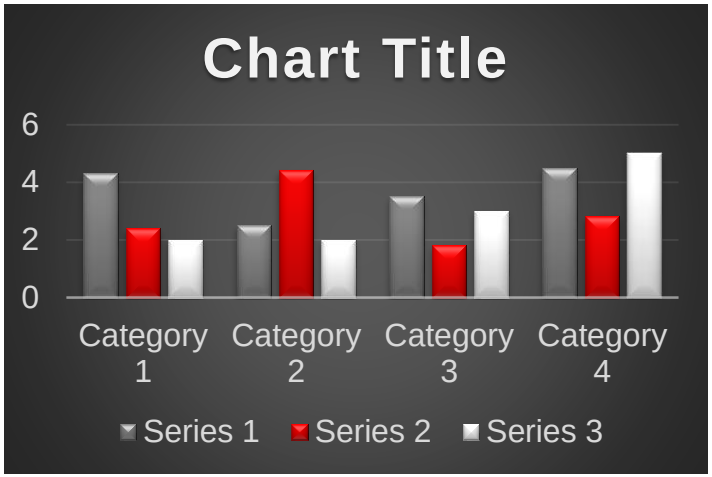
Data–ink ratio = Data ink / Total ink

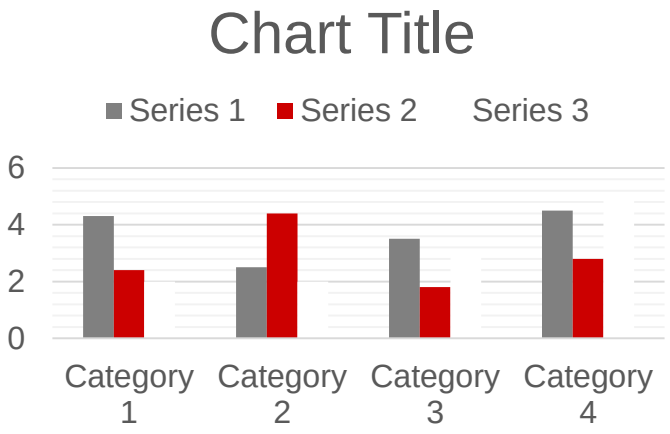
= Share of ink devoted to non-redundant display of data-information
= 1 – Share of ink that can be erased without loss of data-information

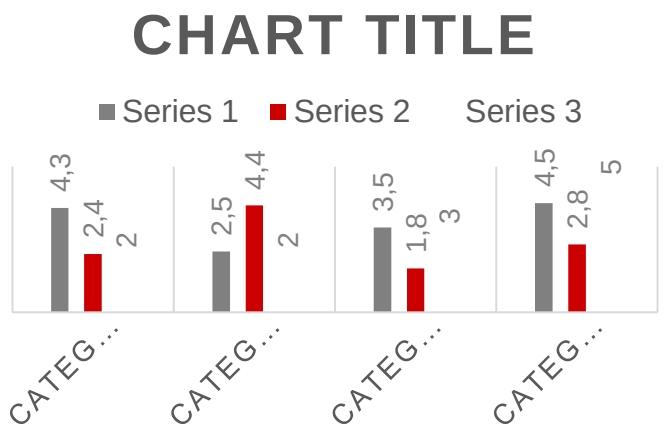
- Erase non-data ink.
- Erase redundant data ink.
- Revise and edit.

MS PowerPoint 2016: Insert Chart: Clustered Column









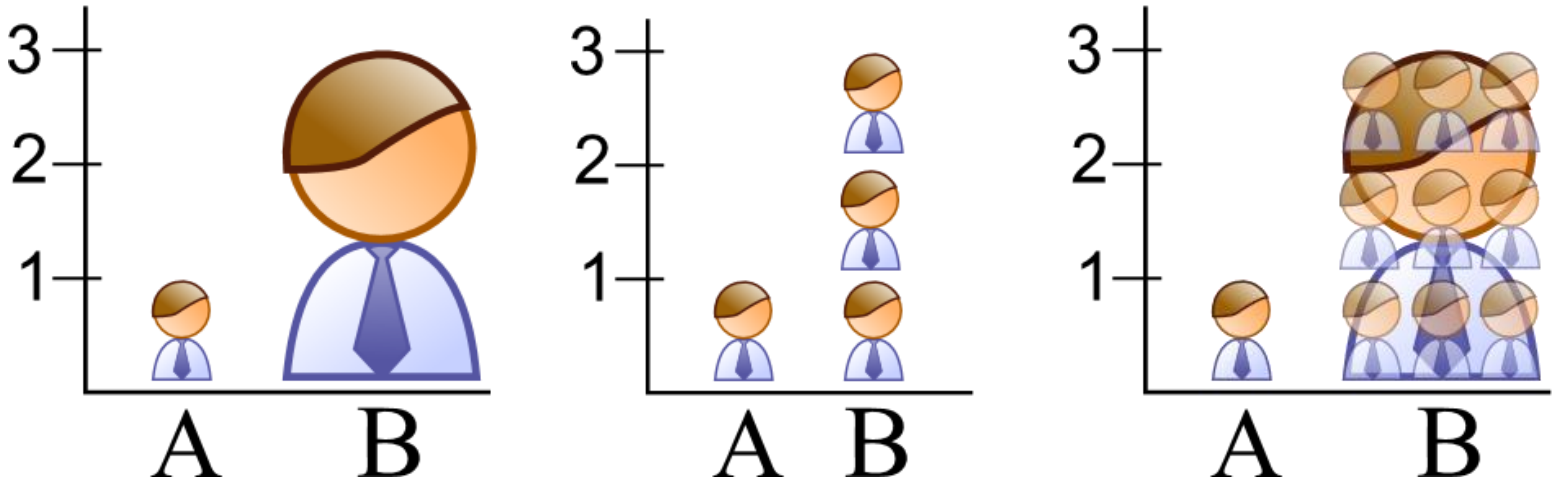
Graphical integrity (Edward Tufte)

- Clear, detailed, thorough labeling; explanations of the data on the graphic itself etc.

- Lie factor:

  = Size of effect shown in graphics / Size of effect in data

Pictograms



Misleading graphs (2012). In *Wikimedia Commons*. Retrieved from https://commons.wikimedia.org/wiki/File:Improperly_scaled_picture_graph.svg
https://commons.wikimedia.org/wiki/File:Picture_Graph.svg
https://commons.wikimedia.org/wiki/File:Comparison_of_properly_and_improperly_scaled_picture_graph.svg

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Truncated axes

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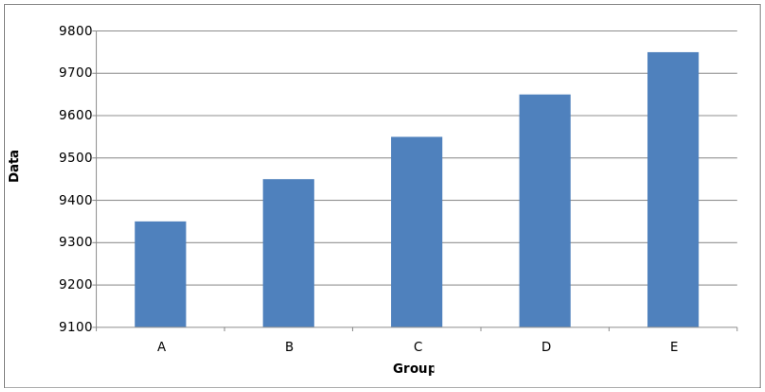

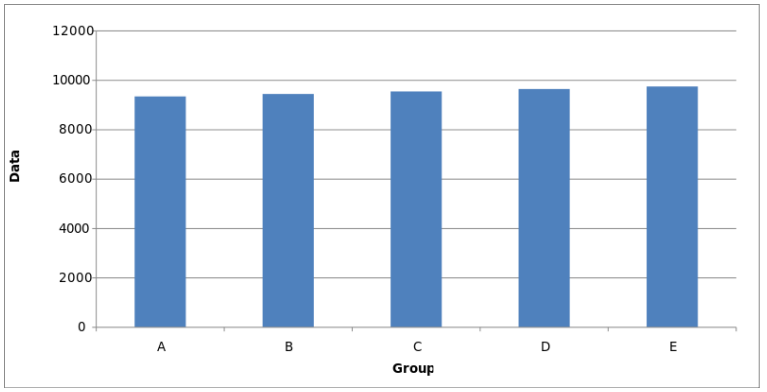

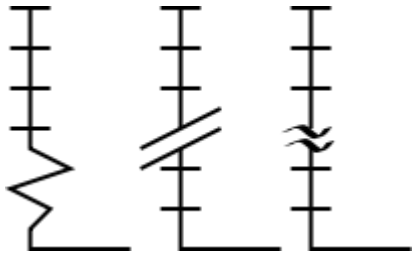

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Misleading graphs (2012). In *Wikimedia Commons*. Retrieved from https://commons.wikimedia.org/wiki/File:Truncated_Bar_Graph.svg
https://commons.wikimedia.org/wiki/File:Bar_graph.svg
https://commons.wikimedia.org/wiki/File:Y-axis_break.svg

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Role of visualization in official statistics

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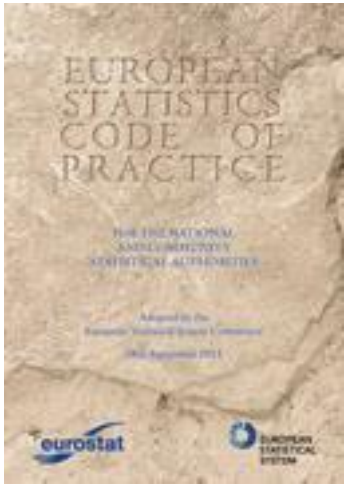
European Statistics Code of Practice



Principle 15: Accessibility and Clarity

European Statistics are **presented in a clear and understandable form**, released in a suitable and convenient manner, available and accessible on an impartial basis with supporting metadata and guidance.

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Generic Statistical Business Process Model (GSBPM)

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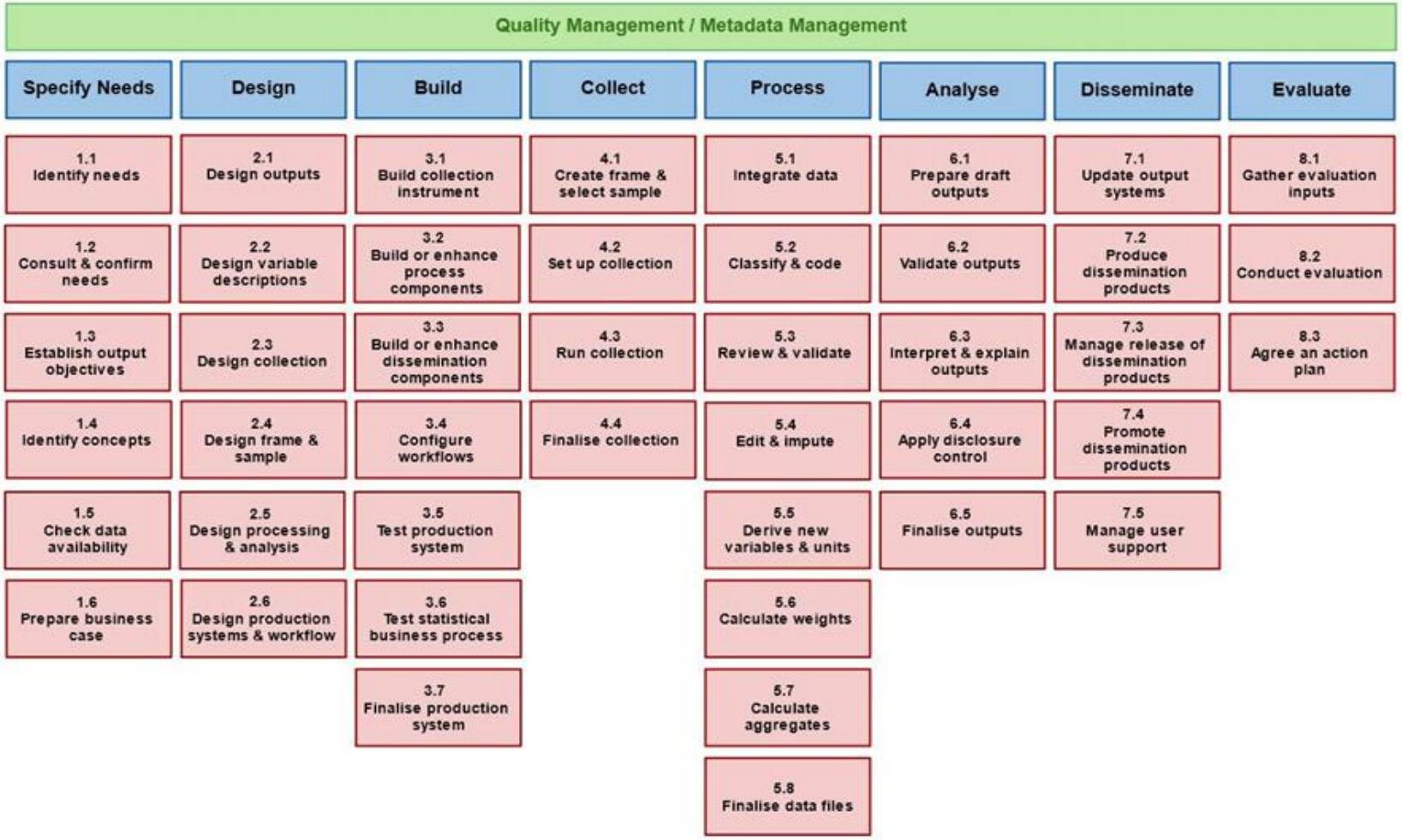

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UNECE (2013). The Generic Statistical Business Process Model. v5.0. Retrieved from http://www1.unece.org/stat/platform/display/metis/The+Generic+Statistical+Business+Process+Model

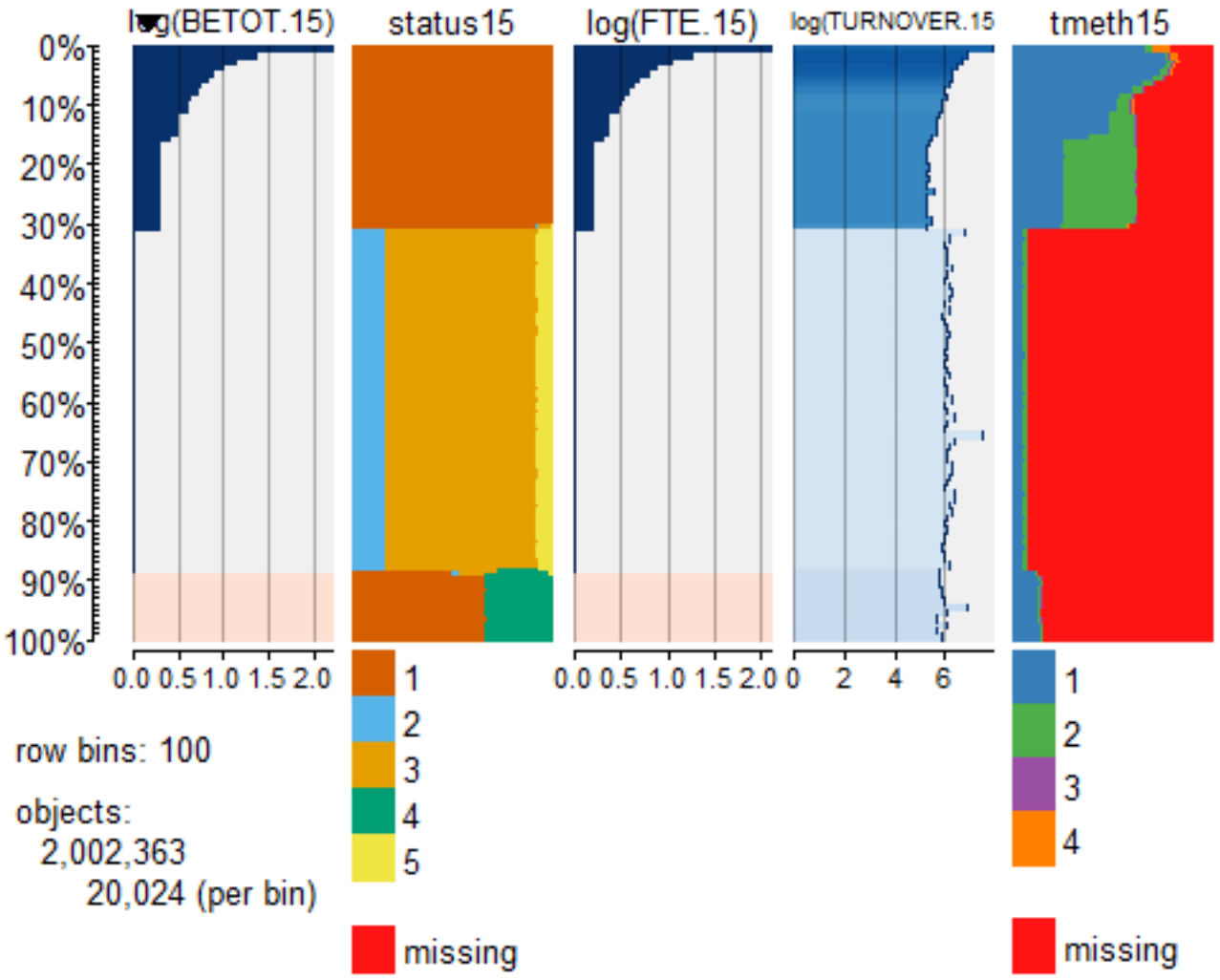
Questionnaire design

Jenkins & Dillman (1995) introduced into survey research design principles that emphasize visual presentation of information, e.g.:

- Present survey question + instruction in close proximity
- Deemphasize information that disturbs question-answering process (e.g. legal basis)
- Use visual elements consistently throughout the questionnaire

Jenkins, C., & Dillman, D. (1995). Towards a Theory of Self-Administered Questionnaire Design. In *Survey Measurement and Process Quality* by L. Lyberg et al., Wiley. Retrieved from https://www.sesrc.wsu.edu/Dillman/papers/1997/A%20Theory%20of%20Self-Administered%20Questionnaire%20Design.pdf

Processes of statistical production



Salamin, P.-A., & Tomasini, F. (2016). How to Communicate the Content of Quality Indicators of a Statistical Business Register. Paper presented at ICES-V, Geneva.

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Processes of statistical production

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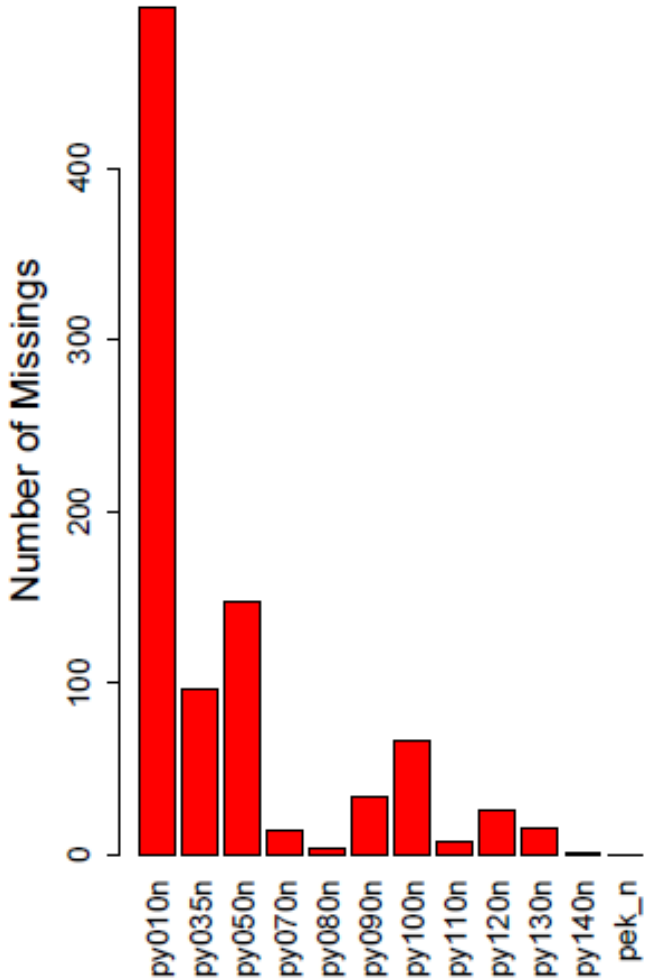

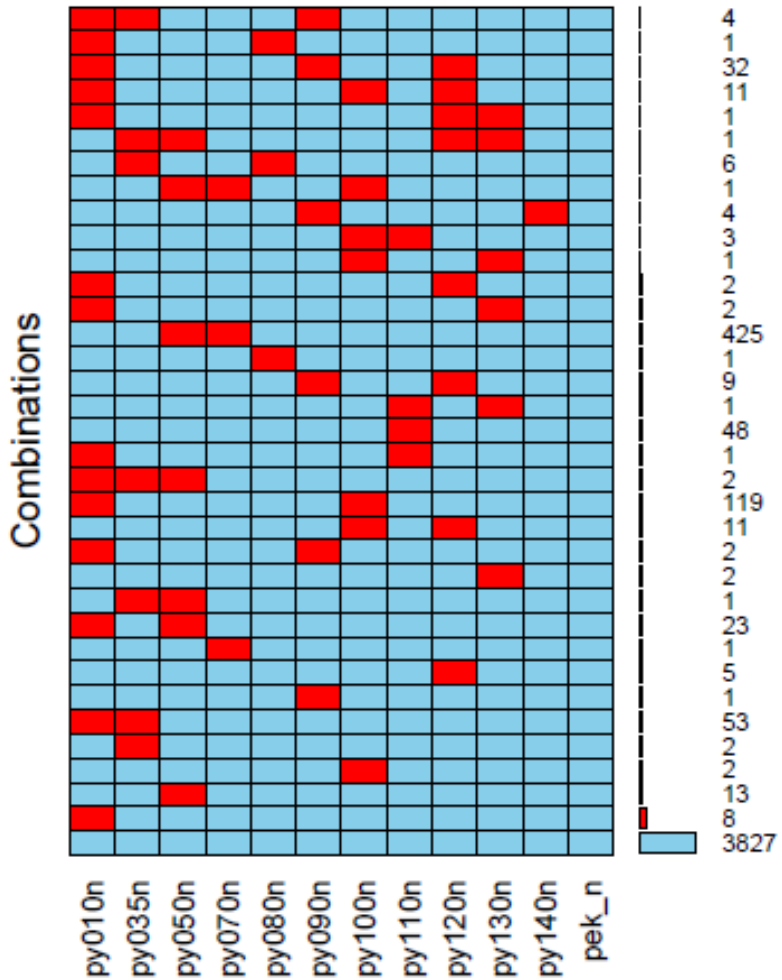

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Kowarik, A., Meindl, B., & Templ, M. (2016). The R-Packages VIM (Visualization of Missing Values) and sparkTable (Generating Graphical Tables). Paper presented at ESS Visualization Workshop, Valencia.

Processes of statistical production

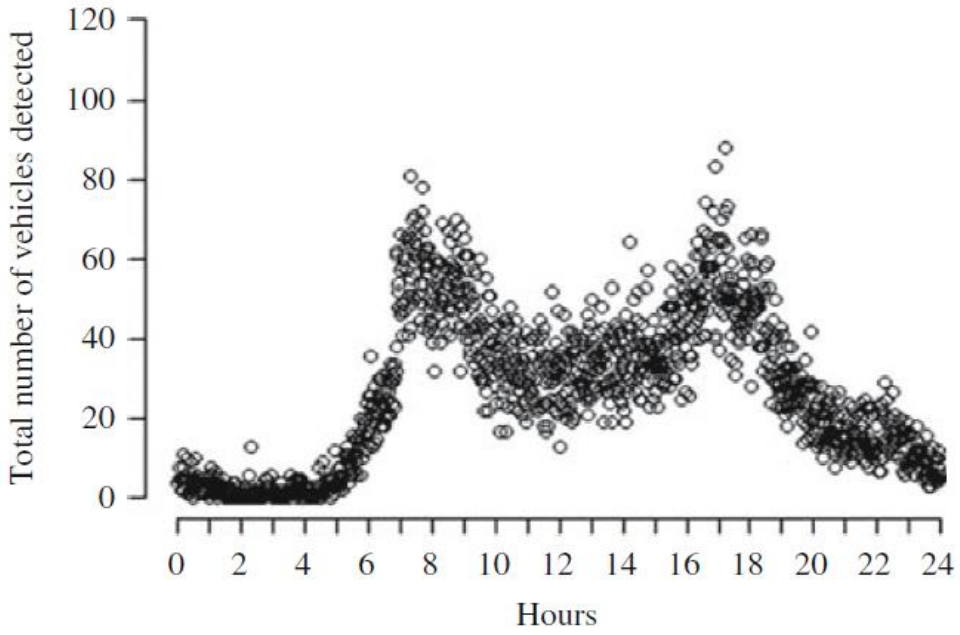

Fig. 3. Total number of vehicles counted by a detection location on highway A4 near Bergen op Zoom.

Daas, P., Puts, M., Buelens, B., et al. (2015). Big Data as a Source for Official Statistics. *Journal of Official Statistics*, 31(2), pp. 249-262. Retrieved 13 May. 2017, from doi:10.1515/jos-2015-0016

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Data dissemination

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Nature of data

User groups & Purpose

Medium

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Jorge Camoes
excelcharts.com

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Created by Giuditta Valentina Gentile
from Noun Project

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Color for non-designers: make it functional, not aesthetic

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Manage color stimuli intensity: create layers of meaning with gray, pale colors and saturated colors

Minimize it, play with gray

Define functional tasks

- **Categorize**
- **Group**
- **Emphasize**
- **Sequence**
- **Diverge**
- **Alert**

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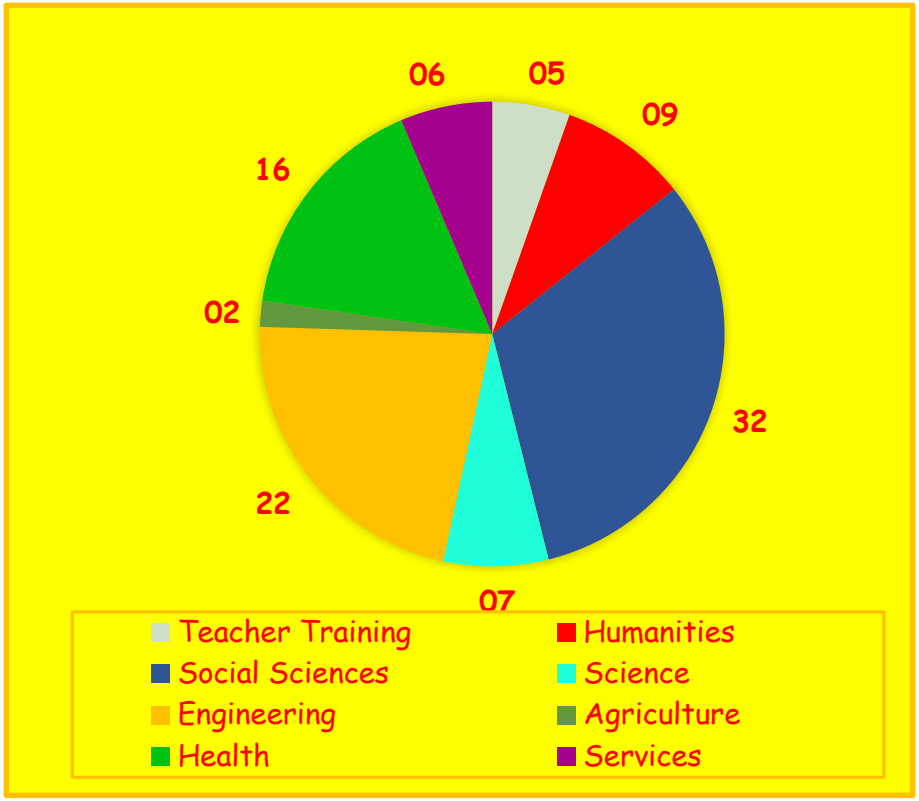
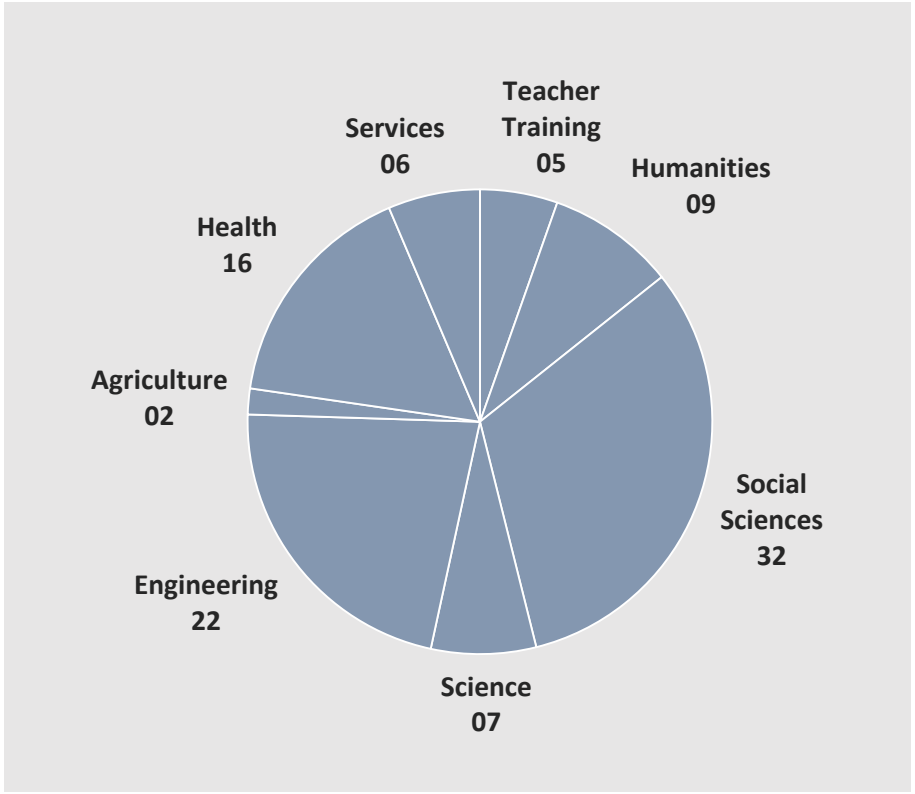
Stimuli intensity





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Categorize

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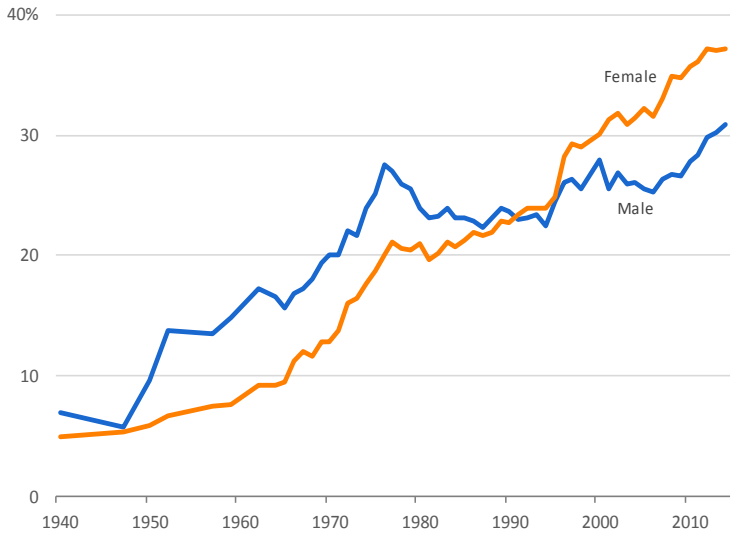
AFTER MORE THAN 30 YEARS, ARE MEN PLAYING CATCH-UP IN EDUCATION?

People aged 25 years and over who have completed college



Source: U.S. Census Bureau

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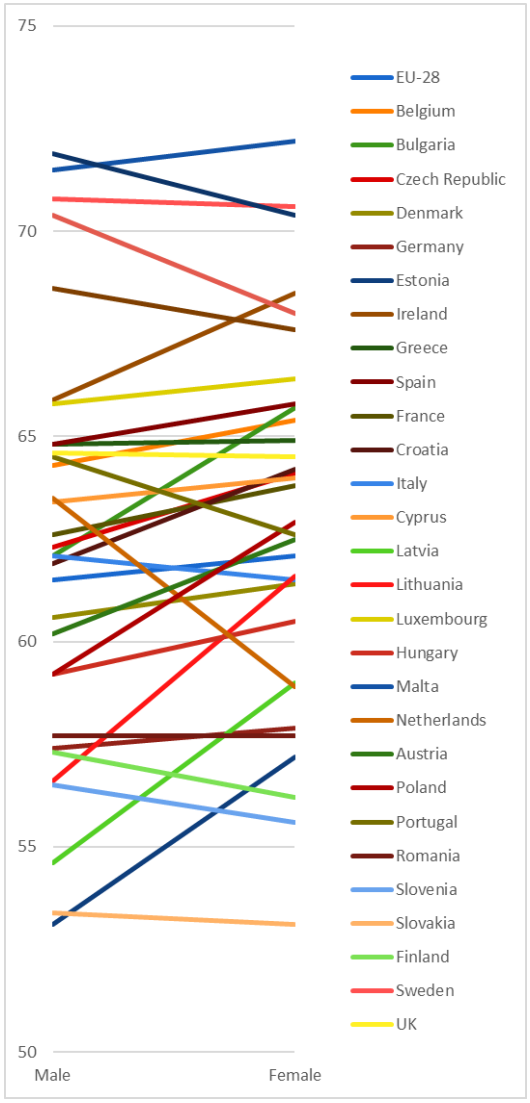
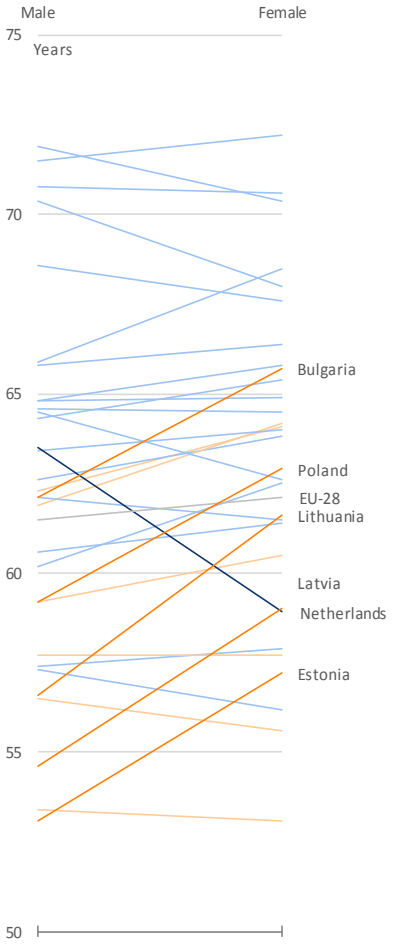
Emphasize



COUNTRIES WHERE THE GAP IN HEALTHY LIFE EXPECTANCY BETWEEN MEN AND WOMEN IS MORE THAN THREE YEARS
Healthy life expectancy by sex and country, in 2012



Source: Eurostat

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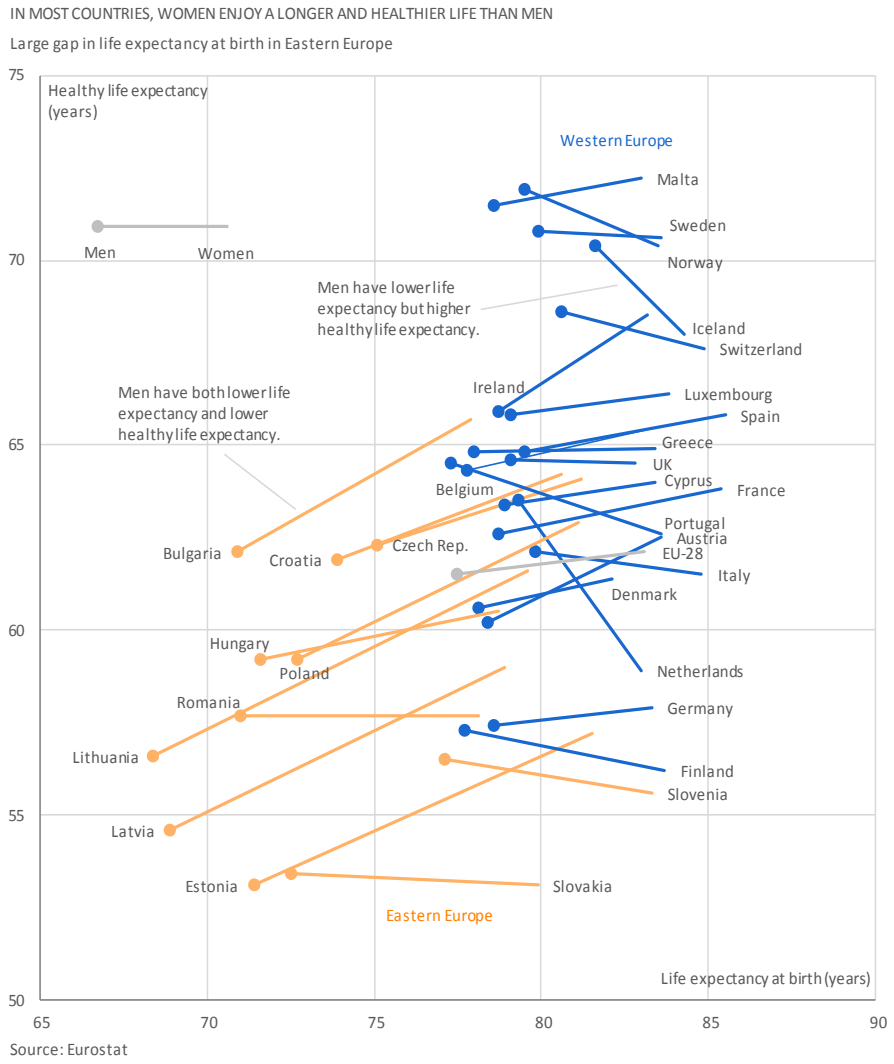

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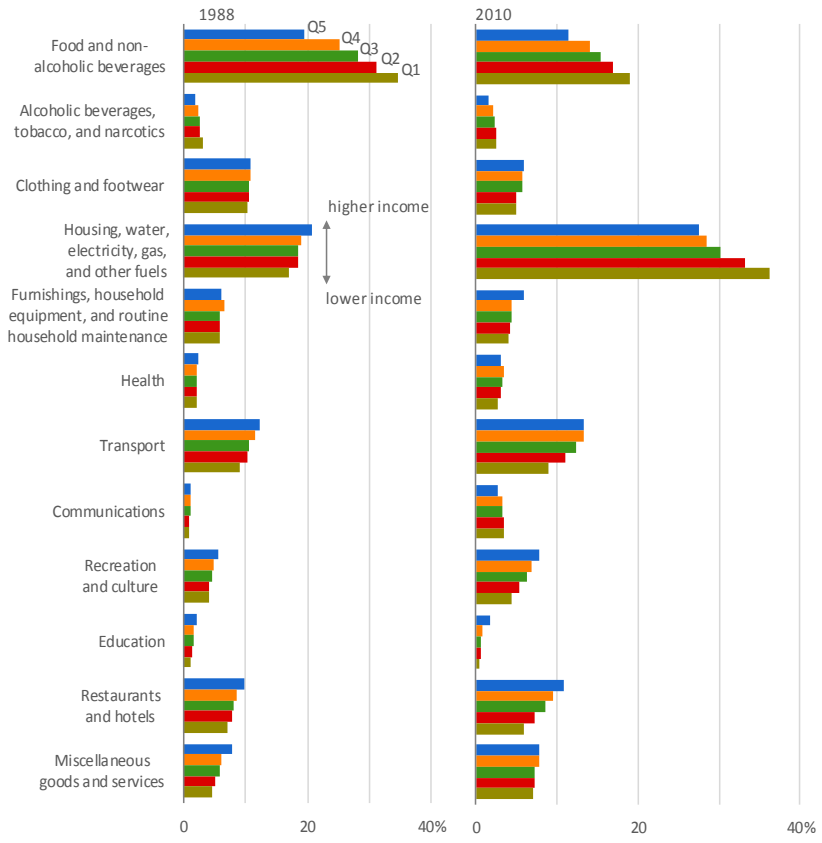
Sequence

LESS IN FOOD, MORE IN HOUSING: CHANGES IN EXPENDITURE IN SPAIN

Proportion of household expenditure per category and income quintile



Source: Eurostat

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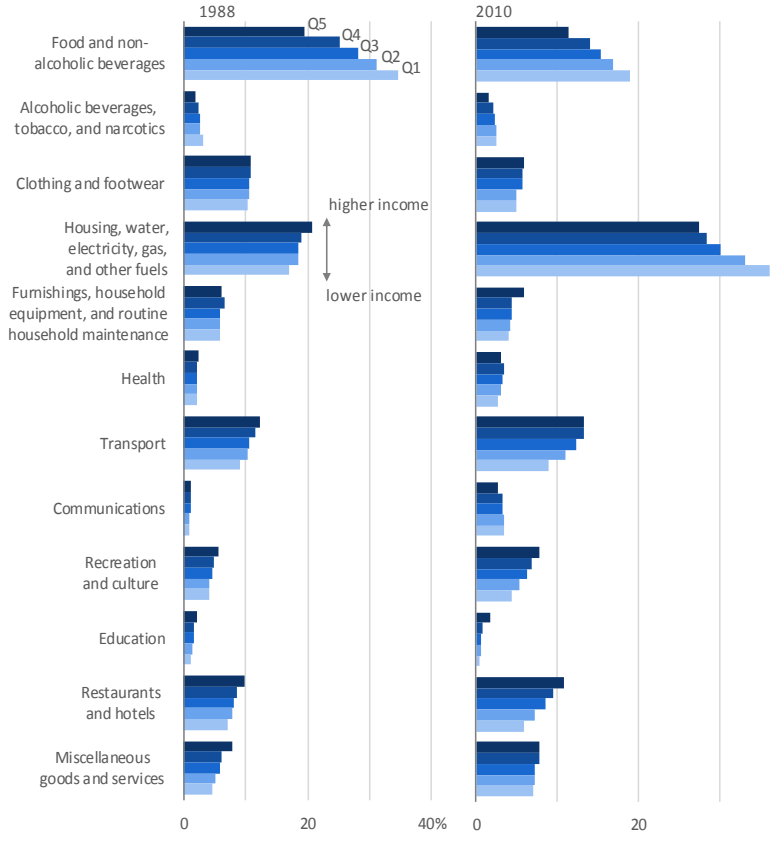
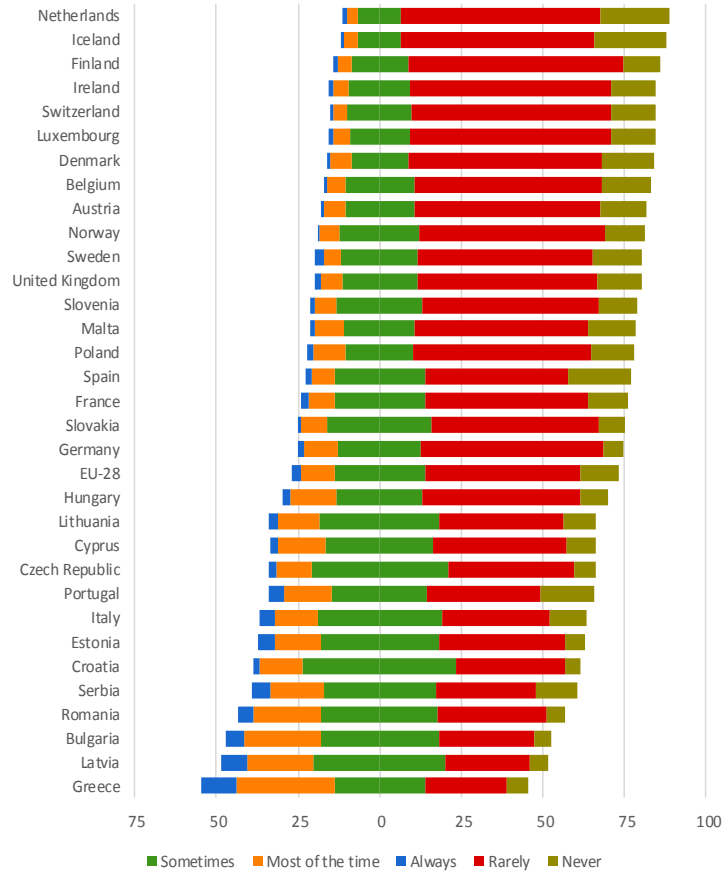


Source: Eurostat

Diverge

FREQUENCY OF BEING HAPPY IN THE LAST 4 WEEKS

Population over 16 years old in 2013



Source: Eurostat

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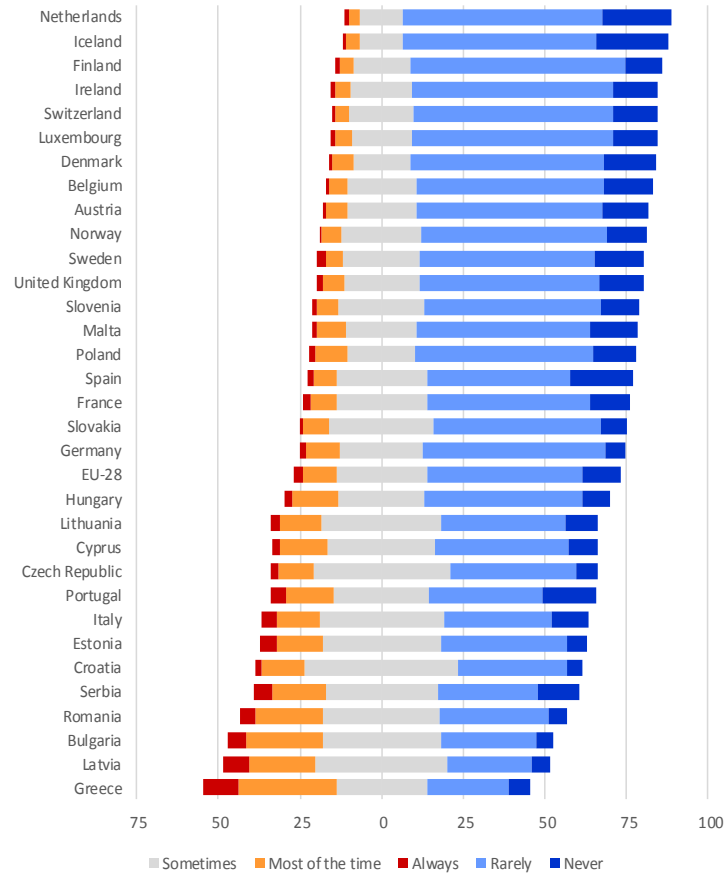
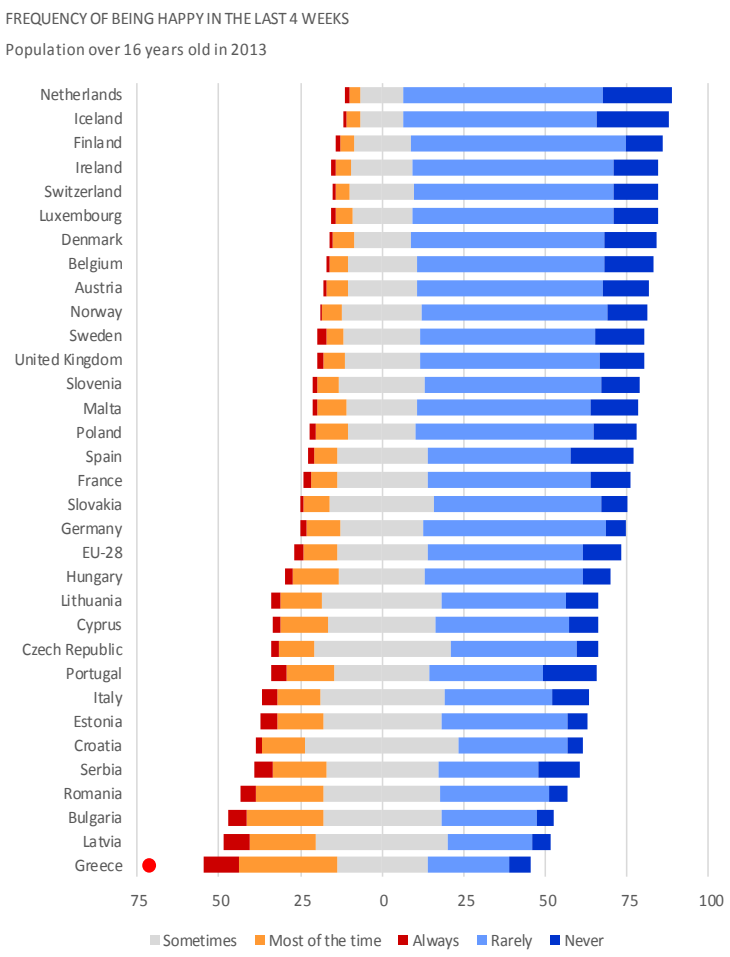
Population over 16 years old in 2013



Source: Eurostat

Alert


FREQUENCY OF BEING HAPPY IN THE LAST 4 WEEKS
Population over 16 years old in 2013
Netherlands
Iceland
Finland
Ireland
Switzerland
Luxembourg
Denmark
Belgium
Austria
Norway
Sweden
United Kingdom
Slovenia
Malta
Poland
Spain
France
Slovakia
Germany
EU-28
Hungary
Lithuania
Cyprus
Czech Republic
Portugal
Italy
Estonia
Croatia
Serbia
Romania
Bulgaria
Latvia
Greece
75
50
25
0
25
50
75
100
Sometimes
Most of the time
Always
Rarely
Never

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Play with gray

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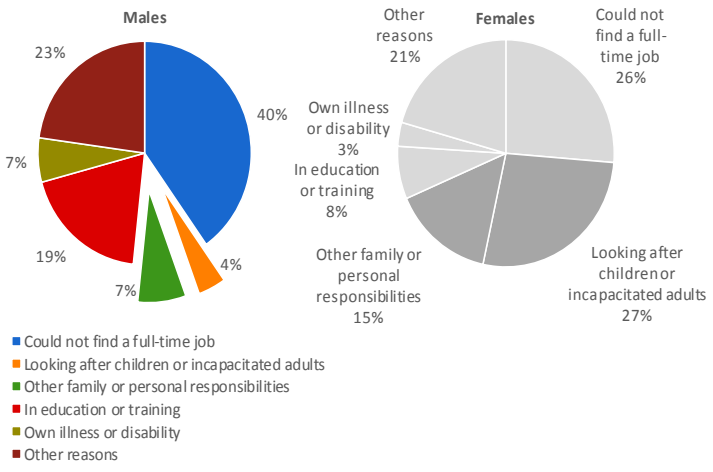
MAIN REASONS FOR PART-TIME EMPLOYMENT BY SEX

From 15 to 64 years old, in the European Union (EU-28), in 2014

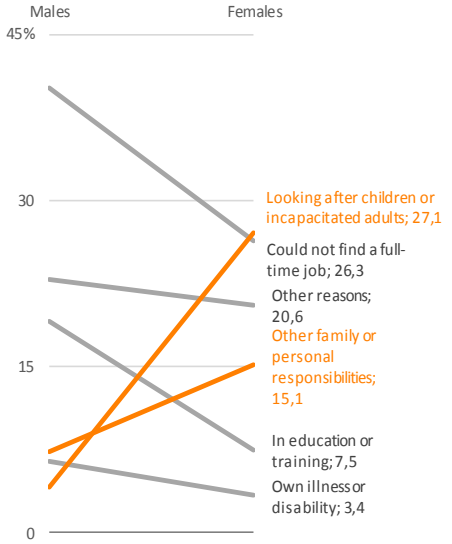


Source: Eurostat

No need for color

MAIN REASONS FOR PART-TIME EMPLOYMENT BY SEX

From 15 to 64 years old, in the European Union (EU-28), in 2014



Source: Eurostat

Use gray for context

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Color palettes: color brewer

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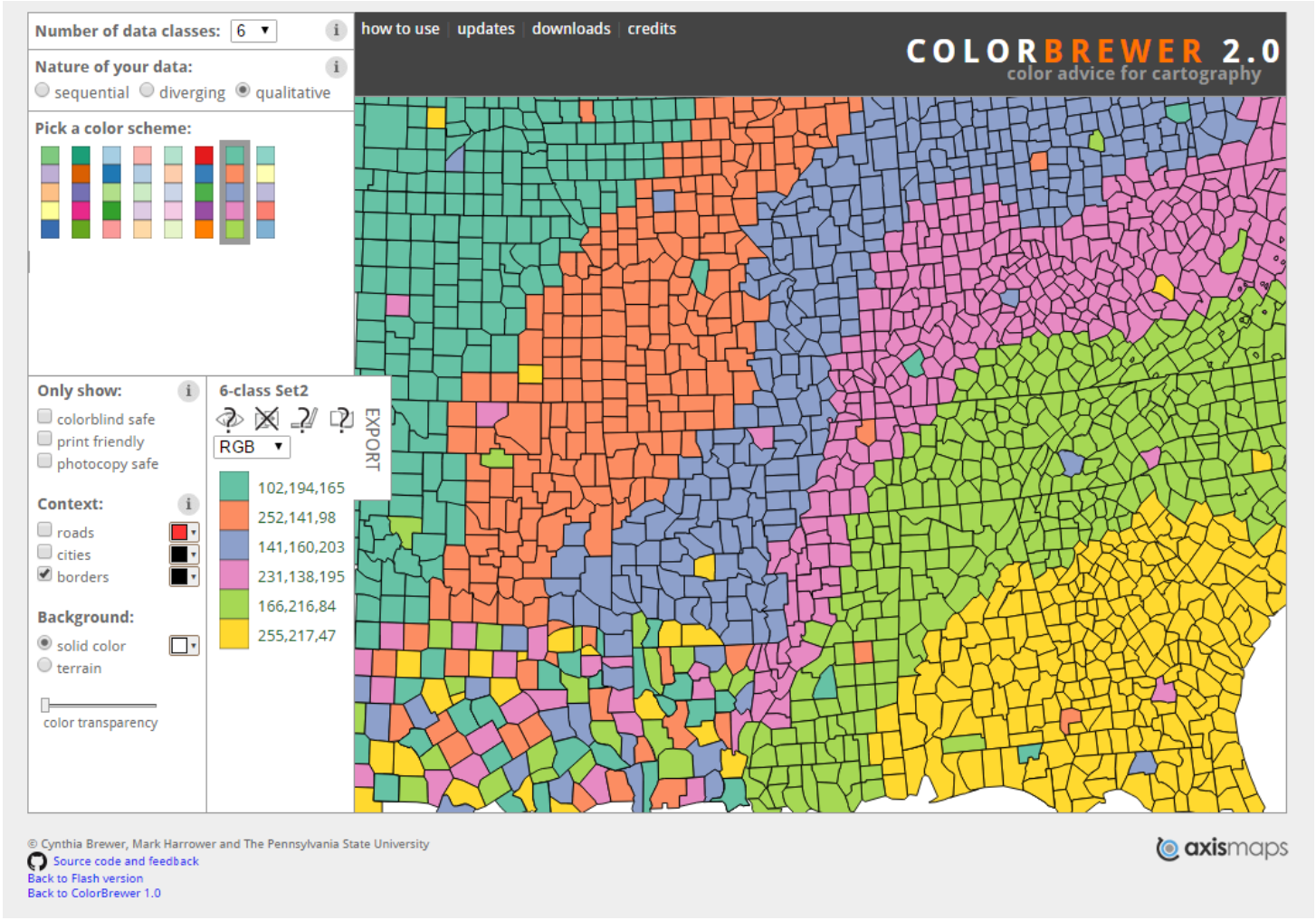

http://colorbrewer2.org

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Questions?

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Further reading: Starting set ☺

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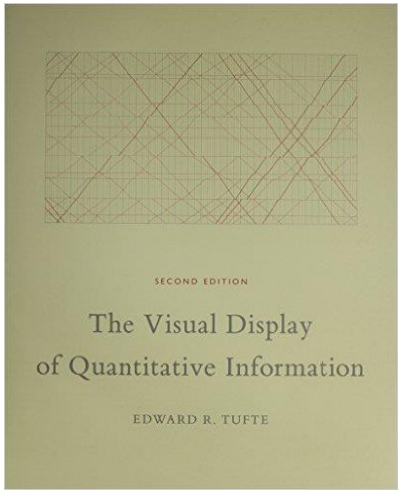

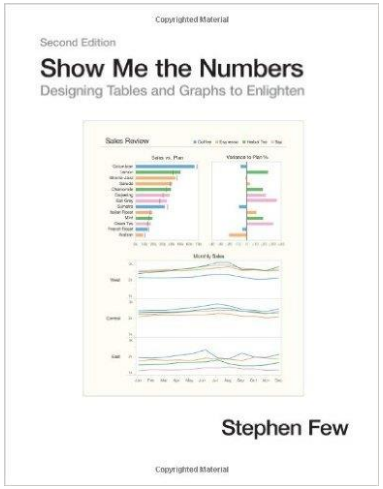

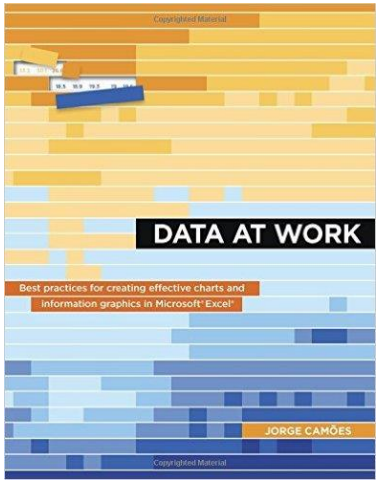

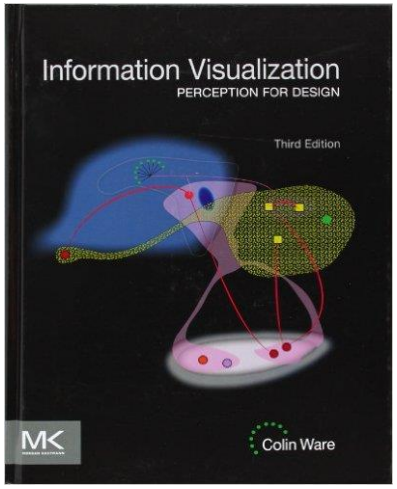

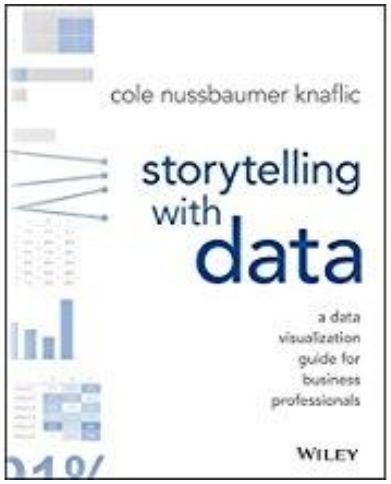

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