Essential Research Toolkit for the Humanities

Week 6: Data visualization

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Psycholinguistics and Cognitive Modeling Lab

Register for the exam starting tomorrow!

Homework

General comments

`dplyr` and `readr` are loaded together with `tidyverse`. You don't need to load `psych` if you're not using it.

You can save/assign to variable and then call the variable to shorten code. What you don't assign, disappears.

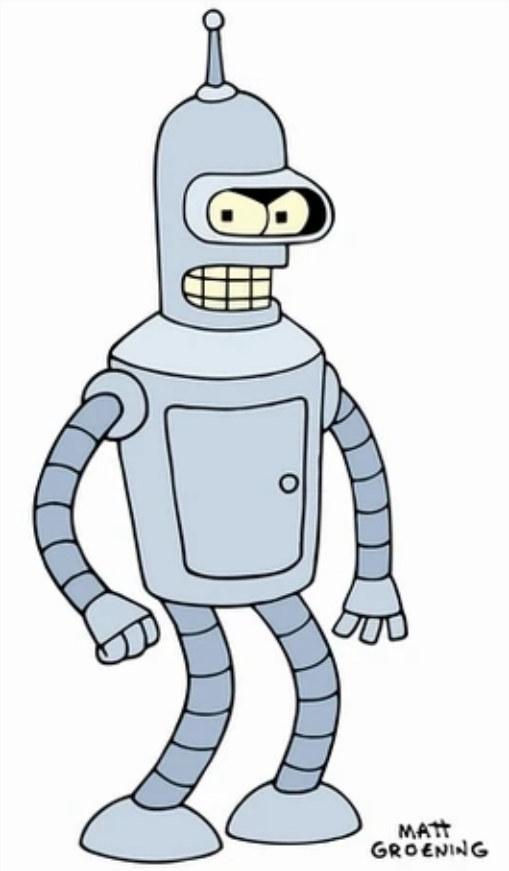
`arrange()` by default arranges by first column (or more).

Test your code on a clean slate/empty environment (sometimes stuff isn't actually working):

```
df.perc <- summarise(moses.preproc, Count=n()) |>
      mutate(Perc=Count/sum(df.perc$Count)*100)
```

If nothing in you code works, read the error messages and look for help (Correct working directory? Loaded required packages? Documentation? Slides? Forum? Email?).

AI use



I can tell when you use AI for help. If you're smart about it, I'll turn a blind eye to it. If you're dumb about it, I will fail the assignment.

If you use the `magrittr` pipe I expect you to explain why.

Moses illusion

The conditions were not “correct, incorrect, don’t know”.

I prefer %, but counts are ✔

I prefer % adding to 100% per condition, but 100% overall is ✔

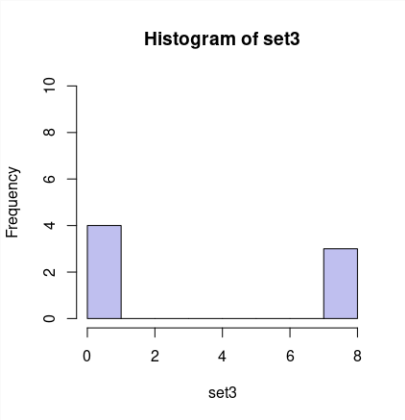
Asked for %, got proportions (accepted this time).

Count “don’t know” and “incorrect” together.

When counting incorrect answers, higher number = worse accuracy.

Noisy channel

I wanted to see the standard deviation or similar.



Questions?

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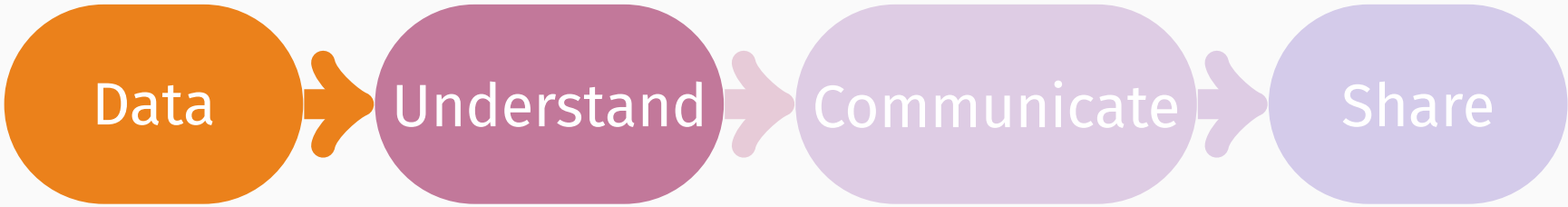
Where are we this week?

Recap



R & RStudio, packages, data types, formats, encoding

import from workspace, assign values, operations, clean, filter, arrange, select, merge, group, summarize, visualize, export

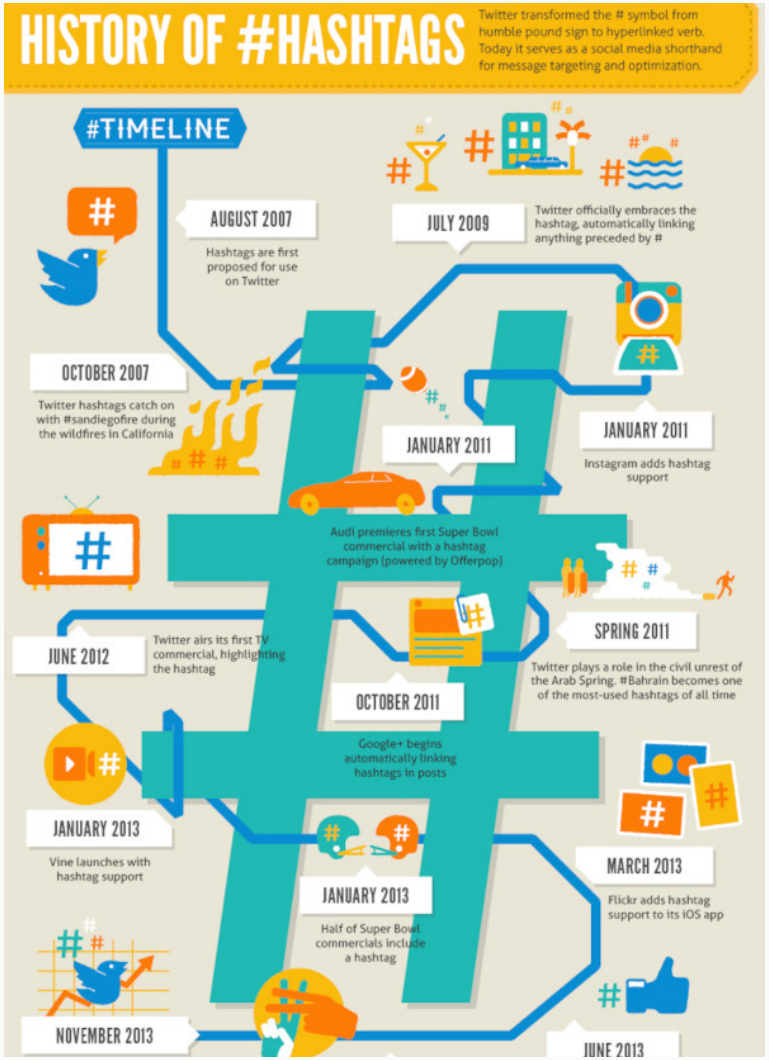
document, create clean and beautiful reports

connect, collaborate, backup

Data visualization

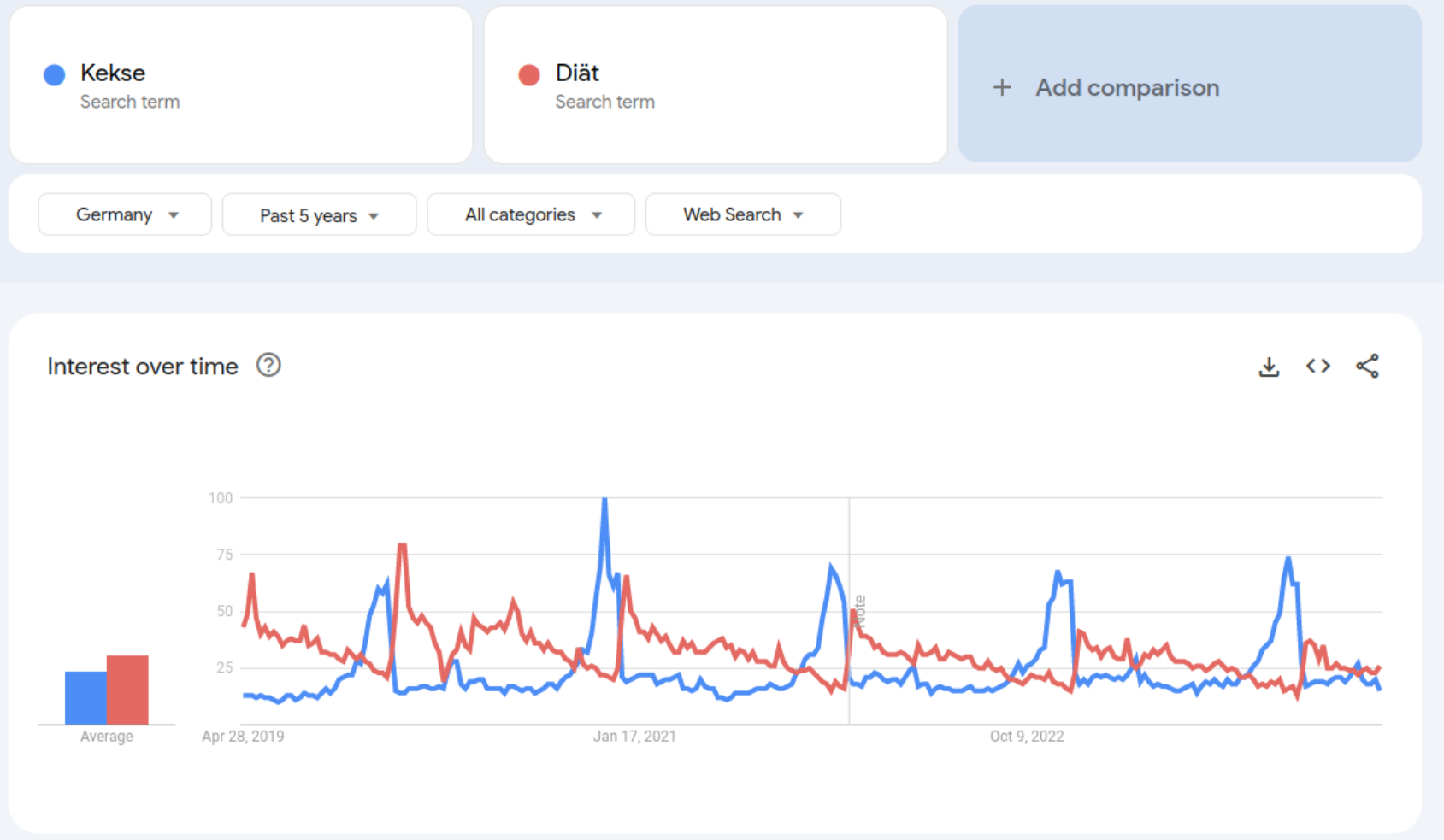
What is data visualization?

Interdisciplinary field

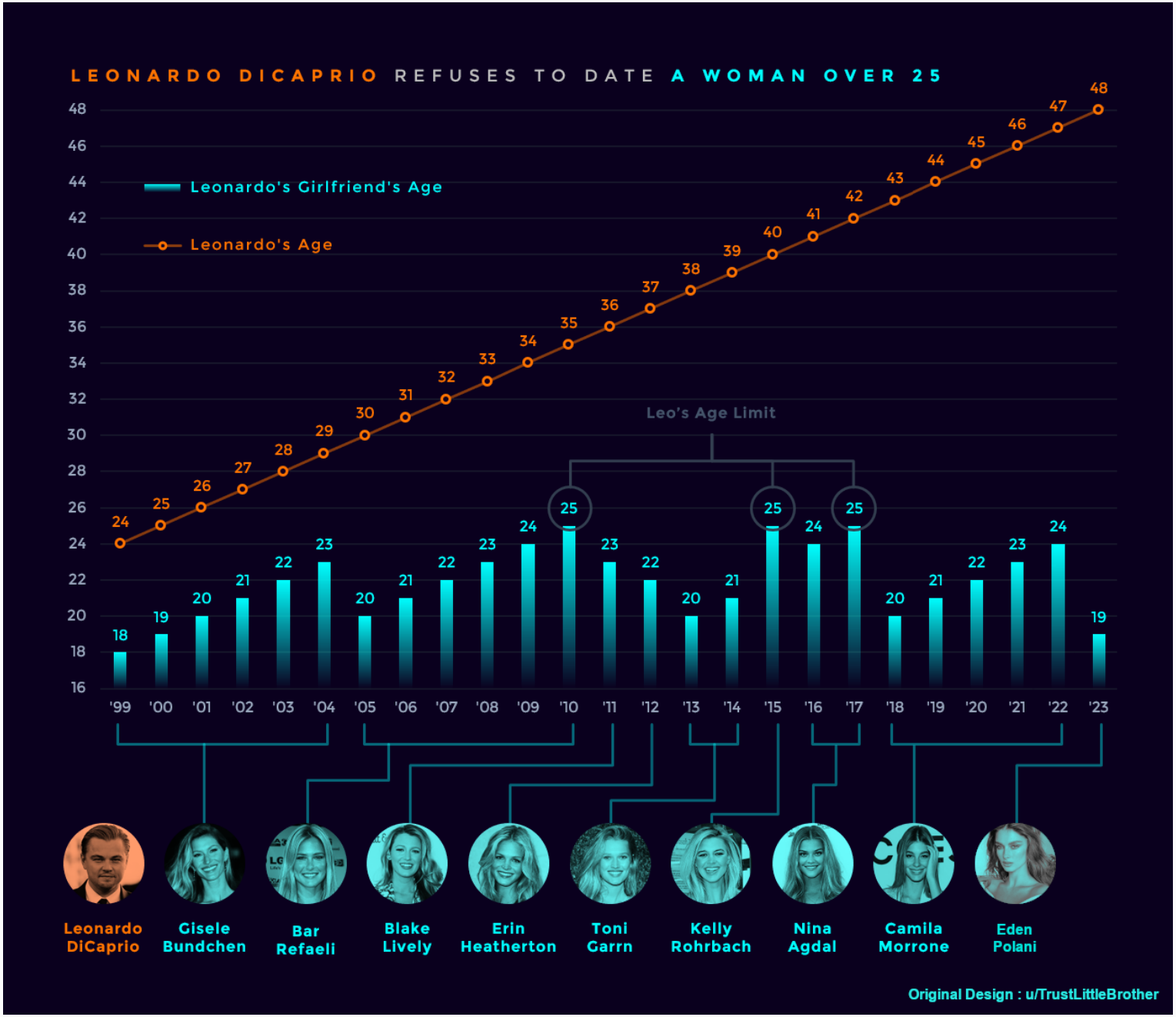


Graphical representation of data & information

What is data visualization?

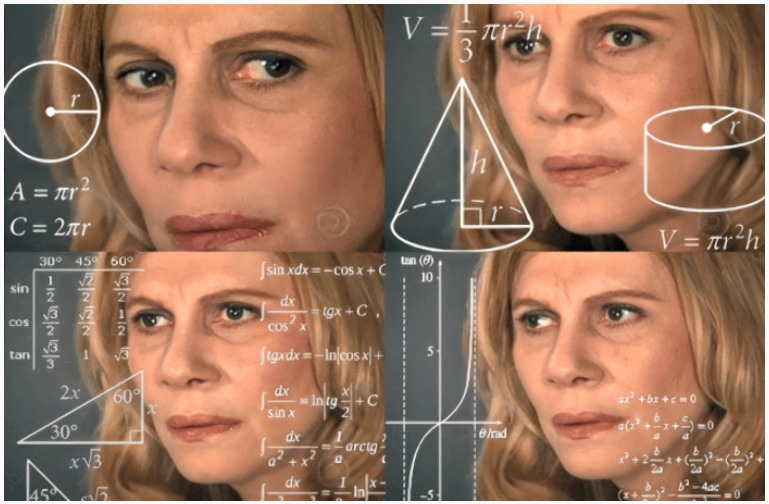


Efficient way of communicating (Google Trends cookies vs. diet)

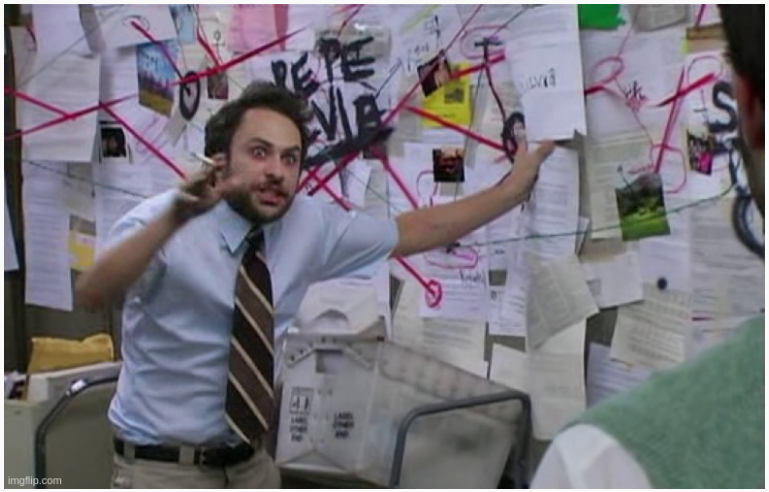


Communicate complex relationships & insights in a comprehensible way

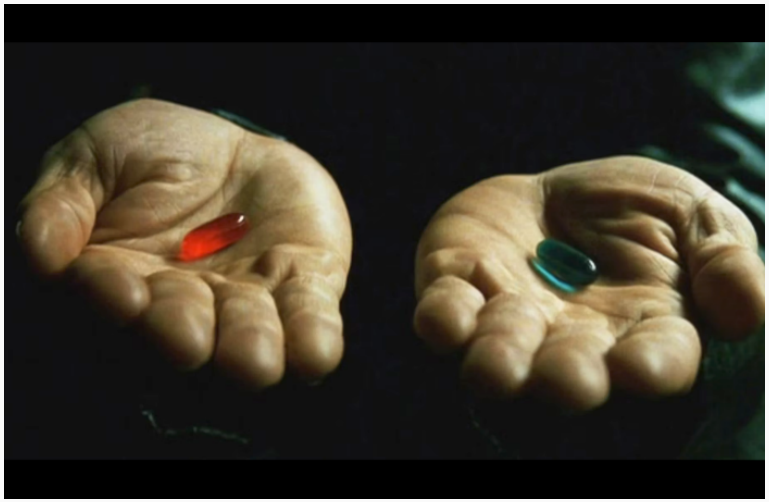
Data visualization goals



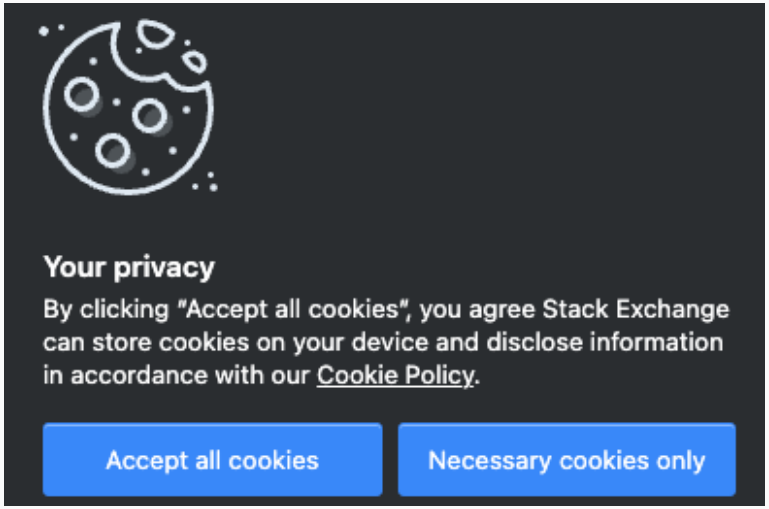
Communication & understanding



Analysis & exploration



Decision making



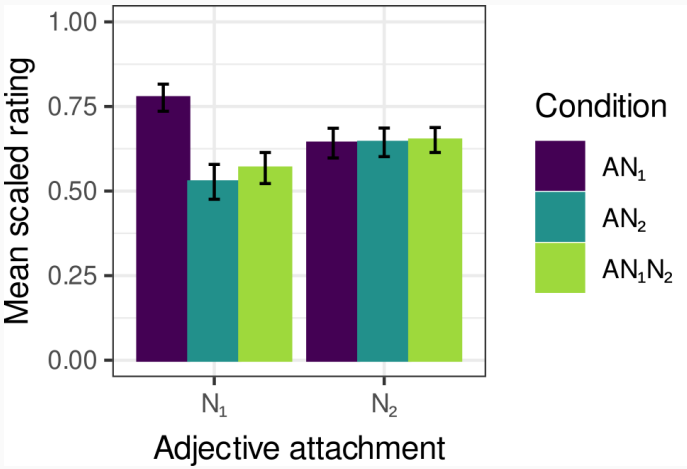
It's likely required in your career

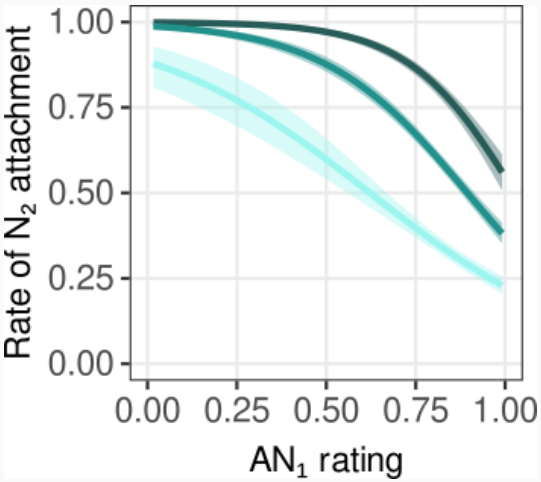
Visualization types

Tables

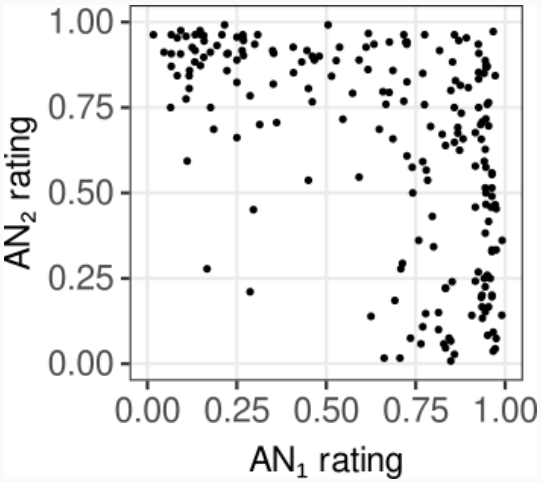
item	sentence	N1	N2	unclear
3	sommerliche Arbeitskleidung	0	20	0
11	silberne Bahnhofsuhr	0	20	0
12	amtliche Baugenehmigung	0	19	1
16	hohler Bienenstock	0	20	0
19	gefüttertes Brillenetui	0	20	0
22	lackiertes Bücherregal	0	20	0
23	evangelischer Büroangestellter	0	20	0

Bars



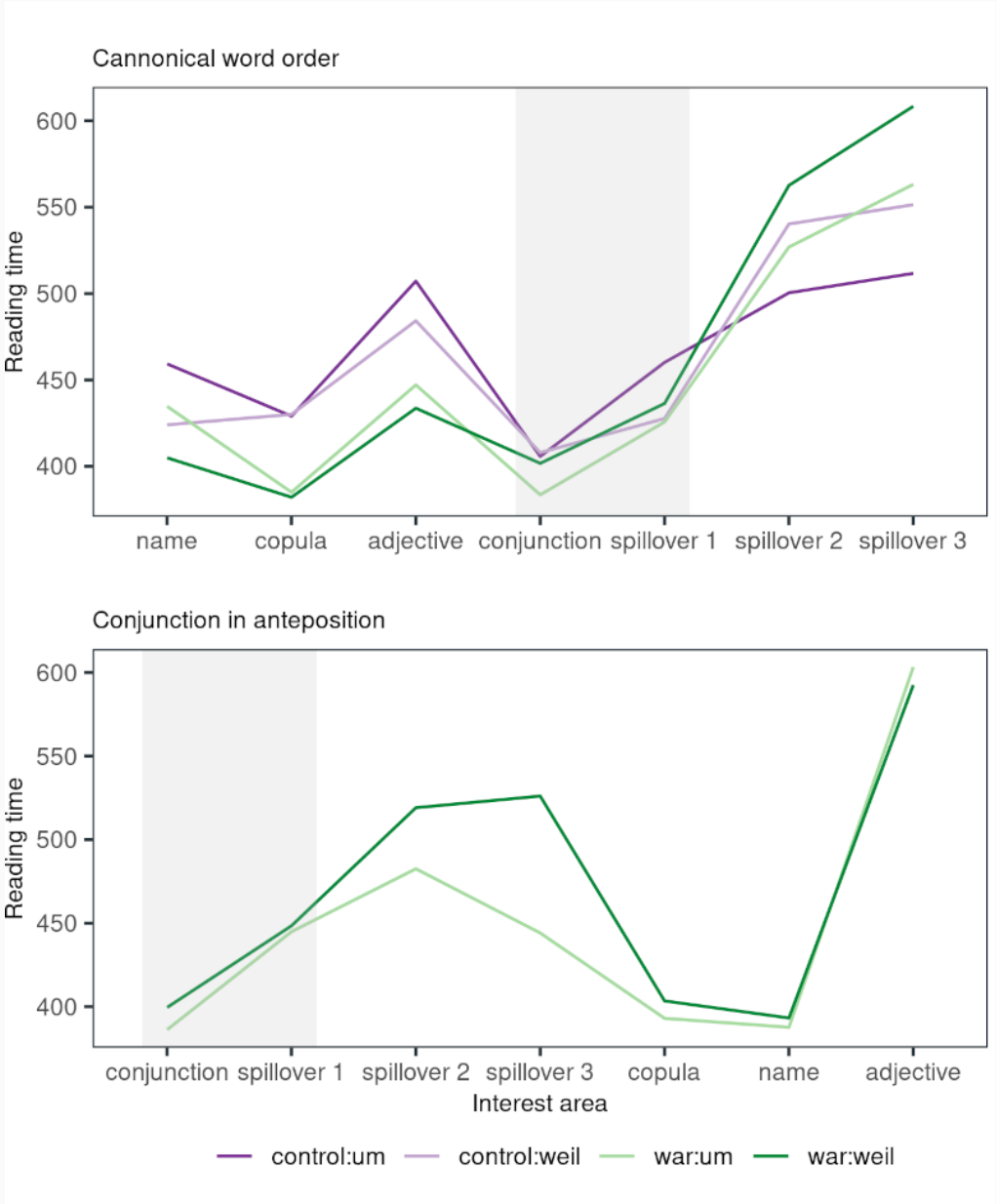


Lines

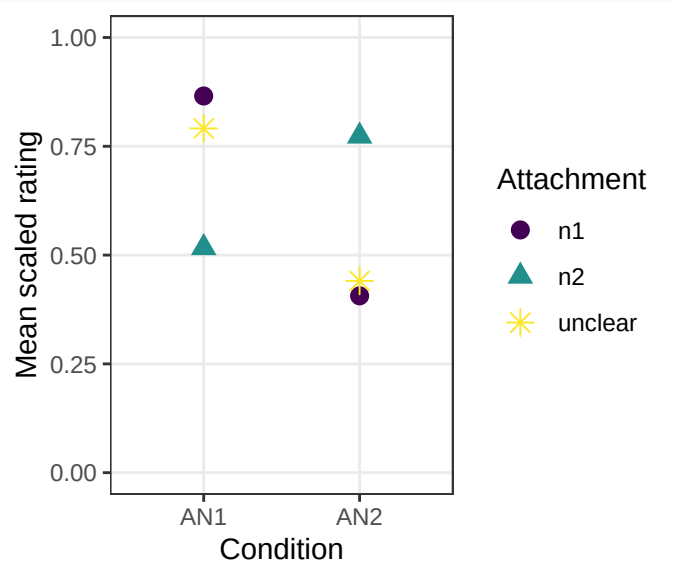


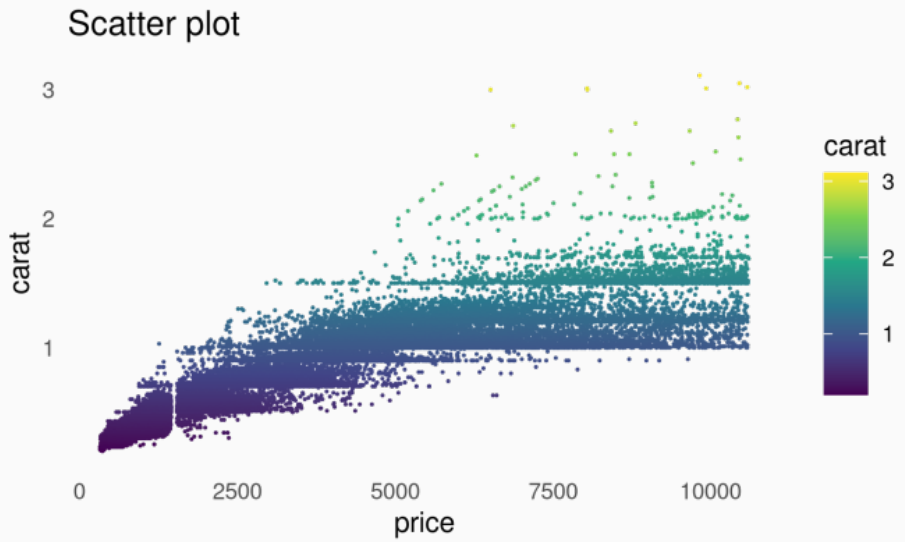
Points

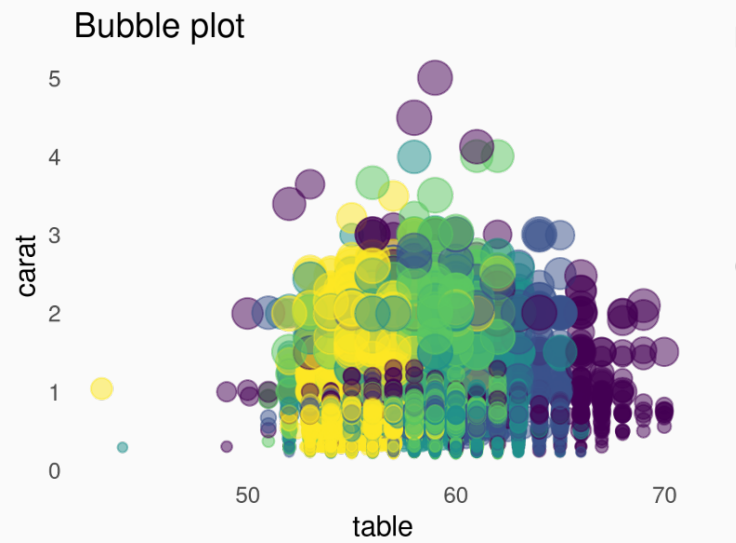
Lines


Cannonical word order
Reading time
600
550
500
450
400
name
copula
adjective
conjunction
spillover 1
spillover 2
spillover 3
Conjunction in anteposition
Reading time
600
550
500
450
400
conjunction
spillover 1
spillover 2
spillover 3
copula
name
adjective
Interest area
control:um
control:weil
war:um
war:weil

Points

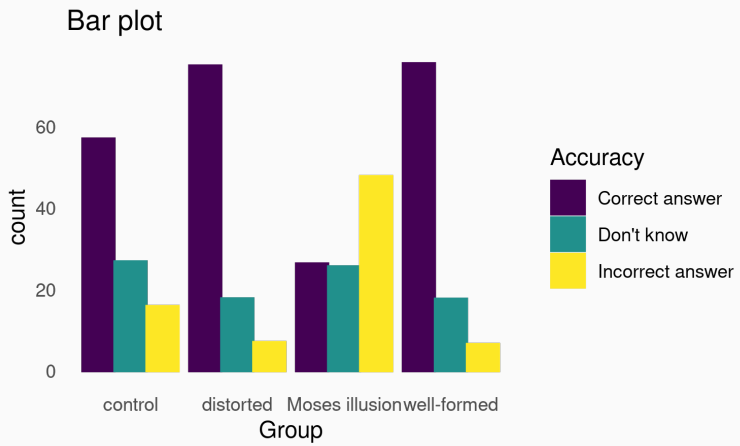


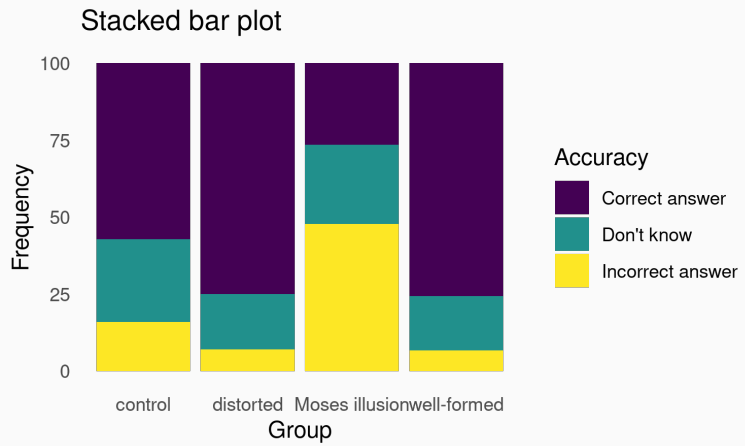


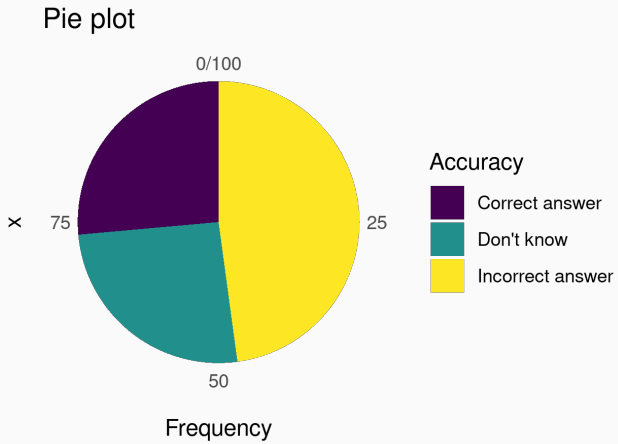


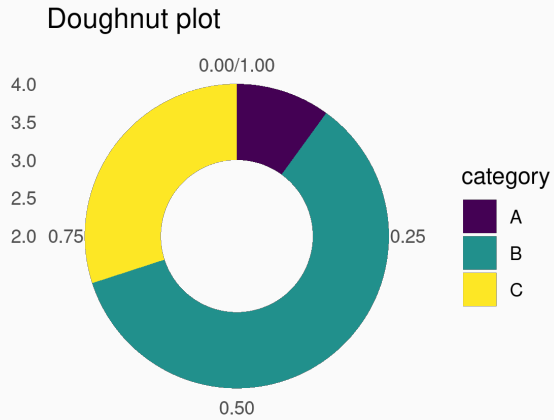
→https://r-graph-gallery.com/

Bars

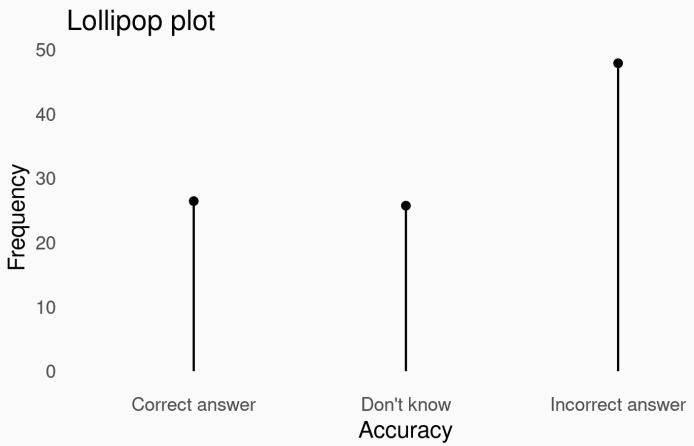

Bar plot
count
60
40
20
0
control
distorted
Moses illusion
well-formed
Group
Accuracy
Correct answer
Don't know
Incorrect answer

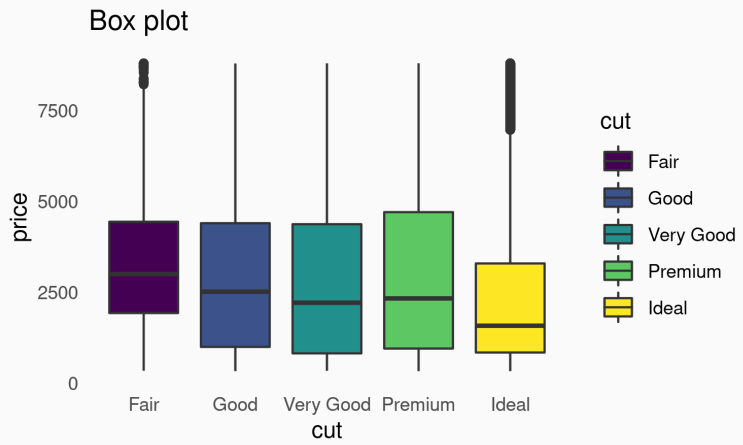

Stacked bar plot
Frequency
100
75
50
25
0
control
distorted
Moses illusion
well-formed
Group
Accuracy
Correct answer
Don't know
Incorrect answer


Pie plot
0/100
x
75
25
50
Frequency
Accuracy
Correct answer
Don't know
Incorrect answer

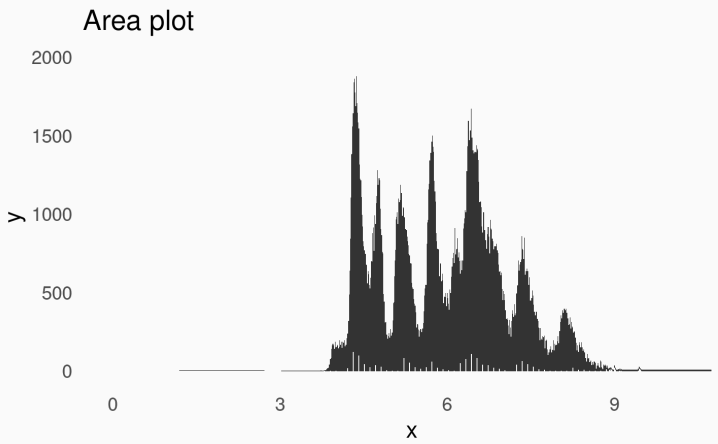

Doughnut plot
0.00/1.00
4.0
3.5
3.0
2.5
2.0
0.75
0.25
0.50
category
A
B
C

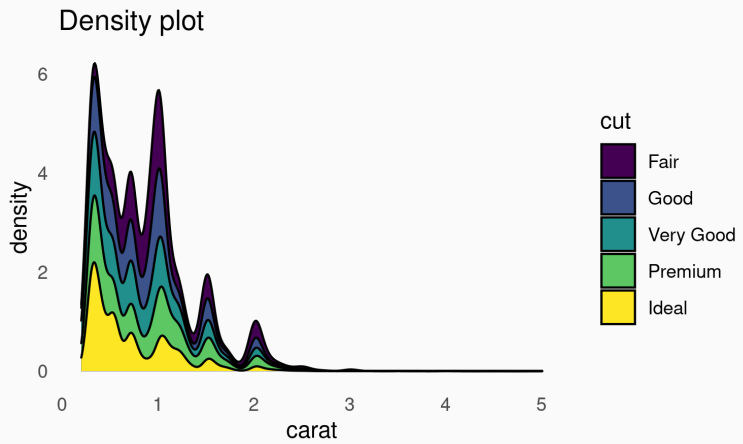
Hybrids

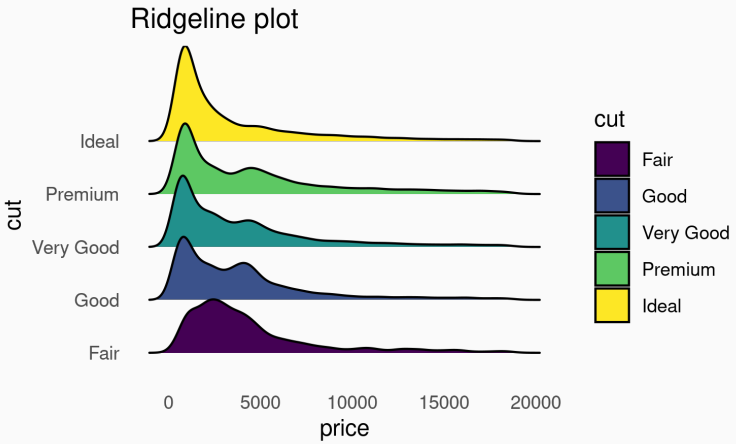

Lollipop plot
50
40
30
20
10
0
Frequency
Correct answer
Don't know
Incorrect answer
Accuracy

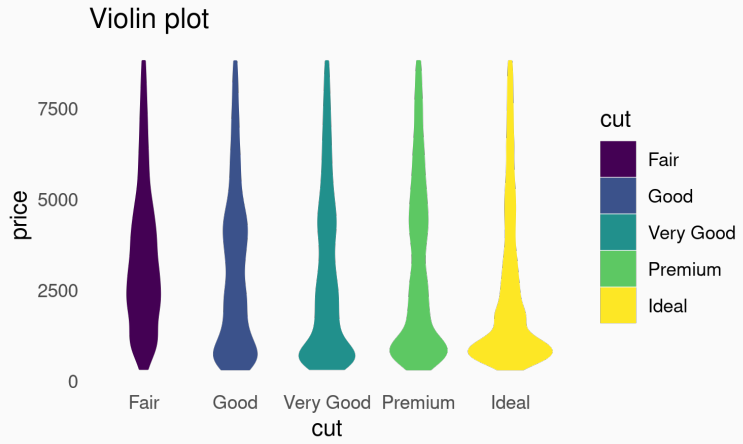

Box plot
7500
5000
2500
0
price
Fair
Good
Very Good
Premium
Ideal
cut
cut
Fair
Good
Very Good
Premium
Ideal

Hybrids


Area plot
2000
1500
1000
500
0
y
0
3
6
9
x


Density plot
6
4
2
0
density
0
1
2
3
4
5
carat
cut
Fair
Good
Very Good
Premium
Ideal

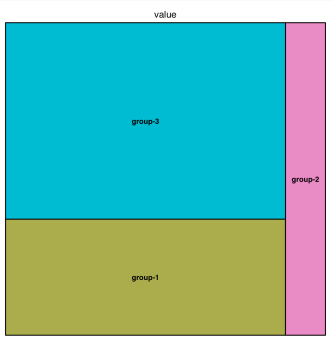

Ridgeline plot
Ideal
Premium
Very Good
Good
Fair
cut
0
5000
10000
15000
20000
price
cut
Fair
Good
Very Good
Premium
Ideal


Violin plot
7500
5000
2500
0
price
Fair
Good
Very Good
Premium
Ideal
cut
cut
Fair
Good
Very Good
Premium
Ideal

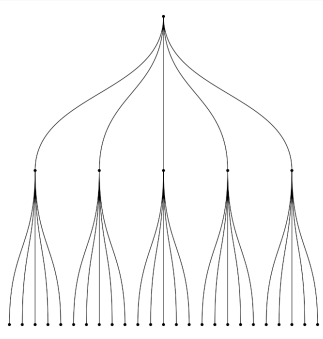
Others

Radar

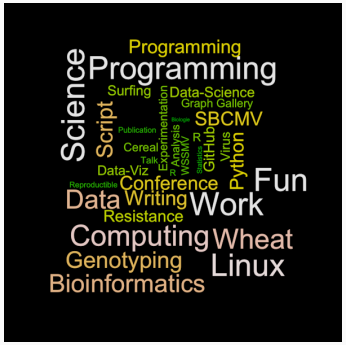
Treemap



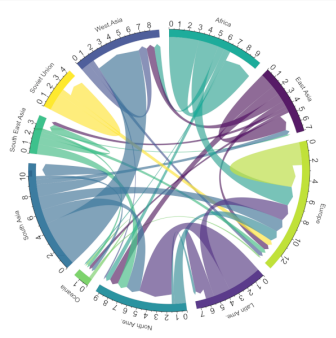
Dendrogram



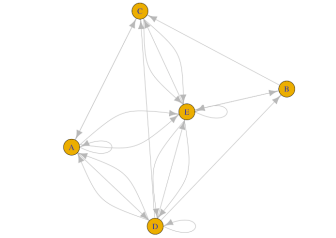
Wordcloud



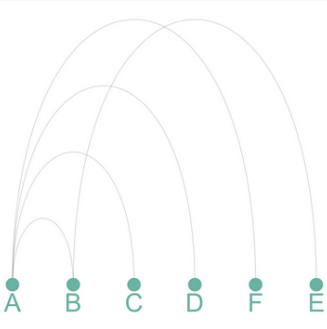
Chord



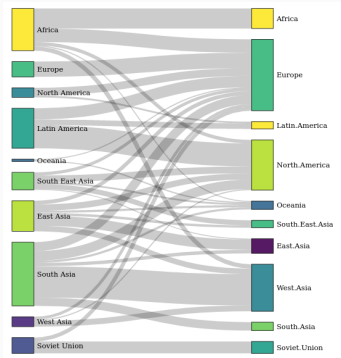
Network



Arc



Sankey



Source: `www.data-to-viz.com`

Accessibility

The 4 Principles of Accessibility

Web Content Accessibility Guidelines (WCAG)

Perceivable: Information and interface components are perceivable by users (understandable and not hidden from any senses).

Operable: User interface components and navigation should be operable (usable and cannot require tasks beyond users' abilities).

Understandable: Information and the operation of user interfaces must be understandable (understand the information and how to interact with the interface).

Robust: Content must be so robust that most users can interpret it (as technology progresses, content should remain accessible, including via assistive technologies).

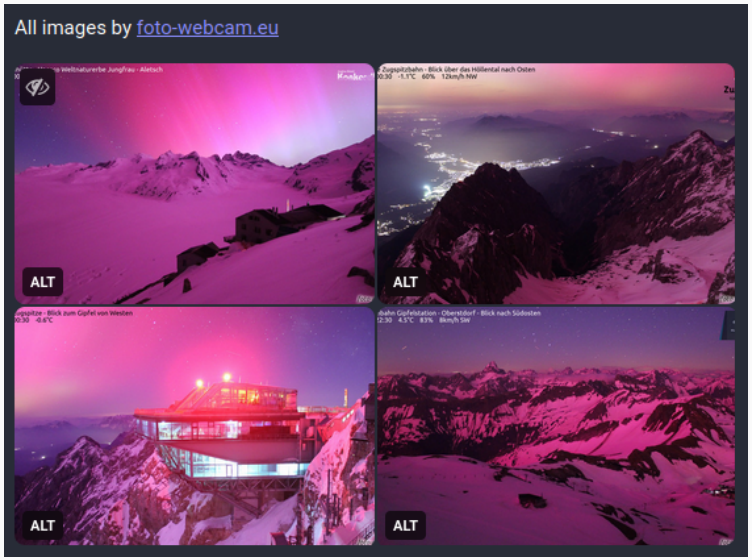
Best honest effort

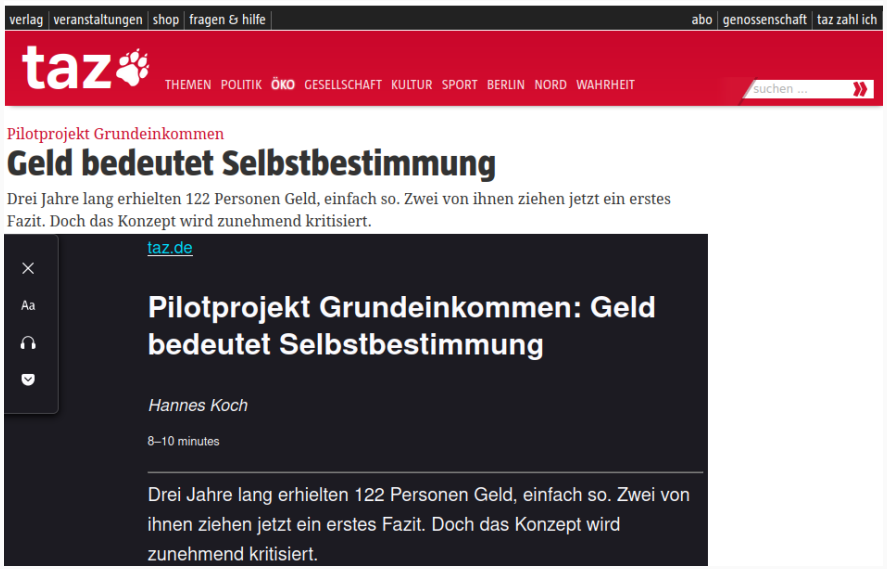
Perceivable Application

Provide **text alternatives** for non-text content (e.g. ALT, subtitles) that can be changed into LARGE PRINT, Braille, speech, translations, simple language.

Create content that can be modified **without losing information or structure** (e.g. simple layout, reader view).

Chose a form that makes **seeing and hearing content easy** (e.g. foreground vs. colors).





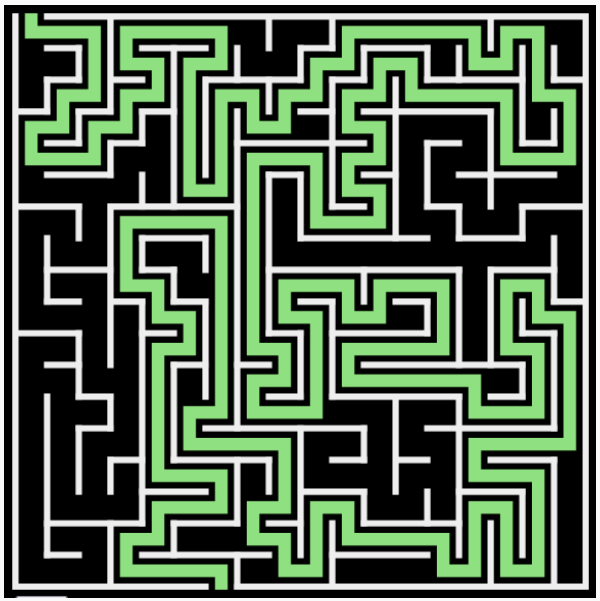
Operable Application

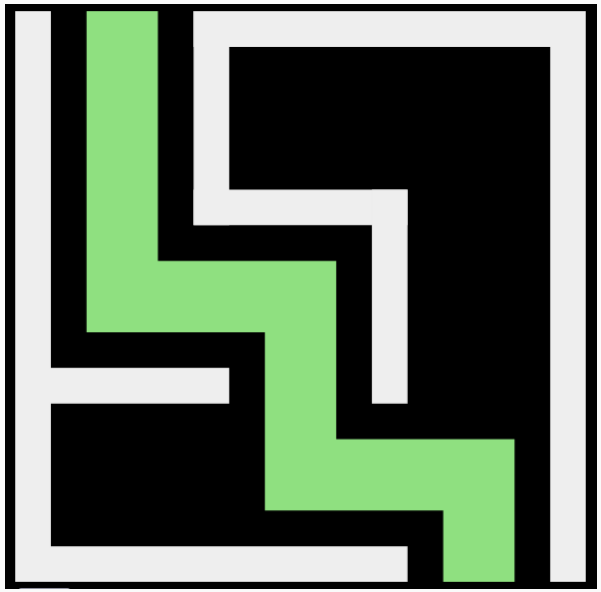
Make all functionality **keyboard accessible** and allow **different input modalities**.

Give **enough time** to read and use content.

Don’t design content in a way that is known to cause **seizures or physical reactions**.

Make content **easy to find and navigate**.





Understandable Application

Provide **labels and instructions**.
Make content **readable and understandable**.
Make your content appear and operate in **predictable** ways.
Provide **input assistance** (to avoid/correct mistakes).

BILLY DISASSEMBLY INSTRUCTIONS

IKEA has created a number of Disassembly Instructions to help customers extend the lifecycle of their furniture. This easy-to-use guide will help customers take apart one of their favourite IKEA furniture items, BILLY, so it can be re-built in its new home.

1
Remove books and other decorative items.

2
Remove shelves, shelf support pins and wall brackets.

3
Place bookshelf on floor, remove pins on back board and slide backing off.

4
Place on side and remove screws.

5
Remove shelves and remove screws.

6
Here are all the parts you should have for your disassembled BILLY.

Note: If any screws or bolts are missing when you come to rebuild your bookshelf (or any other item), you can pick up free replacements from our Spare Parts Library. Simply visit Customer Returns once stores reopen.

Robust Application

Maximize compatibility with current and future software and hardware.
Make compatible with **assistive technologies**.
Simple UI > complex UI.
Use **simple markup** languages.
Test content for crashes.
Include **meta information** (session info).

Choice of visualization

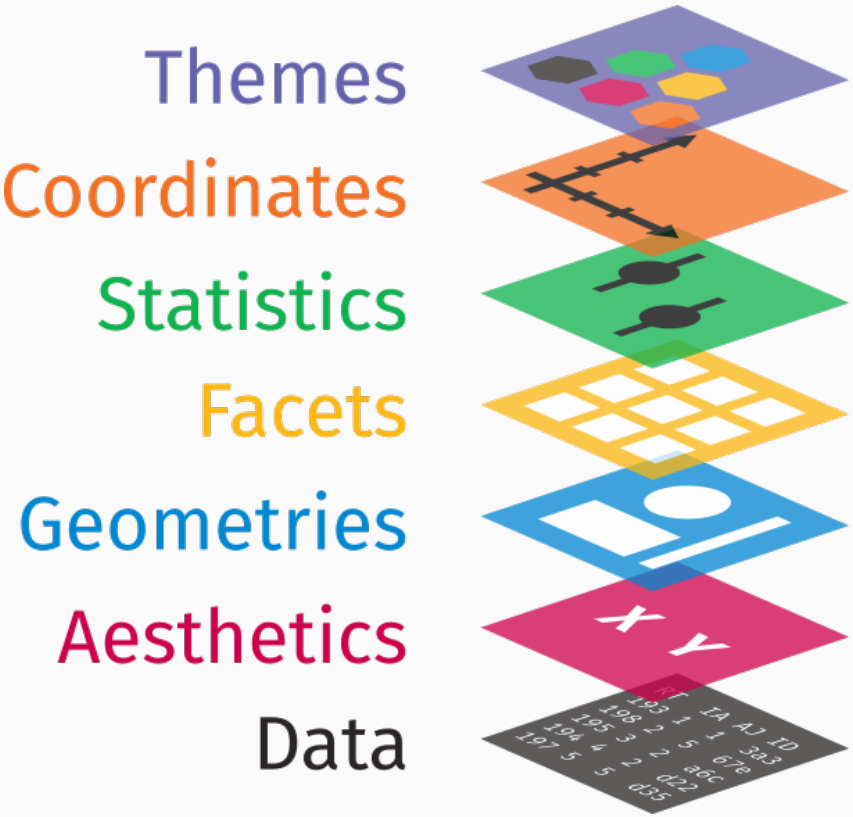
Plot choice examples

These are loose recommendations. Every case is different.

Change over time	line plot
Part-to-whole	stacked bar or area plot
Data distribution	bar plot, histogram, density curve, box plot, violin plot
Comparing groups	bar plot, dot plot, line plot, box plot, violin plot
Relationships between variables	scatter plot, bubble plot

Plotting in R

ggplot2: A Layered Grammar of Graphics



Created by Hadley Wickham.

Design and construct graphics in a structured manner from data upwards.

"A **layer** is a collection of geometric elements and statistical transformations" (Wickham et al. n.d.).

Assembly

1. Create a plot object
2. Add aesthetic mapping
3. Add geometric objects
4. Add appearance and statistics
... repeat 3 and 4 until you're happy
5. Print and profit!

```
my.plot <- ggplot()+
             aes()+
          geom_*()+
  coord_*() + theme()
```

Data

	CONDITION	IA	MeanRT	SD
	<chr>	<chr>	<dbl>	<dbl>
1	implausible	1	823.	119.
2	implausible	2	759.	107.
3	implausible	3	818.	179.
4	implausible	4	1023.	133.
5	plausible	1	781.	106.
6	plausible	2	700.	64.8
7	plausible	3	783.	115.
8	plausible	4	1092.	137.

Aesthetics

Aesthetics `aes()` translates data into visual elements:

`x, y`	variables
`colour`	colours the lines of geometries
`fill`	fill geometries
`group`	groups based on the data
`shape`	defines the shape (point, triangles)
`linetype`	defines the type of line (solid, dashed)
`size`	define sizes of elements
`alpha`	changes the transparency

Geometries

Geometries (`geom_*()`) provide the shapes and patterns to the data:

`geom_point()`	dot-plot (e.g. scatter-plot)
`geom_line()`	lines connecting (invisible) points
`geom_bar()`	bar charts for categorical x axis
`geom_histogram()`	histogram for continuous x axis
`geom_boxplot()`	box plot for categorical variables

Facets

Facets (`facet_*`) divide your plot into smaller sections across panels.

`facet_wrap()`	based on one variable, it arranges plots in a single row or column, adding more rows/columns as needed
`facet_grid()`	does the same, but based on two variables

Statistics

Statistics (`stat_*()`) compute and add statistical transformations to the data (e.g. means, counts, linear models)

Coordinates

Coordinates (`coord_*()`) change the coordinate system and axes.

`coord_cartesian()`	sets the limits of the coordinate system
`coord_polar()`	circular plots
`coord_map()`	map projections
`coord_flip()`	flips the coordinates

Themes

Themes (`theme_*()`) fine-tune the overall appearance and style:

- fonts,
- background color,
- line width,
- legend,
- axis and tick label sizes and colors,

... and so much more!

Honorable mention: Labels

`labs()` allows you to set titles for the x-axis, y-axis, plot title, and other labels.

`x`	x-axis
`y`	y-axis
`title`	plot title
`subtitle`	plot subtitle
`caption`	an additional caption
`colour`	color legend title
`size`	size legend title
`fill`	fill legend title


THERE'S NO TIME!!!!
memegenerator.net

`esquisse`: a rough or preliminary sketch

`esquisse` lets you explore data interactively. Uses `ggplot2` for visualization.

You can export the generated graph and save the code to generate it.

Available in many languages (incl. French, Turkish, Korean, German).

It has its limitations but is useful to get a first impression/overview.

Wrap-up

Summary

- ✔ data visualization goals
- ✔ accessibility and WCOG
- ✔ plot types and choice of visualization
- ✔ plotting in R with `ggplot2` and `esquisse`
- ⏩ no class next week, then more data viz

Homework assignment due May 17th 15:30

Submit 1 R script.

- Complete assignment 5 ($\rightarrow$ ILIAS)
- Cookbook for R: `http://www.cookbook-r.com/`
- R Graph Gallery: `https://r-graph-gallery.com/`
- Tidyverse documentation: `https://ggplot2.tidyverse.org/`
- Wickham et al. (n.d.)

References

 Wickham, Hadley, Danielle Navarro, and Thomas Lin Pedersen (n.d.). *ggplot2: Elegant Graphics for Data Analysis*. URL: https://ggplot2-book.org/.