

Visualization as a design process

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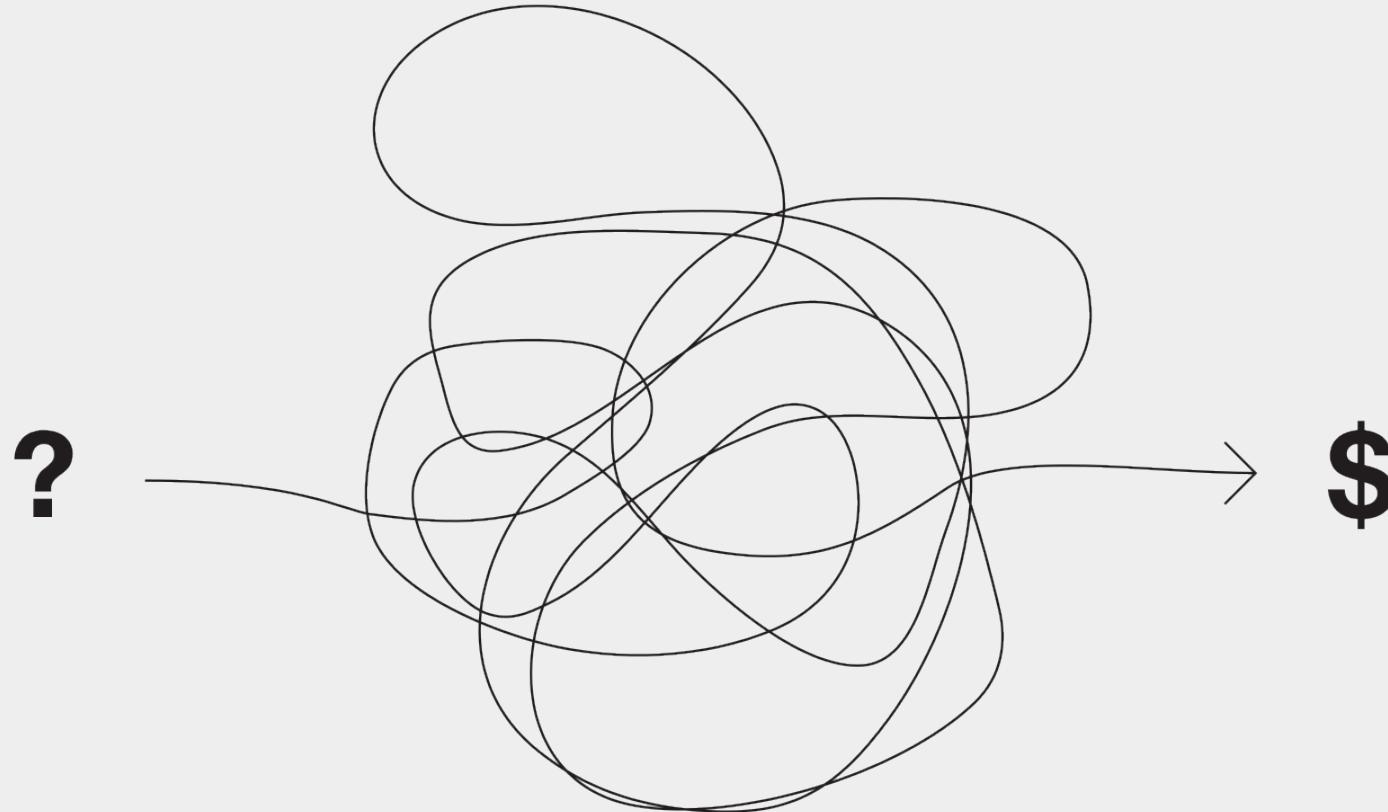


Max-Planck Odense Center on the
Biodemography of Aging



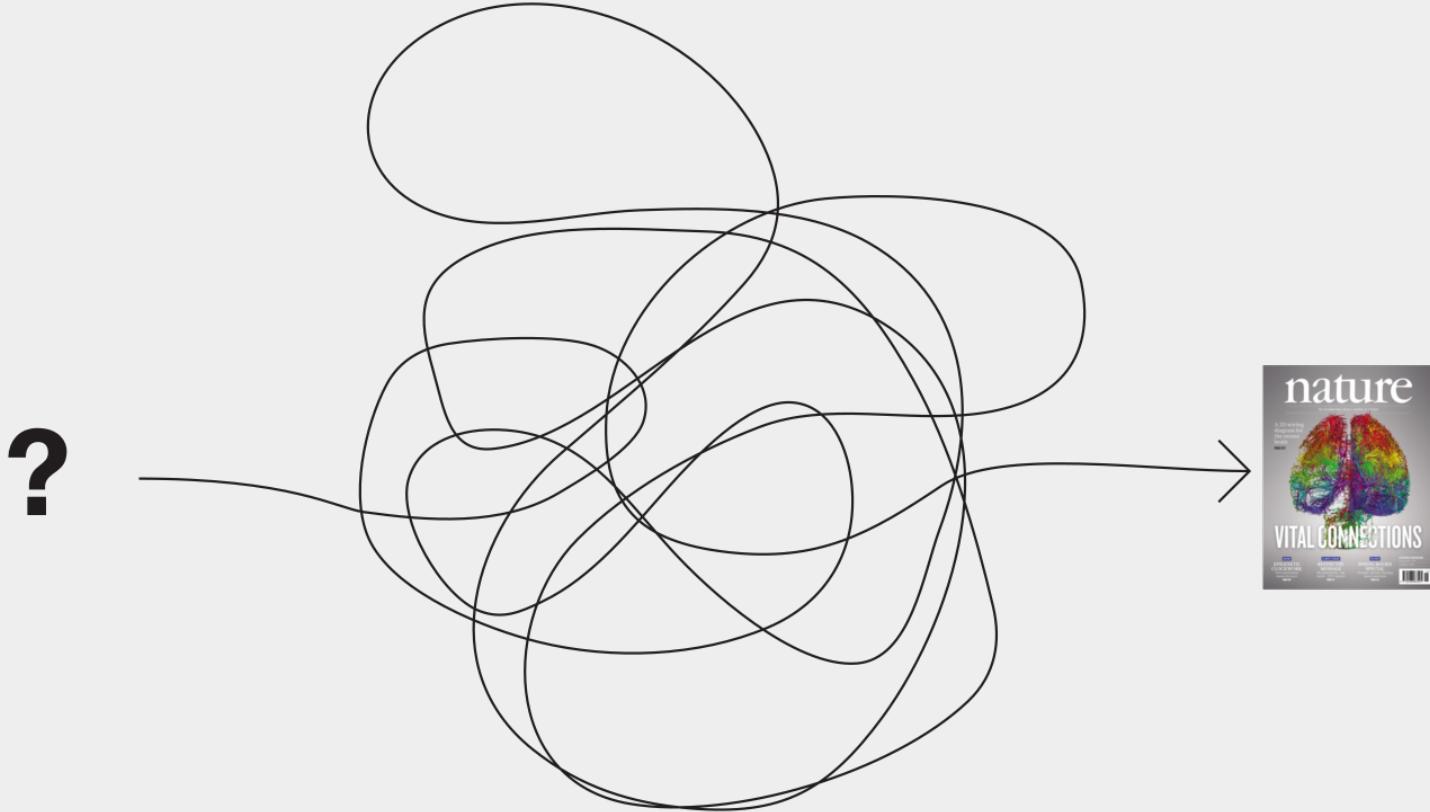
Department of Public Health
University of Southern Denmark

What is a design process?



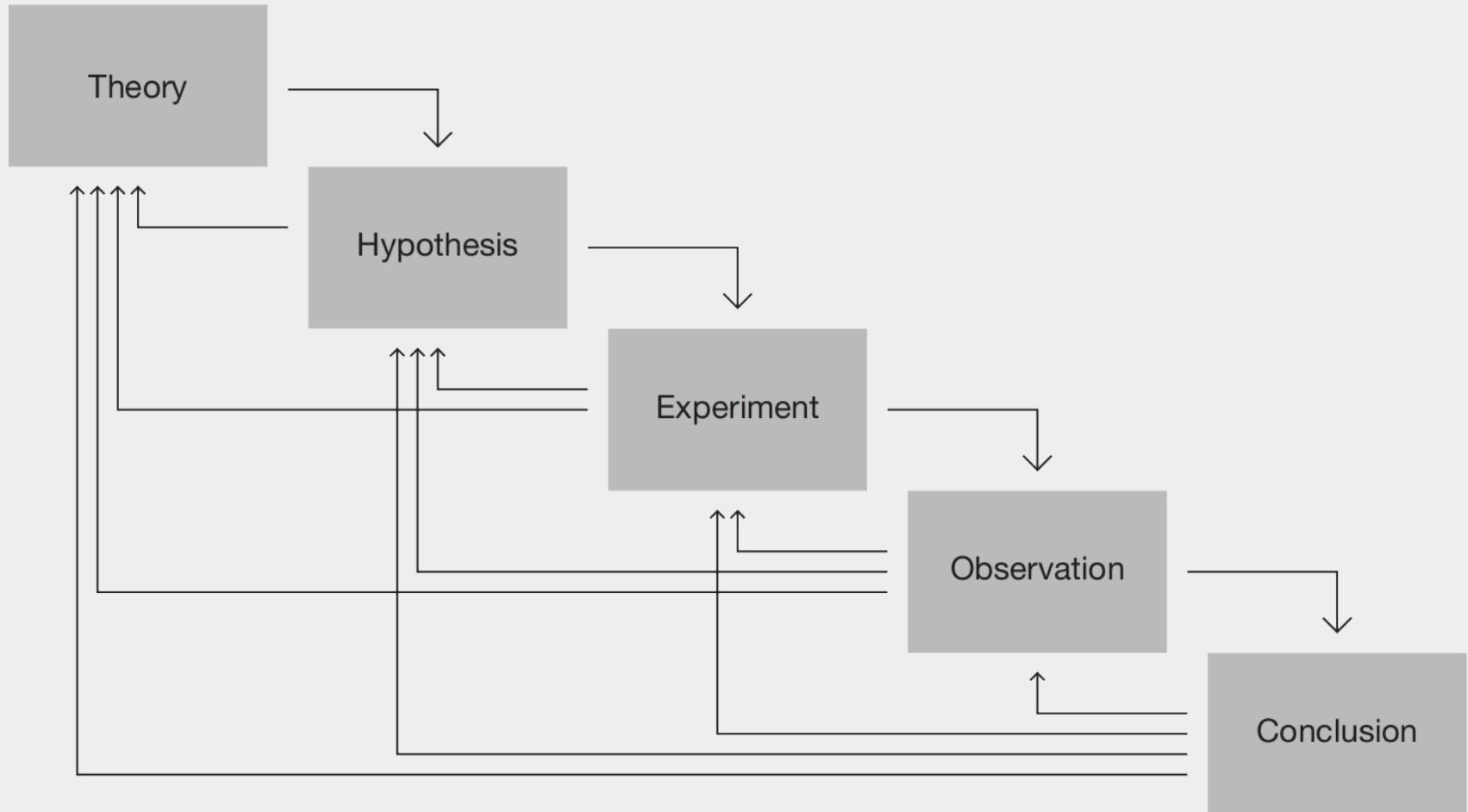
Tim Brennan (~1990) via Dubberly (2008). How do you design? A Compendium of Models.

What is a design process?



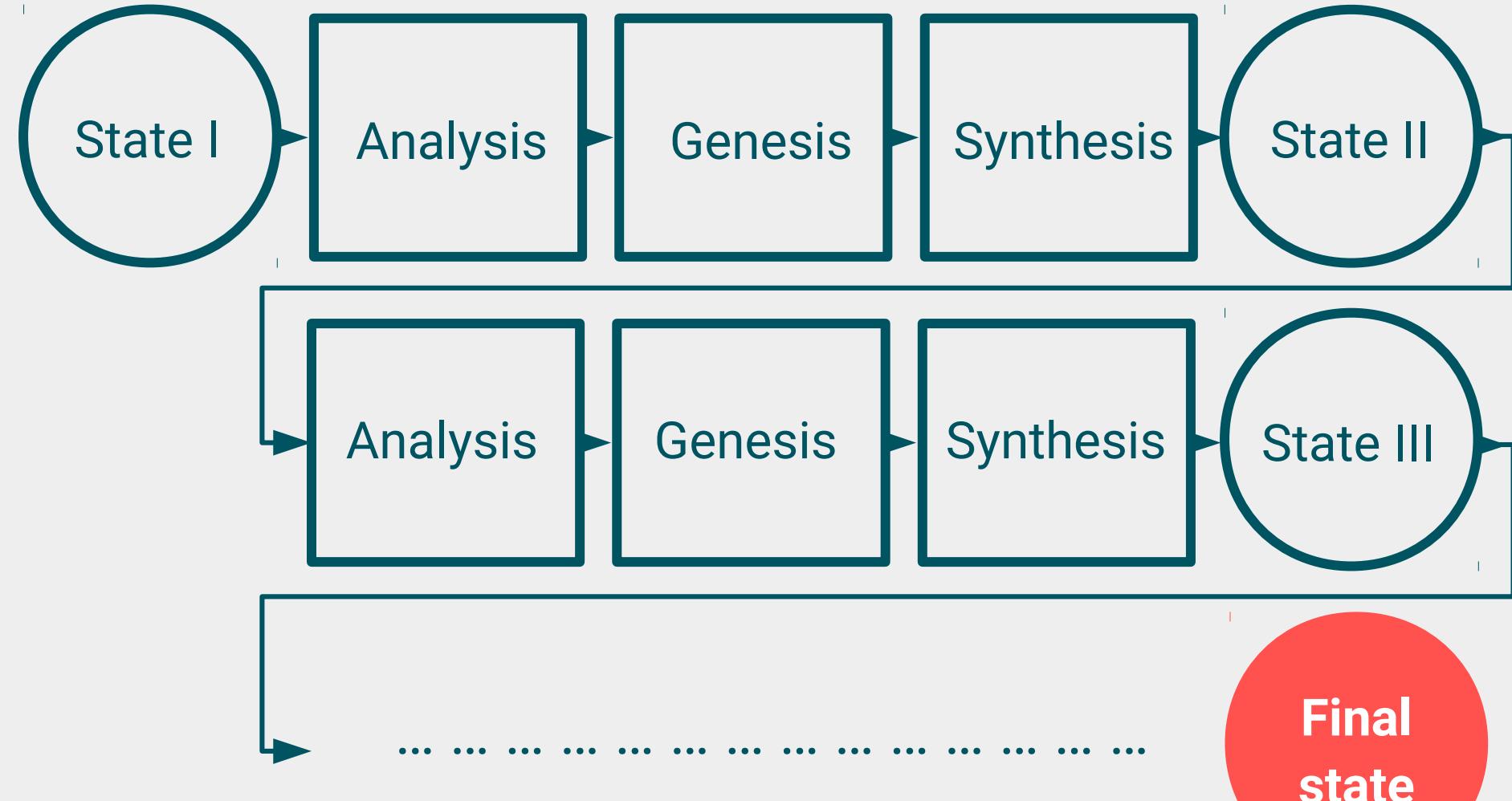
Tim Brennan (~1990) [adapted for the academic design process].

The scientific (design) process



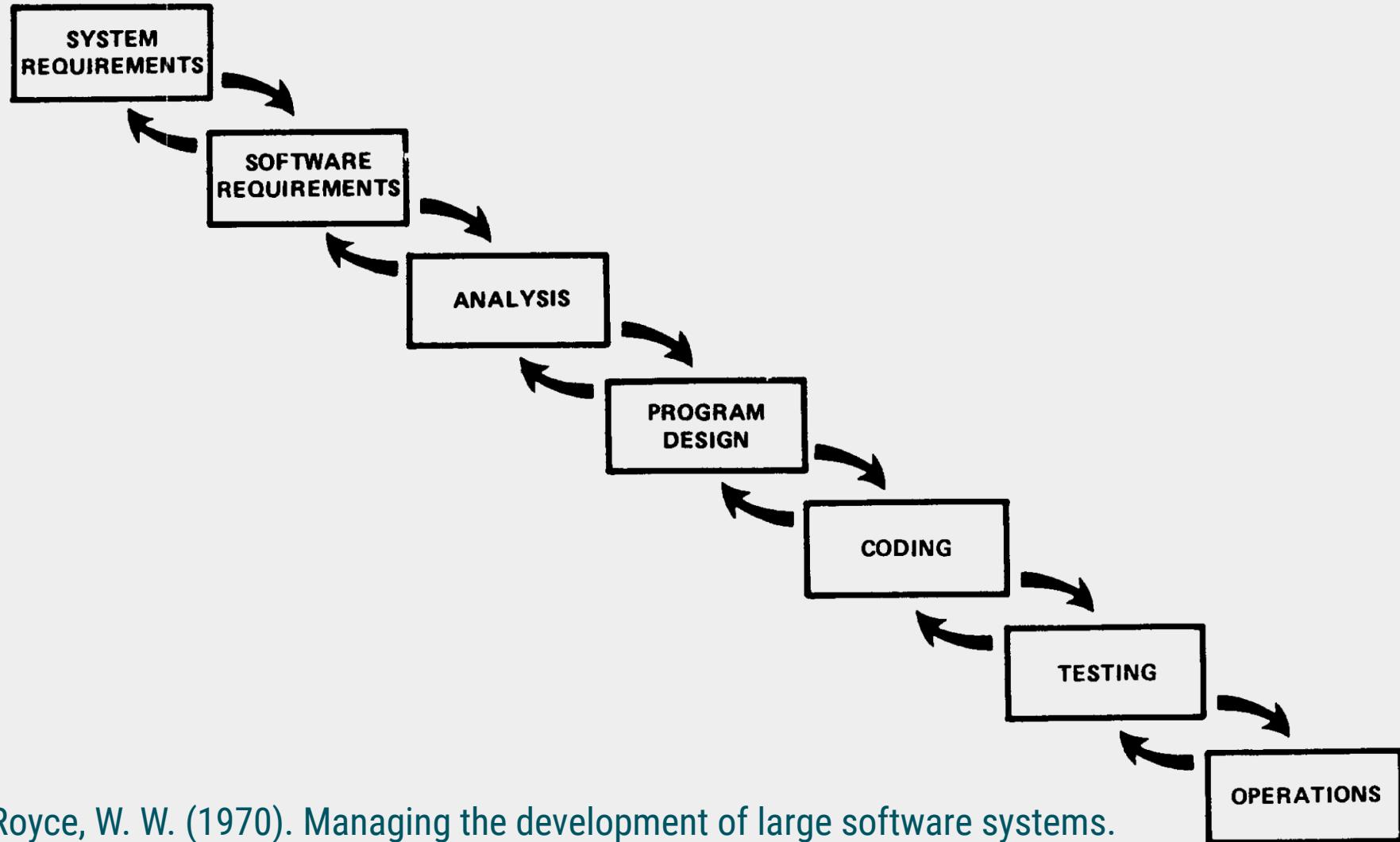
Dubberly (2008). How do you design? A Compendium of Models.

Analysis, genesis, synthesis



Doblin, J. (1987). A Short, Grandiose Theory of Design. STA Design Journal.

The “Waterfall” life-cycle



Royce, W. W. (1970). Managing the development of large software systems.
Electronics, 26 (August), 1–9.

The essence of every design process

**Iteration until converging
on a predefined goal**

The four nested levels of viz design

Domain situation

Observe target users using existing tools

Data/task abstraction

Visual encoding/interaction idiom

Justify design with respect to alternatives

Algorithm

Measure system time/memory

Analyze computational complexity

Analyze results qualitatively

Measure human time with lab experiment (*lab study*)

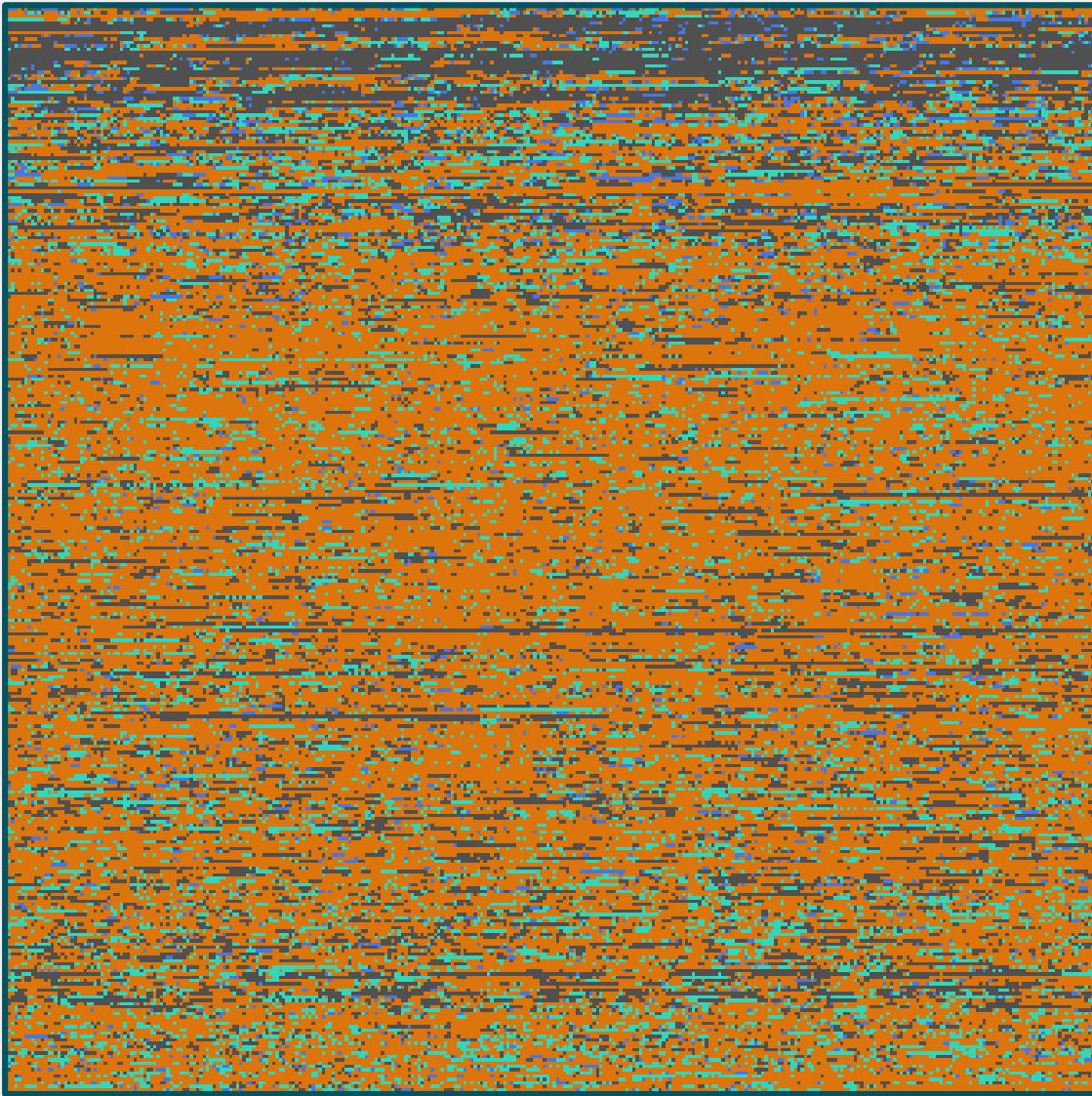
Observe target users after deployment (*field study*)

Measure adoption

Munzner, T. (2015).
Visualization
Analysis & Design.
Chapter 4.

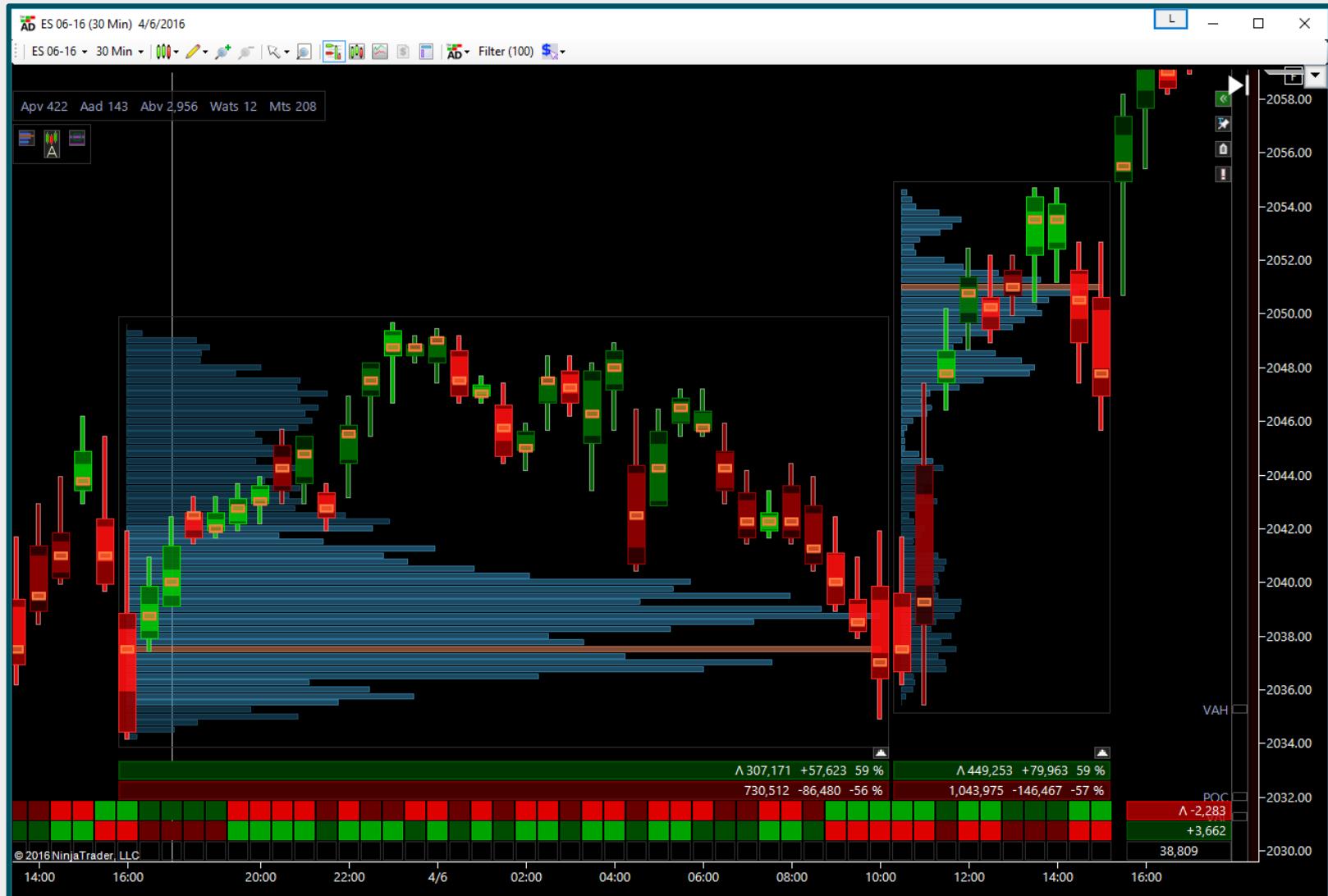
**Different domains,
different design goals**

Data-art



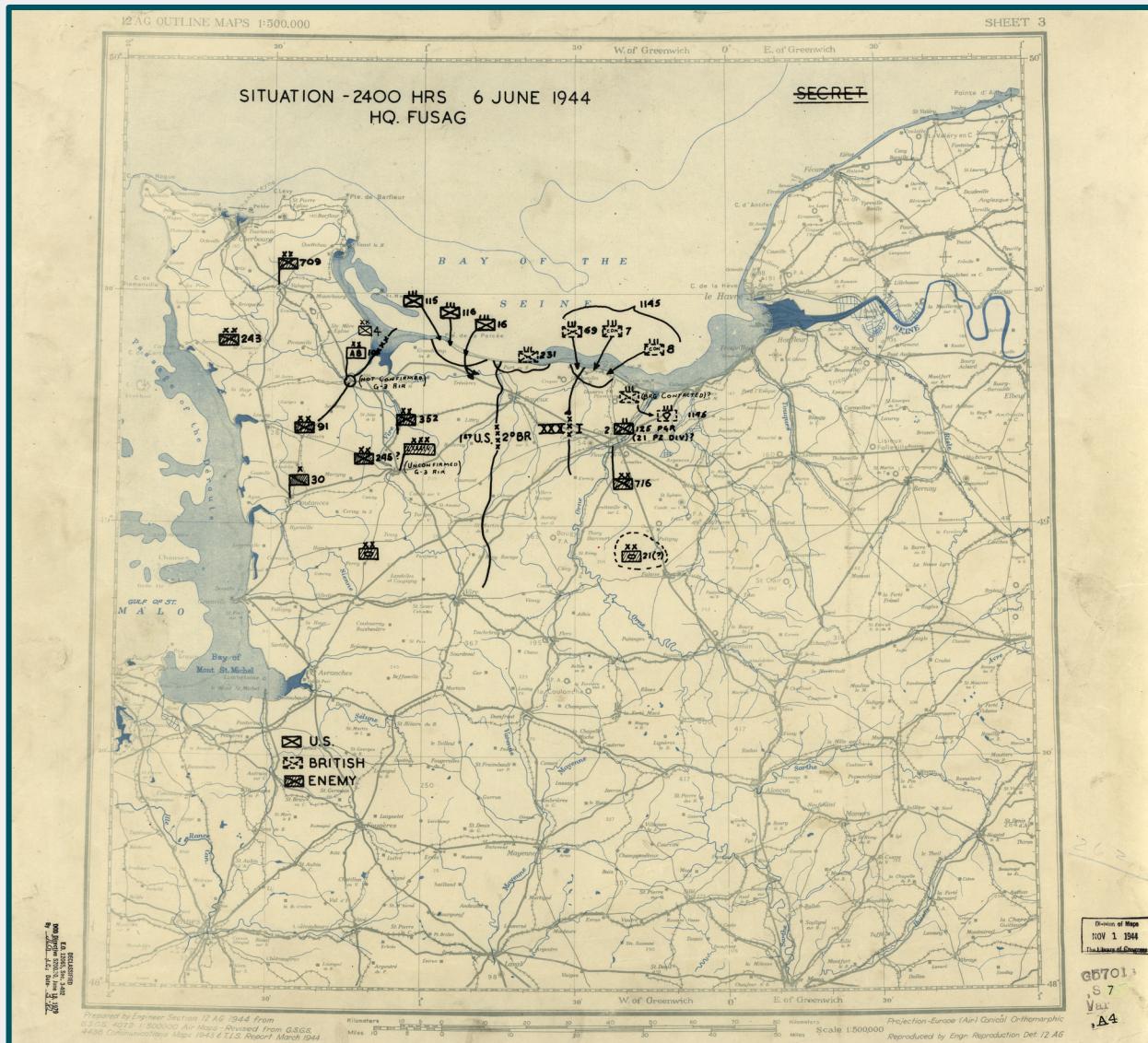
Kamel Makhlofi (2010). Function.
[cutout].

Trader terminal



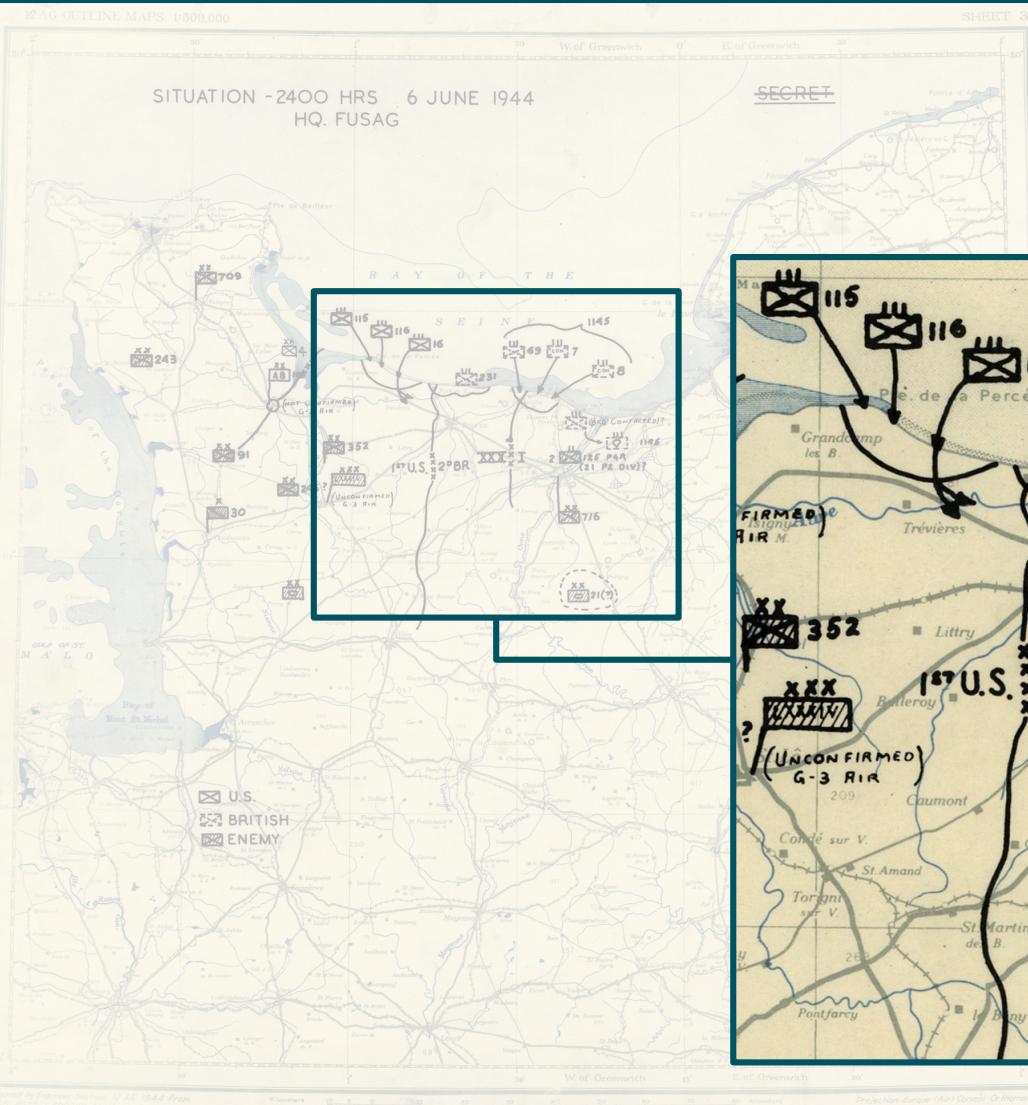
Auction Dashboard™ composite volume profile view.

Situation room

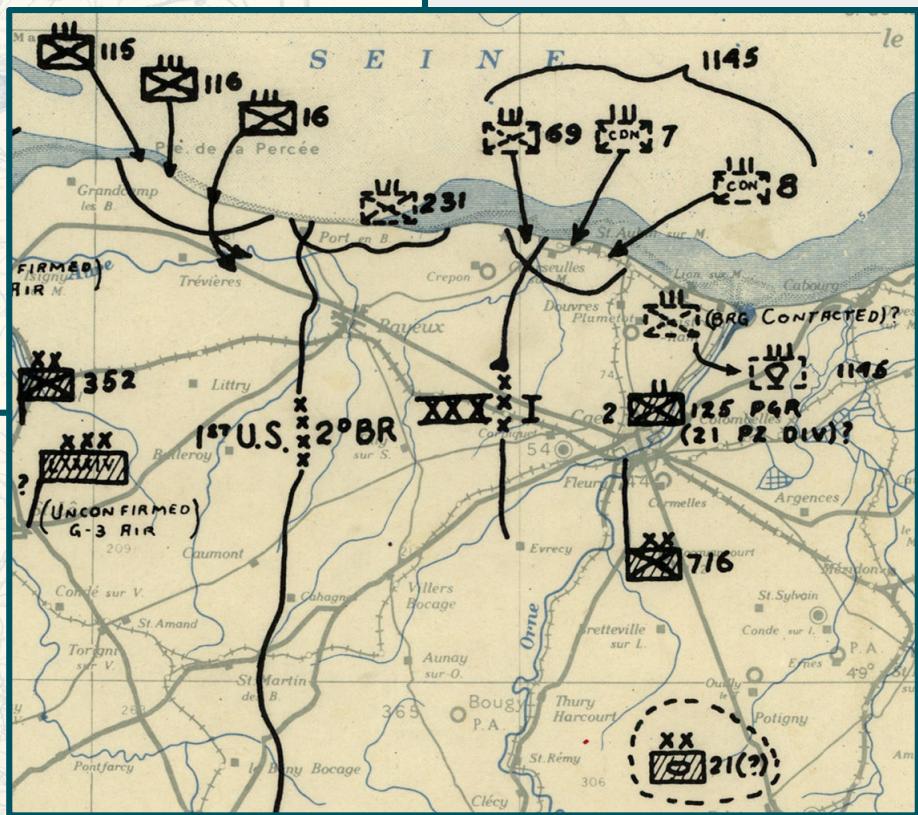


Official U.S. 12th army position map at 2400 hours on D-Day.

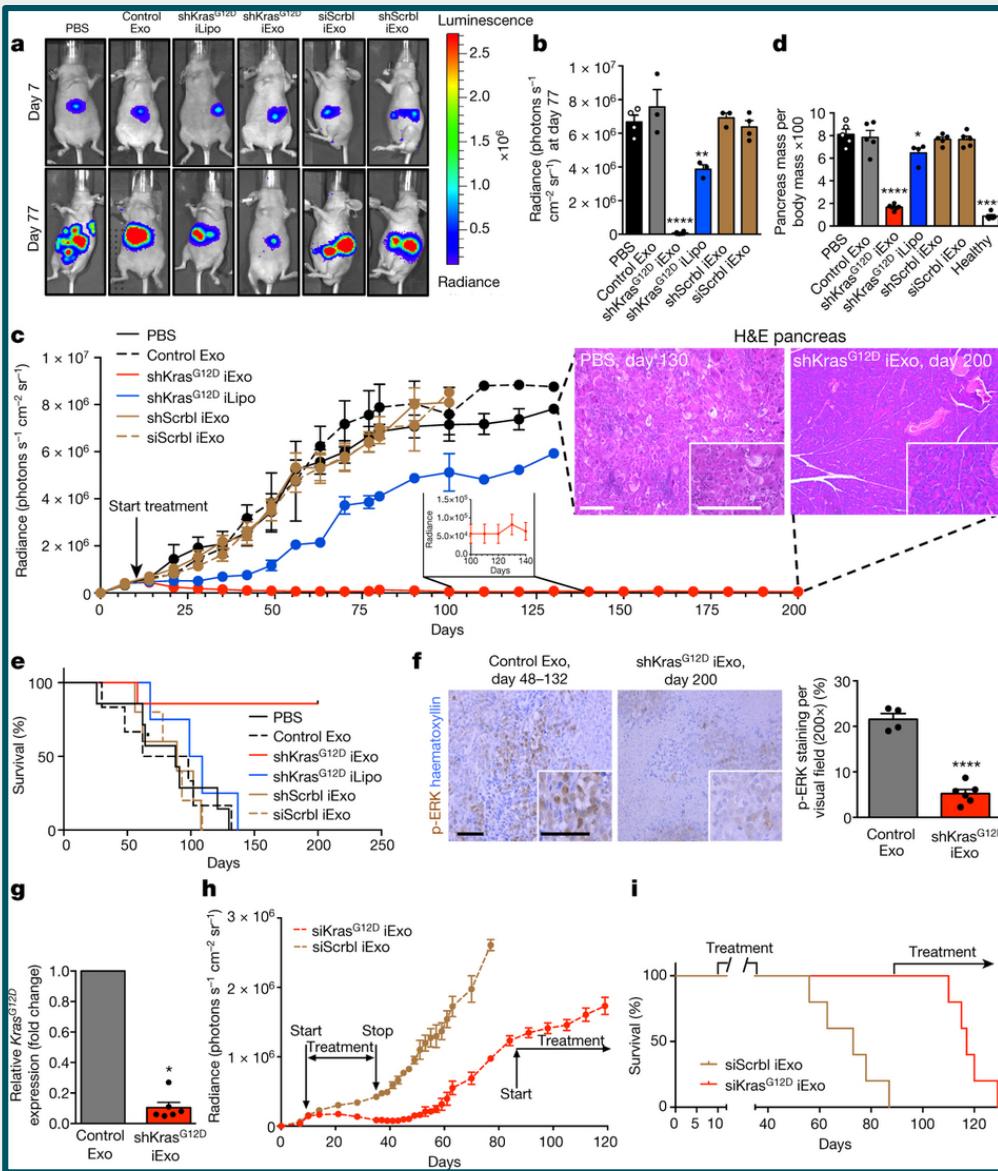
Situation room



Official U.S. 12th army position map at 2400 hours on D-Day.

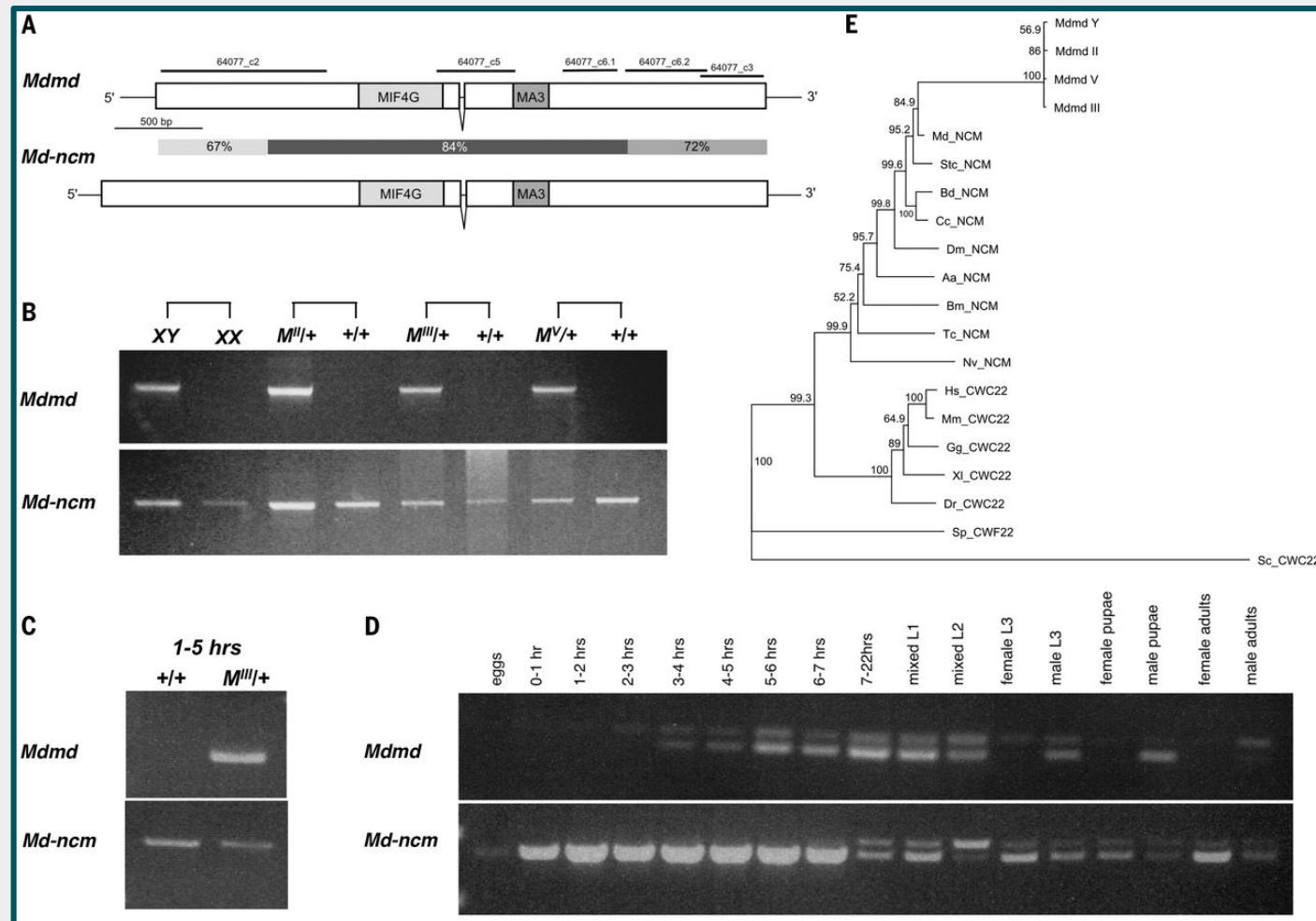


High-gloss science



Kamerkar (2017). Exosomes facilitate therapeutic targeting of oncogenic KRAS in pancreatic cancer. Nature.

Molecular biology

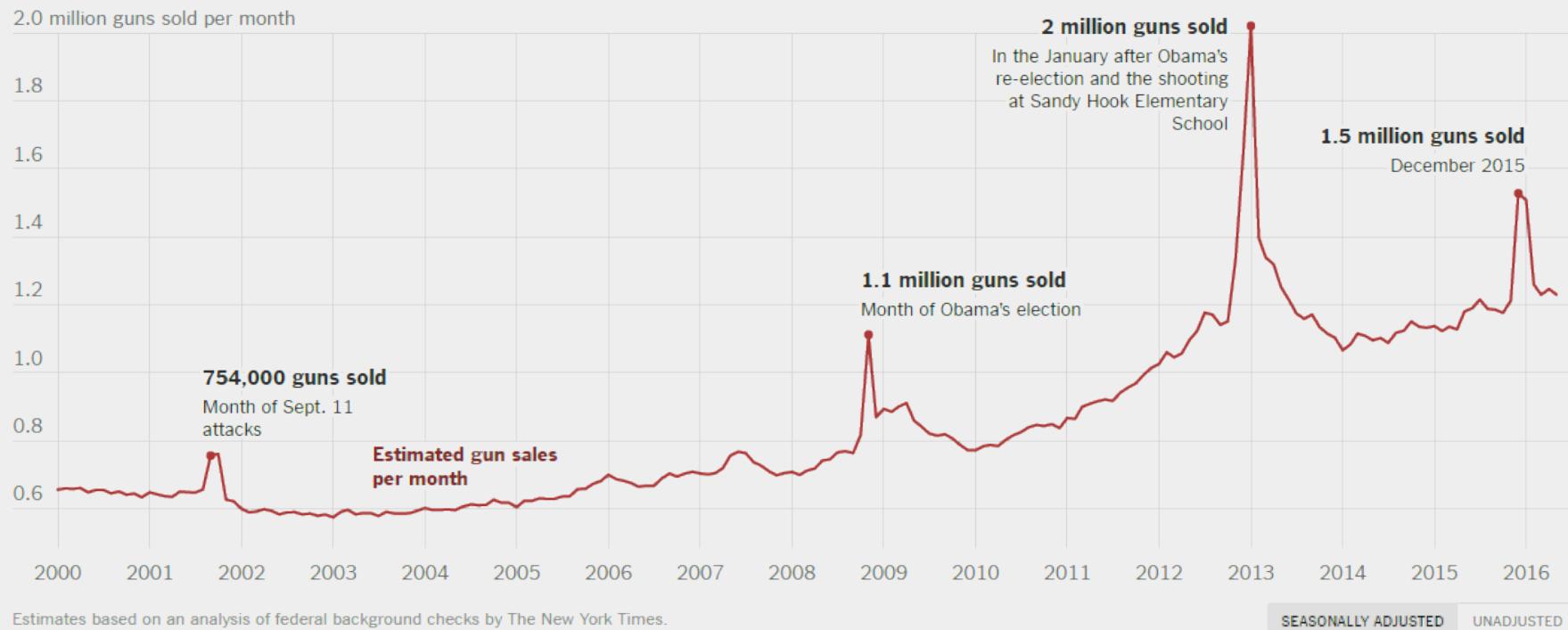


Sharma et al. (2017). Male sex in houseflies is determined by Mdmd, a paralog of the generic splice factor gene CWC22. Science, 356(6338), pp. 642-645.

News graphics

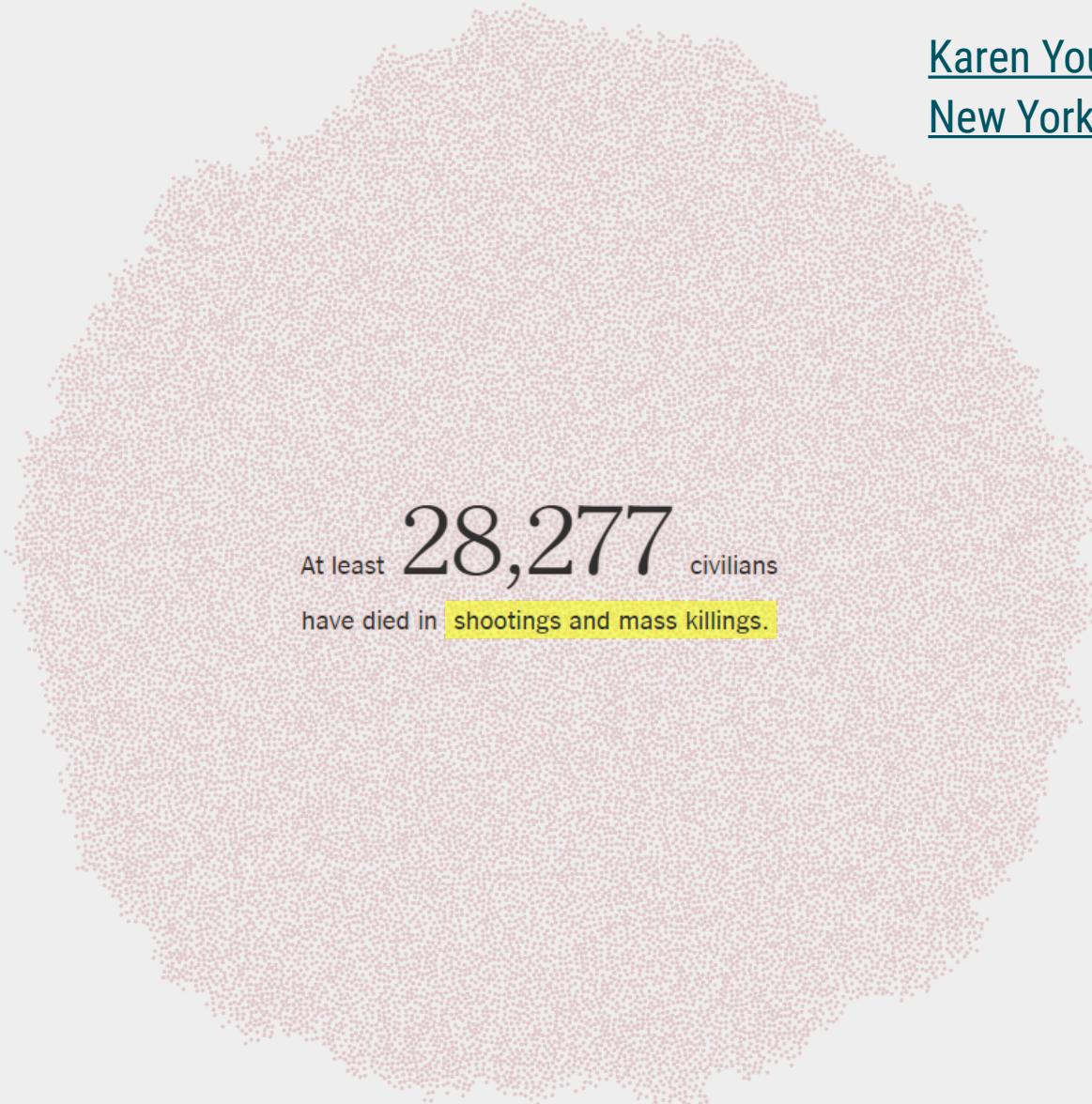
What Happens After Calls for New Gun Restrictions? Sales Go Up

By GREGOR AISCH and JOSH KELLER UPDATED June 13, 2016



Gregor Aisch and Josh Keller (2016). What Happens After Calls for New Gun Restrictions? Sales Go Up. New York Times.

News graphics



Karen Yourish et al. (2015). Death in Syria.
New York Times.

Propaganda

A STUDY IN EMPIRES



German Library of Information (1940). A study in empires. Facts in Review 2 (5).

Reprinted in Monmonier (1996). How to Lie with Maps.

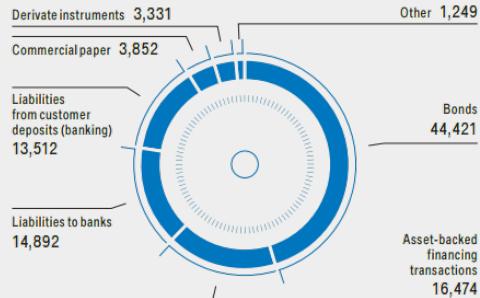
The executive report

BMW Group (2016). Annual report 2016. [excerpt].

BMW Group financial liabilities

→ 45

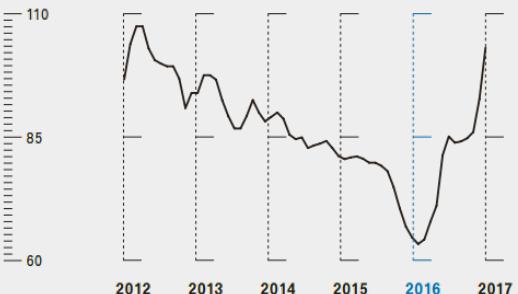
in € million



Steel price trend

→ 18

Index: January 2012 = 100



Proportion of female executives within management/function levels I and II at BMW AG

→ 65

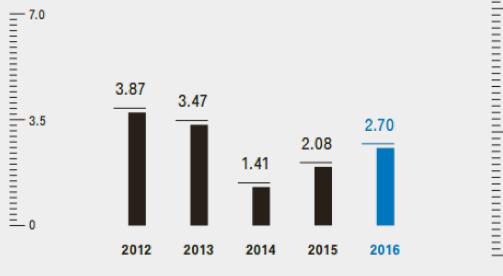
in %



Employee attrition rate at BMW AG*

→ 36

as a percentage of workforce



BMW Group value added 2016

→ 51

in %

Depreciation and amortisation 8.7

Cost of materials 52.5

14.1 Other expenses

24.7 Net value added

48.8 % Employees

8.3 % Providers of finance

13.7 % Government/public sector

9.7 % Shareholders

19.3 % Group

0.2 % Minority interest

Visualization design goals

User perspective

Why?

Actions

Targets

Analyze

→ Consume



→ Present



→ Enjoy



All Data

→ Trends



→ Outliers



→ Features



Attributes

→ One

→ Distribution



→ Many

→ Dependency



→ Correlation

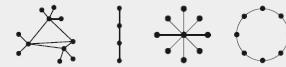


→ Similarity

Extremes

Network Data

→ Topology



→ Paths



Spatial Data

→ Shape



Munzner, T. (2015).
Visualization Analysis & Design.

What?

Why?

How?

Figure 3.1. Why people are using vis in terms of actions and targets.

Producer perspective

@lisacrost

Attention
& Beauty

Under-
standing

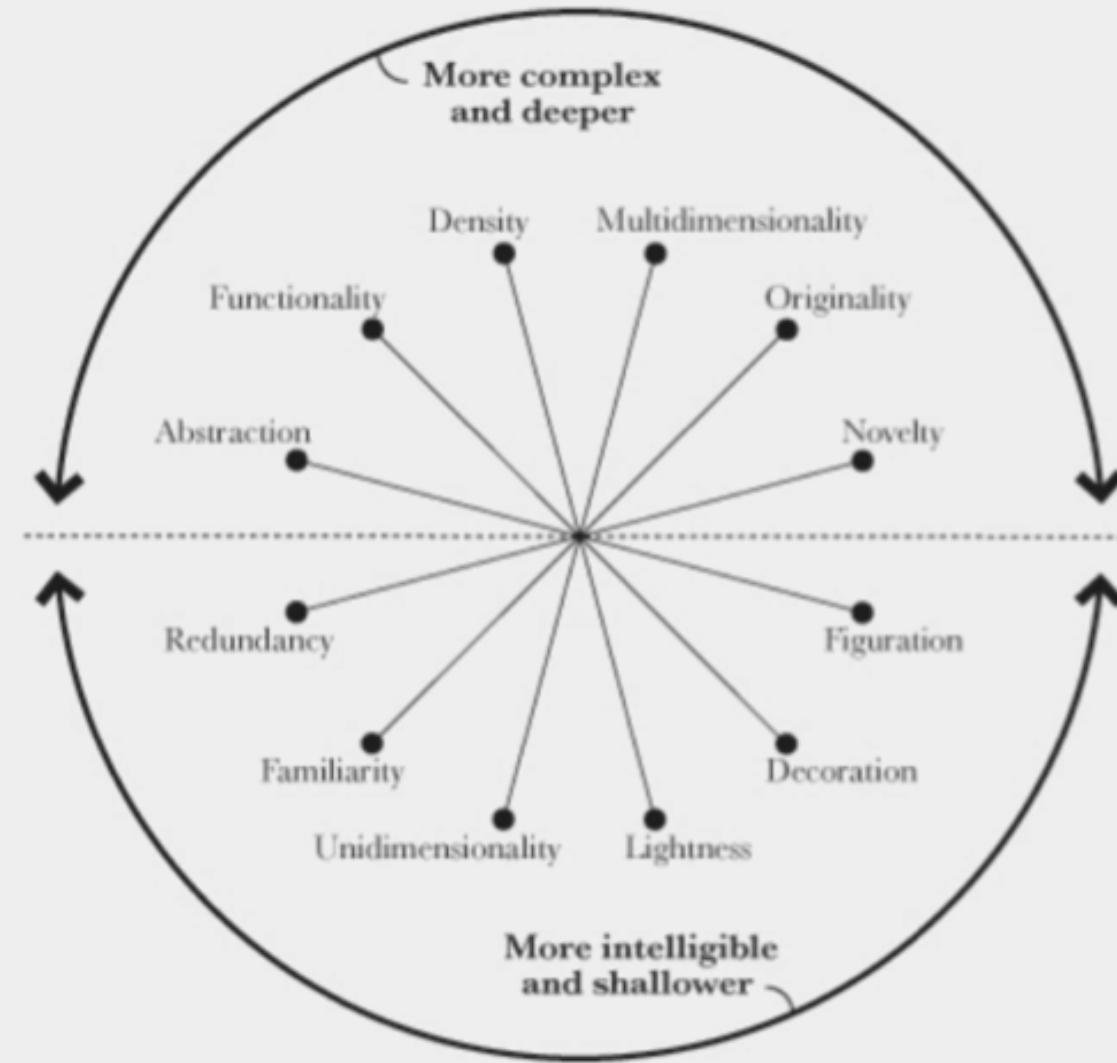
Implication

Goals of Data Vis

- | | | |
|--|---|---|
| <ul style="list-style-type: none">1. Get them to read2. Attract different learning types3. Go with the hype4. Create beauty | <ul style="list-style-type: none">1. Understand2. Explain3. Get people to explore | <ul style="list-style-type: none">1. Prove2. Correct views3. Evoke feelings4. Evoke actions5. Go meta |
|--|---|---|

Rost (2017). Why do we visualize data? INCH conference presentation.

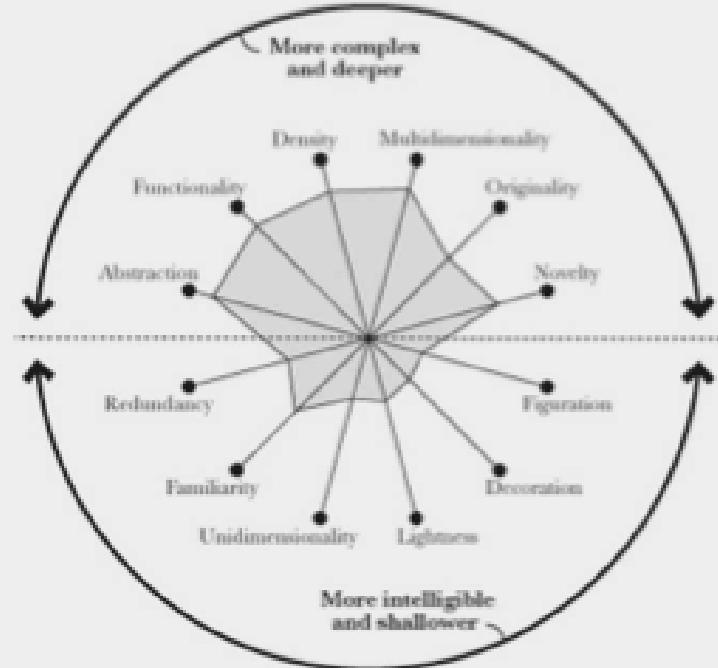
Trade-off in viz design



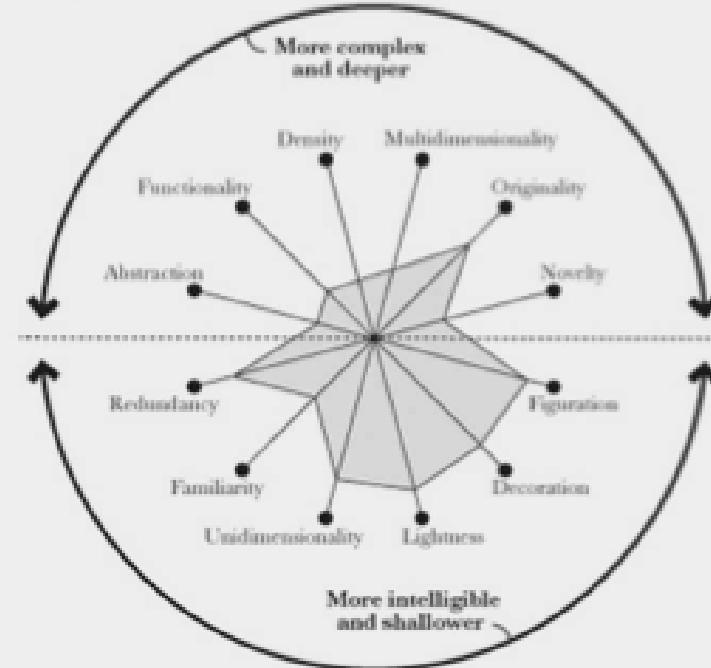
Cairo, A. (2012). The Functional Art.

Trade-off in viz design

The wheel preferred by scientists and engineers



The wheel favored by artists, graphic designers, and journalists



Cairo, A. (2012). *The Functional Art*.

Clarity & effectiveness

Testable hypothesis in viz research

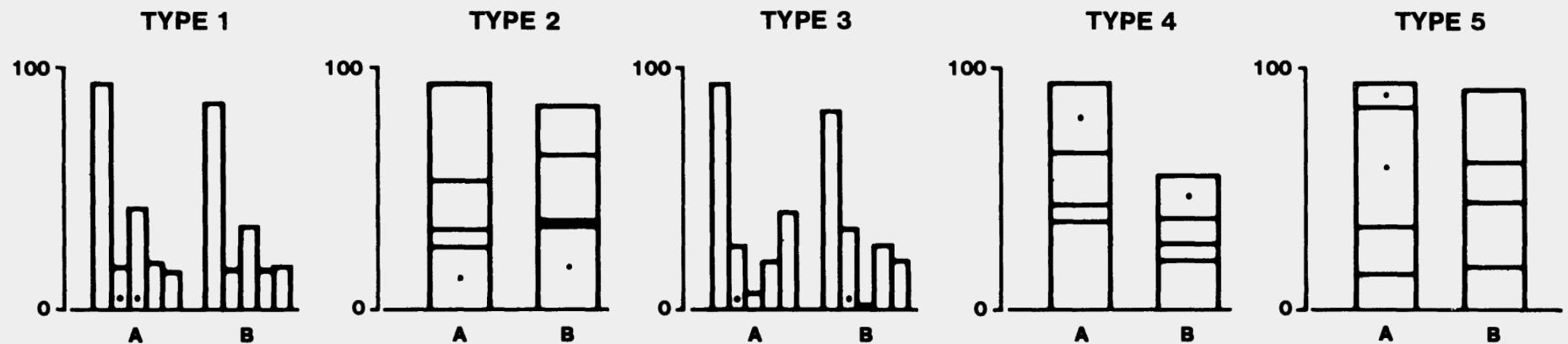


Figure 4. Graphs from position-length experiment.

Cleveland, W. S., & McGill, R. (1984). Graphical Perception: Theory, Experimentation, and Application to the Development of Graphical Methods. *Journal of the American Statistical Association*, 79(387), 531.

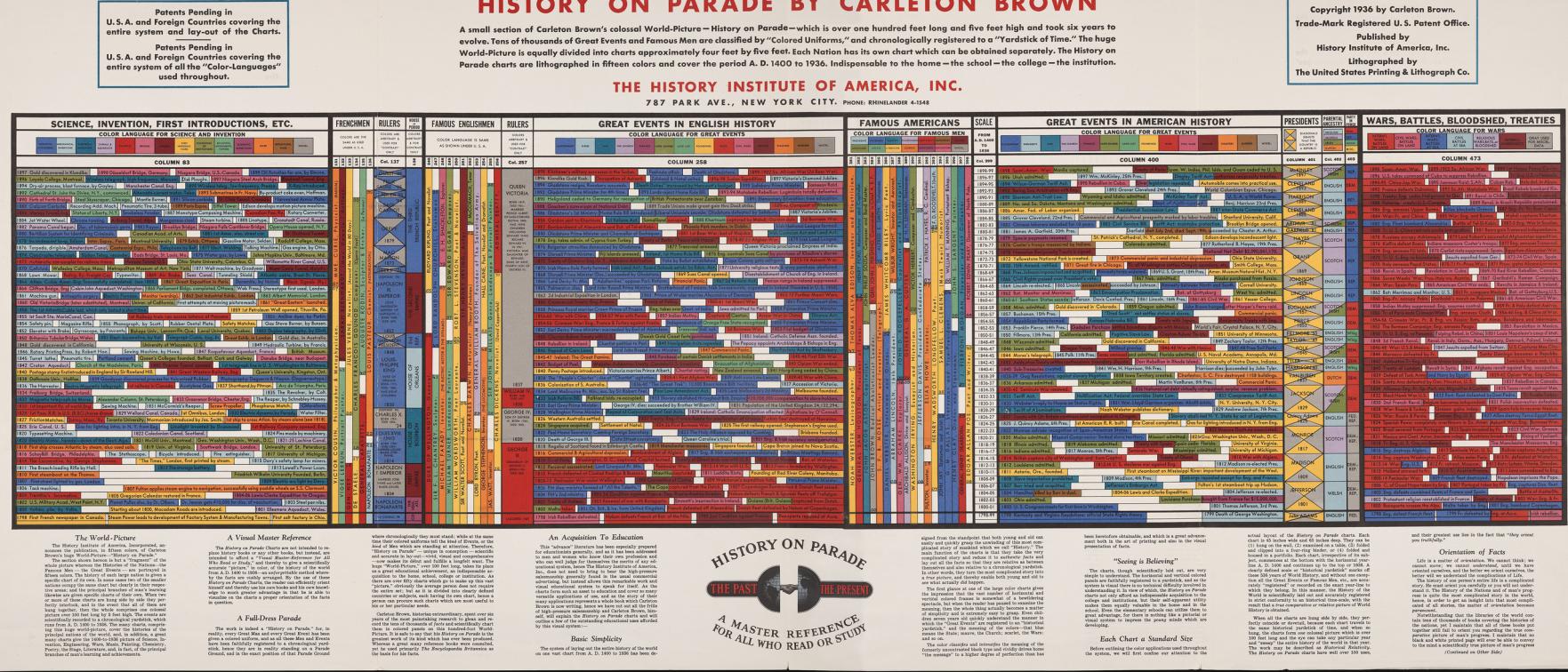
What makes a visualization engaging?

“Wimmelbilder”



Markus Wende (2016). Wimmelbild “Recht auf Stadt” [cutout].

Macro view



Carleton Brown (1936). History on parade by Carleton Brown. History Institute of America, Inc.

Micro view



Carleton Brown (1936). History on parade by Carleton Brown. History Institute of America, Inc.

Macro view



The State of Vertebrate Conservation

IUCN Red List conservation status for each species

UCN Conservation Status

- Extinct
- Extinct in the Wild
- Critically Endangered
- Endangered
- Vulnerable
- Near Threatened
- Least Concern
- Unknown

Threatened

Taxonomic Rank

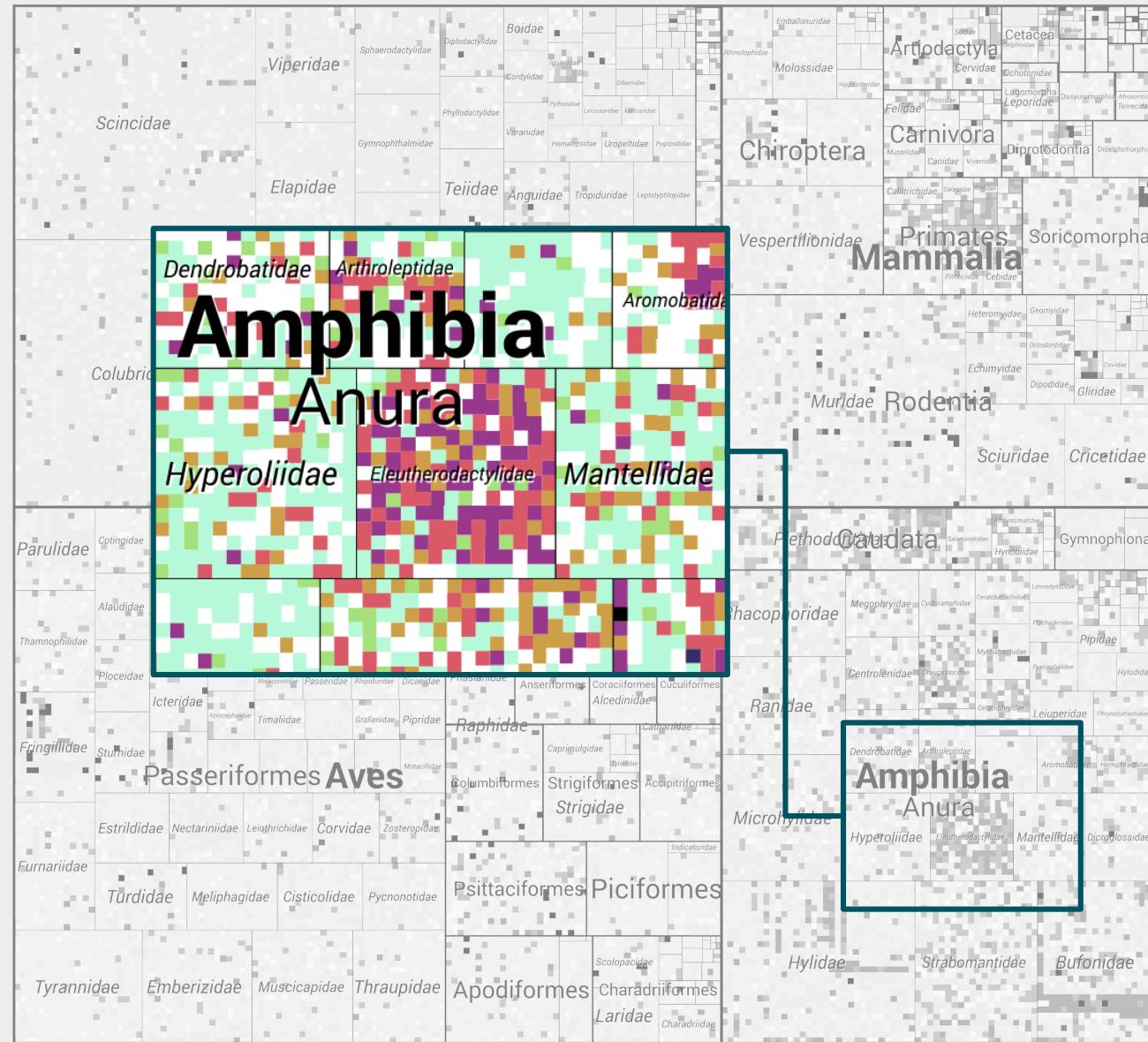
Class —

Order —

Family —

by DISKo
Demographic Index
of Species Knowledge

Micro view



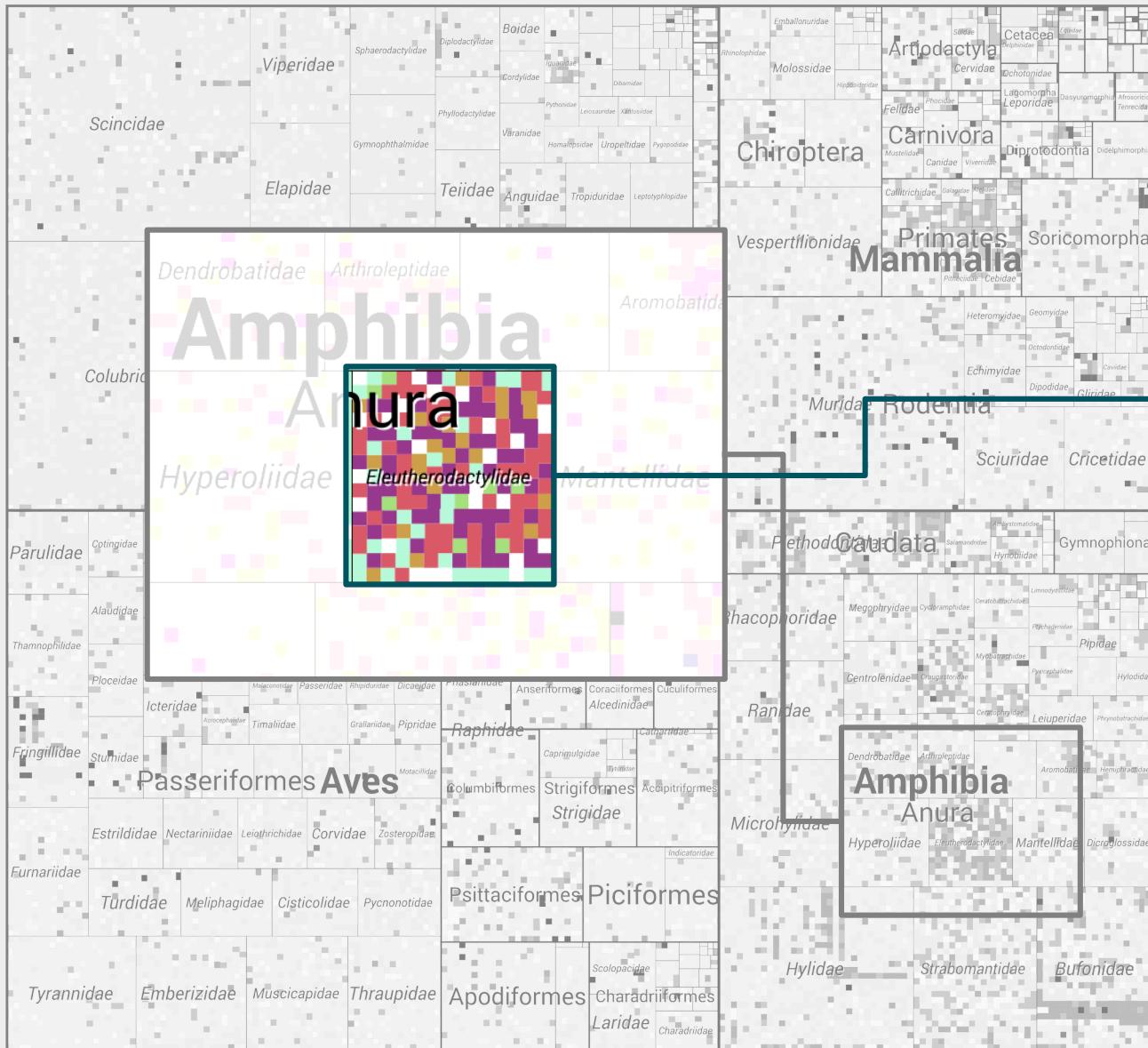
The State of Vertebrate Conservation

IUCN Red List conservation status for each species



by DISKo
Demographic Index
of Species Knowledge

Micro-micro view (drill down)

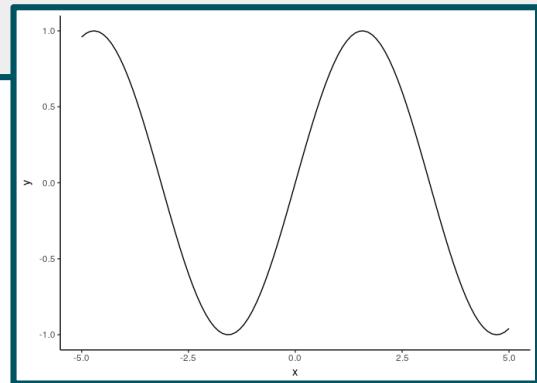
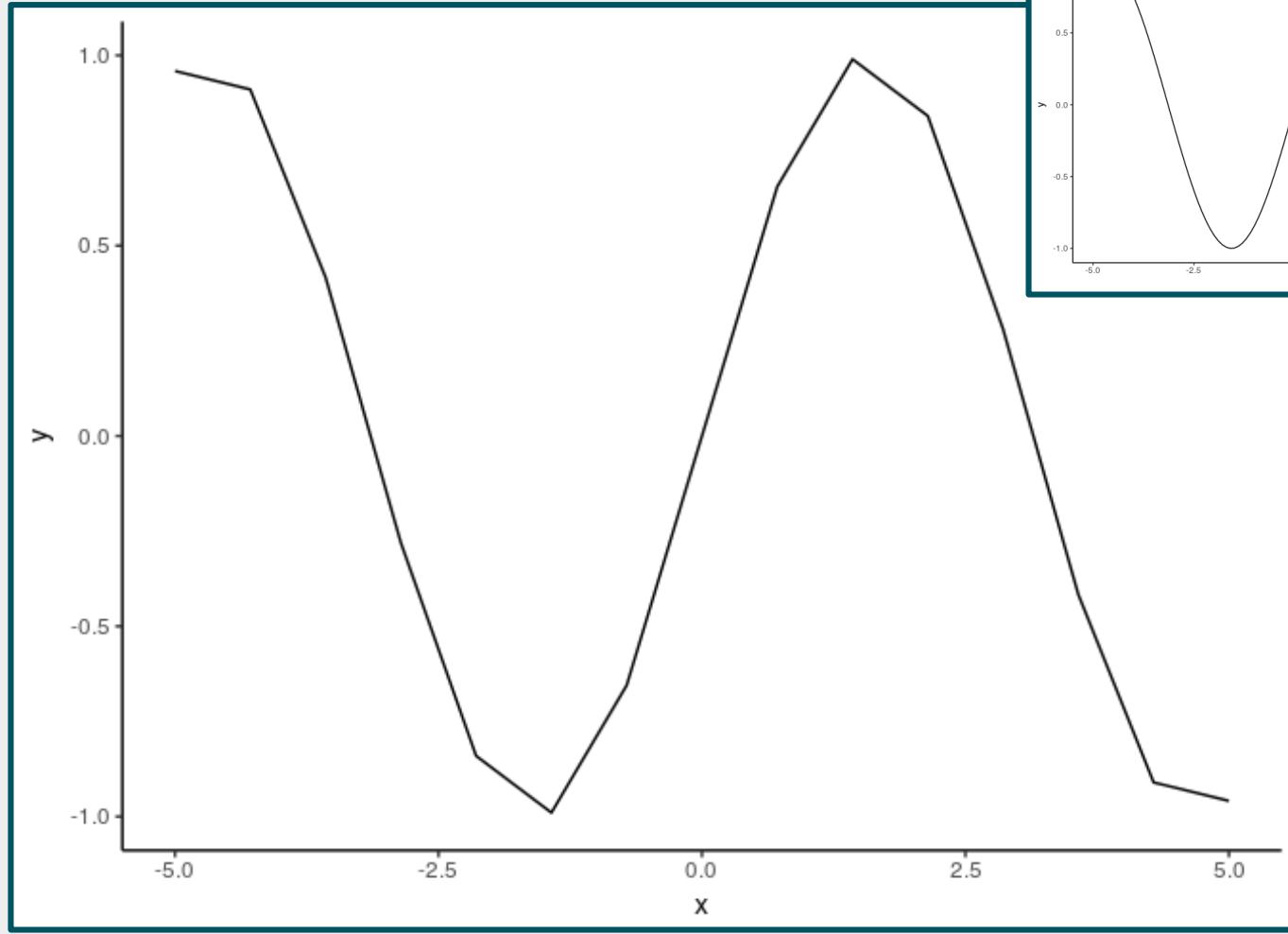


Eleutherodactylidae

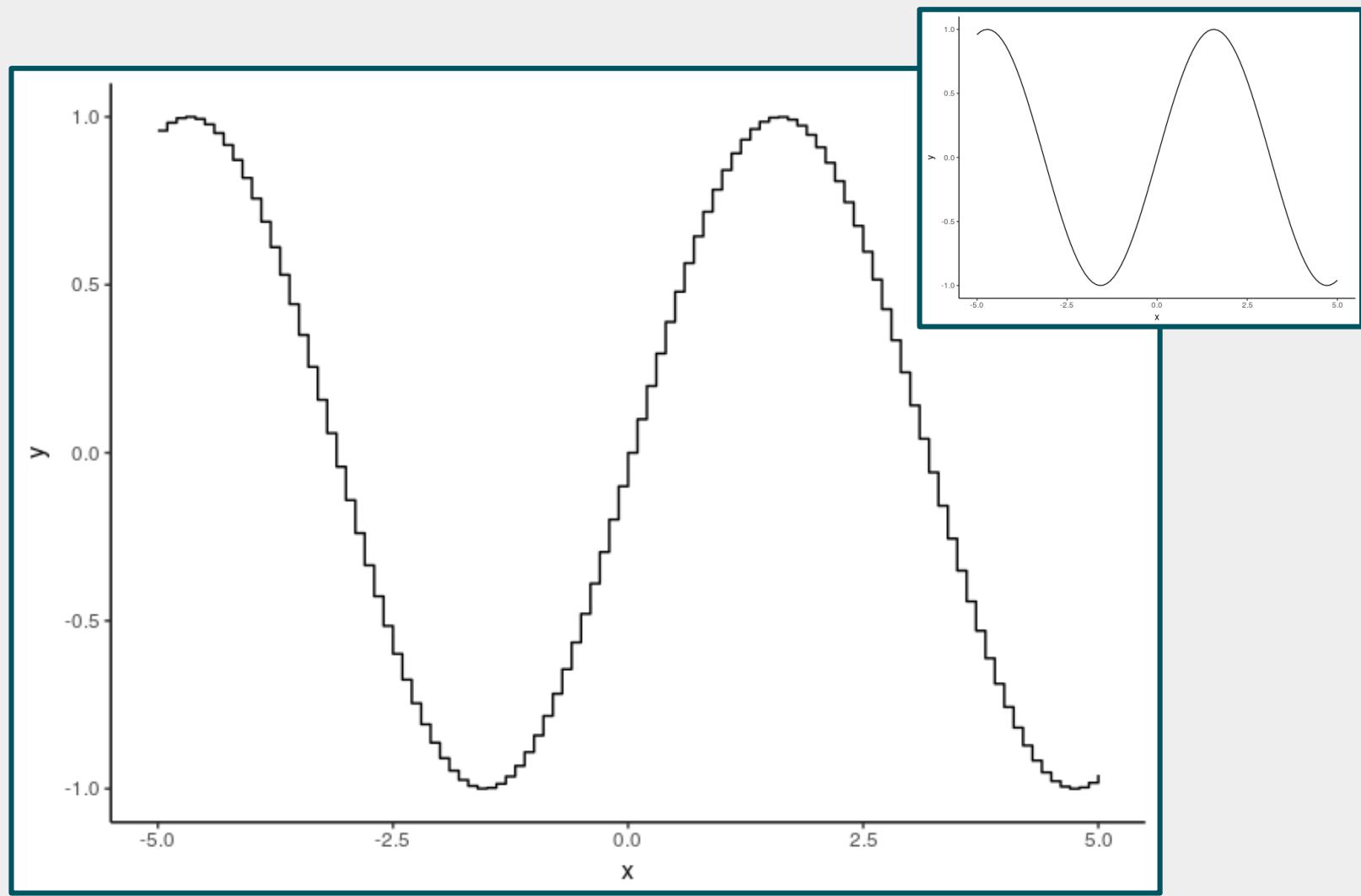
Eleutherodactylus danae

Precision

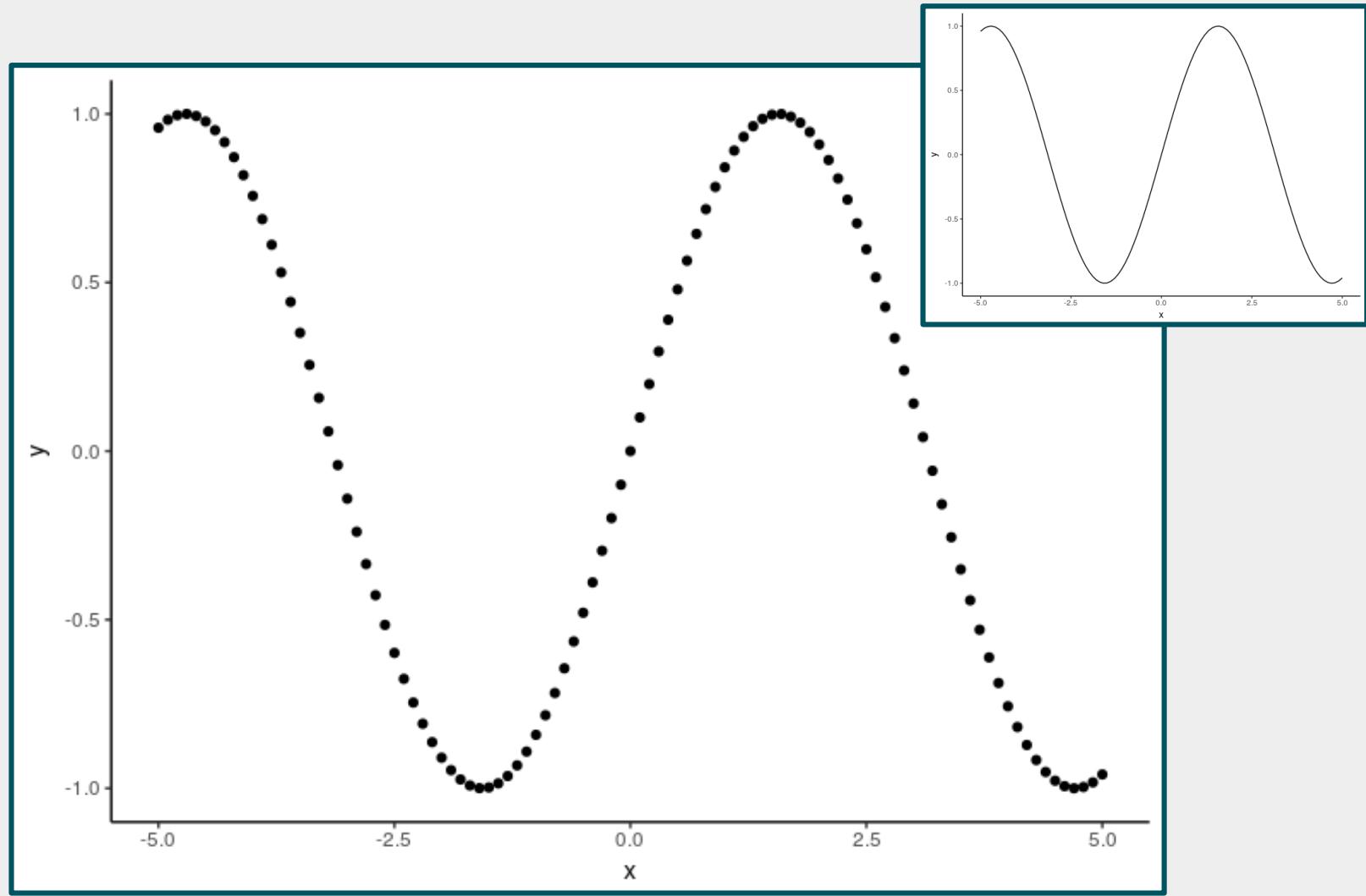
Be precise when it counts



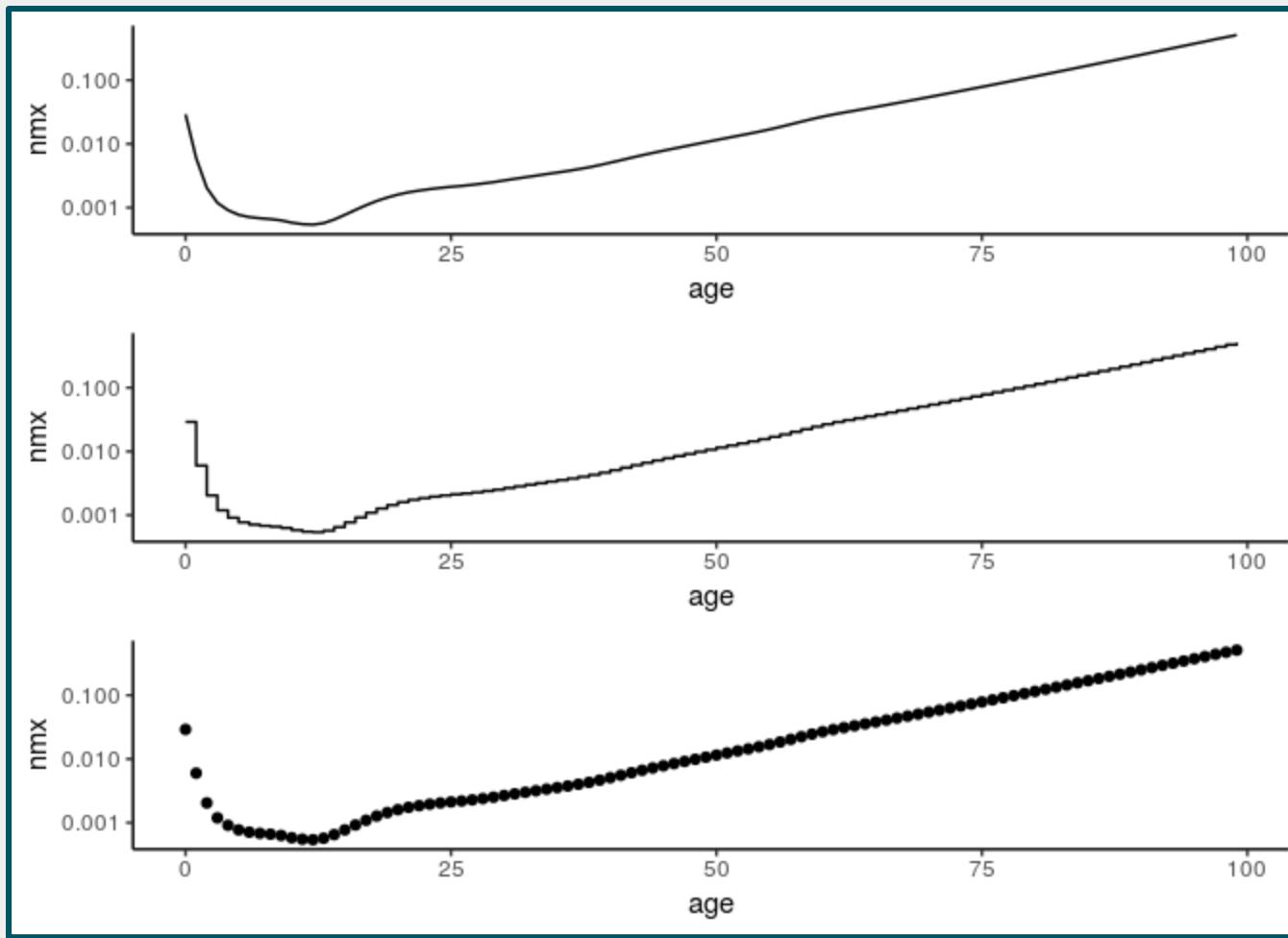
Be precise when it counts



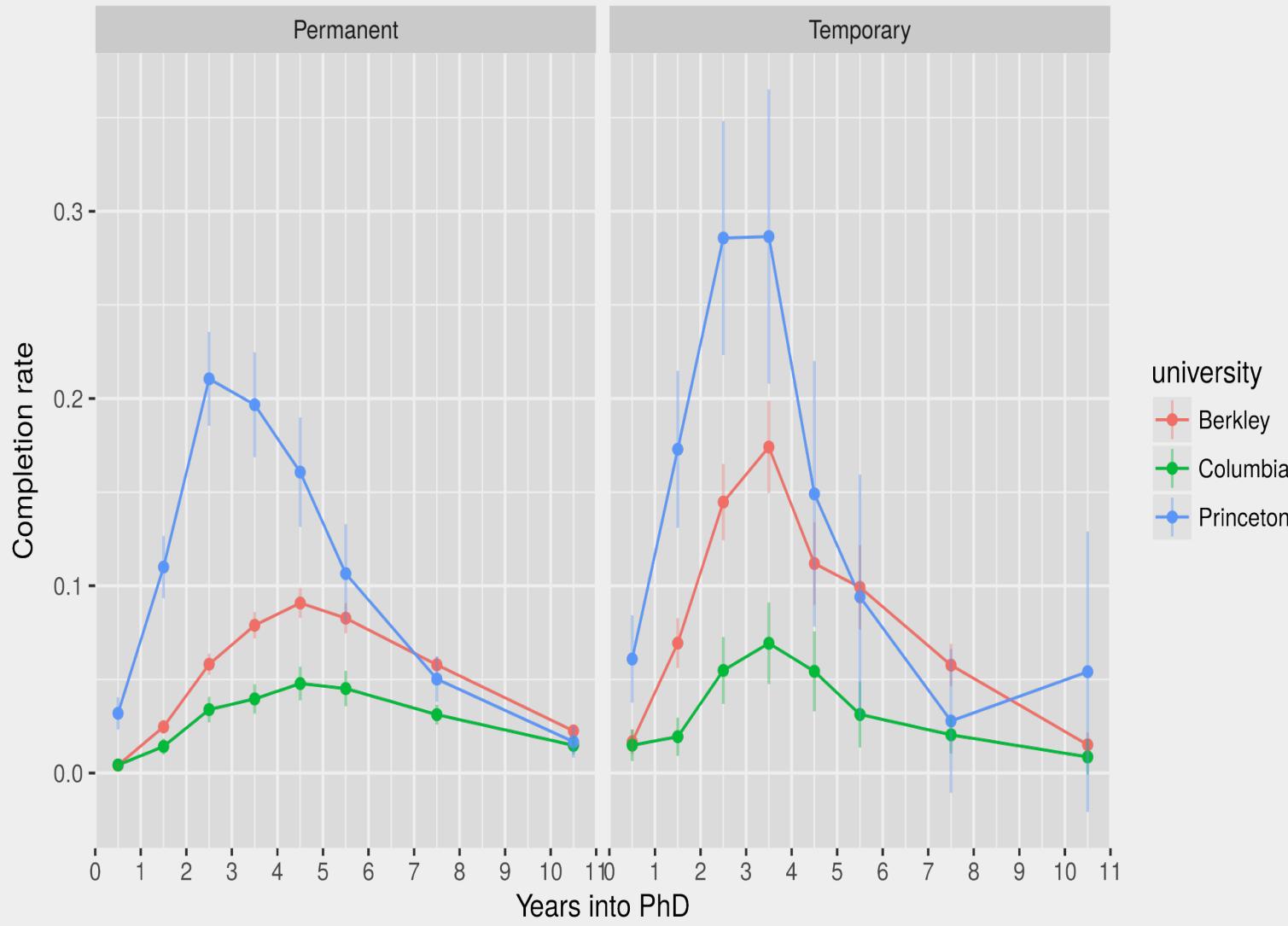
Be precise when it counts



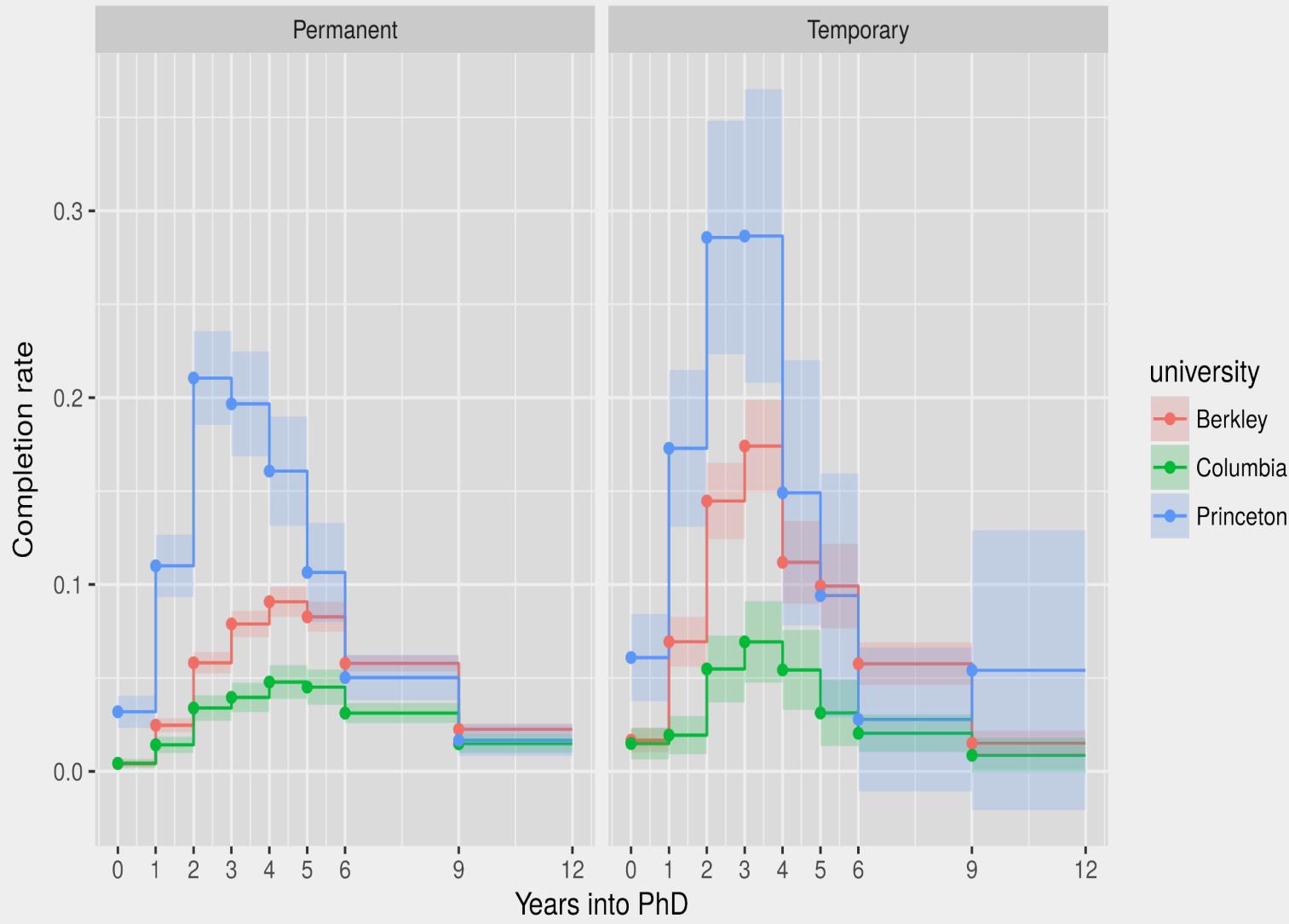
Are those the same?



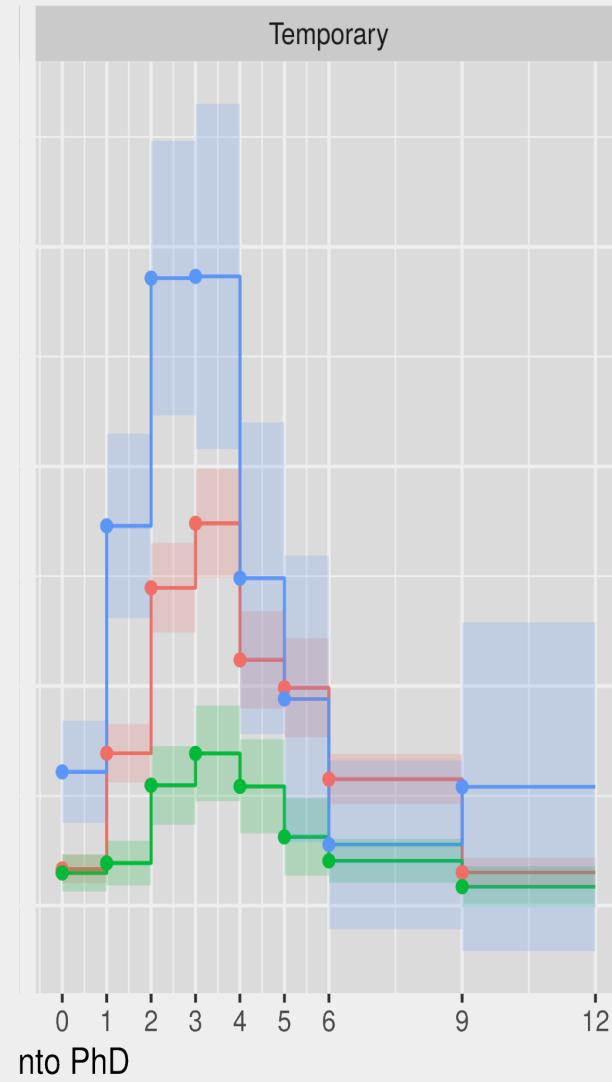
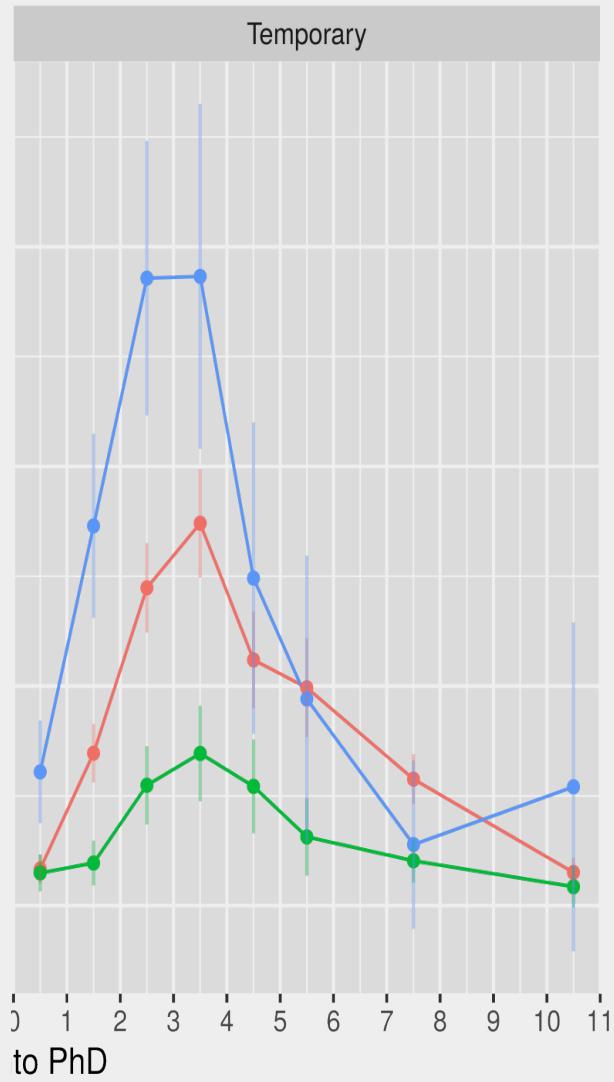
Precision versus clarity



Precision versus clarity

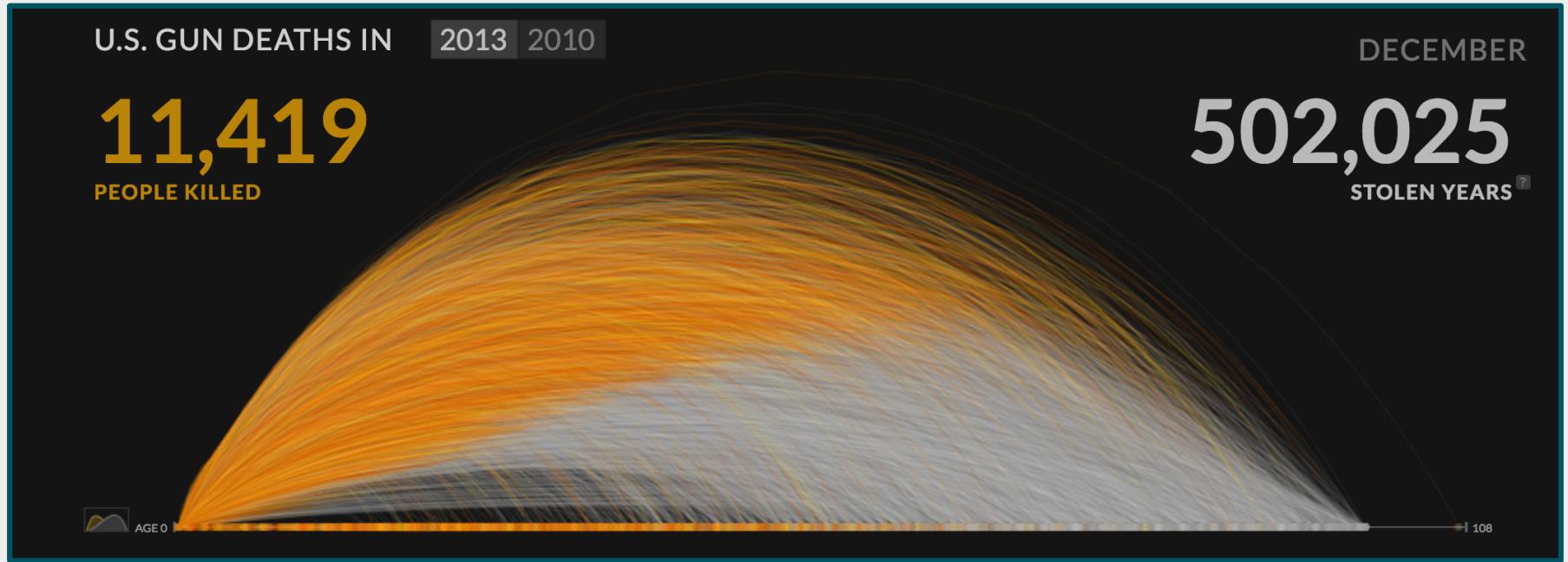


Precision versus clarity



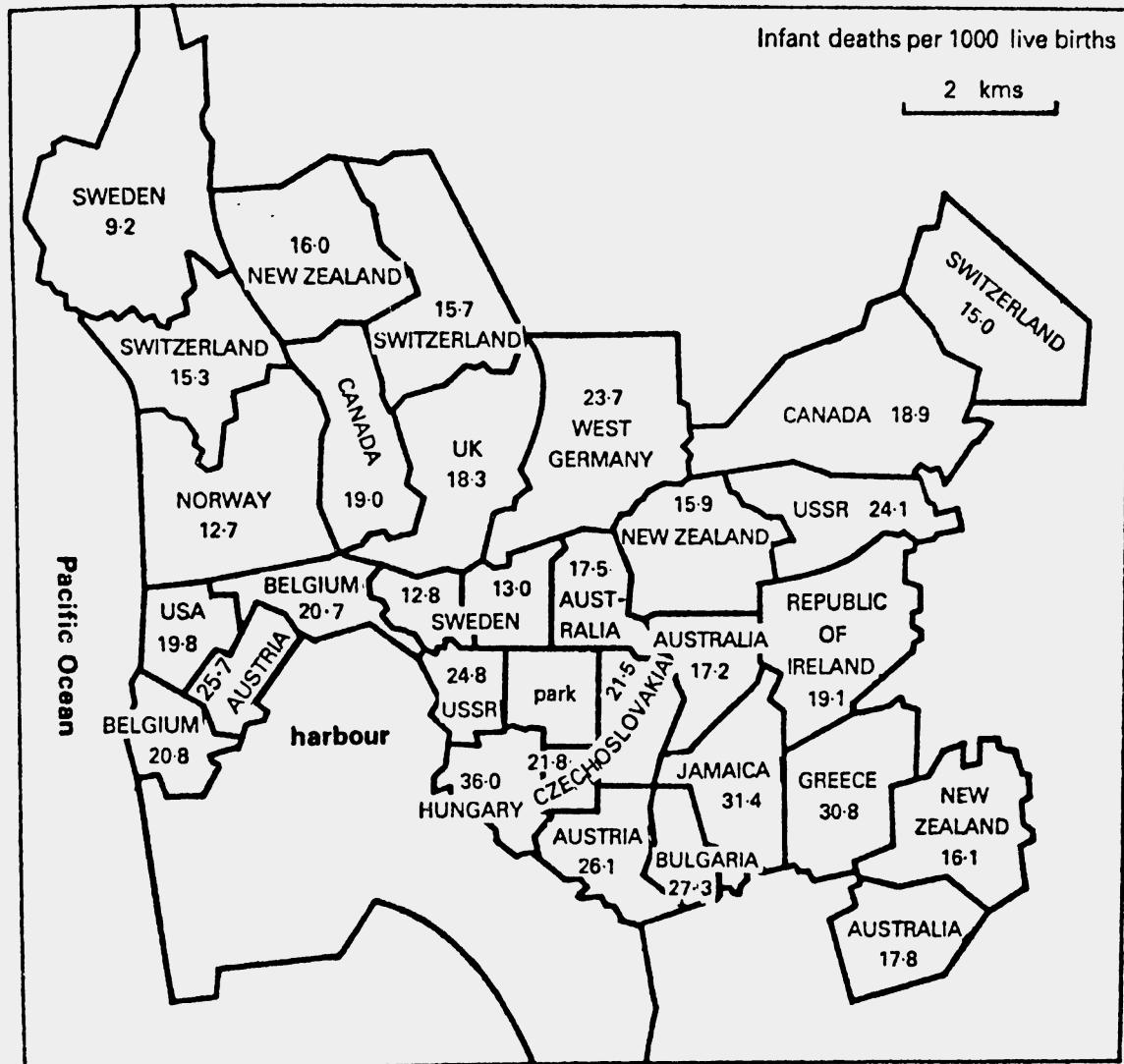
Truthfulness, persuasion
Truthful persuasion?

Micro data, intuitive units



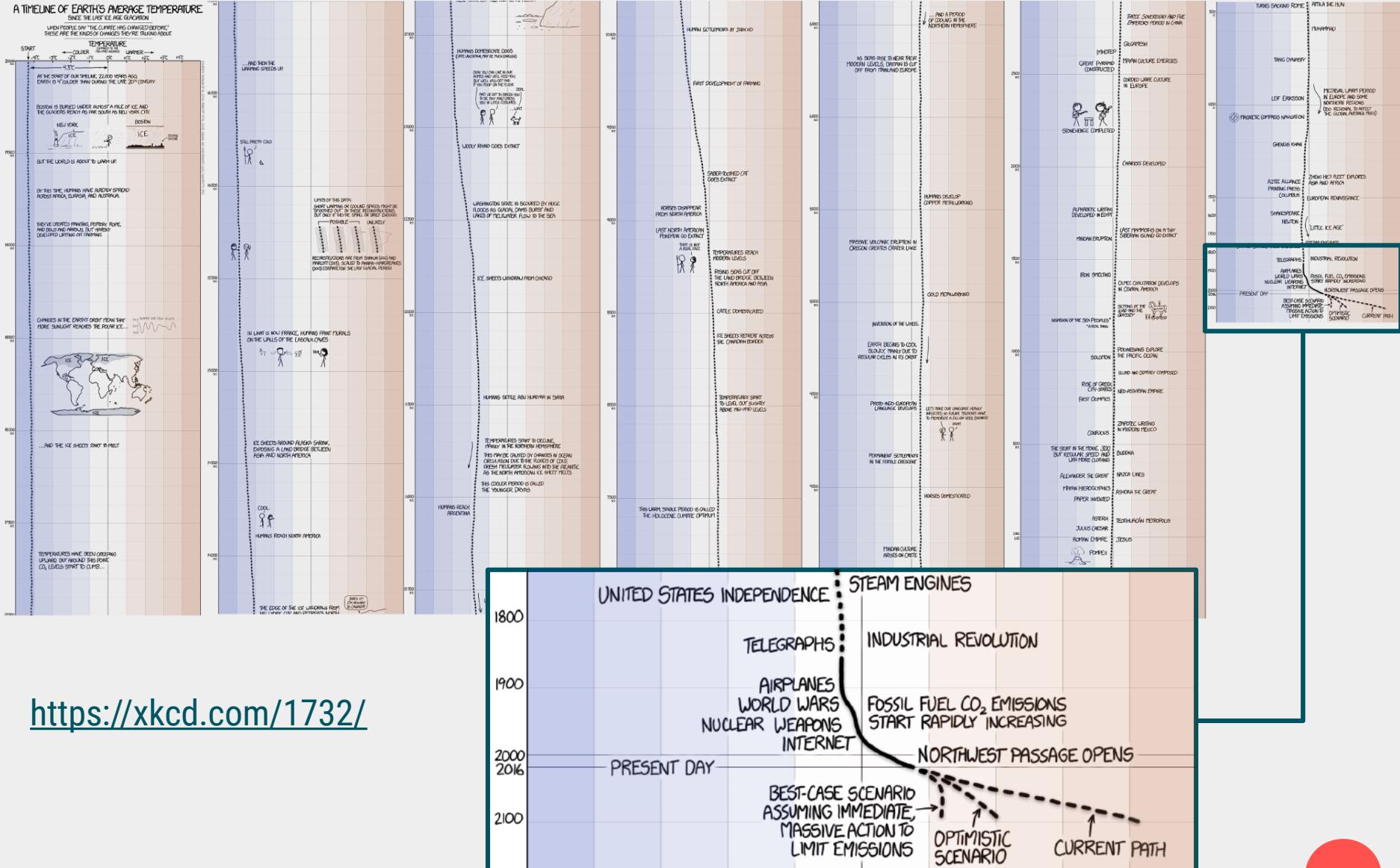
<http://guns.periscopic.com/>

Intuitive comparisons



Infant mortality rates for parts of San Diego, California expressed in national rates of comparable nations.
Monmonier (1996). How to lie with maps.

Overwhelm with data, make relevant comparisons



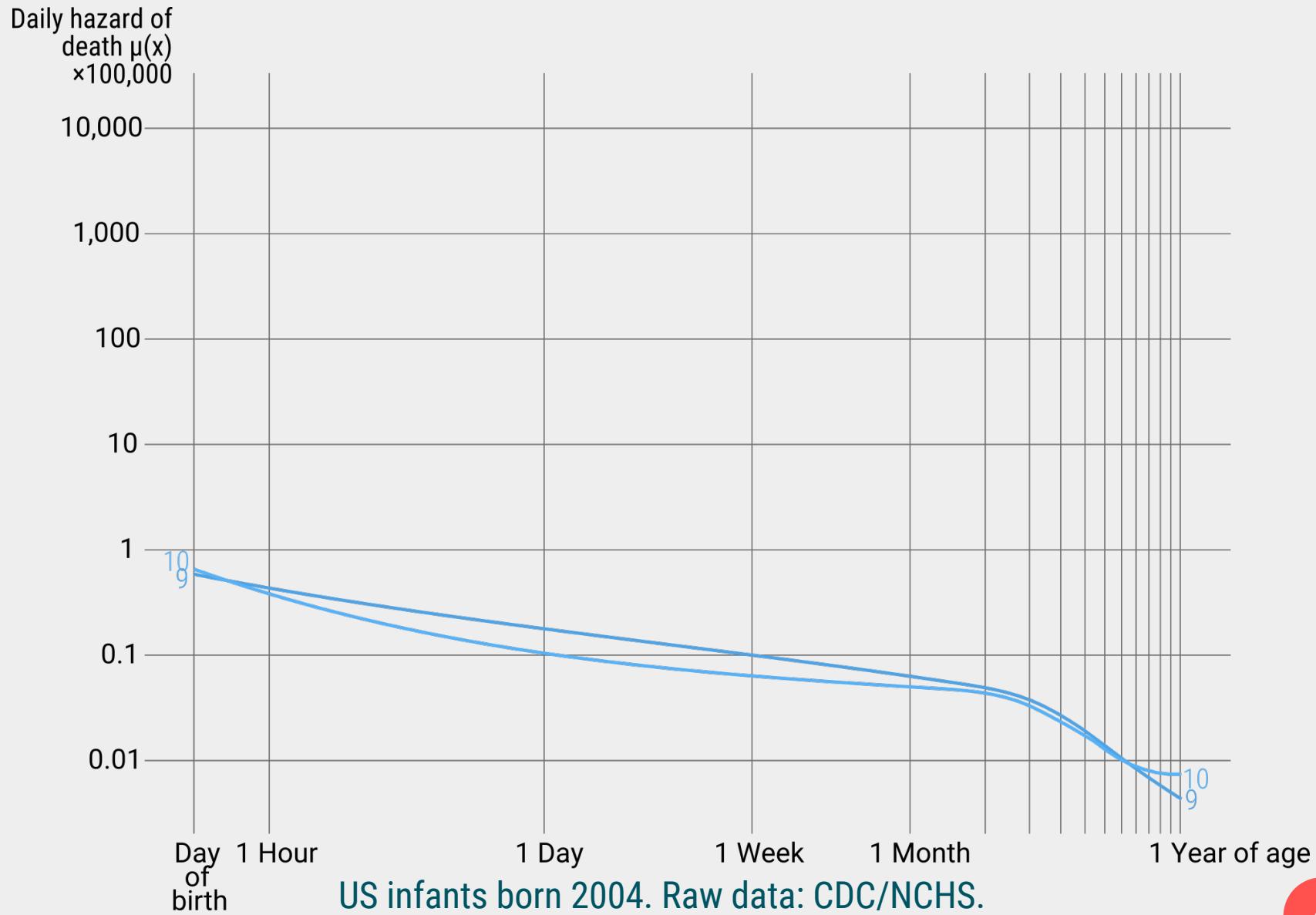
<https://xkcd.com/1732/>

Focusing attention

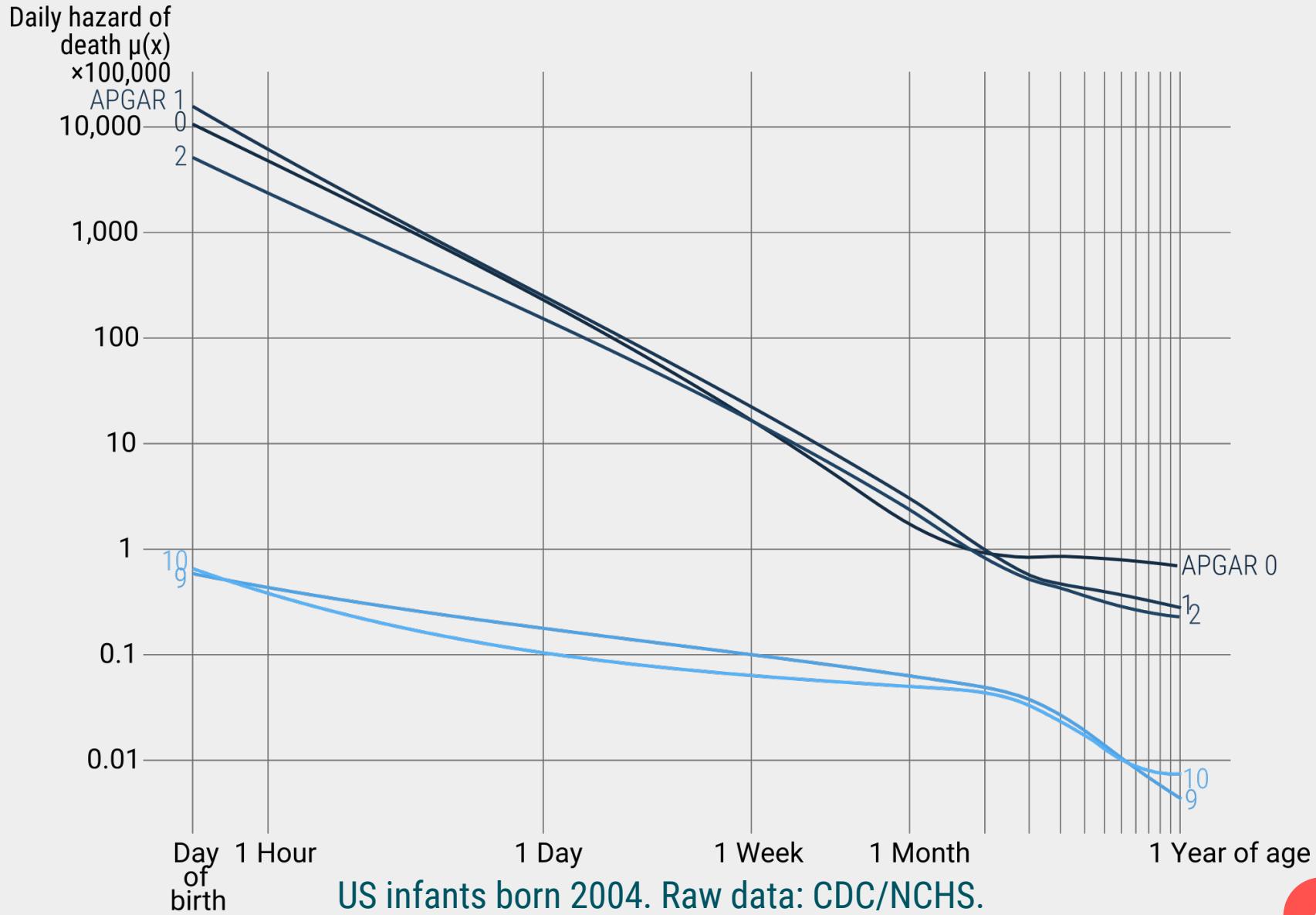
Visual storytelling

What's really warming the world?

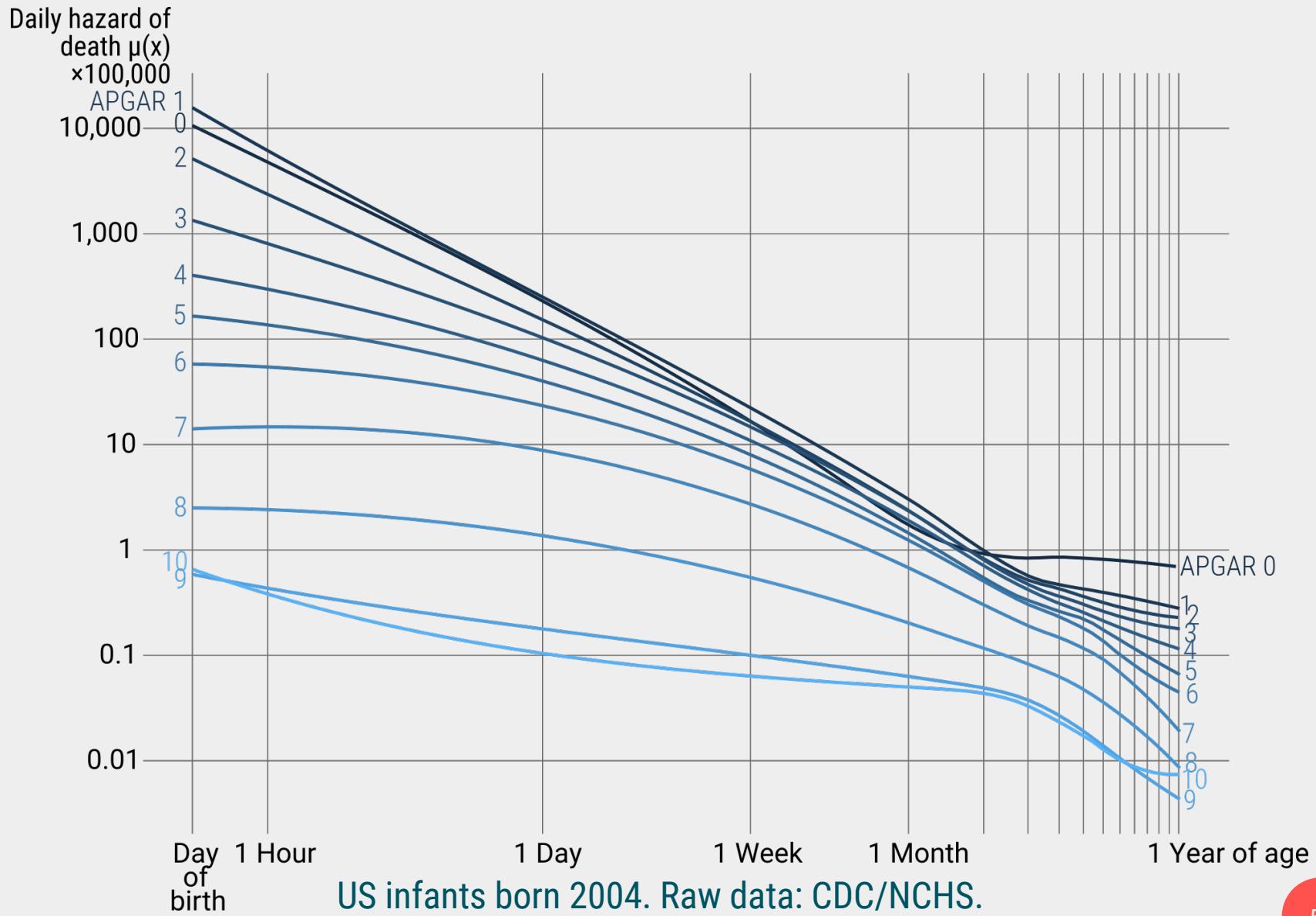
Visual storytelling via cumulative plot building



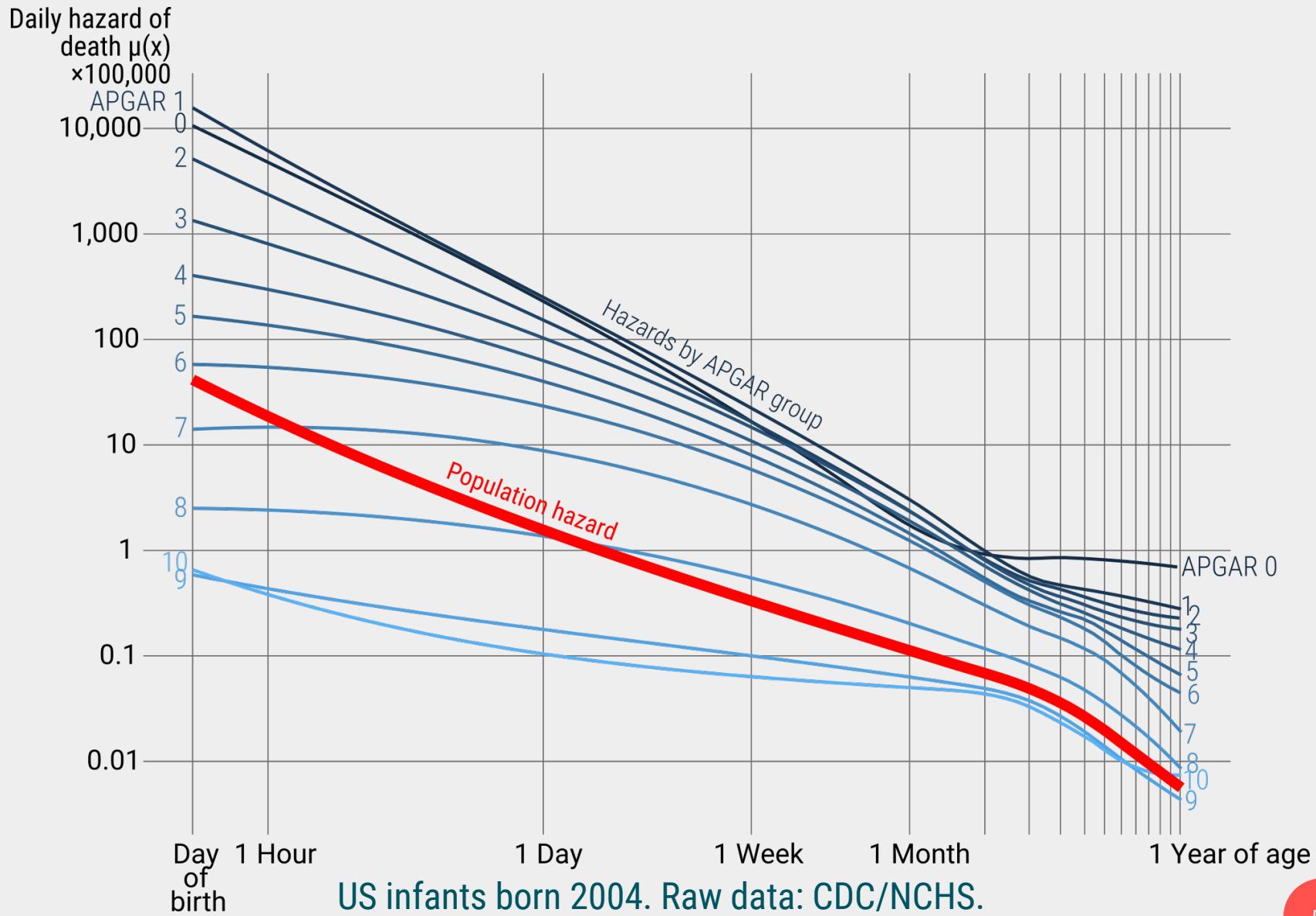
Visual storytelling via cumulative plot building



Visual storytelling via cumulative plot building



Visual storytelling via cumulative plot building



Today's exercise

Prepare **3 visualizations** of the **same data**

1. For publication in a peer-reviewed journal
2. For presentation at a conference
3. For publication as a news highlight to the general public

Prepare to discuss your **design choices**.

Use whatever data and tools you're most comfortable with.

Once you're done put your visualizations into the shared

Dropbox folder. Use your initials as filename, e.g. js1.png, js2.png, js3.png

Slides available at
github.com/jschoeley/idem_viz

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Twitter: [@jschoeley](https://twitter.com/jschoeley)