

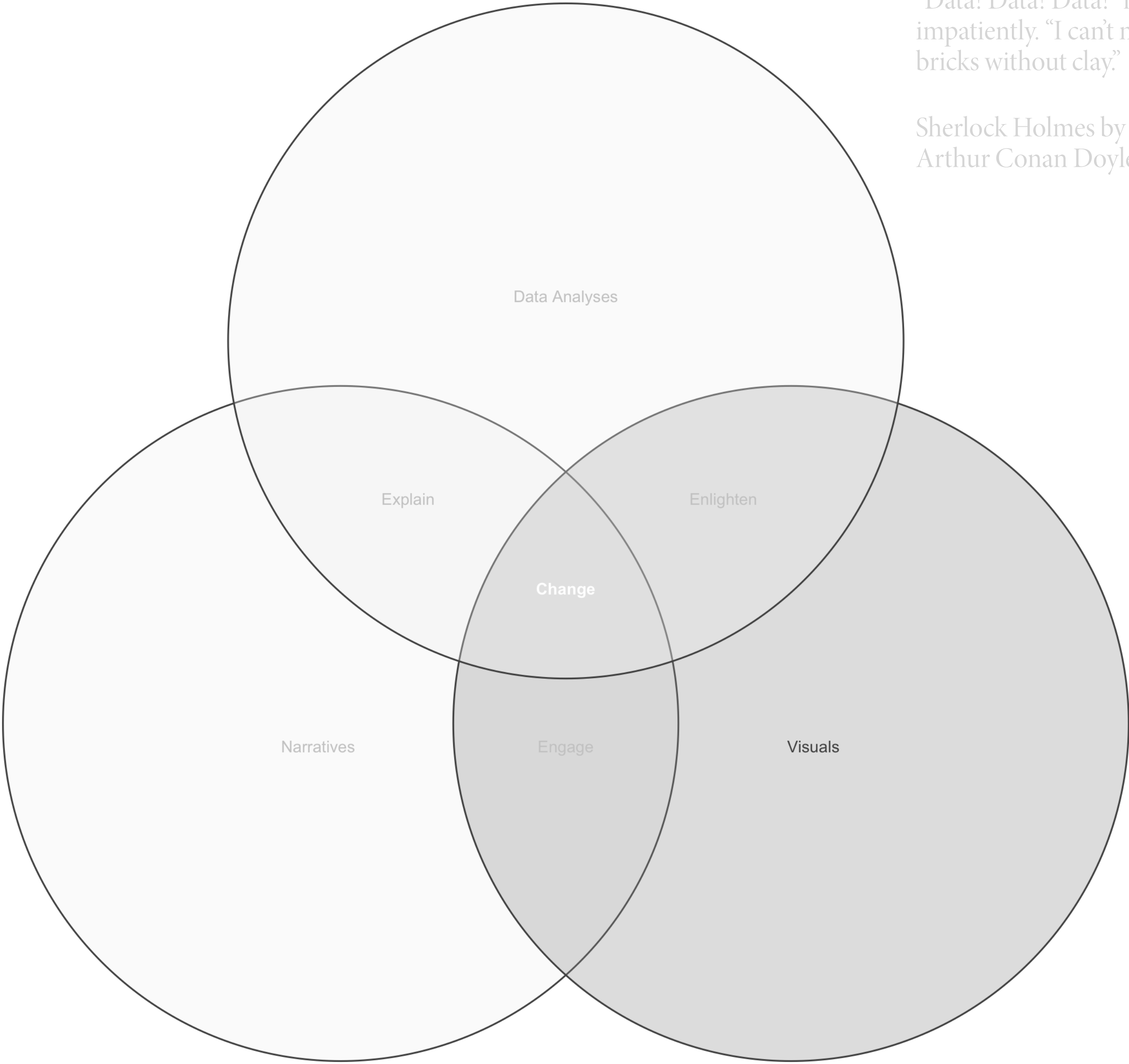
Storytelling with data

04 | from exploring to explaining: experiments with data-ink ratios; annotations; hierarchy; audiences and complexity; (re)design

course overview, learn to drive change using data visuals and narrative

“Data! Data! Data!” he cried impatiently. “I can’t make bricks without clay.”

Sherlock Holmes by Sir Arthur Conan Doyle, *author*



No one ever made a decision because of a number. They need a story.

Daniel Kahneman, *psychologist, behavioral economist, and author*

The greatest value of a picture is when it forces us to notice what we never expected to see.

John W Tukey, *mathematician*

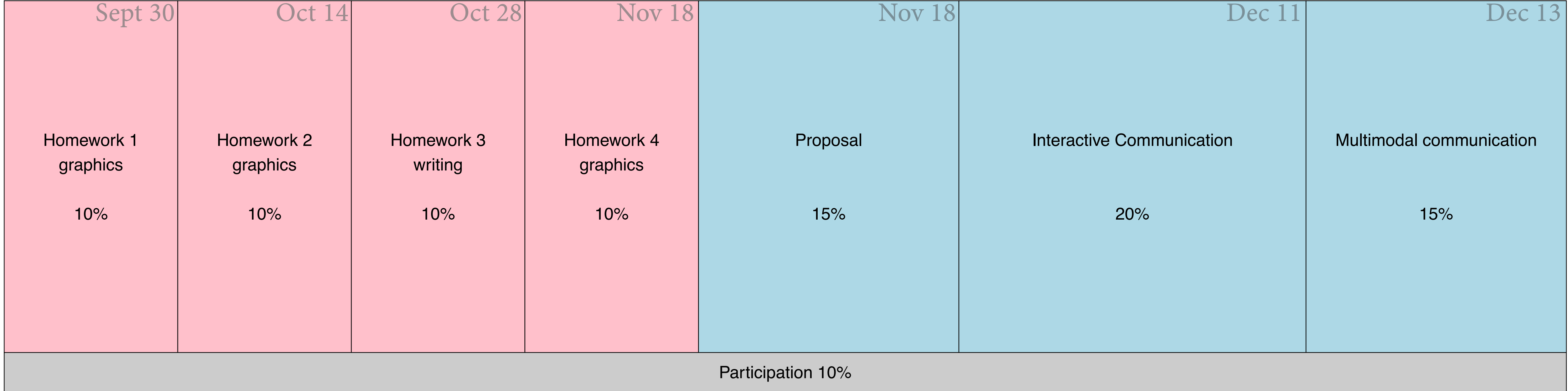
general course deliverable timeline

Individual Work

For learning data visualization and written narrative techniques

Group work

For building graphics and narrative into interactive communications



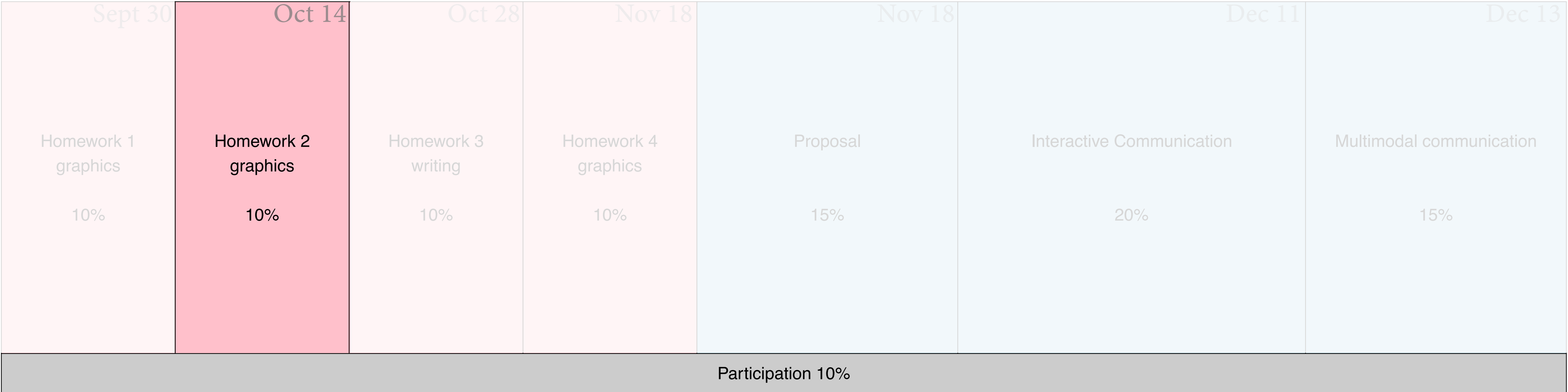
next deliverable, homework two

Individual Work

For learning data visualization and written narrative techniques

Group work

For building graphics and narrative into interactive communications



homework two check-in | graphics
practice with Citi Bike rebalancing study

homework two check-in, questions?

Saldarriaga, Juan Francisco. *CitiBike Rebalancing Study*. Spatial Information Design Lab, Columbia University, 2013. <https://c4sr.columbia.edu/projects/citibike-rebalancing-study>.

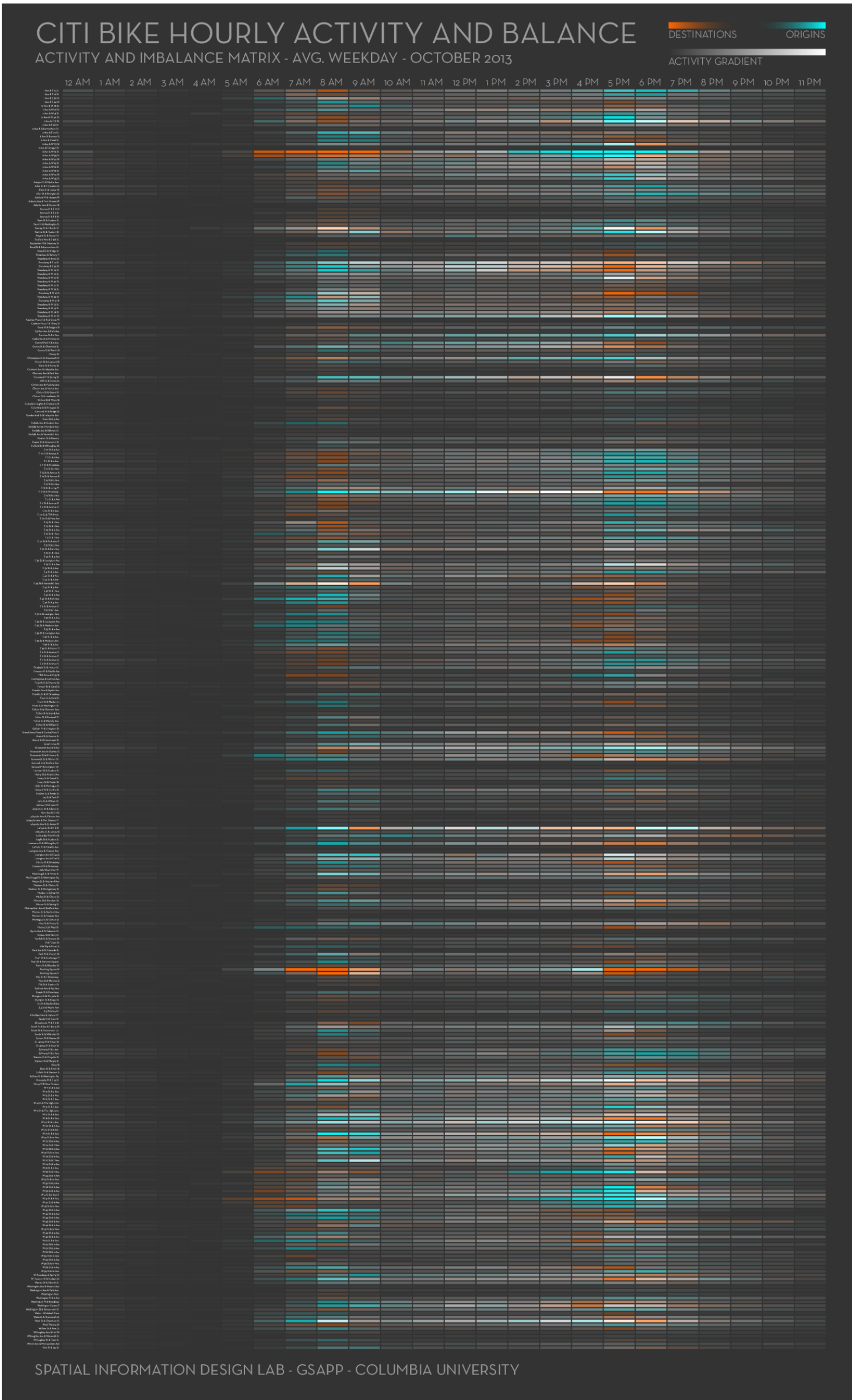
The screenshot shows a R Markdown editor window titled "homework 2.rmd". The editor contains the following content:

```
1 ---
2 title: 'Homework 2: graphics practice'
3 author: 'Last name, first name'
4 date: `r format(Sys.Date(), "%Y, %B %d")`
5 output: distill::distill_article
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(
10   eval = FALSE,
11   echo = TRUE,
12   message = FALSE,
13   error = FALSE,
14   warning = FALSE)
15 ```
16
17
18
19 # Preliminary
20
21
22
23 For this homework assignment, we'll continue exploring data related to our Citi
24 Bike case study as a way to practice the concepts we've been discussing in
25 class.
26
27 In our third discussion, we briefly considered an exploratory visualization of
28 activity and docking station (im)balance, conducted in 2013 by Columbia
29 University's Center for Spatial Research.
30 [https://c4sr.columbia.edu/projects/citibike-rebalancing-study] (https://c4sr.columbia.edu/projects/citibike-rebalancing-study).
31
32 As practice in understanding encodings, let's review and reconstruct one of the
33 Center's graphics, titled: "CITI BIKE HOURLY ACTIVITY AND BALANCE". You can
34 download and zoom in on a high resolution pdf of the graphic here:
35 [https://c4sr.columbia.edu/sites/default/files/Activity\_Matrix\_Composite.pdf] (https://c4sr.columbia.edu/sites/default/files/Activity\_Matrix\_Composite.pdf).
36
37
38
39 # Question 1(a) and 1(b) – data types and visual encodings
40
41 What variables and data types have been encoded?
```

On the right side of the editor, a table of contents is visible:

- Preliminary
- Question 1(a) and 1(b) – data types and visual encodings
- Question 2 – coordinate systems
- Question 3 – comparing encoded data
- Question 4 – workflow, tidying and transforming data
- Question 5 – transforming data
- Question 6 – scaling data
- Question 7 – mapping data to visual channels
- Question 8 – decoding and interpretation: critical thinking
- Bonus – advanced practice
- Knit and submit

At the bottom of the editor, the status bar shows "289:264" and "Knit and submit".



Doumont's *three laws of communication* applied to data encoding

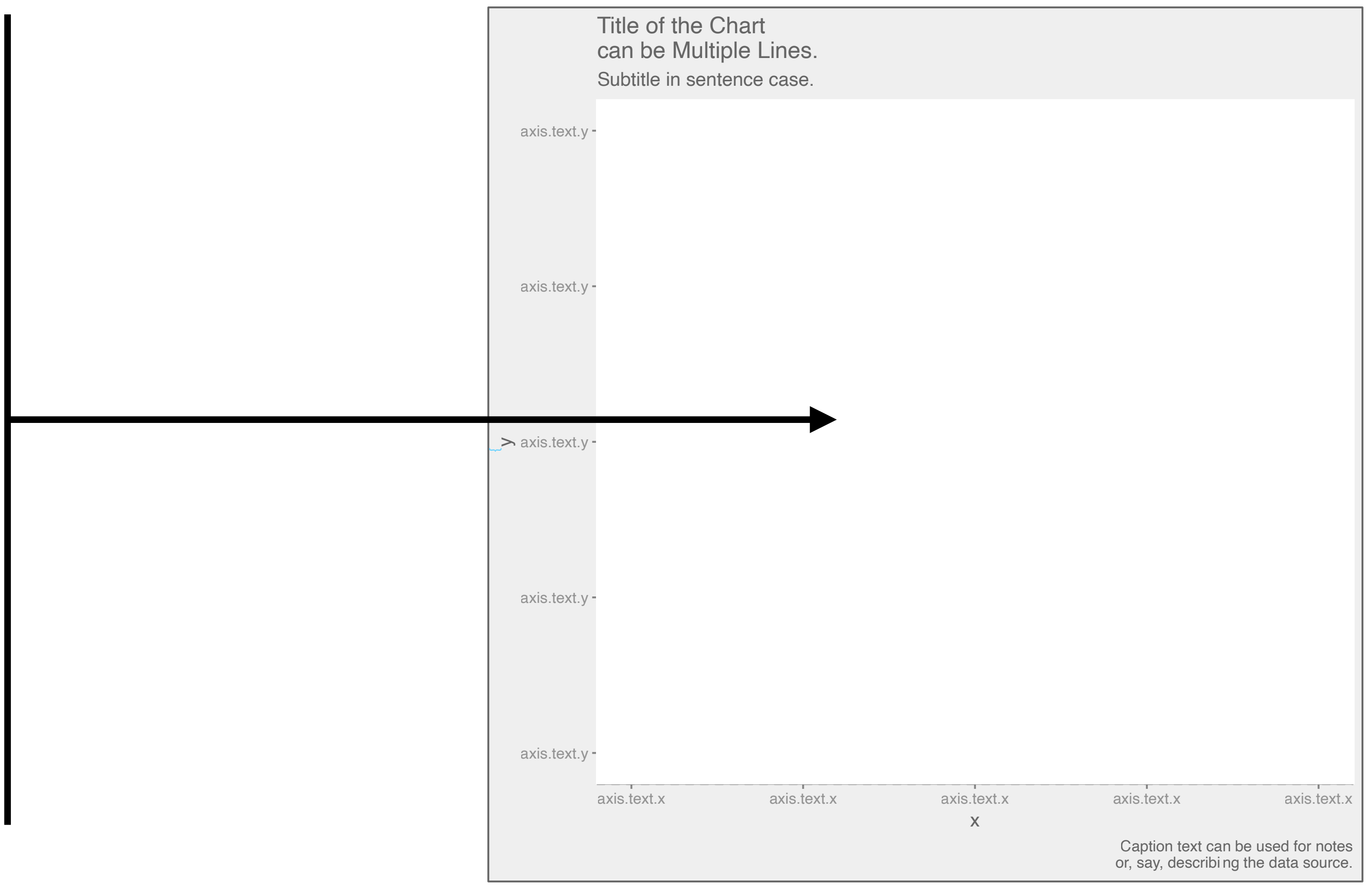
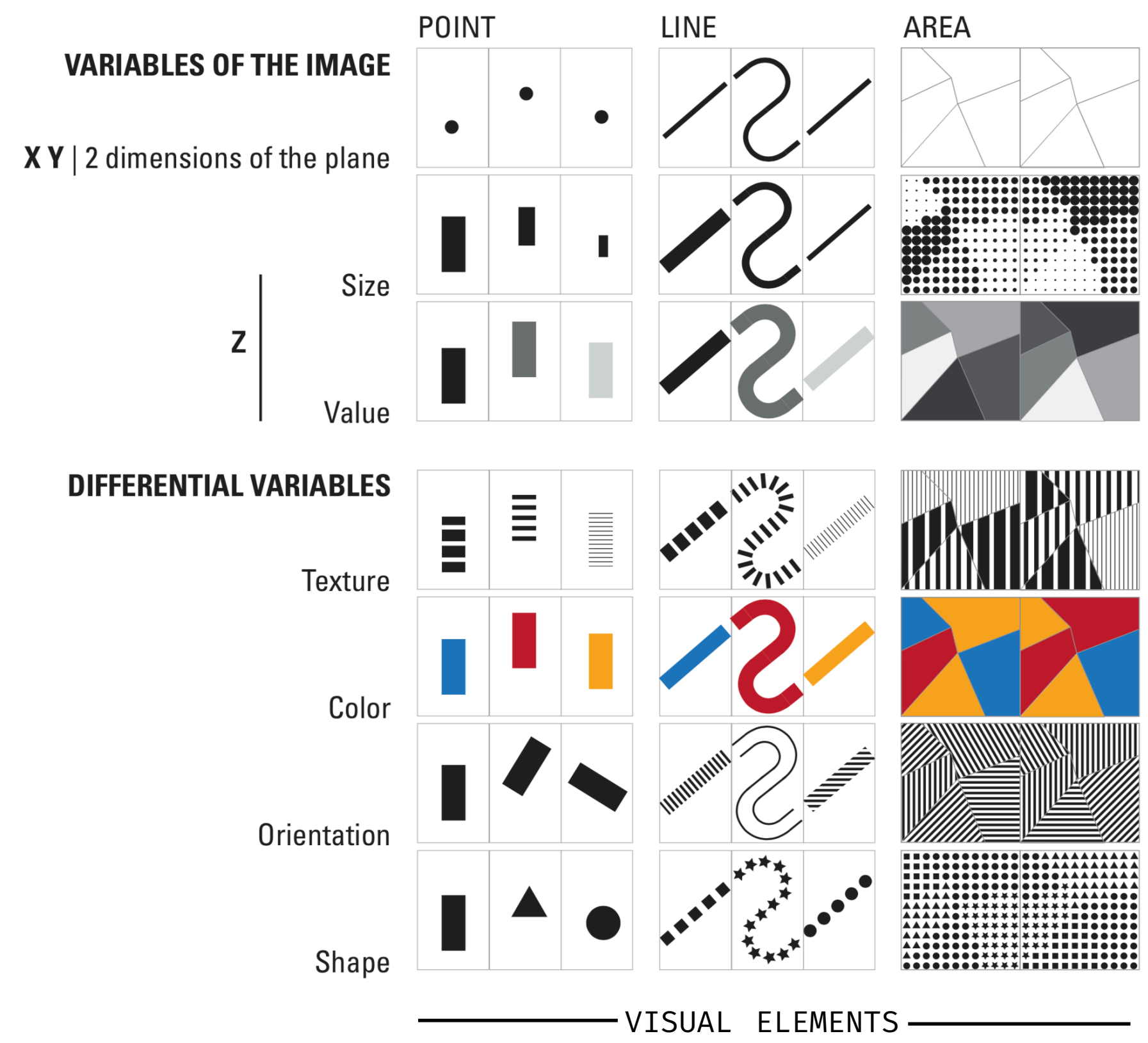
Doumont applied to data encoding, Doumont's three laws of communication

Adapt to your audience

Maximize the signal-to-noise ratio

Use effective redundancy

Doumont applied to data encoding, “data ink” — Jacques Bertin’s visual channels for encoding data



Doumont applied to data encoding, the data ink — example functions to draw encoded data in ggplot2

```
# load grammar of graphics
library(ggplot2)
```

```
p <-
```

```
# functions for data ink

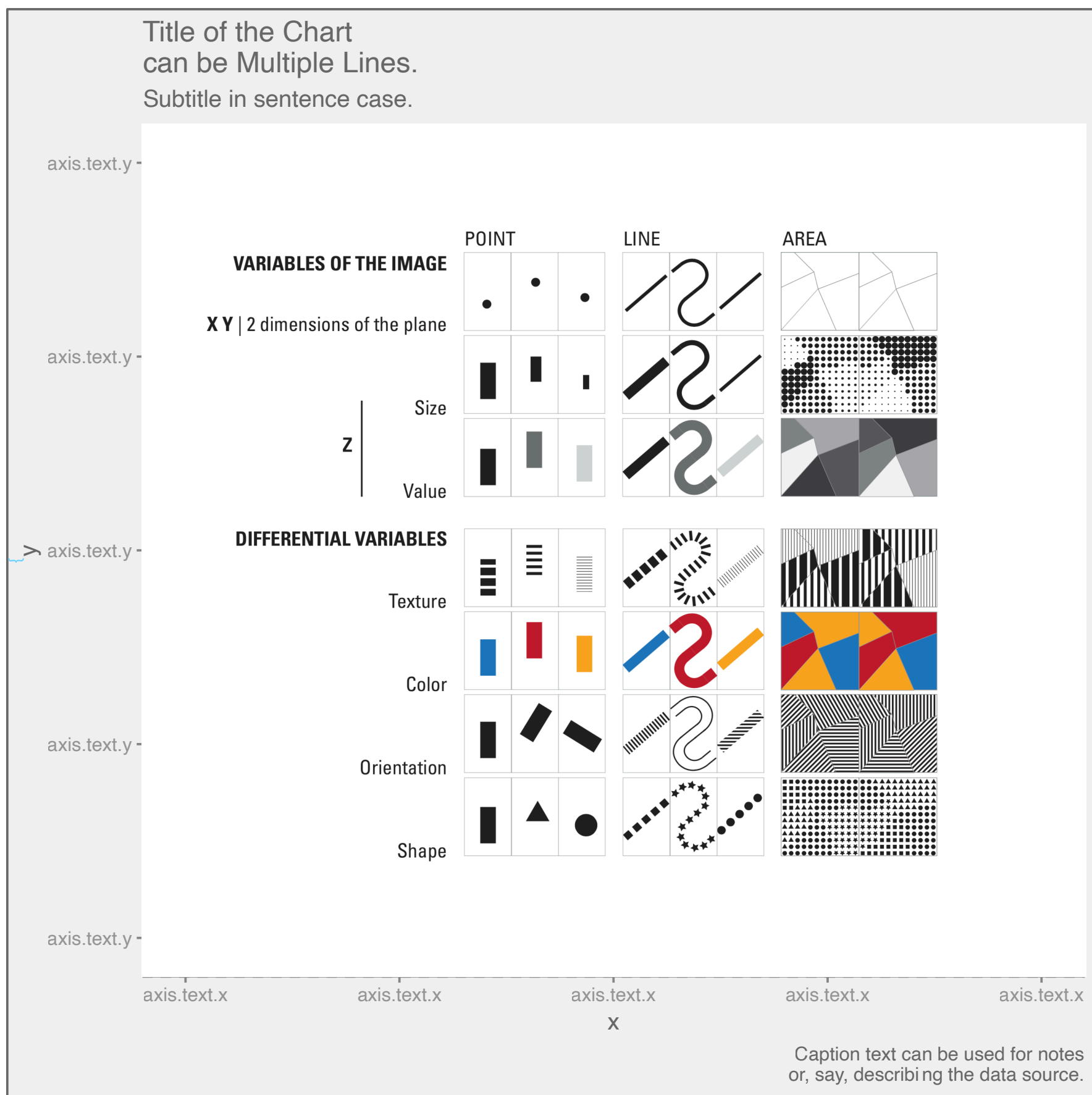
ggplot(data = <data>,
       mapping = aes(<aesthetic> = <variable>,
                    <aesthetic> = <variable>,
                    <...> = <...>)) +

geom_<type>( <...> ) +
scale_<mapping>_<type>( <...> ) +
coord_<type>( <...> ) +
facet_<type>( <...> ) +
<...> +
```

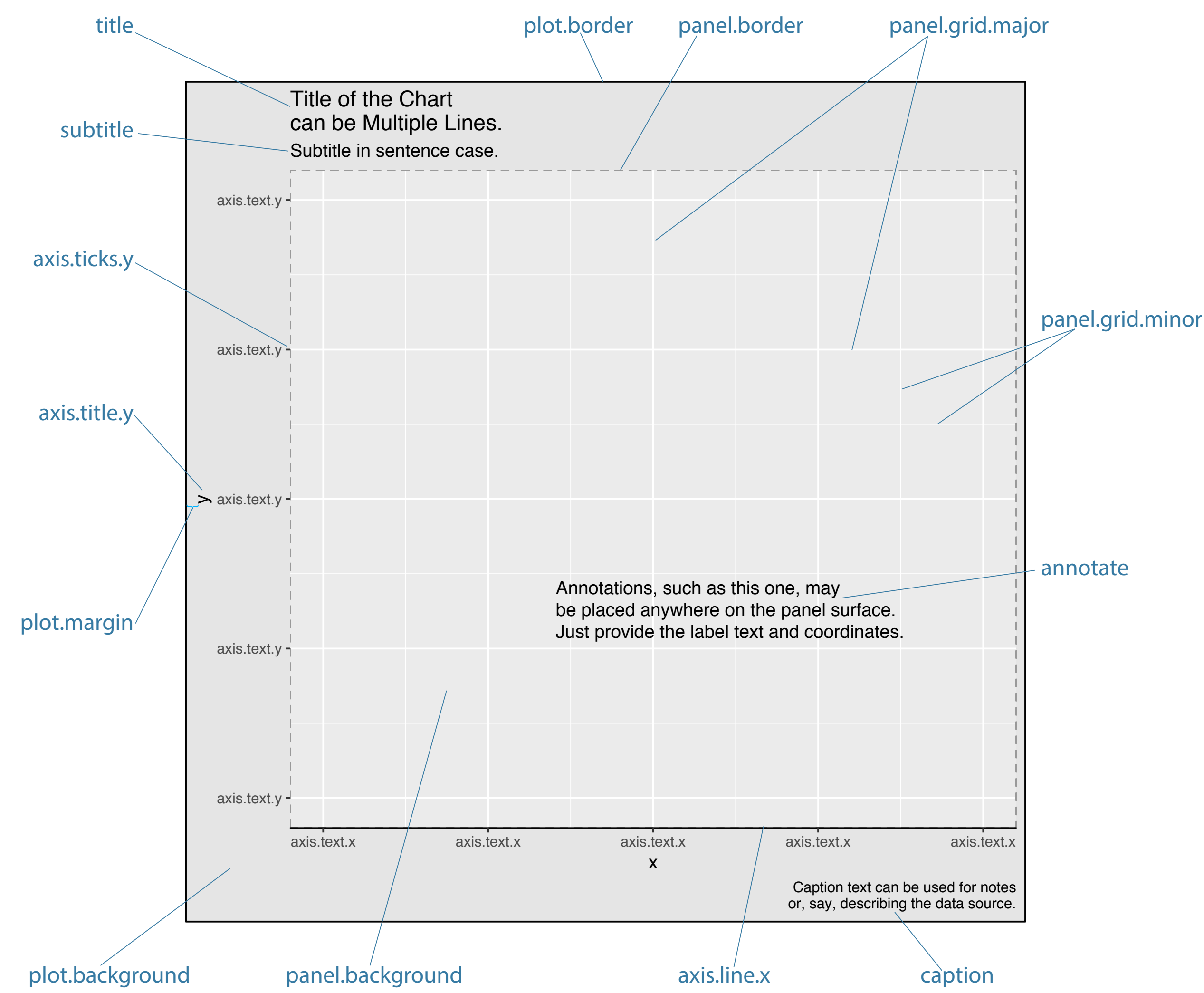
functions for non-data ink

```
labs(<...>) +
theme(<...> = <...>) +
annotate(<...>) +
<...>
```

```
element_blank()
element_line(<...> = <...>)
element_rect(<...> = <...>)
element_text(<...> = <...>)
```



Doumont applied to data encoding, non-“data ink”



Doumont applied to data encoding, non-“data ink” — example functions to draw non-data ink in ggplot2

```
# load grammar of graphics
library(ggplot2)
```

```
p <-
```

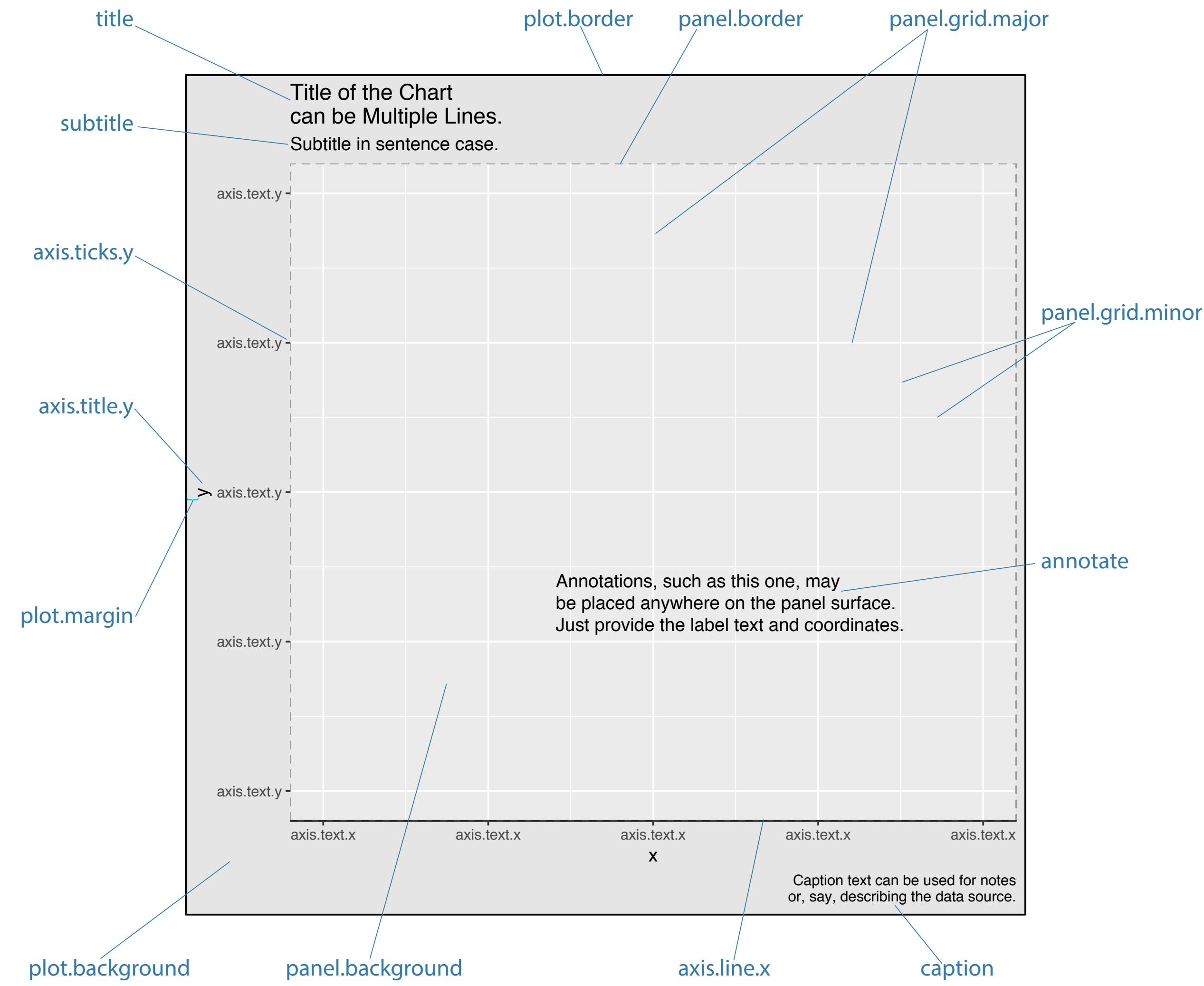
functions for data ink

```
ggplot(data = <data>,
       mapping = aes(<aesthetic> = <variable>,
                    <aesthetic> = <variable>,
                    <...> = <...>)) +
  geom_<type>(<...>) +
  scale_<mapping>_<type>(<...>) +
  coord_<type>(<...>) +
  facet_<type>(<...>) +
  <...> +
```

functions for non-data ink

```
labs(<...>) +
theme(<...> = <...>) +
annotate(<...>) +
<...>
```

```
element_blank()
element_line(<...> = <...>)
element_rect(<...> = <...>)
element_text(<...> = <...>)
```



Doumont applied to data encoding, Tufte — data-ink maximization, *within reason*

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

= proportion of a graphic’s ink devoted to the non-redundant display of data-information

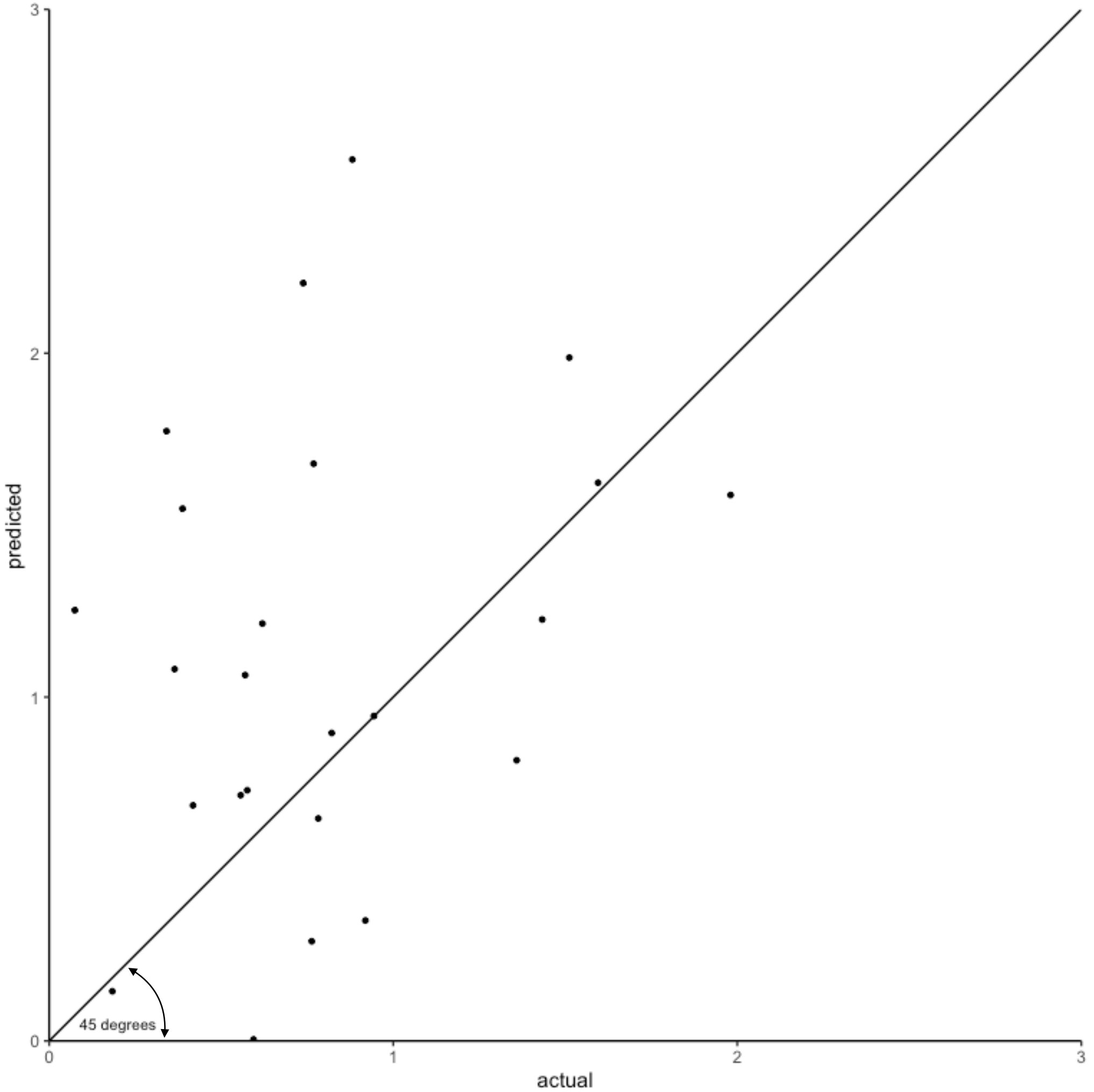
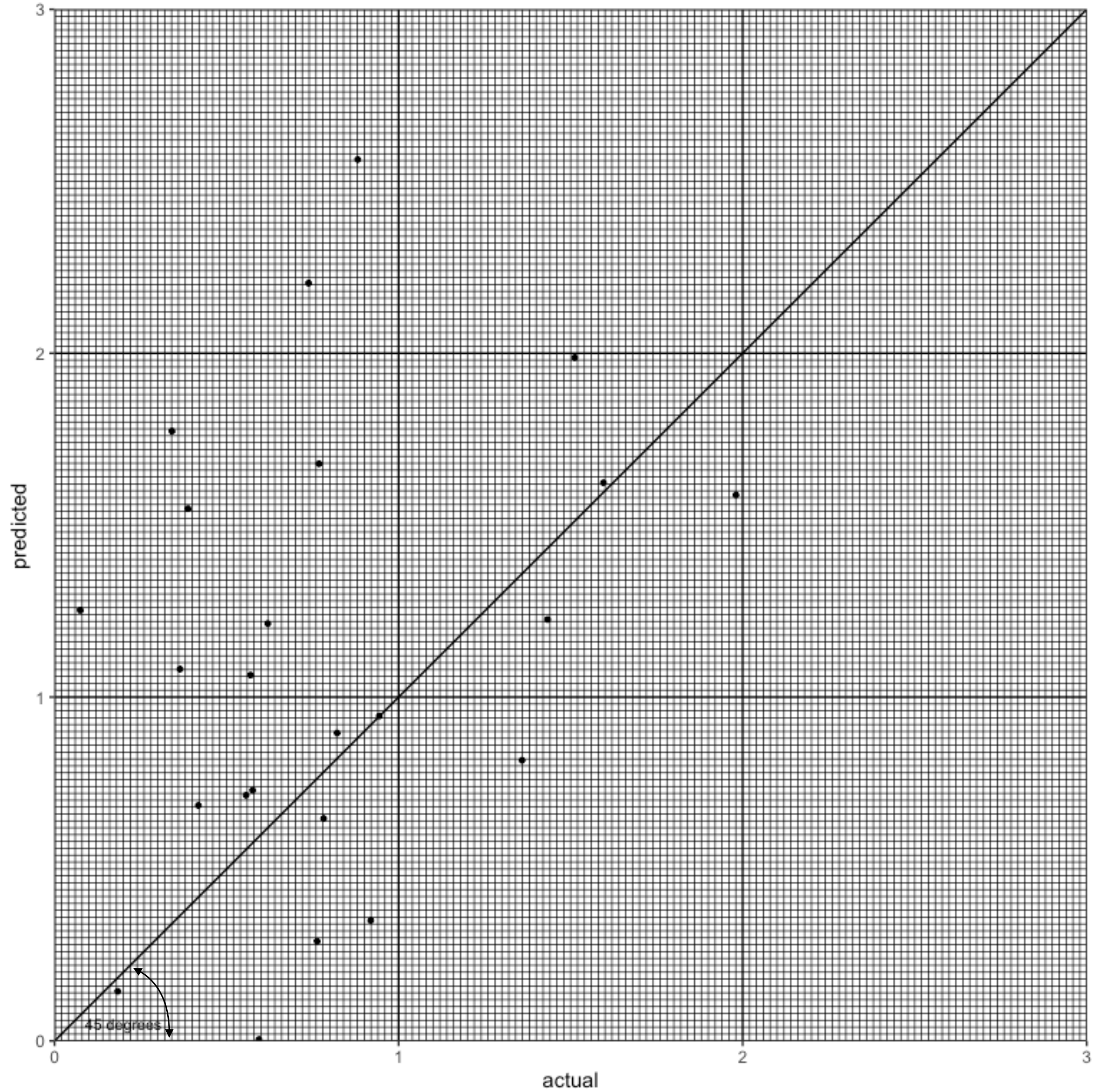
= 1.0 – proportion of a graphic that can be erased without loss of data-information

“The principle *helps conduct experiments* in graphical design.”

— Tufte, Edward, *The Visual Display of Quantitative Information*

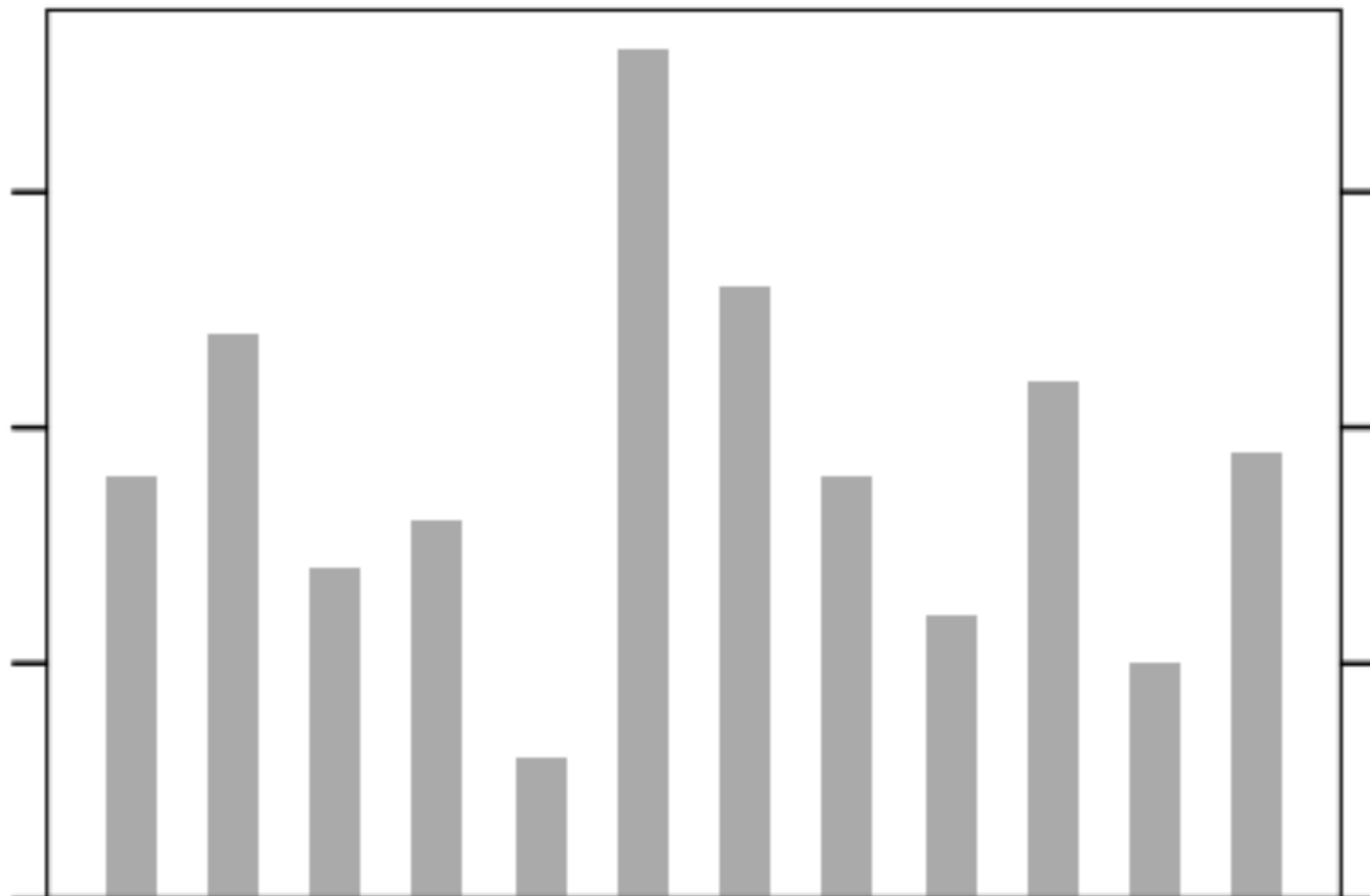
Doumont — “maximize the signal-to-noise ratio”

Doumont applied to data encoding, example — removing gridlines increases the data-ink ratio

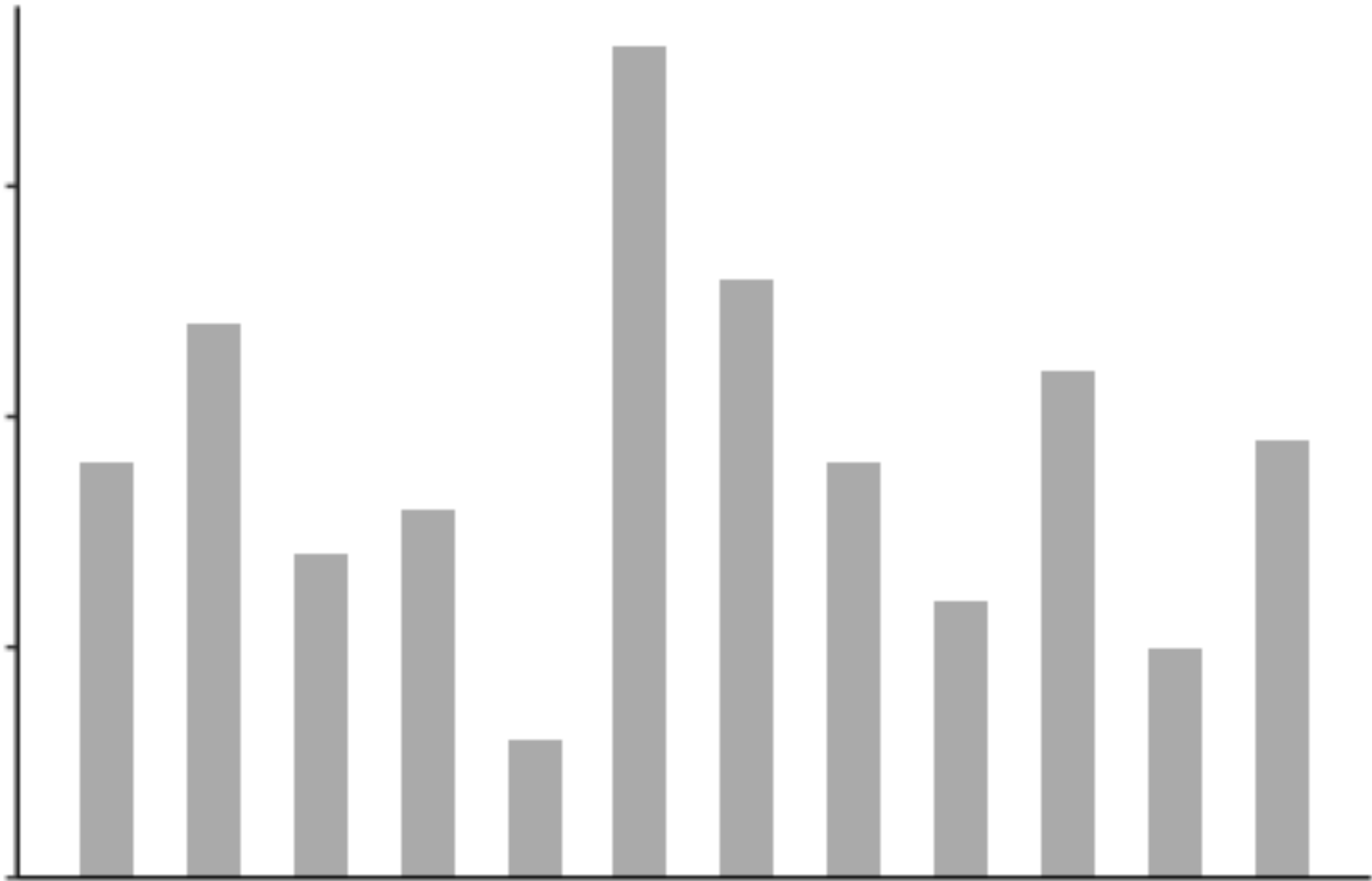


Doumont — “maximize the signal-to-noise ratio”

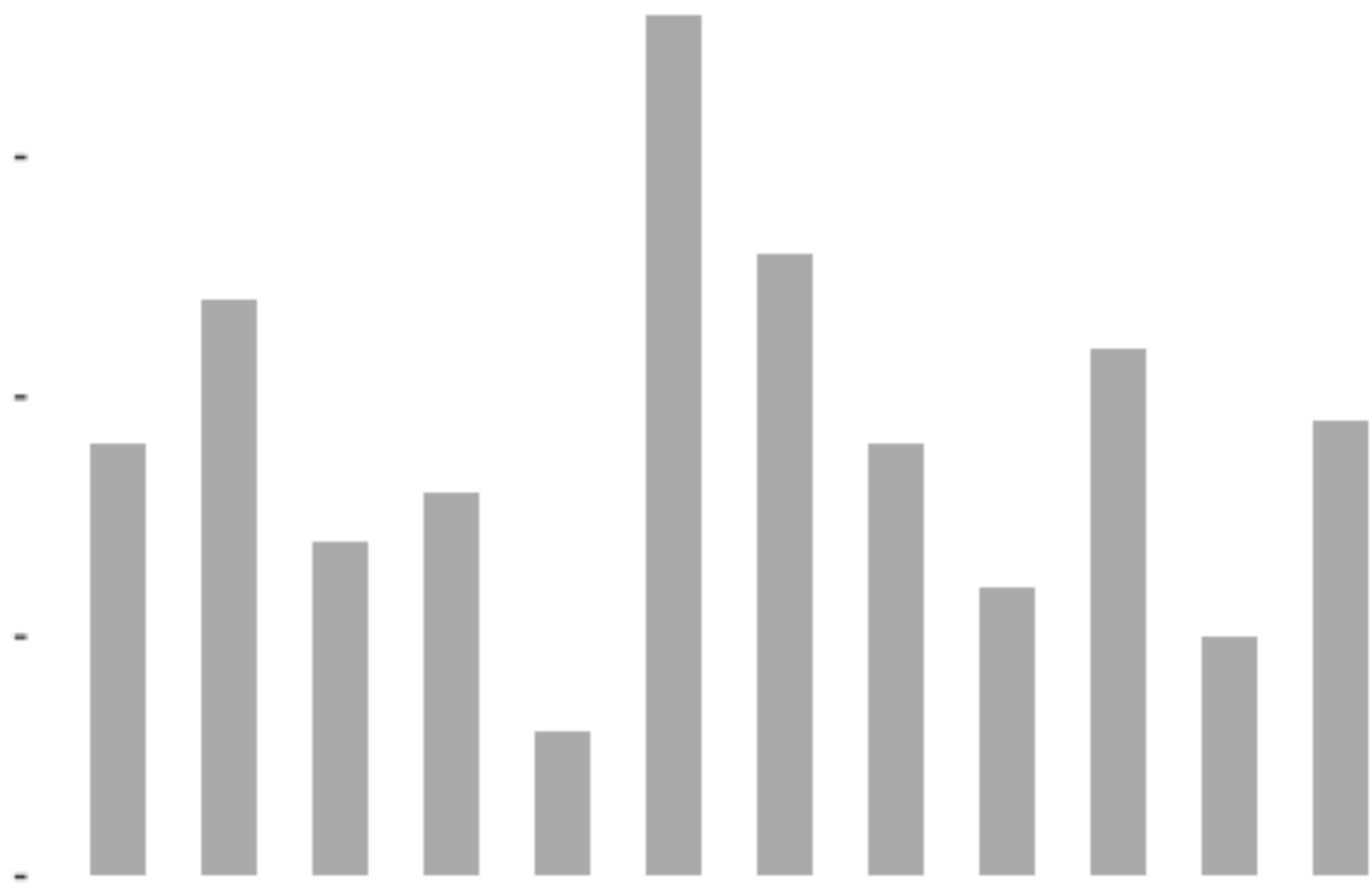
Doumont applied to data encoding, **experimentation** — redesigning a bar chart



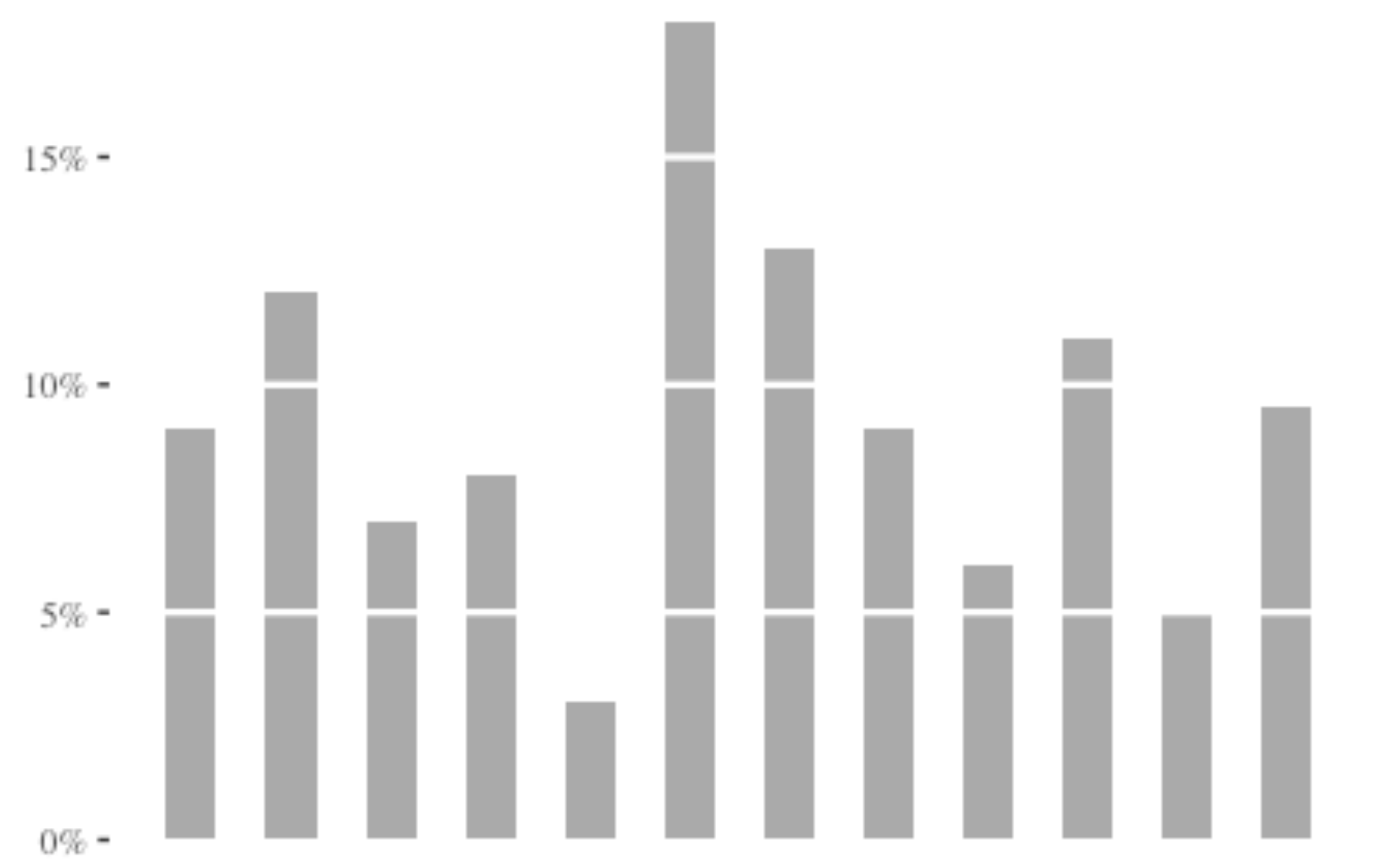
Doumont applied to data encoding, **experimentation** — redesigning a bar chart



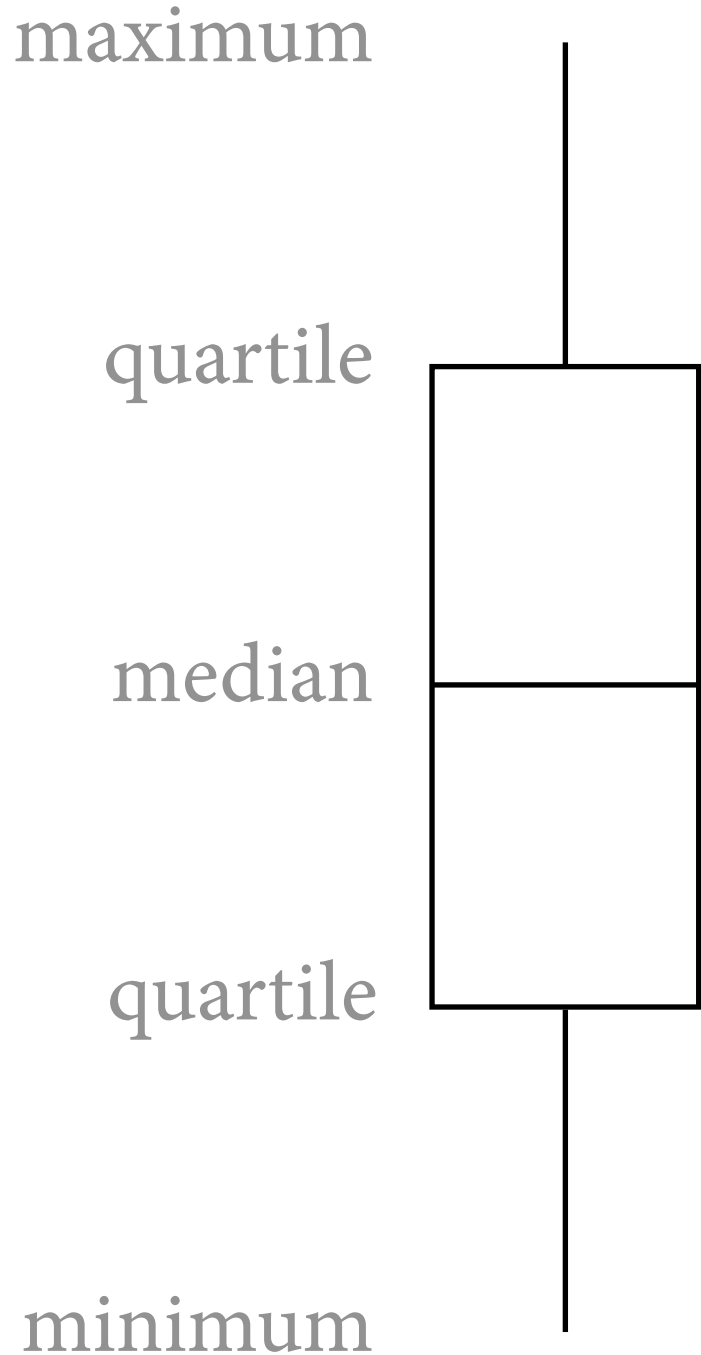
Doumont applied to data encoding, **experimentation** — redesigning a bar chart



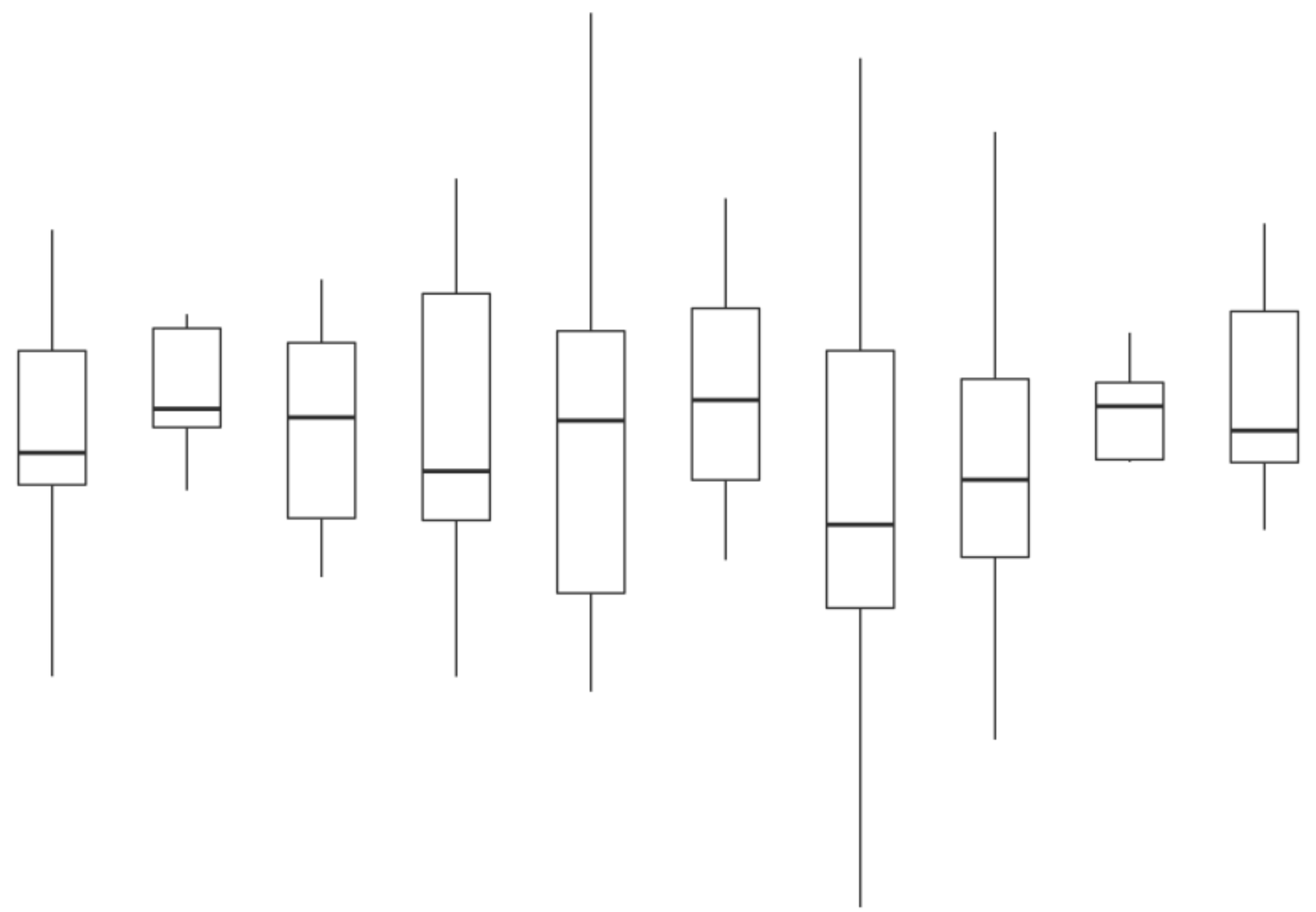
Doumont applied to data encoding, **experimentation** — redesigning a bar chart



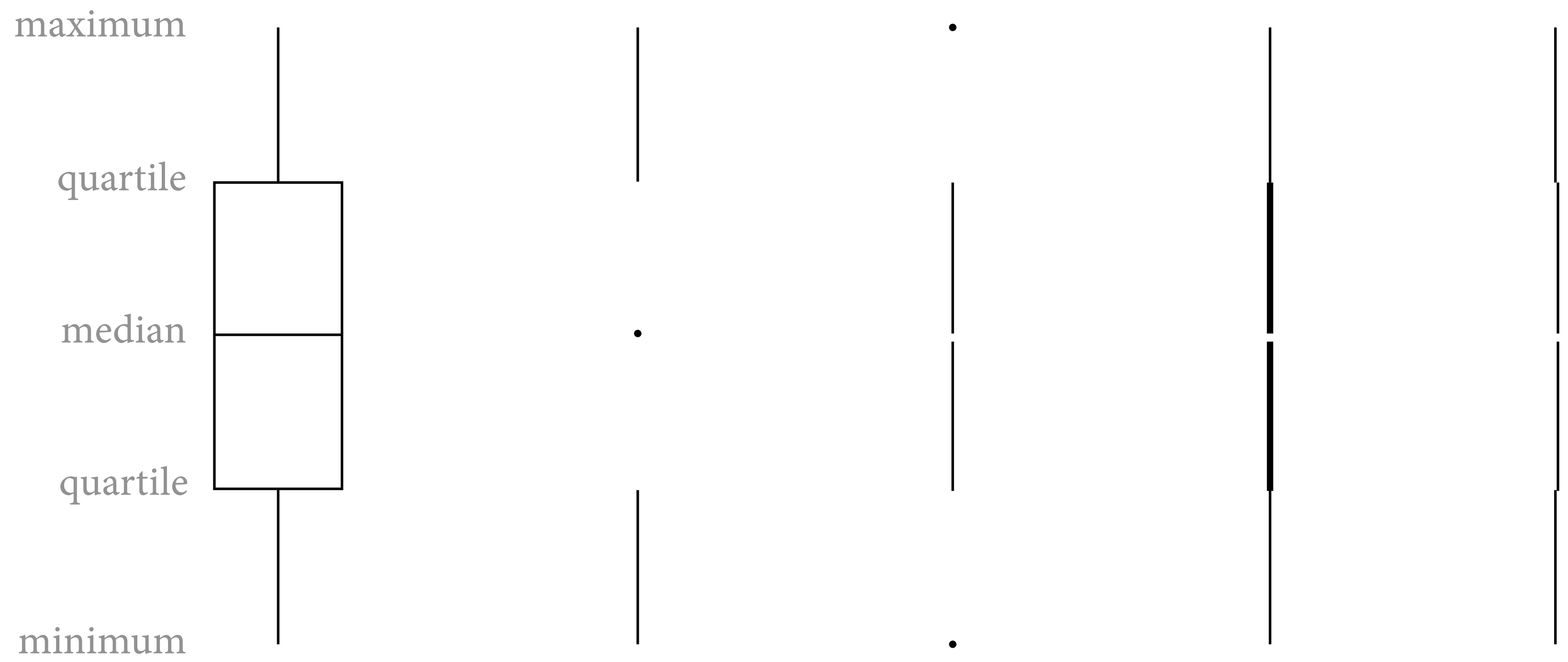
Doumont applied to data encoding, **experimentation** — redesigning John Tukey's box plot



Doumont applied to data encoding, **experimentation** — redesigning John Tukey's box plot



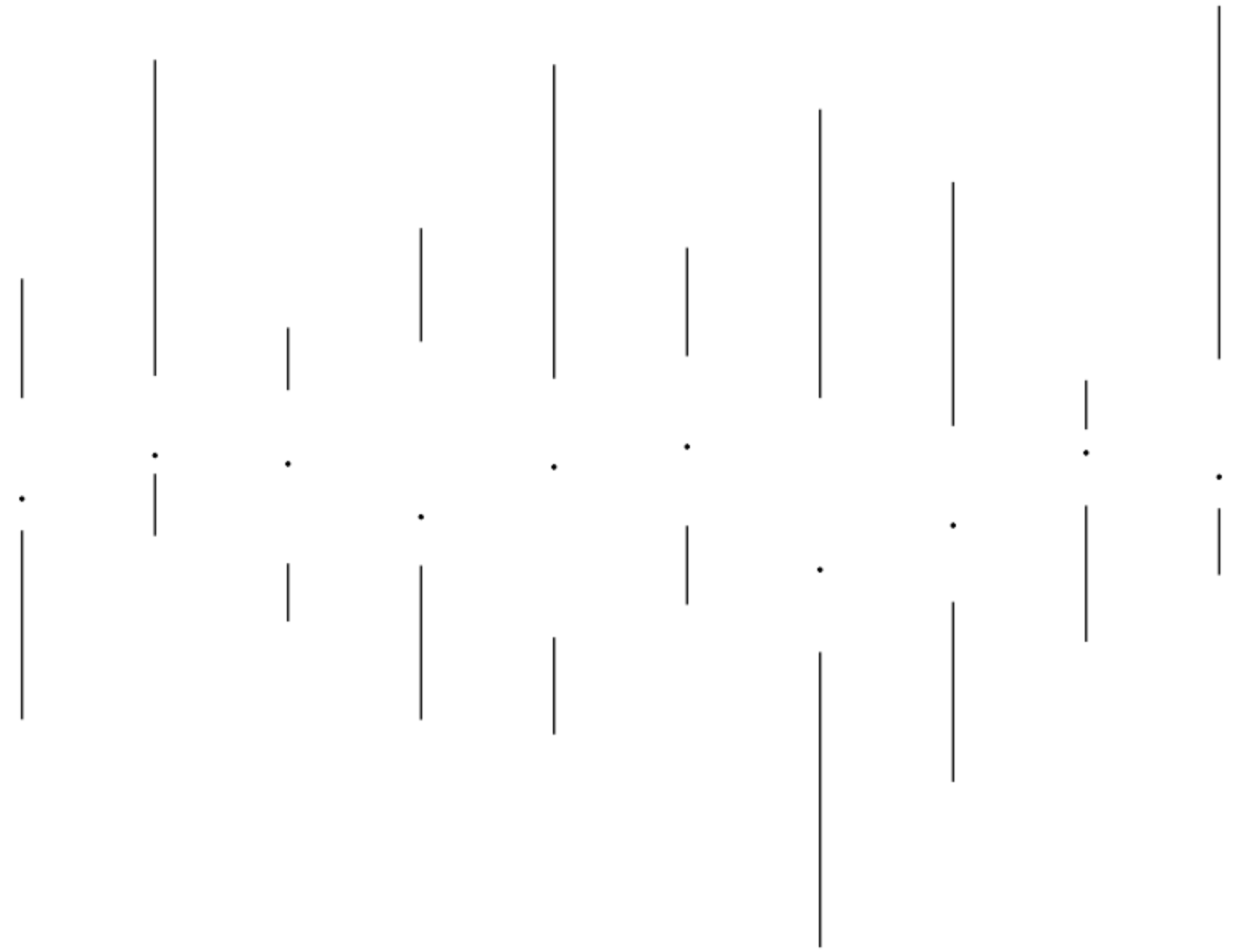
Doumont applied to data encoding, **experimentation** — redesigning John Tukey's box plot



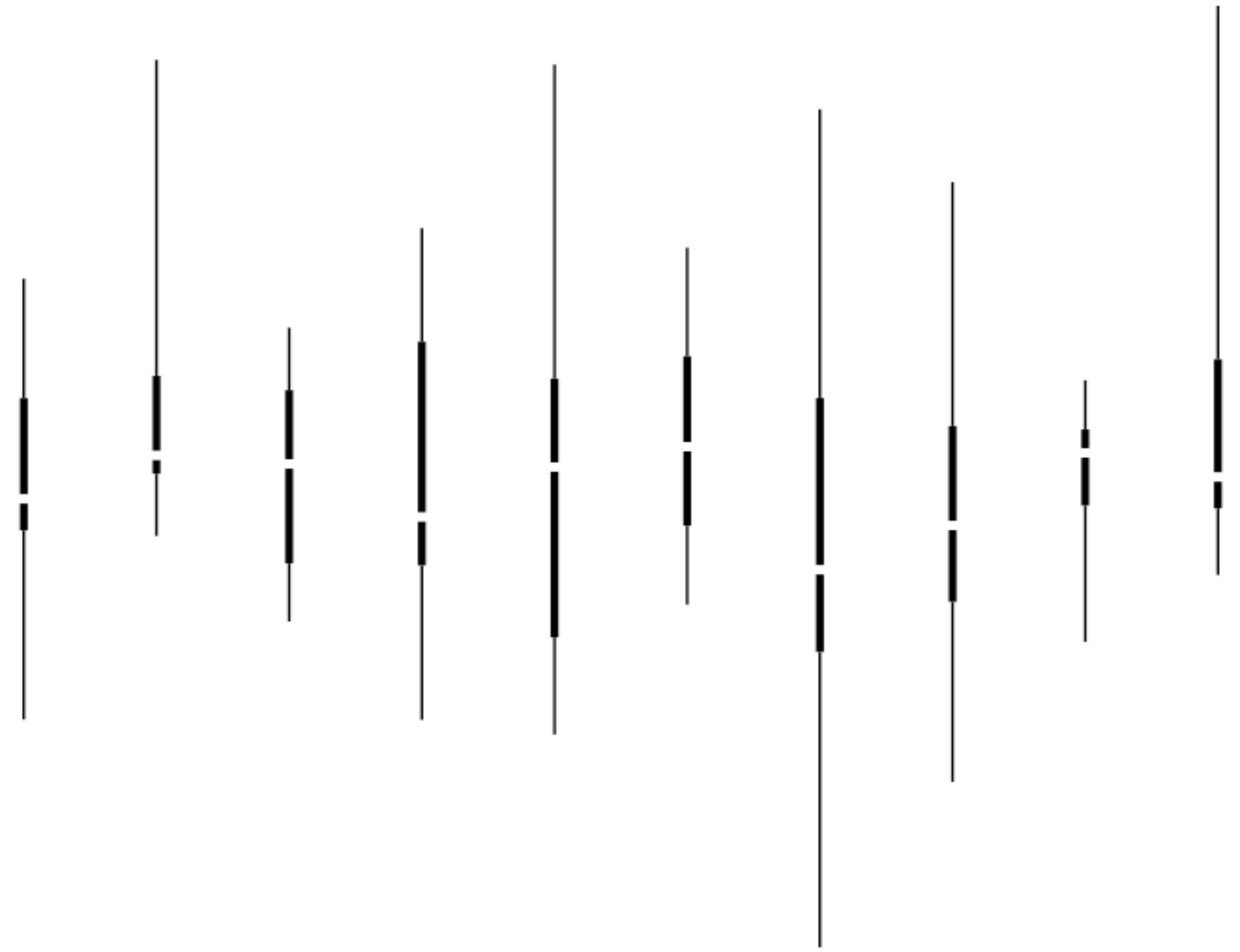
“In these revisions of the box plot, . . . the best overall arrangement naturally also rests on statistical and aesthetic criteria — in other words, the procedure is one of *reasonable* data-ink maximizing.”

— Tufte, Edward, *The Visual Display of Quantitative Information*

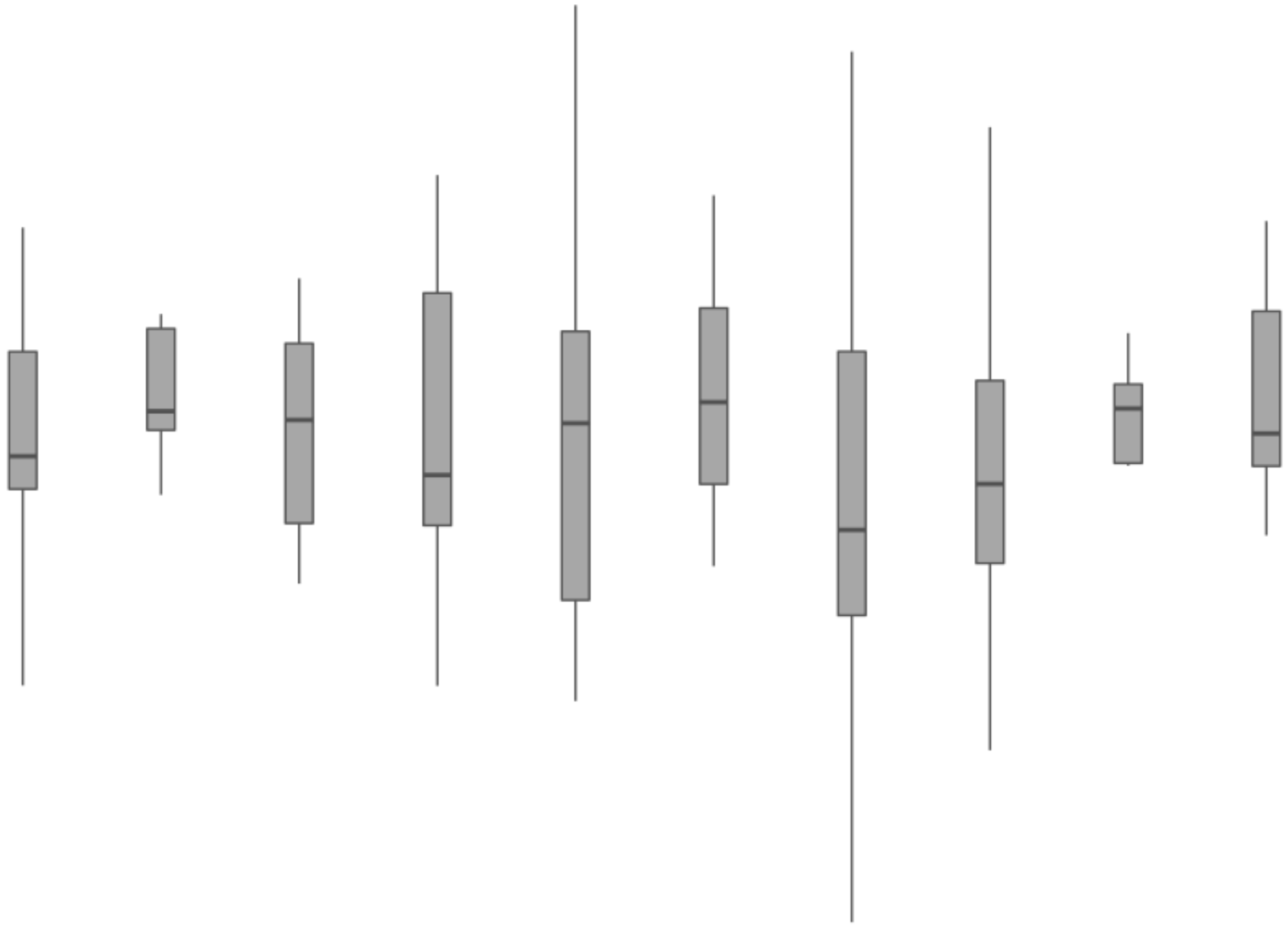
Doumont applied to data encoding, **experimentation** — redesigning John Tukey's box plot



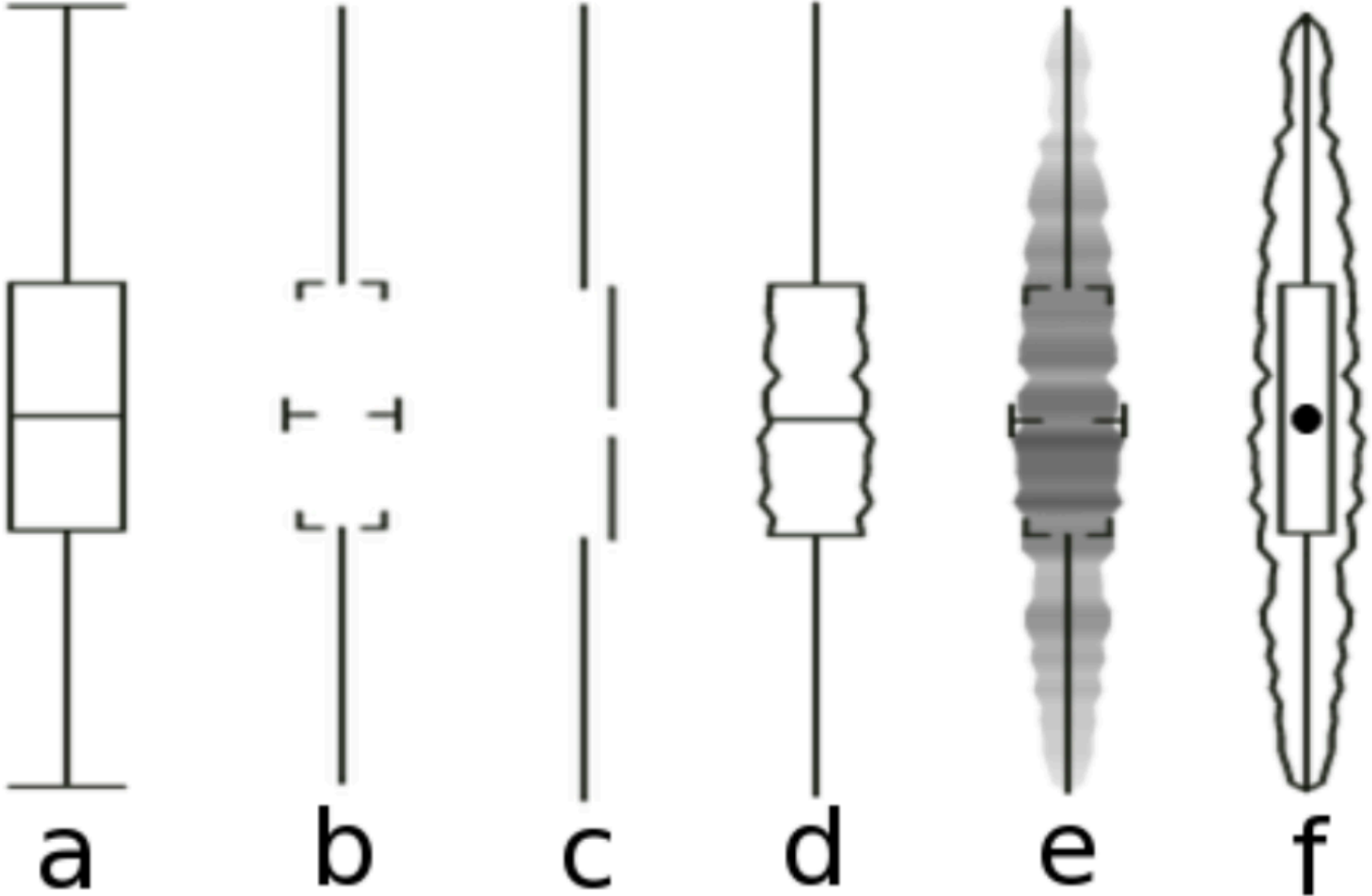
Doumont applied to data encoding, **experimentation** — redesigning John Tukey's box plot



Doumont applied to data encoding, **experimentation** — redesigning John Tukey's box plot



Doumont applied to data encoding, which works best? — *iterative process of creating, questioning, testing!*



One empirical experiment, asking participants to state data characteristics, given one of these randomized versions of the boxplots shown here, suggested that one of Tufte’s erasures (option C) was most cognitively difficult for viewers to interpret.

Cues like labels and gridlines, together with some strictly superfluous embellishment of data points or other design elements, may sometimes be an aid rather than an impediment to interpretation.

Adapt to your audience.

Doumont — “adapt to your audience”

Doumont applied to data encoding, **data-ink maximization** — **one of many design considerations**

“Maximizing data ink (within reason) **is but a single dimension of a complex and multivariate design task.**

The principle helps conduct
experiments in graphical design.

Some of those
experiments will succeed.

There remain, however, many **other considerations** in the design of statistical graphics — not only of efficiency, but also of **complexity, structure, density, and even beauty.**”

— Tufte, Edward, *The Visual Display of Quantitative Information*

Doumont applied to data encoding, which works best? — *iterative process of creating, questioning, testing!*

**Prototypes should
emphasize speed over polish.**

Design is a search problem

**Get fresh eyes frequently.
Invite criticism.**

**Move from
exploring to refining.**

Doumont applied to data encoding, which works best? — iterative process of creating, questioning, testing!

SECTIONS
HOME
SEARCH

The New York Times

Account
Settings



Joe Biden, in Video, Says He Will Be 'More Mindful' of Personal Space



Senate Republicans Go 'Nuclear' to Speed Trump Confirmations

Subpoena for Mueller Report and Documents Approved by House Judiciary Committee



House Intelligence Committee Seeks Documents From Trump's Inaugural

In Rare S...
Leader S...

POLITICS | ONE-PARTY RULE SHARE

Taking the Battle to the States

By HAEYOUN PARK, JEREMY ASHKENAS and MIKE BOSTOCK JAN. 11, 2014

Republicans or Democrats have single-party control of both the legislature and the governor's office in 36 states, the most in six decades. Lawmakers in these states have been seeking to reshape government policy in recent years, from legalizing same-sex marriage to restricting labor unions. Some of these laws were passed after the rapid rise of single-party control in 2010; others have been in place for years. Below is a look at where states stand on some key issues.



88 million people live in states with **Democratic** control of both legislatures and the governor's office.

69 million people live in states with **mixed** control.

157 million people live in states with **Republican** control.

Did not pass new restrictions in 2013



Abortion

Twenty-two states — all but six controlled by Republicans — enacted 70 abortion restrictions in 2013, according to the Guttmacher Institute, a research group. Laws ranged from bans on abortions 20 weeks after fertilization to limitations on insurance coverage of abortions.

Passed new restrictions in 2013



Expanded Medicaid



Medicaid

A 2012 Supreme Court decision allowed states to decide whether to expand Medicaid to more low-income adults under the Affordable Care Act. All 13 Democratic states have expanded the program. Most Republican states did not. Pennsylvania, Indiana and Tennessee have not expanded it but may do so.

Have not expanded at this time



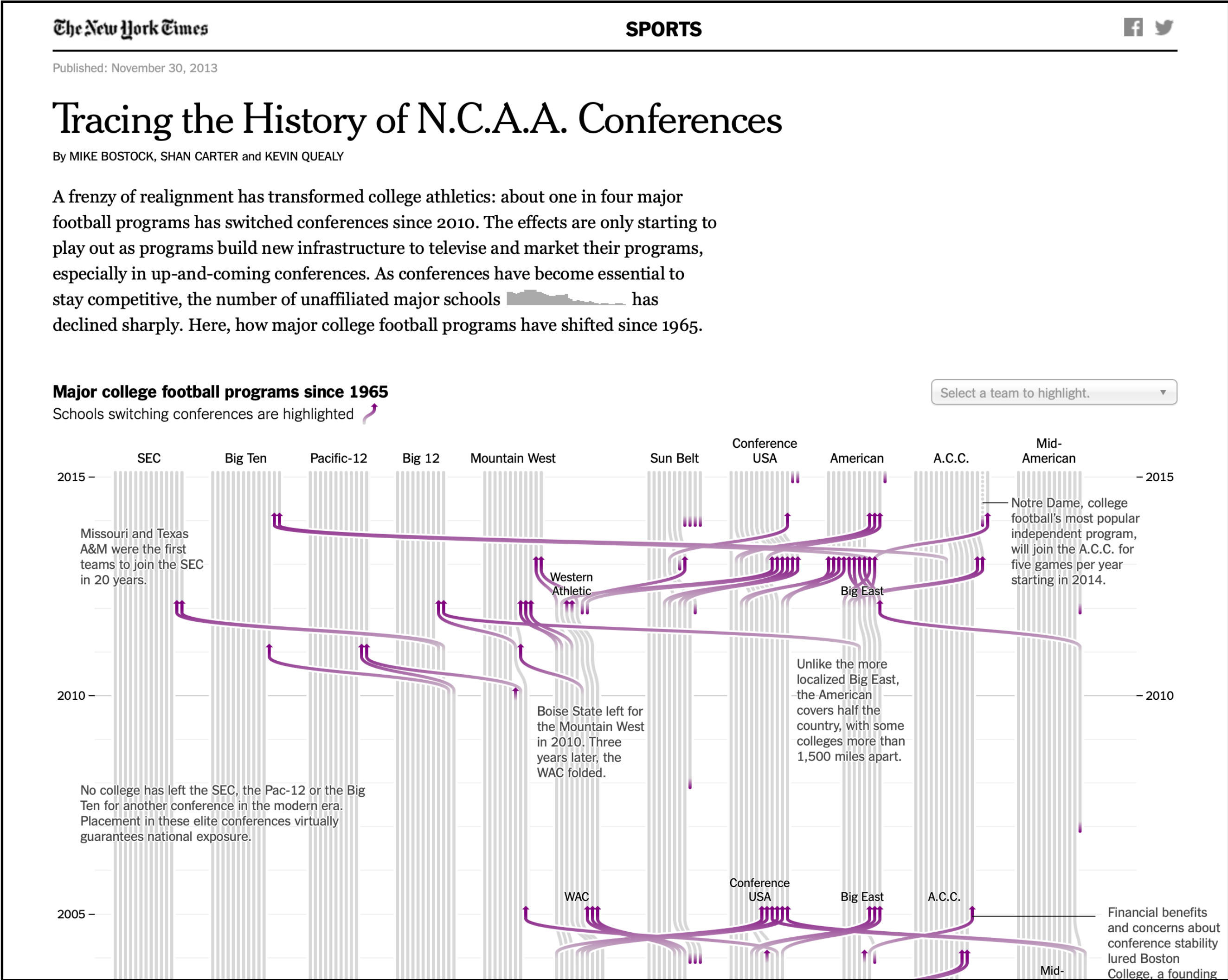
© 2021 Scott Spencer / <https://ssp3nc3r.github.io> scott.spencer@columbia.edu

28

Doumont applied to data encoding, which works best? — *iterative process of creating, questioning, testing!*



Doumont applied to data encoding, which works best? — iterative process of creating, questioning, testing!



Doumont applied to data encoding, which works best? — *iterative process of creating, questioning, testing!*



from exploring to explaining

Get our audience(s) to

**pay attention to,
understand,
(be able to) act upon**



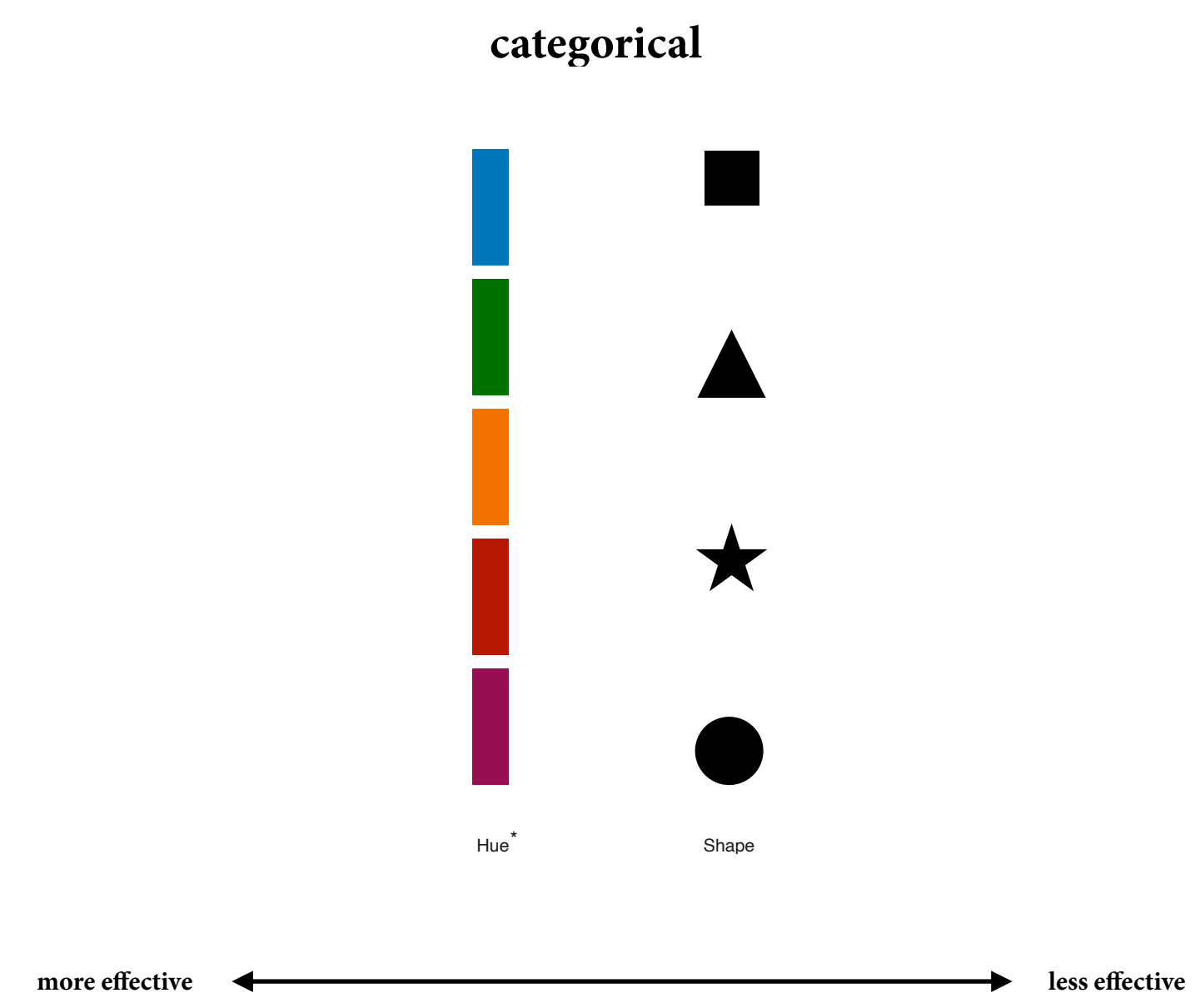
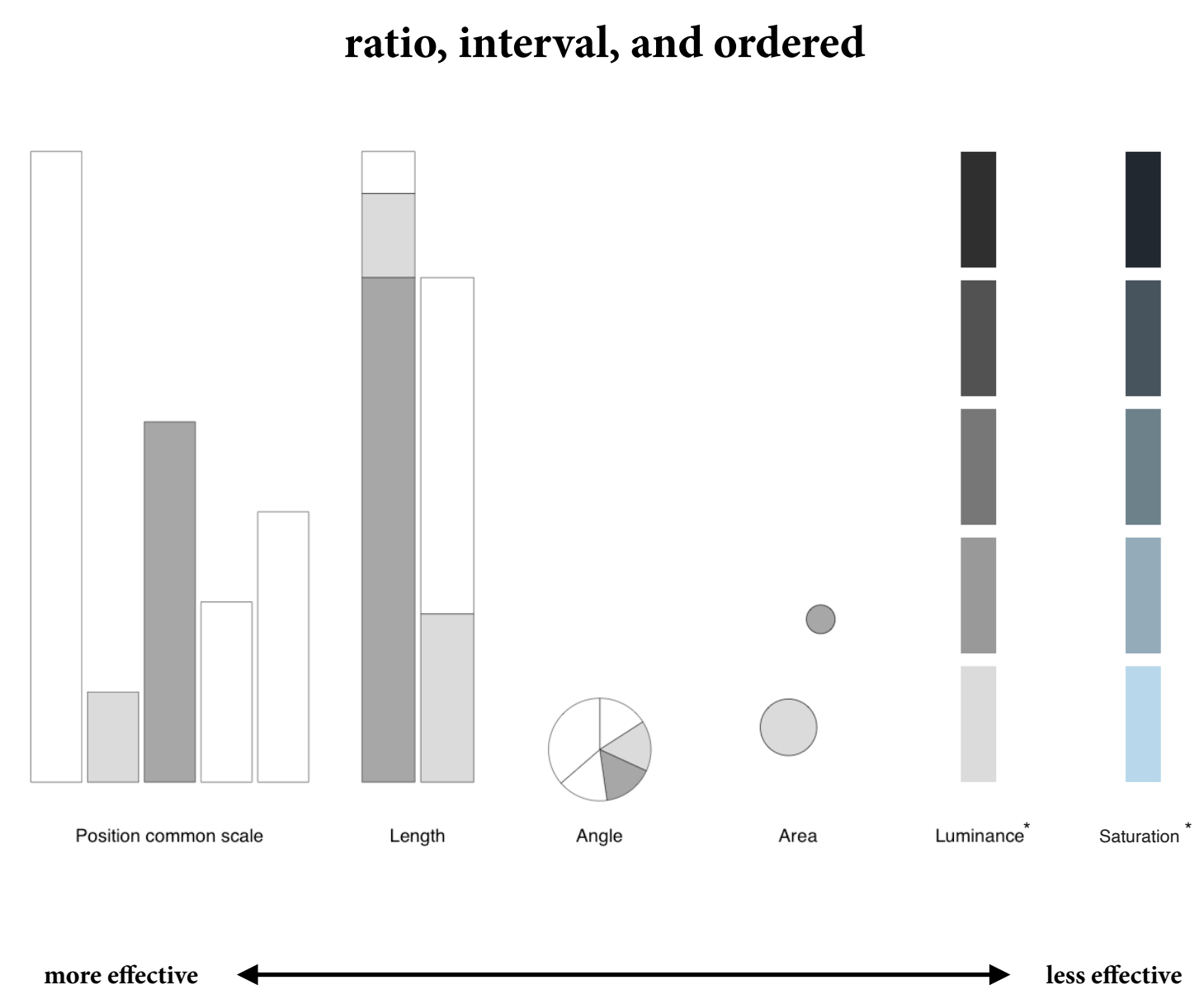
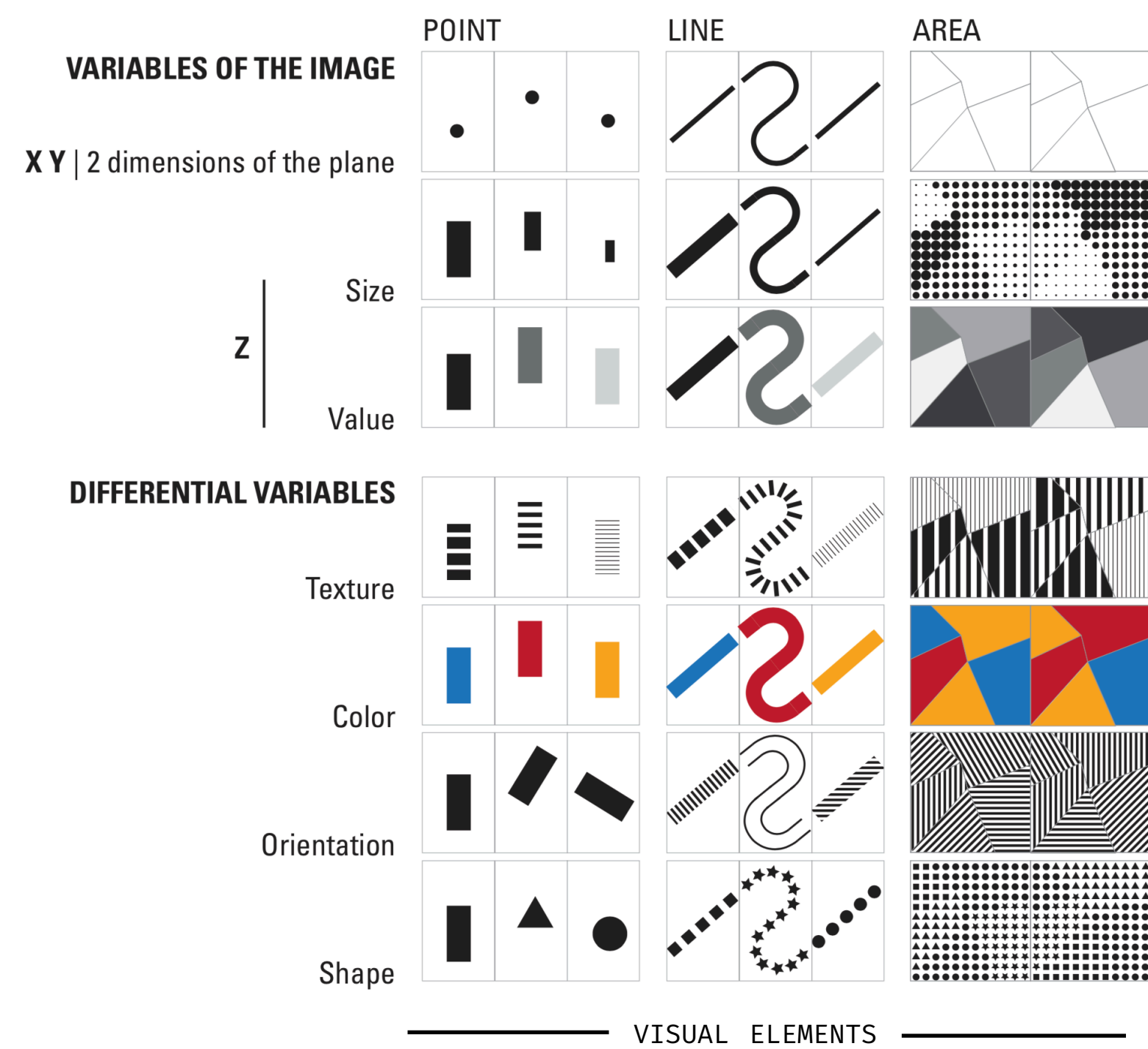
**a maximum of messages,
given constraints.**

We worked with IR.

We worked with IR. IR stands for Information Resources and is a new department.

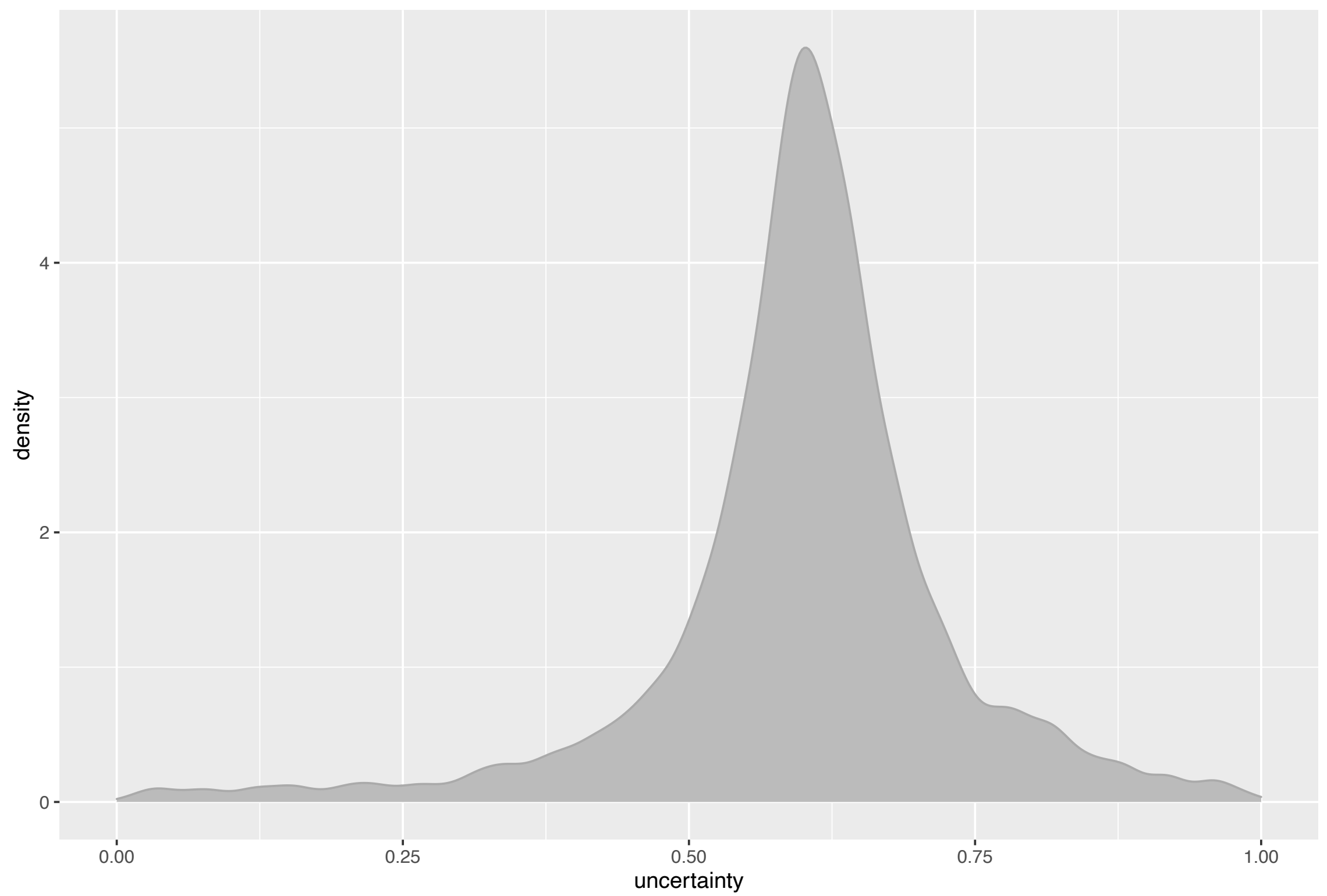
We worked with the recently launched Information Resources (IR) department to ...

exploring to explaining, *adapting to your audience* — first, optimize encodings for a communication purpose

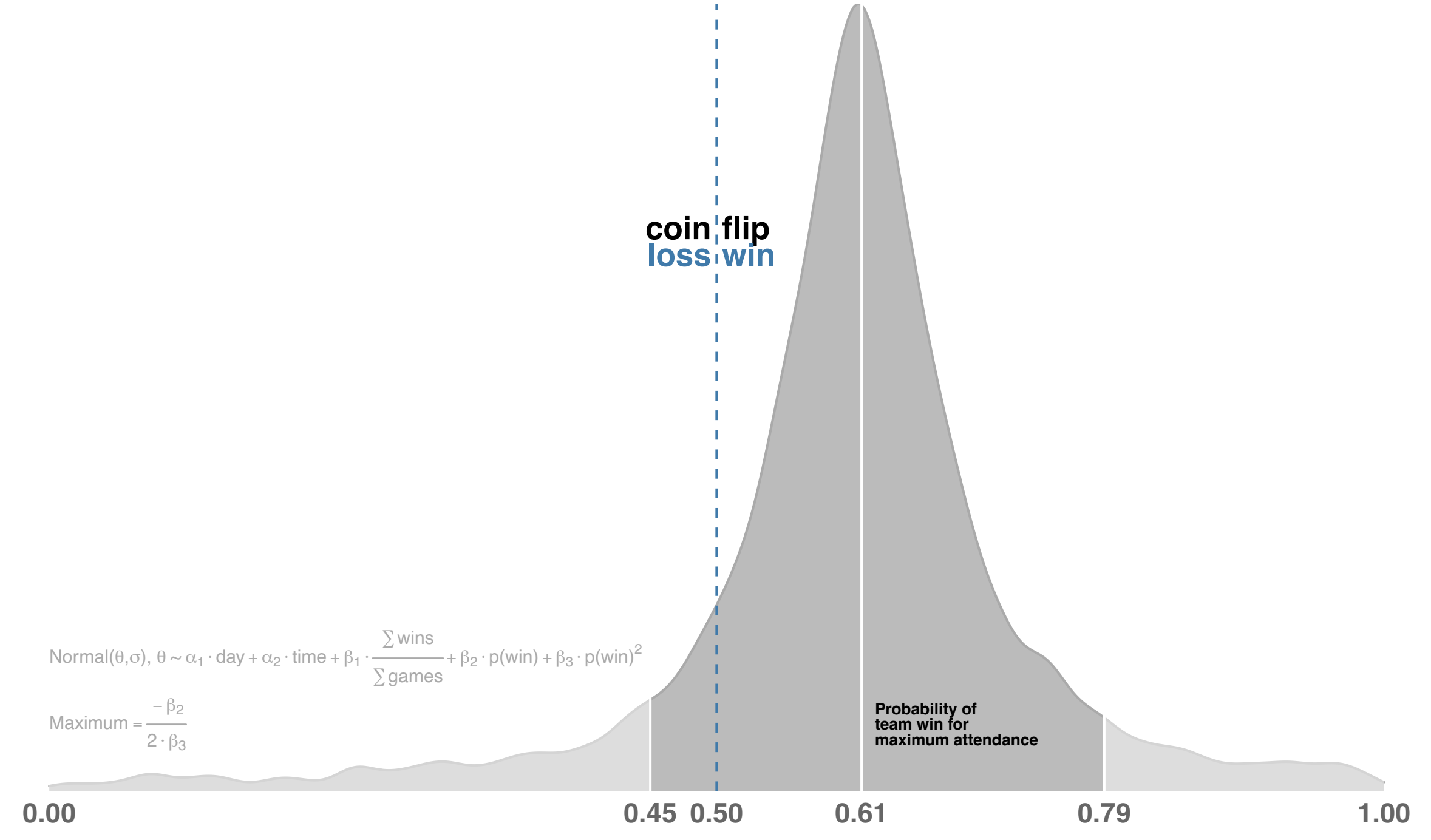


Once data-to-visual encodings have been optimized for showing the intended comparison or trend of interest to our audience, we should generally *adapt it to our audience by explaining*, not by changing optimized encodings.

exploring to explaining, **titles**, as an overall graphics annotation, should explain the point of the graphics



More fans generally pay admission to our games when the chance of winning was near a median of 0.61.
Fans want favorable odds without predicting the outcome.

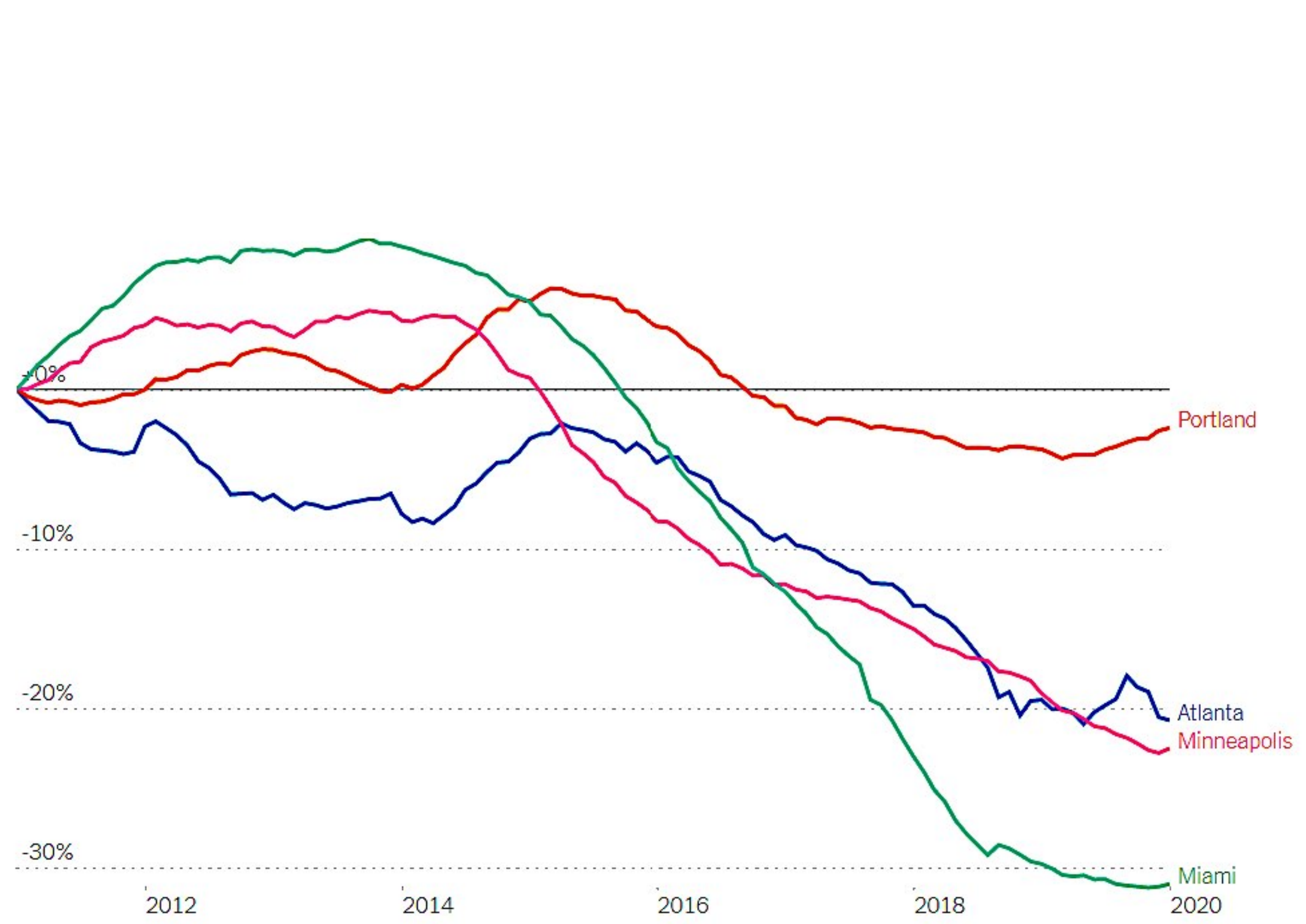
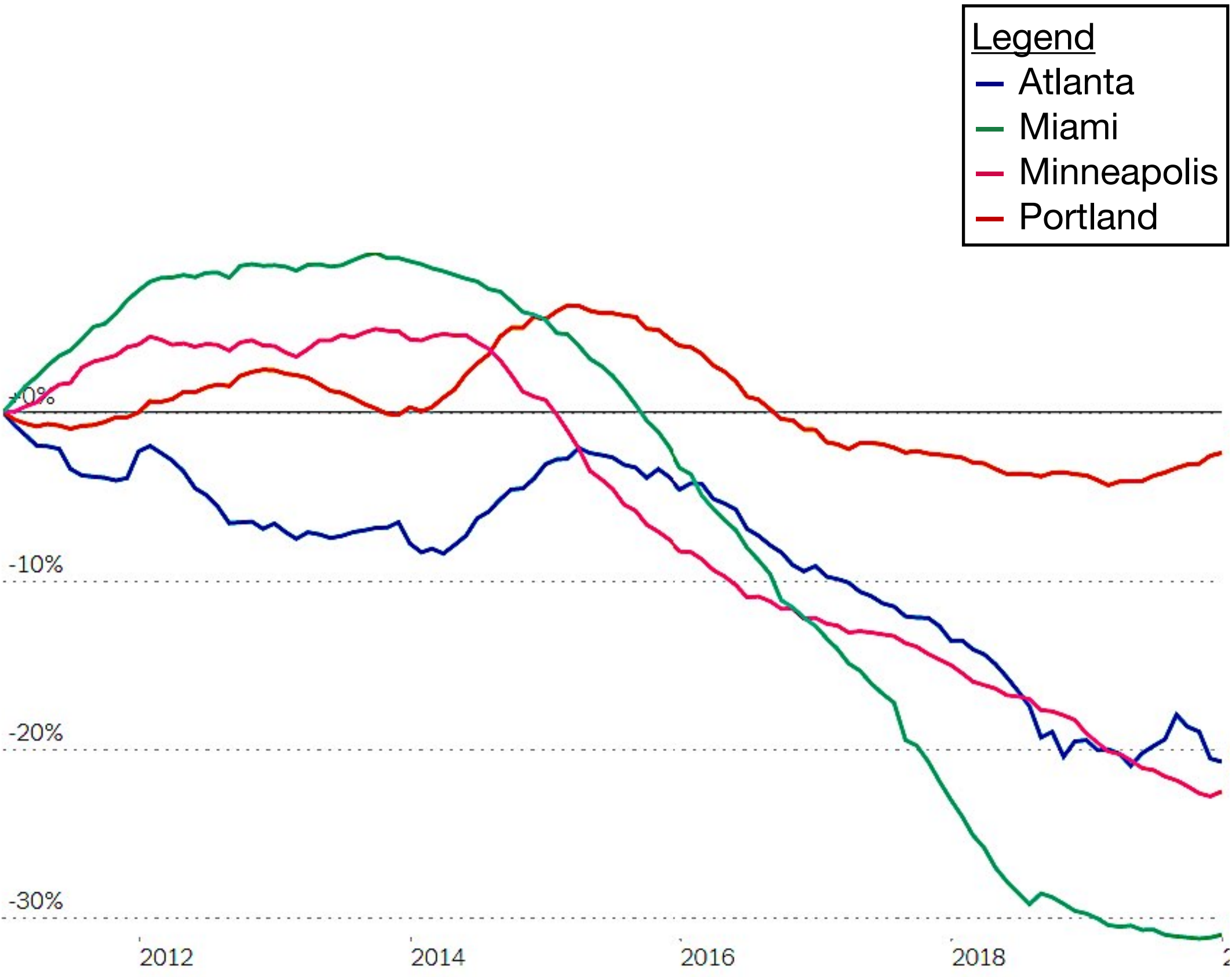


$$\text{Normal}(\theta, \sigma), \theta \sim \alpha_1 \cdot \text{day} + \alpha_2 \cdot \text{time} + \beta_1 \cdot \frac{\sum \text{wins}}{\sum \text{games}} + \beta_2 \cdot p(\text{win}) + \beta_3 \cdot p(\text{win})^2$$

$$\text{Maximum} = \frac{-\beta_2}{2 \cdot \beta_3}$$

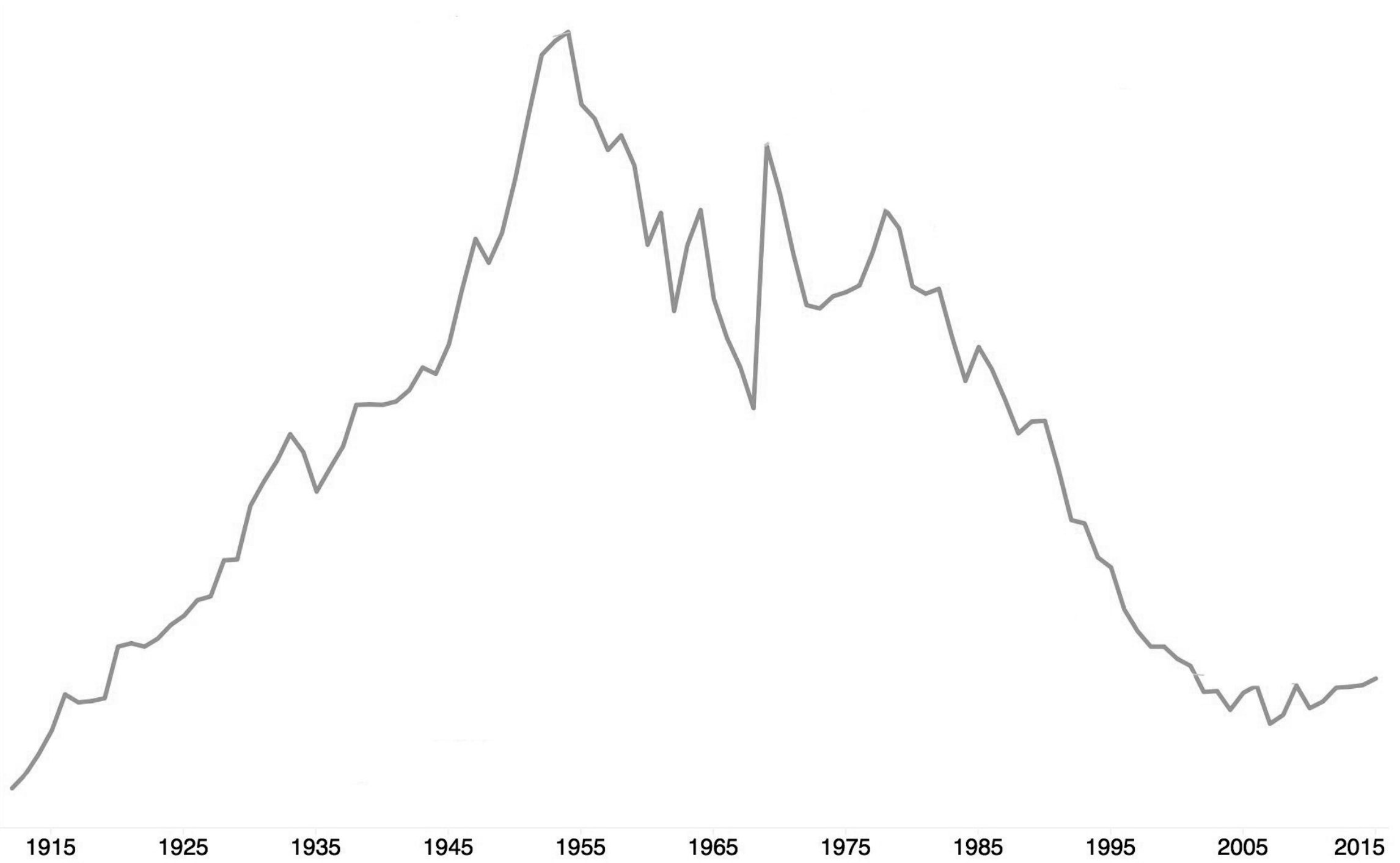
Sources: Pinnacle betting data, 2016; Retrosheet Gamelogs, 2016

exploring to explaining, replacing legends with direct data labeling reduces cognitive load



exploring to explaining, **annotations** go beyond labels, they can help *explain* and *compare* with *context*

These are tiny paragraphs that explain thing one or thing two.

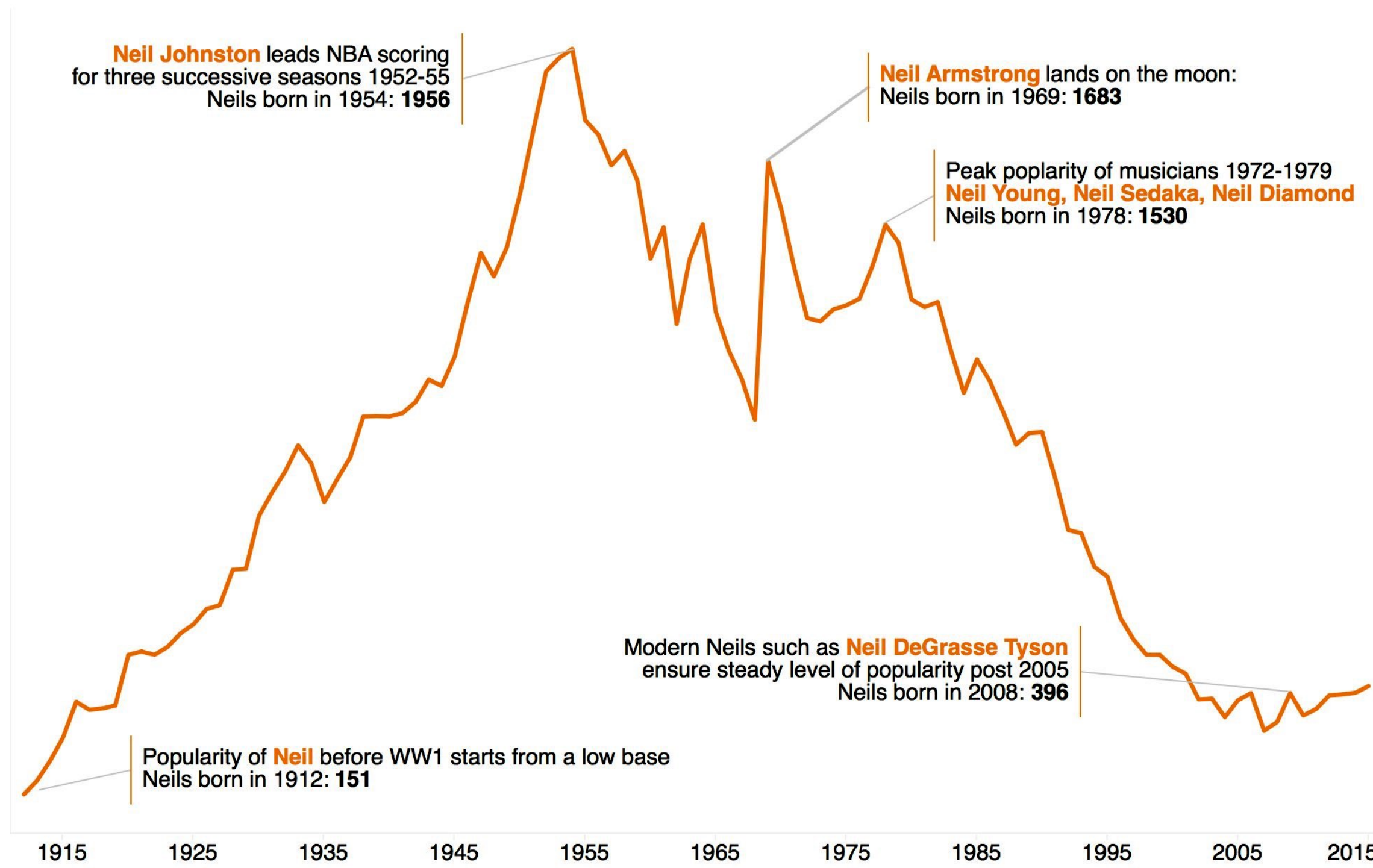


Visualisation: @theneilreichards

#SWDChallenge

Rise and Fall of the name **Neil** in the USA Births 1912-2015

Source: data.gov



Visualisation: @theneilreichards

#SWDChallenge

exploring to explaining, annotations *as important as* data encodings

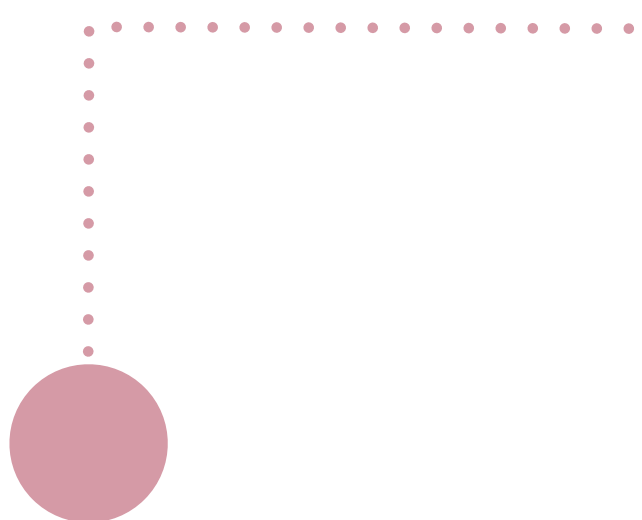
“The **annotation** layer is the *most important thing* we do ... otherwise it’s a case of ‘here it is, you go figure it out.’

— Amanda Cox, the Data Editor at the *New York Times*



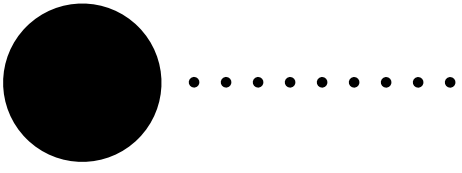
“Although our primary focus on creating a visualization is the graphic elements—bars, points, or lines—the **text we include in and around our graphs** is *just as important*.”

— Jonathan Schwabish, *Better Data Visualizations*



“**Annotations** are of *vital importance*. Often overlooked, **annotations** are one of the best ways to make a chart understandable to an audience. Underutilized in many data visualizations, **annotations** are the ideal way to highlight exactly those things that you, as the creator, want the audience to pay attention to.”

— Shirley Wu, *Data Sketches*

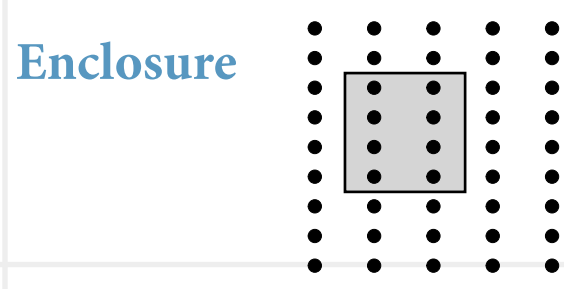
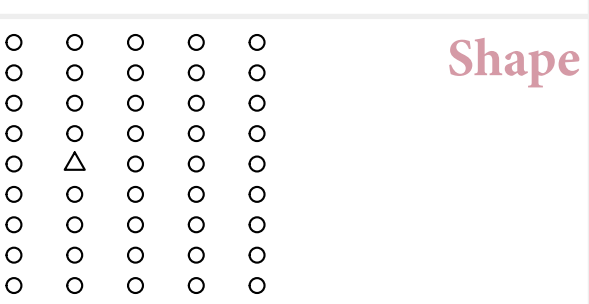
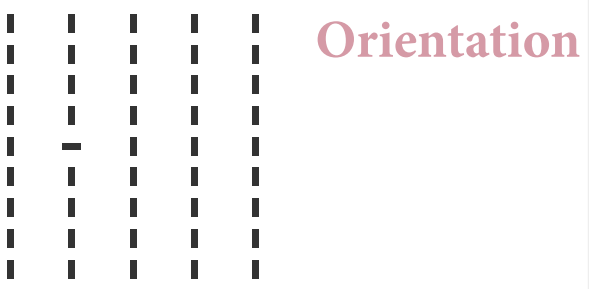


exploring to explaining, (**focus**) our audience on explained, visual encodings

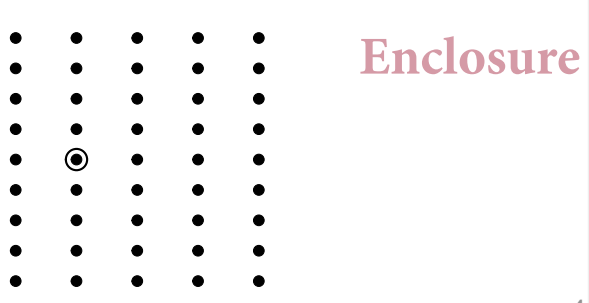
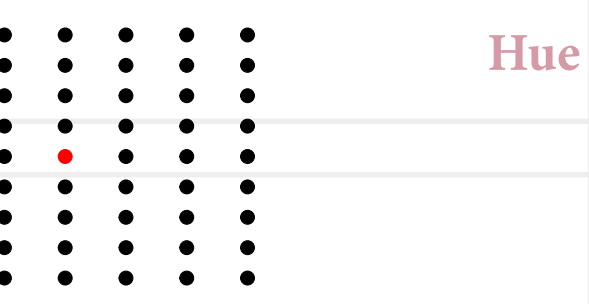
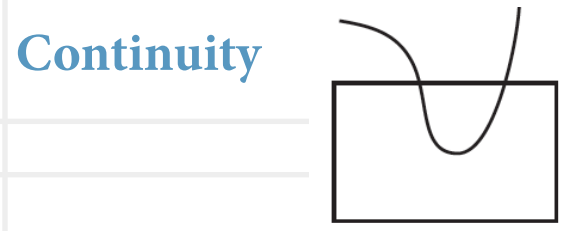
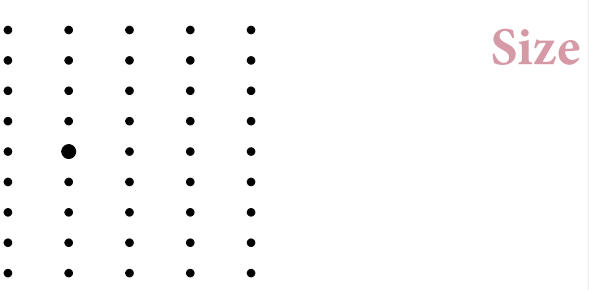
remove clutter | **start with** gray

**mini-design review *continued* —
layering for information hierarchy**

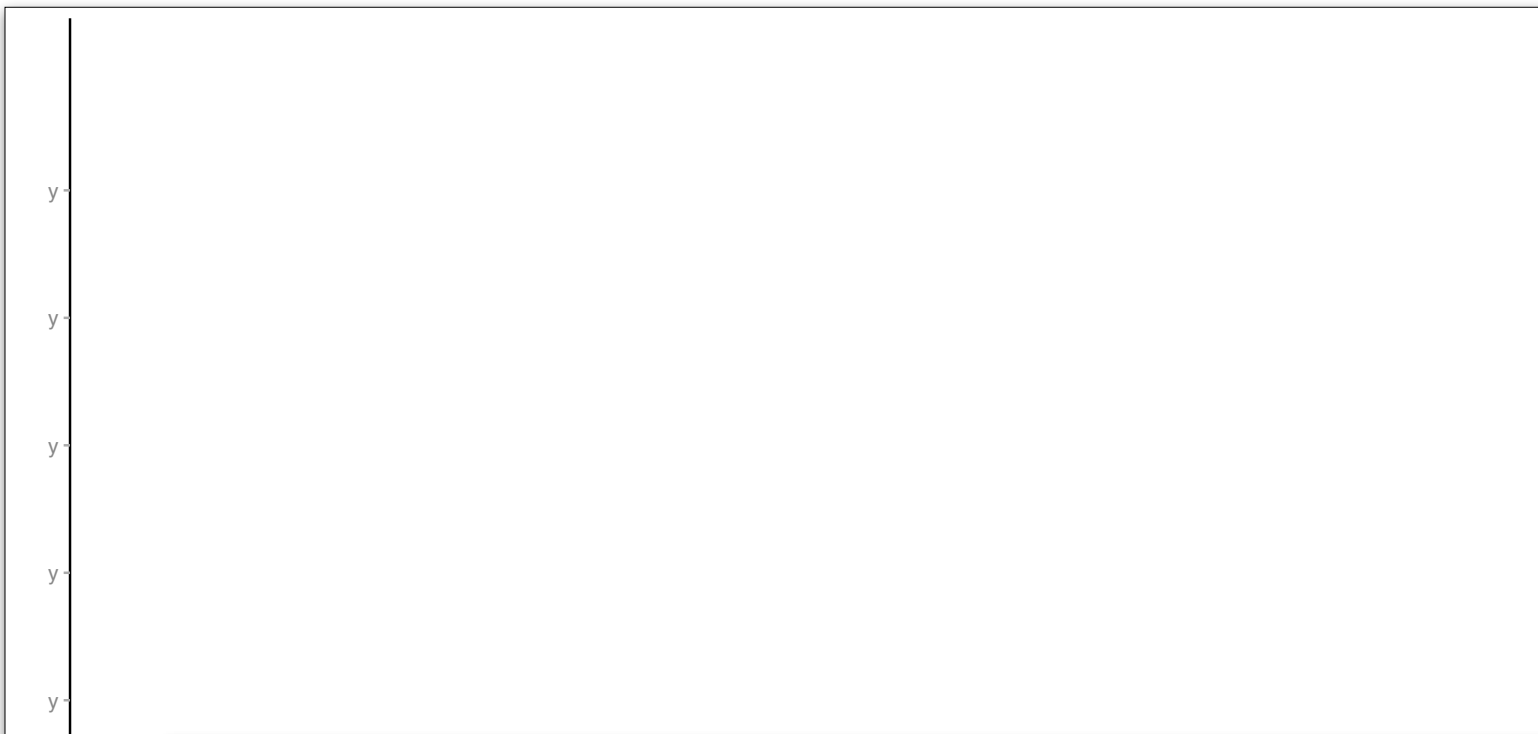
design mini-review



grids, Gestalt principles, and preattentive attributes may be combined



design mini-review | layer the graphic, encode visual channels, annotate, and make hierarchies clear



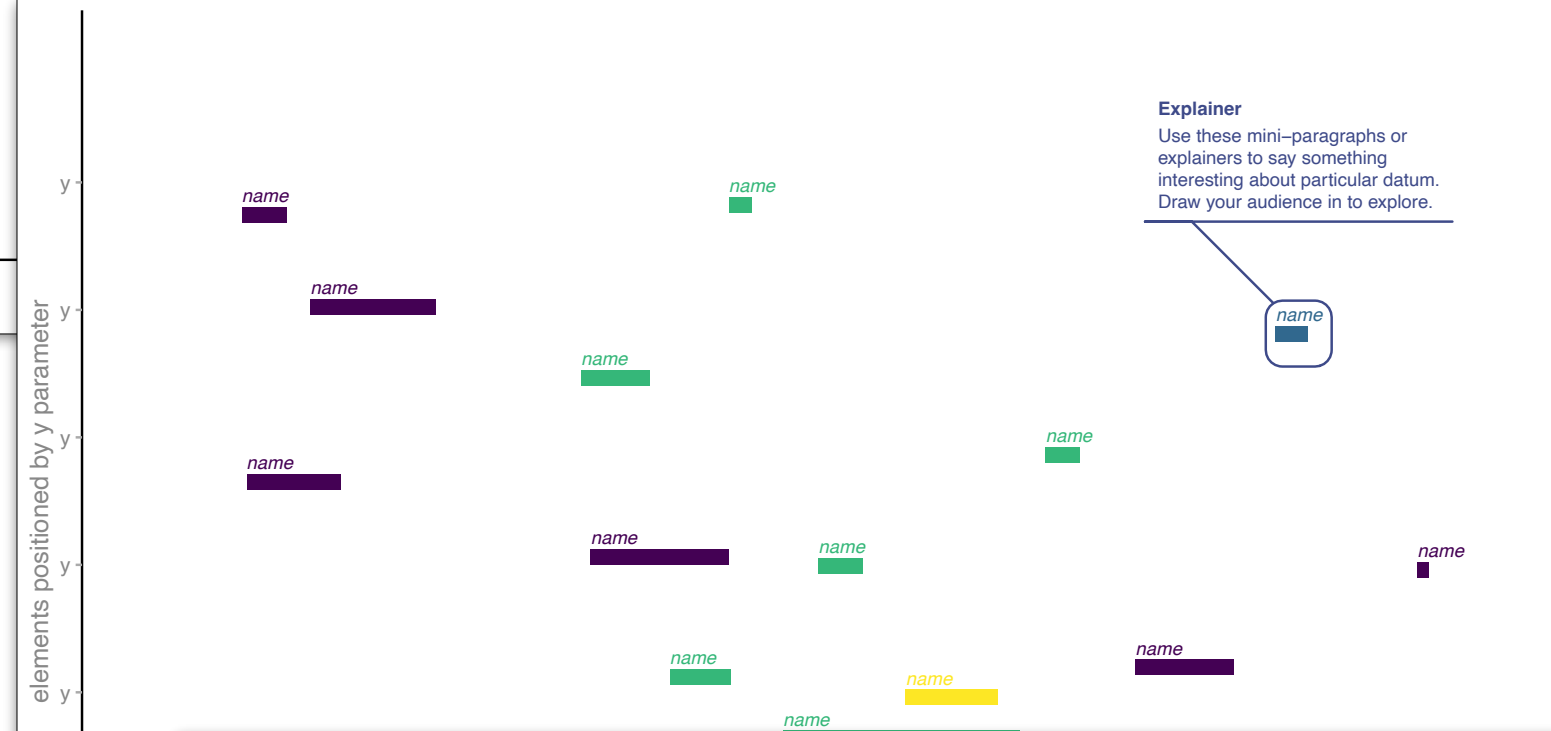
Determine appropriate scaled axes for the data architecture.



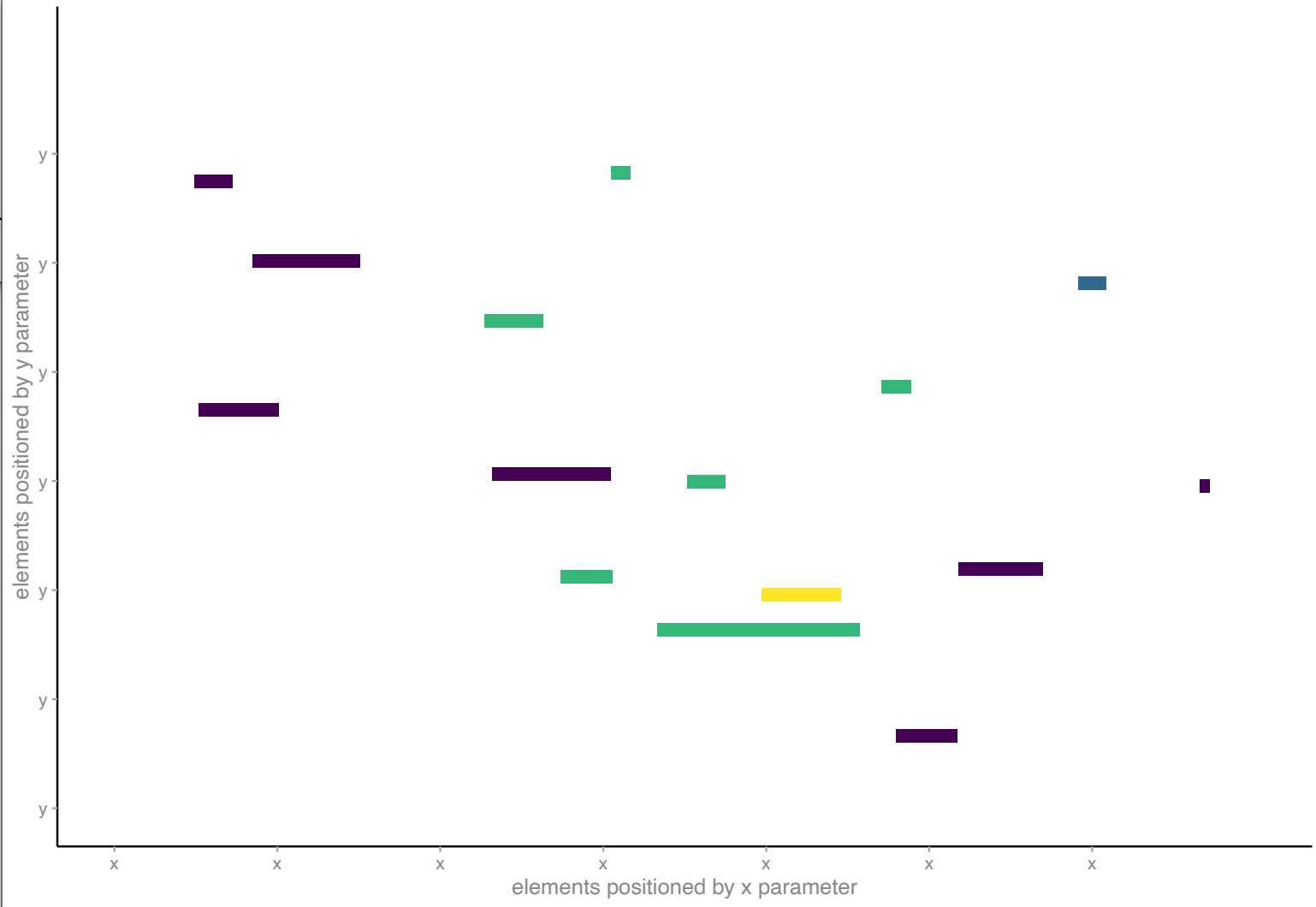
Label elements important to your narrative and audience.



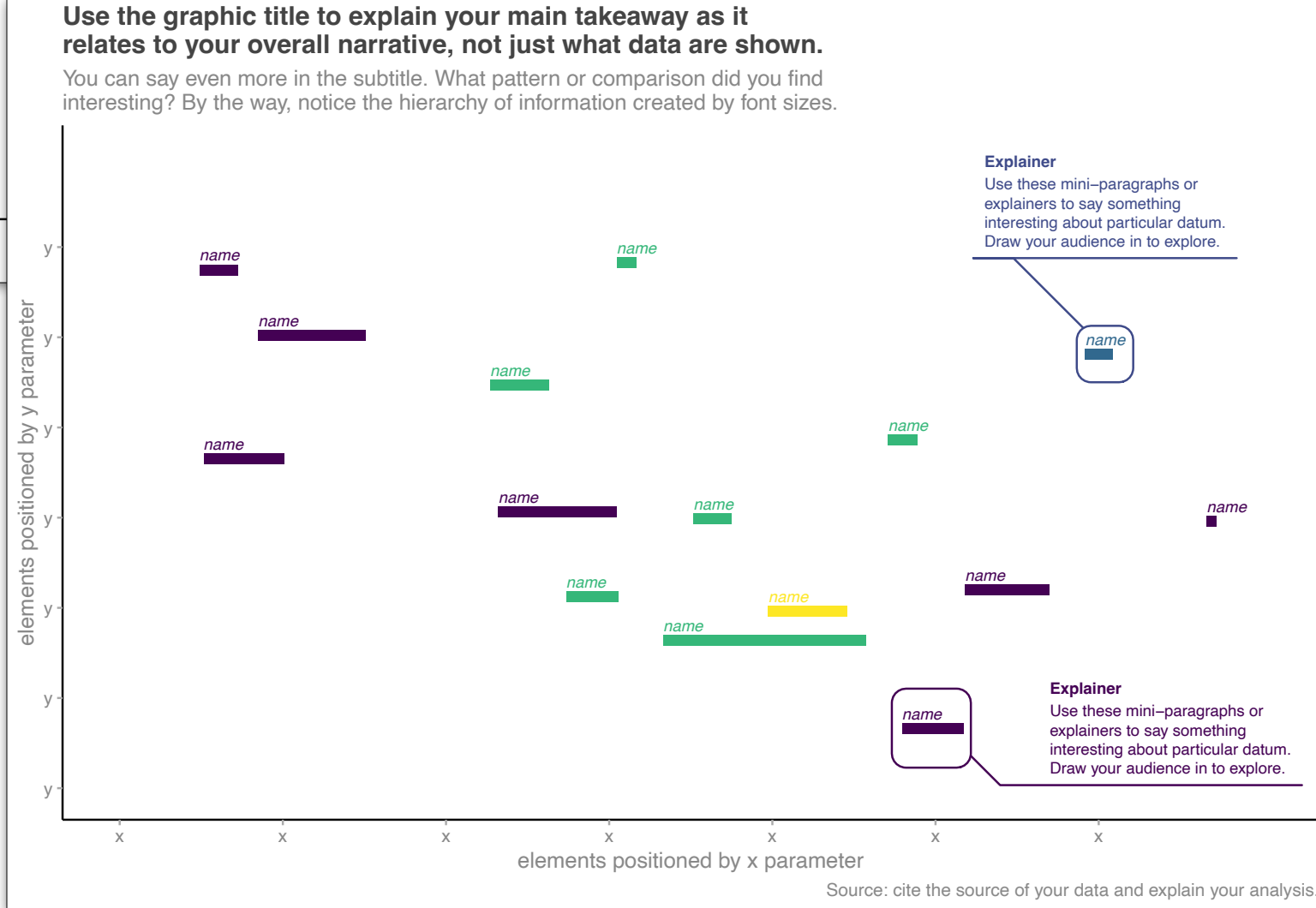
From data, position single elements within the chosen scaled axes.



Add explainers of interesting data, comparisons, and reference points.



Use remaining visual channels and attributes to encode data variables at their coordinate positions.



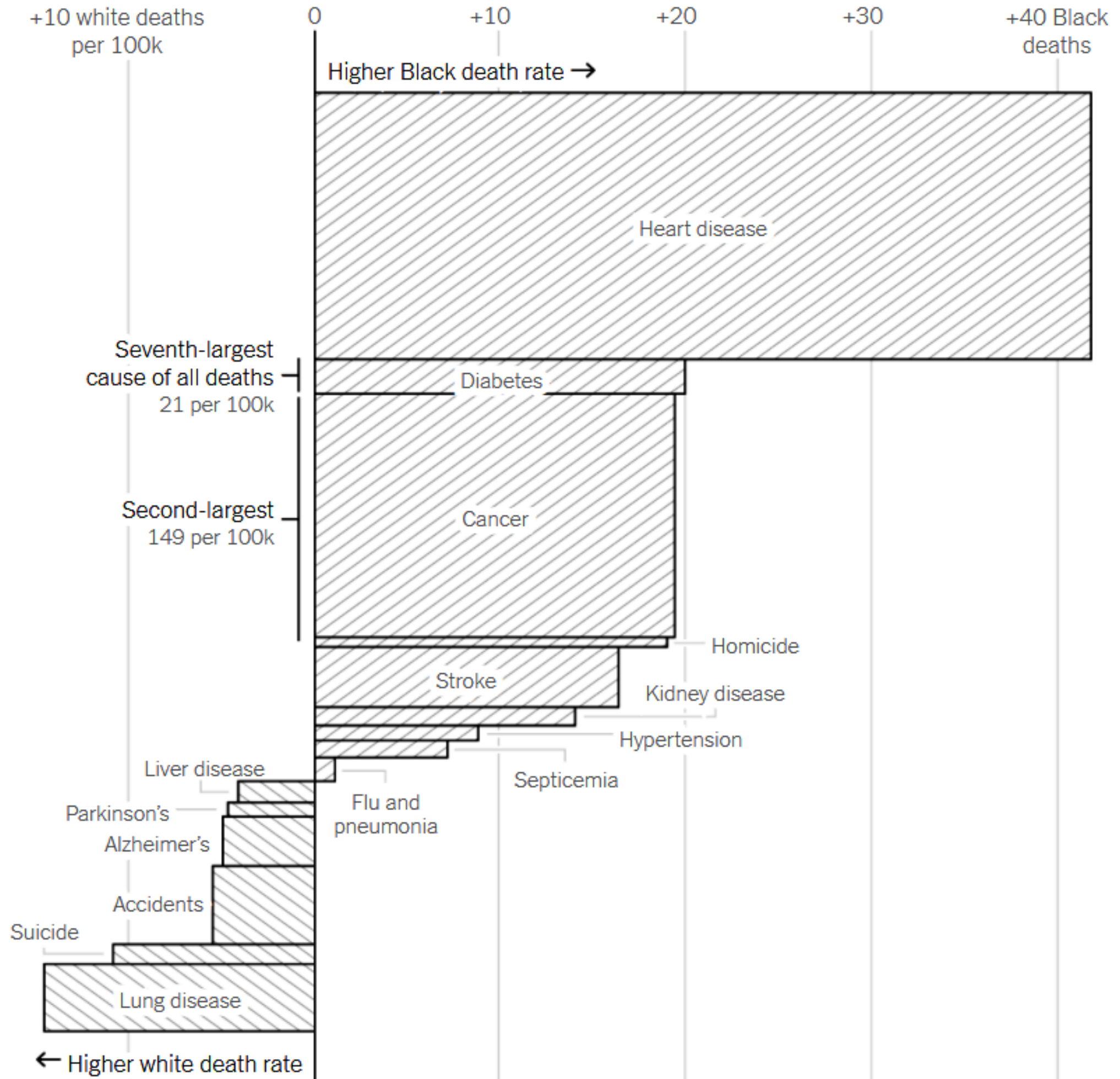
Finish the hierarchy with insights and messages in title, cite sources, other details, like how to read the graphic.

Lighten or color elements gray that add context but aren't the message focus.

audiences understand graphic complexity — once you explain!

explain for audience, external or general audiences *can understand* complex graphics, *with guidance*

Gaps between Black and white mortality rates for the top 15 causes of death



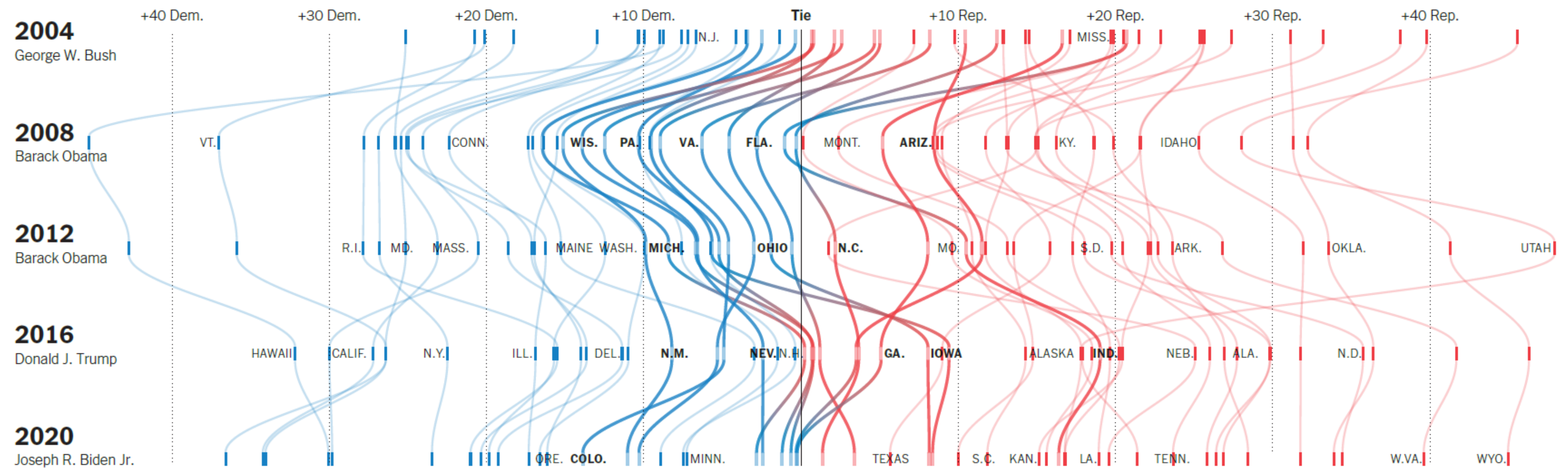
Note: For non-Hispanic Black and white people in 2018. Rates have been adjusted for age and sex. Source: Centers for Disease Control and Prevention

with guidance

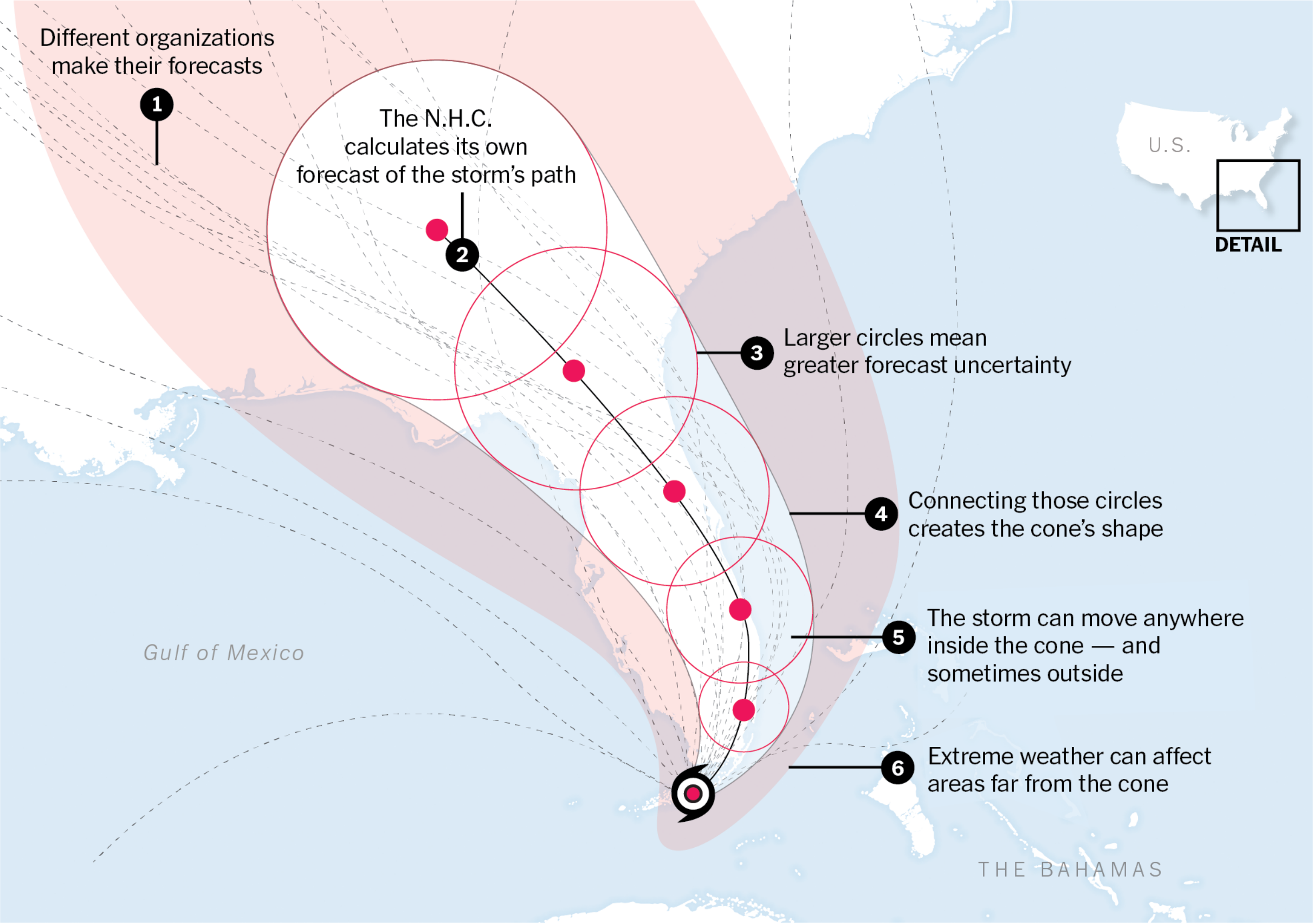
Wezerek, Gus. "Racism's Hidden Toll." *The New York Times*, August 11, 2020, sec. Opinion. <https://www.nytimes.com/interactive/2020/08/11/opinion/us-coronavirus-black-mortality.html>.

explain for audience, external or general audiences *can understand* complex graphics, *with guidance*

with guidance
Lu, Denise, and Karen Yourish. "How Did Trump Do in Counties That Backed Him in 2016?" *The New York Times*, November 11, 2020, sec. Politics. <https://www.nytimes.com/interactive/2020/11/09/us/politics/2016-election-trump-counties.html>.



explain for audience, external or general audiences *can understand* complex graphics, *with guidance*



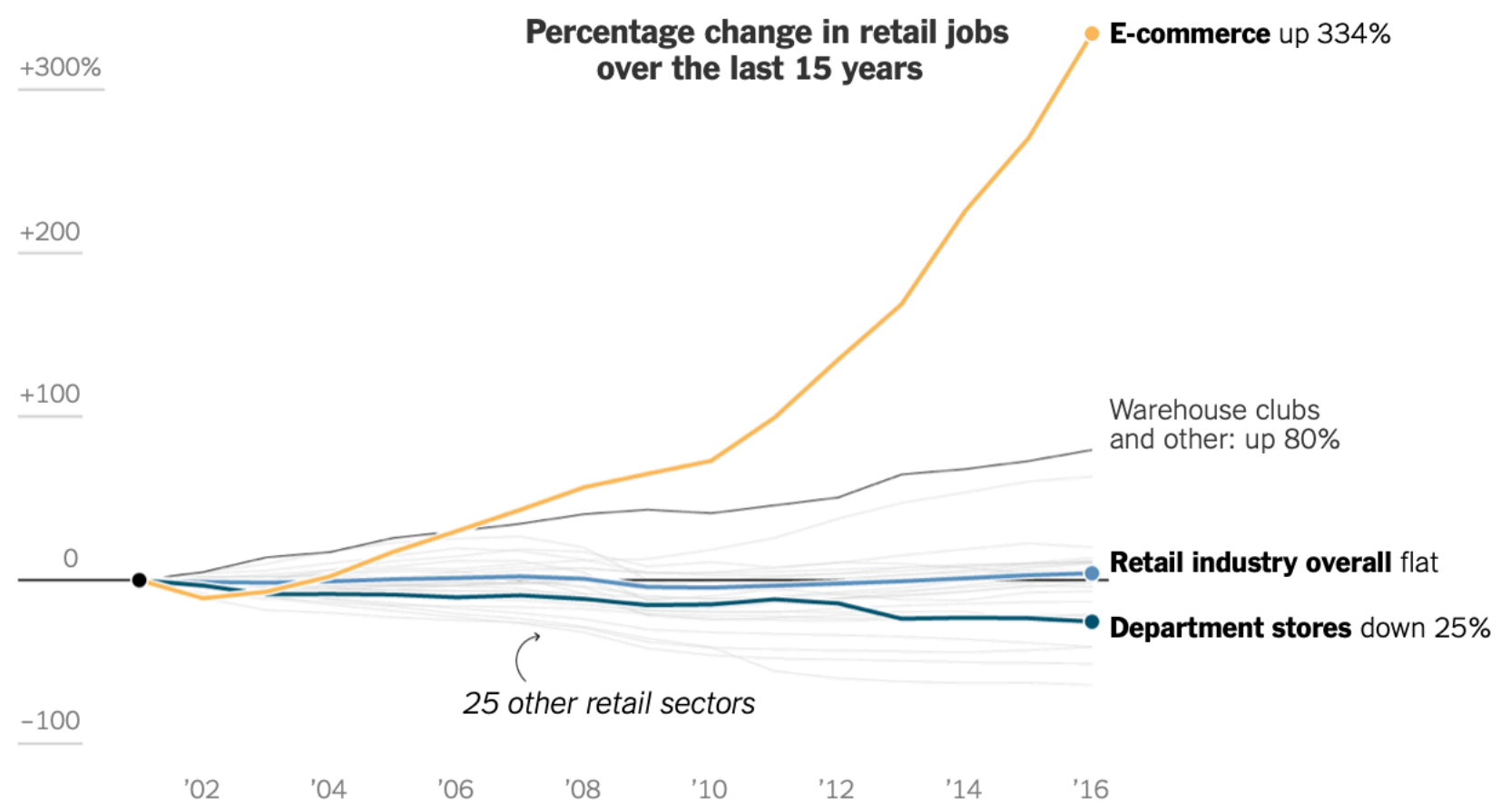
with guidance

Cairo, Alberto, and Tala Schlossberg. “Those Hurricane Maps Don’t Mean What You Think They Mean.” *The New York Times*, March 10, 2019, sec. Opinion. <https://www.nytimes.com/interactive/2019/08/29/opinion/hurricane-dorian-forecast-map.html>.

explain for audience, external or general audiences *can understand* complex graphics, *with guidance*

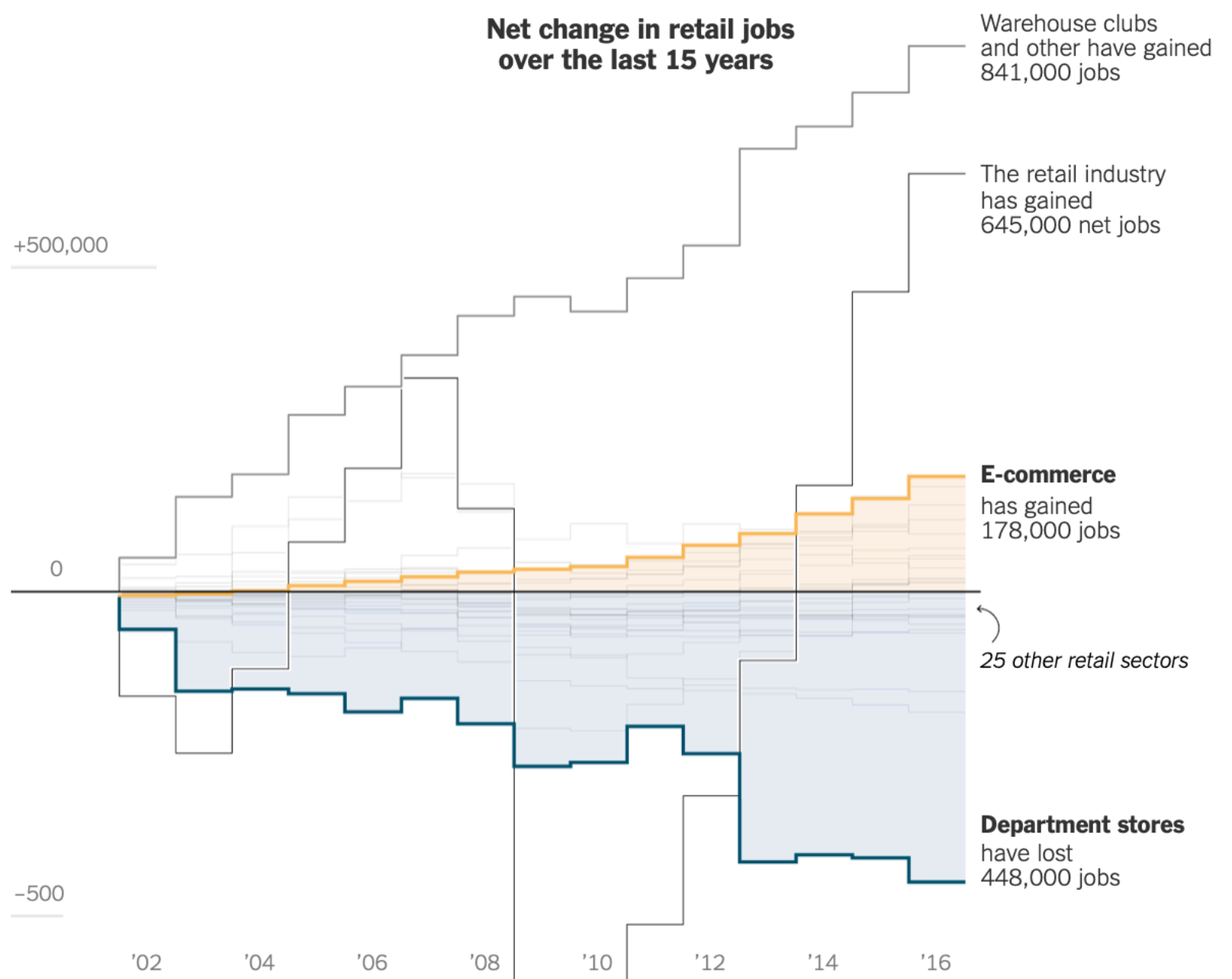
E-commerce jobs are growing fast ...

Employment attributed to electronic shopping firms has doubled in the last five years, outpacing other types of retail.



... but they are still a small component of overall retail employment ...

Even with the fast growth, the number of online shopping jobs is small compared with department stores, warehouse clubs and grocery stores.



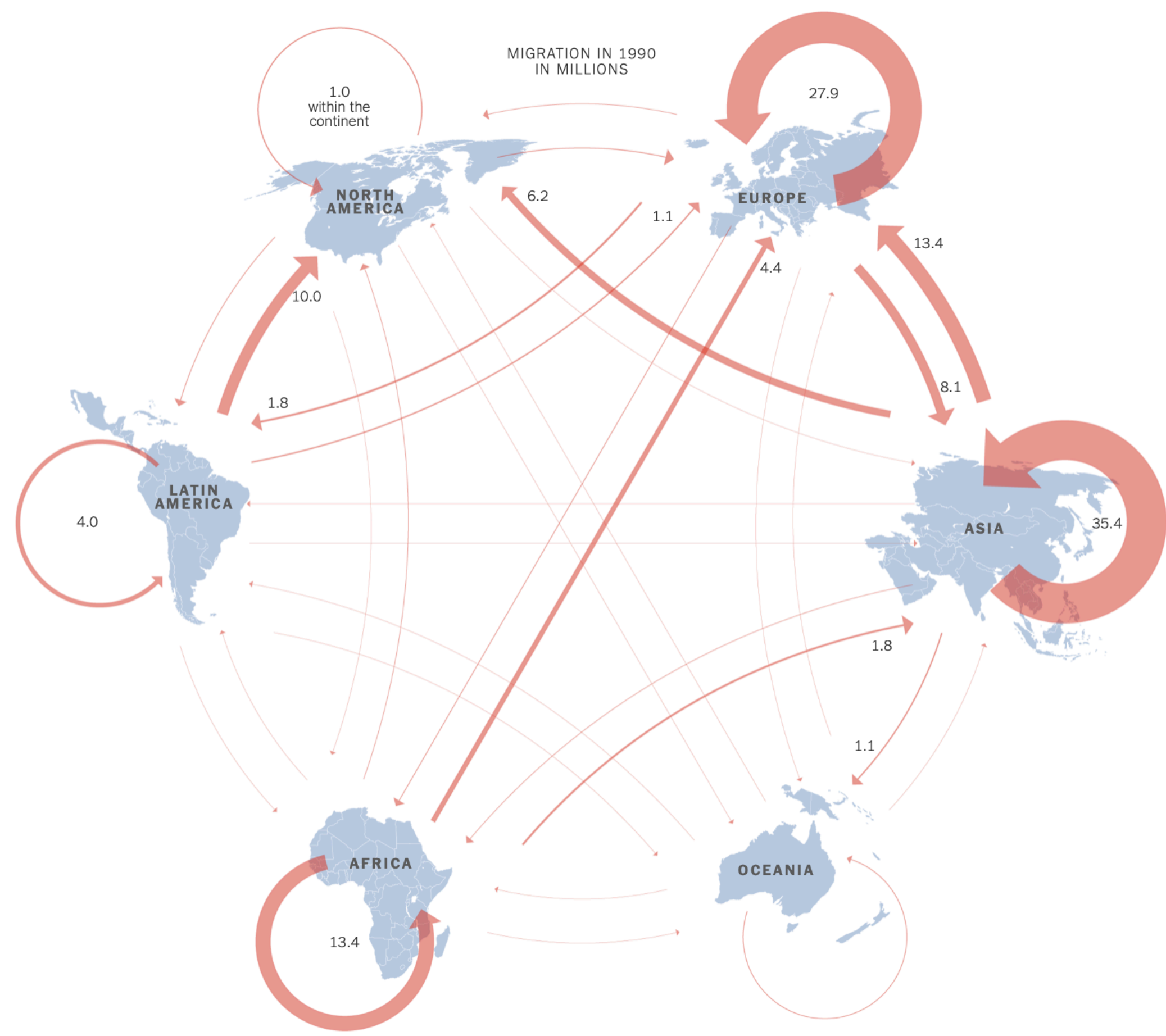
with guidance

Bebeloff, Robert, and Karl Russell. "How the Growth of E-Commerce Is Shifting Retail Jobs." *The New York Times*, July 6, 2017, sec. Business. <https://www.nytimes.com/interactive/2017/07/06/business/ecommerce-retail-jobs.html>.

... partly because e-commerce is less labor intensive.

explain for audience, external or general audiences *can understand* complex graphics, *with guidance*

The flow of migration varies around the world



Largest diaspora populations in 1990 in millions

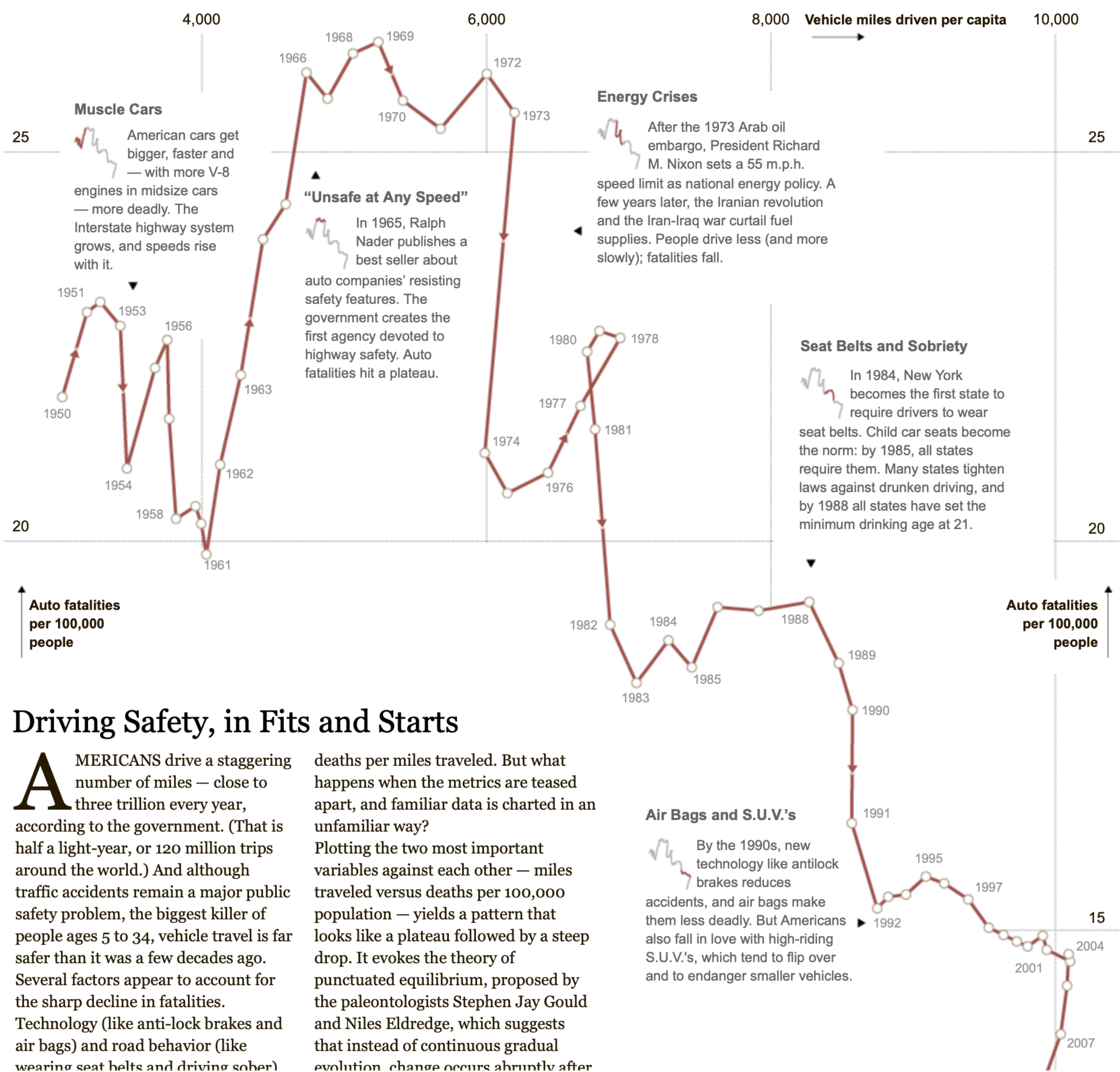
1. Russia	12.7	6. Mexico	4.4	11. Germany	3.3	16. Portugal	1.9	21. Indonesia	1.6	26. Iraq	1.5
2. Afghanistan	6.7	7. China	4.2	12. Kazakhstan	3.0	17. Palestine	1.8	22. Azerbaijan	1.6	27. Spain	1.4
3. India	6.7	8. Britain	3.8	13. Turkey	2.5	18. Belarus	1.8	23. South Korea	1.6	28. Uzbekistan	1.4
4. Ukraine	5.5	9. Italy	3.4	14. Mozambique	2.2	19. United States	1.7	24. Morocco	1.6	29. Egypt	1.3
5. Bangladesh	5.5	10. Pakistan	3.3	15. Philippines	2.0	20. Ethiopia	1.7	25. Poland	1.5	30. El Salvador	1.2

Note: Immigration flows from unknown origins not shown. | Source: United Nations Department of Economic and Social Affairs, Population Division

with guidance

Porter, Eduardo, and Karl Russell. "Migrants Are on the Rise Around the World, and Myths About Them Are Shaping Attitudes." *The New York Times*, June 20, 2018, sec. Economy. <https://www.nytimes.com/interactive/2018/06/20/business/economy/immigration-economic-impact.html>.

explain for audience, external or general audiences *can understand* complex graphics, *with guidance*



Driving Safety, in Fits and Starts

A MERICANS drive a staggering number of miles — close to three trillion every year, according to the government. (That is half a light-year, or 120 million trips around the world.) And although traffic accidents remain a major public safety problem, the biggest killer of people ages 5 to 34, vehicle travel is far safer than it was a few decades ago. Several factors appear to account for the sharp decline in fatalities. Technology (like anti-lock brakes and air bags) and road behavior (like wearing seat belts and driving sober)

deaths per miles traveled. But what happens when the metrics are teased apart, and familiar data is charted in an unfamiliar way? Plotting the two most important variables against each other — miles traveled versus deaths per 100,000 population — yields a pattern that looks like a plateau followed by a steep drop. It evokes the theory of punctuated equilibrium, proposed by the paleontologists Stephen Jay Gould and Niles Eldredge, which suggests that instead of continuous gradual evolution, change occurs abruptly after

with guidance

Fairfield, Hannah. “Driving Safety, in Fits and Starts.” *The New York Times*, September 12, 2012, sec. Science. <https://archive.nytimes.com/www.nytimes.com/interactive/2012/09/17/science/driving-safety-in-fits-and-starts.html>.

empirical study on audience engagement

Haroz, Steve, Robert Kosara, and Steven L. Franconeri. “The Connected Scatterplot for Presenting Paired Time Series.” *IEEE Transactions on Visualization and Computer Graphics* 22, no. 9 (September 1, 2016): 2174–86. <https://doi.org/10.1109/TVCG.2015.2502587>.

(re)design for your audience

redesigns, example — original graphic within government publication explaining part of US economy

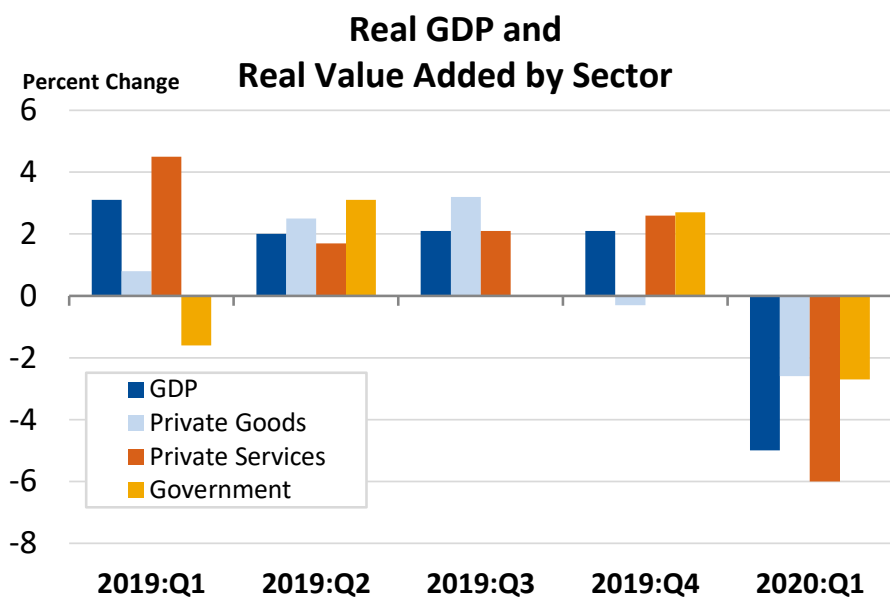


Monday, July 6, 2020
 Contact: Jeannine Aversa, (301) 278-9003

Gross Domestic Product by Industry: First Quarter 2020

Accommodation and food services; finance and insurance; and health care and social assistance industries were the leading contributors to the 5.0 percent (annual rate) decrease in gross domestic product (GDP) in the first quarter of 2020.

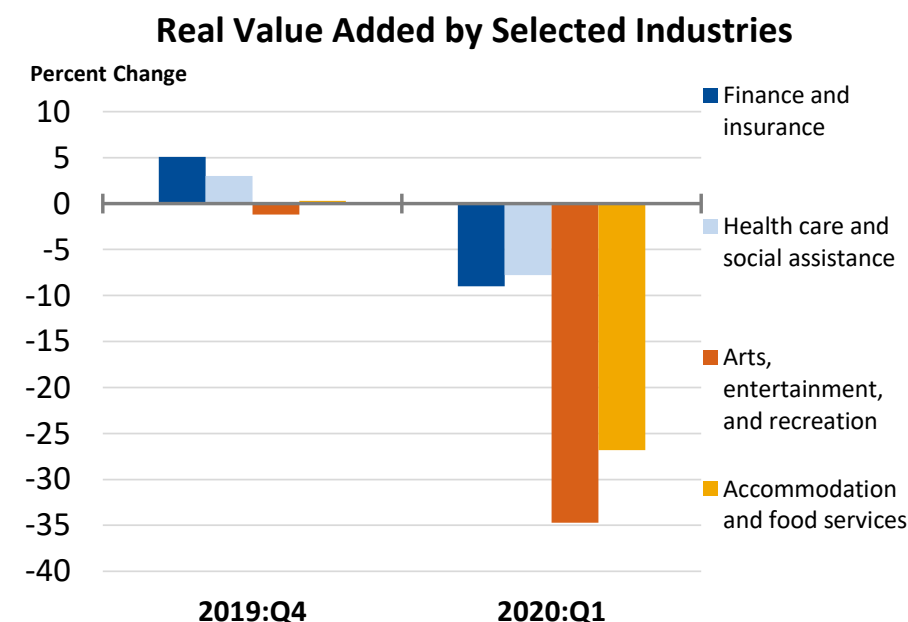
All sectors of the U.S. economy contributed to the decrease, led by a decline in private services-producing industries. The decline in first-quarter GDP reflected the response to the spread of COVID-19, as governments issued “stay-at-home” orders in March. This led to rapid changes in production, as businesses and schools switched to remote work or canceled operations, and consumers and businesses canceled, restricted, or redirected their spending. For more information, see [“Federal Recovery Programs and BEA Statistics: COVID-19 and Recovery”](#) on the BEA website.



U.S. Bureau of Economic Analysis Seasonally adjusted annual rates

Overall, 17 of 22 industry groups contributed to the first-quarter decline in real GDP. Of the five industry groups that offset the decline in the first-quarter real GDP, agriculture, forestry, fishing, and hunting was the largest contributor, increasing 15.5 percent.

For accommodation and food services, real value added—a measure of an industry’s contribution to GDP—decreased 26.8 percent, primarily reflecting a decrease in food services and drinking places.



U.S. Bureau of Economic Analysis Seasonally adjusted annual rates

Finance and insurance decreased 9.0 percent, primarily due to a decrease in insurance carriers and related activities.


Health care and social assistance decreased 7.8 percent, primarily reflecting decreases in ambulatory health care services and in hospitals.

Arts, entertainment and recreation decreased 34.7 percent, primarily reflecting a decrease in performing arts, spectator sports, museums, and related activities.

BEA statistics—including GDP, personal income, the balance of payments, foreign direct investment, the input-output accounts, and economic data for states, local areas, and industries—are available at www.bea.gov. E-mail alerts are also available.

Bureau of Economic Analysis. *Gross Domestic Product by Industry: First Quarter 2020*. <https://www.bea.gov/sites/default/files/2020-07/gdpind120-fax.pdf>.

redesigns, example — what's the point of this graphic? Do encodings intuitively show the point? Let's redesign!



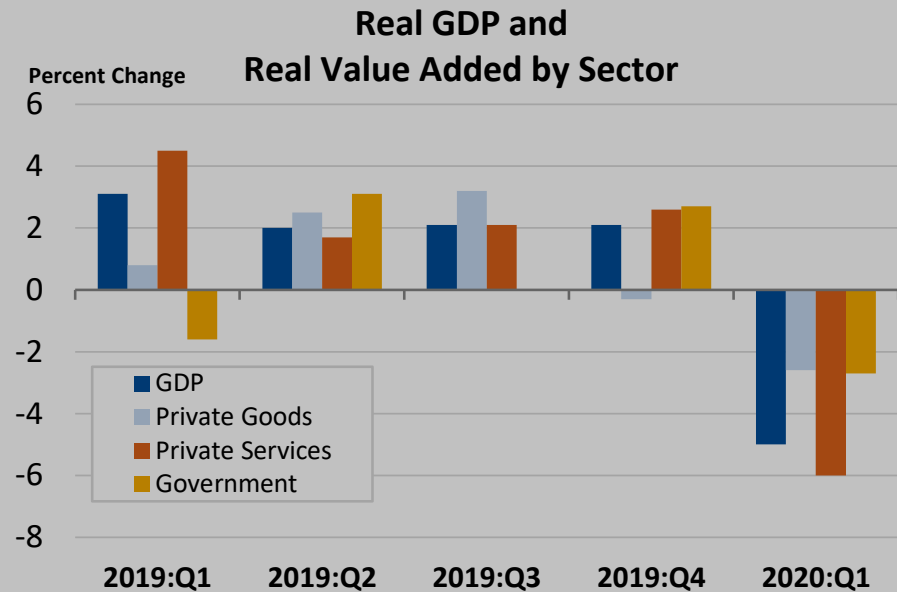
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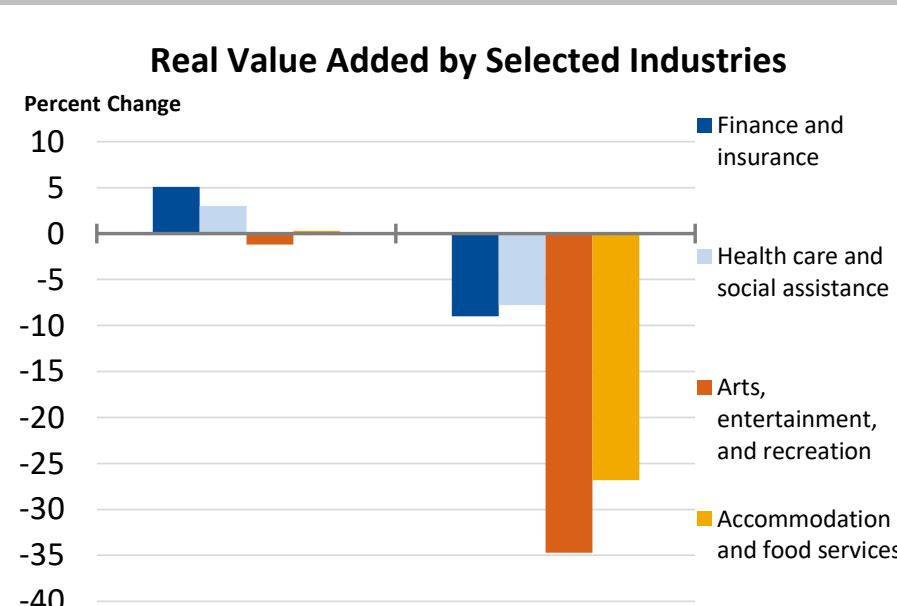
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Real GDP and Real Value Added by Sector



U.S. Bureau of Economic Analysis Seasonally adjusted annual rates

Real Value Added by Selected Industries



U.S. Bureau of Economic Analysis Seasonally adjusted annual rates

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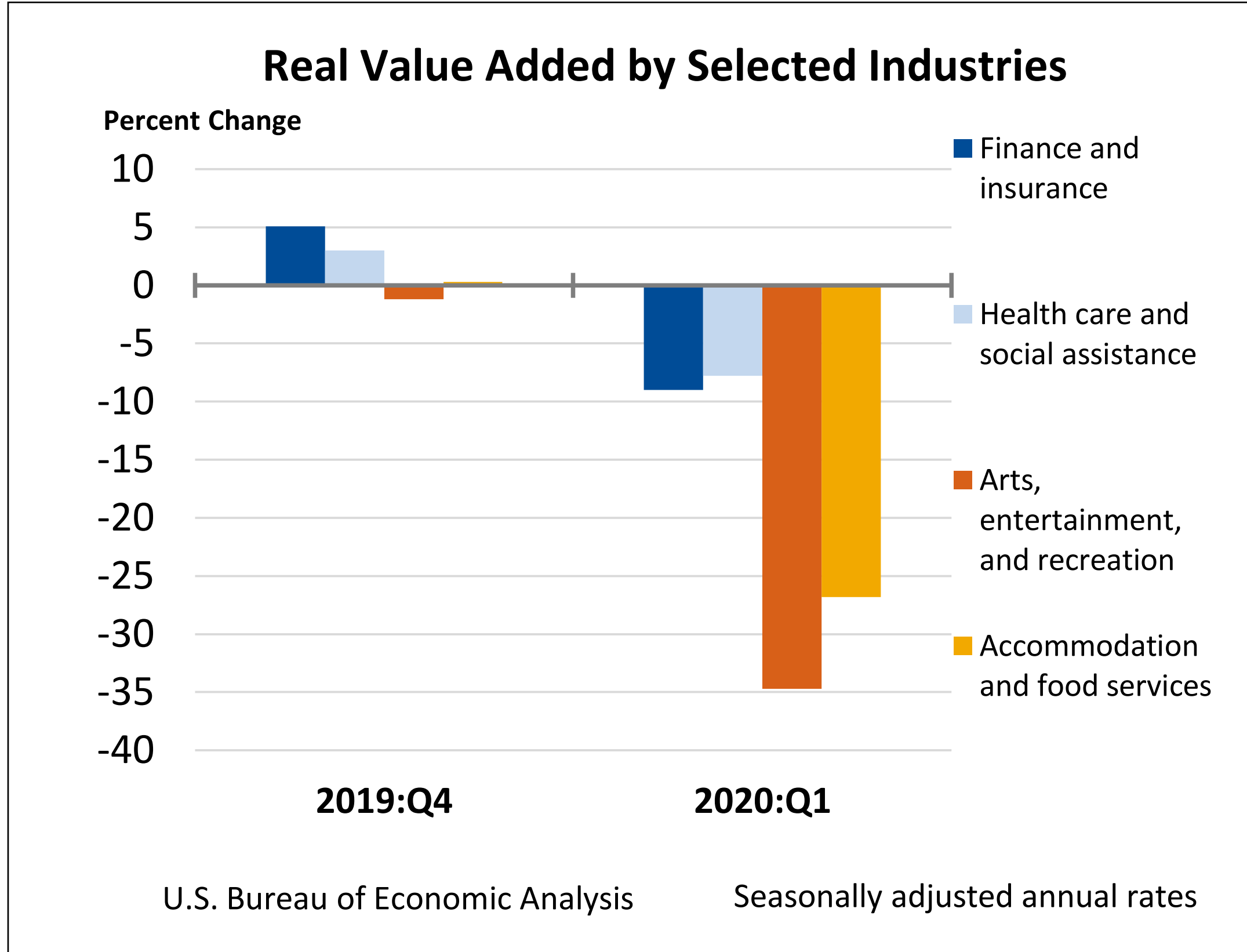
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Health care and social assistance decreased 7.8 percent, primarily reflecting decreases in ambulatory health care services and in hospitals.

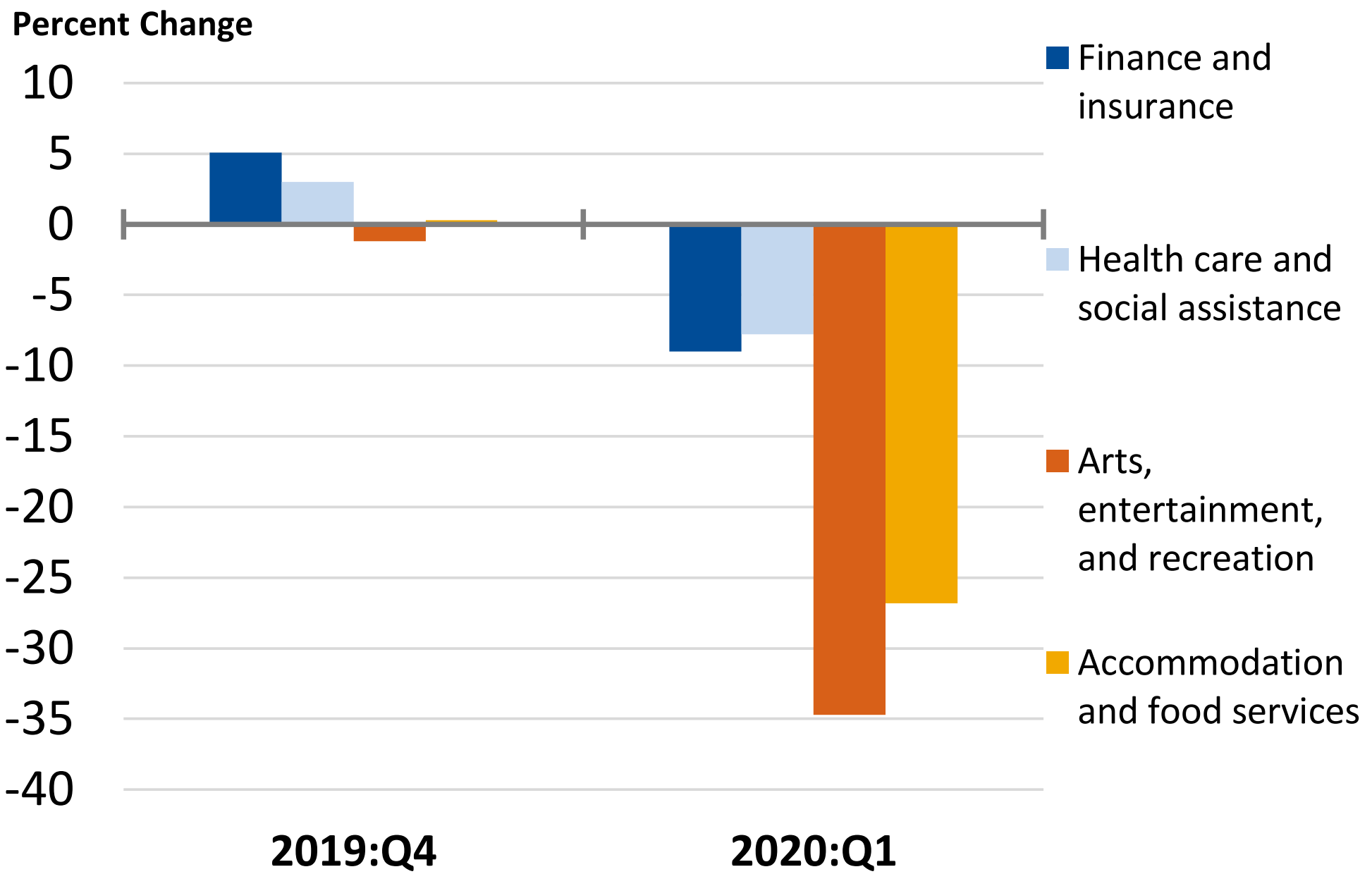
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BEA statistics—including GDP, personal income, the balance of payments, foreign direct investment, the input-output accounts, and economic data for states, local areas, and industries—are available at www.bea.gov. E-mail alerts are also available.



redesigns, example — first possible redesign. Does this redesign more intuitively convey a point?

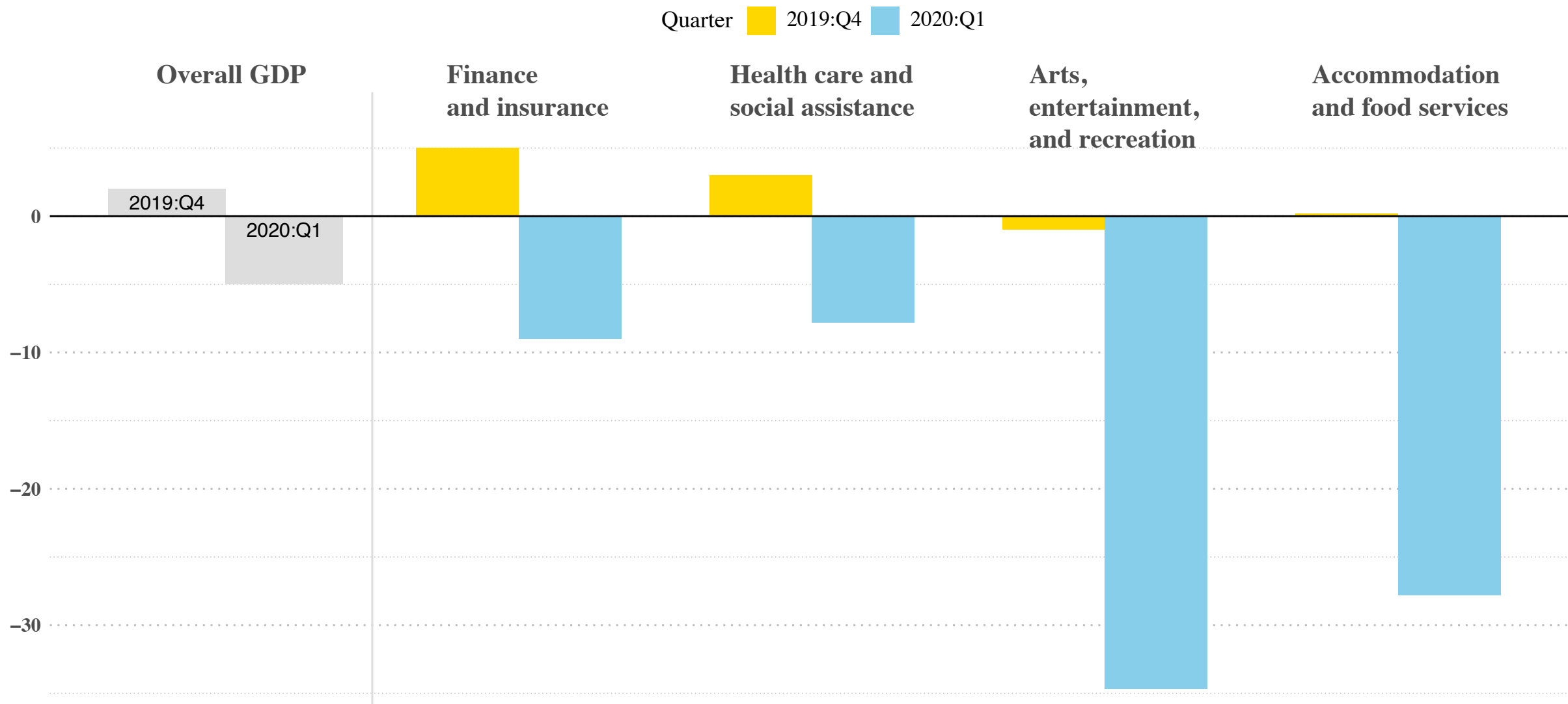
Real Value Added by Selected Industries



U.S. Bureau of Economic Analysis Seasonally adjusted annual rates

As the pandemic set hold, most industries shrank in real value added to GDP, food services and recreation worse than others.

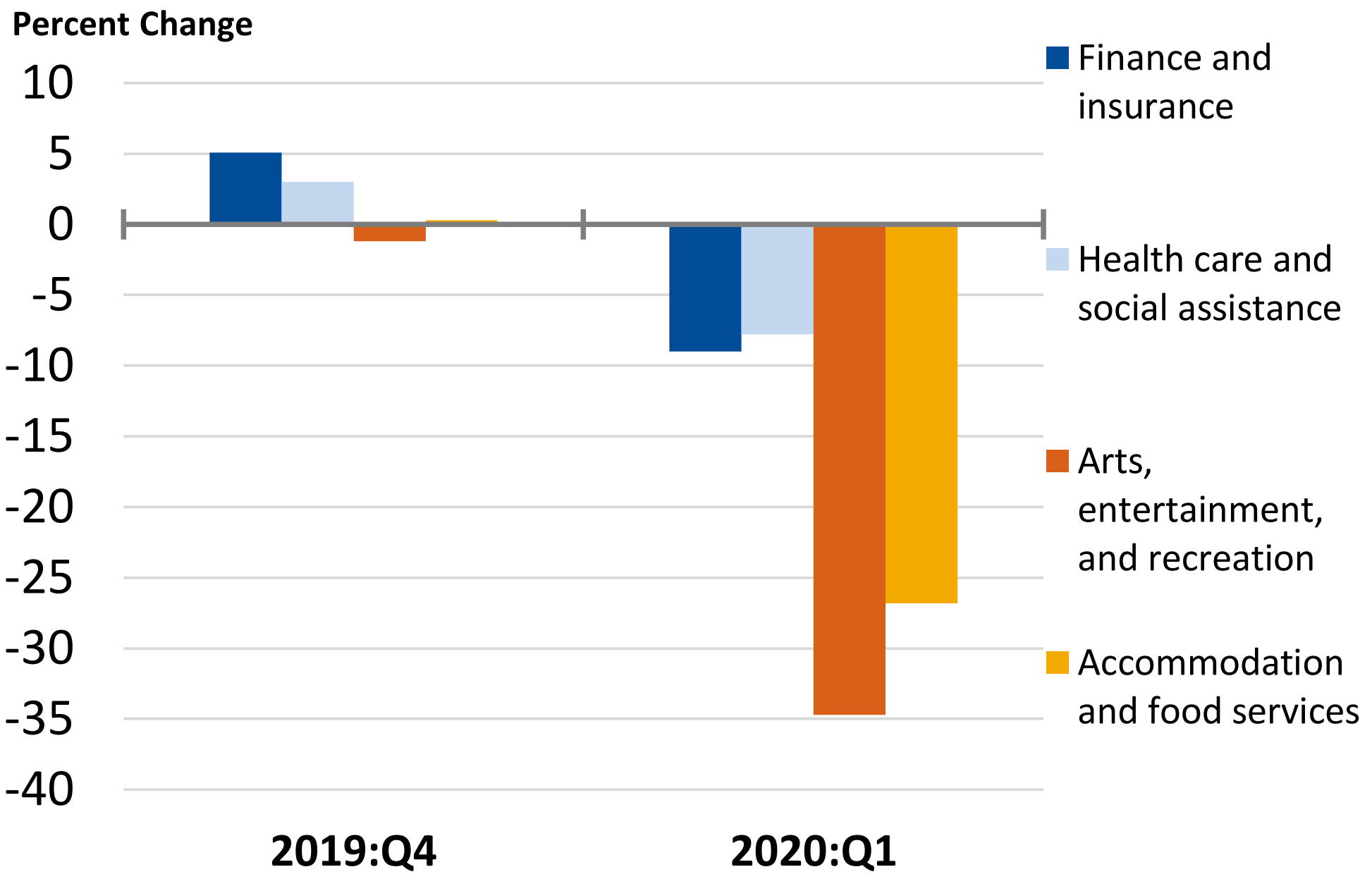
(Percent change from previous quarter)



Source: U.S. Bureau of Economic Analysis, Seasonally adjusted annual rates

redesigns, example — second possible redesign. Does this redesign more intuitively convey a point?

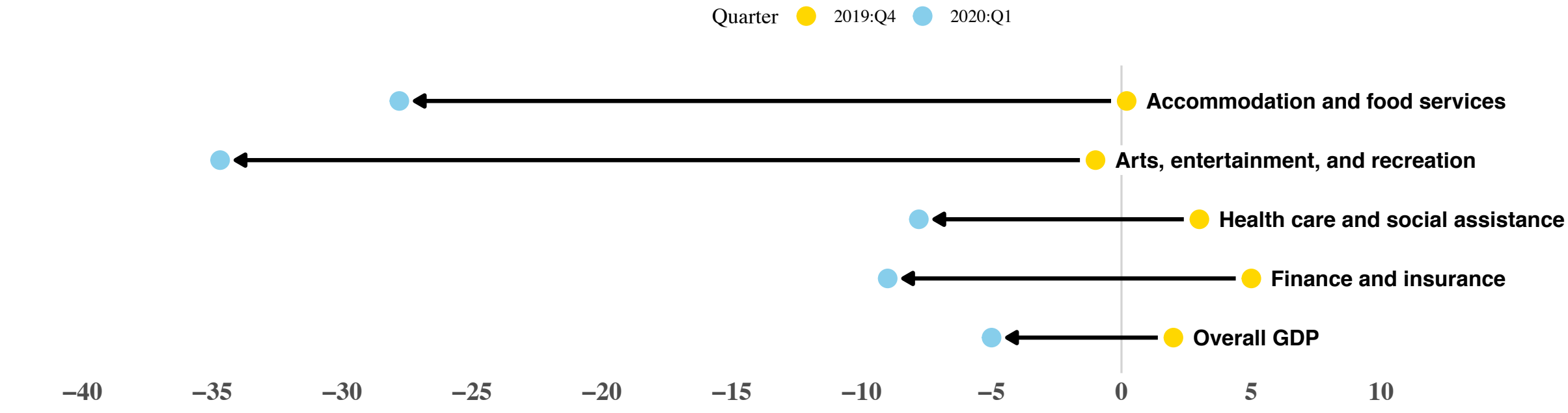
Real Value Added by Selected Industries



U.S. Bureau of Economic Analysis Seasonally adjusted annual rates

As the pandemic set hold, most industries shrank in real value added to GDP, food services and recreation worse than others.

(Percent change from previous quarter)

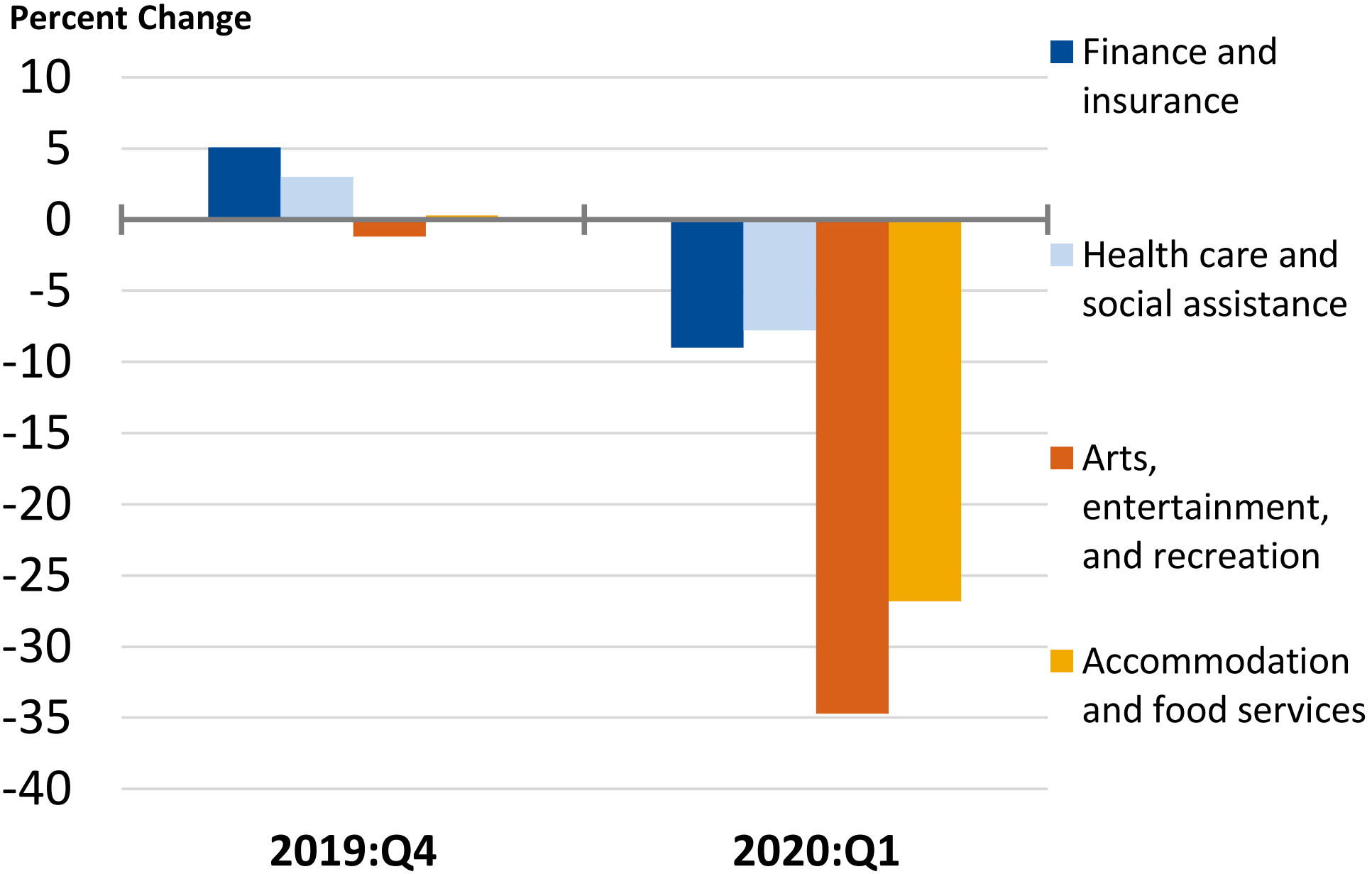


Source: U.S. Bureau of Economic Analysis, Seasonally adjusted annual rates

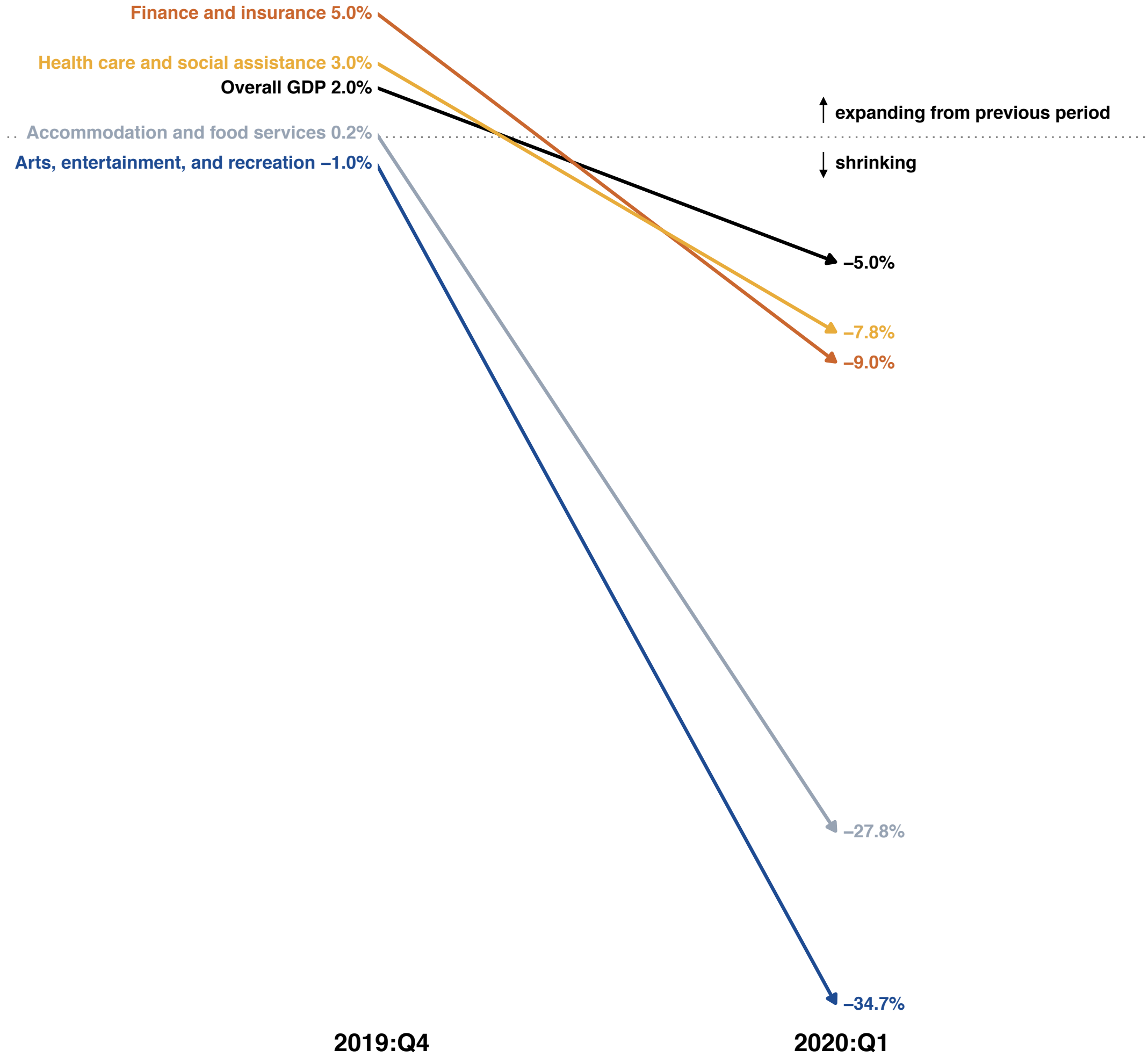
redesigns, example — third possible redesign. Does this redesign more intuitively convey a point?

As the pandemic set hold, most industries shrank in real value added to GDP, food services and recreation worse than others.
 (Percent change from previous quarter)

Real Value Added by Selected Industries



U.S. Bureau of Economic Analysis Seasonally adjusted annual rates



Source: U.S. Bureau of Economic Analysis, Seasonally adjusted annual rates

resources

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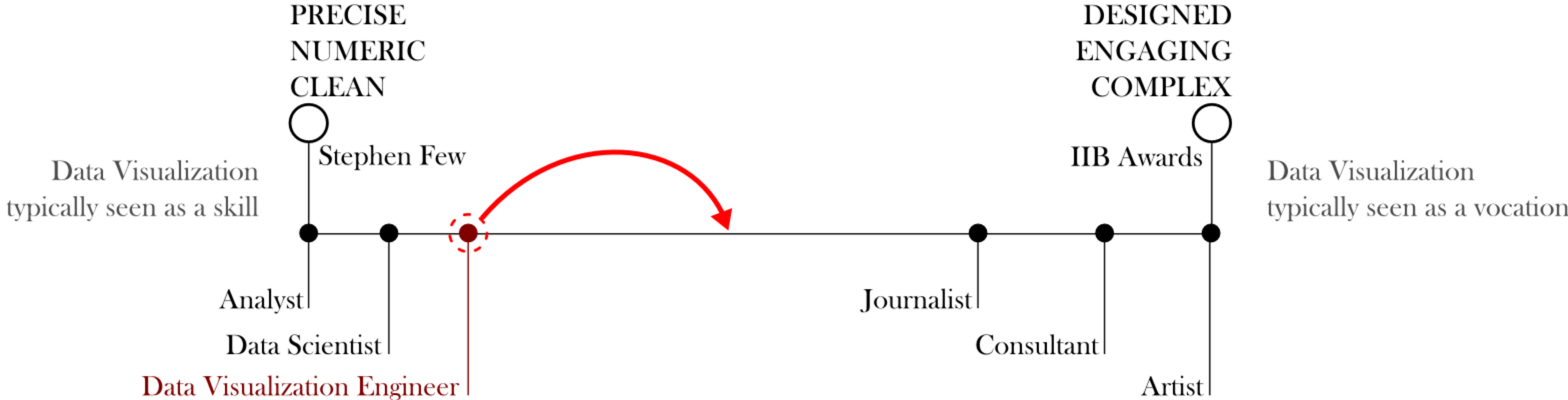
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extra

explain for audience, be open to new approaches for visual communication when designing for an audience



— Meeks, Elijah. “If Data Visualization Is So Hot, Why Are People Leaving?” Blog. Medium, March 21, 2017. https://medium.com/@Elijah_Meeks/why-people-leave-their-data-viz-jobs-be1a7ab5dddc.

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13pt Design for an Audience

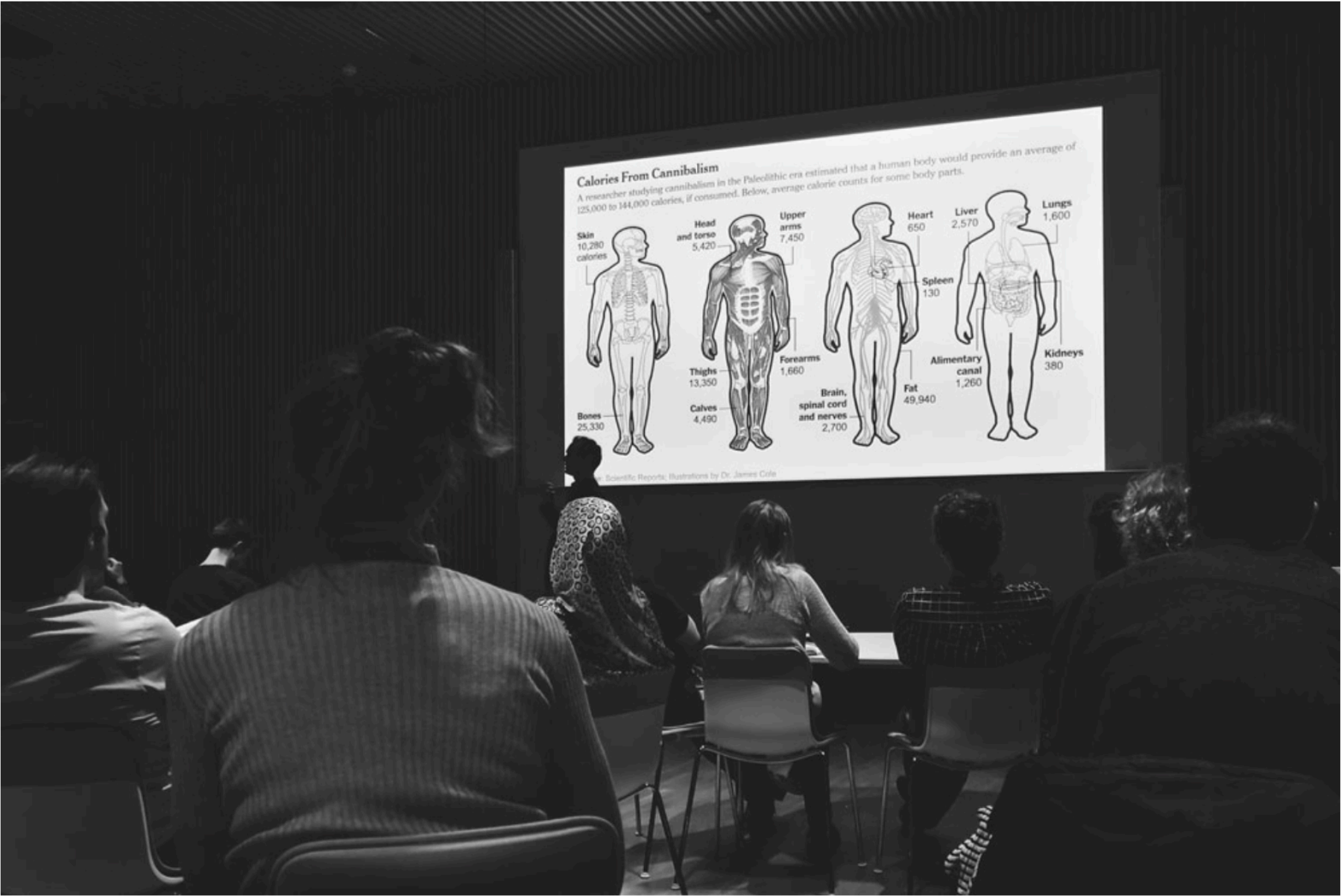


Photo by Niamh Higgins

By Jonathan Corum
April 26, 2018

Last week I gave a workshop and talk at [SUND](#), the University of Copenhagen's Faculty of Health Sciences.

Here's a lightly edited transcript of the talk:

Thank you very much for being here. Thank you for the

Find the visual idea

Translate

Tell a visual story

Focus attention, don't scatter it

Show the content, not the frame

Show the content, not the table

Be consistent

What can you remove?

Reference the real world

Connect images and data

Explain why

Provide context

Build a sequence

Show movement and change

Encourage visual comparisons

More labels, fewer legends

Annotate