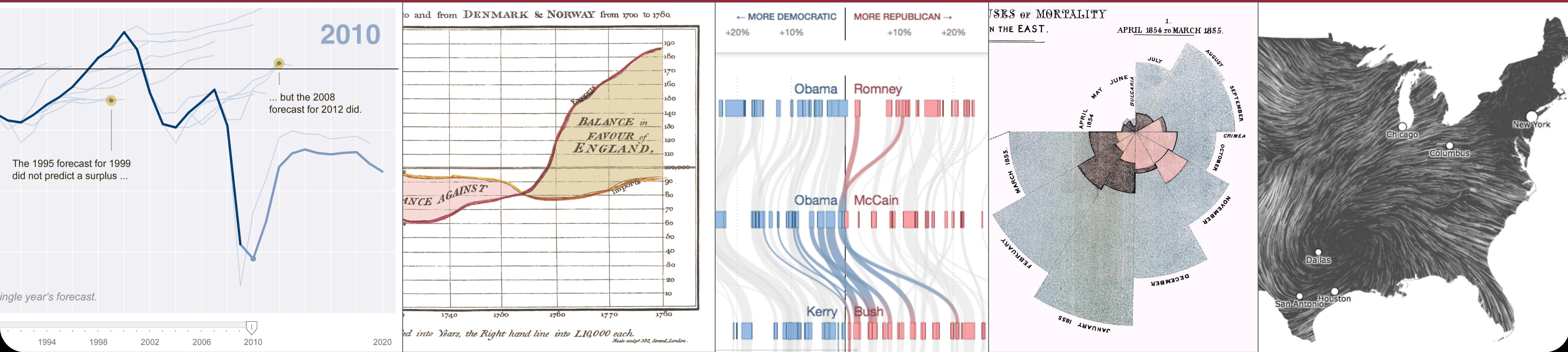


6.894: Interactive Data Visualization

Narrative Visualization

Arvind Satyanarayan



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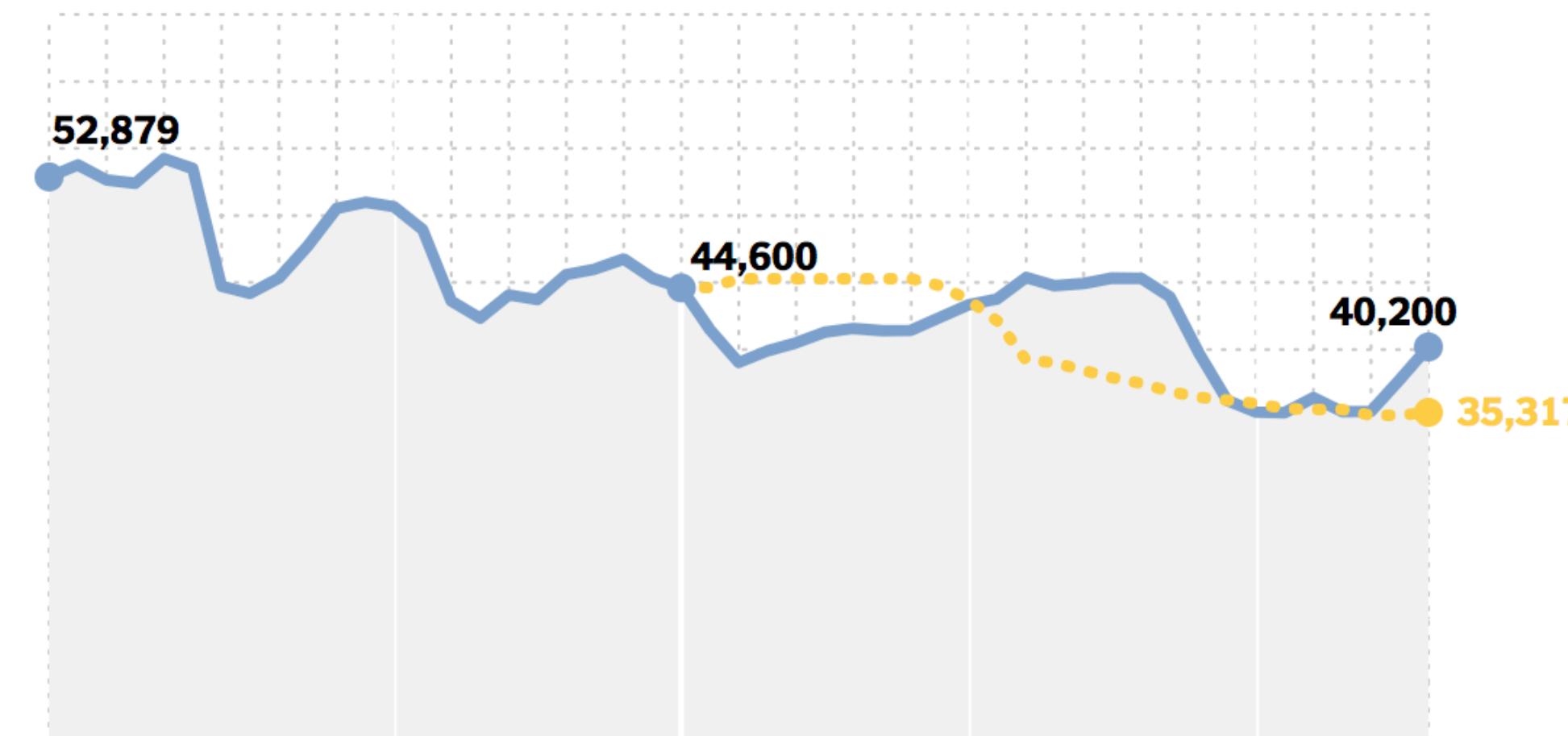
You Draw It: Just How Bad Is the Drug Overdose Epidemic?

By JOSH KATZ UPDATED October 26, 2017

How does the surge in drug overdoses compare with other causes of death in the U.S.? Draw your guesses on the charts below.

yellkey.com/take

Since 1990, the number of Americans who have died every year from **car accidents**...



Narrative Visualization



narrative (n): “*An account of a series of events, facts, etc., given in order and with the establishing of connections between them.*”

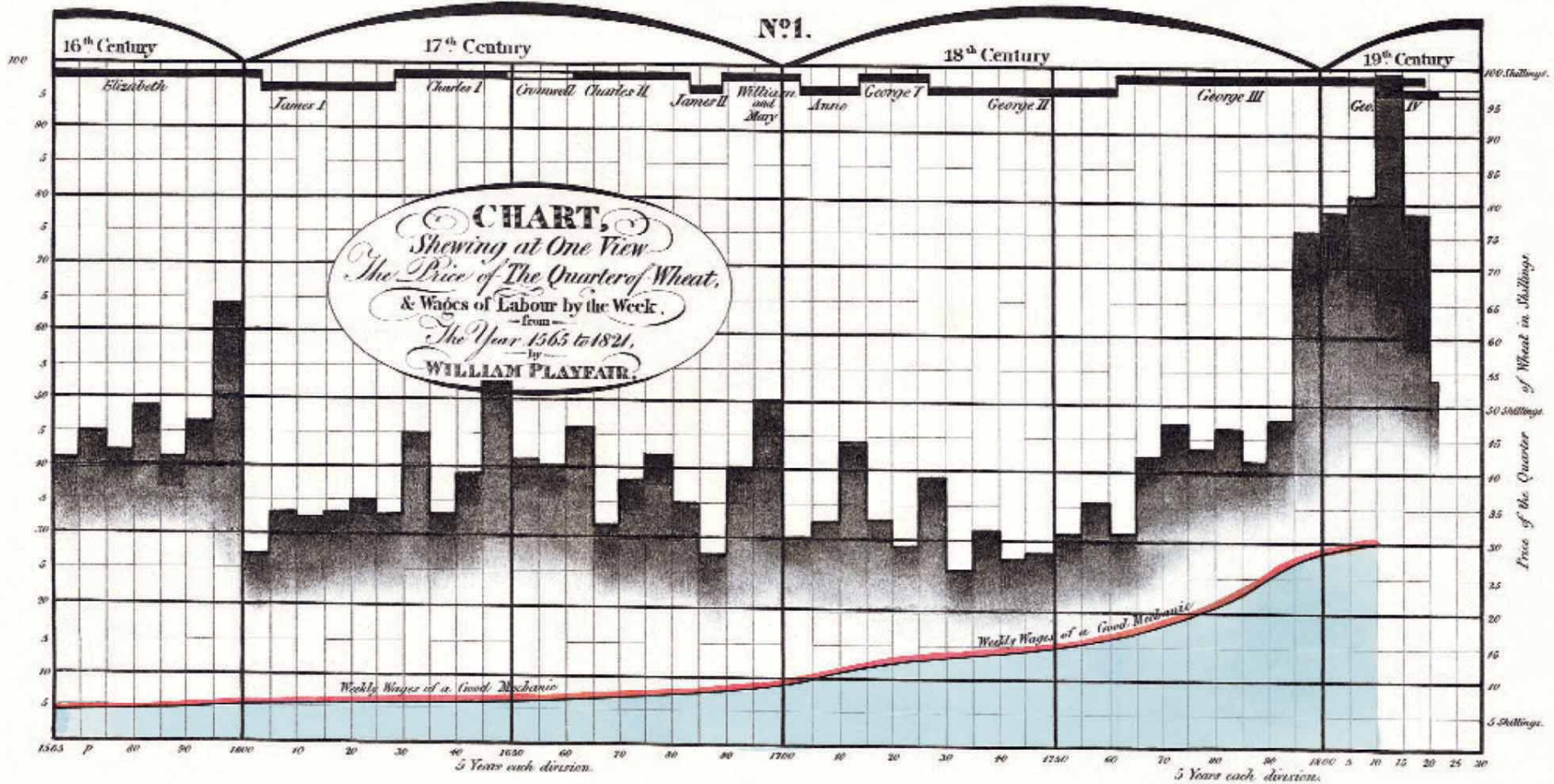
– Oxford English Dictionary

Narrative Visualization

[Ennedi Plateau, Chad. ~2000 BCE]



"You have before you, my Lords and Gentlemen, a chart of the prices of wheat for 250 years [...] the main fact deserving of consideration is, that never at any former period was wheat so cheap, in proportion to mechanical labour, as it is at the present time" — William Playfair, 1822 letter to Parliament.



"to affect thro' the Eyes what we fail to convey to the public through their word-proofears"

— Florence Nightingale on her "coxcomb" of Crimean War Deaths (1856).

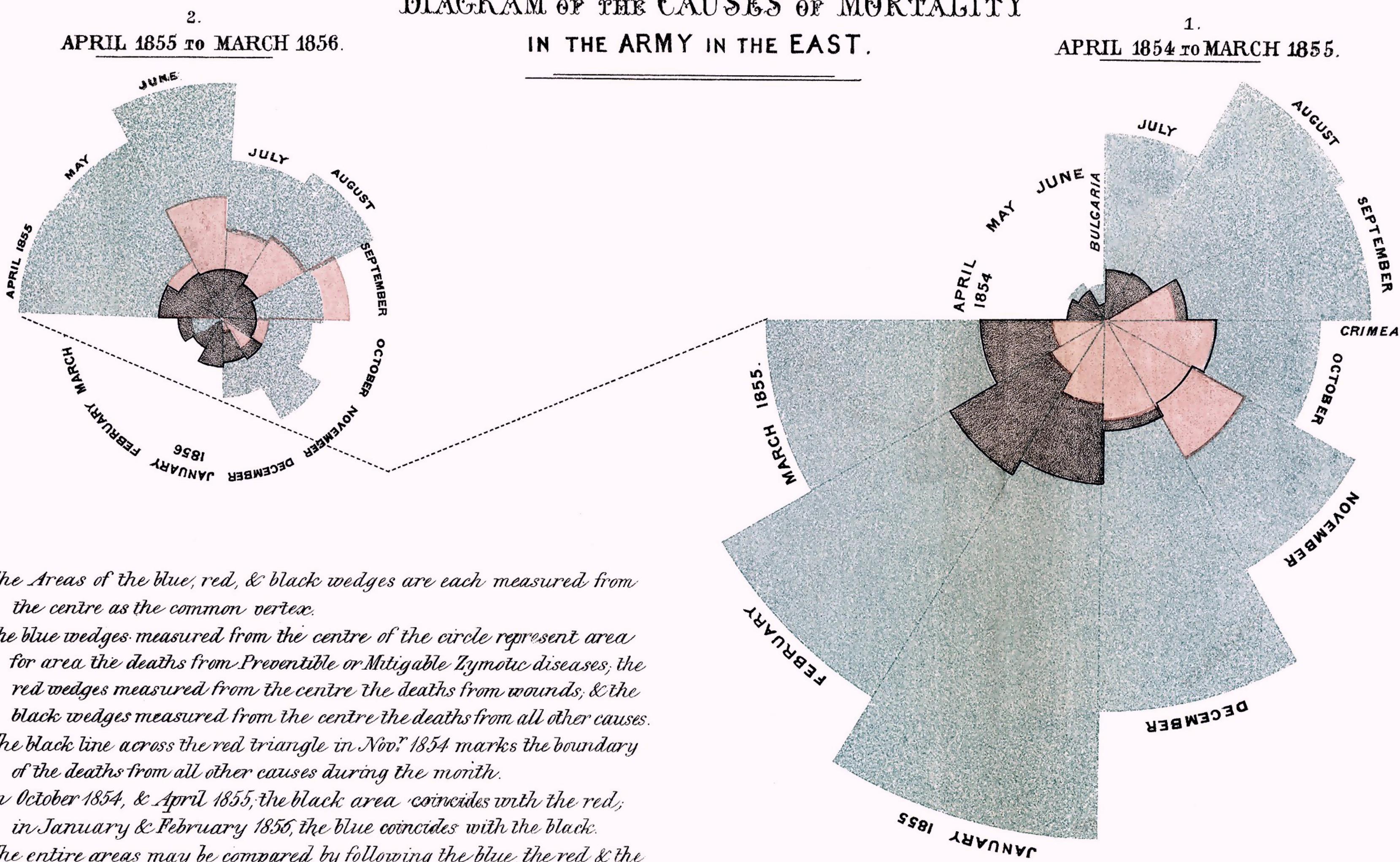


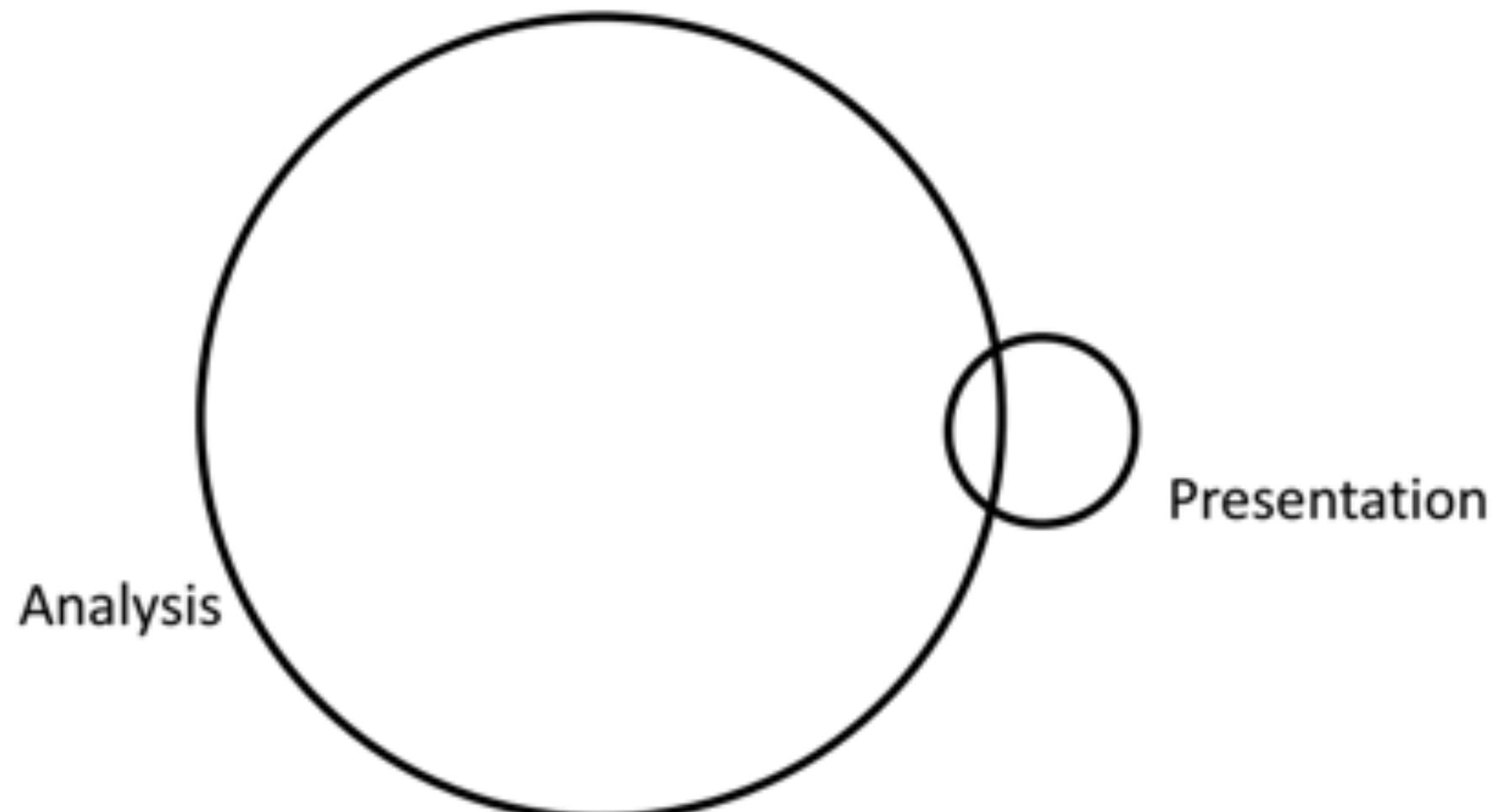
Chart vividly depicts that the main cause of deaths was not war wounds but unsanitary conditions.

Returned to Britain and led a successful campaign for better conditions in barracks and hospitals.

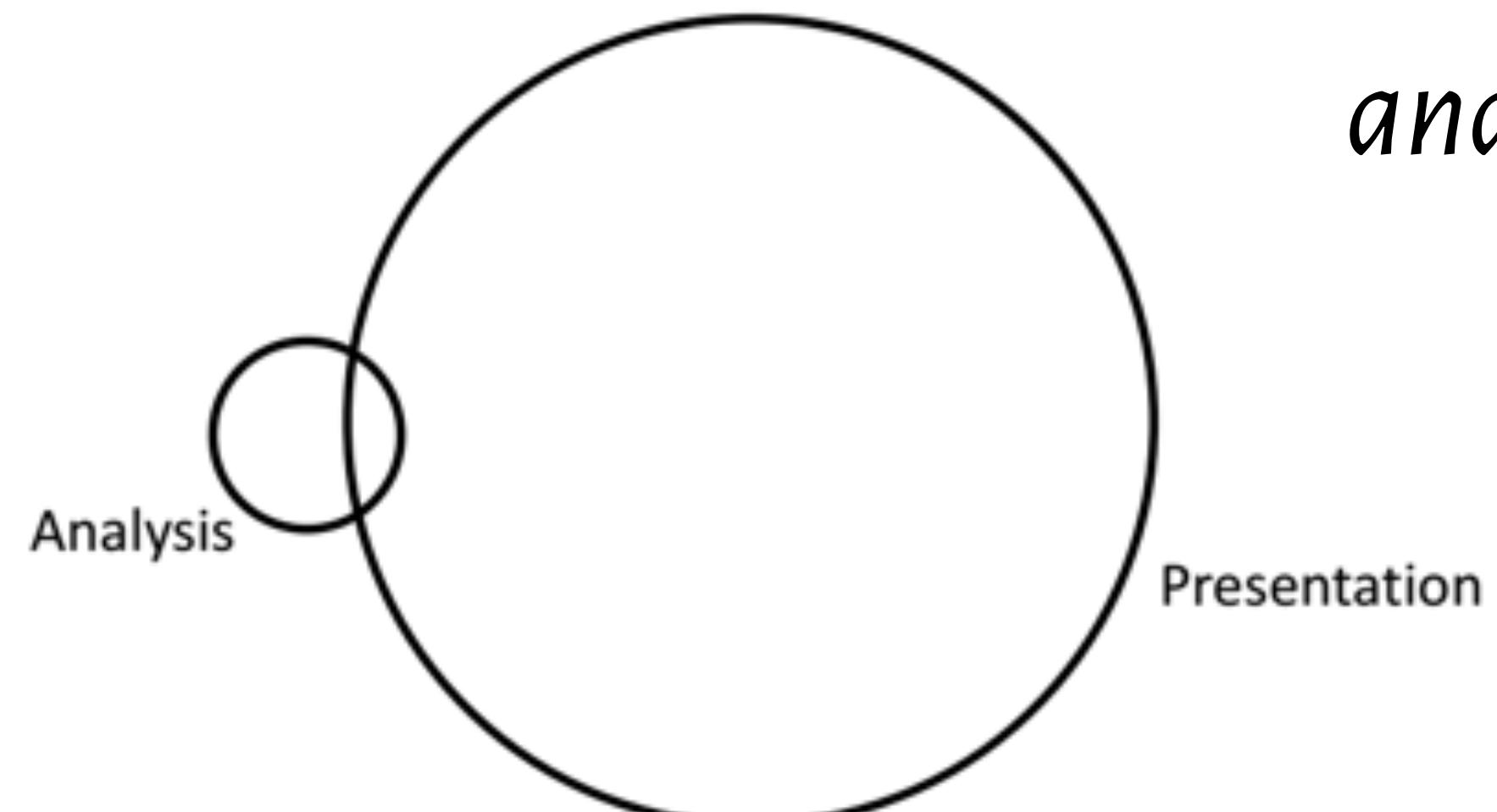
Vis researchers

Views of the World

[John Stasko 2016]



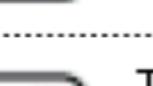
Everyone else



Effective story-telling “require[s] skills like those familiar to movie directors, beyond a technical expert’s knowledge of computer engineering and science.” – Gershon & Page ‘01

Effective story-telling “require[s] skills like those familiar to movie directors, beyond a technical expert’s knowledge of computer engineering and science.” – Gershon & Page ‘01

Figure 2. Two-part script for the visual representation of information (sorted by location); visual operations are in red.

Time	Image	Voice	Time
	Begin Part 1: Show overview (map)	 It is now early in the morning. The time is H+8.	
	Zoom in to show the school building. Show the school building; make it transparent and superimpose a picture of children.	 Our schoolhouse is in the center.	
	Zoom out. Highlight NE/SE entities.	 Enemy is strongest in NE/SE direction. Enemy (SE) became active between H+2 to H+4.	
	Zoom in the G-shaped building. Add lines of fire to the G-shaped building. Highlight the thin lines of fire of the G-shape building.	 G-shape building; not as strong as enemy in SE.  Direction of fire toward the schoolhouse and other directions (S&W). G-shape building, weak fire, thinner lines.	
	Zoom out.	 G-shape building, active between H to H+2, H+2 to H+4.	
	Zoom in to NW enemy position. Add lines of fire while zooming out.	 NW enemy position, direction of fire SW/SE. NW enemy has been active between H to H+6.	
	Zoom out. Show overview while highlighting two little enemy objects.	 Two little enemy activities in the center, UAV reported yesterday.	
	Begin Part 2: Animate the overview from the beginning (time H) to show time dependence.		
	Show overview	 Commander’s Perceptions Enemy is oriented toward the center.	
		No shift in the flanks of any magnitude. One relatively strong flank (SE-NE). Maybe we made him somewhat weaker (SE), too early to tell. It is now early in the morning. Maybe enemy (SE) is not awake yet.	

Observed Narrative Devices

Case Studies

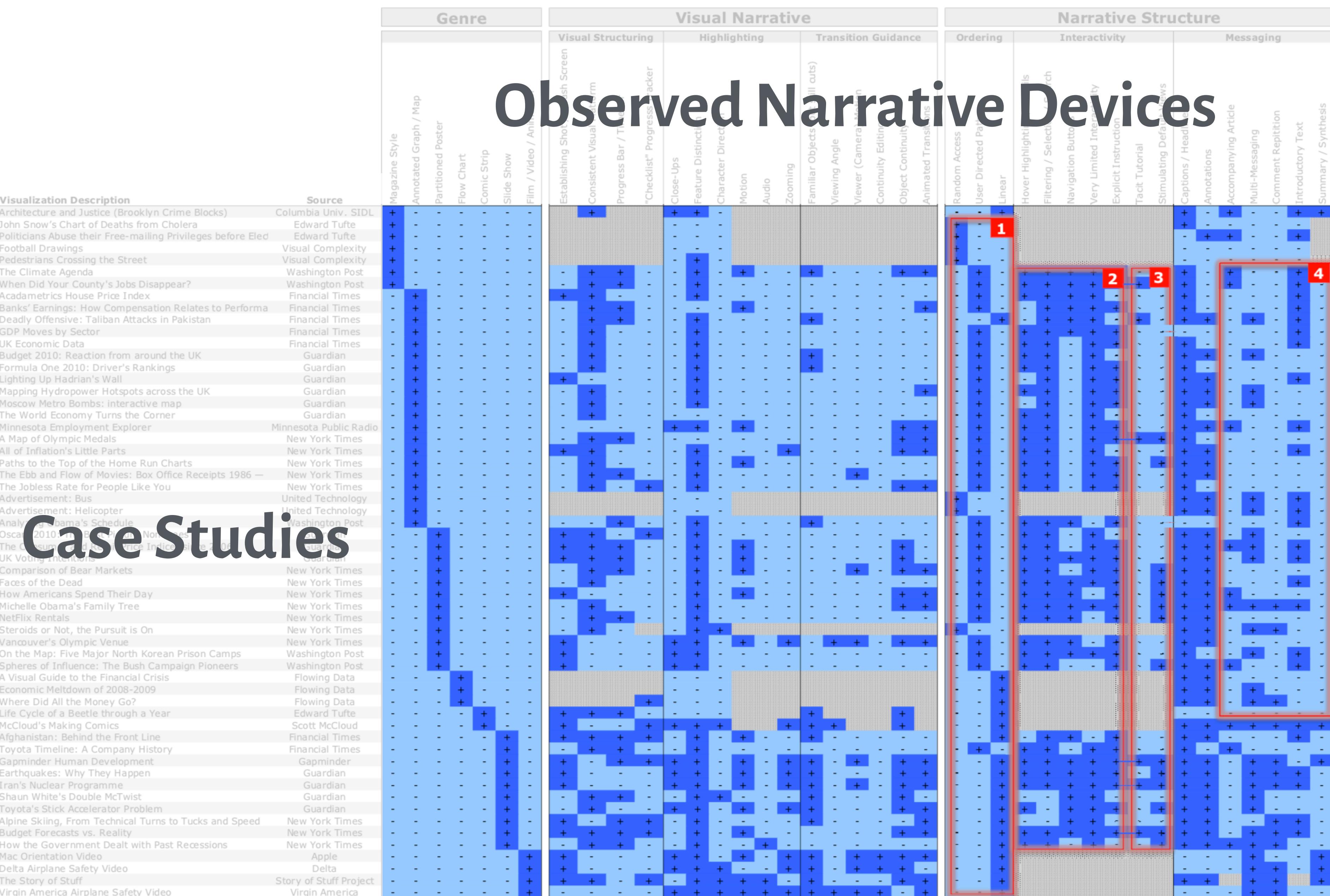
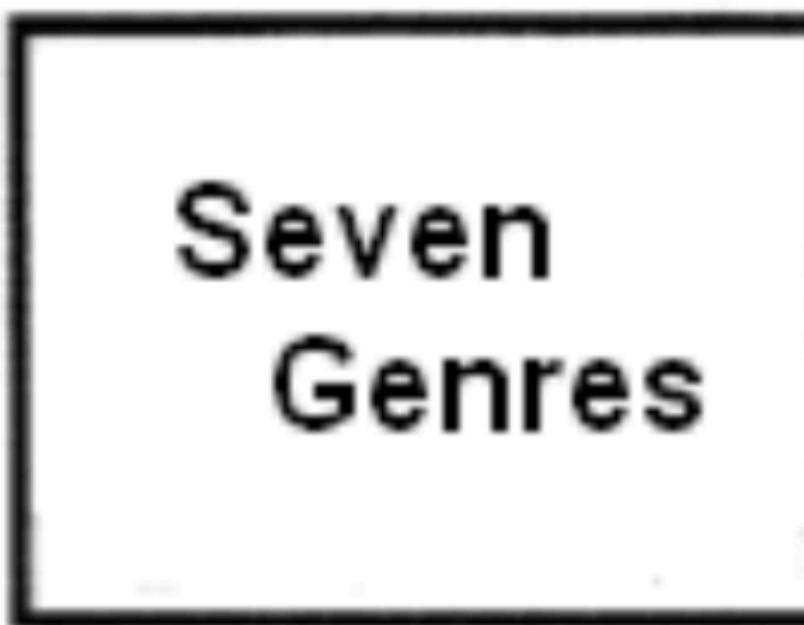


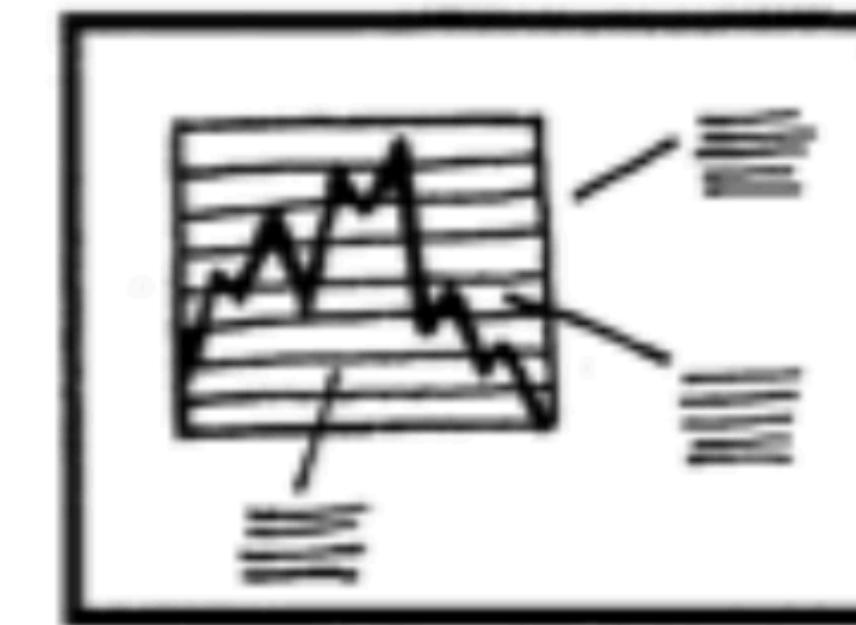
Fig. 7. Design space analysis of narrative visualization. Columns indicate recurring design elements and selected regions highlight patterns in the data. Region (1) shows clusters of ordering strategies that correspond to distinct genres of visual narration. Region (2) highlights the consistency of interactive designs used by visualizations. Region (3) shows the under-utilization of strategies to engage the user in the interactive functionality. Region (4) shows the under-utilization of common storytelling techniques across narrative visualizations.

[Segel & Heer, *InfoVis 2010*]

Narrative Visualization Genres



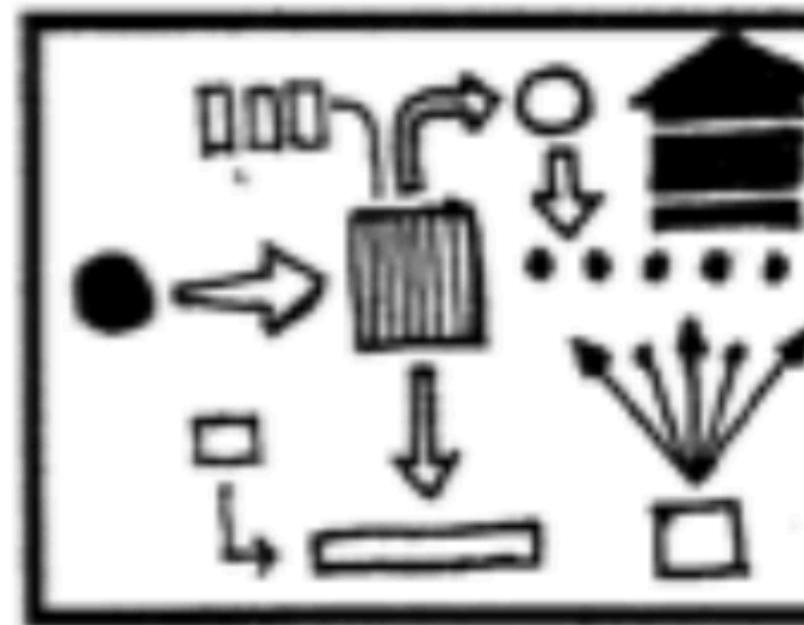
Magazine Style



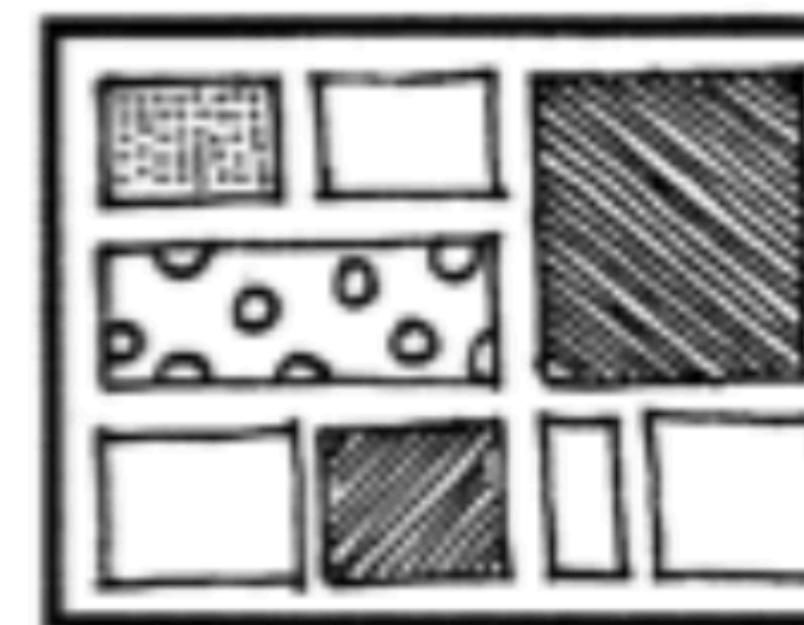
Annotated Chart



Partitioned Poster



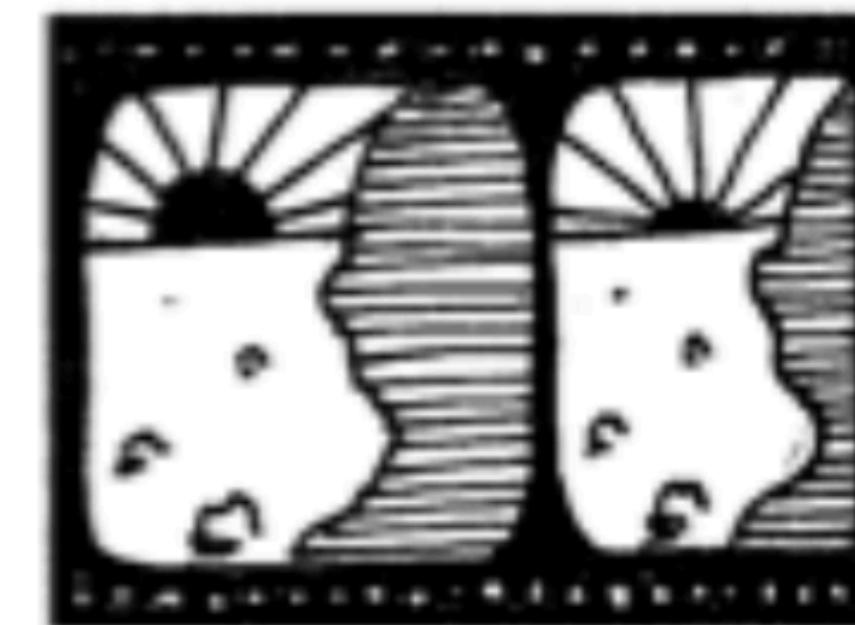
Flow Chart



Comic Strip



Slide Show



Film/Video/Animation

[Segel & Heer, InfoVis 2010]

Genres



Magazine Style

The Economist

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even more sharply in Germany than in Italy, which is in recession, note economists at Goldman Sachs, a bank. Yet Germany's service sector appears to be growing strongly, as does that of the euro zone as a whole.

Production lines
Purchasing managers' indices*

Manufacturing

Year	Euro area	United States	China
2017	~58	~56	~52
2018	~55	~55	~50
2019	~48	~52	~48

Services

Year	Euro area	United States	China
2017	~58	~56	~52
2018	~55	~55	~50
2019	~52	~55	~50

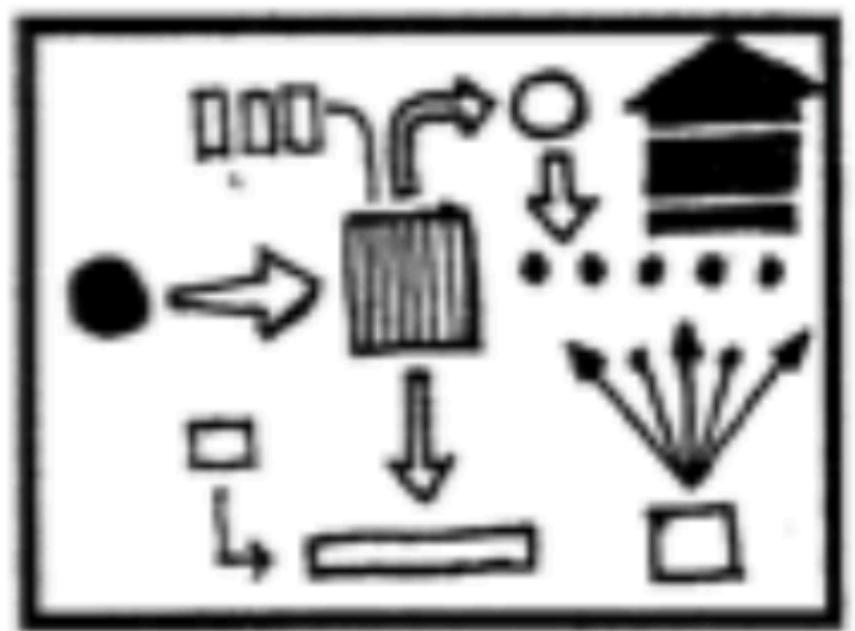
Sources: IHS Markit; Caixin *Based on surveys of executives. A reading above/below 50 indicates an expansion/contraction compared with the previous month

The Economist

Service industries are less volatile than manufacturing, make up a bigger slice of rich-world GDP and, by their nature, trade less. That they remain strong largely reflects relatively buoyant labour markets and consumers (German unemployment is only 3.1%). One exception has been Britain, where survey data released on April 1st and 3rd appear to show growth in manufacturing at its strongest in over a year and services shrinking. Both findings are Brexit-related. The British economy is suffering from falling confidence, while manufacturing appears so strong only because firms are stockpiling in case Britain soon crashes out of the EU without a deal.

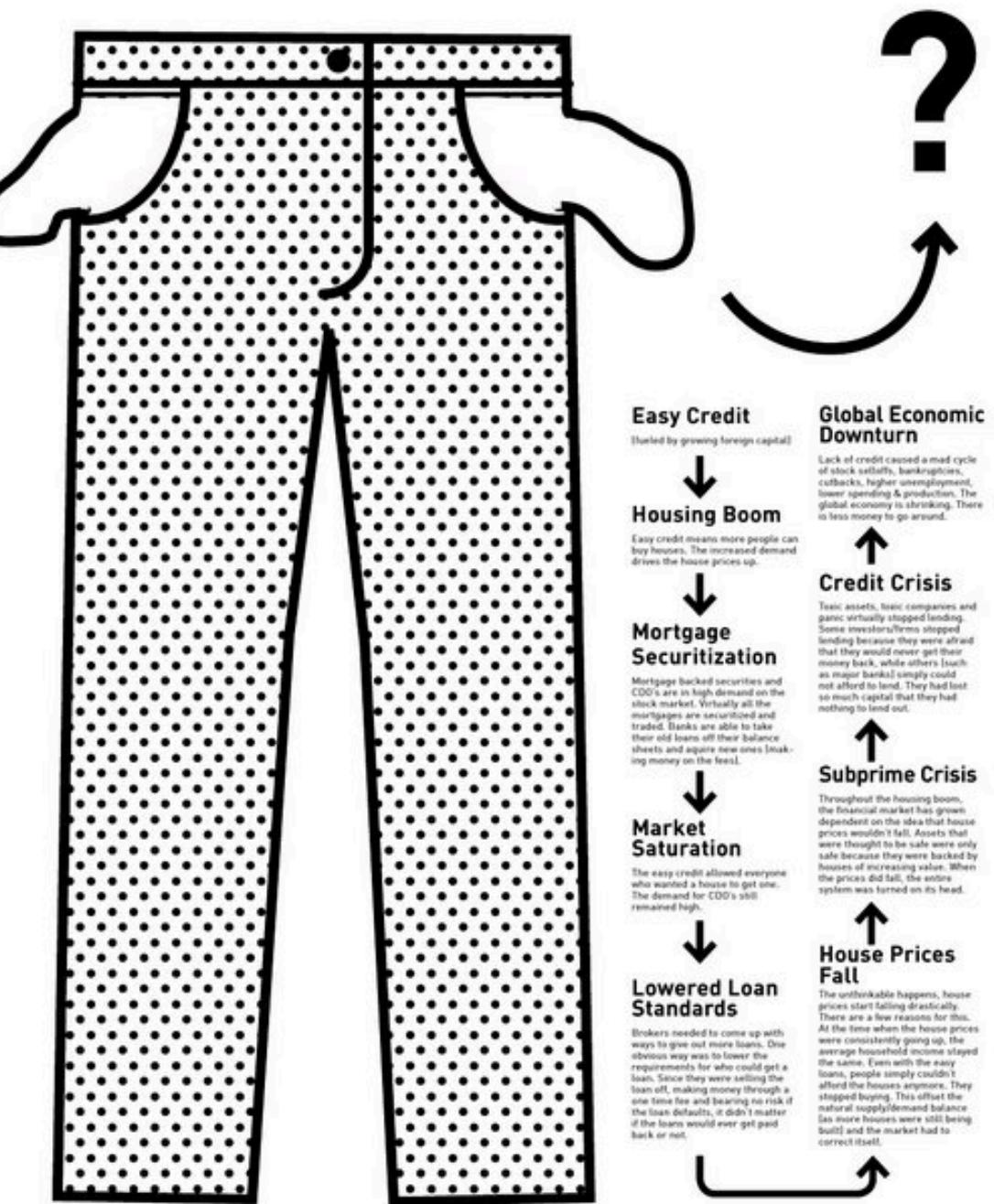
In the 2000s some economists speculated that the growing weight of

Genres



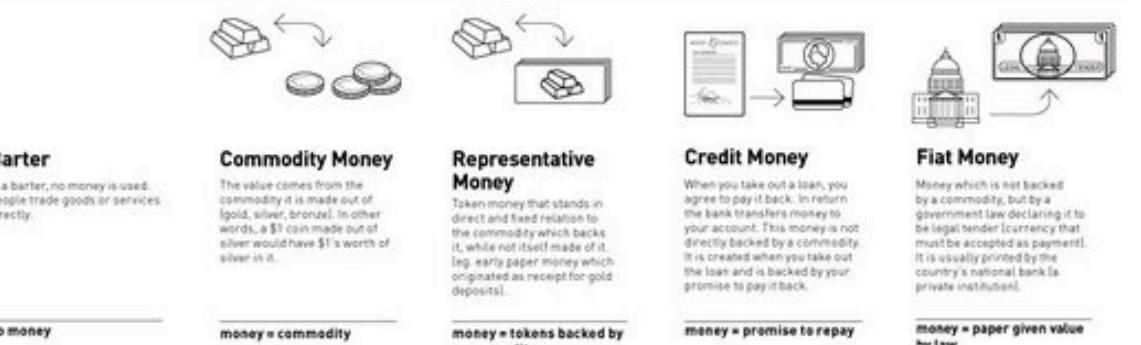
Flow Chart

WHERE DID ALL THE MONEY GO?



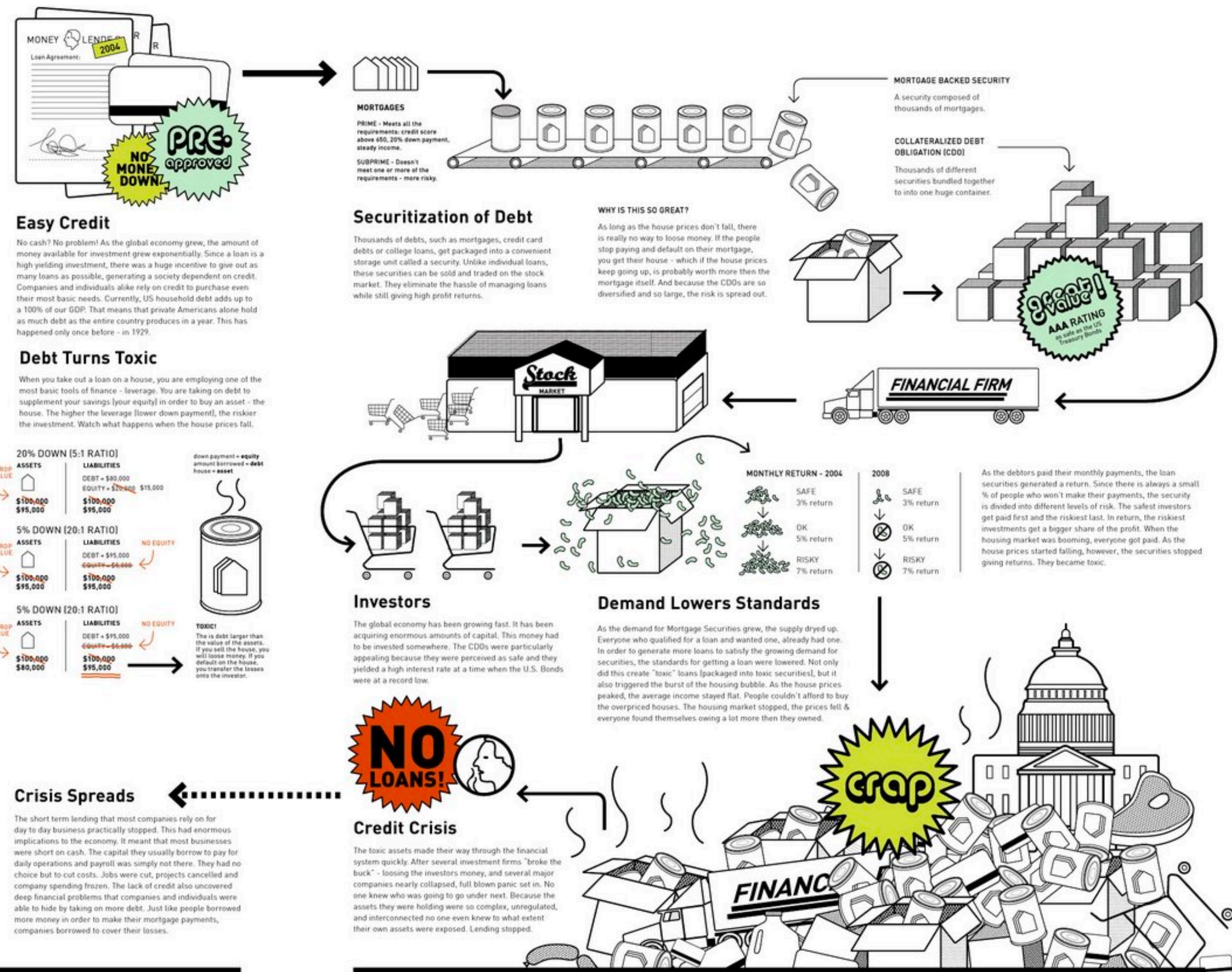
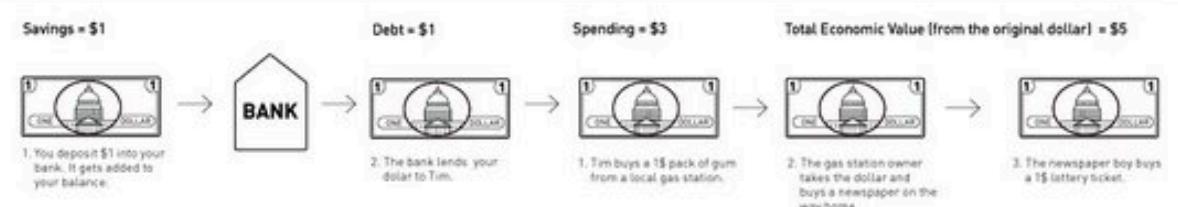
What is money?

Money can be anything. Rare & valuable resources have been used historically because they are easy to control, but anything that people collectively agree on can be used as money. There are four general functions money fulfills: medium of exchange, unit of account, store of value & standard of deferred payment. Money needs to have a perceived value. This is an overview of the different forms of money and where their value comes from.

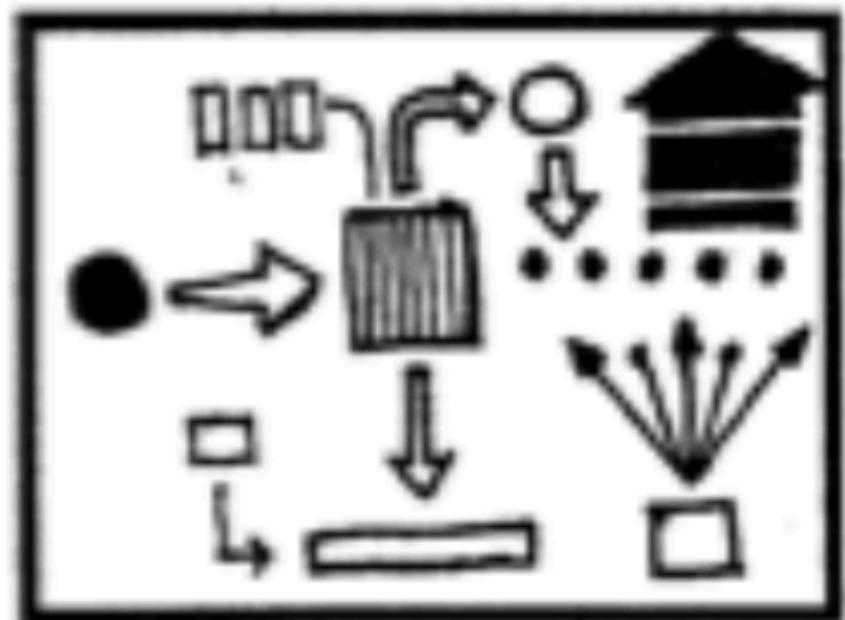


Money Supply

The Money Supply is the amount of available money in the economy. It fluctuates with the market. In times of economic growth, the money supply is high. In a recession, the money supply is low. Lending and spending are two major factors that influence the money supply.



Genres



Flow Chart



Partitioned Poster

755



Steroids or Not, the Pursuit Is On

Barry Bonds is taking aim at the career home run record. He needs only six more to tie Babe Ruth and 47 to equal Hank Aaron.

Lines are cumulative home runs.



Hank Aaron
755 homers
23 seasons



Babe Ruth
714 homers
22 seasons



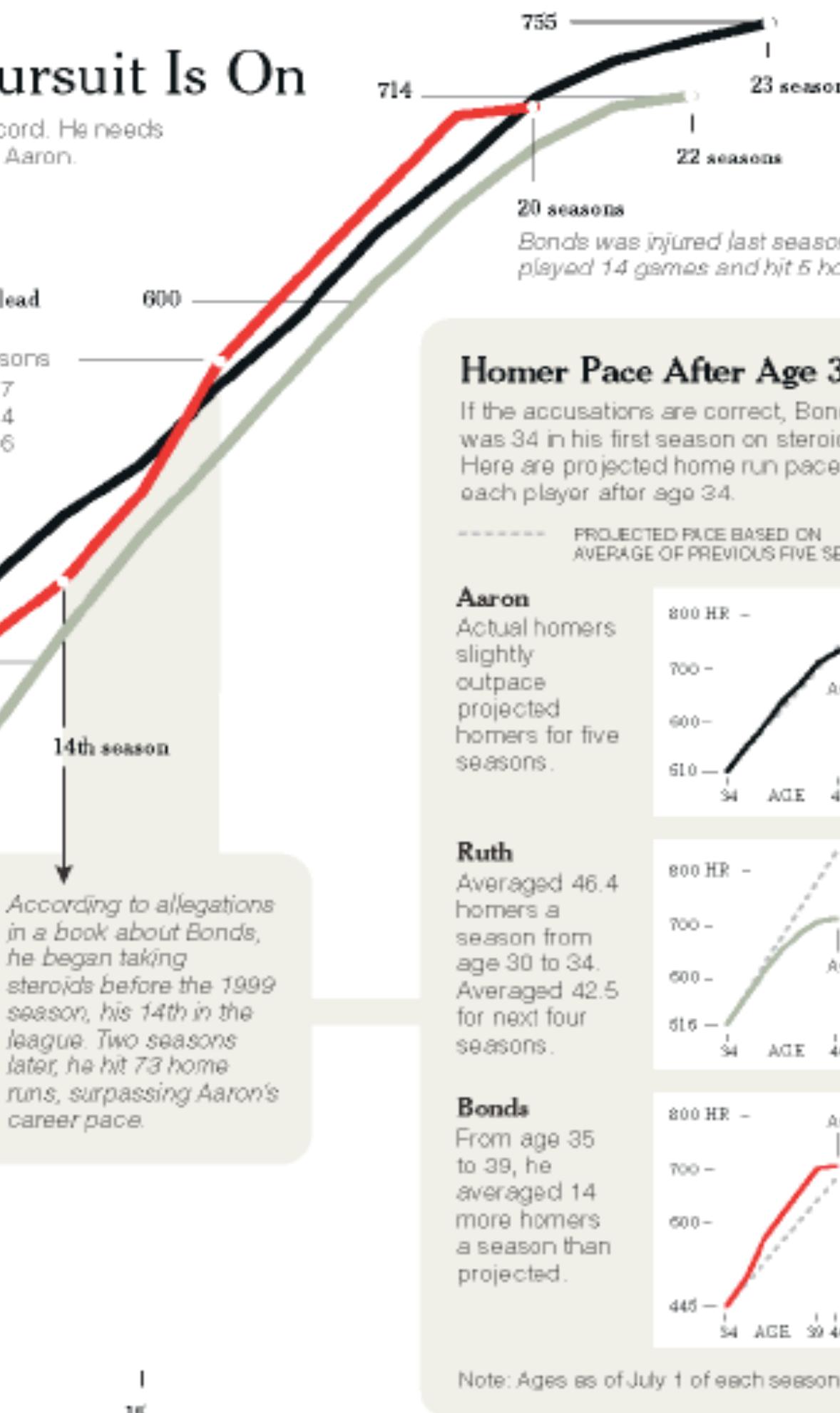
Barry Bonds
708 homers
20 seasons

Bonds takes lead
Home runs after 16 seasons
Bonds 567
Aaron 554
Ruth 516



600
400
200
0

1 5 10 15 SEASONS



According to allegations in a book about Bonds, he began taking steroids before the 1999 season, his 14th in the league. Two seasons later, he hit 73 home runs, surpassing Aaron's career pace.

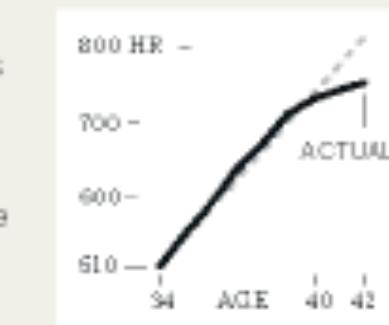
Homer Pace After Age 34

If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS

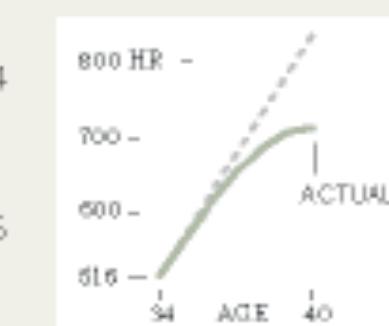
Aaron

Actual homers slightly outpace projected homers for five seasons.



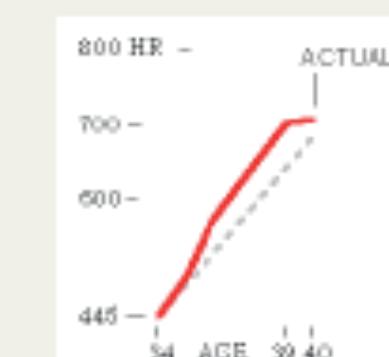
Ruth

Averaged 46.4 homers a season from age 30 to 34. Averaged 42.5 for next four seasons.



Bonds

From age 35 to 39, he averaged 14 more homers a season than projected.

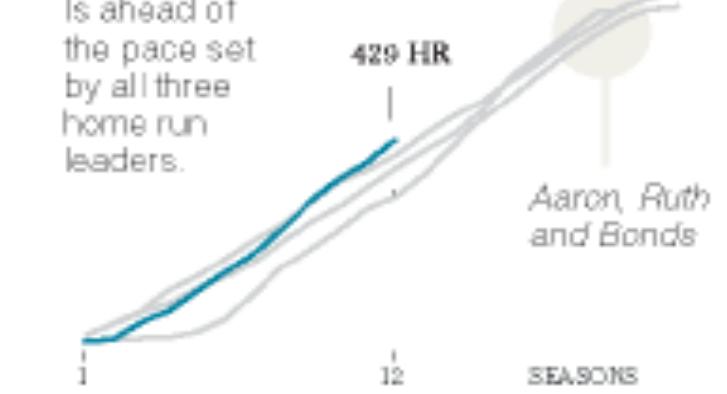


Note: Ages as of July 1 of each season.

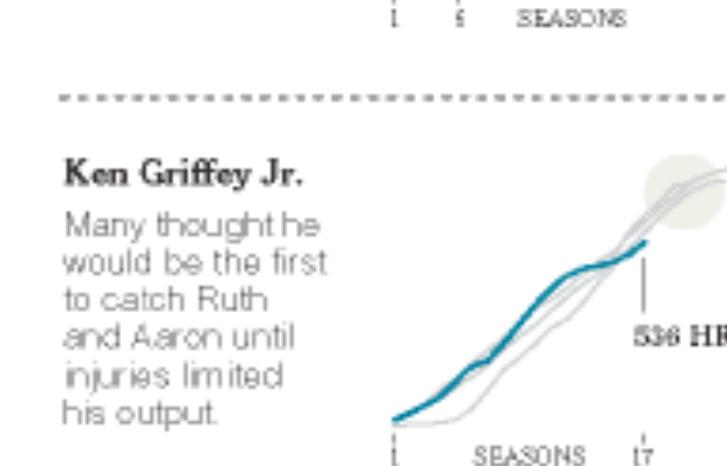
Others Taking Aim



Alex Rodriguez
Is ahead of the pace set by all three home run leaders.



Albert Pujols
Averaging 40 homers a season, he has started stronger than the three leaders did.

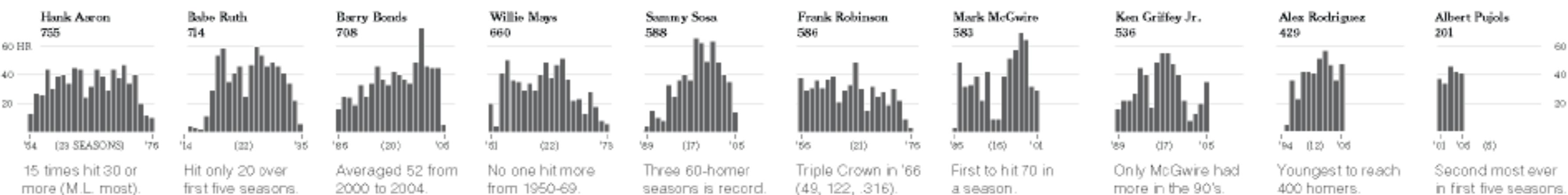


Ken Griffey Jr.
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.

201 HR

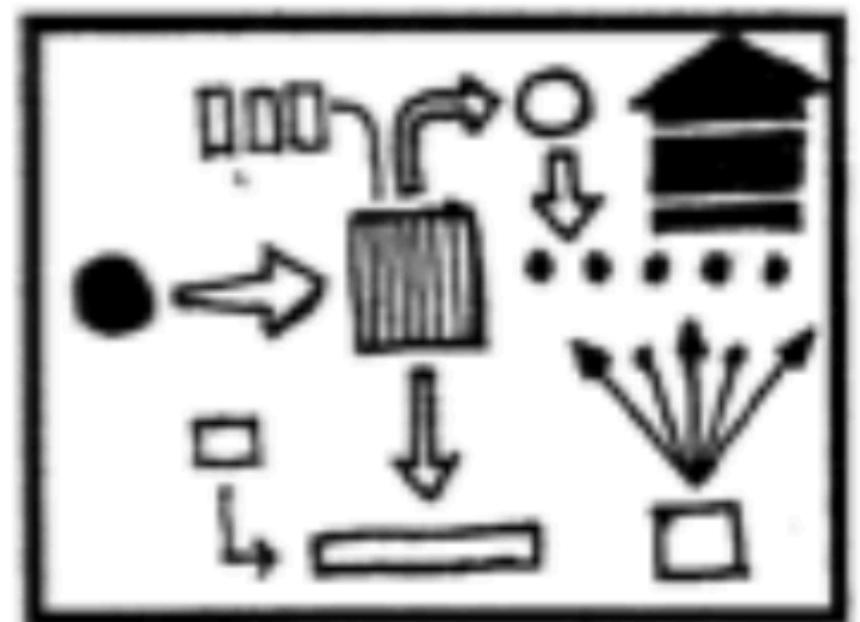
Differing Paths to the Top of the Charts

The top seven players on the career home run list, along with a look at Griffey (12th), Rodriguez (37th) and Pujols (tied 257th).



Annette Cox and Joe Ward/The New York Times

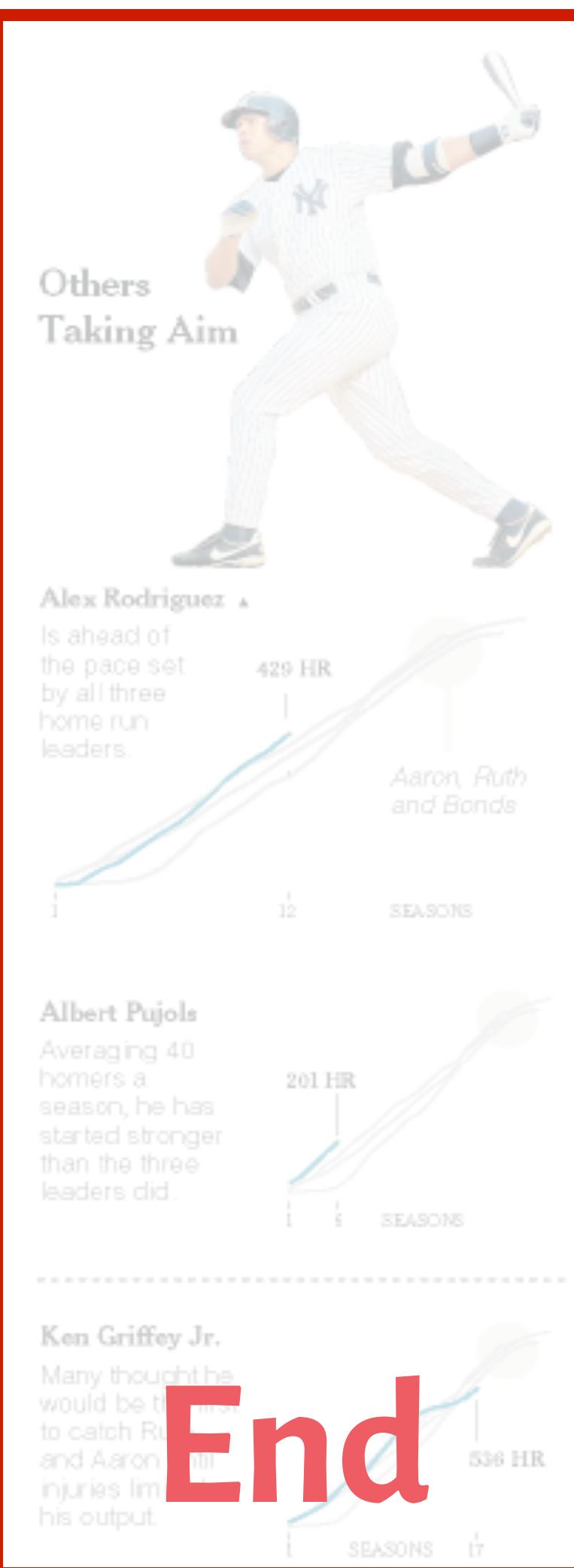
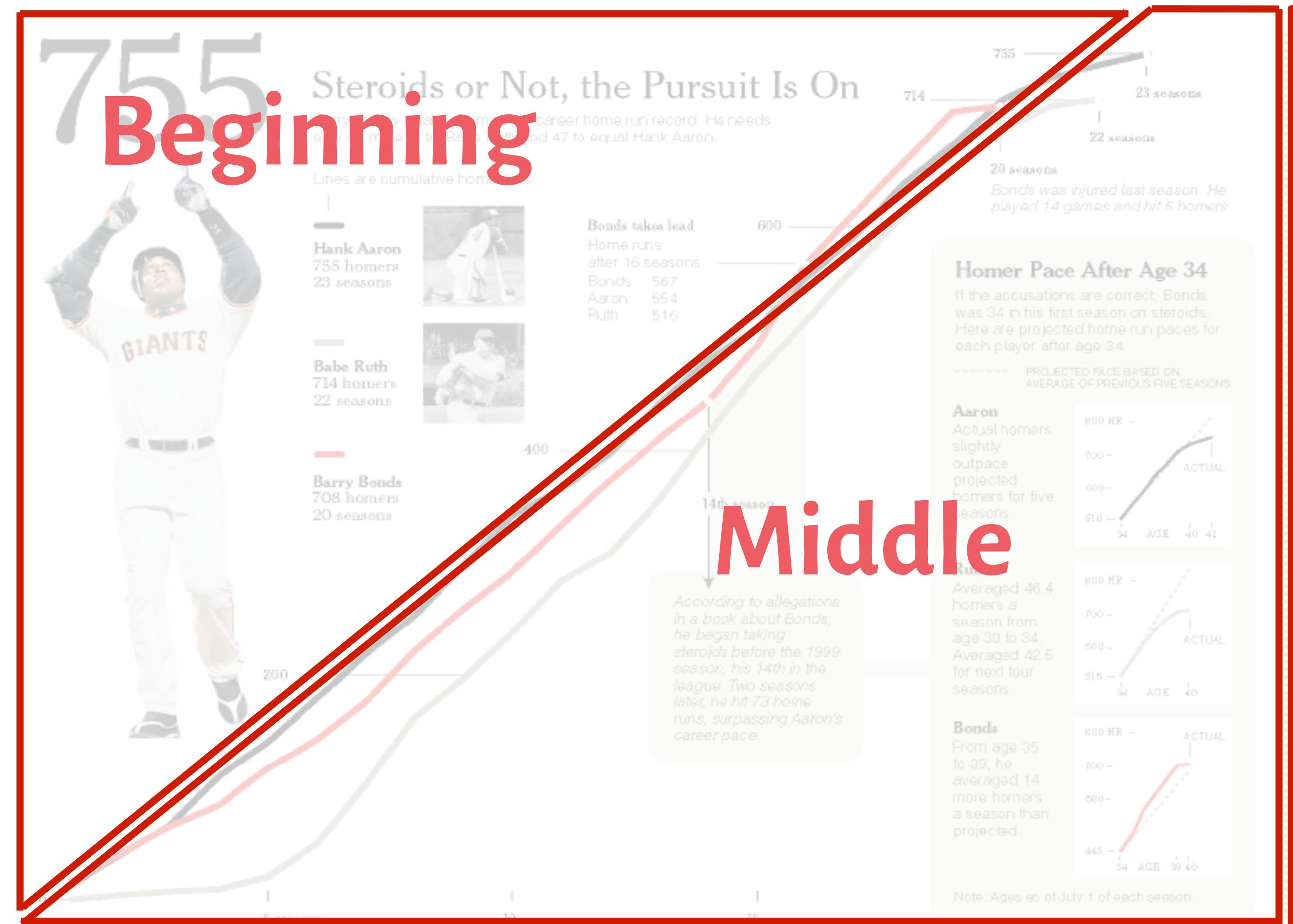
Genres



Flow Chart



Partitioned Poster



Differing Paths to the Top of the Charts



Adrienne Cox and Joe Ward/The New York Times

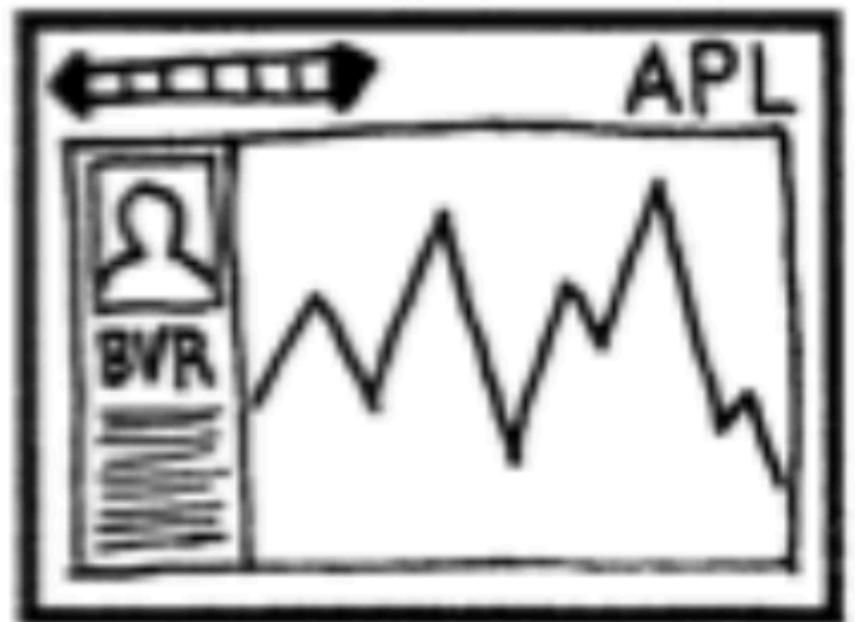
Genres

Published: February 2, 2010

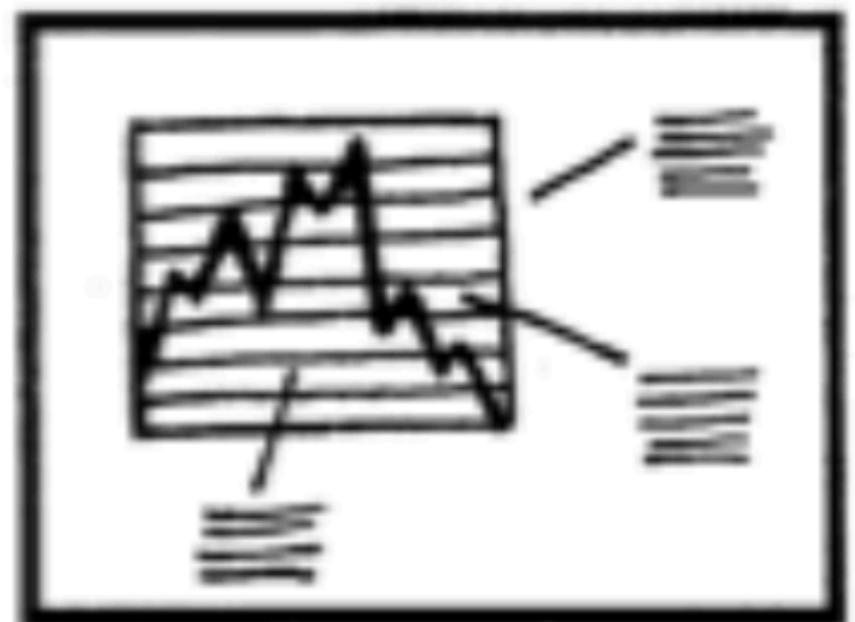
Budget Forecasts, Compared With Reality

Just two years ago, surpluses were predicted by 2012. How accurate have past White House budget forecasts been?

1 2 3 4 5 6 **NEXT ►**



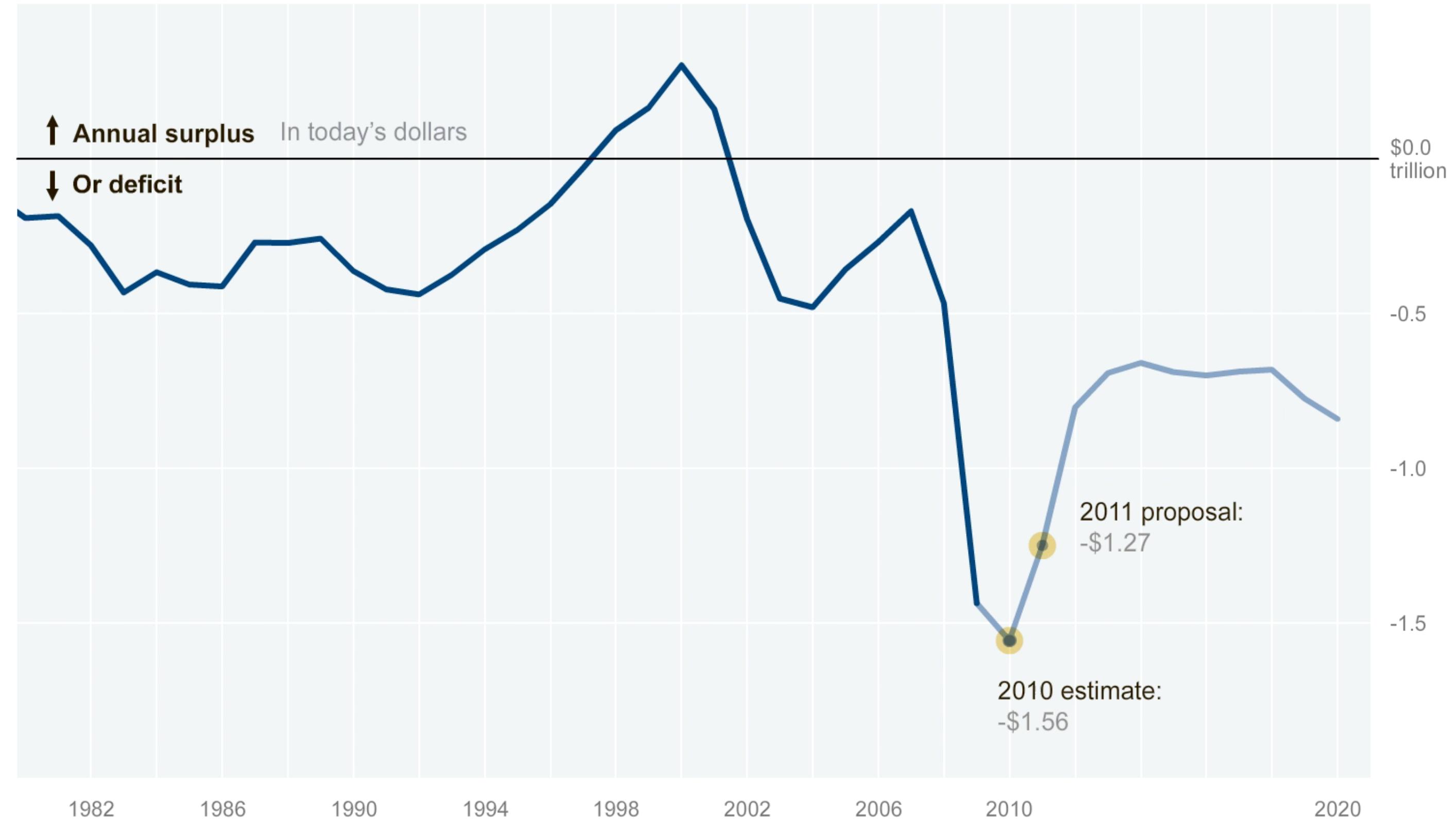
Slide Show



Annotated Chart

Falling short

President Obama's budget proposal estimates a deficit of \$1.6 trillion for the current fiscal year and \$1.3 trillion in 2011.

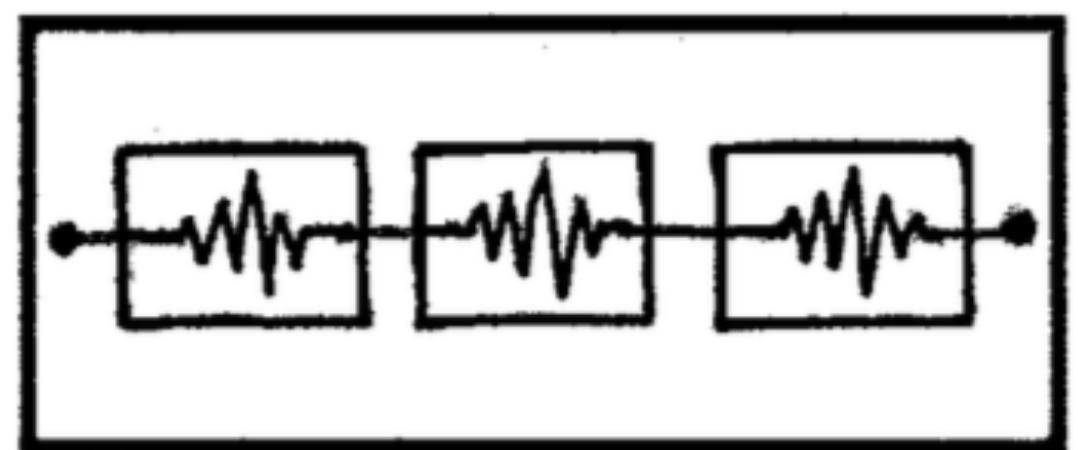


By AMANDA COX | [Send Feedback](#)

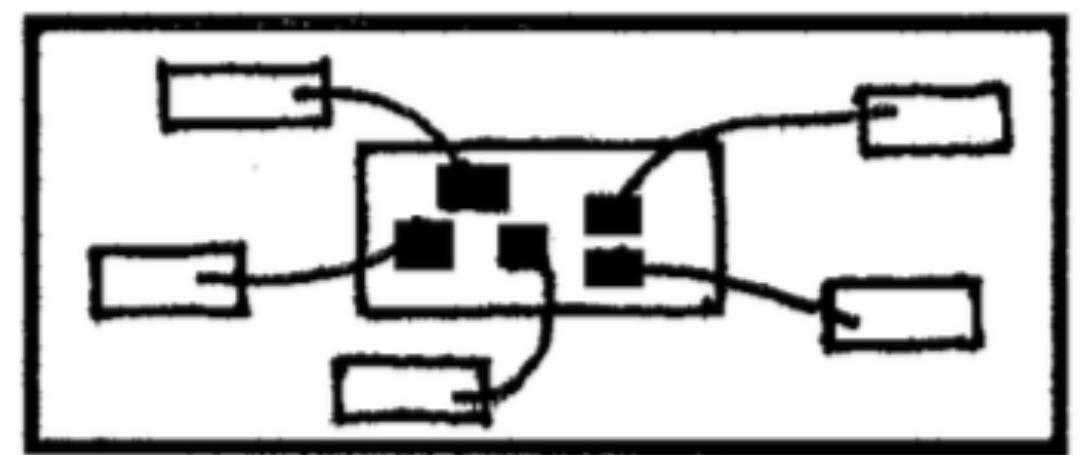
Source: Office of Management and Budget

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Interactive Slideshow



Drill-Down



Author-Driven

[Segel & Heer, *InfoVis 2010*]

Reader-Driven

On the Map: Five Major North Korean Prison Camps

North Korea has operated political prison camps for more than 50 years, twice as long as the Gulag in the former Soviet Union. People suspected of opposing the government are forced to do slave labor in the camps, which hold an estimated 200,000 prisoners. North Korea's government says the camps don't exist, but high-resolution satellite images show otherwise.

RELATED

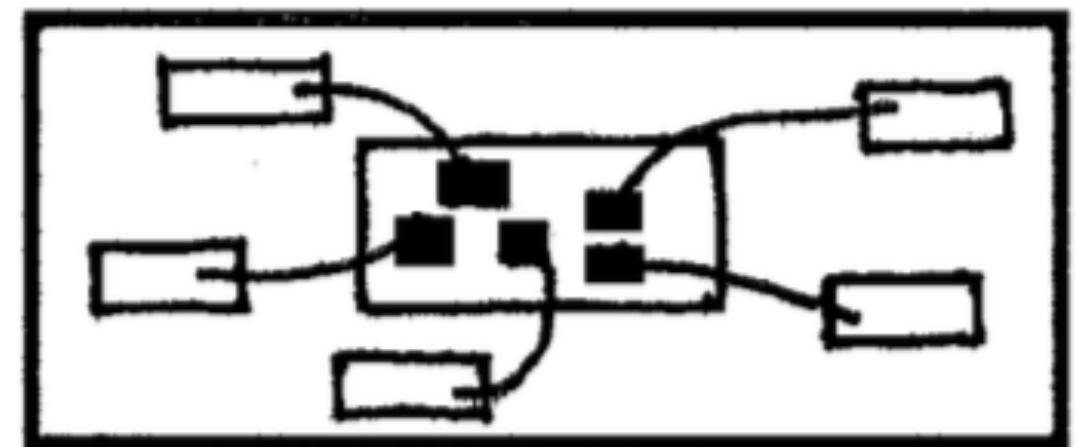
- Article: [On the Diplomatic Back Burner](#)
- [Google Earth: North Korea Uncovered](#)

Click on the  map markers below for more information on each site.

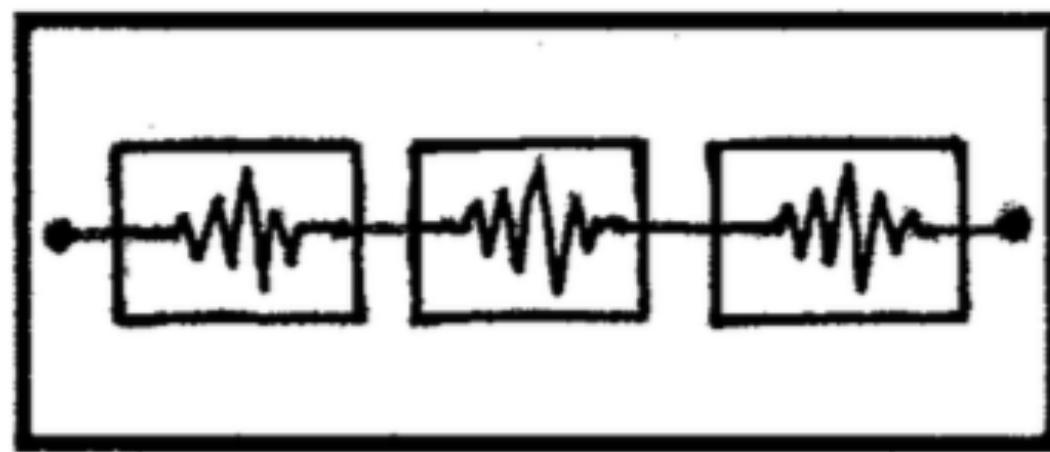


SOURCES: North Korea Uncovered; Korean Bar Association ("2008 White Paper on Human Rights in North Korea"); "The Hidden Gulag," David Hawk, U.S. Committee for Human Rights in North Korea; Joshua Stanton, One Free Korea; interviews with former prisoners and guards; Satellite Images: Google Earth; GRAPHIC: Kat Downs, Blaine Harden, Liz Heron, Laris Karklis and Francine Uenuma - The Washington Post

Drill-Down



Interactive Slideshow



Stepper

Published: February 2, 2010

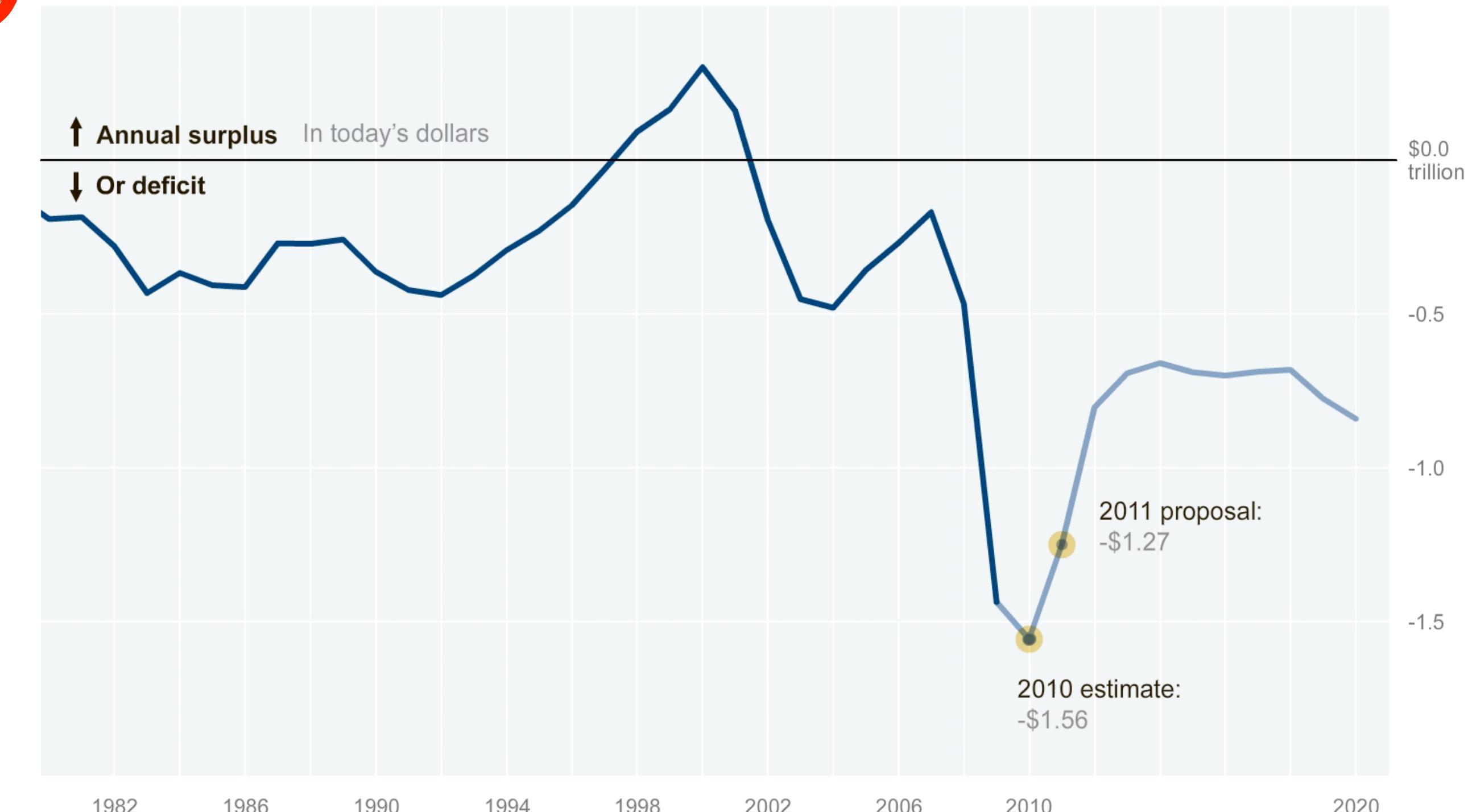
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1 2 3 4 5 6 NEXT ►

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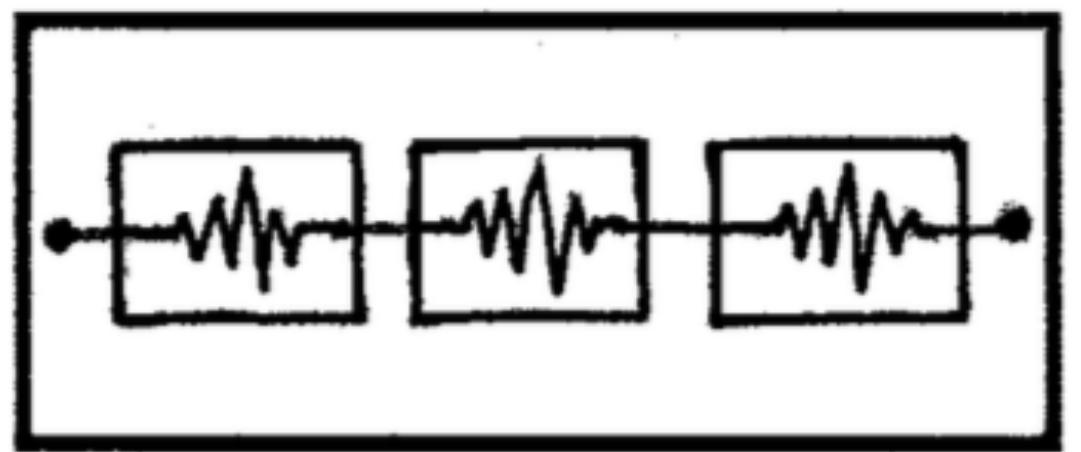
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R2
D3

A visual
introduction to
machine learning

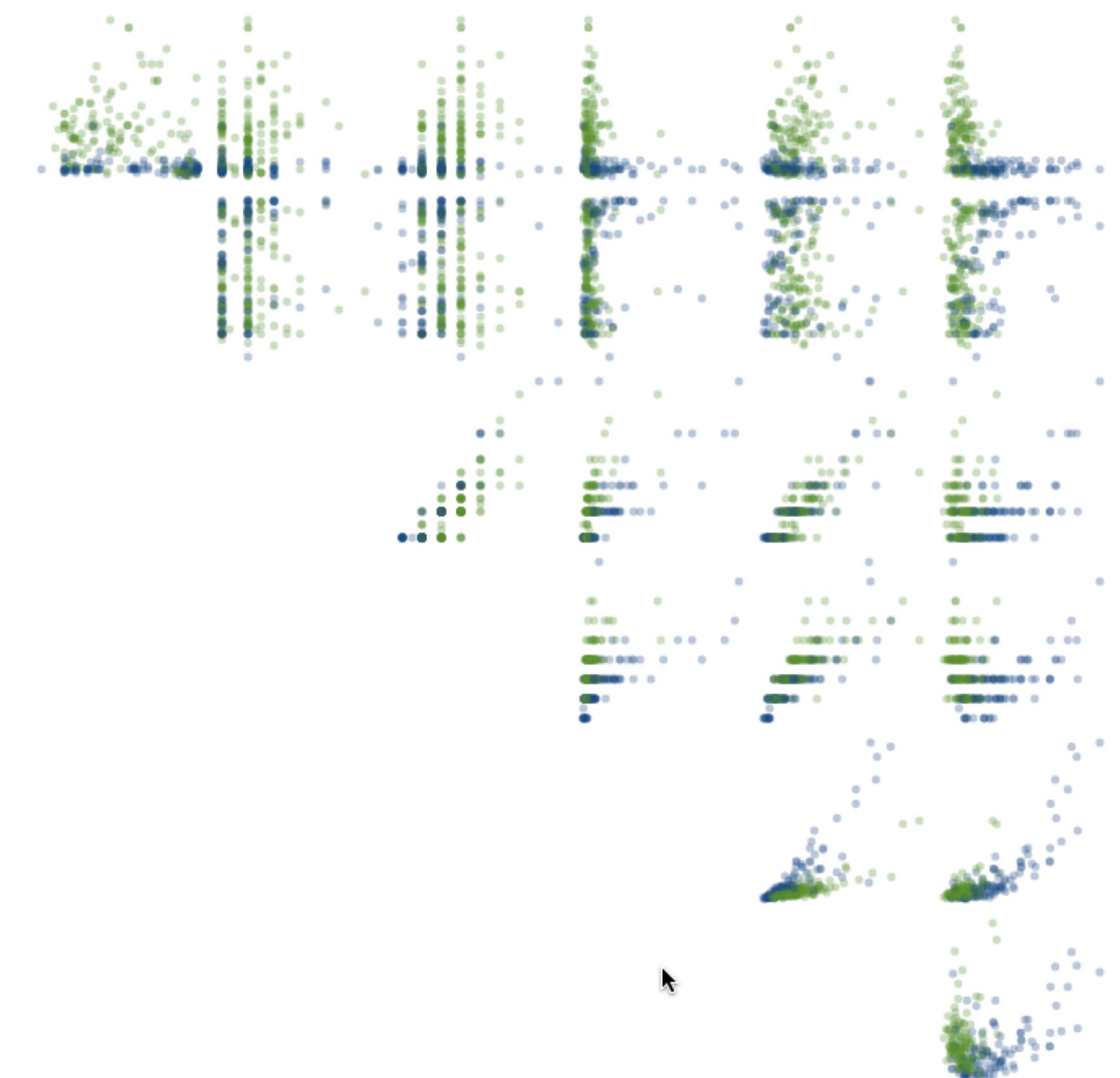
🌐 English ▾

In machine learning, computers apply **statistical learning** techniques to automatically identify patterns in data. These techniques can be used to make highly accurate predictions.

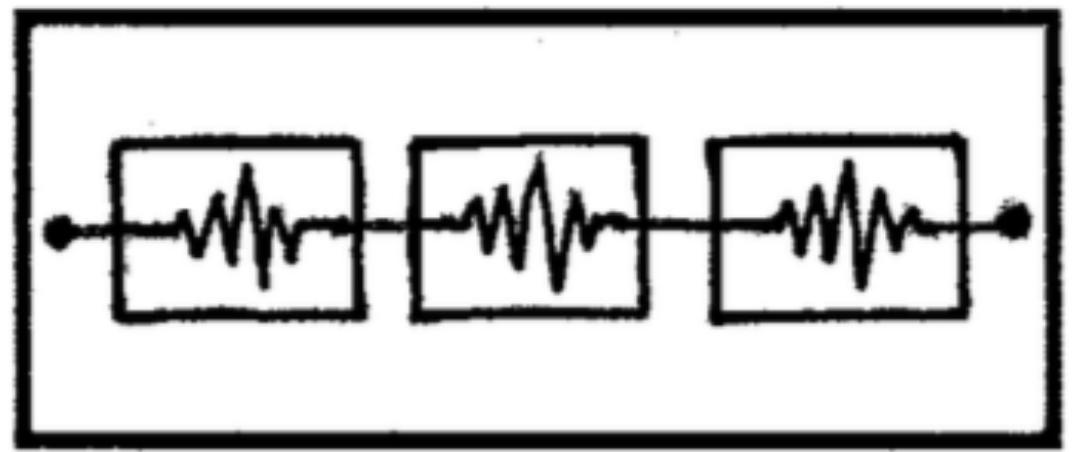
Keep scrolling. Using a data set about homes, we will create a machine learning model to distinguish homes in New York from homes in San Francisco.

“Scrolly”-telling

SCROLL



Interactive Slideshow



R2
D3

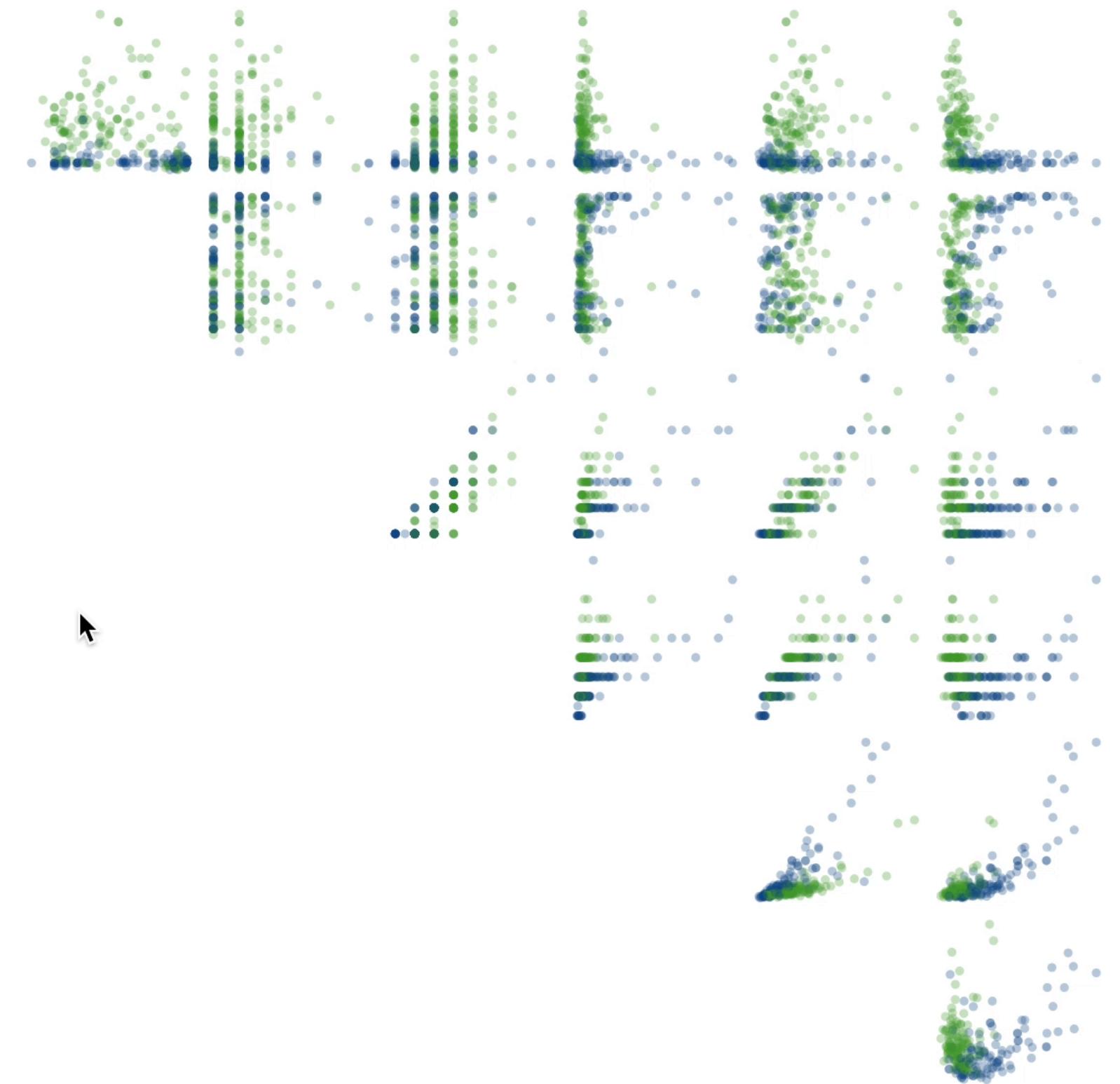
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SCROLL



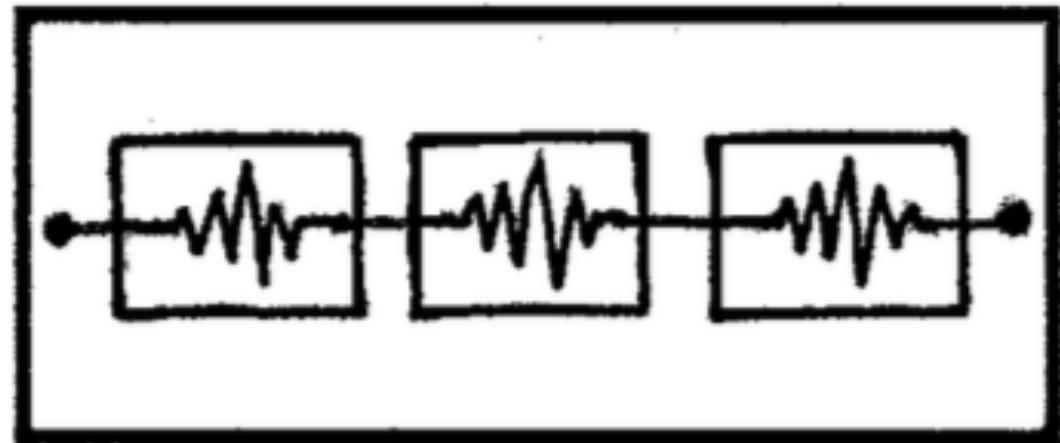
Discrete vs. Continuous Steps

A source of debate among practitioners!

Discrete

- ✓ Simple & familiar.
- ✗ But less engaging?

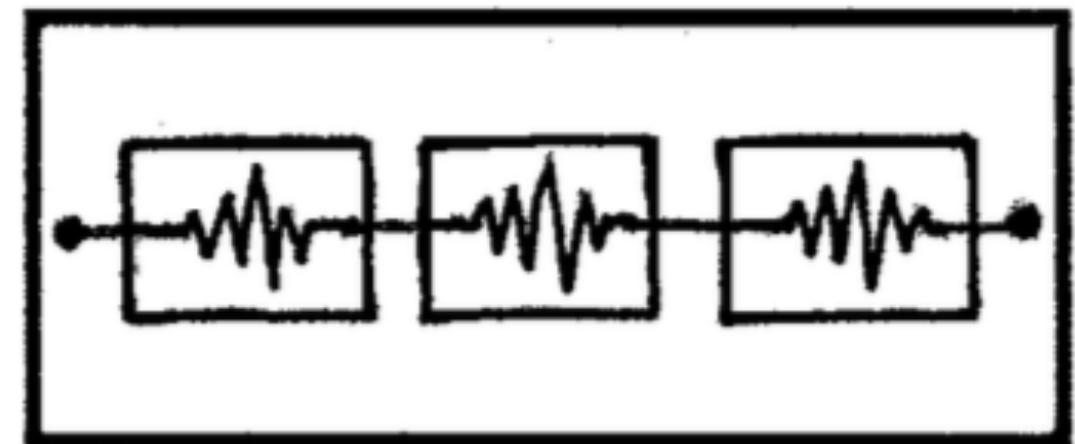
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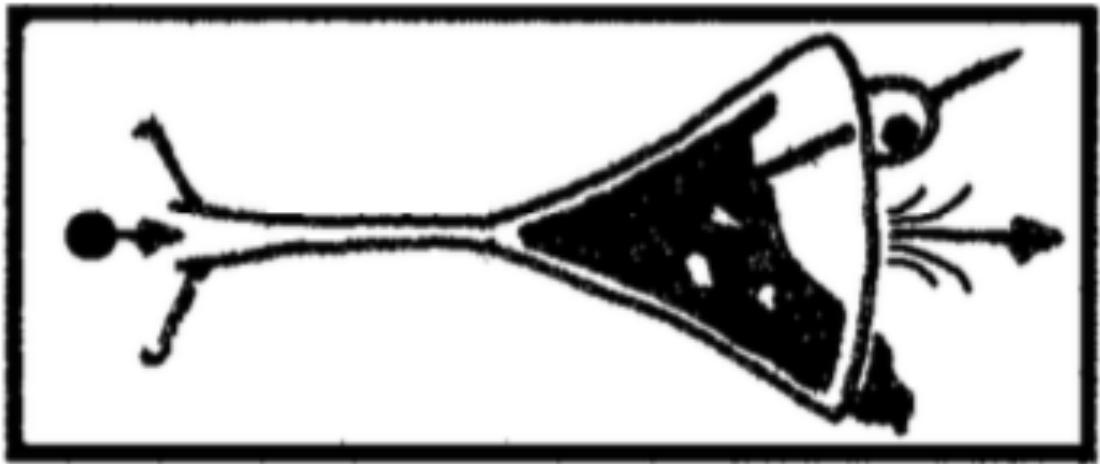
Continuous

- ✓ Less “activation energy” required.
- ✓ More fluid/direct: parameterized by scroll position = rapid, incremental experience.
- ✗ But, difficult to implement properly. Can result in “scrolljacking.”

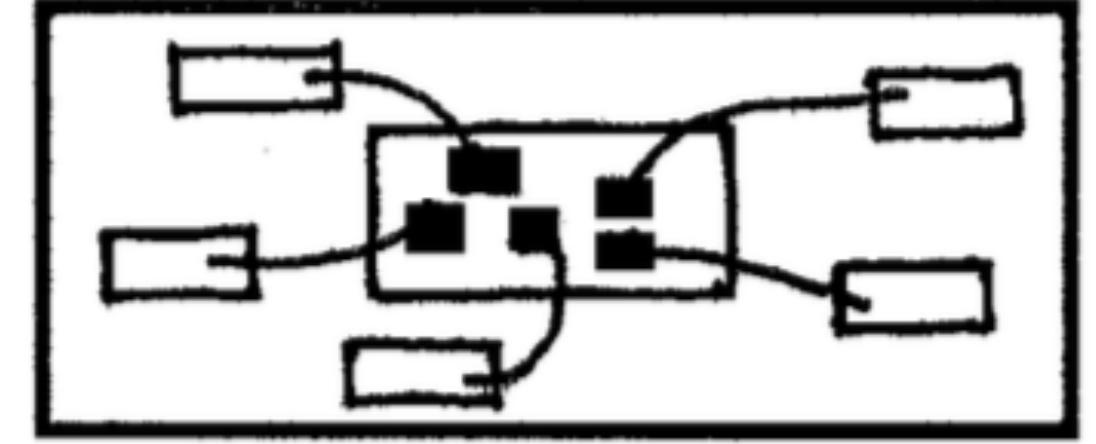
Interactive Slideshow



Martini Glass



Drill-Down



← Author-Driven →

Reader-Driven

Kernel Density Estimation

By: [Matthew Conlen](#)





EXPLORABLE EXPLANATIONS

Lion cubs play-fight to learn social skills. Rats play to learn emotional skills. Monkeys play to learn cognitive skills. And yet, in the last century, we humans have convinced ourselves that play is useless, and learning is *supposed* to be boring.

Gosh, no wonder we're all so miserable.

Welcome to **Explorable Explanations**, a hub for learning through play! We're a disorganized "movement" of artists, coders & educators who want to *reunite play and learning*.

Let's get started! Check out these **3 random Explorables**:

Explorable Explanations

Bret Victor / March 10, 2011

What does it mean to be an **active reader**?

An active reader asks questions, considers alternatives, questions assumptions, and even questions the trustworthiness of the author. An active reader tries to generalize specific examples, and devise specific examples for generalities. An active reader doesn't passively sponge up information, but uses the author's argument as a springboard for critical thought and deep understanding.

Do our reading environments encourage active reading? Or do they utterly oppose it? A typical reading tool, such as a book or website, displays the author's argument, and nothing else. The reader's line of thought remains internal and invisible, vague and speculative. We form questions, but can't answer them. We consider alternatives, but can't explore them. We question assumptions, but can't verify them. And so, in the end, we blindly trust, or blindly don't, and we miss the deep understanding that comes from dialogue and exploration.

Explorable Explanations is my umbrella project for ideas that *enable and encourage truly active reading*. The goal is to change people's relationship with text. People currently think of text as *information to be consumed*. I want text to be used as an *environment to think in*.

This essay presents examples of a few initial ideas:

A **reactive document** allows the reader to play with the author's assumptions and analyses, and see the consequences.

An **explorable example** makes the abstract concrete, and allows the reader to develop an intuition for how a system works.

Contextual information allows the reader to learn related material just-in-time, and cross-check the author's claims.



In the case of California, there are many windy areas that are perfect for wind turbines. A significant portion with wind turbines, however, is that the wind is an unreliable source of energy. It is not windy all of the time, which means that when there is no wind power, energy can't be produced. In California, it is generally windy during the summer time when the wind farms located from coastal locations, like the ocean, and then replaces the hot rising air from California's central valley and desert.

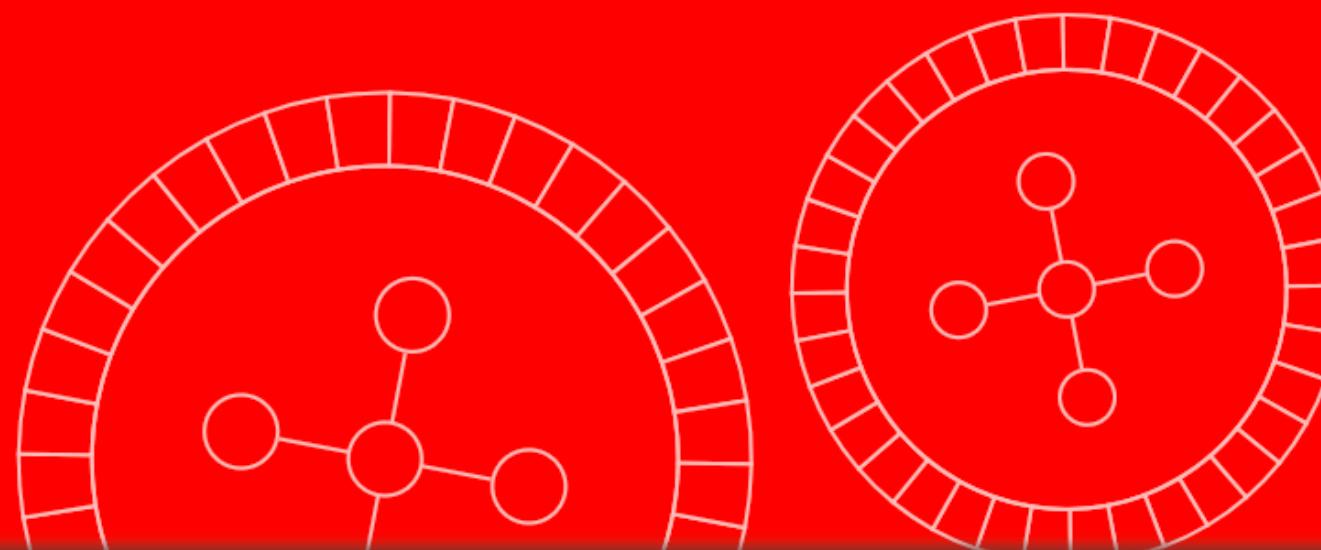
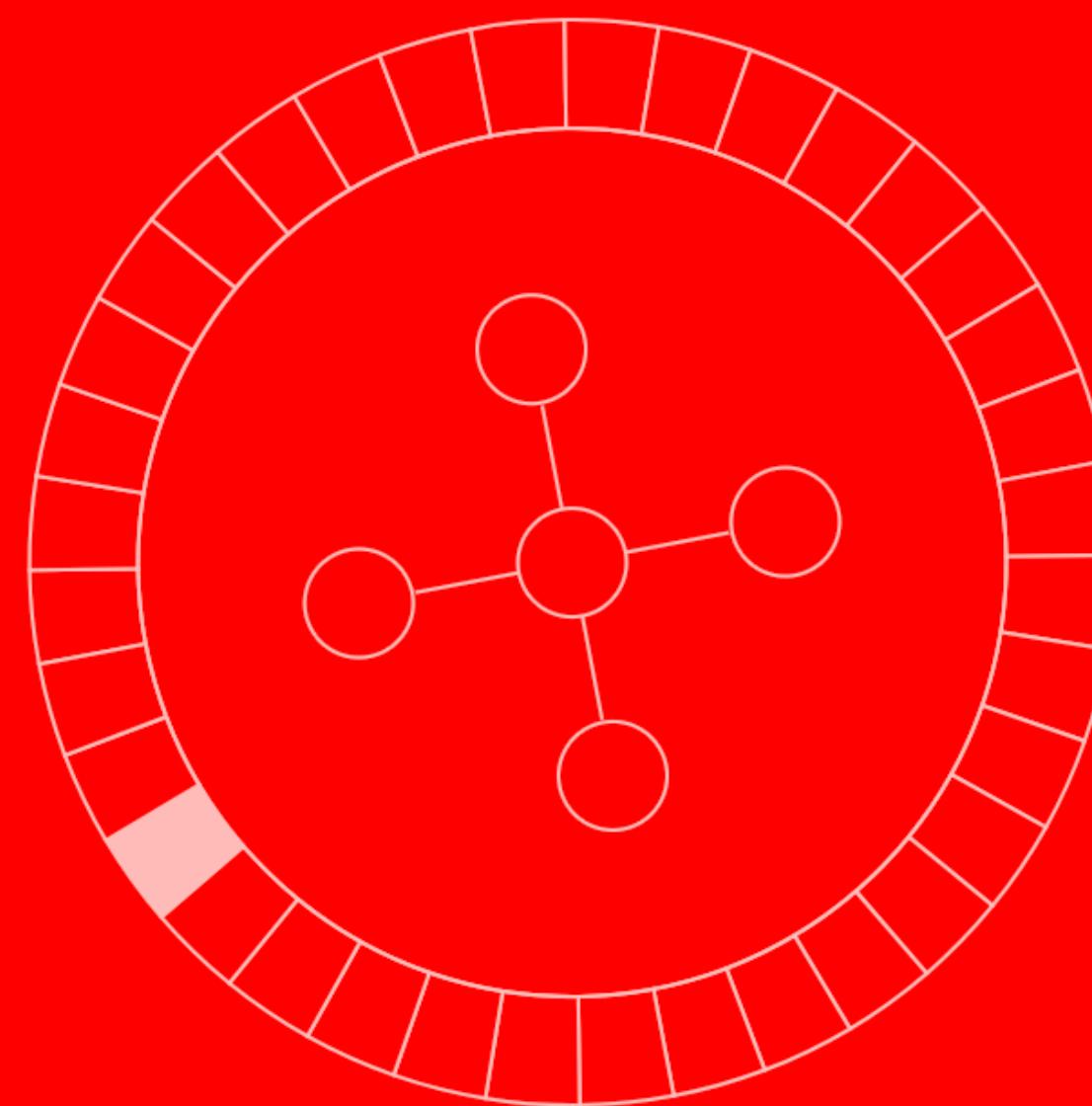
In the case of [California wind](#), there are many windy areas that are perfect for wind turbines. A significant portion with wind power in California has been an area of concentrated activity for many years. California was the first U.S. state where large wind farms were developed, beginning in the early 1980s. By 1988, California produced 30% of the entire world's wind energy capacity. Overall, about 10% of California's electricity comes from wind power. This situation has changed, and now, currently the nuclear or wind power development in the state is driven by taxes and regulations.

Wind power in California is a significant portion with 10% of the time, which means solar during the summer to 'hot rising air from California's central valley and desert'.

Hooked: how pokies are designed to be addictive

Poker machines use a range of design features that leverage psychology to keep people playing. Here, we break them down so you can see exactly how they work, and how they affect people

Tip: this feature uses sound. You can turn off sound at the top right, but we recommend leaving it on

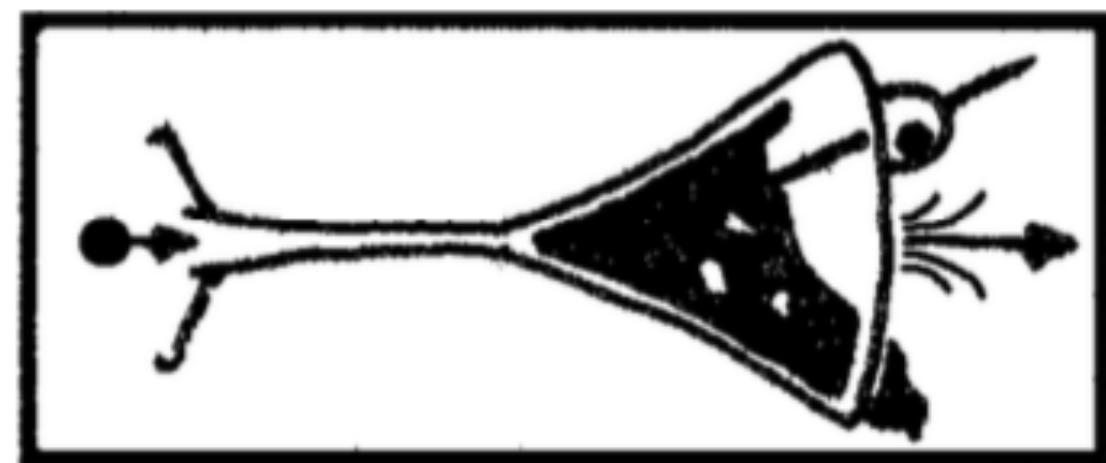


 The UpshotFOLLOW US:
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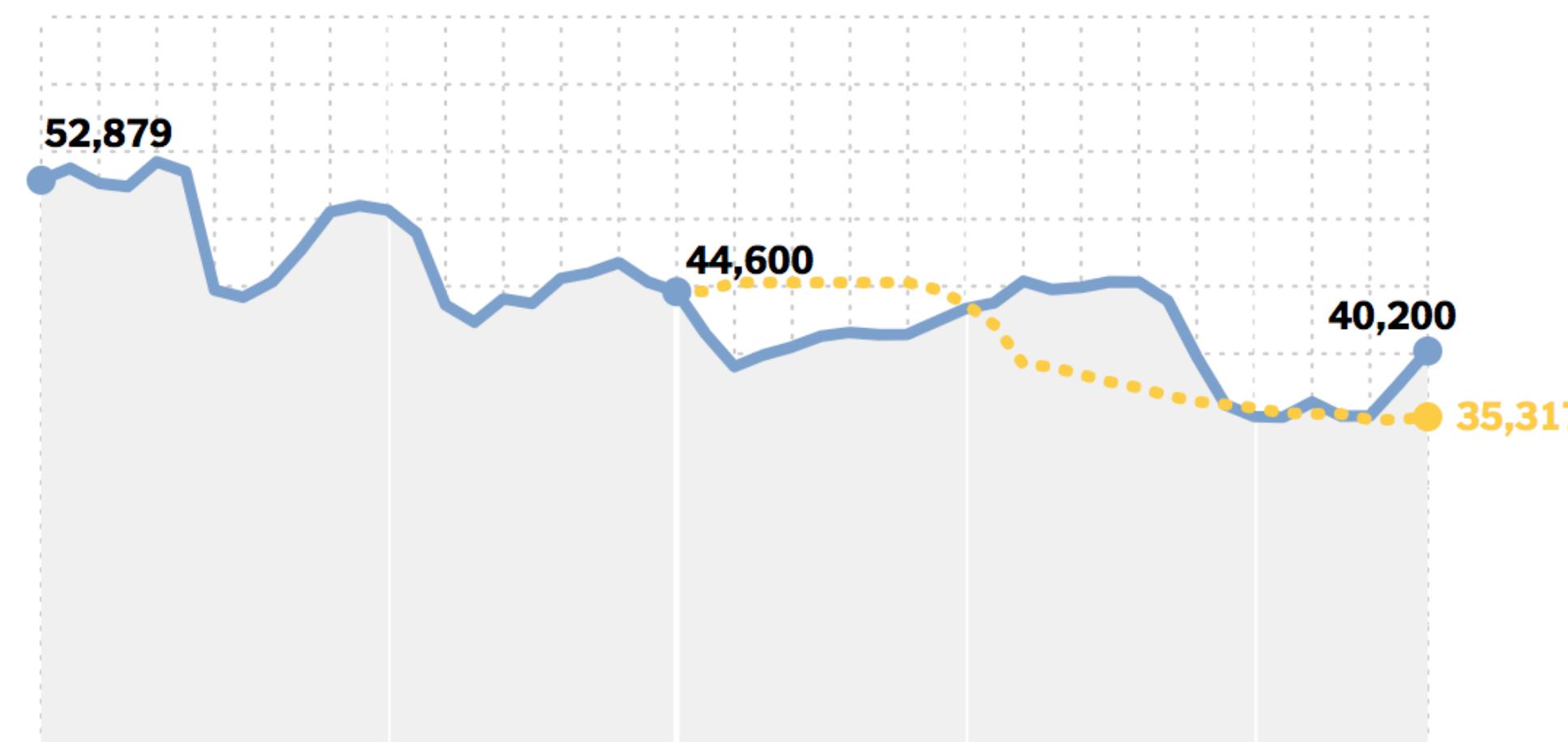
You Draw It: Just How Bad Is the Drug Overdose Epidemic?

Martini Glass

By JOSH KATZ UPDATED October 26, 2017

How does the surge in drug overdoses compare with other causes of death in the U.S.? Draw your guesses on the charts below.

Since 1990, the number of Americans who have died every year from **car accidents**...

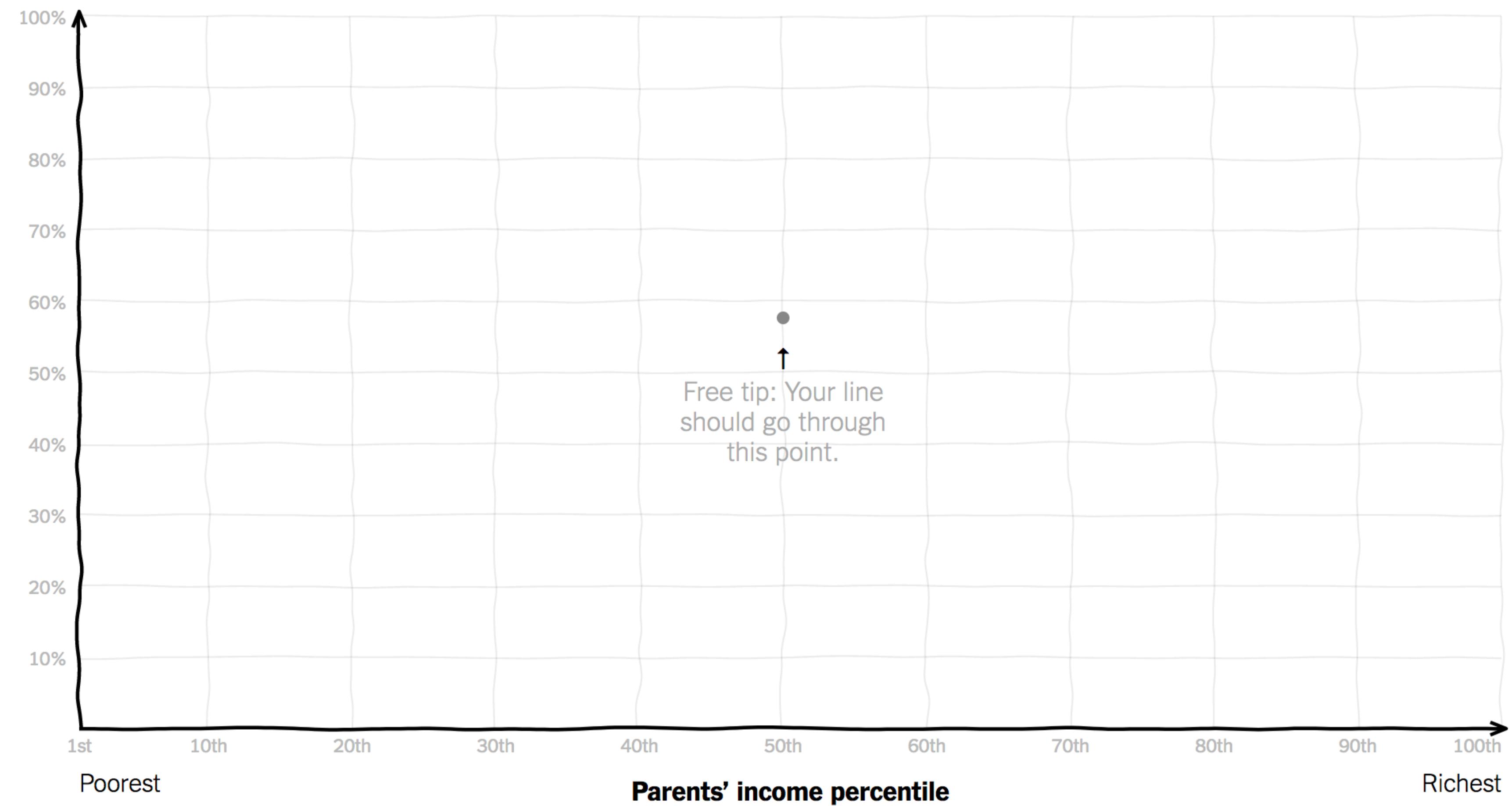




yellkey.com/outside

Draw your line on the chart below

Percent of children who attended college



Belief-Driven Narratives

Engage users by surprising them:
sketching predictions to emphasize gap
between beliefs and observed data.

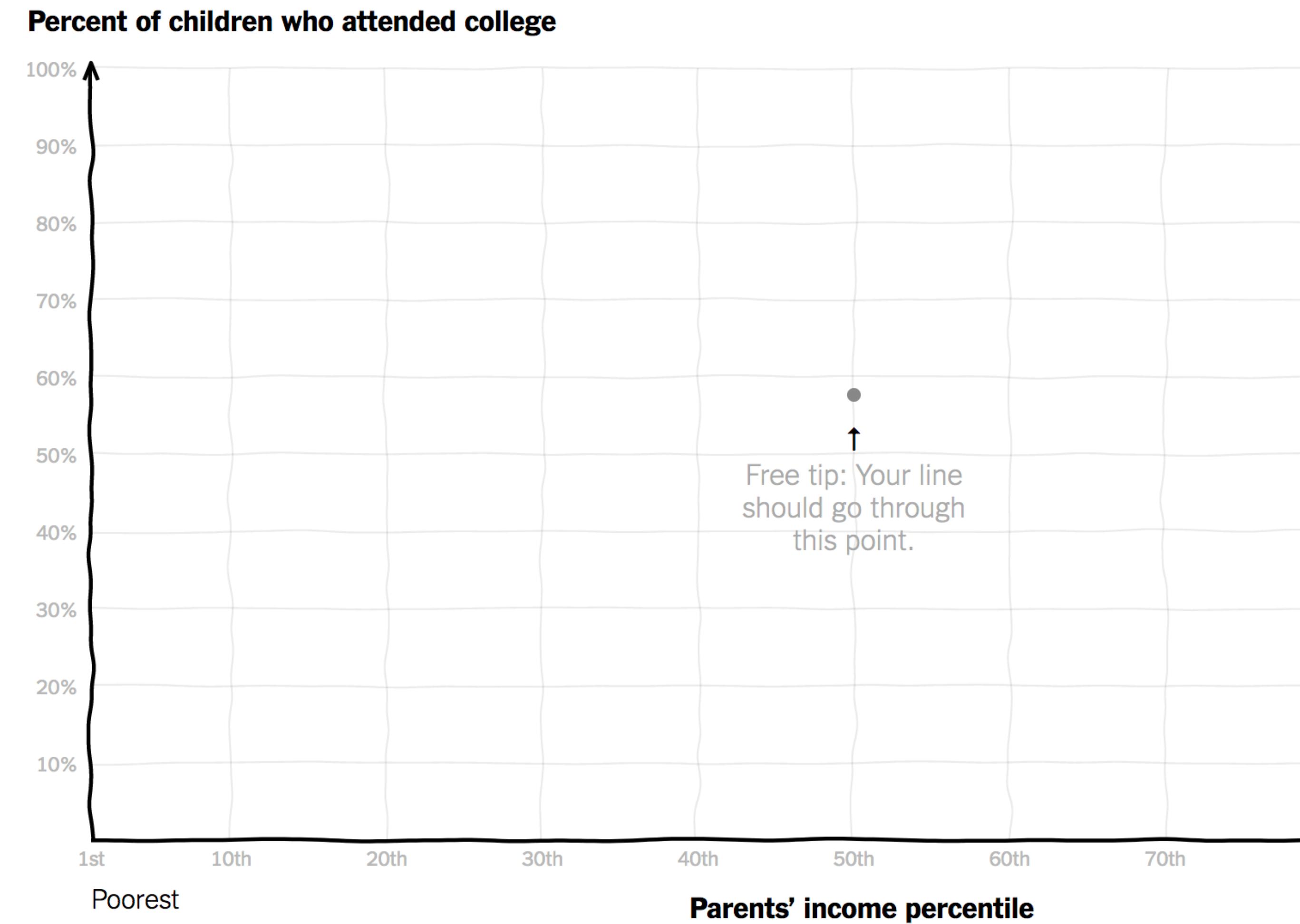
Provide active learning: prompt readers
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on errors they made.

[Kim et al., InfoVis 2017]

[Kim et al., CHI 2017]

[Nguyen et al., C+J 2019]

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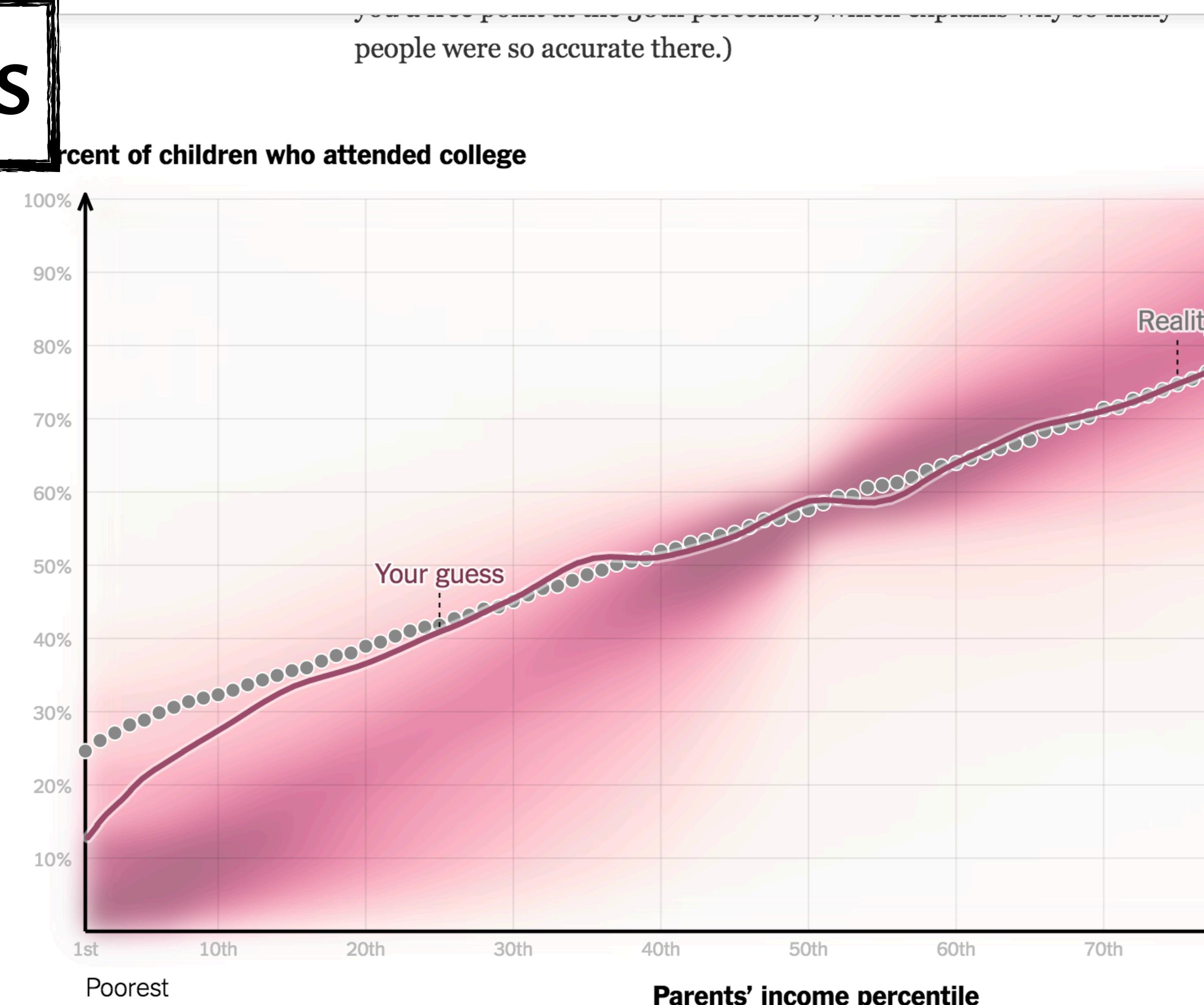


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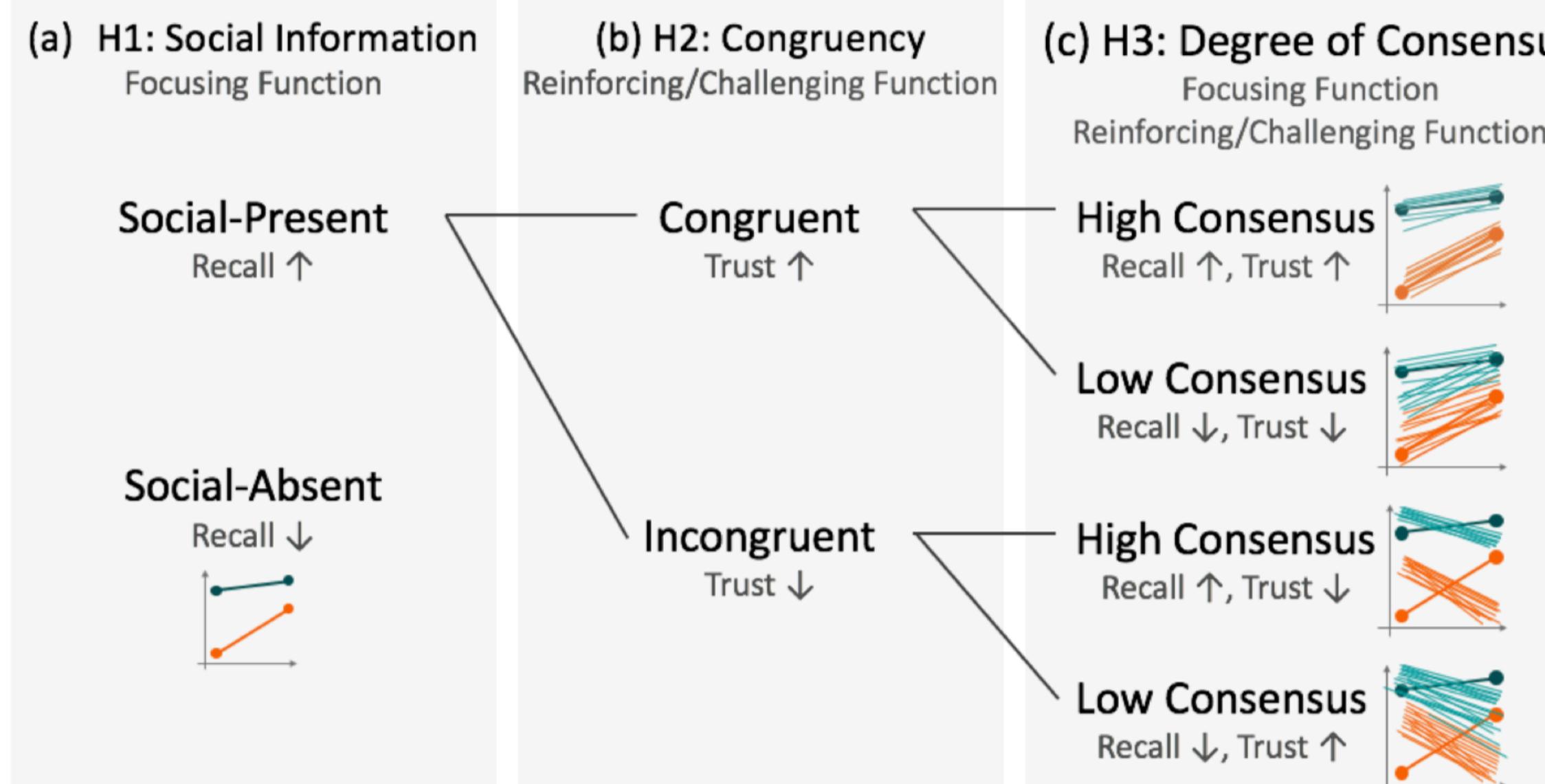
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Moving up a single percentile on the family-income distribution makes enrolling in college about 0.7 percentage points more likely, up and down the distribution. Whether you're a poor child getting a little bit less poor or a rich child getting slightly more rich, every step counts

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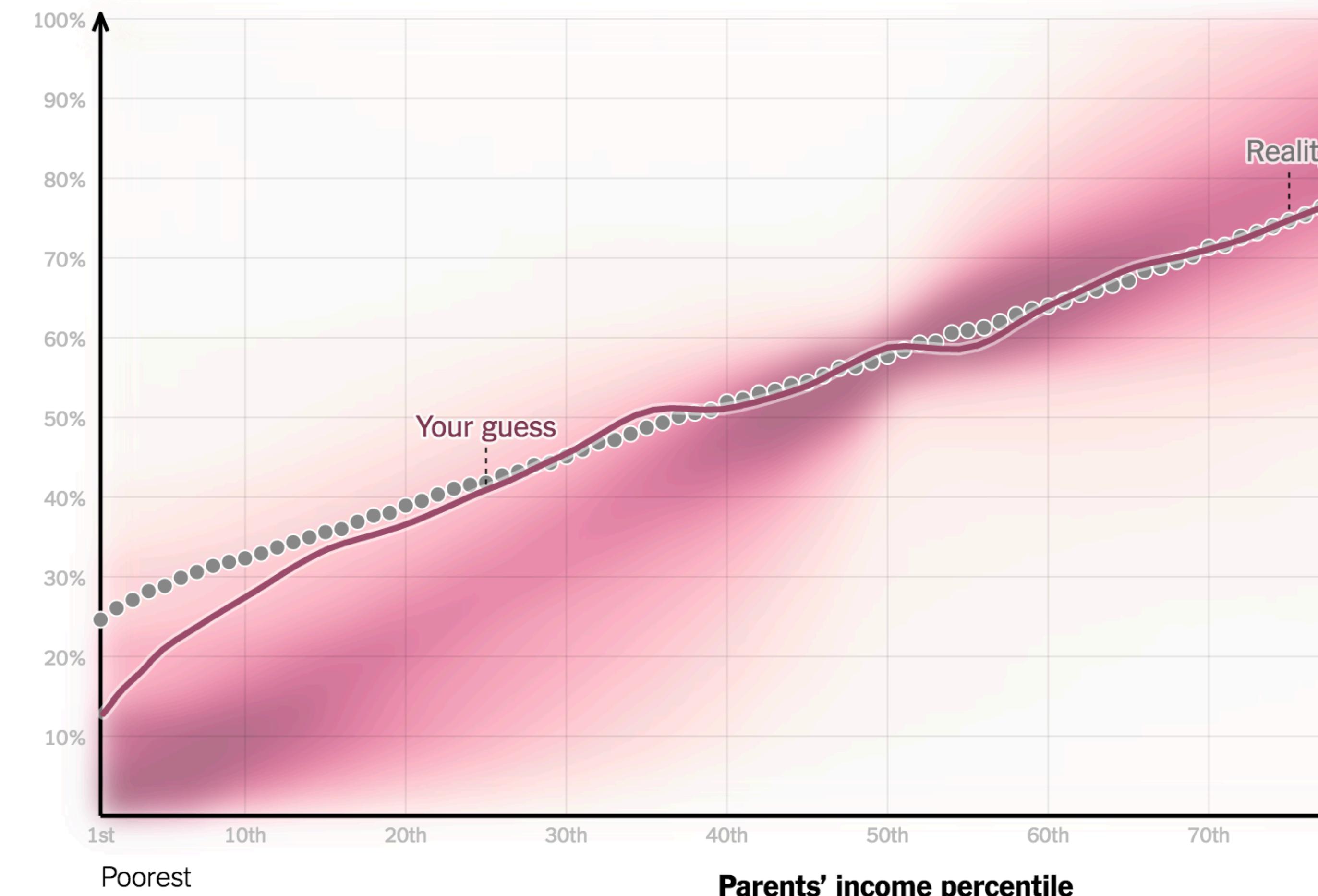


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Contextualizing Data

Data is Personal: people want to find themselves
in the dataset. [Peck et al., CHI 2019]

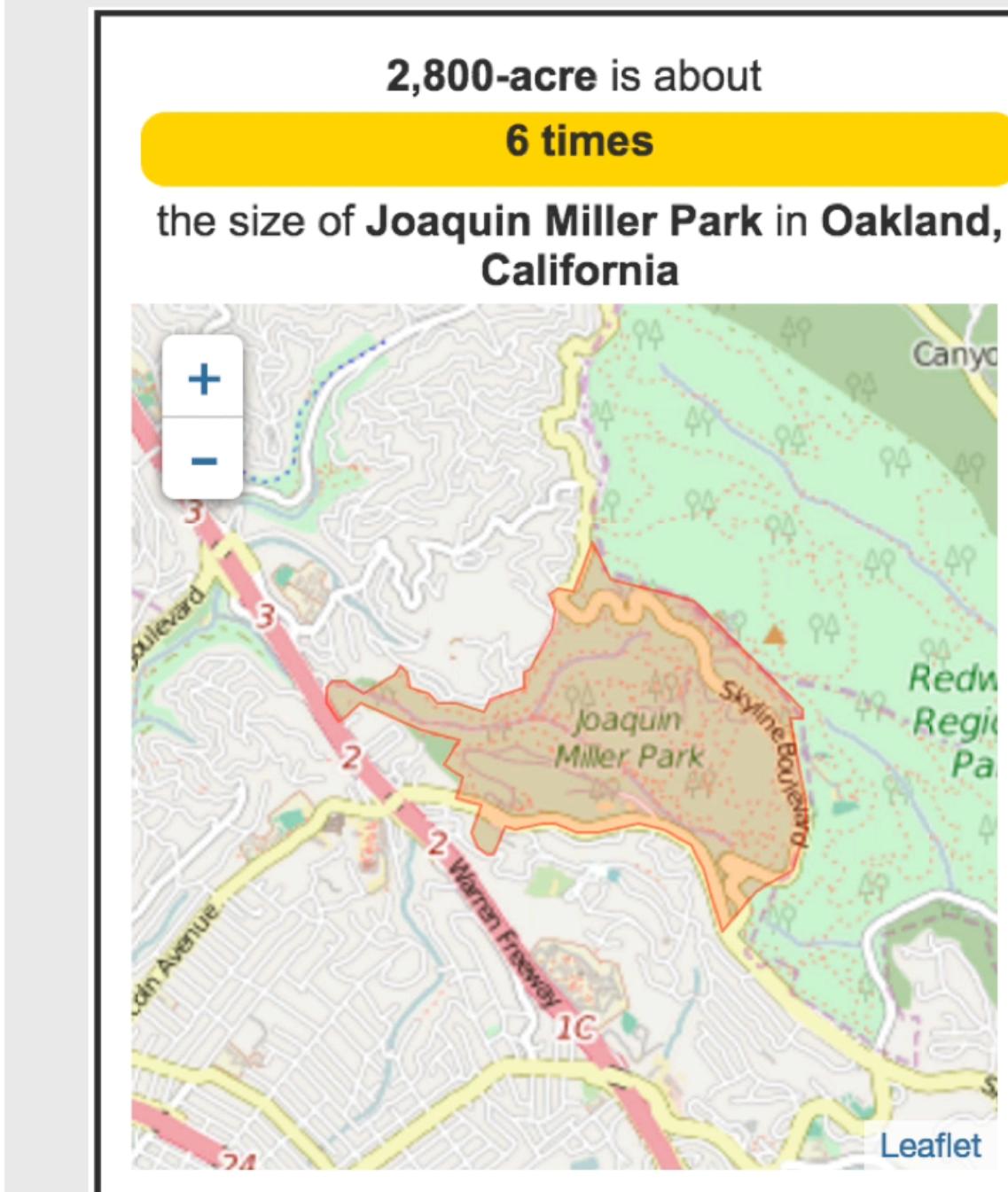
How Much Hotter Is Your Hometown Than When You Were Born?

As the world warms because of human-induced climate change, most of us can expect to see more days when temperatures hit 90 degrees Fahrenheit (32 degrees Celsius) or higher. See how your hometown has changed so far and how much hotter it may get.

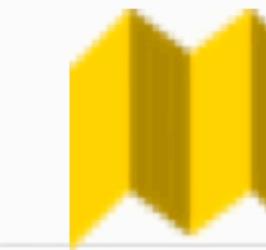
Your hometown

Birth year

Please enter your information to continue.



ATLAS OF ME



On-demand personalized maps for
unfamiliar distances, areas, and locations.

Created by Yea-Seul Kim, Francis Nguyen, and Jessica Hullman, University of Washington

Improving Comprehension of Measurements Using Concrete Re-expression Strategies

Visualization Rhetoric

Rhetorical Categories

Information Access
Provenance
Mapping
Procedural
Linguistic

Editorial Layers

Data
Visual Representation
Annotation
Interactivity

“We use the term rhetoric to refer to the set of processes by which intended meanings are represented in the visualization via a designer's choices and then shaped by individual end-user characteristics, contextual factors, [...]”

While this term may bring to mind negatively connotated notions [...] **we seek to objectively describe** the rhetorical nature of visualization design rather than to comment on the appropriateness of persuasion.”

“We gathered a sample of fifty-one professionally-produced narrative visualizations, many from international news outlets like the New York Times (NYT) or BBC. In the interest of diversity, we also included online visualizations from news magazines, local news providers, political outlets, and independent graphic designers.”

Information Access Rhetoric

Omission – a necessary evil? Trade-off overcomplicating a variable vs. defining it ambiguously? What are strategies to deal with this?

Filtering – puts rhetoric choices in readers' hands. Does this absolve the author of any responsibility?

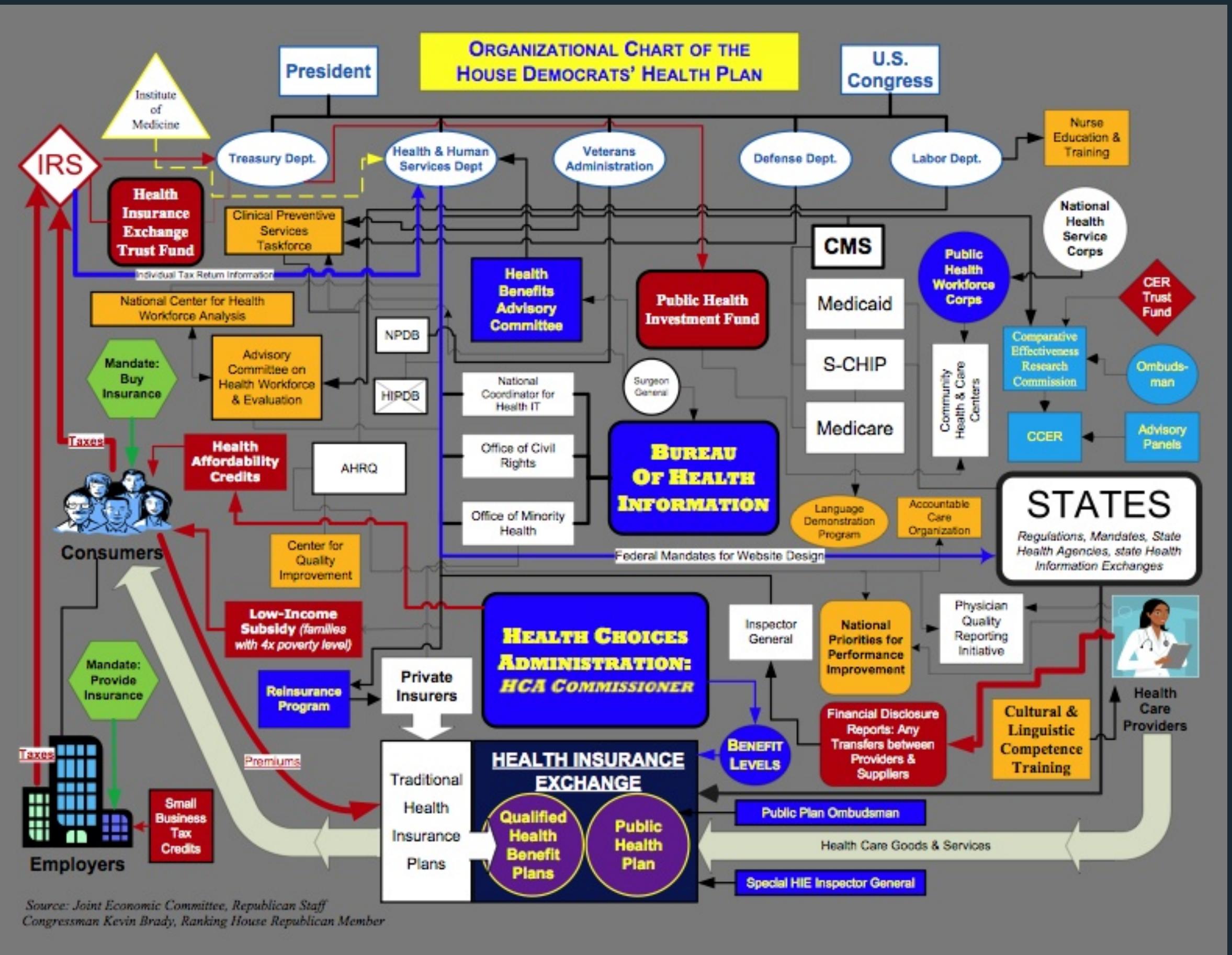
What might best practices be?

Provenance Rhetoric

Is this even necessary? Does it accomplish what authors think?
Who is it serving (readers or “virtue-signaling” to other authors?).

Trade-off with information access? Does citing sources contradict/
preclude omission techniques?

Mapping Rhetoric



Organizational Chart of the House Democrats' Health Plan

