

Good for Scientists Bad for Society

What happens when our charts
don't change our minds?



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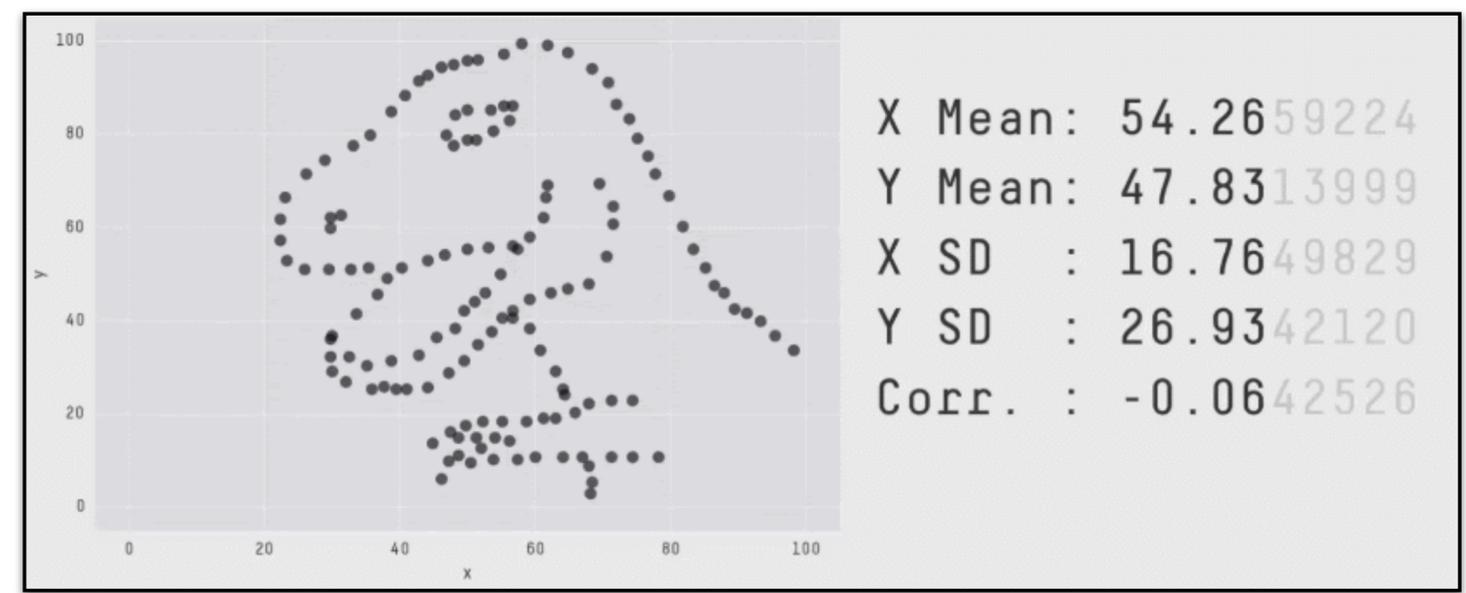
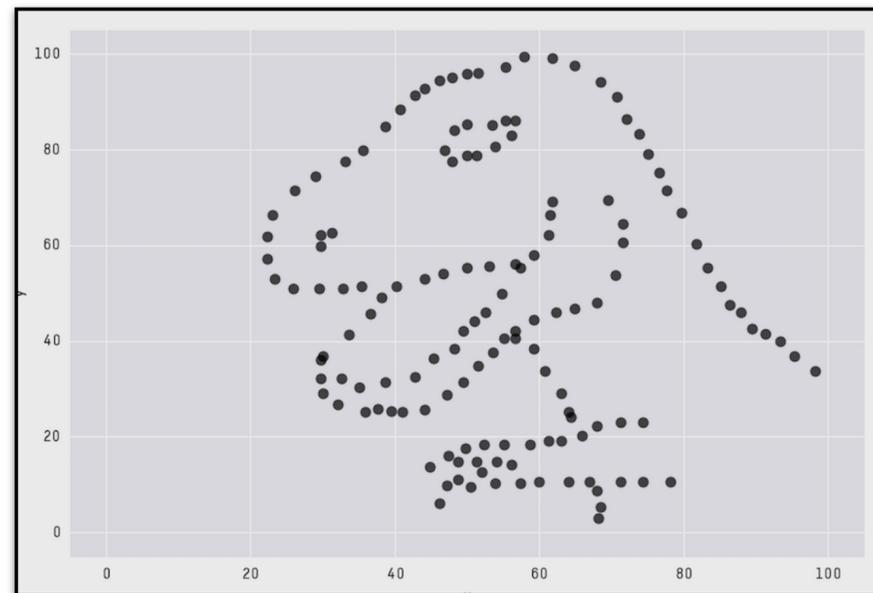
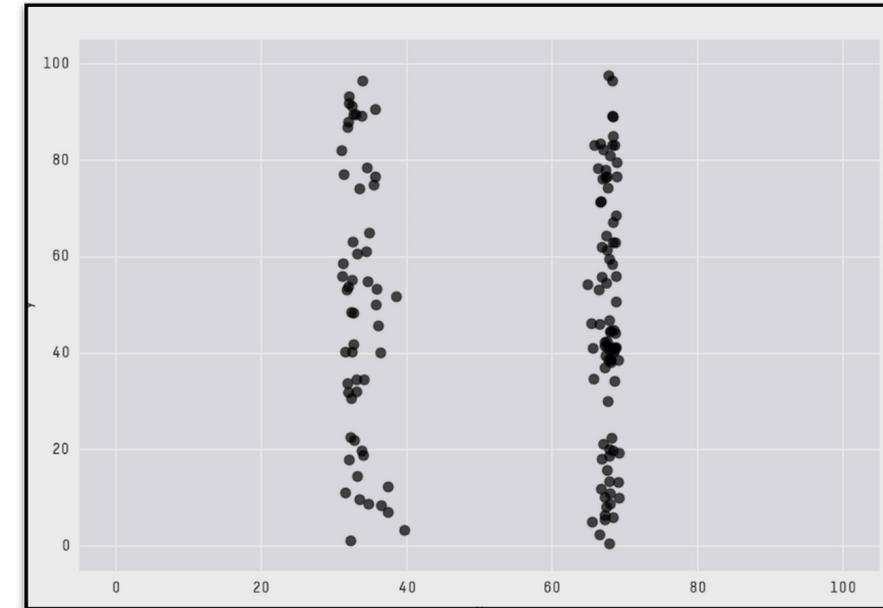
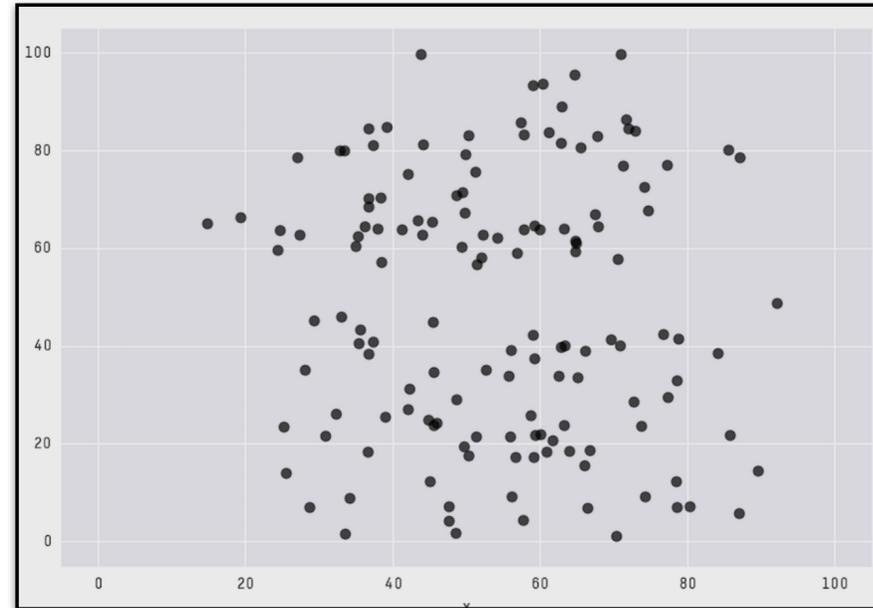
evan.peck@colorado.edu



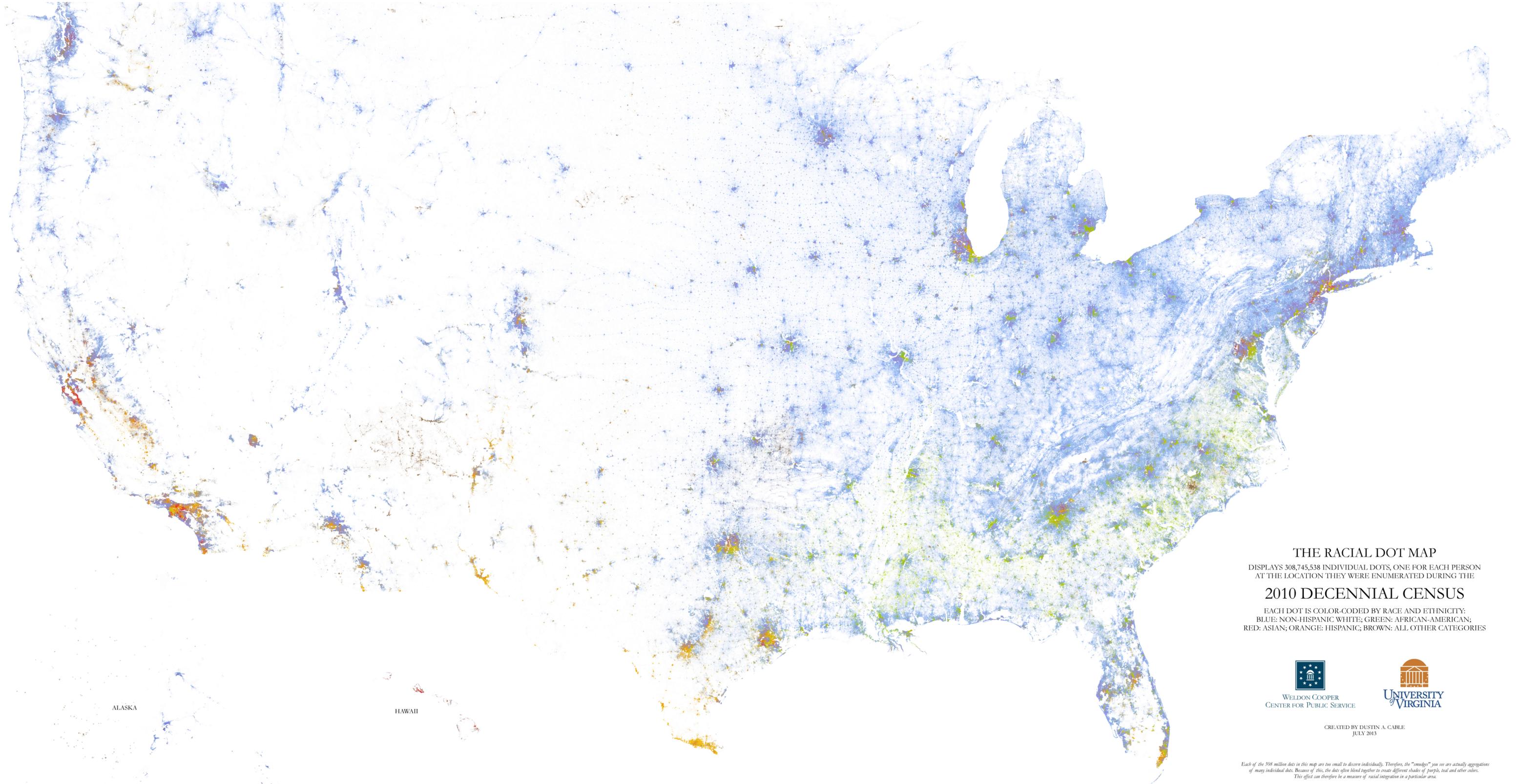
**What is the story we tell each other
about information visualization?**

seeing the invisible

```
X Mean: 54.26  
Y Mean: 47.83  
X SD : 16.76  
Y SD : 26.93  
Corr. : -0.06
```



revealing patterns we live with



THE RACIAL DOT MAP

DISPLAYS 308,745,538 INDIVIDUAL DOTS, ONE FOR EACH PERSON AT THE LOCATION THEY WERE ENUMERATED DURING THE

2010 DECENNIAL CENSUS

EACH DOT IS COLOR-CODED BY RACE AND ETHNICITY:
BLUE: NON-HISPANIC WHITE; GREEN: AFRICAN-AMERICAN;
RED: ASIAN; ORANGE: HISPANIC; BROWN: ALL OTHER CATEGORIES



WELDON COOPER
CENTER FOR PUBLIC SERVICE

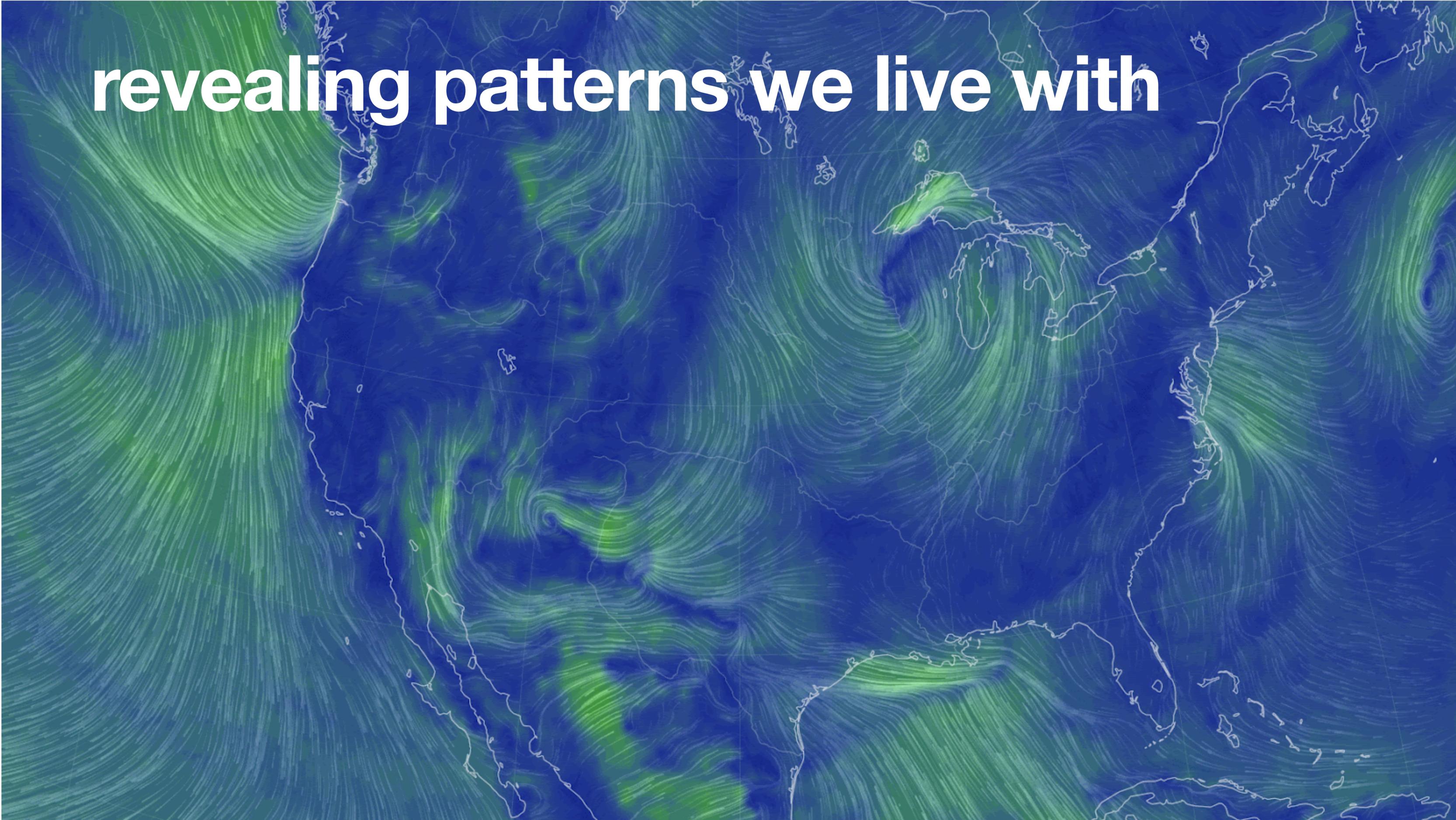


UNIVERSITY
of VIRGINIA

CREATED BY DUSTIN A. CABLE
JULY 2013

Each of the 308 million dots in this map are too small to discern individually. Therefore, the "smudges" you see are actually aggregations of many individual dots. Because of this, the dots often blend together to create different shades of purple, teal and other colors. This effect can therefore be a measure of racial integration in a particular area.

revealing patterns we live with

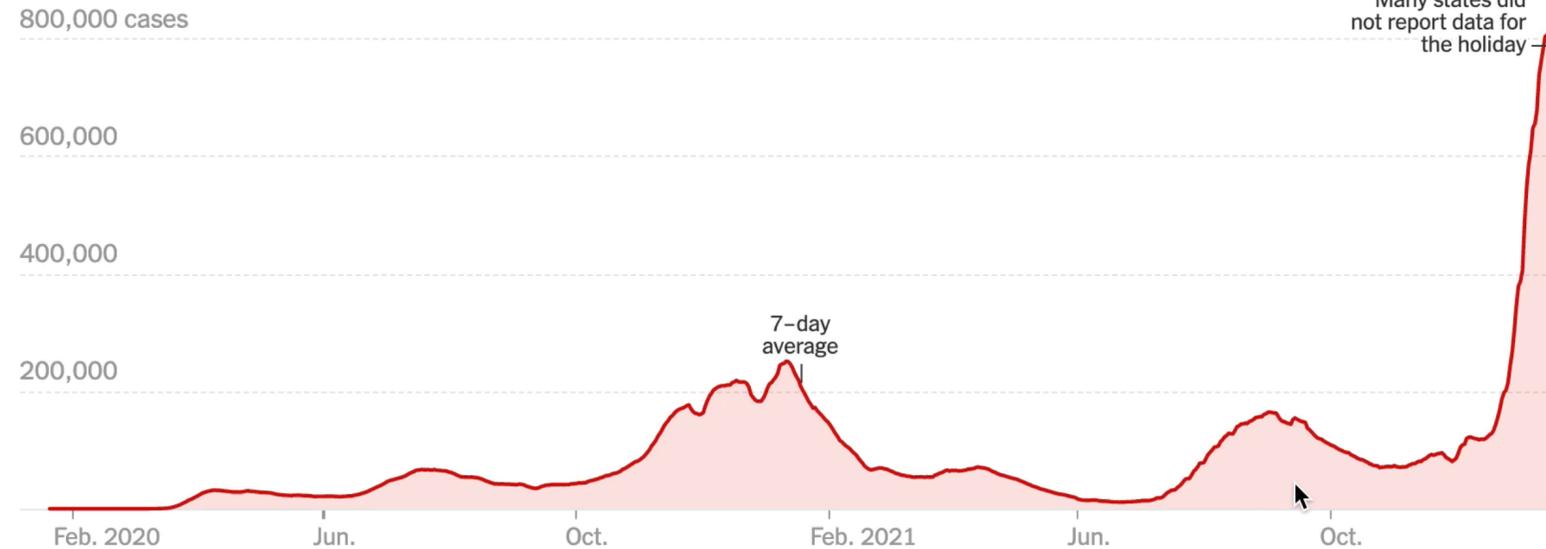


communicate to everyone

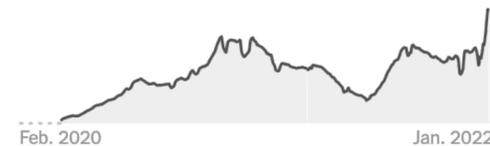
Updated Jan. 18, 2022

New reported cases

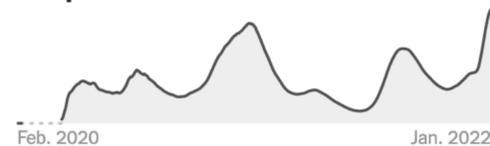
All time Last 90 days



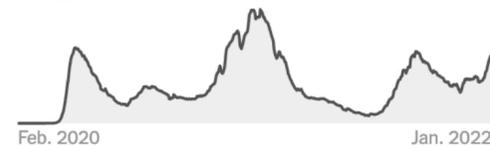
Tests



Hospitalized



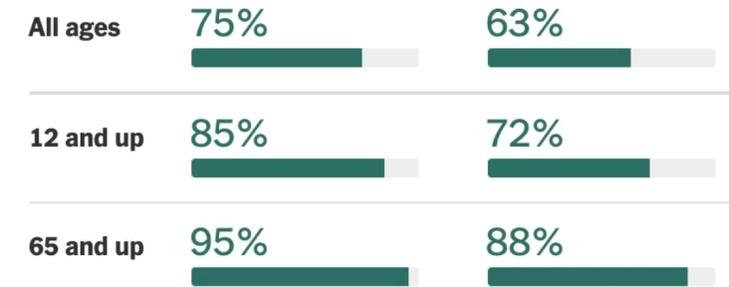
Deaths



| | DAILY AVG. ON JAN. 17 | 14-DAY CHANGE | TOTAL REPORTED |
|--------------|-----------------------|---------------|----------------|
| Cases | 790,553 | +62% | 66,526,927 |
| Tests | 2,505,068 | +96% | — |
| Hospitalized | 156,505 | +54% | — |
| Deaths | 1,961 | +54% | 850,750 |

Vaccinations

AT LEAST ONE DOSE FULLY VACCINATED



[See more details >](#)

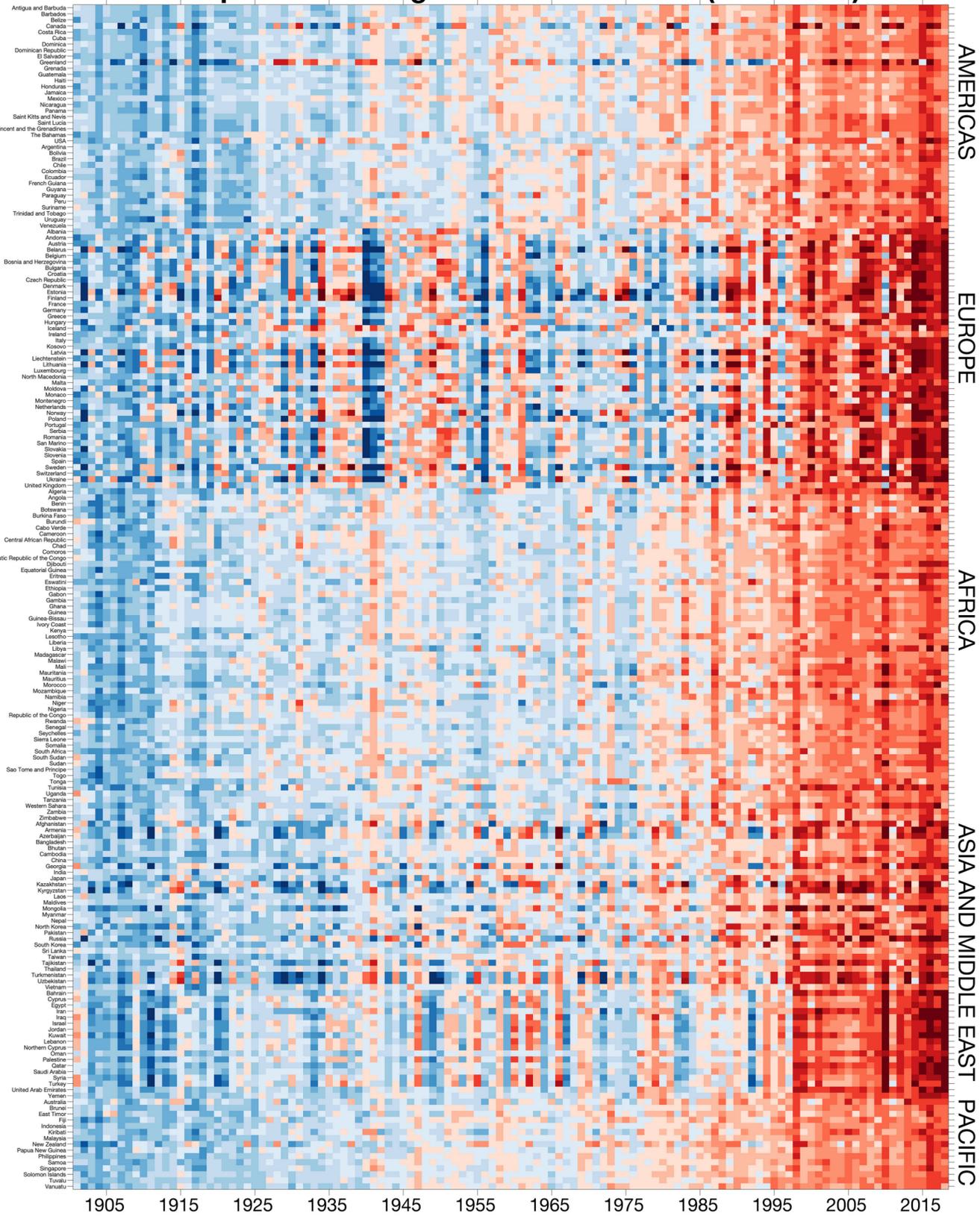
[About this data](#)

State of the virus

Update for Jan. 14

- The Omicron variant has pushed the country's daily case reports to record levels, with more than 800,000 new infections being reported each day.
- Most of the country continues to see explosive case growth, but infection levels [seem to have peaked](#) in some of the places that were hit first by Omicron. [Puerto Rico](#), [Cleveland](#), [Chicago](#), [New York City](#) and [Washington, D.C.](#), are among the places beginning to see improvement.
- About 150,000 coronavirus patients are

Temperature changes around the world (1901-2018)



Why doesn't our data promote more positive change?

Visual estimation of the 1:7 ratio is noisier toward bottom

Caveats for the visual encoding in each row

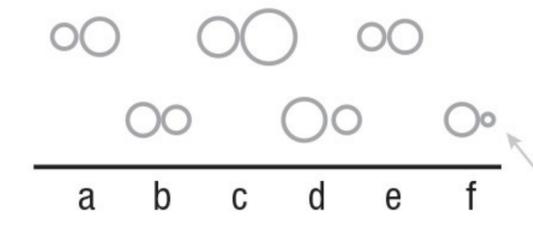
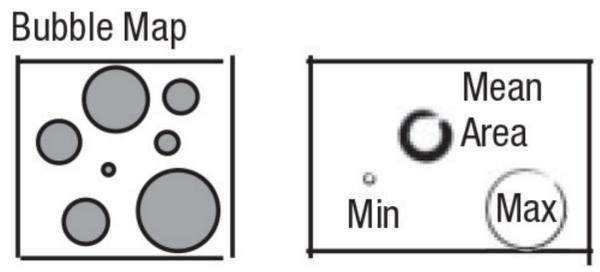
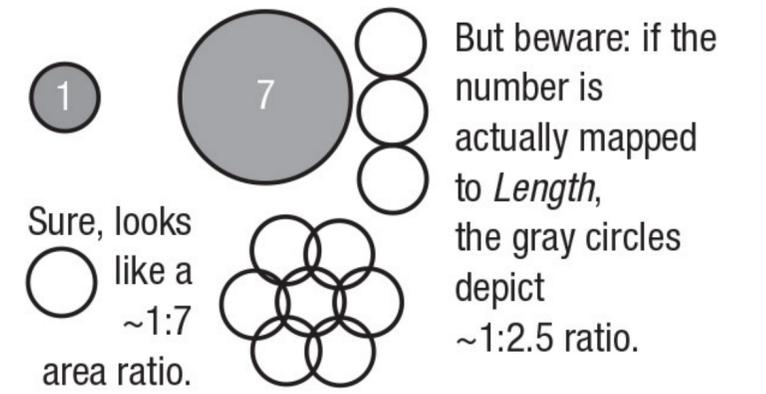
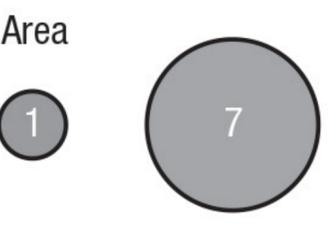
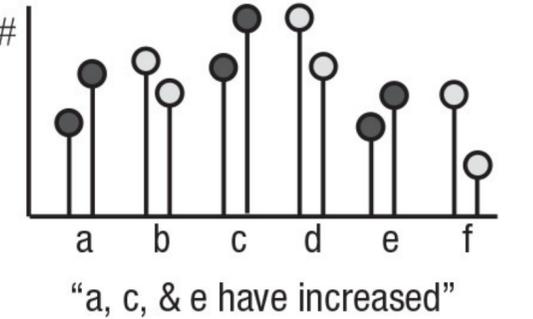
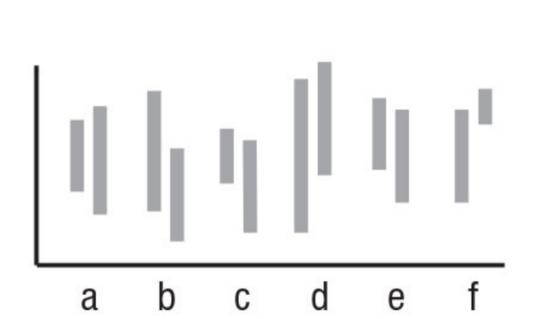
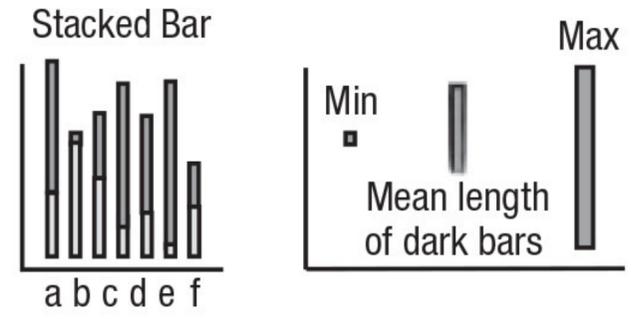
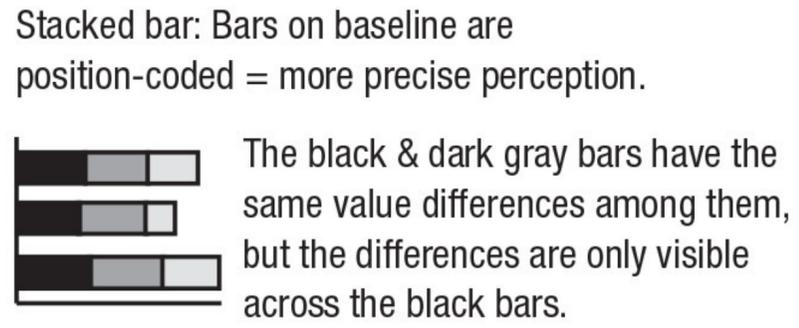
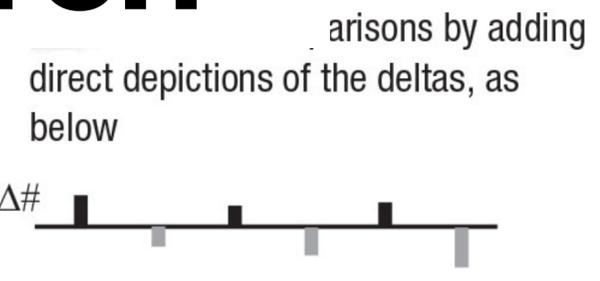
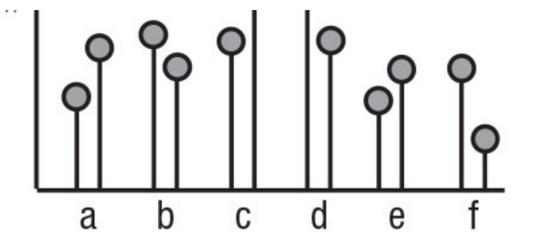
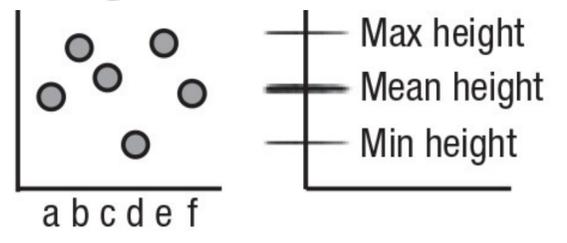
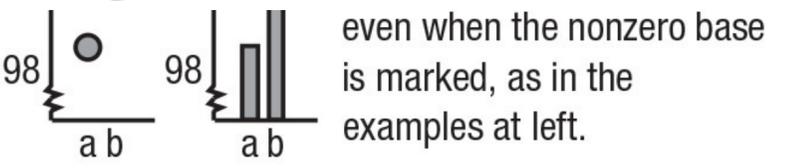
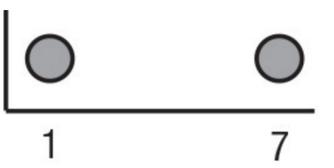
For each visualization, statistics are available quickly

Isolating pairs with "larger second values" is tough...

So guide viewers to the right comparisons

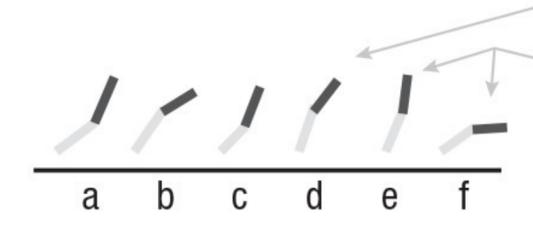
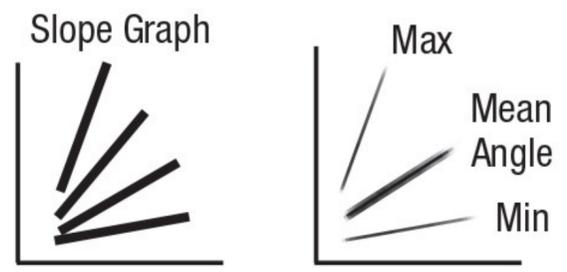
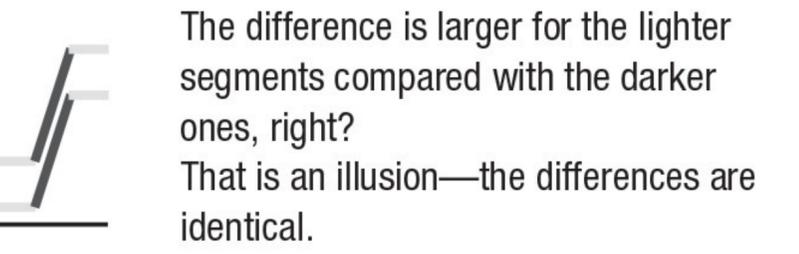
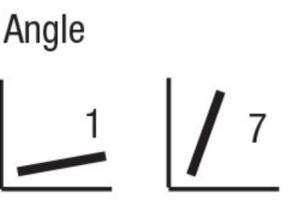
Reflecting on the long arc of vis research

Highest



Tool: Highlight and annotate the right comparisons for your viewers, as above.

Tool: You and your viewers will (generally) compare values that (a) are close together or connected and (b) have similar colors, in that priority order.



Franconeri, Steven L., Lace M. Padilla, Priti Shah, Jeffrey M. Zacks, and Jessica Hullman. "The science of visual data communication: What works." *Psychological Science in the Public Interest* 22, no. 3 (2021): 110-161.



EFFICIENCY evaluation, timelines

UNIVERSALITY principles, presentation

IMPARTIALITY objective, unbiased

EFFICIENCY CARE

UNIVERSALITY CONTEXTUALITY

IMPARTIALITY POSITIONALITY

EFFICIENCY. CARE.

(how I became a visualization evaluation cynic)

What does visualization evaluation capture?

There is a newly discovered disease, Disease X, which is transmitted by a bacterial infection found in the population. There is a test to detect whether or not a person has the disease, but it is not perfect. Here is some information about the current research on Disease X and efforts to test for the infection that causes it.

There is a total of 1000 people in the population. Out of the 1000 people in the population, 10 people actually have the disease. Out of these 10 people, 8 will receive a positive test result and 2 will receive a negative test result. On the other hand, 990 people do not have the disease (that is, they are perfectly healthy). Out of these 990 people, 95 will receive a positive test result and 895 will receive a negative test result.

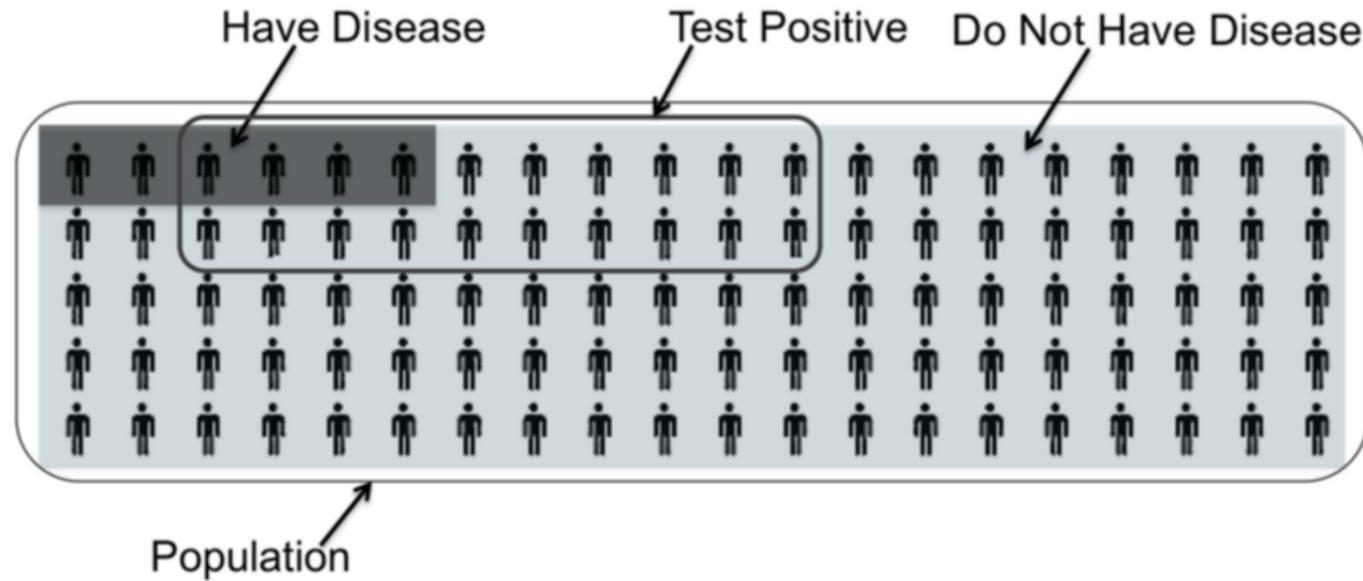
**~1 out of 4 people
answered these
questions correctly**

Imagine 1000 people are tested for the disease.

(a) How many people will test positive? ----

(b) Of those who test positive, how many will actually have the disease? ----

74%



Structured-Text

There is a total of 100 people in the population.

Out of the 100 people in the population, 6 people actually have the disease. Out of these 6 people, 4 will receive a positive test result and 2 will receive a negative test result.

On the other hand, 94 people do not have the disease (i.e., they are perfectly healthy). Out of these 94 people, 16 will receive a positive test result and 78 will receive a negative test result.

Another way to think about this is...

Out of the 100 people in the population, 20 people will test positive. Out of these 20 people, 4 will actually have the disease and 16 will not have the disease (i.e., they are perfectly healthy).

On the other hand, 80 people will test negative. Out of these 80 people,

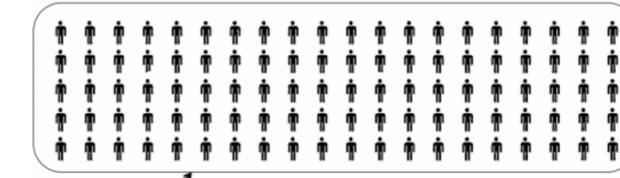
2 will actually have the disease and 78 will not have the disease (i.e., they are perfectly healthy).

77%

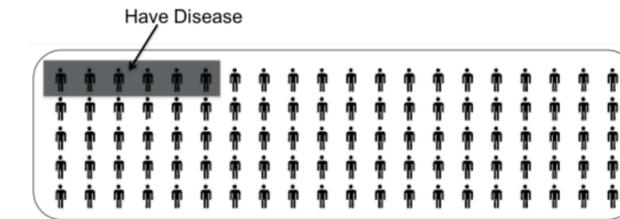
377 participants on MTurk

Storyboarding

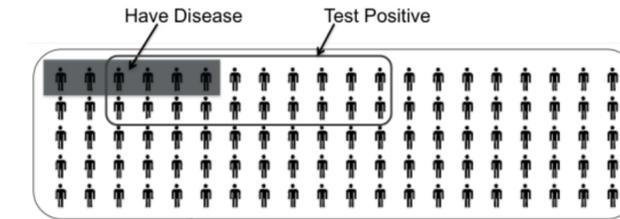
There is a total of 100 people in the population.



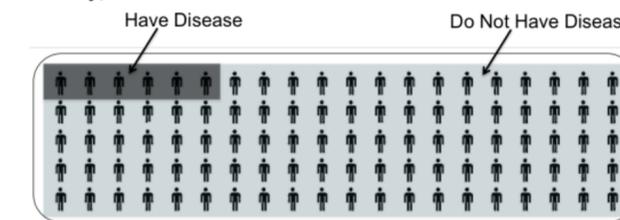
Out of the 100 people in the population, 6 people actually have the disease.



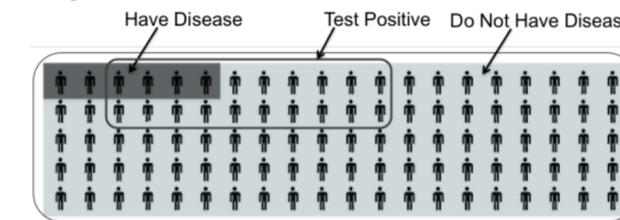
Out of these 6 people, 4 will receive a positive test result and 2 will receive a negative test result.



On the other hand, 94 people do not have the disease (i.e., they are perfectly healthy).



Out of these 94 people, 16 will receive a positive test result and 78 will receive a negative test result.



49%

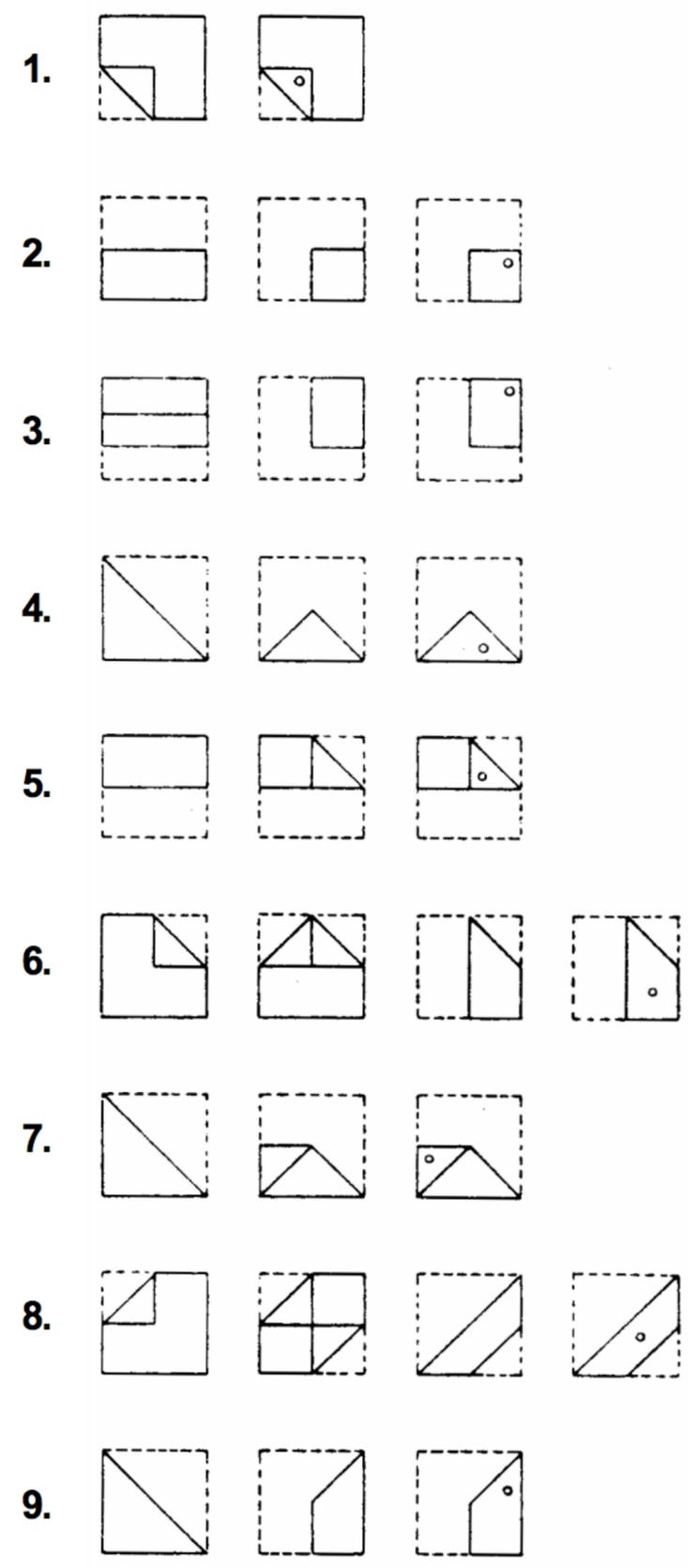
Paper folding as a proxy for spatial ability



low



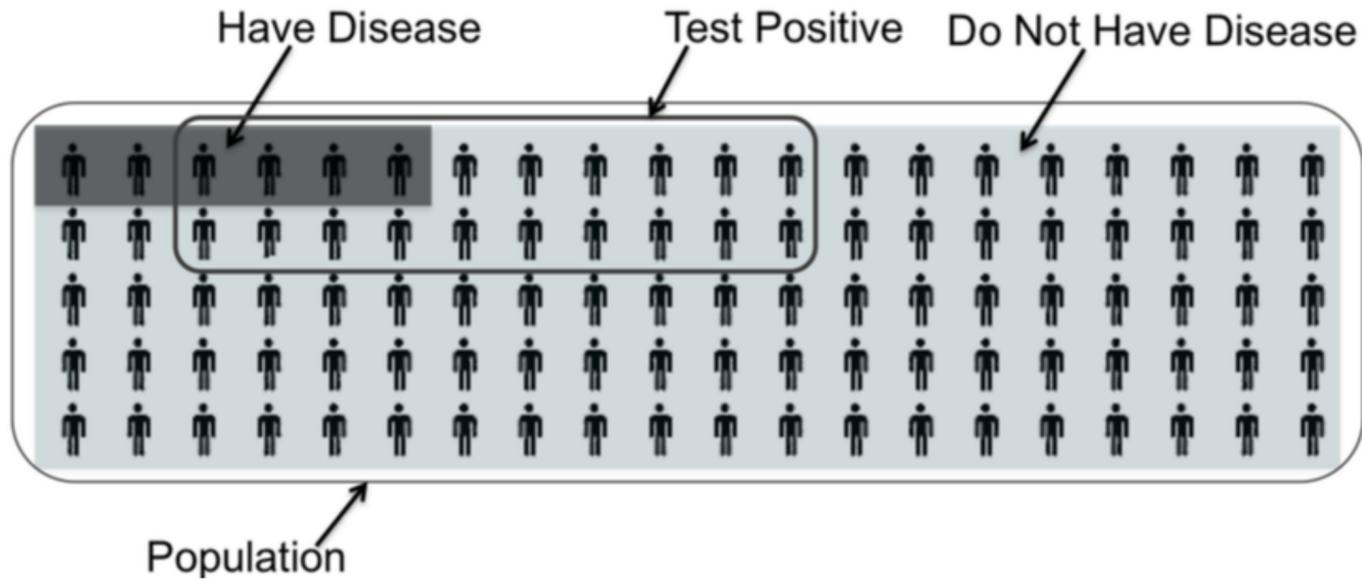
high



| | A | B | C | D | E |
|----|---|---|---|---|---|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |



74%
50%



Structured Test
There is a total of 100 people in the population.
Out of the 100 people in the population, 6 people actually have the disease.
Of these 6 people, 4 will receive a positive test result and 2 will receive a negative test result.

In our efficiency-informed study designs, who are we missing?

perfectly healthy). Out of these 94 people, 16 will receive a positive test result and 78 will receive a negative test result.

Another way to think about this is...

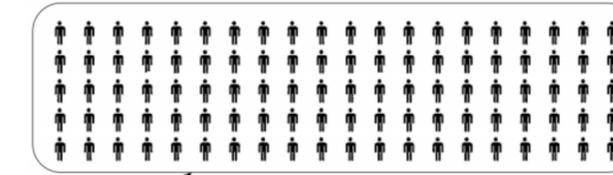
Out of the 100 people in the population, 20 people will test positive. Out of these 20 people, 4 will actually have the disease and 16 will not have the disease (i.e., they are perfectly healthy).

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2 will actually have the disease and 78 will not have the disease (i.e., they are perfectly healthy).

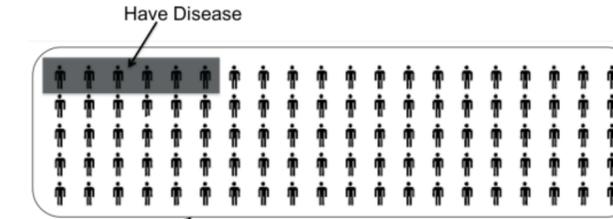
Storyboarding

There is a total of 100 people in the population.



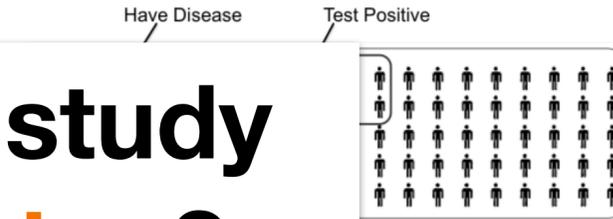
Population

Out of the 100 people in the population, 6 people actually have the disease.

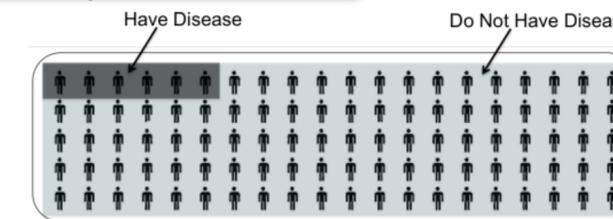


Population

Out of these 6 people, 4 will receive a positive test result and 2 will receive a negative test result.

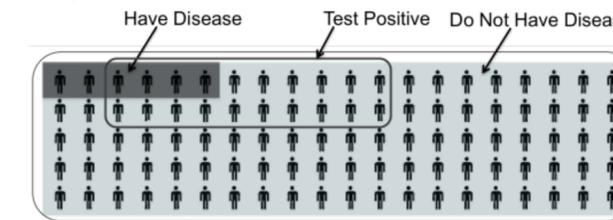


Do not have the disease (i.e., they are perfectly healthy)



Population

Out of these 94 people, 16 will receive a positive test result and 78 will receive a negative test result.



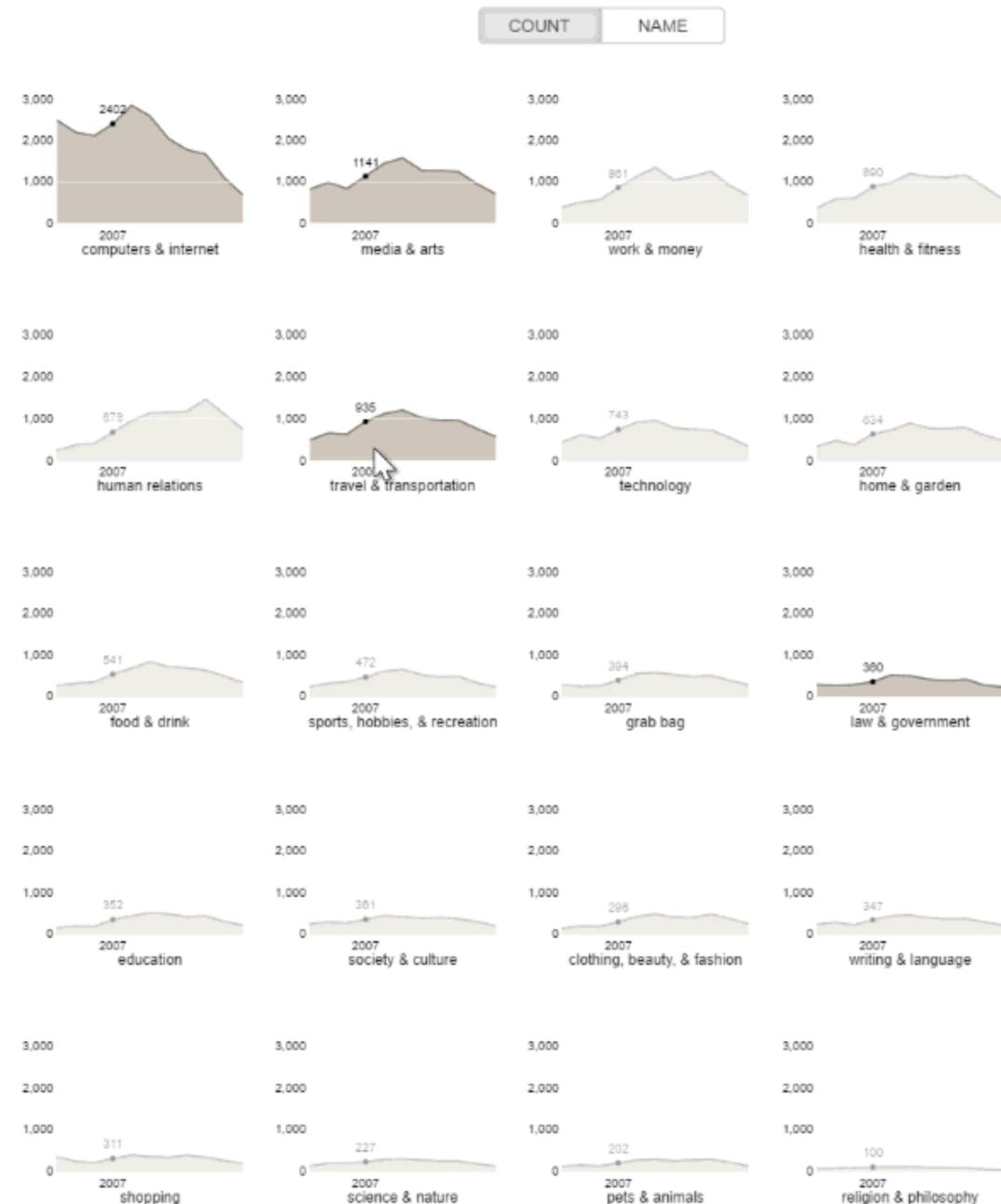
Population

49%
29%

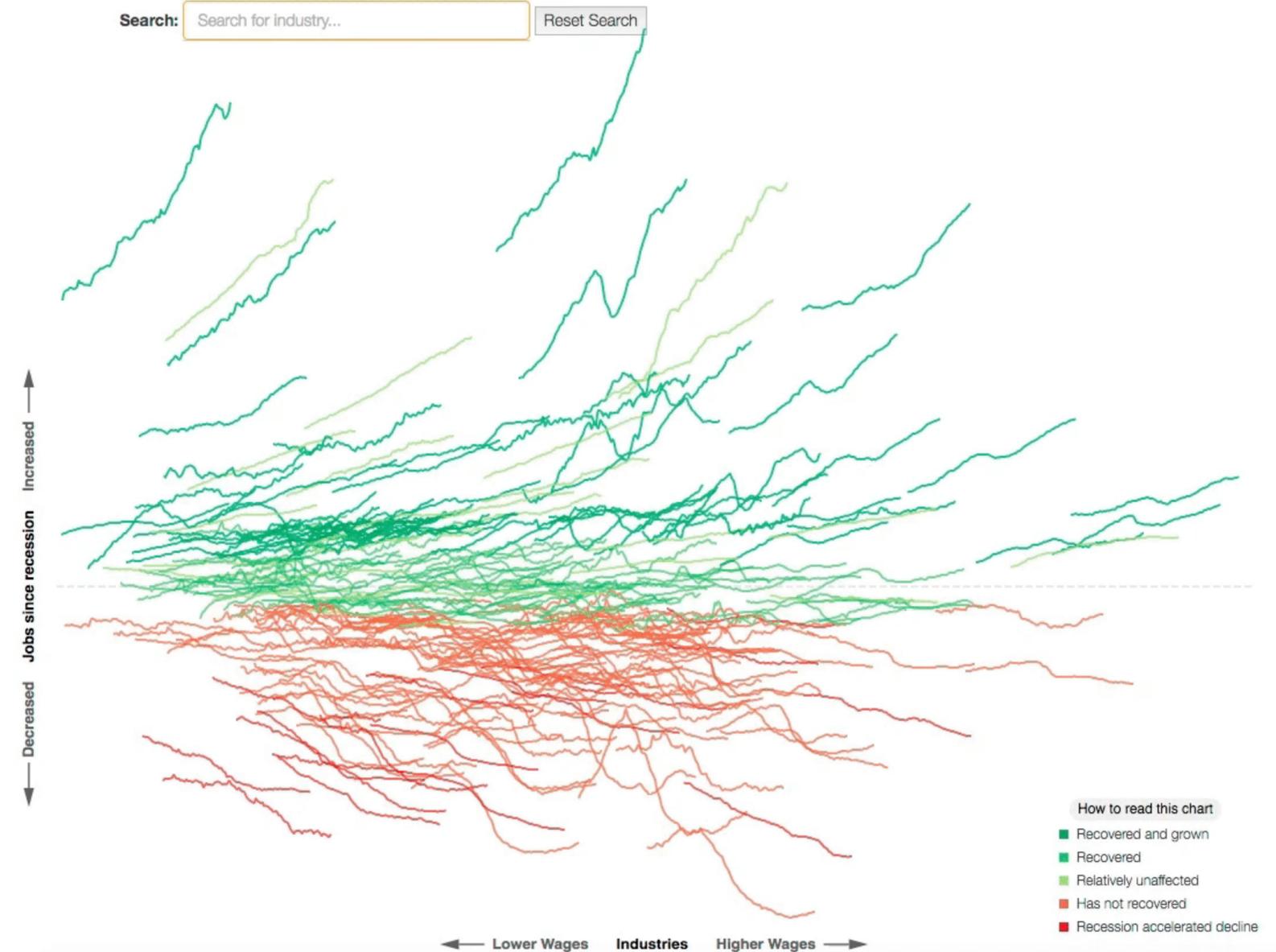
77%
50%

Interaction techniques to improve **public** engagement on the web

Hindsight: personal interaction history



quantifying the effects of search



Feng, Mi, Cheng Deng, Evan M. Peck, and Lane Harrison. "Hindsight: Encouraging exploration through direct encoding of personal interaction history." *IEEE transactions on visualization and computer graphics* 23, no. 1 (2016): 351-360.

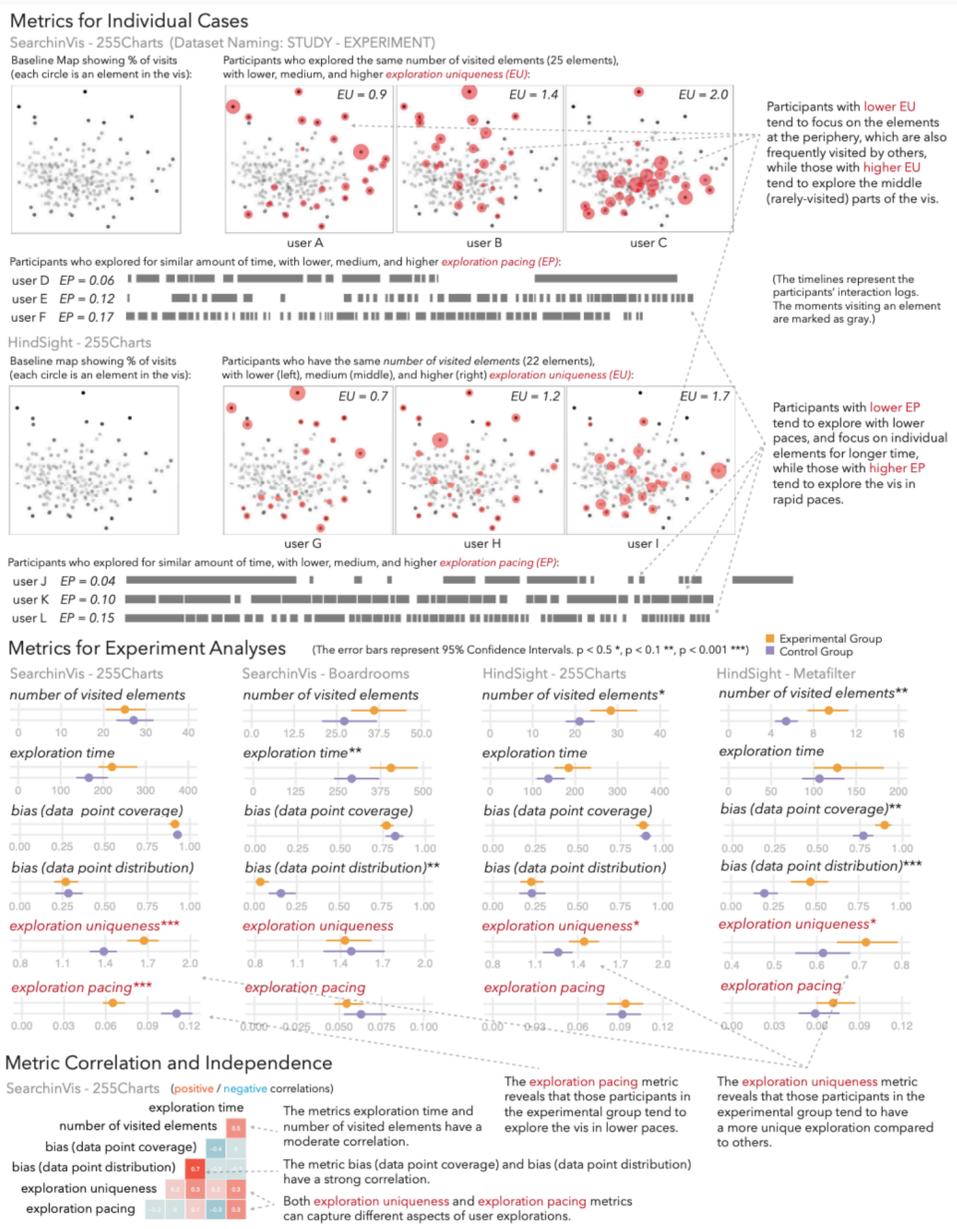
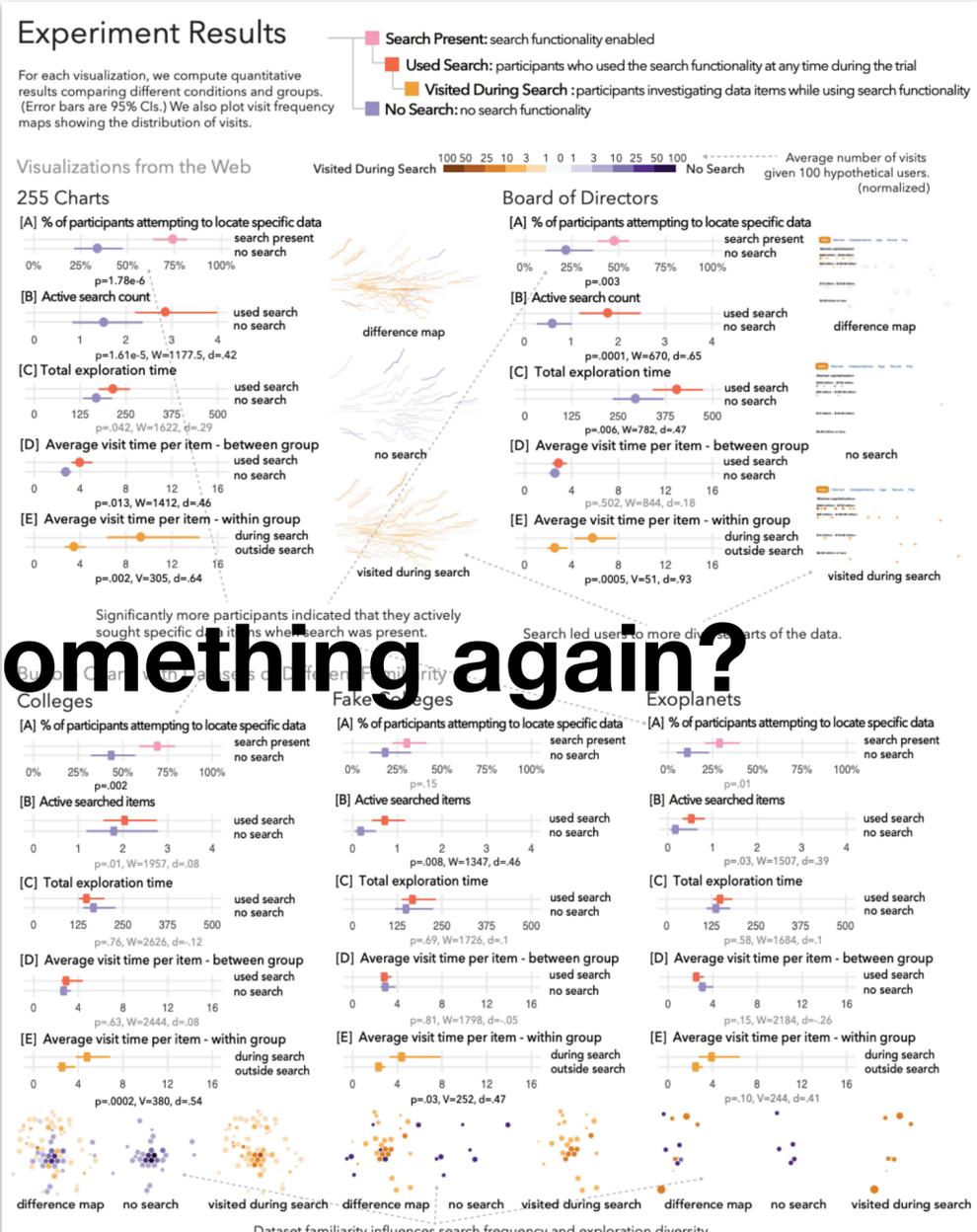
Feng, Mi, Cheng Deng, Evan M. Peck, and Lane Harrison. "The effects of adding search functionality to interactive visualizations on the web." In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, pp. 1-13. 2018.

Capturing the impact of interaction

interaction history

impact of search

... more metrics!



Feng, Mi, Cheng Deng, Evan M. Peck, and Lane Harrison. "Hindsight: Encouraging exploration through direct encoding of personal interaction history." IEEE transactions on visualization and computer graphics 23, no. 1 (2016): 351-360.

Feng, Mi, Cheng Deng, Evan M. Peck, and Lane Harrison. "The effects of adding search functionality to interactive visualizations on the web." In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, pp. 1-13. 2018.

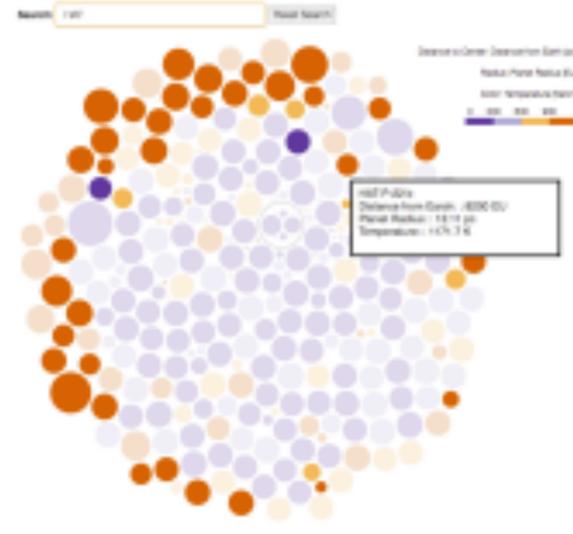
Feng, Mi, Evan M. Peck, and Lane Harrison. "Patterns and Pace: Quantifying Diverse Exploration Behavior with Visualizations on the Web" IEEE TVCG: Transactions on Visualization and Computer Graphics (InfoVis 2018)

College Admissions (experimental)



Search allows users to find a college of interest.

Exoplanets (experimental)



Search allows users to find a planet of interest.

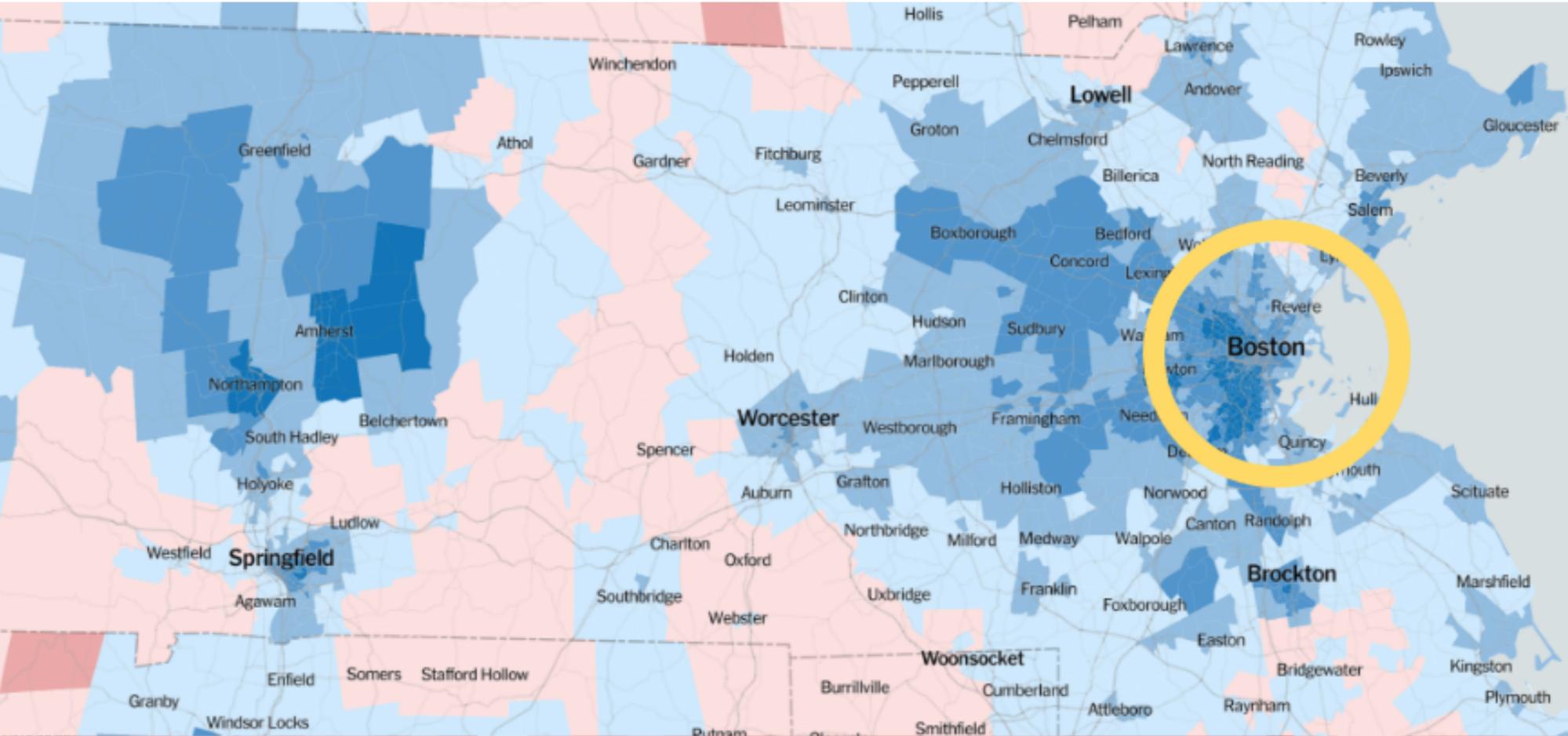
The interaction wasn't nearly as interesting as **our relationship to the data.**

Duke University is very expensive at \$61,000 a year... when I was a kid I wanted to go to Duke

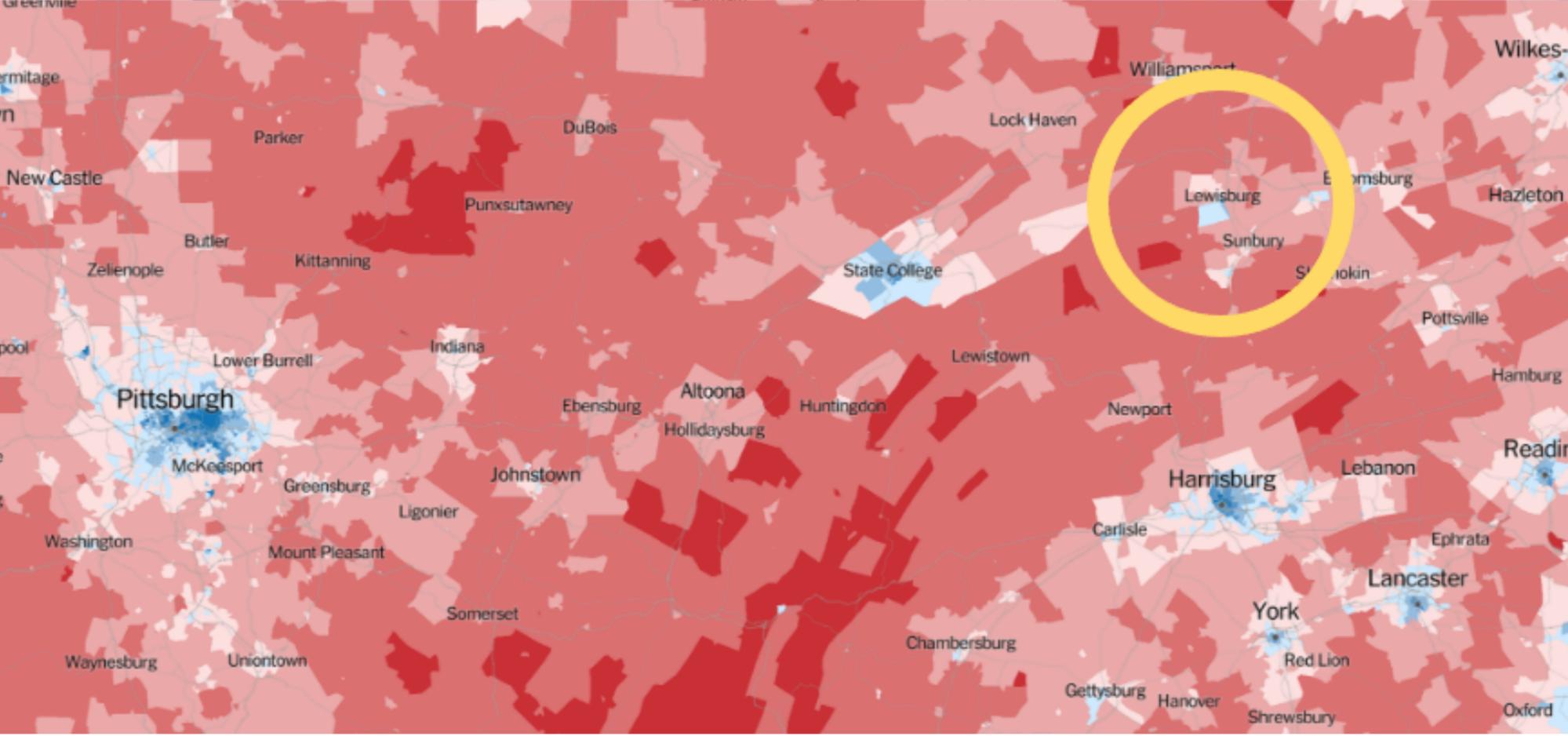
Tech colleges promise the most consistent ROI... [I'm] interested in science. Also, my brother applied to these schools

And the evaluation wasn't capturing it

UNIVERSALITY. **CONTEXTUALITY.**



Do you think we see the world the same way?



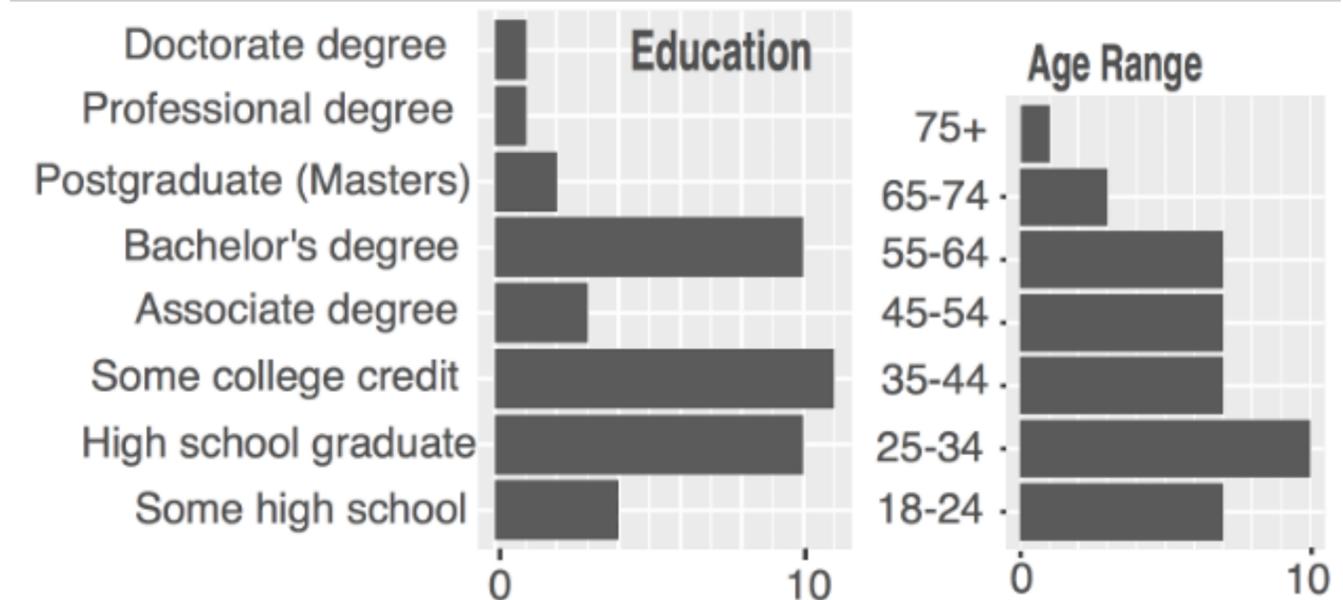
Should we expect that people see charts the same way?



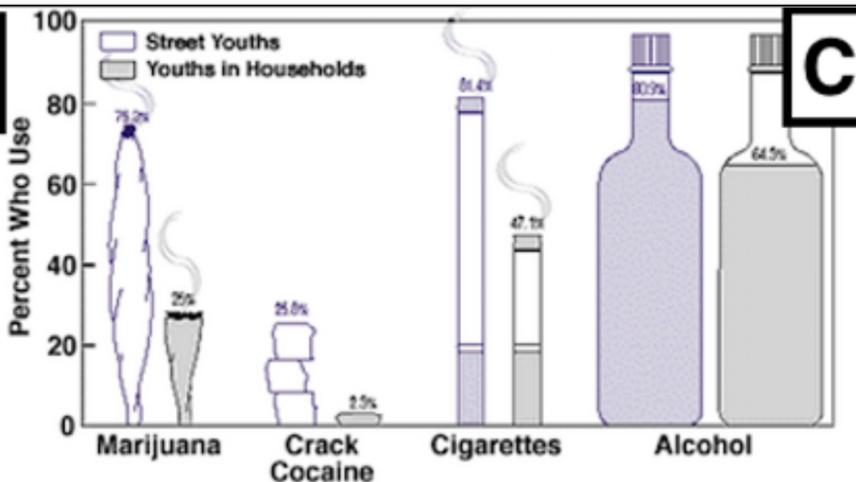
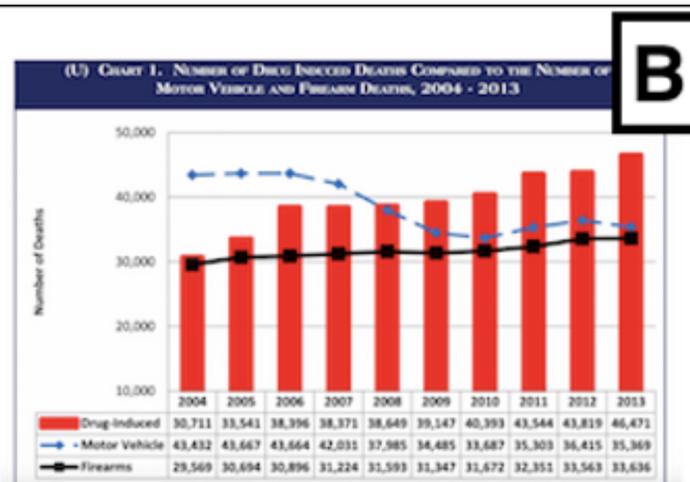
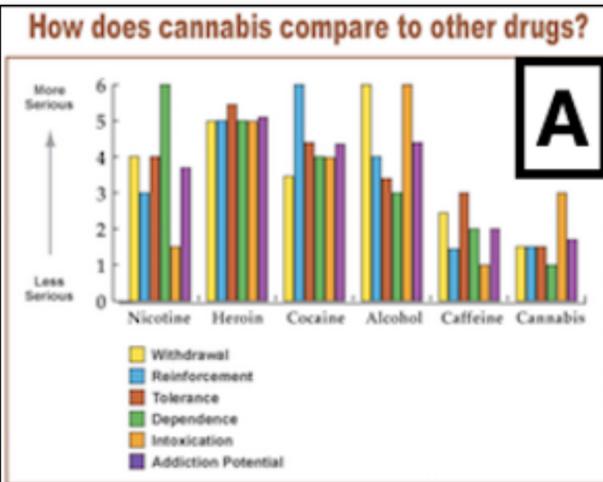
We interviewed 42 community members about charts & graphs

Where farmers market
 construction site
 staff @ university

Who



Peck, Evan M., Sofia E. Ayuso, and Omar El-Etr. "Data is personal: Attitudes and perceptions of data visualization in rural pennsylvania." In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, pp. 1-12. 2019. **Best Paper Award**



WHAT IS ADDICTION?

THE SCIENCE OF DRUG ABUSE

WHO IS ADDICTED?

- 9 in 10** adults who currently smoke cigarettes first began using nicotine before their 18th birthday.
- 4 in 10** teenagers who begin drinking at age 13 or younger will develop alcoholism.
- The relapse rate for addiction is between **40% and 60%**.

HOW DOES ADDICTION WORK?

Both environmental and biological factors can influence the likelihood that a person will develop addiction.

ENVIRONMENTAL | **GENETIC**

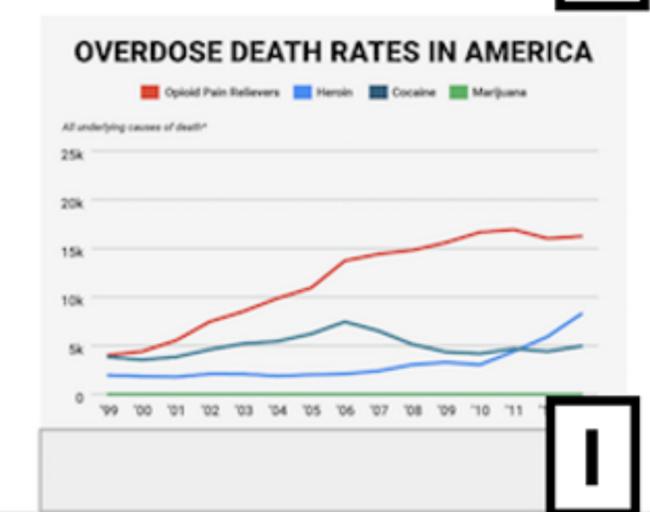
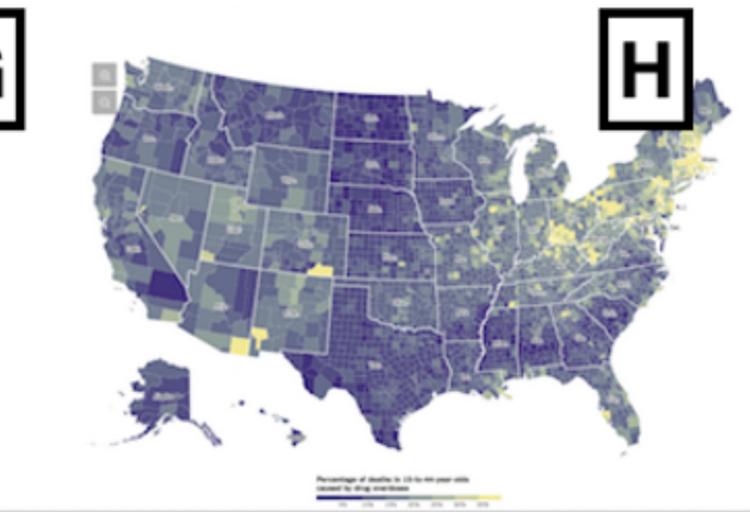
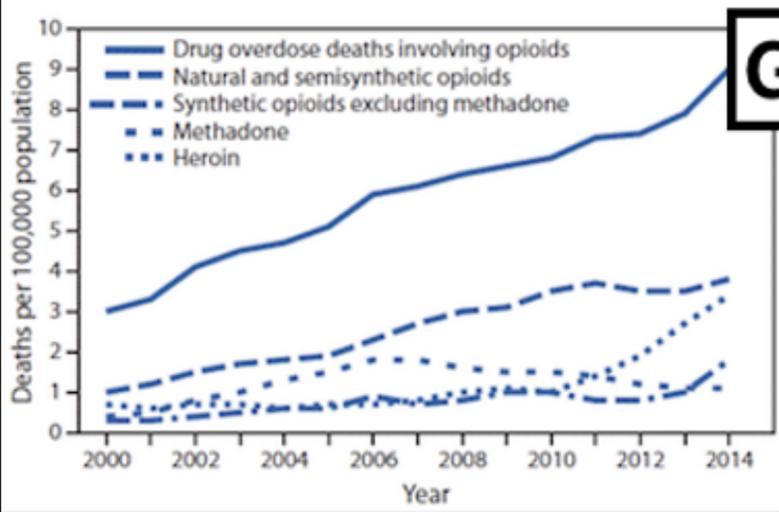
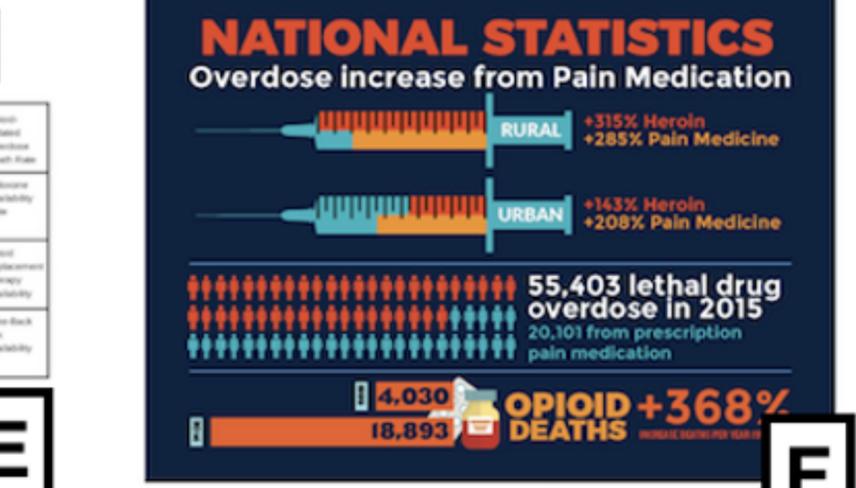
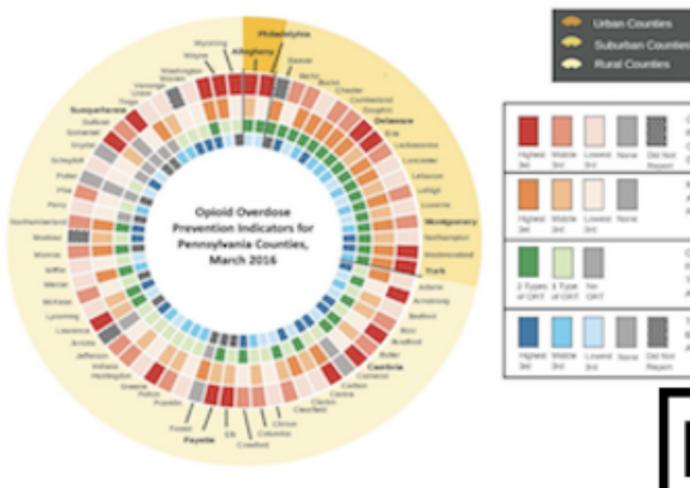
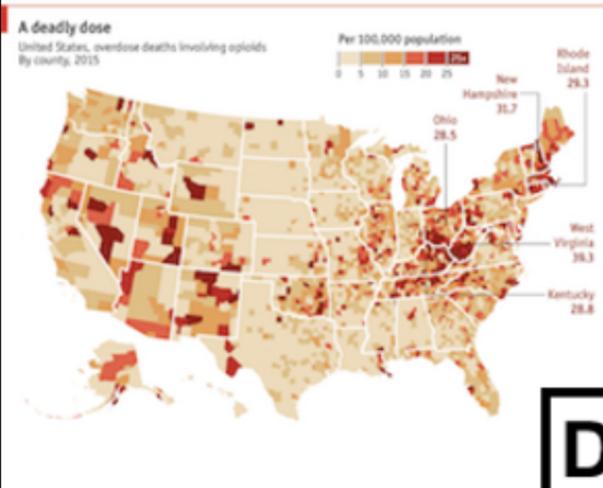
LONG-TERM DRUG ABUSE can permanently damage how the brain functions.

UNLIKE SOME DISEASES, there is not one gene responsible for addiction. Instead, researchers have found that ADDICTION OCCURS AS THE RESULT OF MANY GENE INTERACTIONS.

ENVIRONMENT PLAYS A SIGNIFICANT ROLE IN ADDICTION. A person may have biological tendencies toward drug or alcohol addiction, but these tendencies may be dormant until activated by an environmental factor.

WHILE NOT EVERYONE BECOMES ADDICTED AFTER ABUSING A SUBSTANCE, ENVIRONMENTAL AND BIOLOGICAL FACTORS INCREASE THE LIKELIHOOD OF DEVELOPING AN ADDICTION.

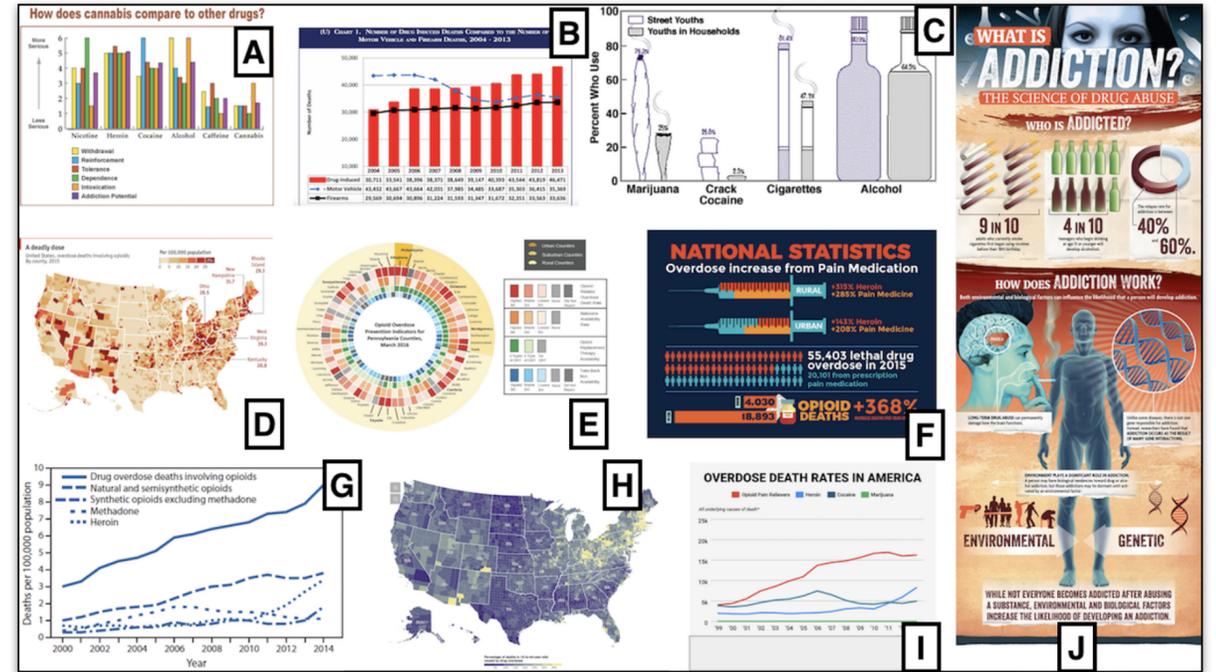
D **E** **F** **G** **H** **I** **J**



Peck, Evan M., Sofia E. Ayuso, and Omar El-Etr. "Data is personal: Attitudes and perceptions of data visualization in rural pennsylvania." In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, pp. 1-12. 2019. **Best Paper Award**

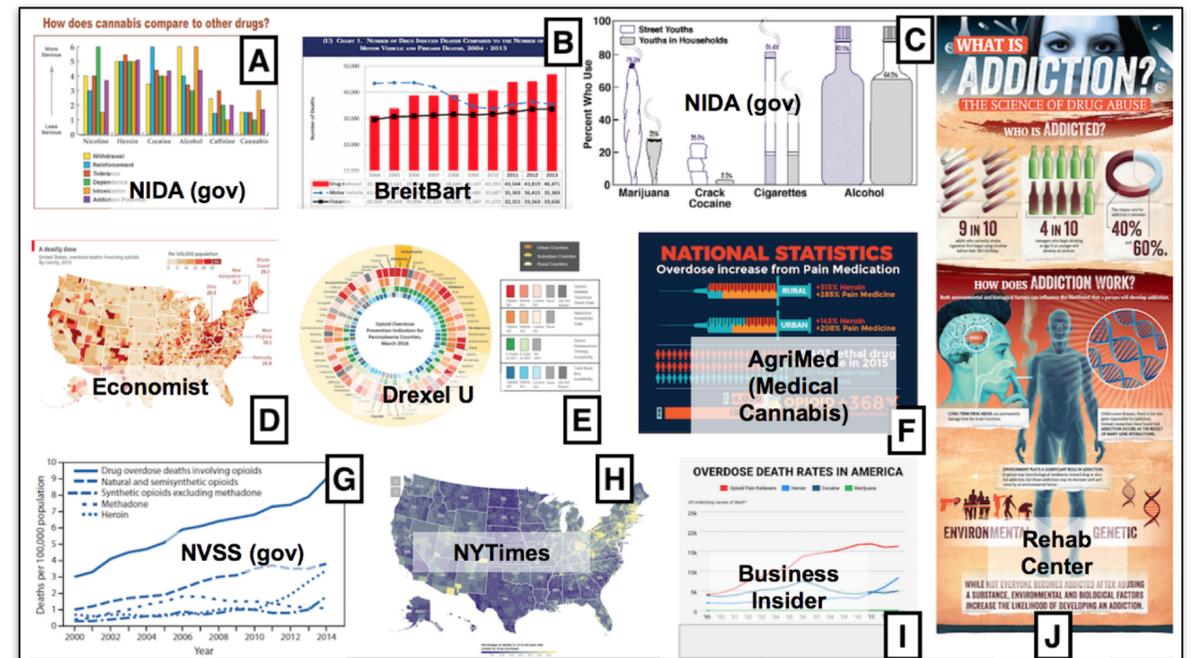


Rank them



Reveal sources

Rerank



Peck, Evan M., Sofia E. Ayuso, and Omar El-Etr. "Data is personal: Attitudes and perceptions of data visualization in rural pennsylvania." In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, pp. 1-12. 2019. **Best Paper Award**



Data is Personal

People prioritized charts in which they could make **personal connections.**

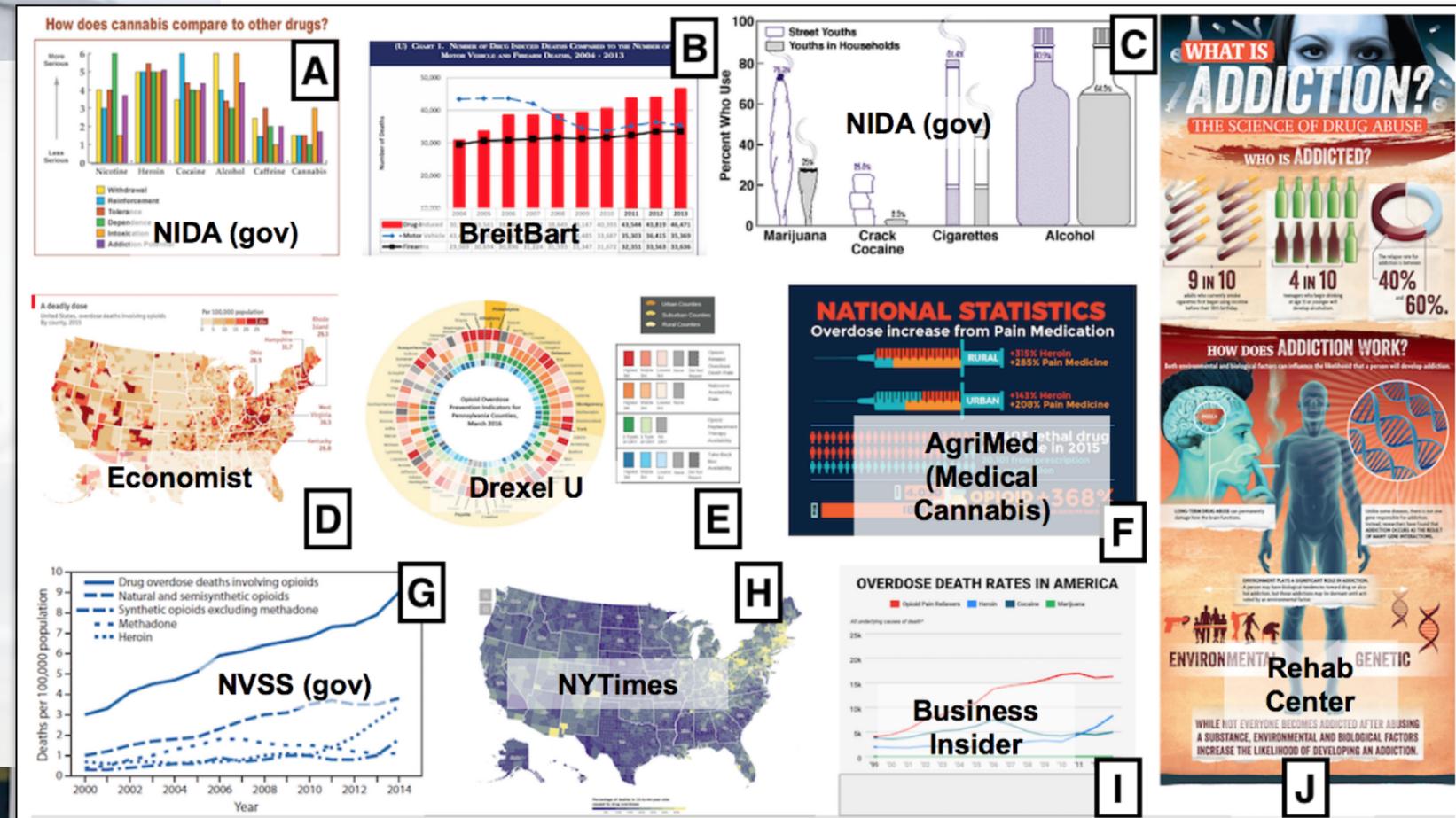
We found more than 20 instances in which people made person connections with the data.

Peck, Evan M., Sofia E. Ayuso, and Omar El-Etr. "Data is personal: Attitudes and perceptions of data visualization in rural pennsylvania." In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, pp. 1-12. 2019. **Best Paper Award**

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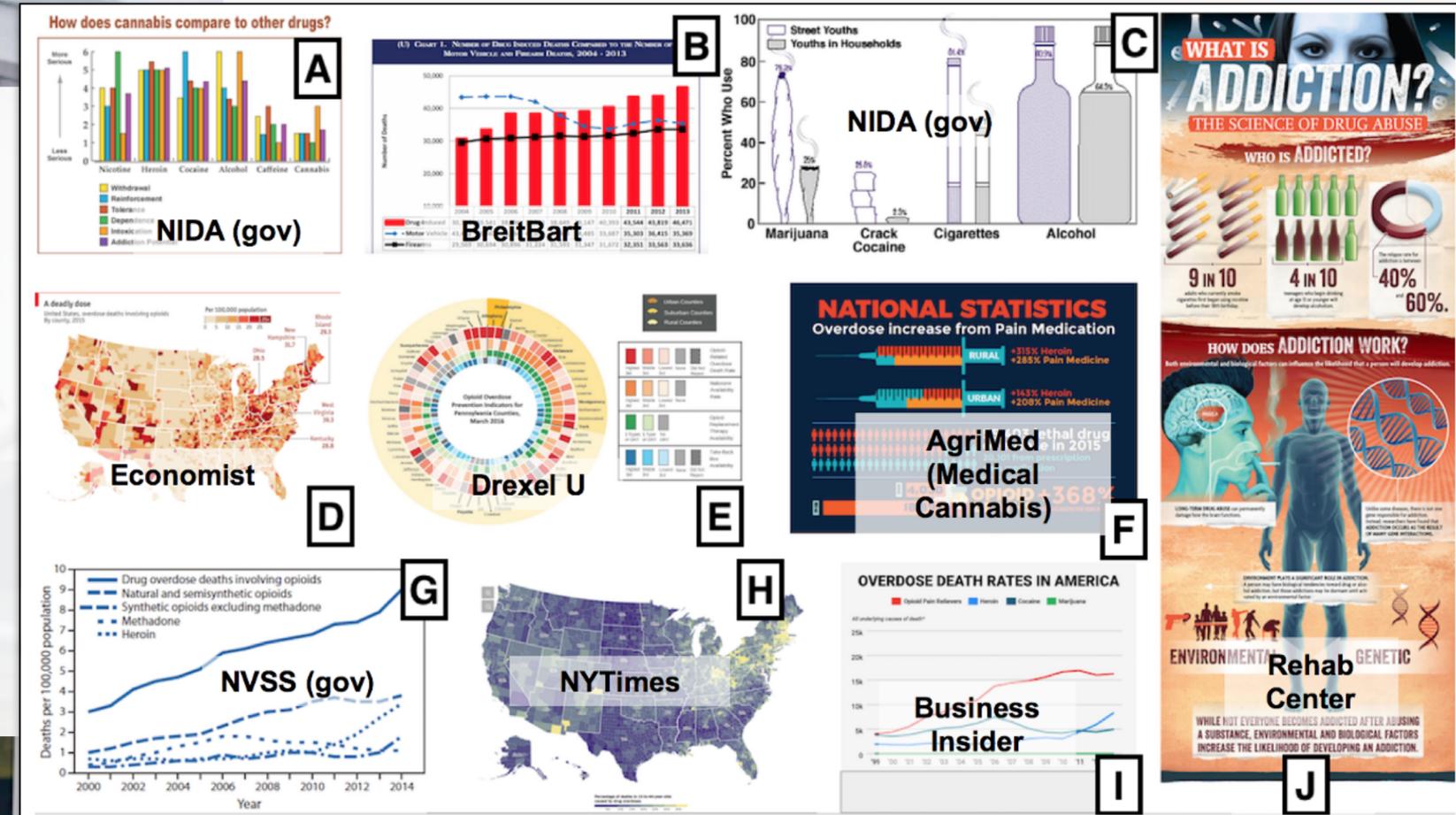
“Information about alcohol. I’m dealing with a functioning alcoholic... well, was a functioning alcoholic. The most important person in my life is an alcoholic. Right now, that’s important to me.”



Data is Personal

People prioritized charts in which they could make **personal connections.**

“As for some of the [other graphs I ranked high], I unfortunately know quite a few people who happen to have an issue with opioids... and it's something you consider... are you going to see that person tomorrow or not?”



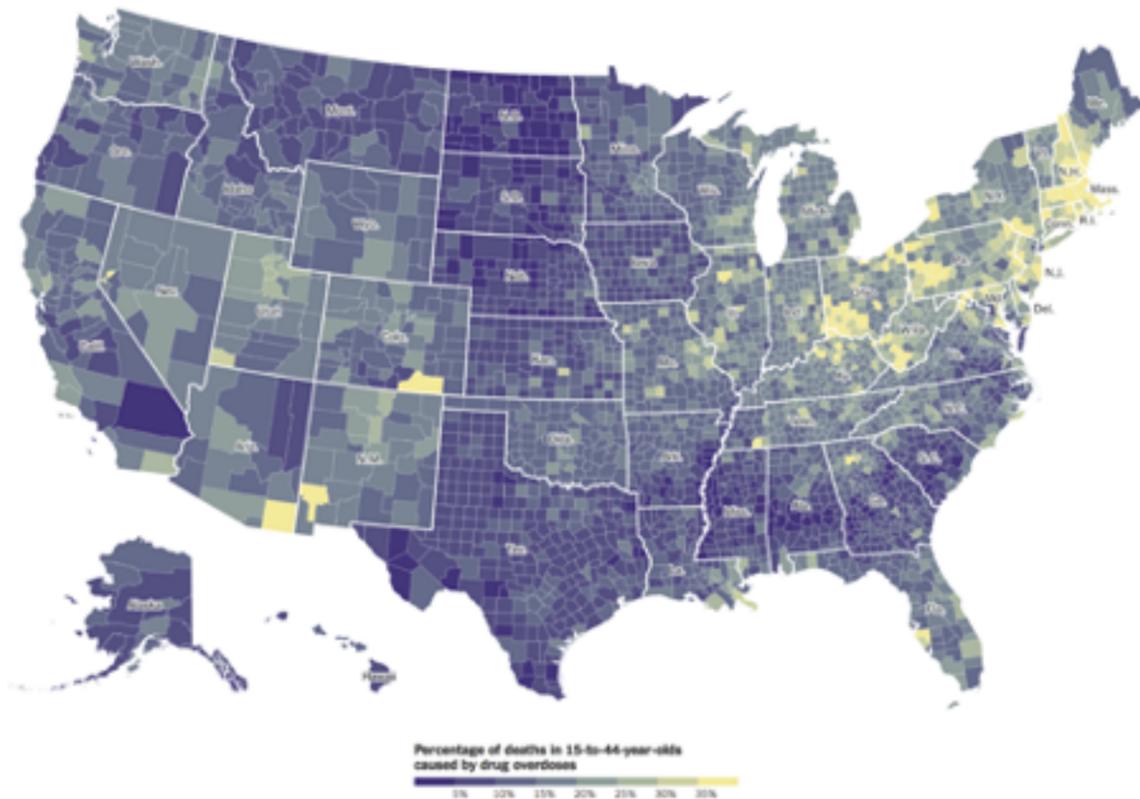
Visualization mantra:

Overview first, Zoom and filter, Details on demand (Shneiderman 1996)

It's just a little more **congested**... trying to pinpoint where in a state I would be - 45-54 year old

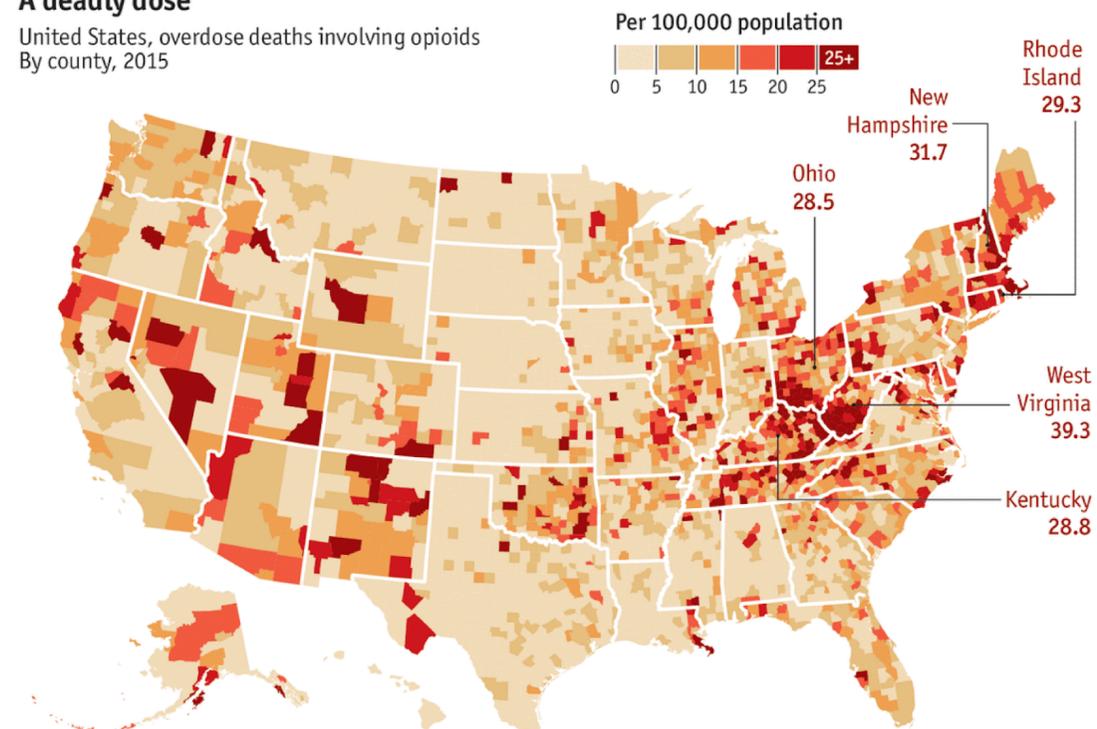
I like them less. **It's the whole country; it's so huge.** You naturally look at your state. It's too busy. - 65-74 year old

I don't read this newspaper. Even if I did like this picture, I still won't buy the newspaper because **I don't live in New York**; The Sunbury paper – that's close to here. Then I would read it.. I still won't read that one. - 55-64 year old



A deadly dose

United States, overdose deaths involving opioids
By county, 2015



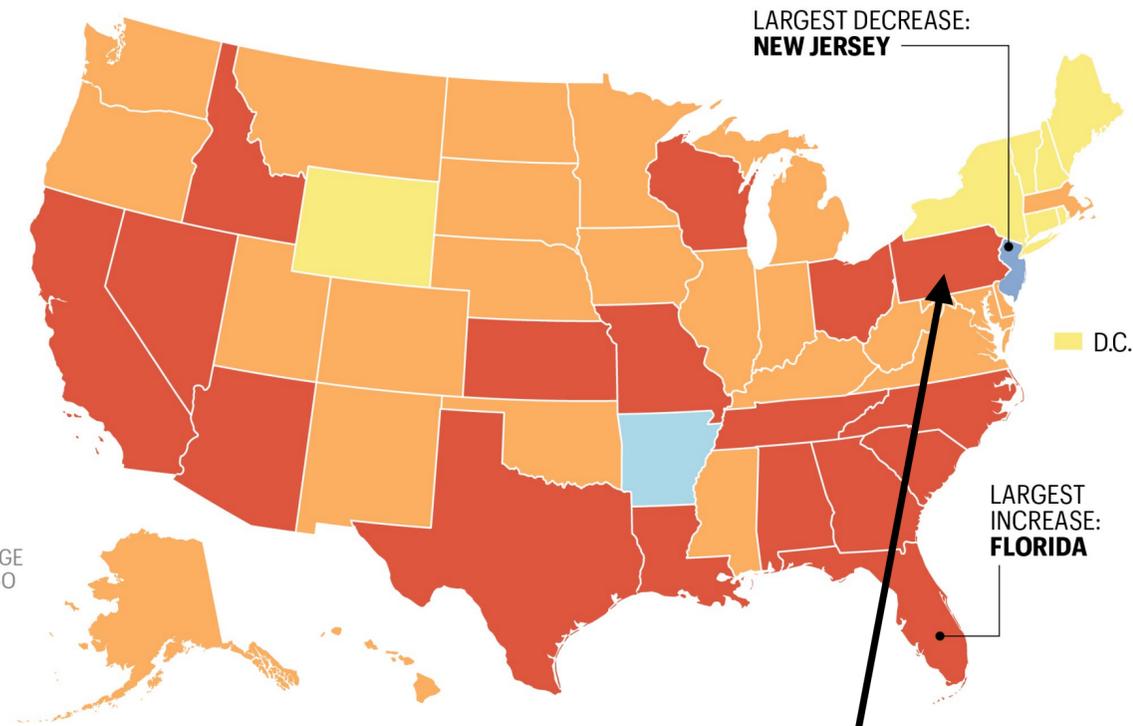
The cost of ignoring local context in our design?

RISING AND FALLING NEW CORONAVIRUS CASES

CHANGE IN NUMBER OF NEW CASES COMPARED TO 14 DAYS AGO*

- STRONG DECREASE
- DECREASE
- FLAT
- INCREASE
- STRONG INCREASE

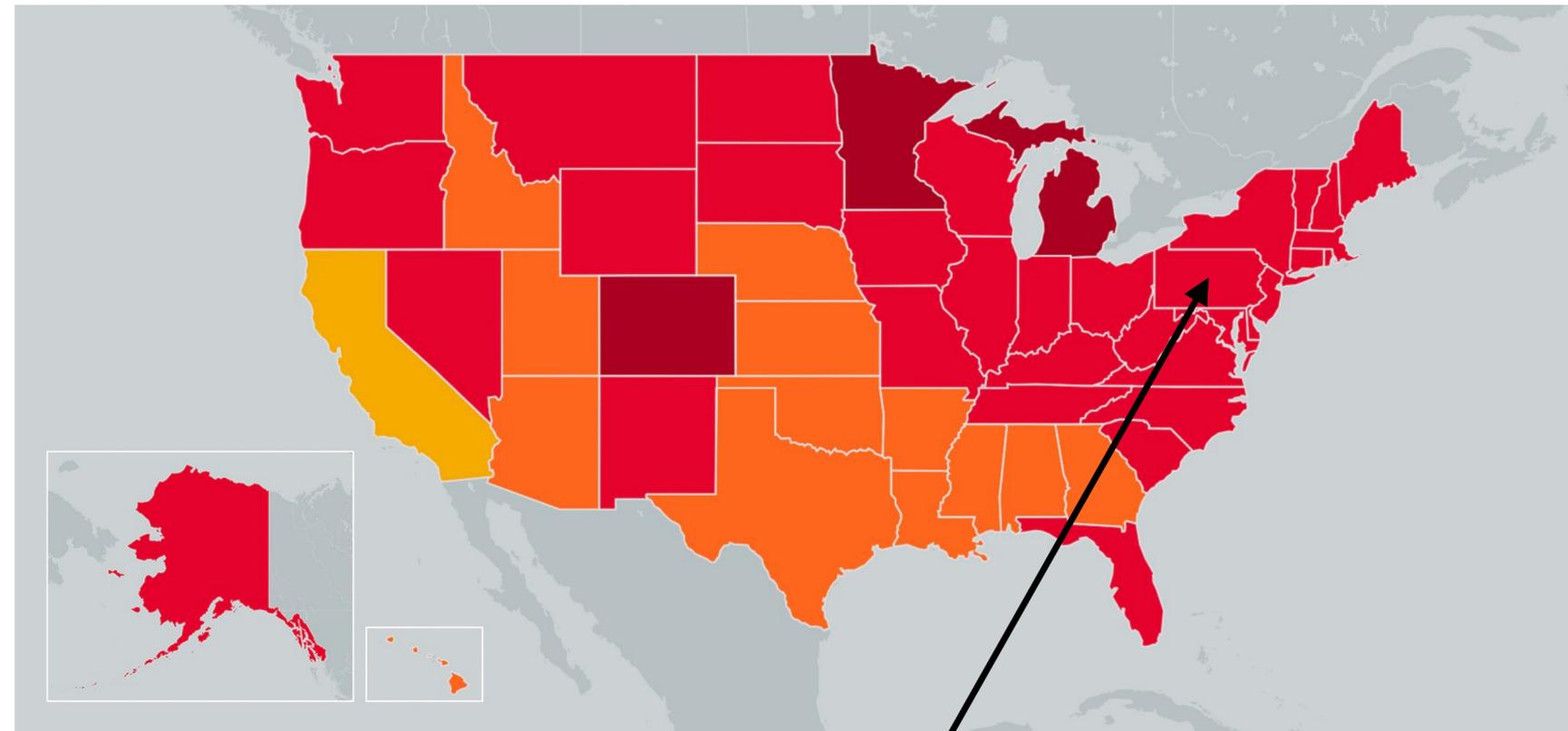
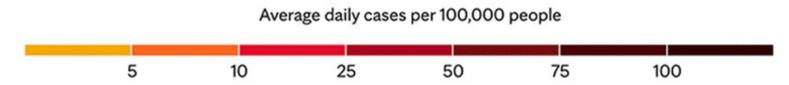
*CHANGE IN SEVEN-DAY AVERAGE OF NEW CASES TWO WEEKS AGO TO 7/9/2020. "STRONG" CHANGE: +/- 200; "FLAT": +/- 10



SOURCE: N.Y. TIMES COMPILATION OF STATE AND LOCAL GOVERNMENTS AND HEALTH DEPARTMENTS DATA DATA THROUGH 7/9/2020 FORTUNE

Fortune

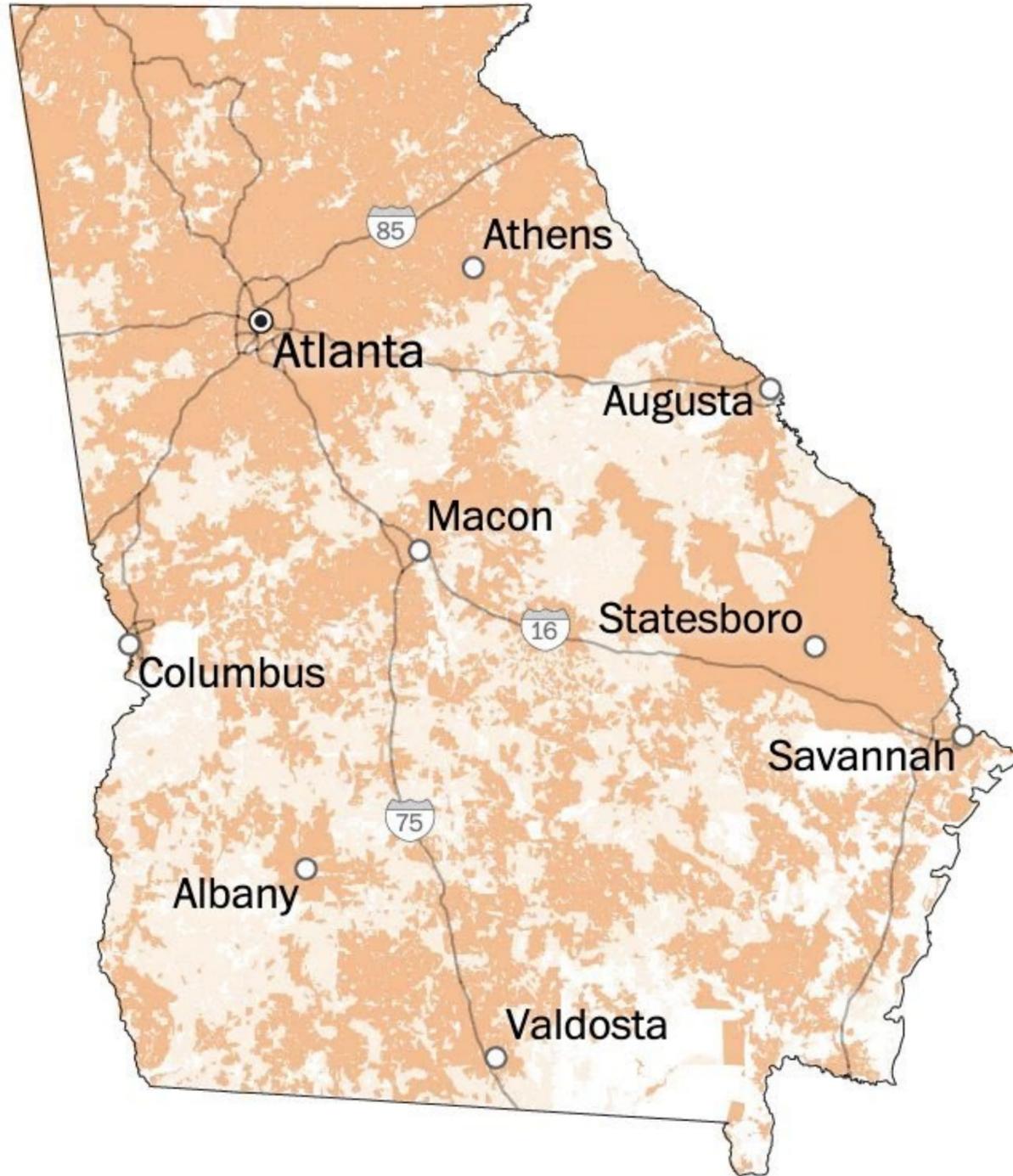
COVID-19 hot spots



Graphs at a moment in which my county in central PA had yet to record a day with more than 2 positive cases

■ Served area ■ Unserved area □ No data

**Connected areas,
according to the FCC**



Our visualizations fail to contextualize within our data definitions

At least 1 location with 25 Mbps download speeds and upload speeds of 3Mbps

Sources: Census Bureau; Federal Communications Commission; Georgia Broadband Program; University of Georgia's Carl Vinson Institute of Government

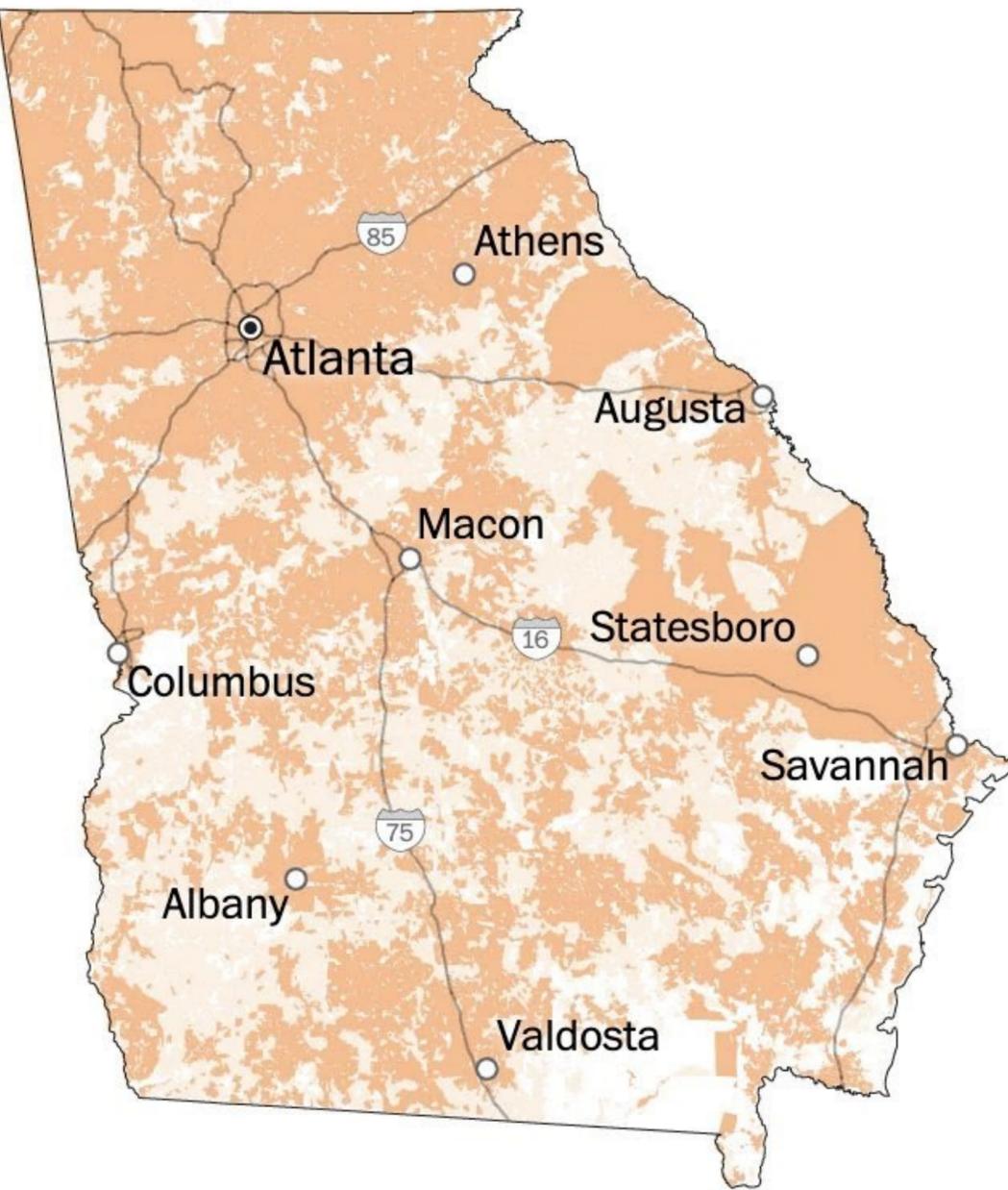
<https://www.washingtonpost.com/technology/2021/12/14/bidens-ambitious-broadband-funding-has-key-impediment-an-outdated-map-who-needs-it/>

At least 1

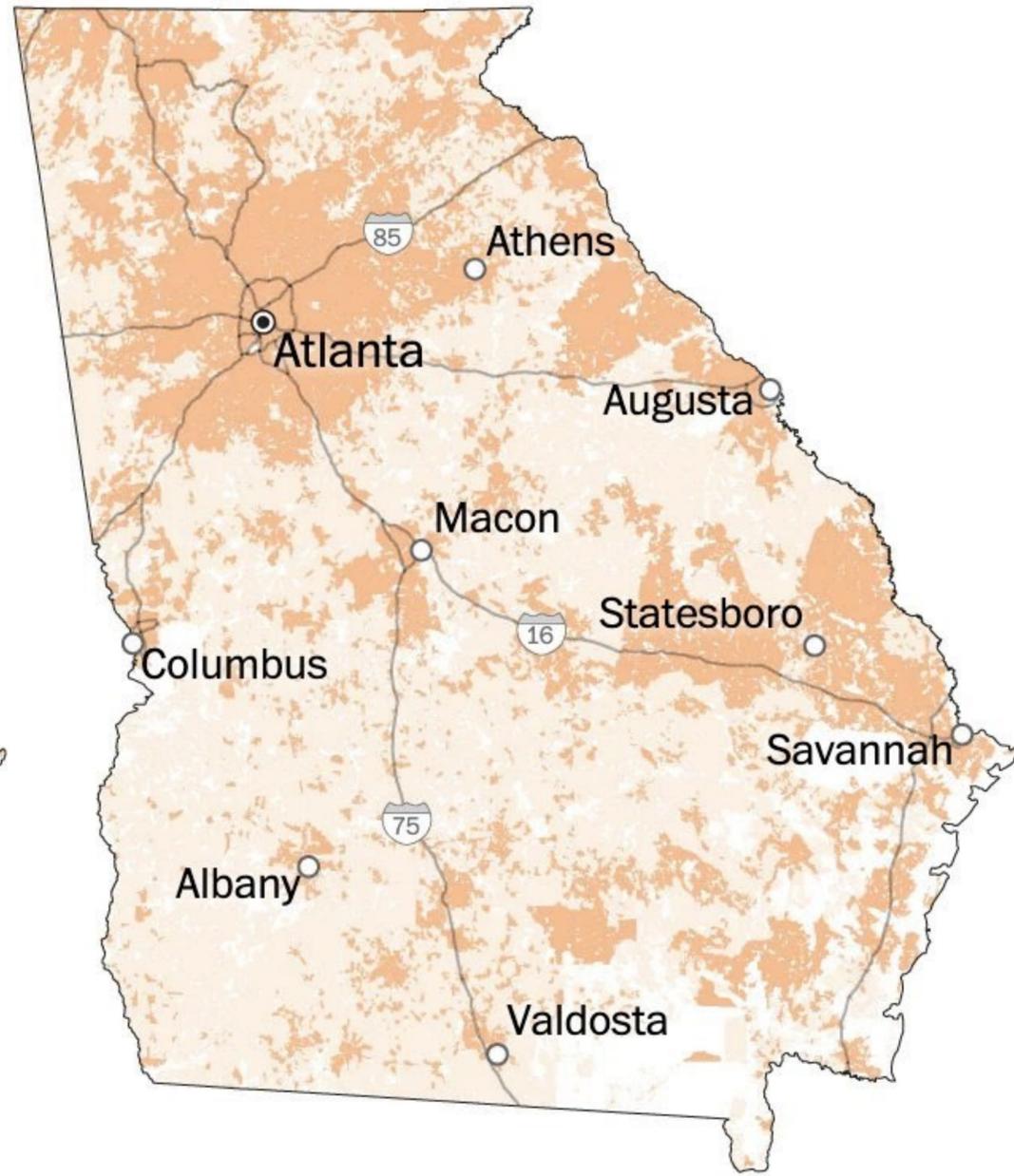
80%

■ Served area ■ Unserved area □ No data

Connected areas, according to the FCC



Connected areas, according to Georgia



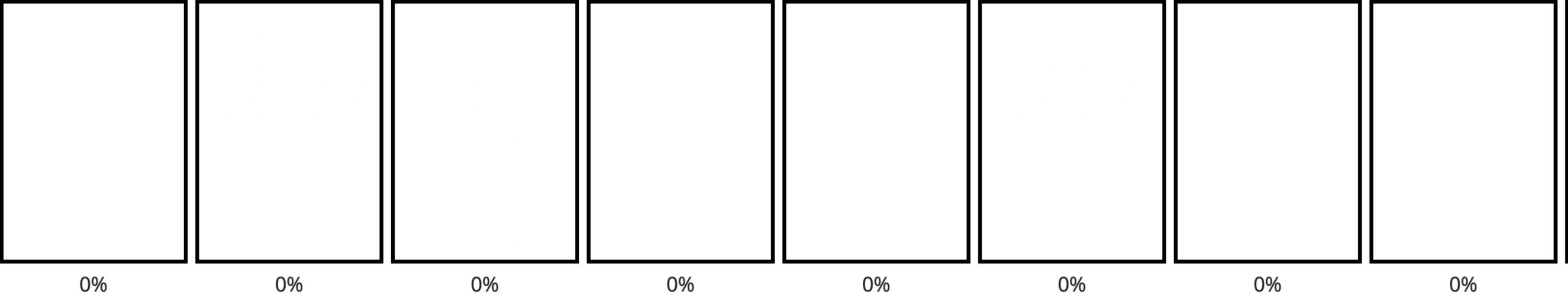
My father's childhood home. It has *never* had stable broadband connectivity. It is in an area defined as broadband coverage

Sources: Census Bureau; Federal Communications Commission; Georgia Broadband Program; University of Georgia's Carl Vinson Institute of Government

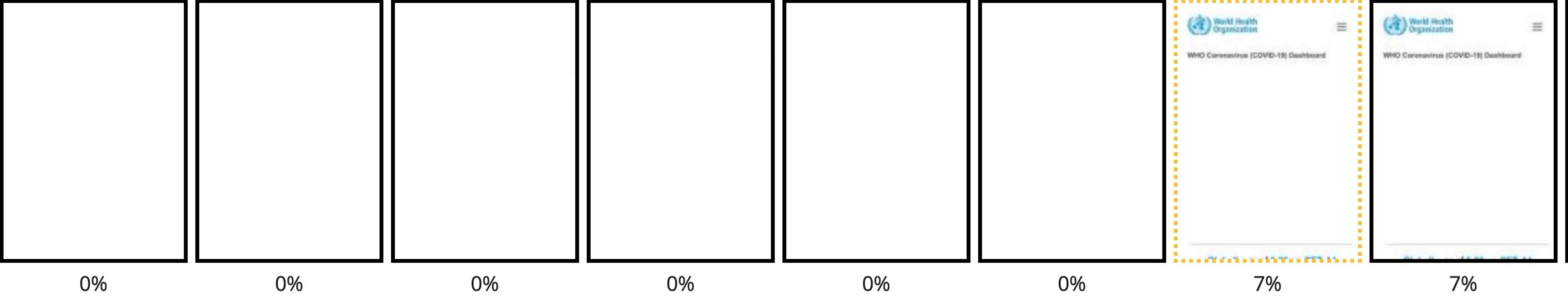
How COVID dashboards load on a phone with 3G

0.0s 0.5s 1.0s 1.5s 2.0s 2.5s 3.0s 3.5s

1: NYTimes (Edit title)

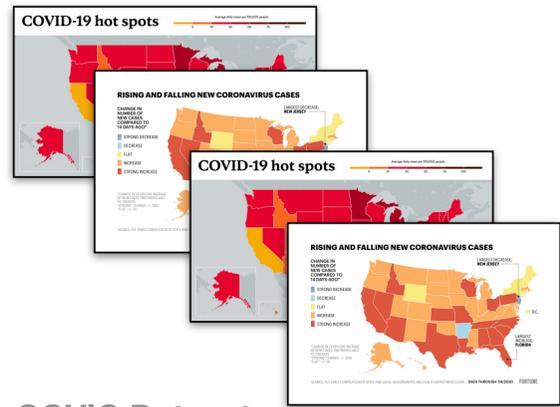


2: WHO (Edit title)

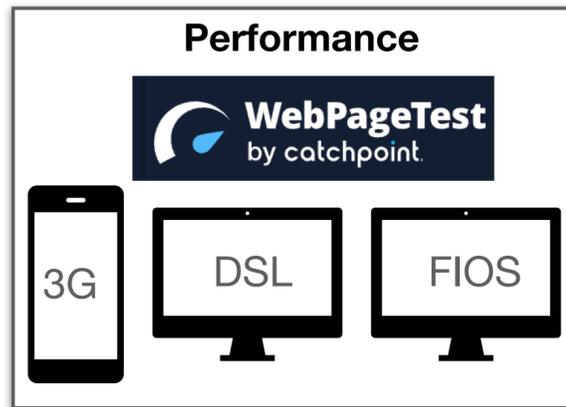


Who do we design for when we design on the web?

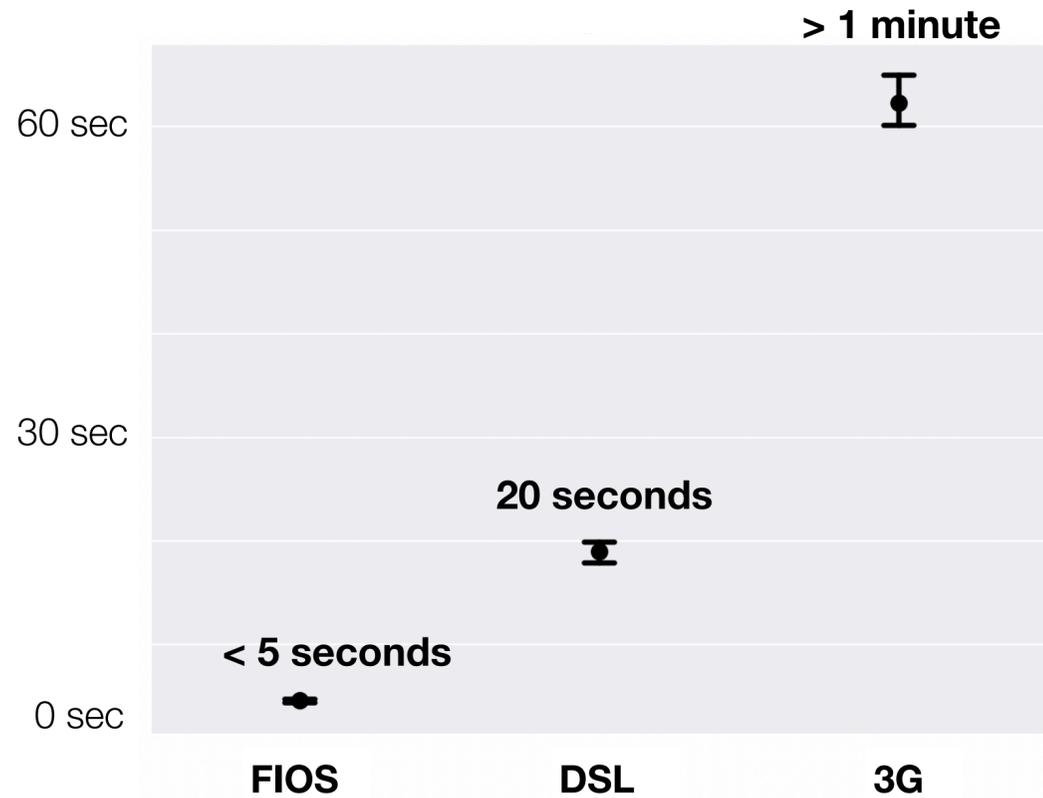
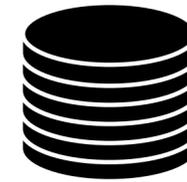
3000+ COVID-19 web visualizations



COVIC Dataset
Paul Kahn, Hugh Dubberly, Dario Rodighiero 2022



150 GB of performance + accessibility data



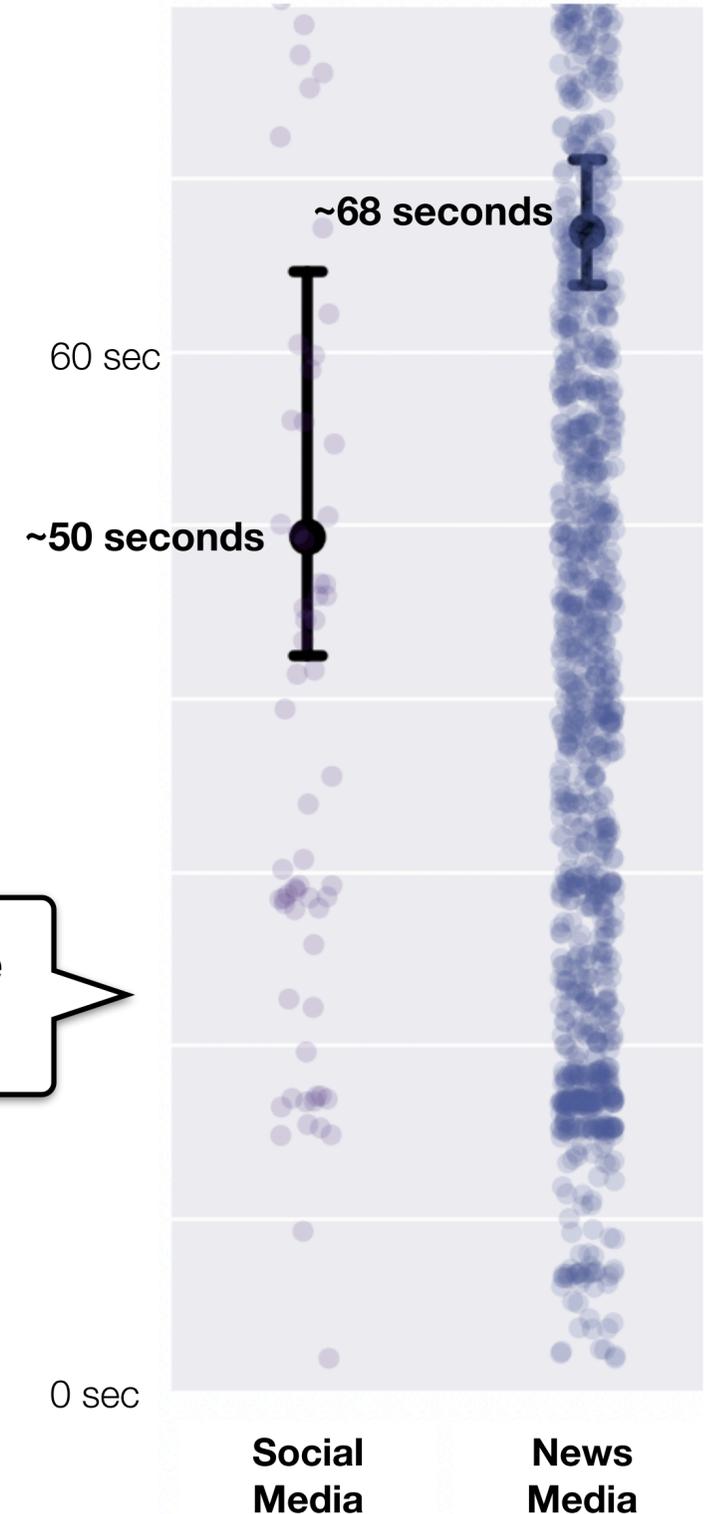
On average, it takes more than 1 minute to access COVID-19 graphs on a slow, mobile connection

COVID-19 graphs on News Media sites take ~30% longer to load than on social media

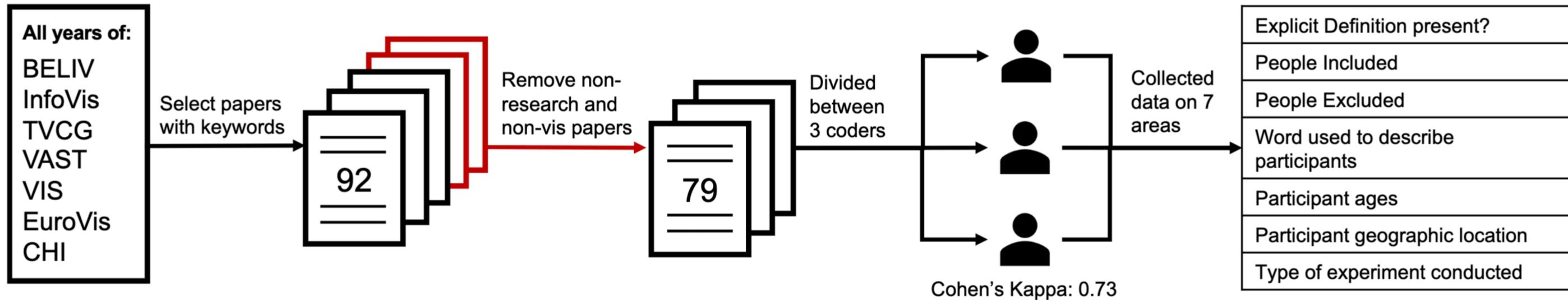


lower income, racial minorities, less educated

Pew Internet



Why does our research about **novices** in visualization often fail? **general public** **non-experts**



80% of papers rely on implicit definitions for novices (often ambiguous)

Implicitly...

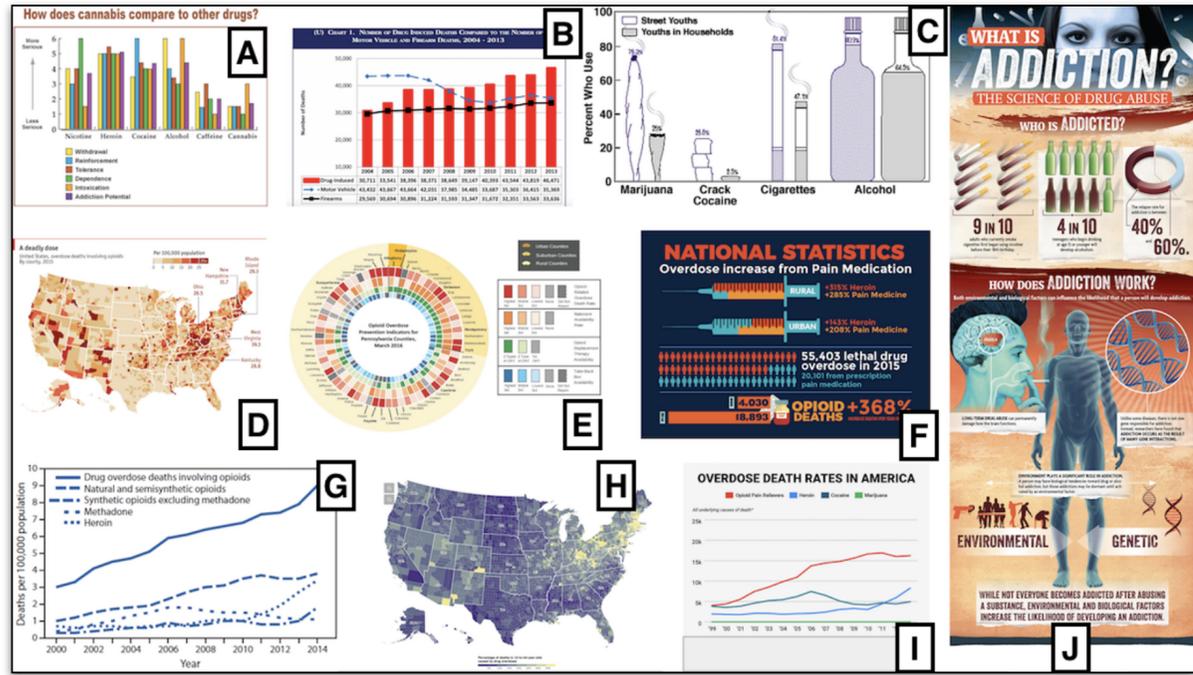
A novice is most likely to be **young**

A novice is most likely to be **a university student**

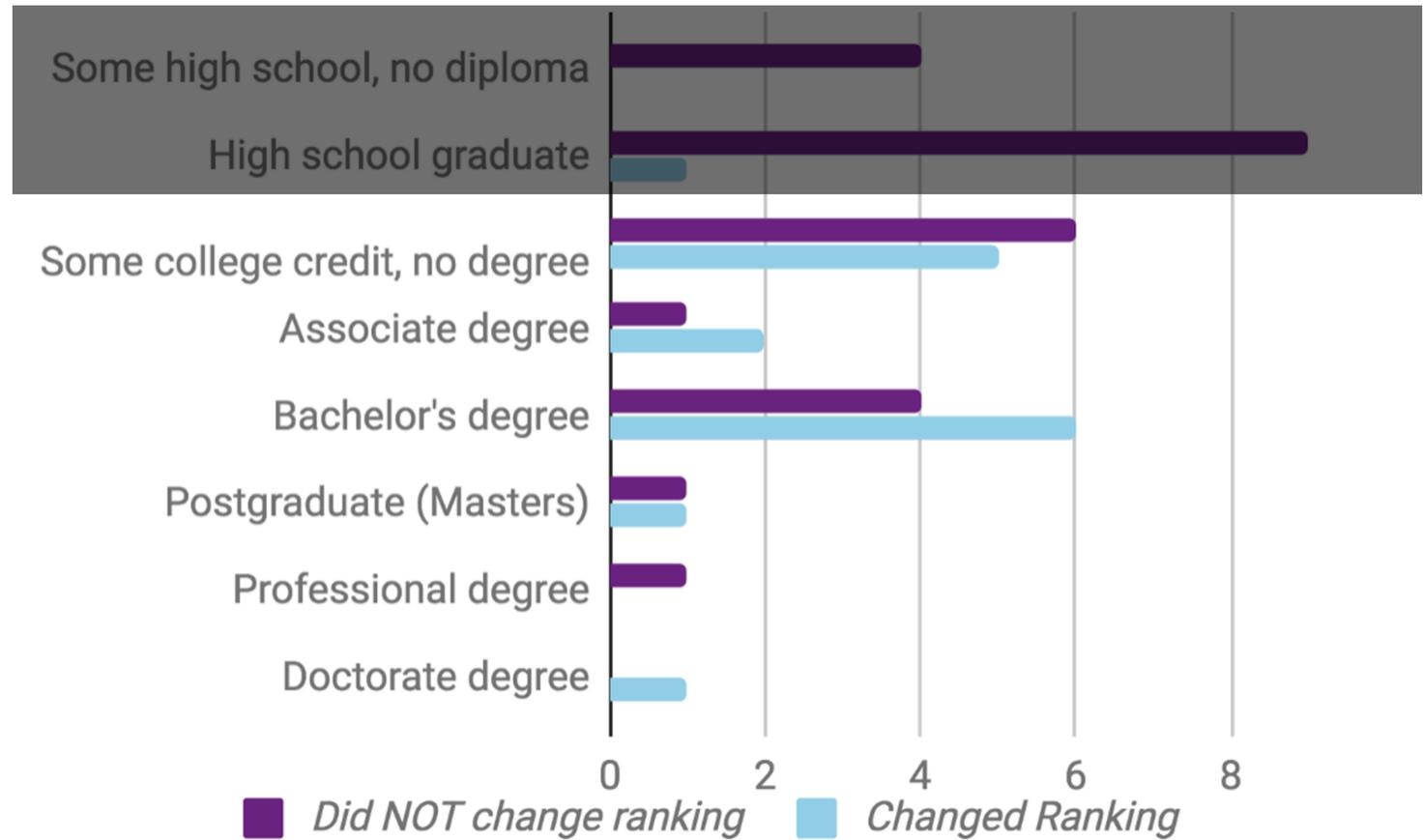
A novice is most likely to be **a US resident**

A novice is most likely to **lack traditional STEM expertise**

Rank them

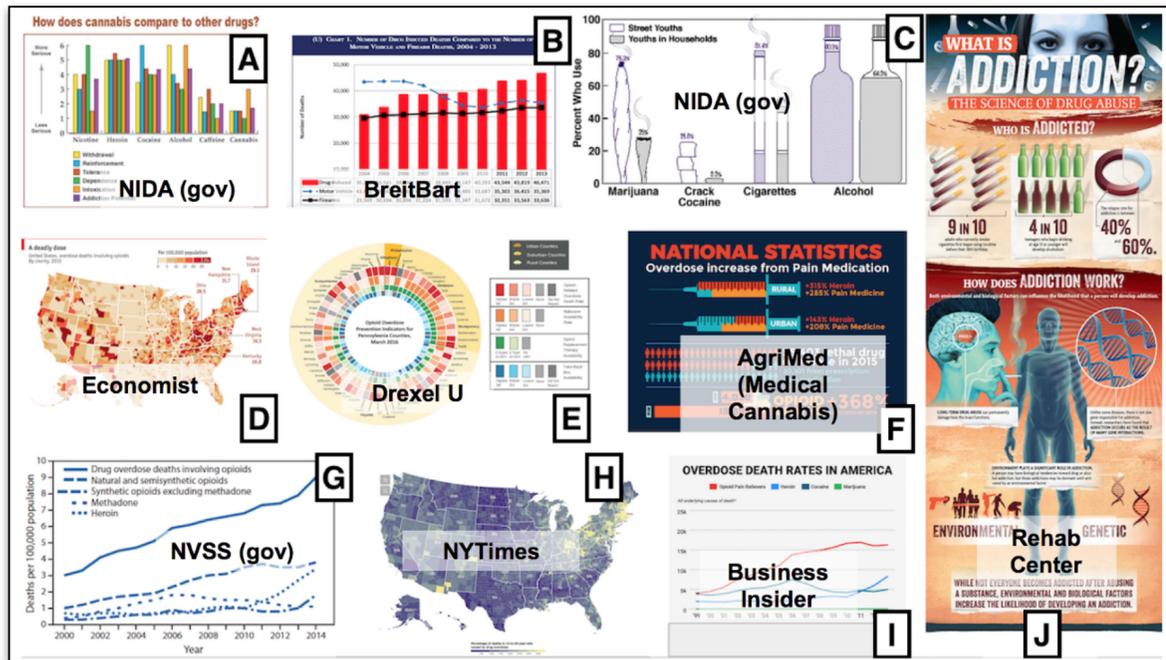


26 out of 42 didn't change any rankings...



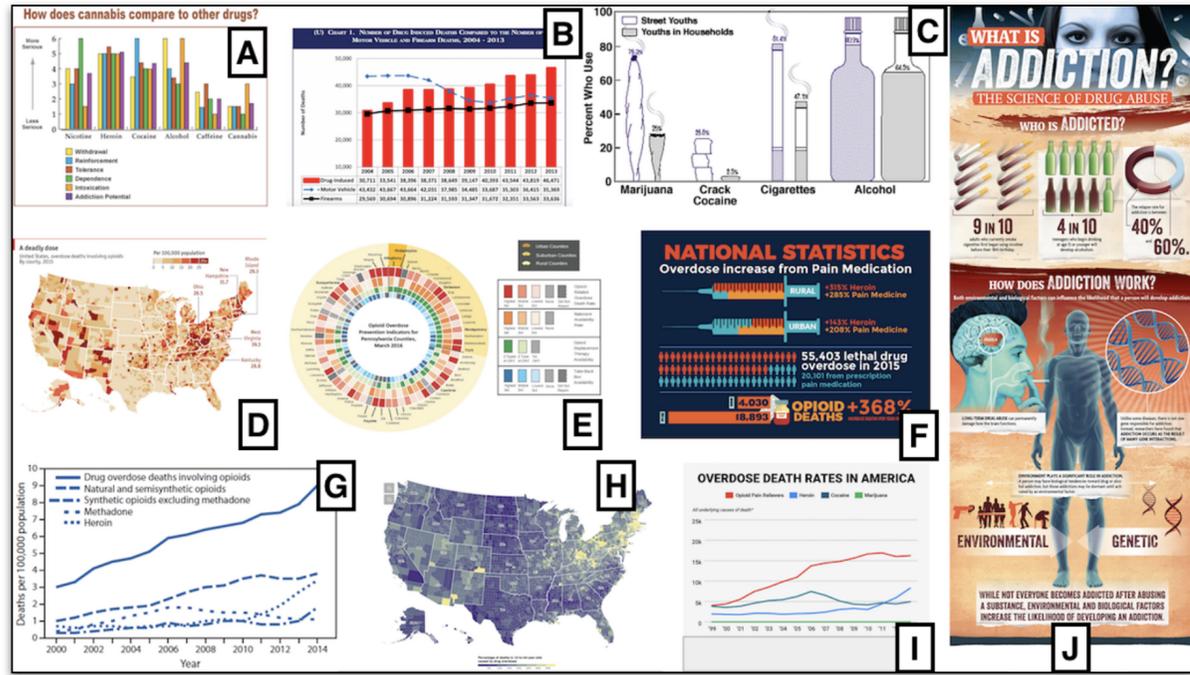
Reveal sources

Rerank

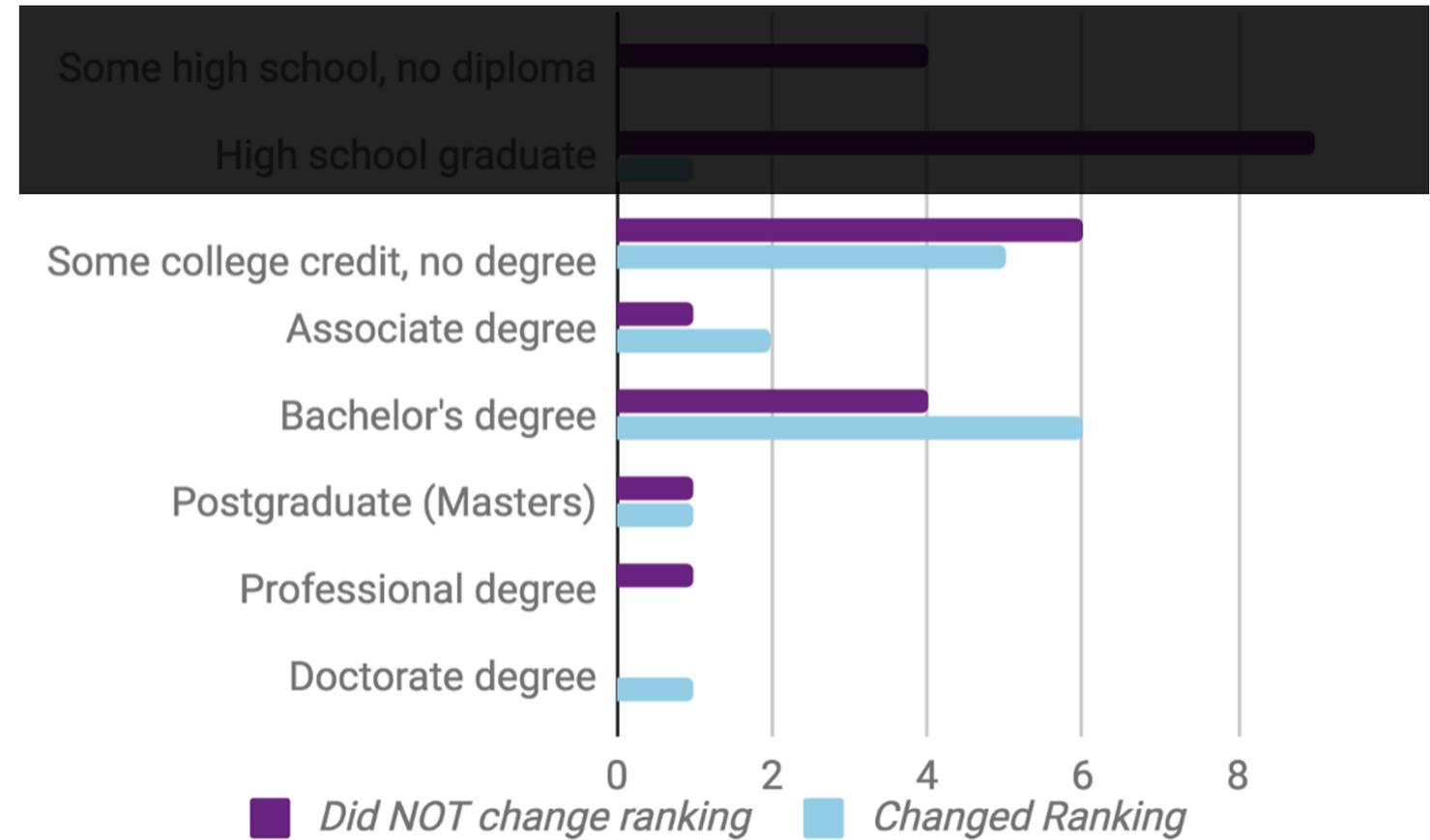


... and people who were **less educated** were **less likely** to change their rankings

Rank them

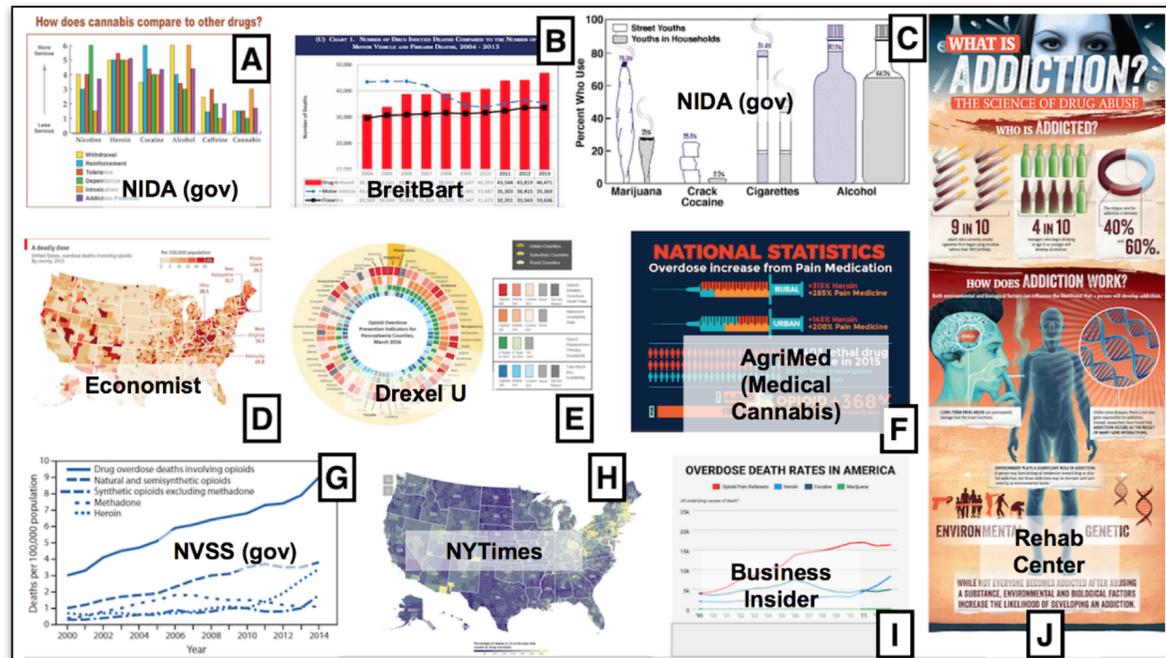


13 out of 28 didn't change any rankings...



Reveal sources

Rerank

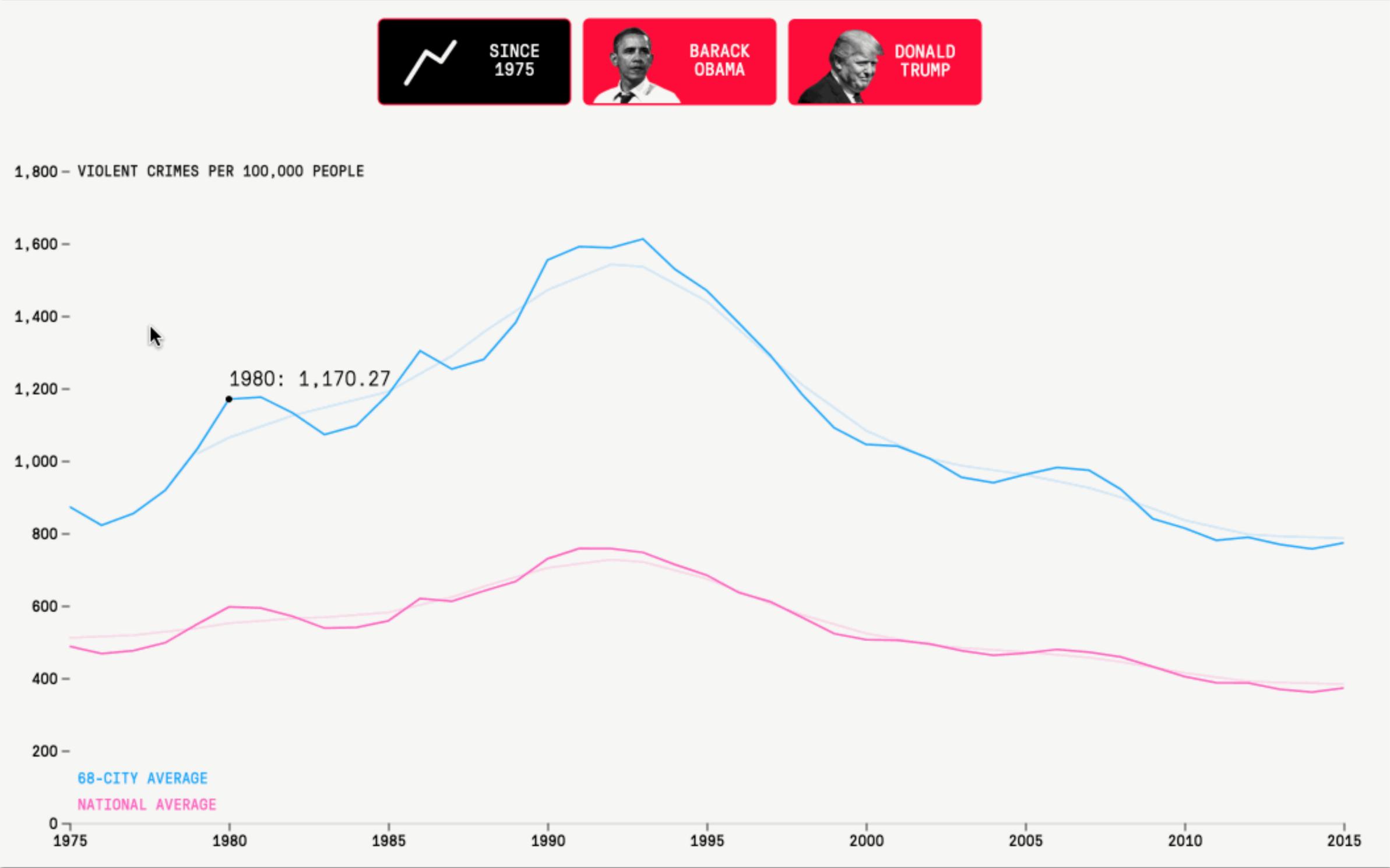


... and we saw no characteristics that correlated with this decision

IMPARTIALITY POSITIONALITY

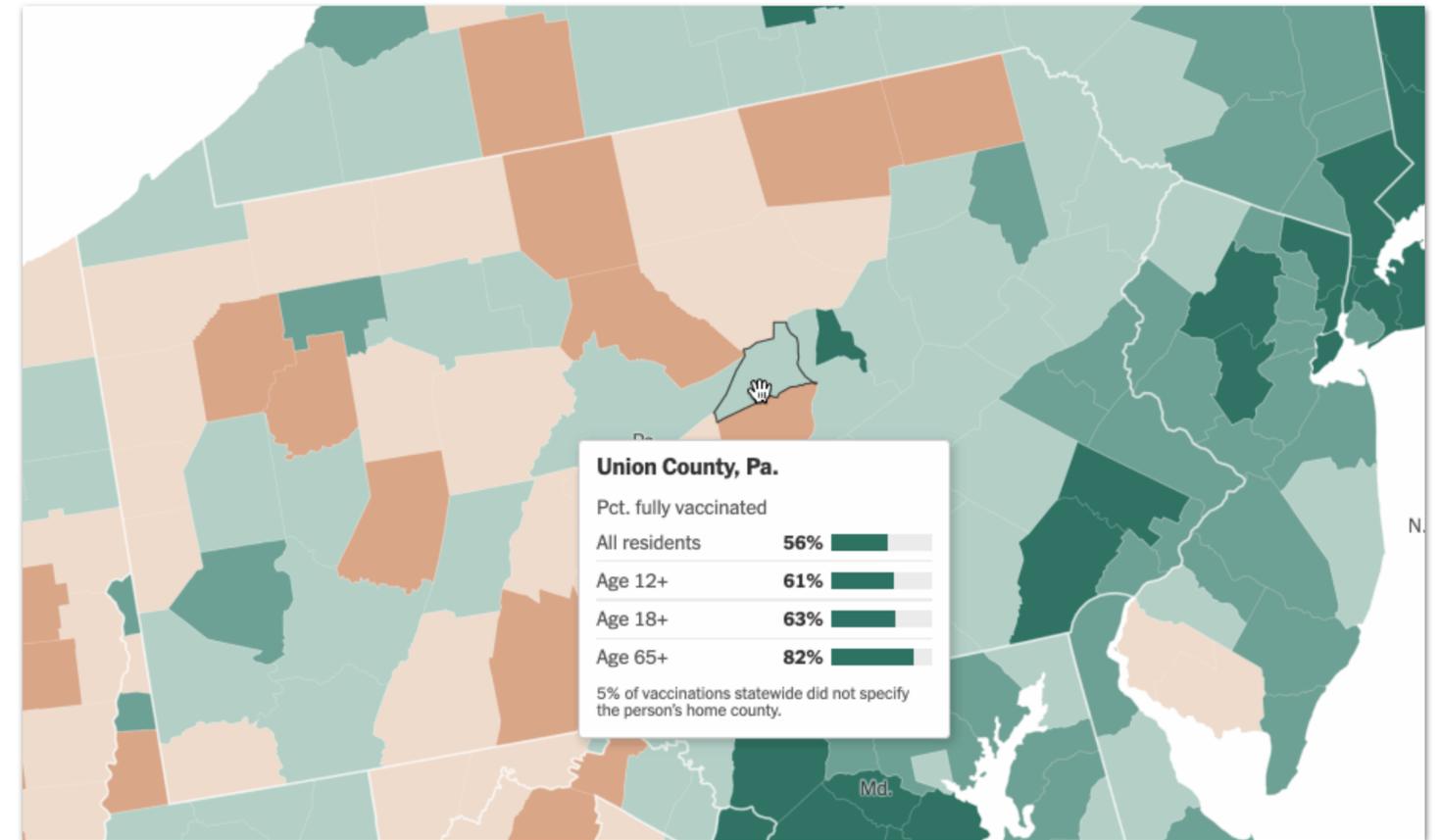
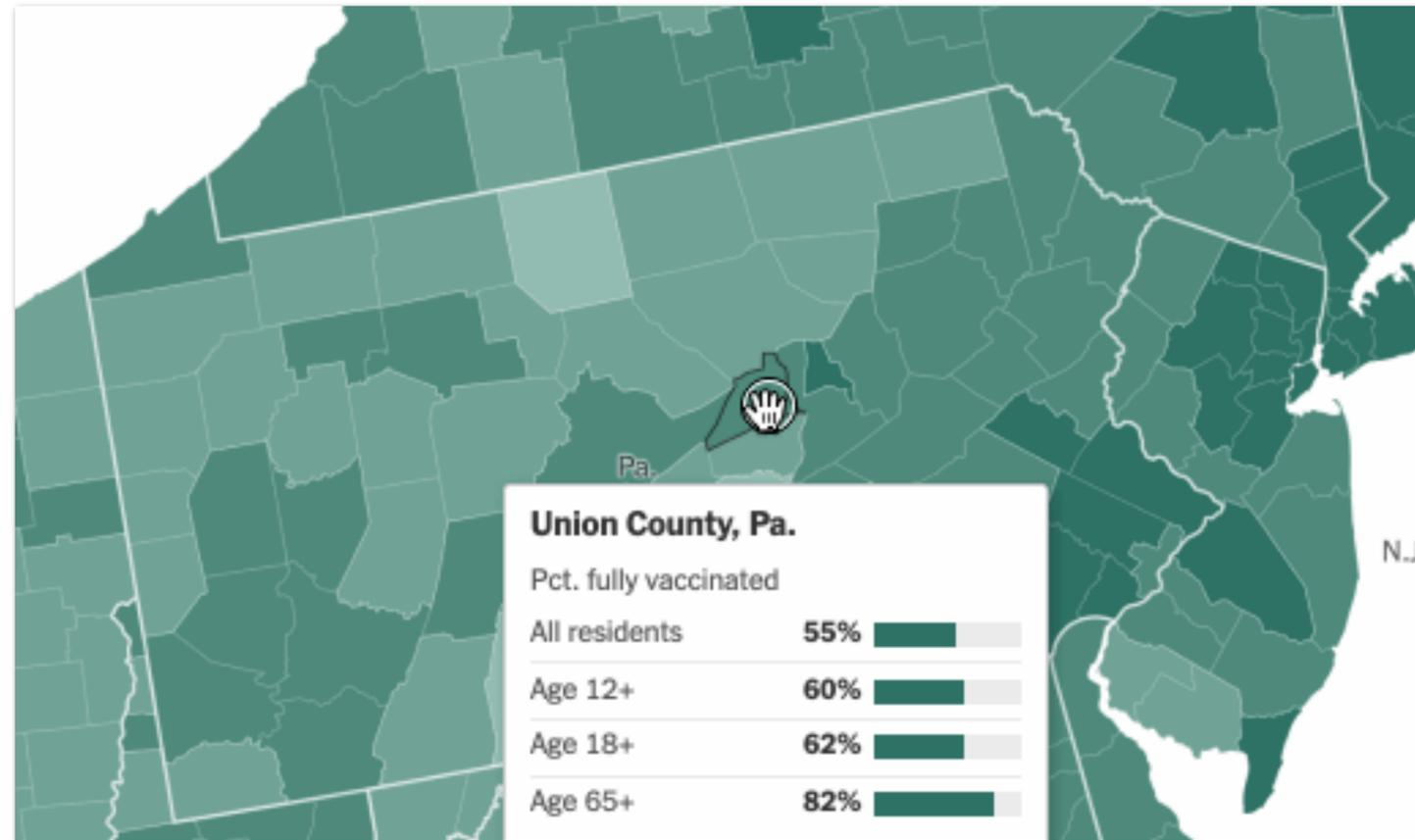
“information is information”

- **Rationale from person who did not change their rankings in our study
(among **more than a dozen** with similar sentiments)**



Exploiting perceived impartiality of data

Invisibility of political decisions



Same graph, almost-identical data, ~1 week apart

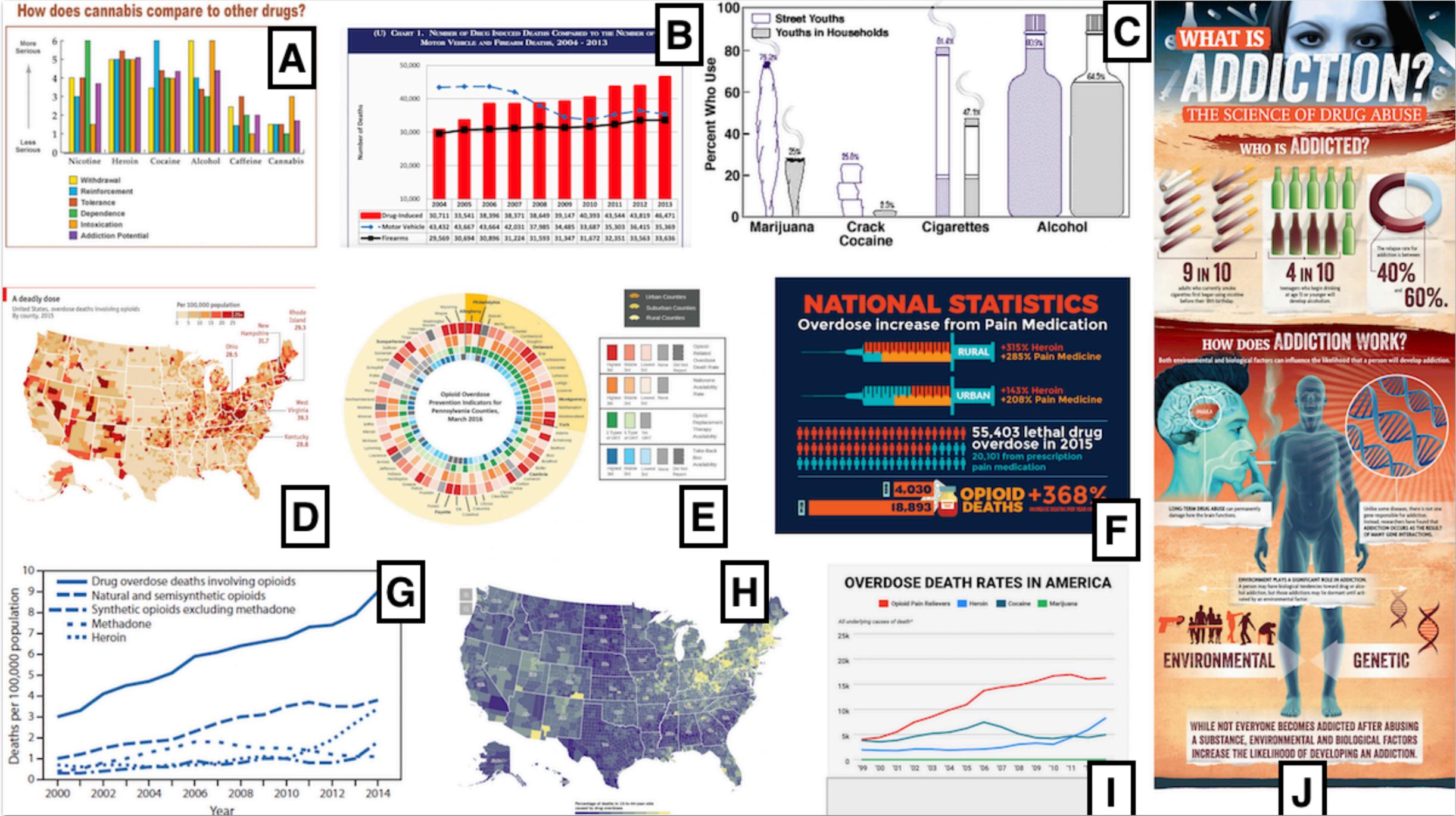
Once trust is lost, the graphs don't matter

"I **don't trust** things if I don't know where it comes from"

"I would **never trust** something from a drug company or Breitbart, and I would always trust something from the CDC or NIH"

"I **don't trust** the CDC. I believe they hide stuff"

"It's **hard to trust** a lot of information because you could put anything on anything"



It's not just data literacy

“anti-mask groups are critical about the data sources used to make visualizations in data-driven stories.”

“For these users, understanding how and why metrics come to be is crucial to understanding whether the pandemic is as bad as the news makes it out to be... many of these anti-mask groups implored their opponents to simply follow the data, as sound data (and their visualizations) are crucial to making informed decisions.”

Curious of the COVID death risk to young children and their parents? Follow these charts. First, here is COVID vs non-COVID deaths by age since February. Ideally I would start Mar 1st but the CDC gives its data in bulk from Feb 1st.

July 12, 2020
20 209 353

Hey Fauci...childproof chart! Even a 4-year old can figure this one out!

July 19, 2020
28 352 689

COVID Fatalities per Million
5 states with highest Rates + AZ, FL, CA & TX

Team Apocalypse keeps moving the #COVID19 goalposts. Cases one day, deaths another, now their focus is on hospitalizations. Fine. Let's use our Florida Case Line data to examine that.

This is a meaty chart but if you take 30 seconds to follow the 1,2,3 I think you'll get it. 1/

July 22, 2020
24 253 449

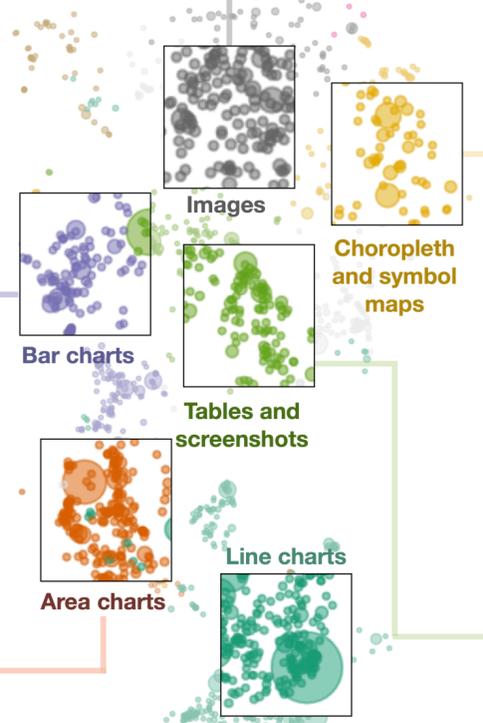
COVID-19 update: Check out Sweden's actual day of death chart.

No lockdowns. No masks.

We are all being taken for an absolute ride. There is precisely zero evidence that masks and/or lockdowns have had any benefit worldwide.

experience.arcgis.com/experience/09f...

July 31, 2020
19 428 587



@onlyright9 no. odds are next to impossible to know anyone that died from Covid. this chart is as of yesterday

July 27, 2020
1 7 8

USA COVID NUMBERS
As of July 19, 2020

I really hope all the people who are scared of COVID, truly scared, and not just trying to keep the economy shutdown, look at this chart and understand its implications. In March over 7% of those hospitalized with COVID, died. Today it's just over 1%, as deaths keep falling.

July 7, 2020
231 1.6K 3.3K

The COVID-19 death rate is steadily in decline, as you see in this chart! Do not be taken by fear and paranoia.

June 26, 2020
228 5K 8.2K

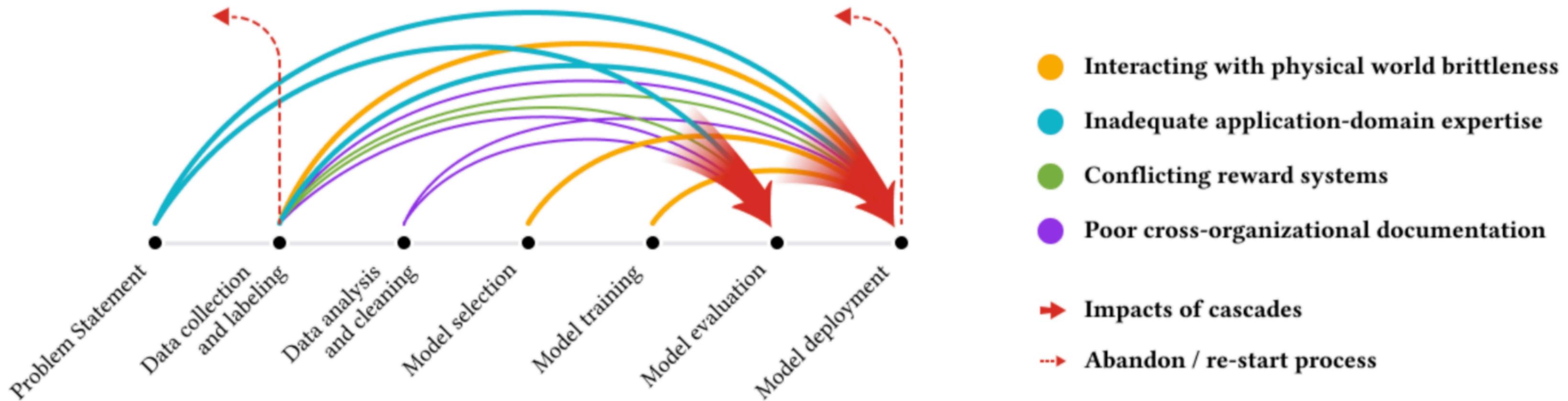
Another great chart that puts covid death risk by age...proportion to other causes. College kids are more likely to die driving to campus for workouts than they are from the coronavirus.

June 20, 2020
45 256 950

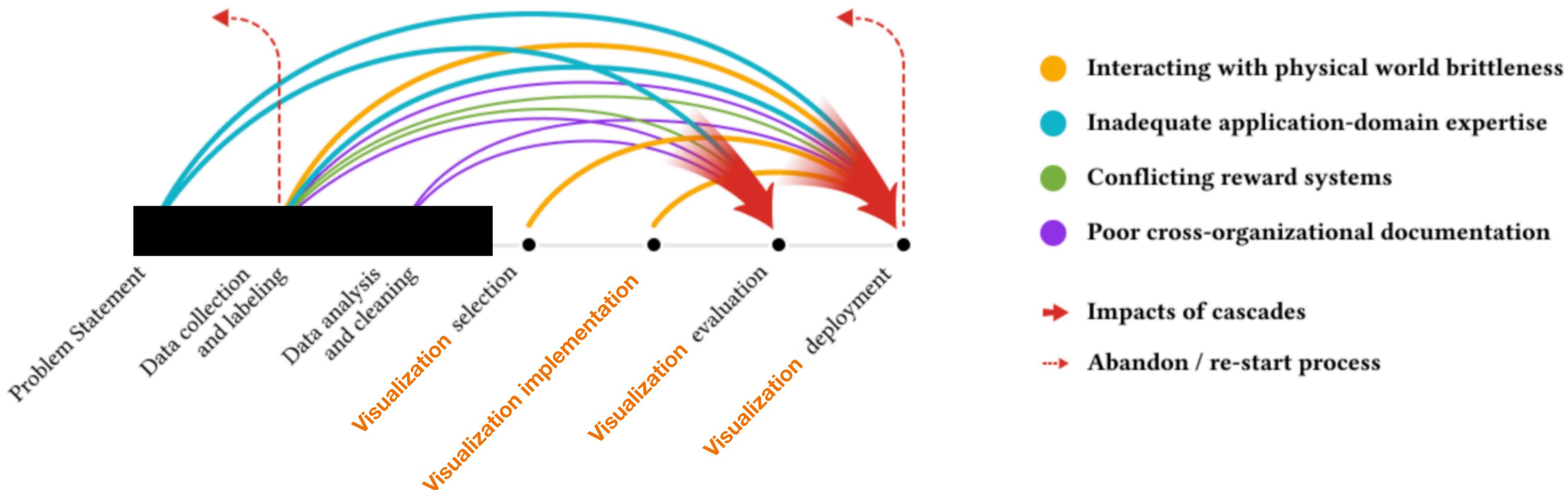
| Age Group | COVID Deaths | Total Deaths | COVID Deaths as % of Total | Population | COVID Deaths per 100,000 | Age Group % of all COVID | Age Group % of all Non-COVID Deaths |
|--------------|--------------|--------------|----------------------------|-------------|--------------------------|--------------------------|-------------------------------------|
| Under 1 year | 0 | 6,157 | 0.0% | 4,138,838 | 0.0% | 0.0% | 0.0% |
| 1-4 years | 5 | 1,126 | 0.4% | 16,438,838 | 0.0% | 0.0% | 0.1% |
| 5-9 years | 18 | 1,705 | 1.0% | 41,968,879 | 0.0% | 0.0% | 0.2% |
| 10-14 years | 25 | 30,946 | 0.1% | 41,268,077 | 0.0% | 0.1% | 0.1% |
| 15-24 years | 89 | 21,270 | 0.4% | 46,889,398 | 1.4% | 0.7% | 2.8% |
| 25-34 years | 1,760 | 18,177 | 9.7% | 42,827,770 | 4.1% | 12.7% | 1.7% |
| 35-44 years | 4,676 | 63,186 | 7.4% | 40,841,916 | 11.4% | 22.2% | 4.0% |
| 45-54 years | 12,387 | 148,510 | 8.3% | 41,013,363 | 28.4% | 13.9% | 11.9% |
| 55-64 years | 21,462 | 228,125 | 9.4% | 38,675,174 | 54.8% | 9.3% | 20.8% |
| 65-74 years | 27,529 | 285,801 | 9.7% | 36,619,323 | 75.0% | 5.0% | 26.4% |
| 75 and over | 36,420 | 360,256 | 10.1% | 34,725,520 | 105.0% | 2.0% | 30.0% |
| All Ages | 105,239 | 1,030,126 | 10.2% | 324,303,416 | 32.8% | 100.0% | 100.0% |

Lee, Crystal, Tanya Yang, Gabrielle D. Inchoco, Graham M. Jones, and Arvind Satyanarayan. "Viral Visualizations: How Coronavirus Skeptics Use Orthodox Data Practices to Promote Unorthodox Science Online." In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, pp. 1-18. 2021.

Public visualization needs to learn from (some of) ML's wrestling with **data processes**, not just models



Public visualization needs to learn from (some of) ML's wrestling with **data processes**, not just models

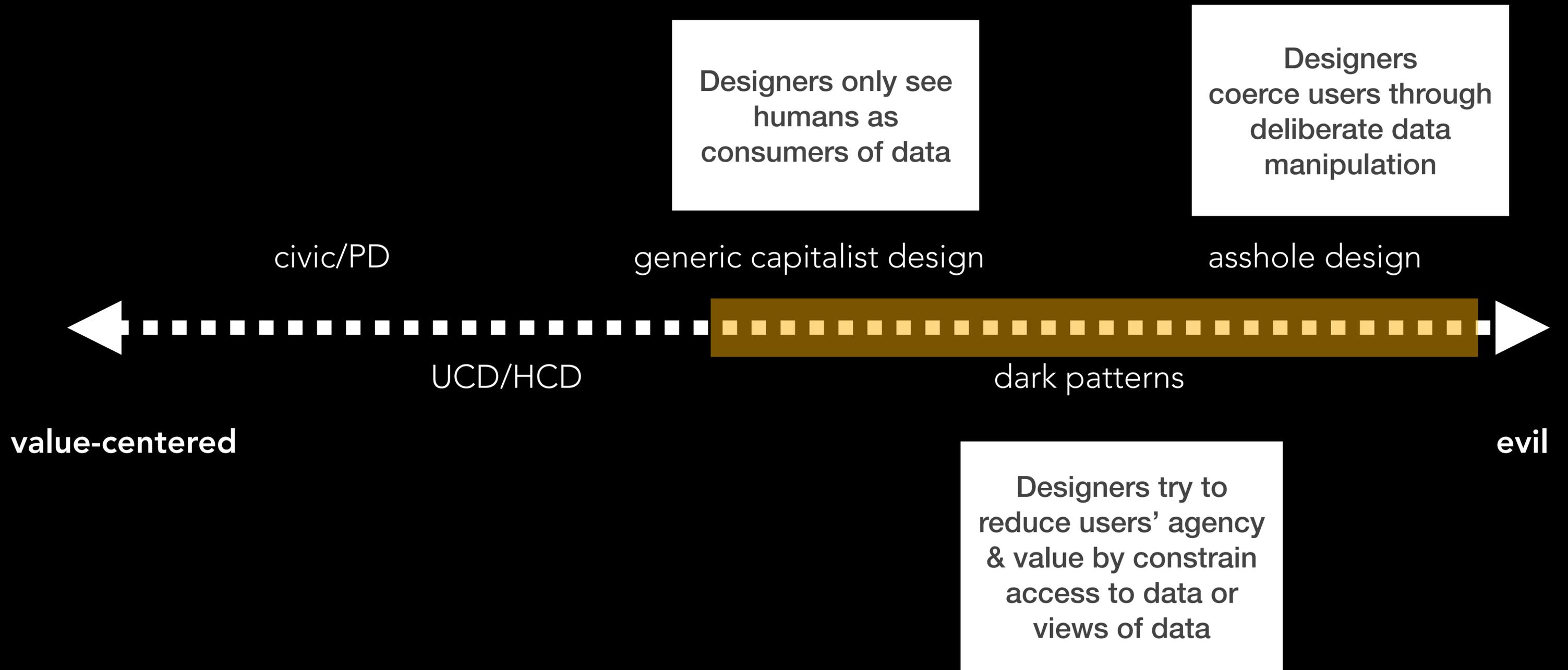


Processes over Principles



Slide modified from Colin Gray's talk on *Dark Patterns, Ethical Engagement, & the Potential for Action*

Processes over Principles



What might it look like to explore design spaces and design processes that **reprioritize our values in human-data interaction?**

Joe's Pond Ice Out Winners

| Year | Winner | Town and State | Date | Time |
|------|---|---|----------|------------|
| 1988 | Edward Bird | West Danville, VT | 4/26/88 | 12:31 p.m. |
| 1989 | Bob Kerschner | Sun City, FL | 5/5/89 | 9:05 a.m. |
| 1990 | John Reilly | Barre, VT | 4/26/90 | 9:40 a.m. |
| 1991 | Scott Lazare | Lido Beach, NJ | 4/22/91 | 4:16 a.m. |
| 1992 | Charese McSheffrey | Barre, VT | 5/6/92 | 1:19 p.m. |
| 1993 | Ray Strousos | Barre, VT | 4/29/93 | 1:38 p.m. |
| 1994 | Jerome Bolkum | Barre, VT | 5/4/94 | 12:12 p.m. |
| 1995 | Tom Buzzi | Kent, OH | 4/23/95 | 2:50 p.m. |
| 1996 | Nancy Potter | Plainfield, VT | 5/1/96 | 11:29 p.m. |
| 1997 | Ralph Bissell | Walden, VT | 5/1/97 | 7:43 a.m. |
| 1998 | Andre Jenny | Montpelier, VT | 4/16/98 | 6:41 p.m. |
| 1999 | Gilles Moreau | East Barre, VT | 4/26/99 | 2:37 a.m. |
| 2000 | Tammy Hatch | West Danville, VT | 4/30/00 | 6:19 a.m. |
| 2001 | Kay Scott | St. Johnsbury, VT | 5/4/01 | 1:44 a.m. |
| 2002 | N. Mason Jeff Temple Stephen Bean Charlene Zabek | Various | 4/18/02 | 4:18 p.m. |
| 2003 | Brodie Frazier | East Montpelier, VT | 4/28/03 | 9:45 a.m. |
| 2004 | Janet & Richard Hazen | South Hero, VT | 4/21/04 | 3:25 p.m. |
| 2005 | G.D. Lanois | Bonita Springs, FL | 4/21/05 | 2:50 p.m. |
| 2006 | Pam Desrochers Frenchie Cutting Lucille Dente | St. Johnsbury, VT Swanton, VT Barre, VT | 04/16/06 | 3:20 p.m. |
| 2007 | Dr. Bob Marshall | Montpelier, VT | 5/1/07 | 4:45 p.m. |
| 2008 | Janet Egizi Roxanne Gorham Joe Kelly Don Rogers | St. Johnsbury, VT Lyndonville, VT Barre, VT Swartz Creek, MI | 4/25/08 | 5:25 p.m. |
| 2009 | Ash Desmond | Richmond, VT | 4/20/09 | 10:21 p.m. |
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| 2012 | Judy Lavelly | Danville, VT | 4/8/12 | 5:25 p.m. |
| 2013 | Gary Clark | Barre, VT | 4/24/13 | 8:46 a.m. |
| 2014 | Kelsey Phillips Bill Brochu | Iowa City, IA Springfield, MA | 4/29/14 | 10:06 a.m. |
| 2015 | Mary Numa | West Haven, CT | 4/29/15 | 6:14 p.m. |
| 2016 | Pamela Swift | Barre, VT | 4/12/16 | 5:04 p.m. |
| 2017 | Emily Wiggett | North Danville, VT | 4/23/17 | 4:32 p.m. |
| 2018 | Michael S. Cody | Barre, VT | 5/4/18 | 11:27 a.m. |
| 2019 | Robynn L. Albert | Essex Junction, VT | 4/25/19 | 5:39 a.m. |
| 2020 | Angela Buttura Nancy Durand | Essex Junction, VT Hardwick, VT | 4/15/20 | 6:07 a.m. |



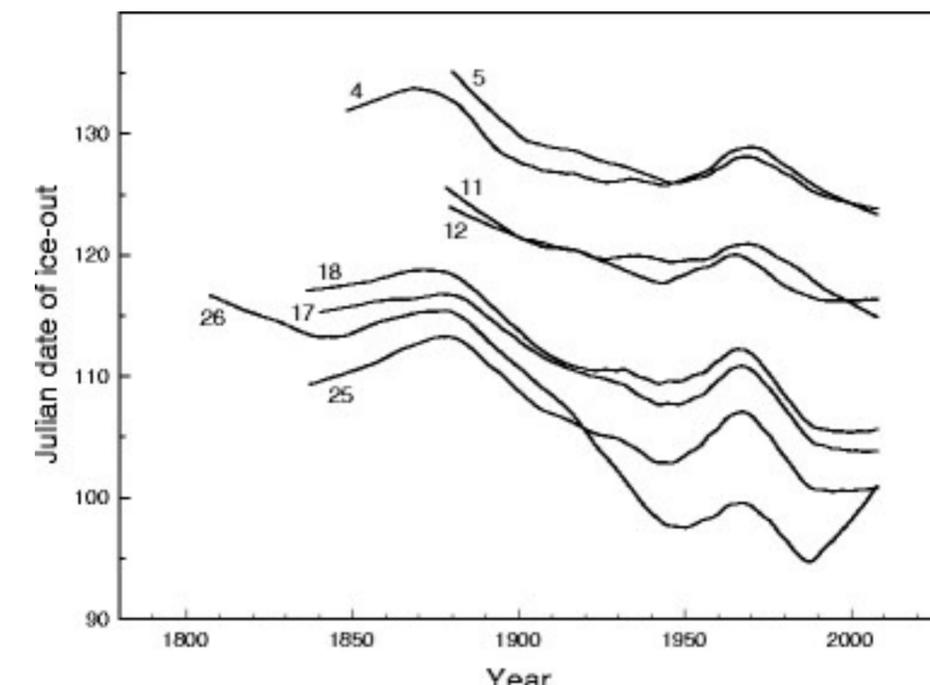
Ice out contests at Joe's Pond in rural Vermont

Joe's Pond Ice Out Winners

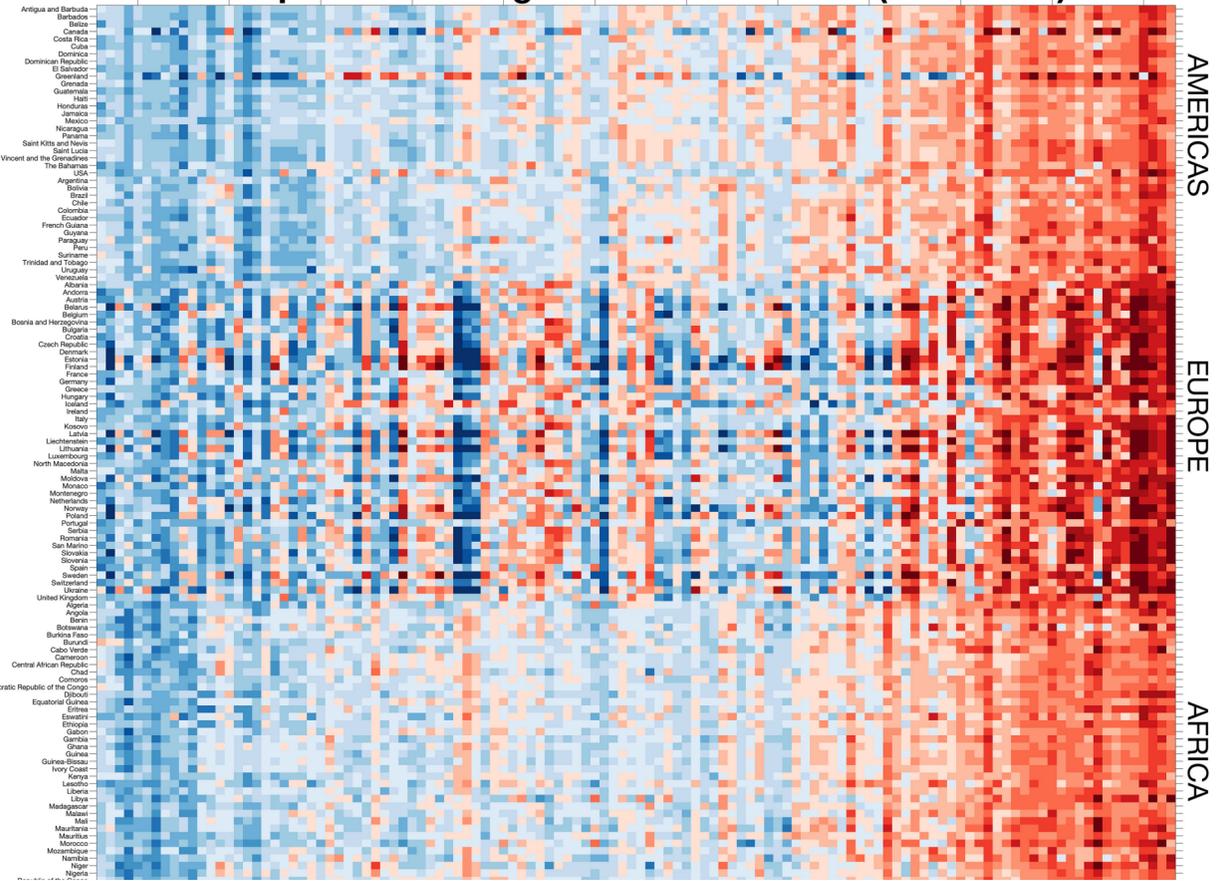
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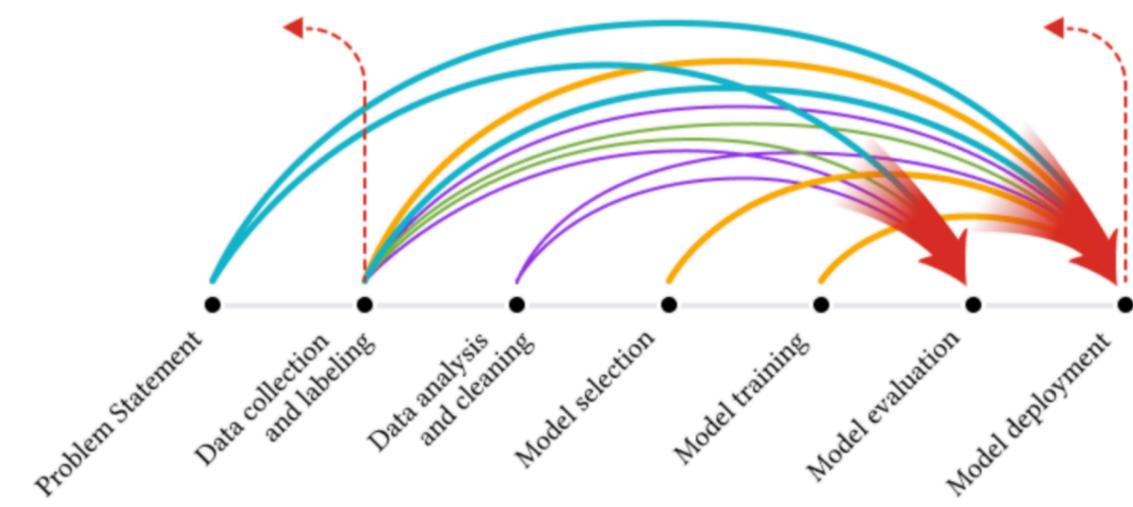
Ice-out events recorded for over 150 years in ponds and lakes across New England



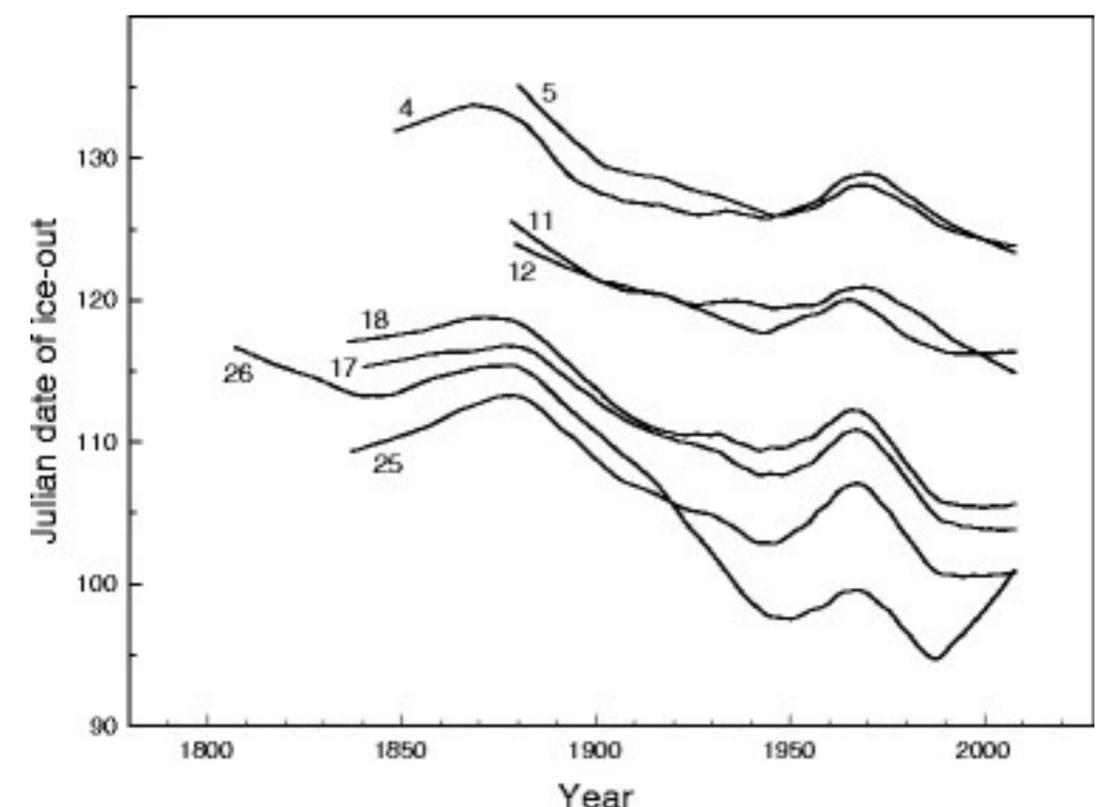
Temperature changes around the world (1901-2018)



EFFICIENCY **CARE**
UNIVERSALITY **CONTEXTUALITY**
IMPARTIALITY **POSITIONALITY**

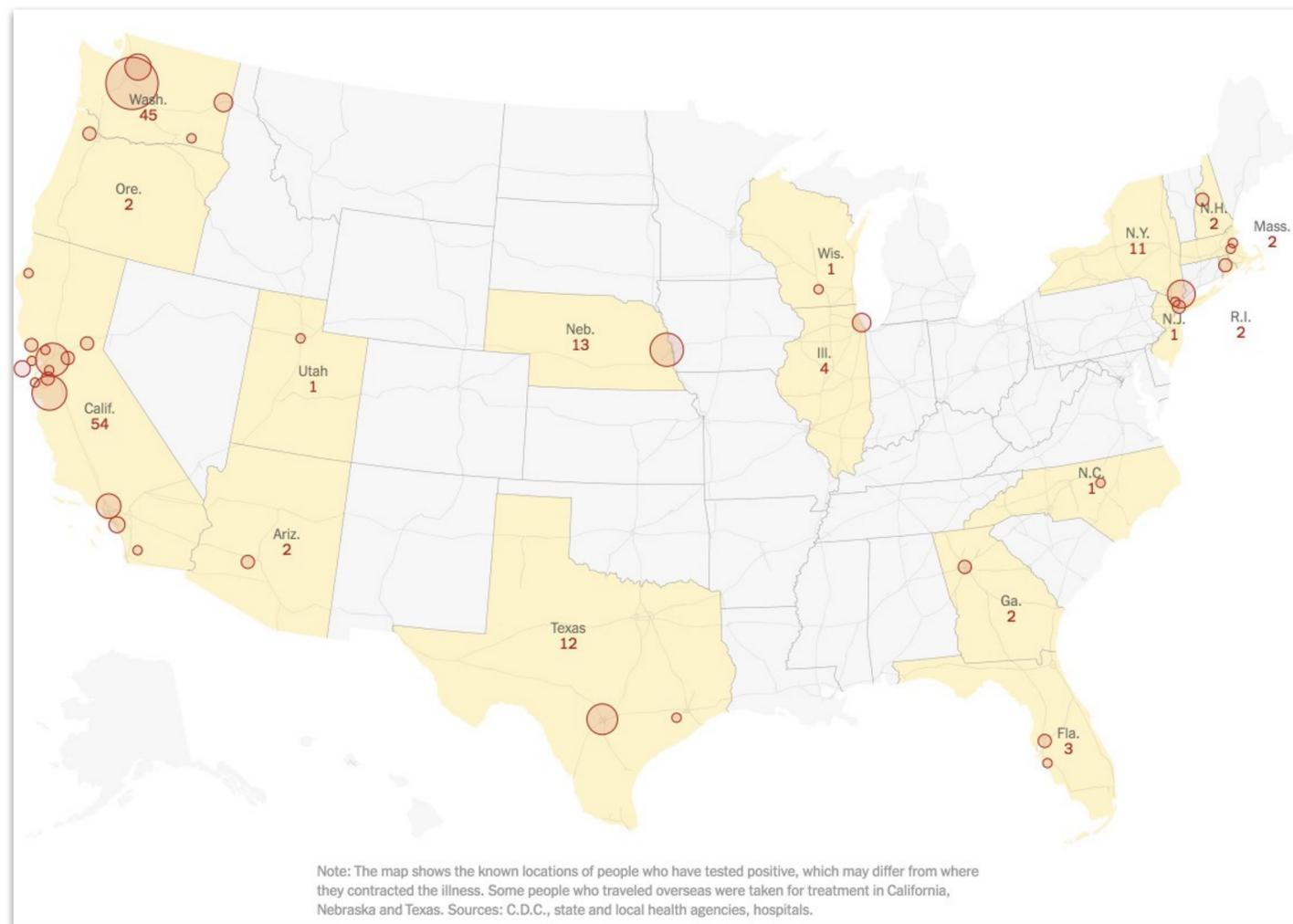


SLOW
LONG
IMPRECISE
PHYSICAL
LOCAL
VISIBLE



Joe's Pond Ice Out Crew Connects Block To Clock
caledonianrecord.com

What do data visualizations look like when they are **local** and **participatory** vs. universal and designer-centered?





What *should* information visualization focus on?

- ... interrogating our data **processes**
not just our visual designs
- ... including people as **participants**
not just as consumers
- ... creating visualizations for **communities**
not just universal outlets
- ... making visible our **framing and bias**
not just assuming objectivity
(It's not possible!)



What *should* information visualization focus on?

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