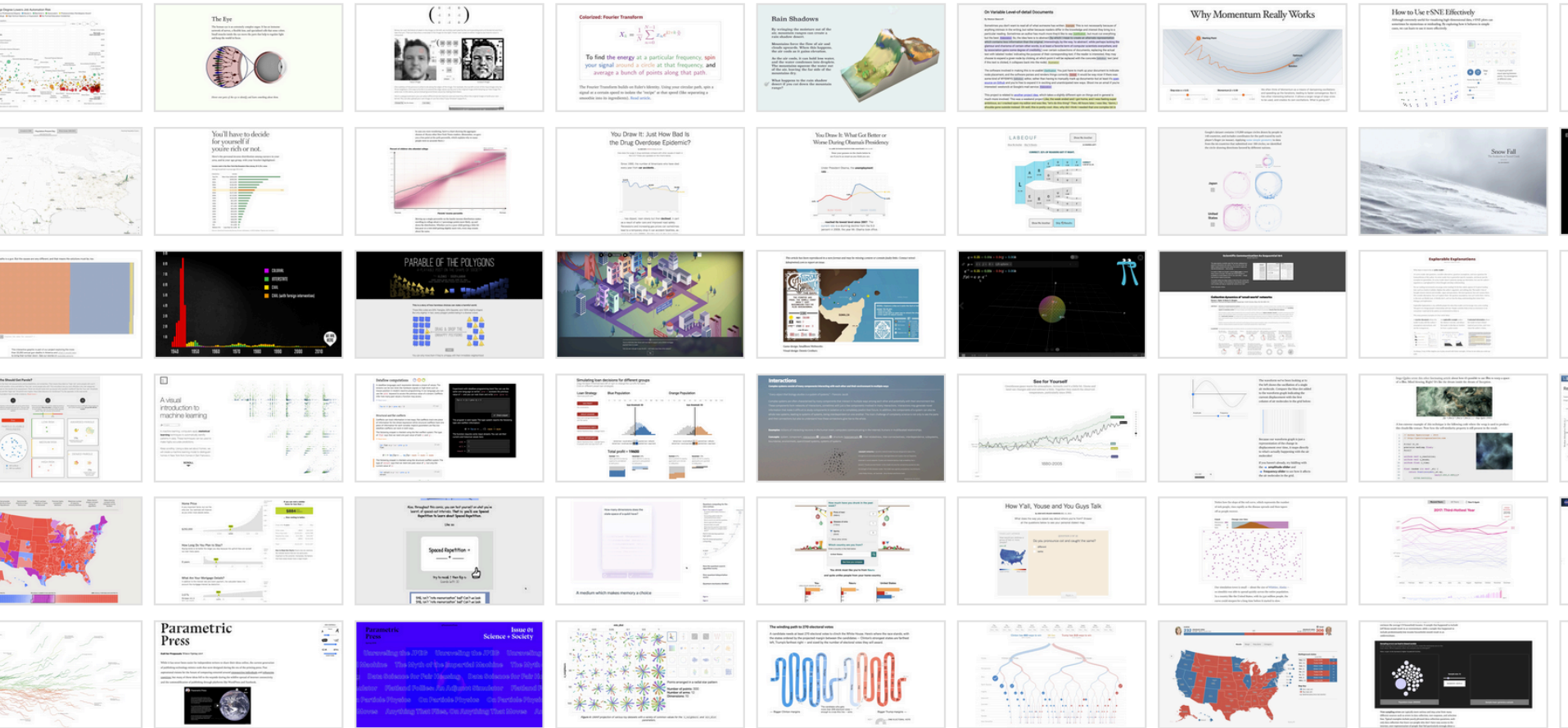


Narrative Visualization



Matthew Conlen

(with material from Jeff Heer, Edward Segel, and Jessica Hullman)

About Me

Ph.D. student @ UW

Advised by Jeff Heer

Background in data journalism

FiveThirtyEight, CNN, New Yorker,
New York Times (current)

Lecture will be biased toward that

Narrative Storytelling

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

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

Narrative Storytelling

Story:

The events or facts you want to convey

Narrative:

How you convey those facts

STORYTELLING

as ancient as mankind



Going forward

I carried wax along the line, and laid it thick on their ears. **They tied me up**, then, plumb amidships, **back to the mast**, lashed to the mast, and took themselves again to rowing. Soon, as we came smartly within hailing distance, the two **Sirens**, noting our fast ship, off their point, **made ready, and they sang...**

STORYTELLING

across various media

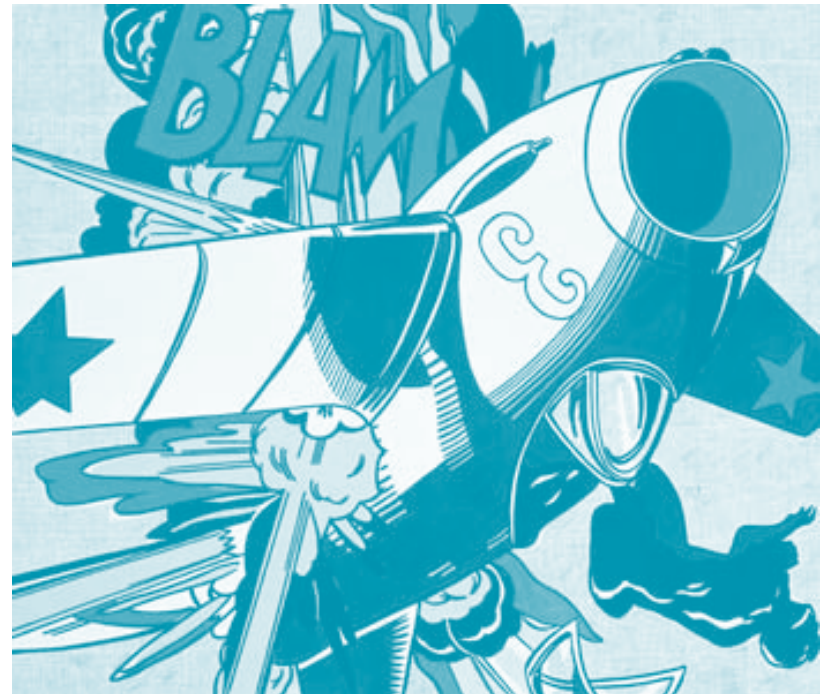
PEOPLE TELL STORIES

WORDS TELL STORIES

IMAGES TELL STORIES

COMICS TELL STORIES

MOVIES TELL STORIES





August 26, 2010

Generals Wary of Move to Cut Their Ranks

By [GINGER THOMPSON](#) and [THOM SHANKER](#)

WASHINGTON — Maj. Gen. Paul D. Eaton, a retired Army officer, is familiar with the perks and pitfalls of power, having commanded tens of thousands of troops at Fort Benning, Ga., managed budgets exceeding \$2 billion in Iraq, and overseen layers upon layers of staff members who helped manage both his professional duties and his personal life.

He has experienced the full range of lifestyles that come with military leadership, living at one point in an elegant antebellum mansion, and at another, with eight other officers crowded in a marble bathhouse behind one of [Saddam Hussein's](#) old palaces.

When he traveled, he was occasionally able to justify the use of military aircraft, but most times, he said, he flew coach. And today he lives on a pension worth 75 percent of his military salary, with health benefits that cover everything except dental and eye care for himself and his wife.

“We are well compensated, and we live very comfortable lives,” General Eaton said, referring to the military’s most senior leaders. “But when you look at all the things going on around a general, the nation is getting a very, very high return on its money.”

Not everyone at the Pentagon agrees. Two weeks ago, Defense Secretary [Robert M. Gates](#) announced a sweeping effort to improve efficiency that, among other things, takes aim at the military’s sacrosanct corps of generals and admirals, ordering his staff to cut at least 50 positions, and making clear that he would be happier if they cut more.

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Anecdotal Lead

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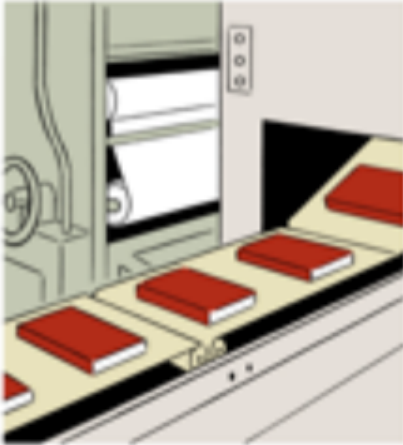
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Nut Graph

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Topics

Narrative visualization

Case Study: Coronavirus Testing

Design space

Interactive articles

Case Study: Carbon Footprint

Authoring tools

Design Inquiry

Choosing visual forms

**Storytelling
... with data?**



Privacy and the internet

Lives of others

BY JAMES HEALING

Facebook and Google face a backlash, from users and regulators alike, over the way they have handled sensitive data

JOHNNIE STOCOMET, Canada's privacy commissioner, interviews with Facebook in August over the social networking site's track record, agreeing to change its policies within a year to comply with the country's privacy law. Now, says Mr Stocomet, the company appears to be moving in an important part of that deal, which involved giving users a clear and easy-to-implement choice over whether to transmit data with third parties. "It doesn't seem to me that Facebook is going in the right direction on this issue," he says, noting that, without a change of course, the firm could soon become the subject of another formal investigation by his organisation.

Facebook is not the only internet giant to provoke the ire of data watchdogs. Google endured scathing criticism this week following news that it had received some personal communication sent over unsecured Wi-Fi data networks in homes and offices in some 30 countries. On May 23rd Peter Schaar, Germany's federal commissioner for data protection, called for an independent investigation into Google's behaviour, claiming that it had "deeply disrupted normal rules in the development and usage of software."

The cases highlight rising tension between guardians of privacy and internet firms. And they reflect concern among web users about how private data are made public. Several prominent internet

ty moguls such as Cory Doctorow, a science-fiction author, and Iain Stewart, a politician, have abandoned Facebook. Sites such as Quia/Facebook Dismantle are urging others to do so, and linking May 26th to a mass Facebook "boycott".

There is a likelihood of top the membership of Facebook, which is poised to claim half a billion members and which draws even more visitors as a whole to its site (see chart). Criticisms have been raised at the company's headquarters in Menlo Park, where bosses are reading over how to respond. Several online folk are now linking that Facebook will soon roll out stricter privacy controls to make it easier to keep more data hidden. MySpace, a rival, is already making its controls stricter in an effort to woo disaffected Facebookers to its service.

A revolt over Facebook's handling of privacy has been brewing for some time. In December the social network changed the default settings on its privacy controls so that individuals' personal information would be shared with "everyone" rather than selected friends. Facebook argued this reflected a shift in society towards greater openness and noted that users could still adjust privacy settings back again. But frustrated privacy activists lobbied hard to be reversed.

The switch should not have come as a surprise: truly 60, many social networks

Also in this section

- 68 Spring companies
- 80 The recovery of General Motors
- 86 Business crime in China
- 70 Italian retail
- 70 Japan's drug firms are the model
- 74 Brazil on tobacco
- 74 Schumpeter: Duernmattel

See July 2011's special section on business, and economist.com/business-features

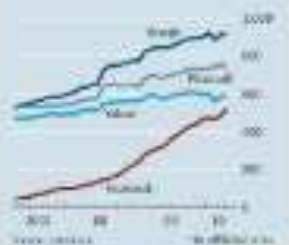
reportedly tough privacy policies in order to attract and increase users. But as more joint controls are gradually loosened to encourage more sharing, as people share more, Facebook can increase the traffic against which it sells advertising. And the more it learns about users' lives and habits, the better it can target ads that generate hundreds of millions of dollars.

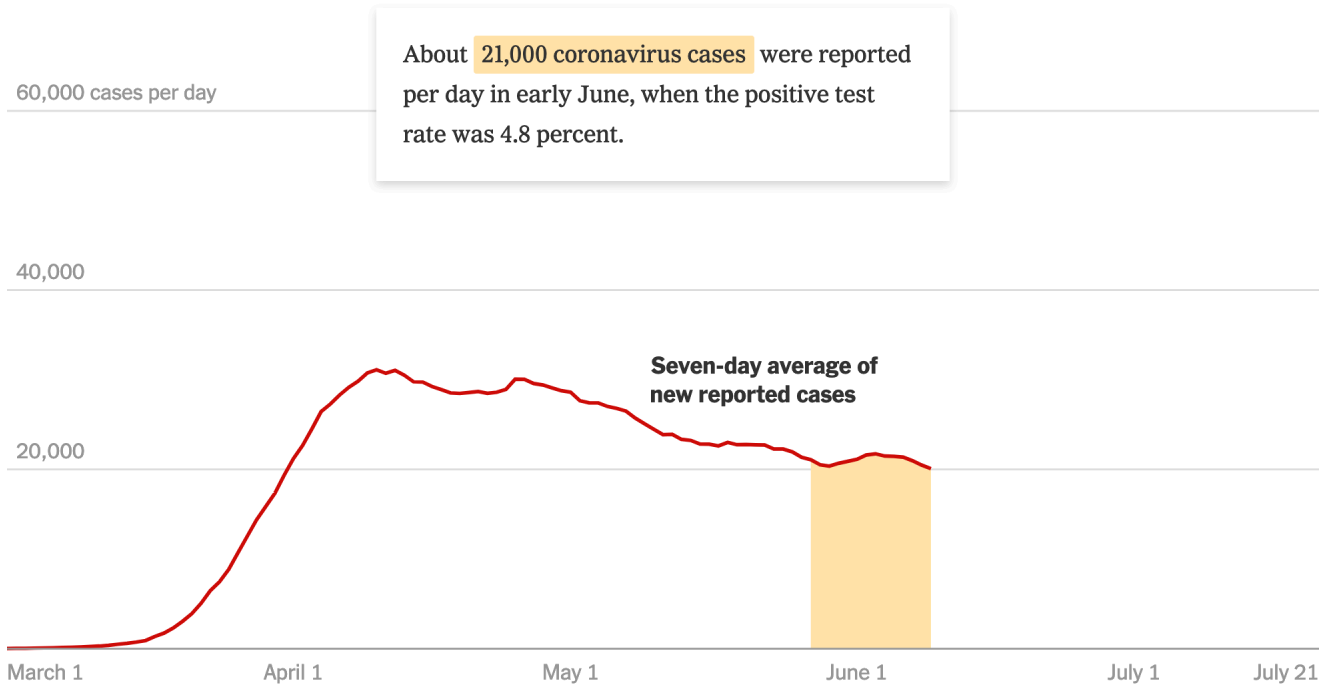
Privacy groups have been following a developers' conference last month at which Mark Zuckerberg, Facebook's boss, announced yet another series of policy changes. One that raised irritation was an "instant personalisation" feature that lets remote third-party websites access Facebook data when people visit. Critics say that Facebook has made it tricky to disable this feature, which may explain why its standard default is so much.

European officials are questioning both Facebook's use. This month a group of data-protection experts also asked the European Commission more to be done on the web, calling for it to set a minimum default settings "non-negotiable". And as the

Not looking fare

By David Foray





CASE STUDY COVID-19 TESTING

Input Data

Daily case and test counts.

Points of Focus

1. Baseline (smoothed average of daily cases)
2. Counterfactual case curve
(baseline positivity rate * daily test counts),
3. Actual case curve (daily cases)

Narrative Devices

What devices communicates best?

Highly dependent on: audience, context, format

Format

Interactive Article

Animation

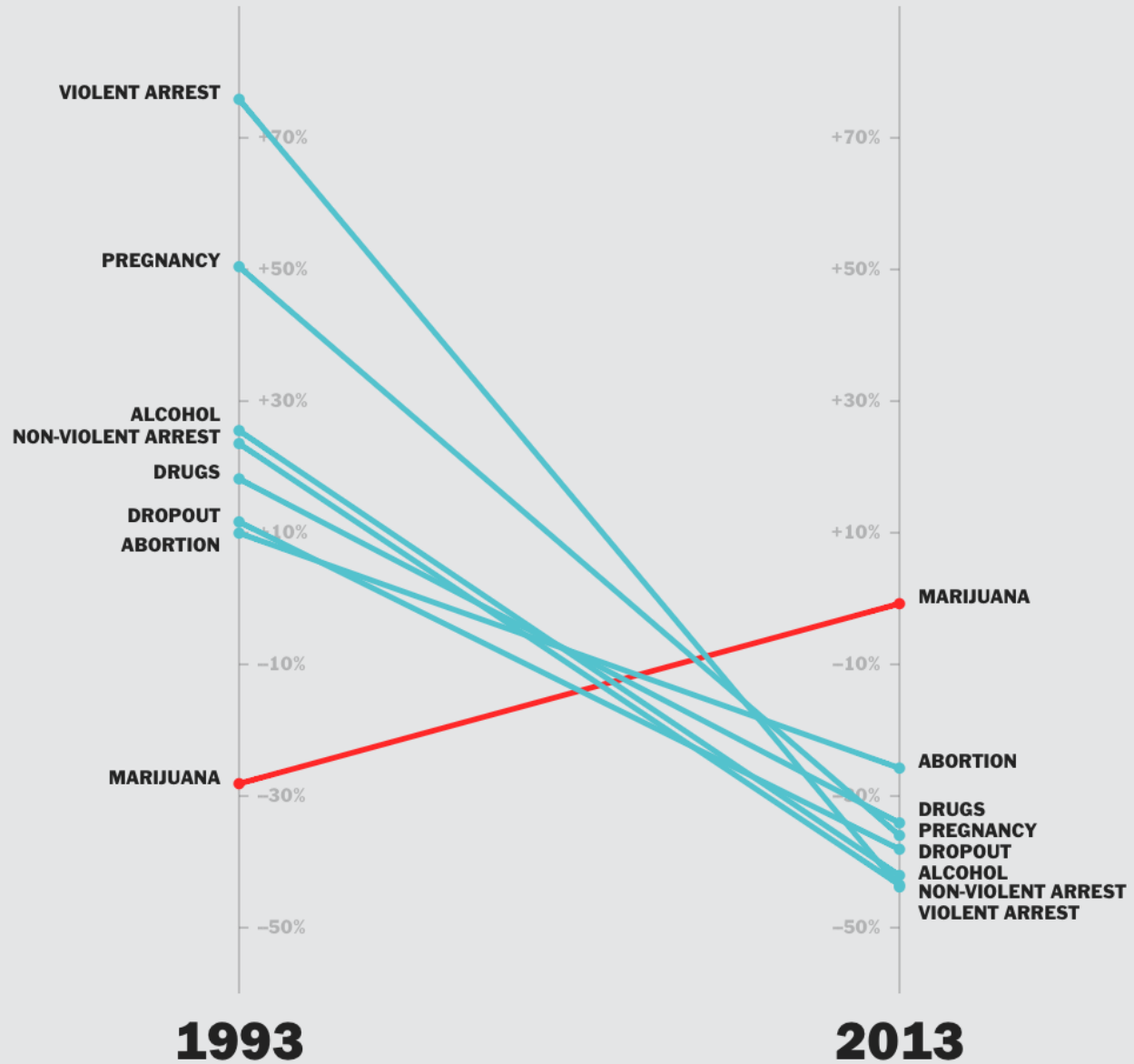
Lecture

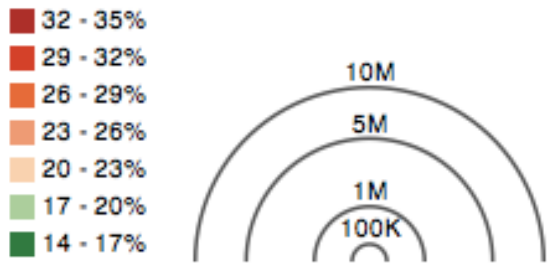
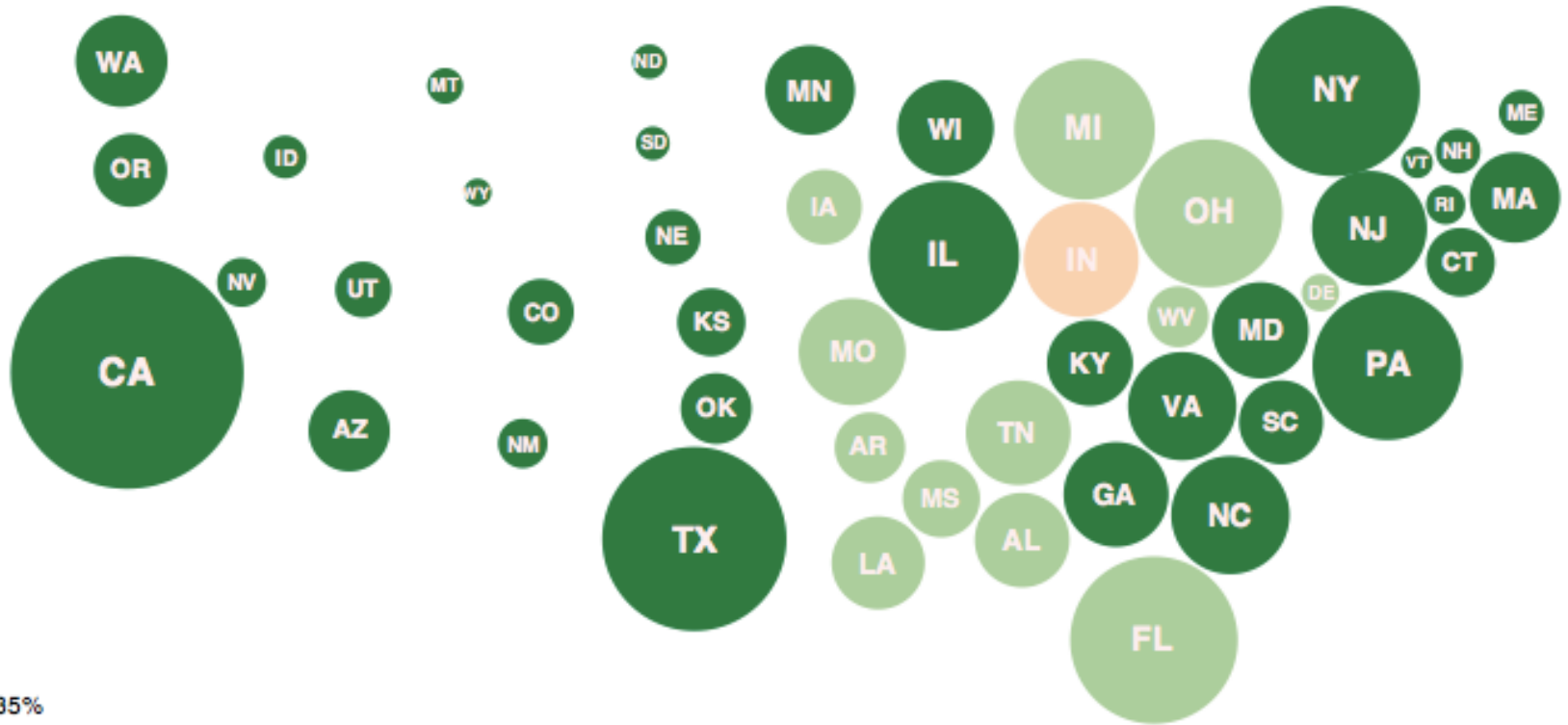
Still Image

Video

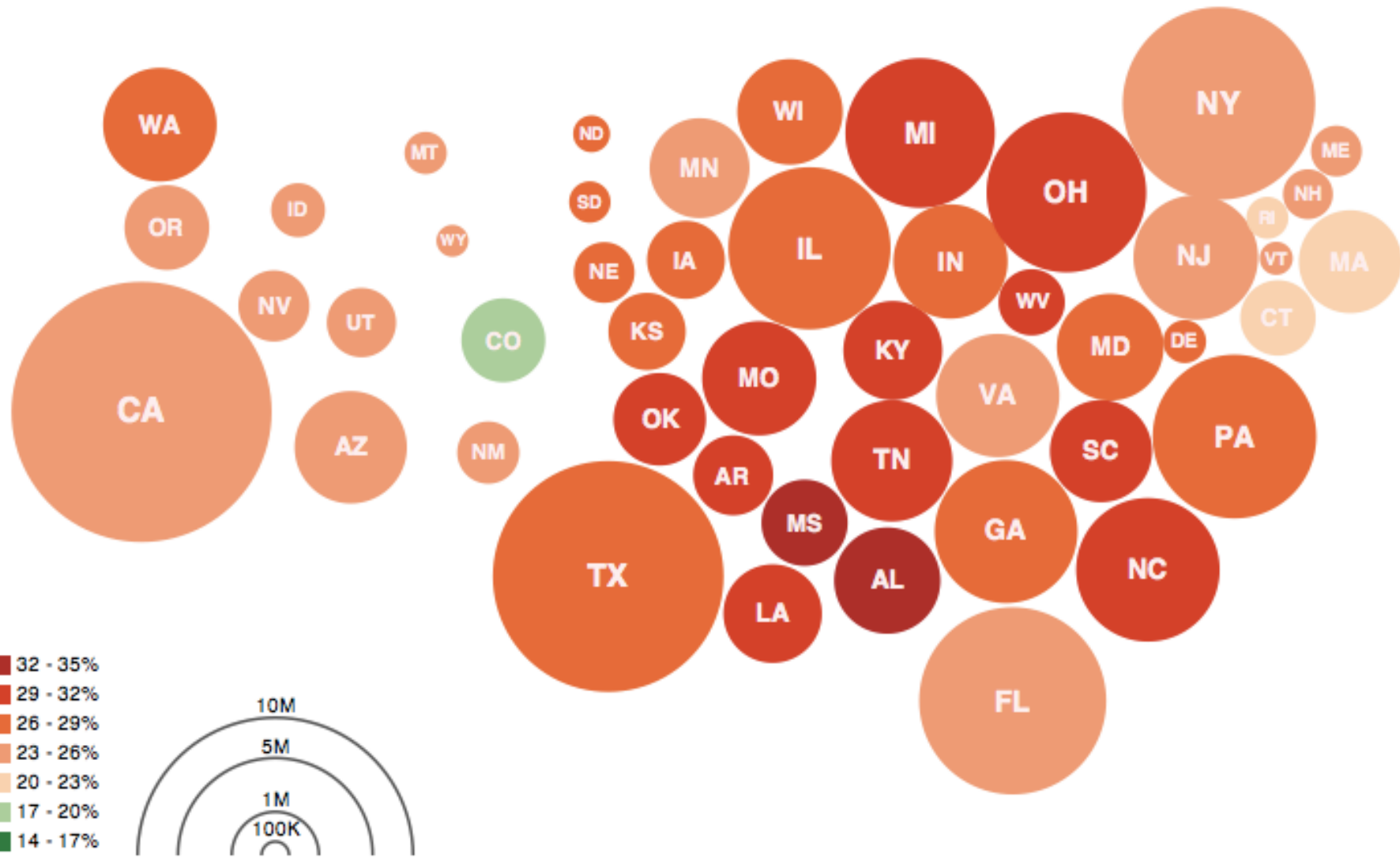
SHENANIGANS

Change in teen shenanigans from 1993 to 2013.
Showing % difference from 2003 levels.





Obesity Map Vadim Ogievetsky



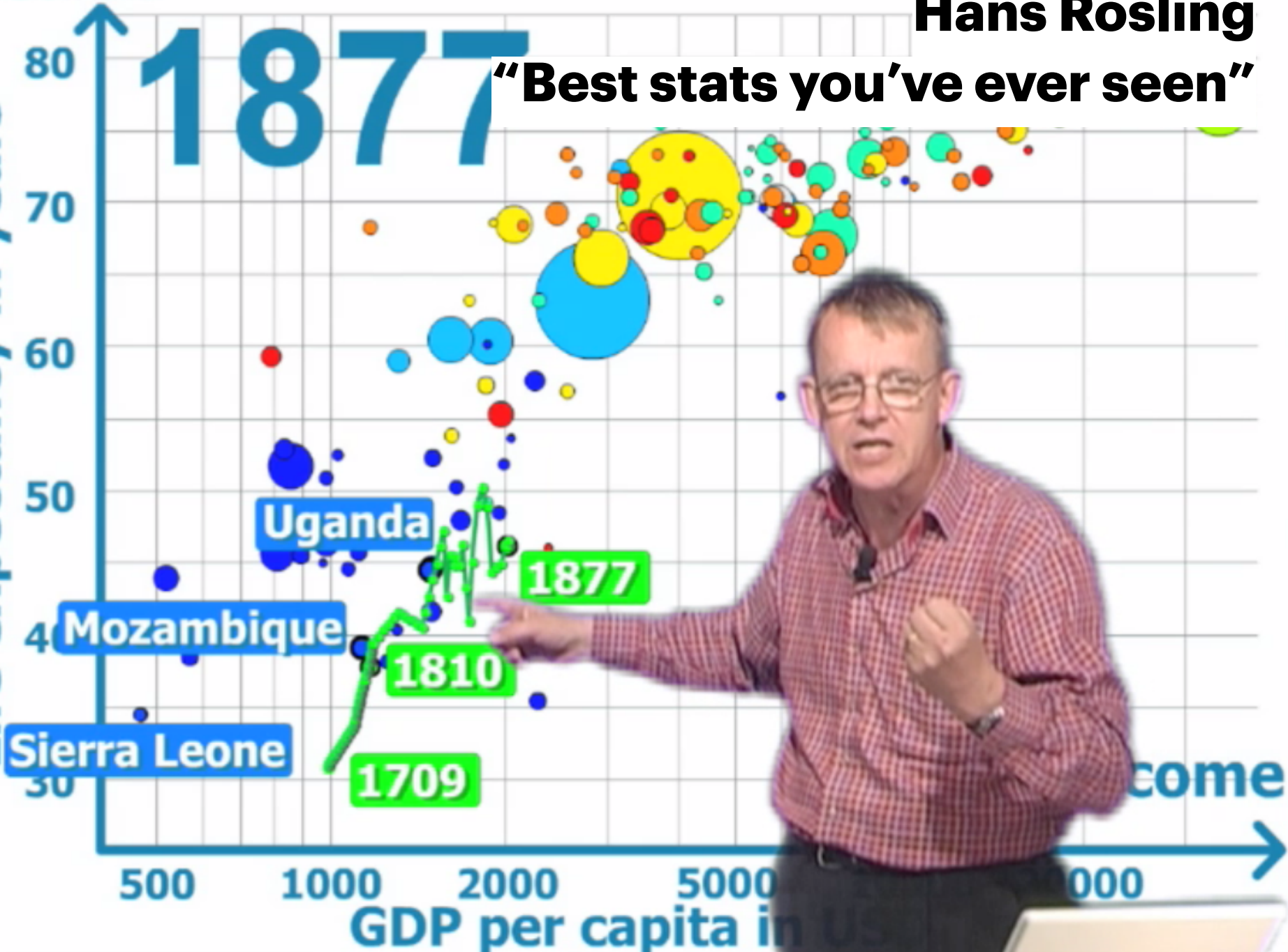
Obesity Map Vadim Ogievetsky

Health

Hans Rosling

"Best stats you've ever seen"

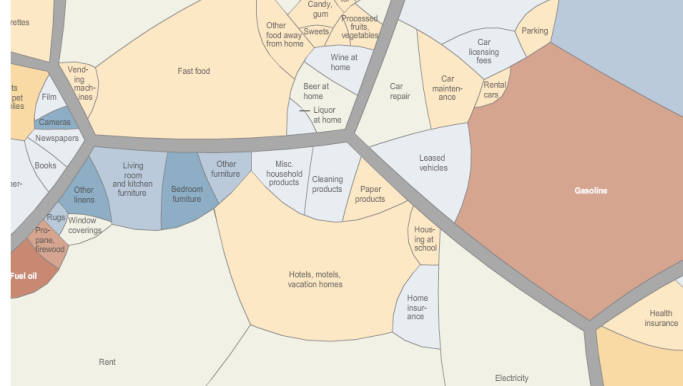
Life expectancy in years



GDP per capita in US\$

Income

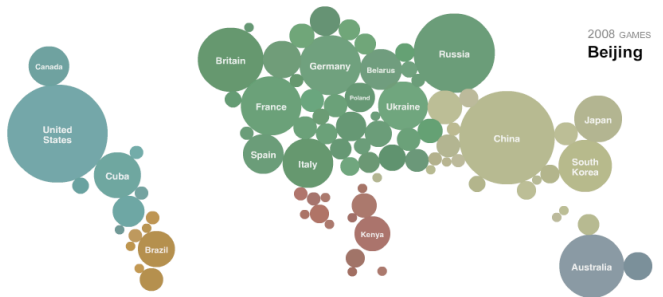
Narrative Visualization Design Space



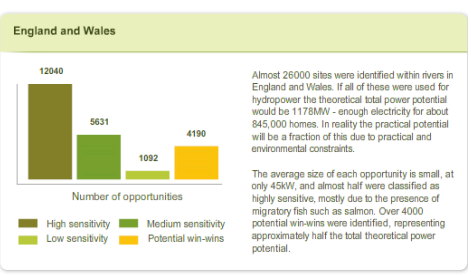
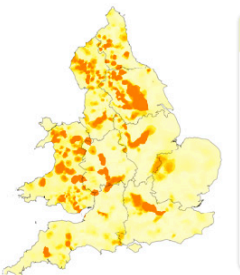
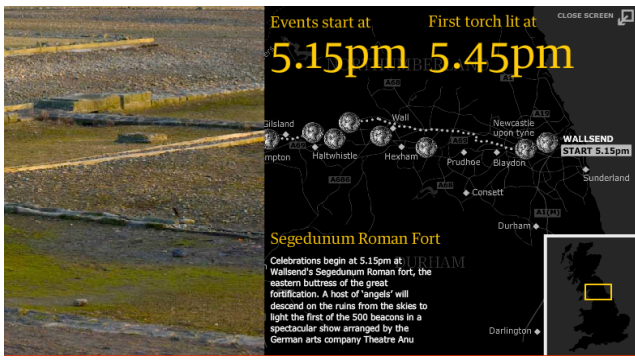
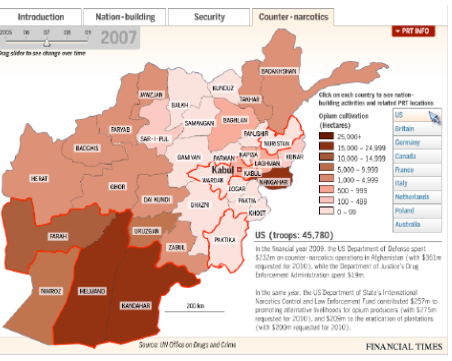
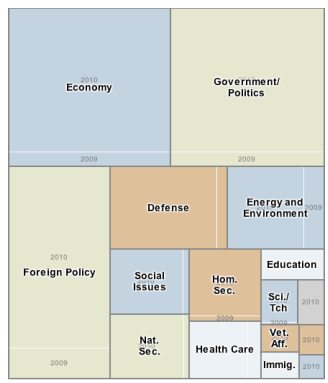
58 CASE STUDIES

70% Journalism
20% Business
10% Research

GEOGRAPHIC VIEW BY RANKING 1896 1900 1904 1908 1912 1920 1924 1928 1932 1936 1948 1952 1956 1960 1964 1968 1972 1976 1980 1984 1988 1992 1996 2000 2004 2008



2008 Medal Count



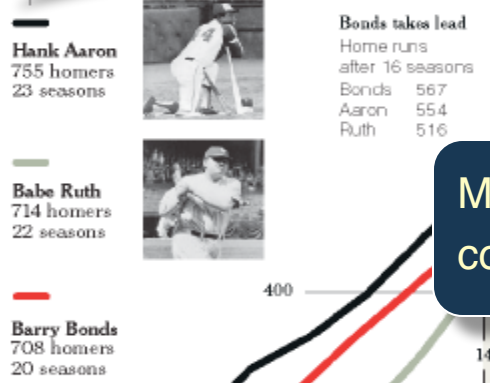
Segel & Heer, 2010

755

Grab attention with image and position



Line chart of cumulative home runs.



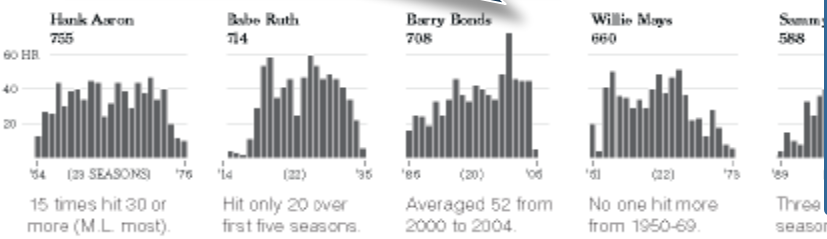
Bonds takes lead
Home runs after 16 seasons
Bonds 567
Aaron 554
Ruth 516

Major concern

According to a book, he began using steroids in the 2000 season, league-wide later, he runs, su career p

Reduced visual priority

Differing Paths to the Top of the Charts The top seven players on the career h

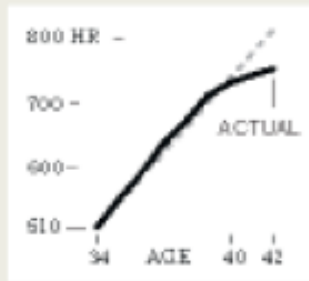


Homer Pace After Age 34

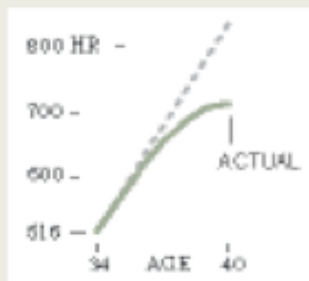
If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

----- PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS

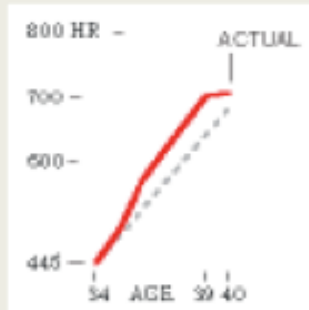
Aaron
Actual homers slightly outpace projected homers for five seasons.



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

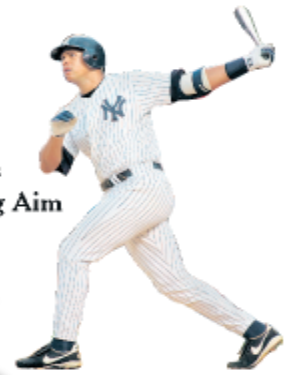


Bonds
From age 35 to 39, he averaged 14 more homers a season than projected.

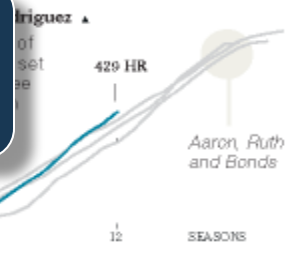


Note: Ages as of July 1 of each season.

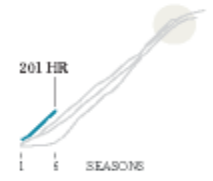
Others Taking Aim



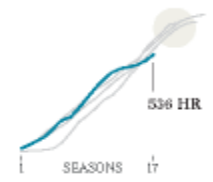
Major concern



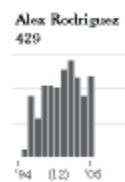
Albert Pujols
Averaging 40 homers a season, he has started stronger than the three leaders did.



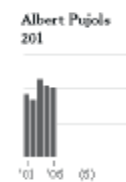
Ken Griffey Jr.
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



(257th).



Youngest to reach 400 homers.



Second most ever in first five seasons.

Beginning

Steroids or Not, the Pursuit Is On

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

Here 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 511

14th season

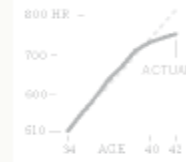
According to allegations in a book about Bonds, he began taking steroids before the 1999 season, his 14th in the league. Two seasons later, he hit 73 home runs, surpassing Aaron's career pace.

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

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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.



Middle

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.

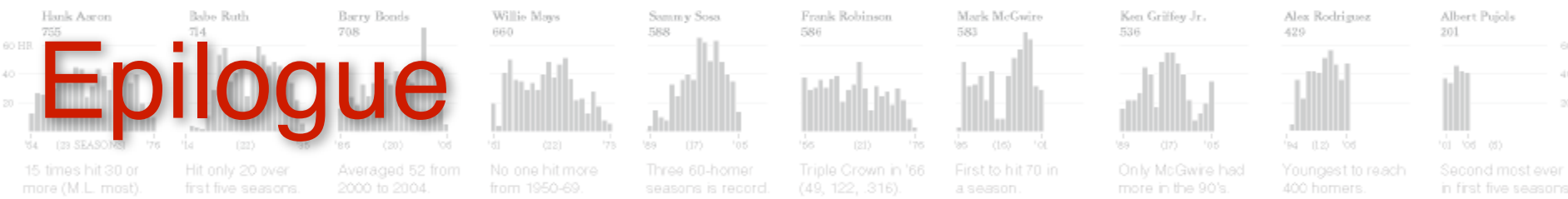
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



End

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).



Epilogue

Visualization Description

Architecture and Justice (Brooklyn Crime Blocks)
John Deere: How farmers abuse their free-mailing privileges before elections
Football: Soccer ball (soccer) drawings
Pedestrians: Pedestrians crossing the street
The Climate Agenda
Whistleblowers: Did Your County's Jobs Disappear?
Academy Awards: Metrics House Price Index
Barista: Barista's earnings: How compensation relates to performance
Death: Daily offensive: Taliban attacks in Pakistan
Google: Moves by Sector
UK: Economic data
Budget: Budget 2010: Reaction from around the UK
Formula One: Formula One 2010: driver's rankings
Light: Lighting up Hadrian's wall
Map: Mapping hydropower hotspots across the UK
Moscow: How metro bombs: interactive map
The World: World economy turns the corner
A Medal: Top of Olympic Medals
All: Inflation's Little Parts
Barista: Bonds visualization (Interactive)
The Beatles: Flow of Money: Beatle's Income (1986 - 2008)
The Obesity: Obesity Rate for People Like You
Advertisement: Advertisement: Bus
Advertisement: Advertisement: Helicopter
Analysis: Analyzing Obama's schedule
Oscar: Oscars 2010: the people nominees
The Consumer: The Consumer and Retailer: Retailer's Share 2008-2009
UK: Voting Intentions
Barista: Bonds Visualization (Static Image)
Comparison: Comparison of Bear Markets
How: How Americans Spend Their Day
Michelle: Michelle Obama's Family Tree
Net: Net Rentals
Variant: Vancouver's Olympic Venue
On the Map: On the Map: Five Major North Korean Prison Camps
A Visual: A Visual Guide to the Financial Crisis
Economic: Economic Meltdown of 2008-2009
What: What Did All the Money Go To?
Life Cycle: Life Cycle of a beetle through a year
McDonald's: McDonald's "Making Comics"
How the Government: How the Government Dealt with Past Recessions
Afghanistan: Afghanistan: Behind the front line
Toyota: Toyota: a timeline: a company history
Gap: Gap: Under Human Development
Earthquake: Earthquakes: why they happen
Iran: Iran: nuclear programme
Shanghai: Shanghai White's Double McTwist
Toyota: Toyota's stick accelerator problem
Alpine: Alpine Skiing, From Technical Turns to Tucks and Speed
Budget: Budget Forecasts vs. Reality
Map: Map: Orientation Video
Delaware: Delaware: Airplane Safety Video
"The Story of Stuff"
Virgin America: Virgin America Airplane Safety Video

Magazine Style	Visual Structuring	Highlighting	Transition Guidance	Ordering	Interactivity	Messaging
Illustrated Graph / Map						
Science Fair Poster						
Power Chart						
Comic Strip						
Slide Show						
Form / Video / Animation						
Establishing Shot / Still / Screen						
Consistent Visual Placement						
Progress Bar / Timeline						
Checklist* Progress Tracker						
Close-Ups						
Feature Distinction (font, color, detail, outline)						
Character Direction						
Attention						
Audio						
Zooming						
Familiar Objects (bullet points)						
Zooming Angle						
Zoomer (Camera) Motion						
Continuity Editing						
Object Continuity						
Animated Transitions						
Random Access						
User Directed Path						
Zoom						
Zoom Highlighting / Still						
Zooming/Selection/Scrolling/Breakdown/Timebar						
Navigation Buttons						
Zoom Limited Interactivity						
Explicit Instruction						
Click Tutorial						
Simulating Default Views						
Annotations / Headlines						
Annotations						
Accompanying Article						
Alert-Messaging						
Comment Repetition						
Introductory Text (more than a sentence)						
Summary/Synthesis						

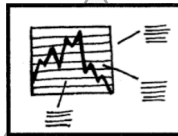
Observed Narrative Devices

Case Studies

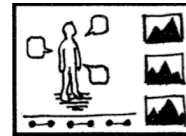
Visual Design



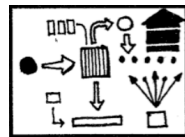
MAGAZINE
STYLE



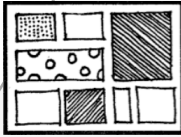
ANNOTATED
CHART



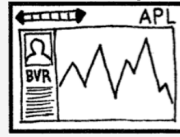
SCIENCE FAIR
POSTER



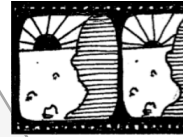
FLOWCHART



COMICSTRIP



SLIDESHOW



MOVIE

Duo-Specific

Captions

Annotations

Attached
Article

Summaries

Interpret

Headlines

Tacit
Tutorial

Selection

Navigation

Details on
Demand

Timelines

Filtering

Highlighting

Messaging

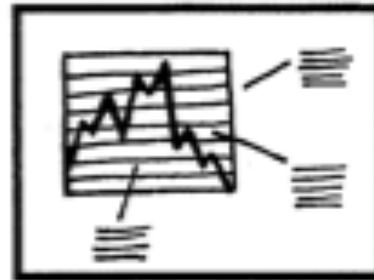
Interactivity

MORE

Seven Genres



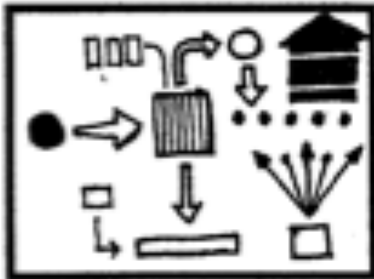
Magazine Style



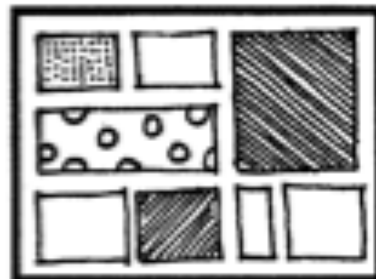
Annotated Chart



Partitioned Poster



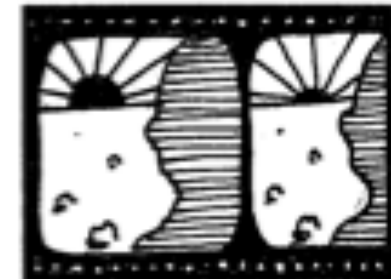
Flow Chart



Comic Strip



Slide Show



Film/Video/Animation

Genres for Narrative Visualization (2010)

Missing "scrolly-telling" designs...

Genres + Interactivity + Messaging =

DESIGN SPACE

STORYTELLING

CLARITY

SPEED

Author Driven

strong ordering
heavy messaging
limited interactivity

Reader Driven

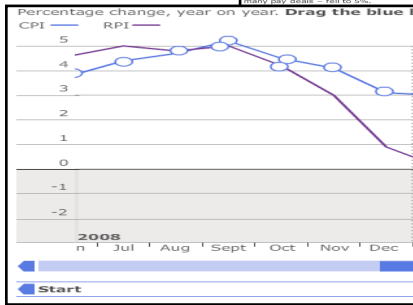
weak ordering
light messaging
free interactivity

ASK QUESTIONS

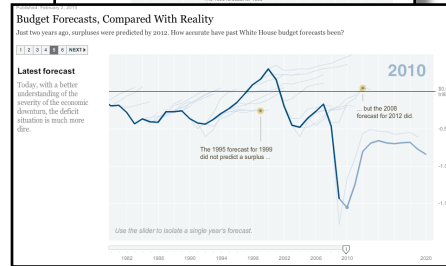
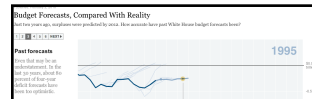
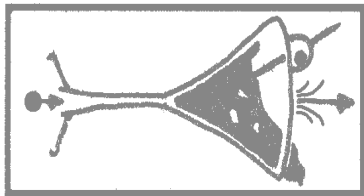
EXPLORE

FIND

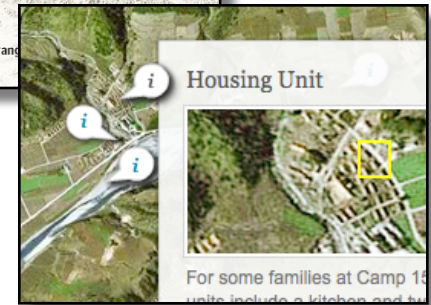
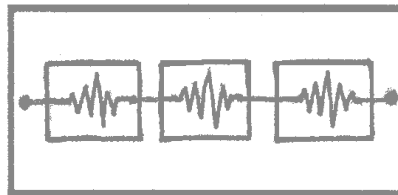
The consumer and retail price indices since 2008. The annual inflation rate fell from 4.5% to 0.2% in June. The Office for National Statistics said bargain offers on electronic goods helped drag inflation lower in June and pulled the government's preferred measure of the cost of living back towards its 2% target. Meanwhile, inflation as measured by the Retail Price Index - the benchmark for many day-to-day costs - fell to 5%.



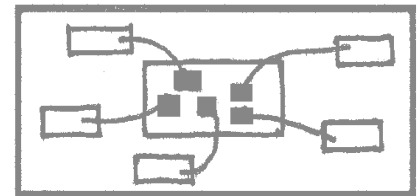
martini glass



interactive slideshow



drill-down story

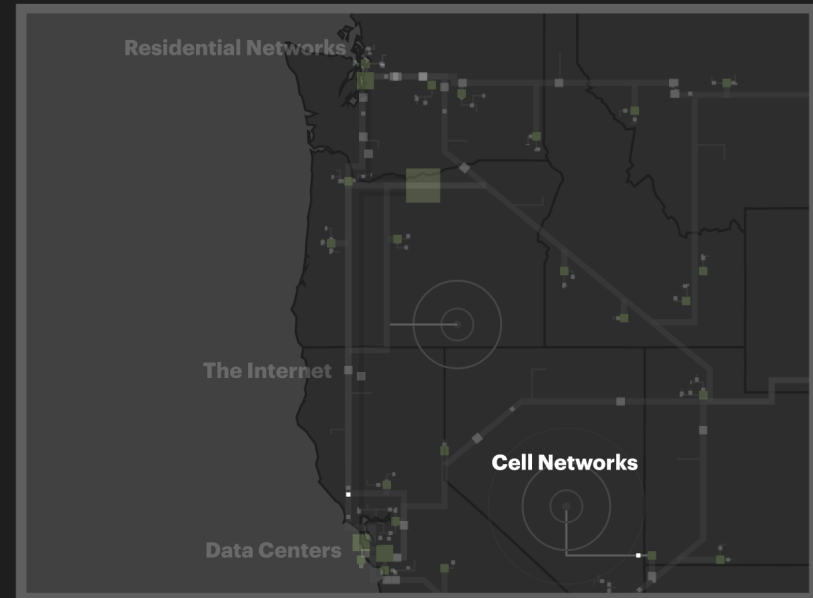


Interactive Articles

YouTube Pipeline + Electricity Usage for 2016

Cellular Networks

In comparison, only 12% of YouTube's traffic went through cellular networks, but they were by far the most expensive part of YouTube's content delivery pipeline, accounting for approximately **8,500 Gigawatt-hours of electricity usage—enough to power over 750,000 U.S. homes [3]**. At over 10 times the electricity usage per unit of traffic, the relative inefficiency of cellular transmission is clear.



8,500 GWh

Enough to power over 750,000 U.S. homes for a year

SOURCE Google, Durairajan et al. 2015 [4], Preist et al. 2017 [3], EIA

Parametric Press

CASE STUDY DIGITAL CARBON FOOTPRINT

Lin, Nirmal, Hathi, Liang, 2020

Communicating with Interactive Articles

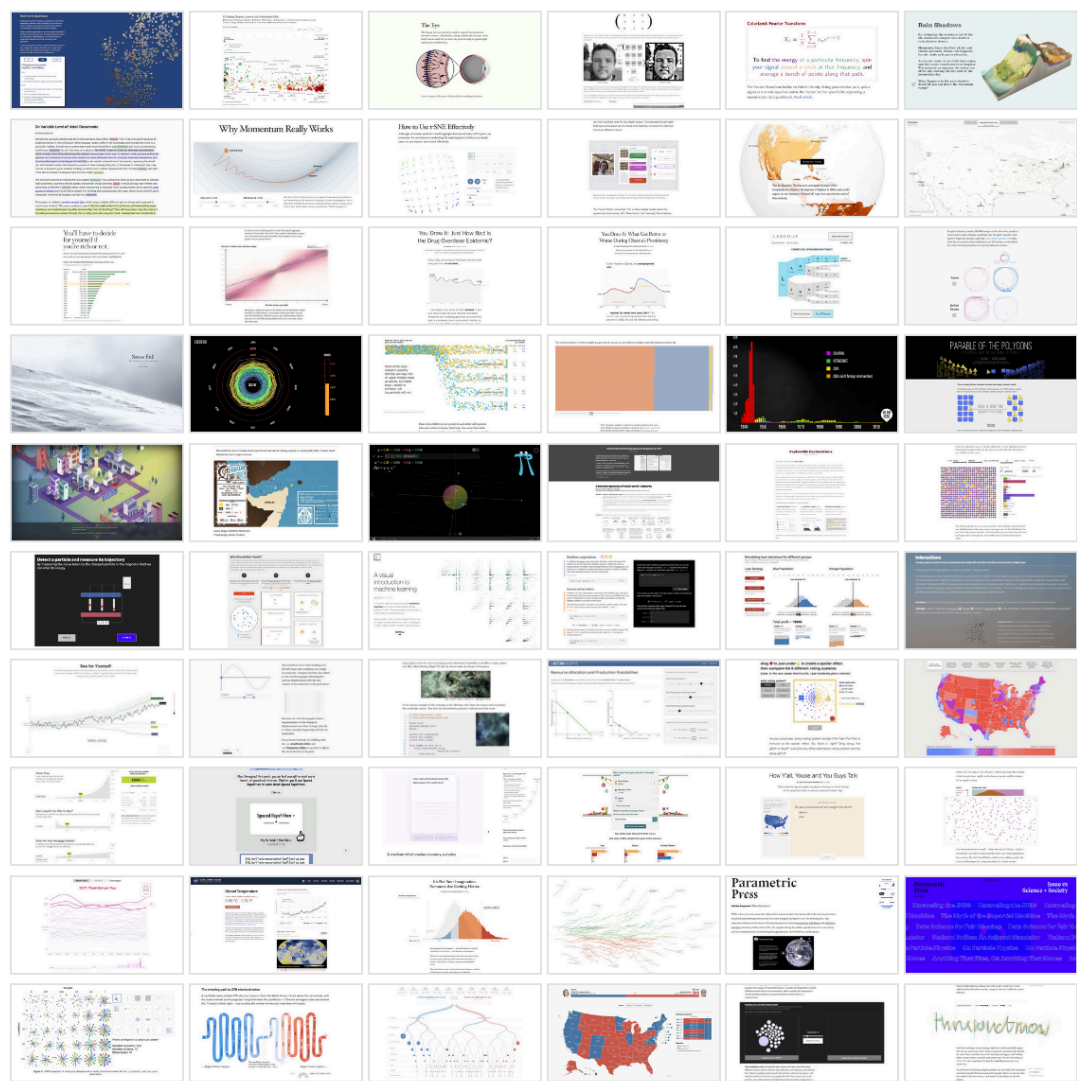
Examining the design of interactive articles by synthesizing theory from disciplines such as education, journalism, and visualization.

60+ Interactive Articles

NYTimes, WaPost

Distill, VisXAI

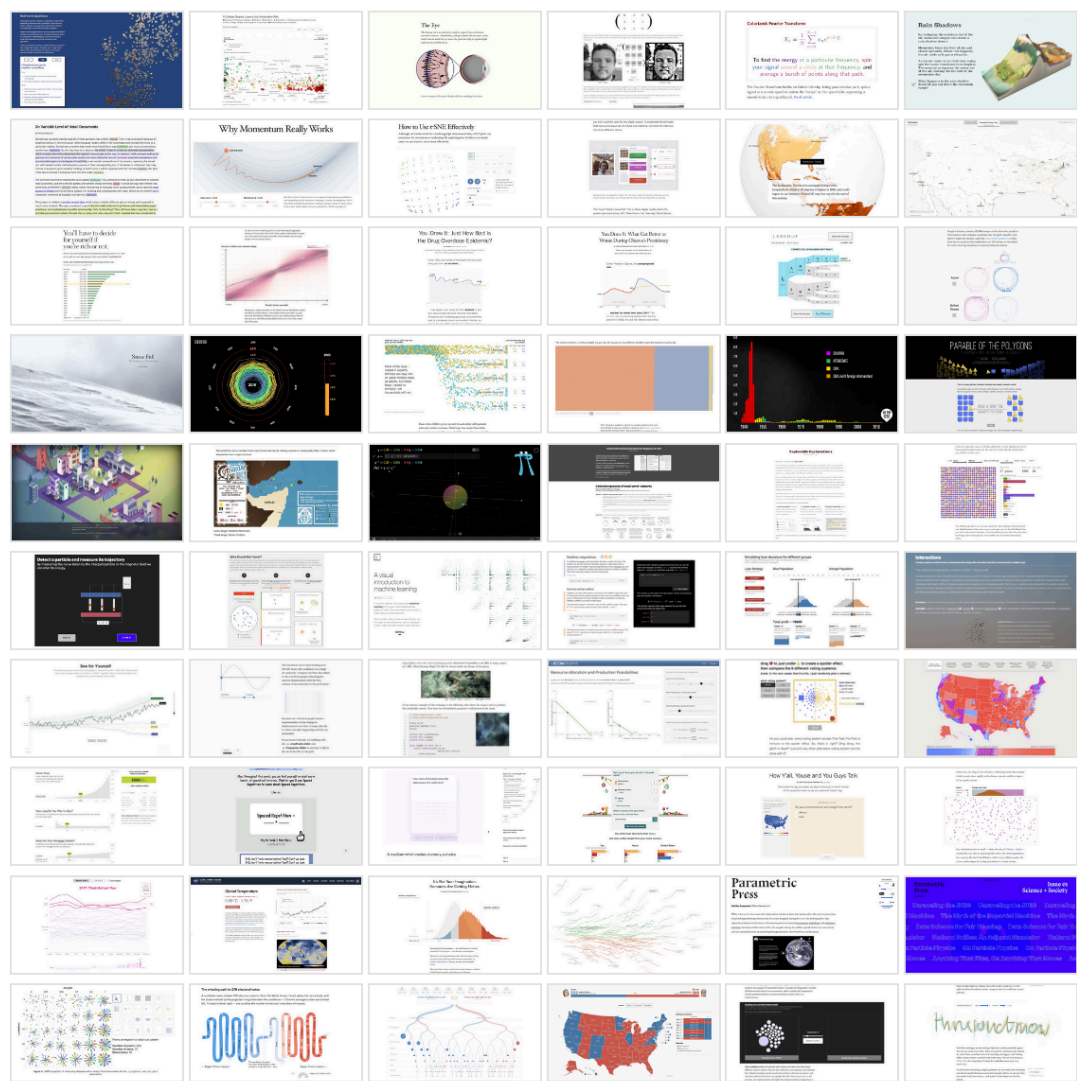
+more



Hohman, Conlen, Heer, Chau
2020

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NYTimes, WaPost

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+more

5 affordances of the format

Connecting people and data

Making systems playful

Promoting self reflection

Personalizing reading

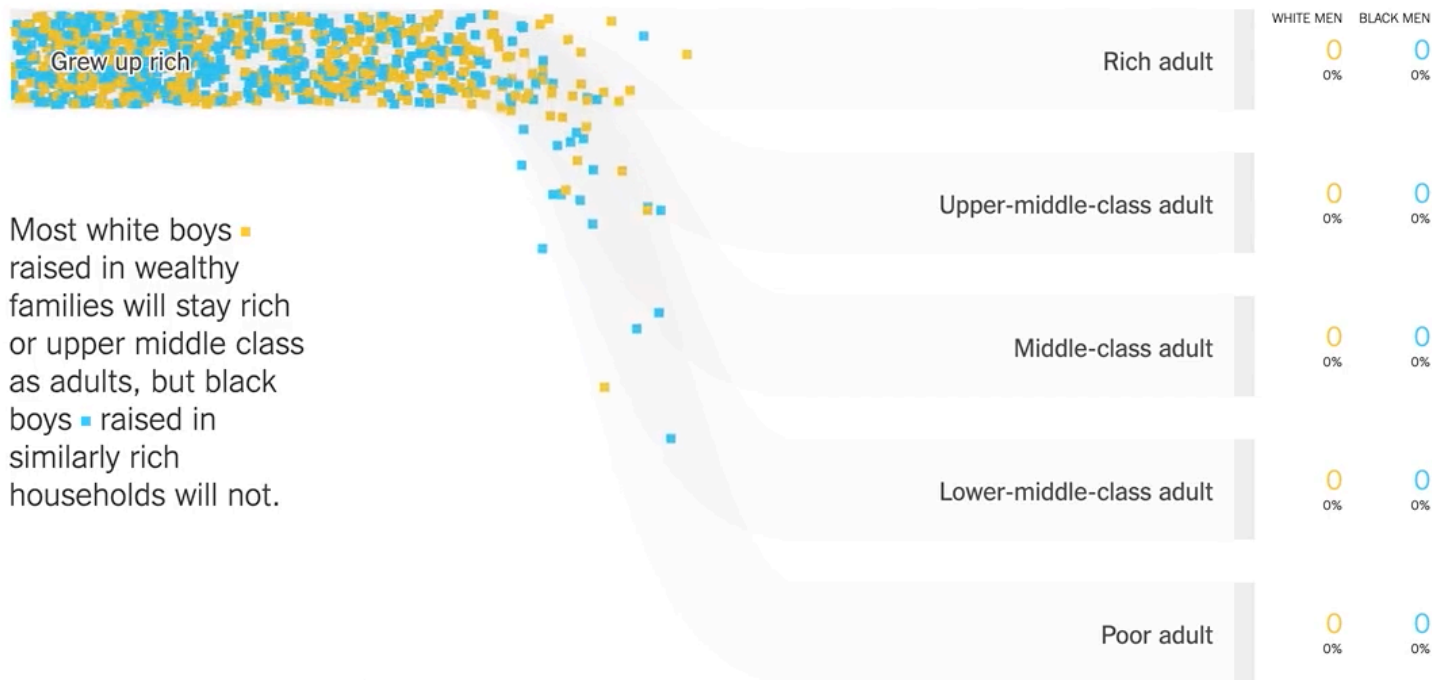
Reducing cognitive load

Hohman, Conlen, Heer, Chau
2020

5 AFFORDANCES OF THE FORMAT **Connecting people and data**

Making systems playful
Promoting self reflection
Personalizing reading
Reducing cognitive load

Follow the lives of 932 boys who grew up in rich families ...



Adult outcomes reflect household incomes in 2014 and 2015.

Most white boys raised in wealthy families will stay rich or upper middle class as adults, but black boys raised in similarly rich households will not.

Even when children grow up next to each other with parents who earn similar incomes, black boys fare worse than white

boys in a segment of America. And the same is true in the

5 AFFORDANCES OF THE FORMAT



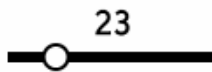
Connecting people and data

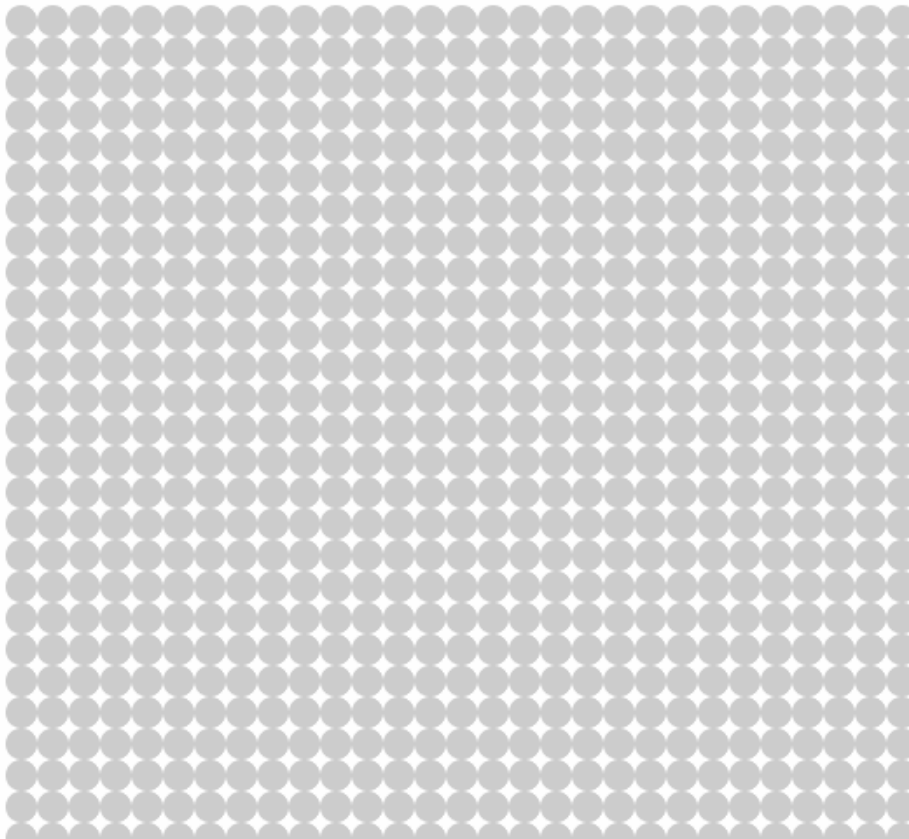
Making systems playful

Promoting self reflection

Personalizing reading

Reducing cognitive load

I am **female**  **White**  and currently  **23** years old. LIVE



AGE OF DEATH	DIED SO FAR	STILL ALIVE
23 years	1%	99%

CAUSE OF DEATH SO FAR

- 0% Infection
- 0% Cancer
- 0% Blood
- 0% Endocrine
- 0% Mental
- 0% Nervous
- 0% Circulatory
- 0% Respiratory
- 0% Digestive
- 0% Musculoskeletal
- 0% Genitourinary
- 0% Perinatal
- 0% Congenital
- 0% External Causes
- 0% Other

Connecting people and data

Making systems playful

5 AFFORDANCES OF THE FORMAT Promoting self reflection

Personalizing reading

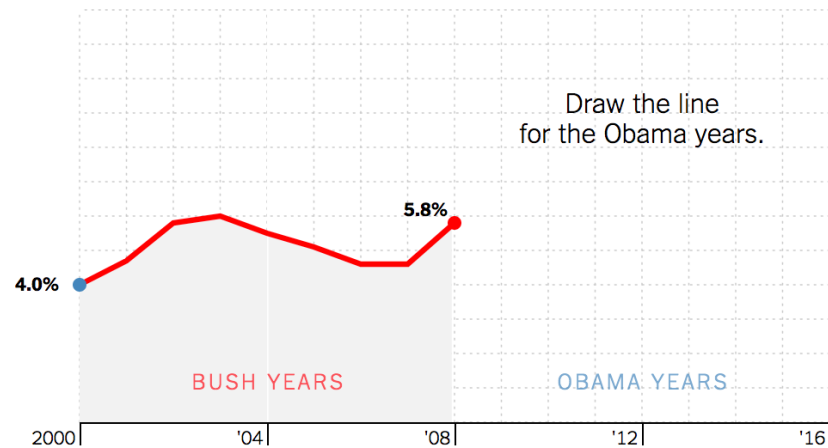
Reducing cognitive load

You Draw It: What Got Better or Worse During Obama's Presidency

By LARRY BUCHANAN, HAEYOUN PARK and ADAM PEARCE JAN. 15, 2017

Draw your guesses on the charts below to see if you're as smart as you think you are.

Under President Obama, the **unemployment rate ...**



Show me how I did.

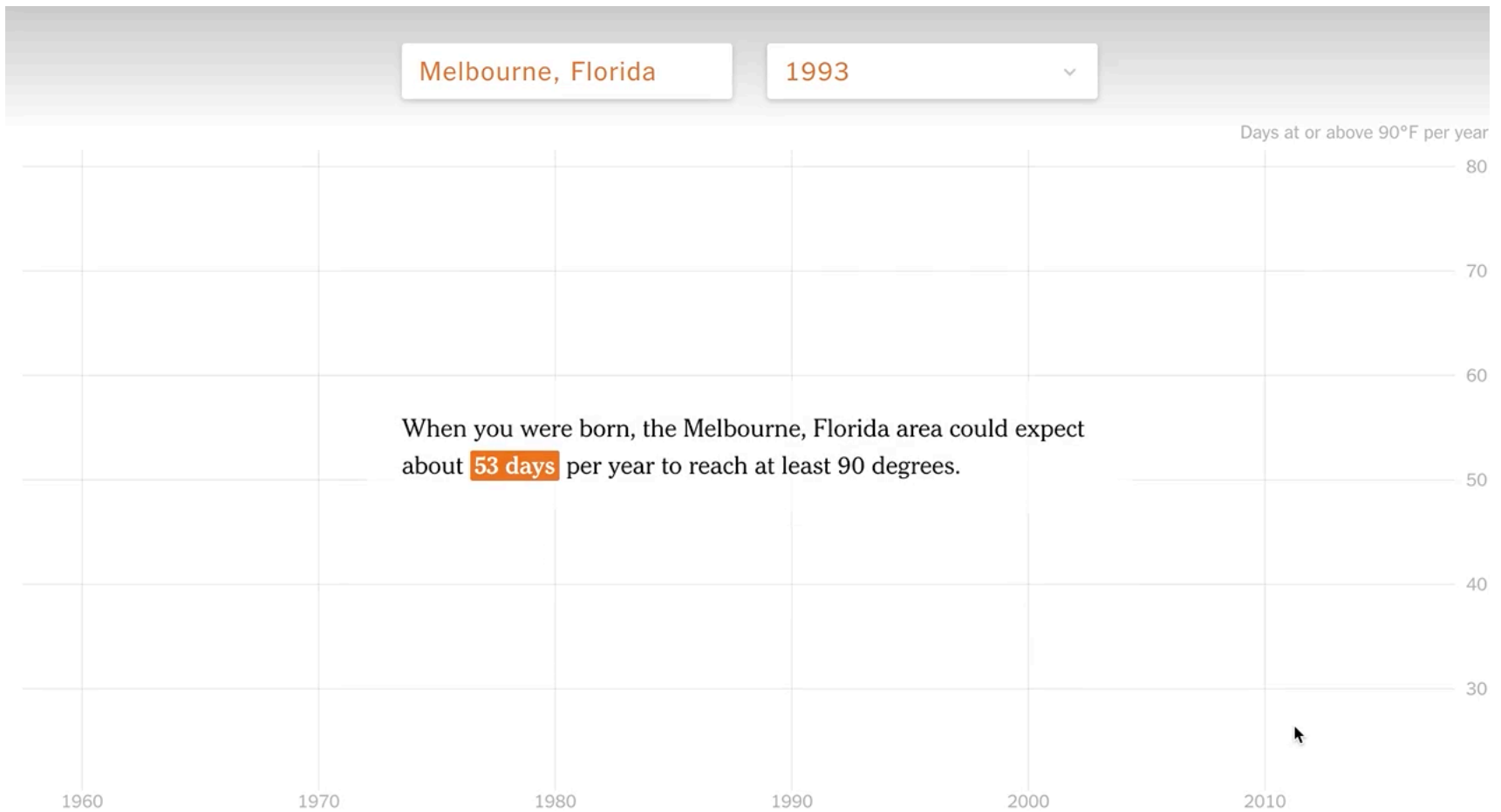
Connecting people and data

Making systems playful

Promoting self reflection

5 AFFORDANCES OF THE FORMAT **Personalizing reading**

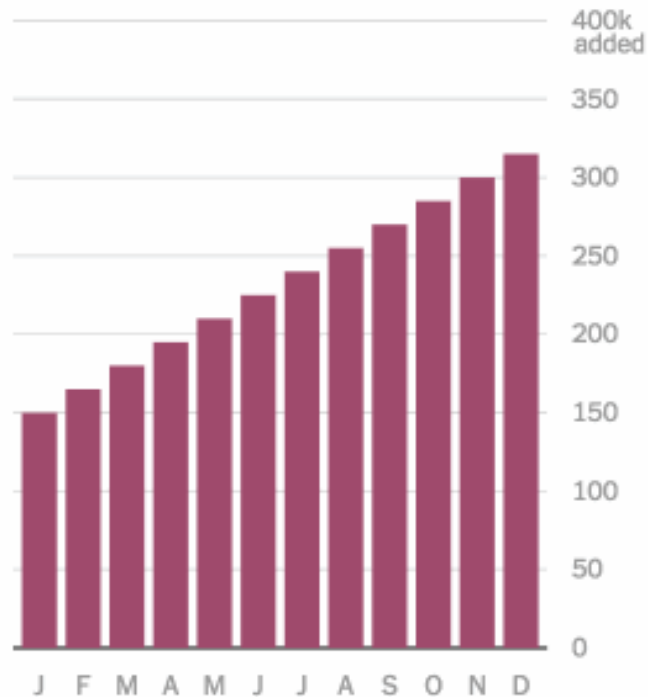
Reducing cognitive load



Connecting people and data
Making systems playful
Promoting self reflection
Personalizing reading

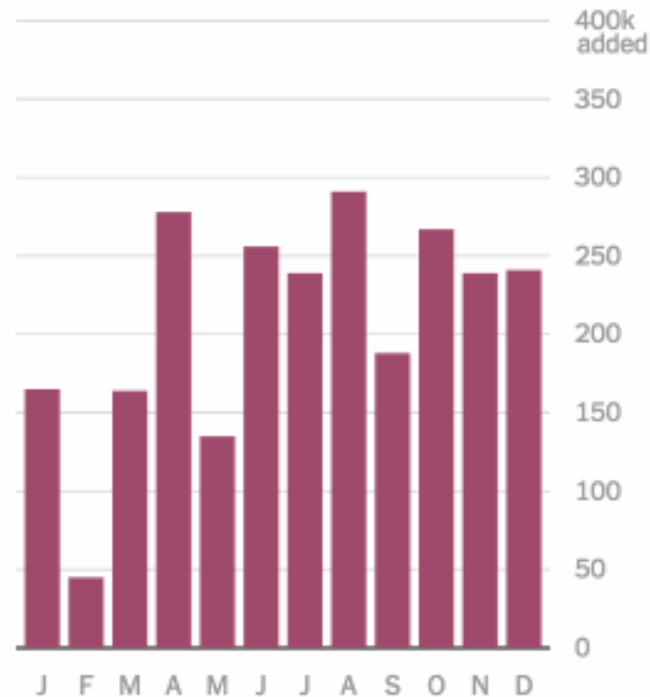
5 AFFORDANCES OF THE FORMAT **Reducing cognitive load**

If job growth **had**
been accelerating...



...the jobs report
could look like this:

Pause



Interactive Documents: Steppers, Scrollers, ...



Gun Deaths In America

By Ben Casselman, Matthew Conlen and
Reuben Fischer-Baum

CLICK to advance



1

2

3

4

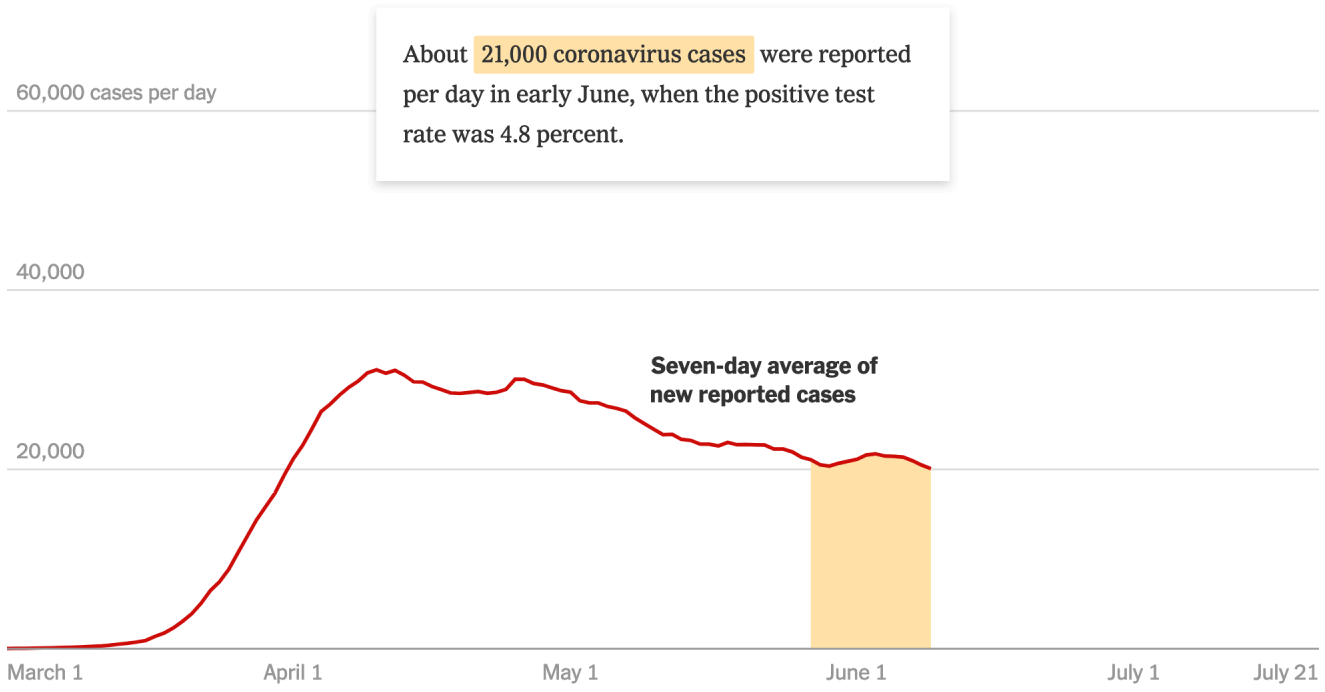
5

6

Stepper

12

| Explore the data for yourself »



Discrete step vs. Continuous scroll

Different means for narrative navigation.

A source of debate among practitioners!

Step: sequential frames as in a slideshow

Simple and familiar, but as engaging?

Scroll: continuous navigation of page

Parameterize content by scroll position

May cause usability / scrolljacking issues

Hybrids: scroller with discrete sections

Narrative Implementation

Do-It-Yourself

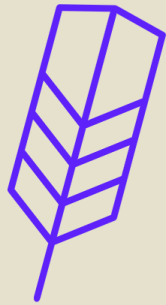
Monitor scroll position & element positions

Guidance: M. Bostock, J. Vallandingham

Third-Party Support

Helper Libraries

Interactive Document Formats: Idyll



idyll

A toolkit for creating data-driven stories
and explorable explanations.

INPUT (EDITABLE)

```
## Hello World  
  
[var name:"x" value:5 /]  
  
The value of x is [Display value:x format:"d" /].  
  
[Range value:x min:0 max:10 /]
```

OUTPUT

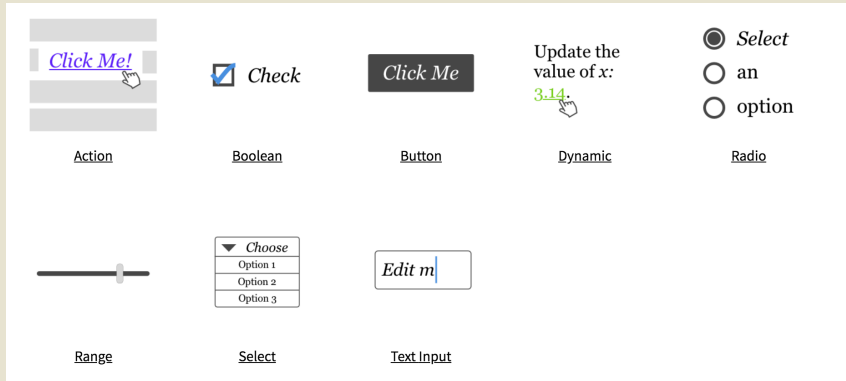
Hello World

The value of x is 6.

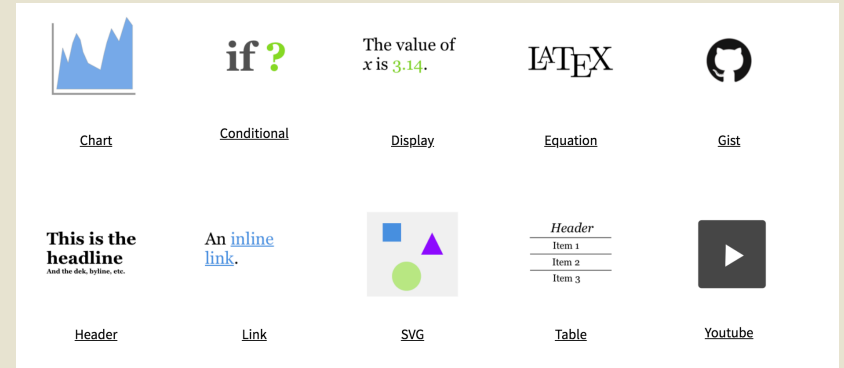


Try Idyll in your browser

28 Built-in Components



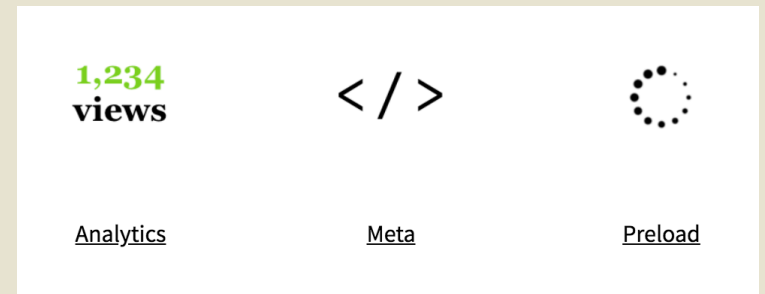
Input



Presentation

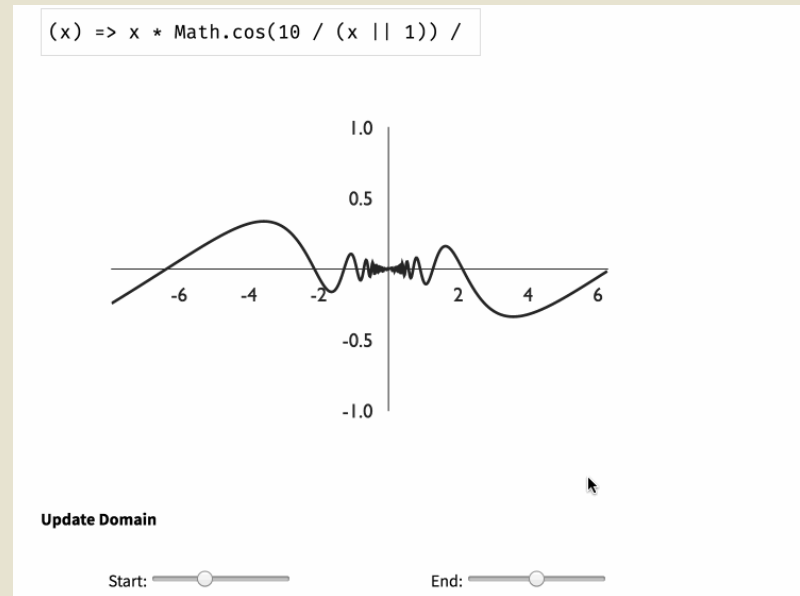


Layout

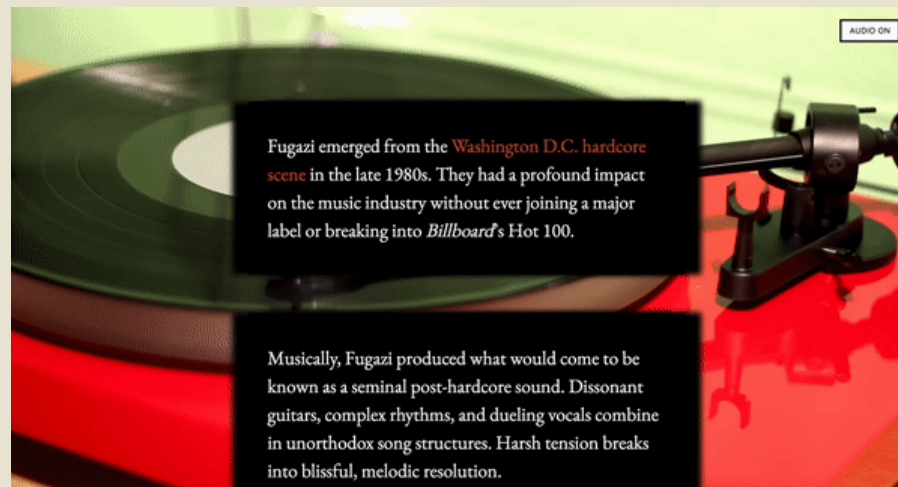


Helpers

Input+ Presentation



Layout+ Presentation



Bring your own graphics

A JavaScript component API is exposed to end users.

Use with libraries like D3, Mapbox, Processing (P5), React, Vega-Lite

Built-in static hosting

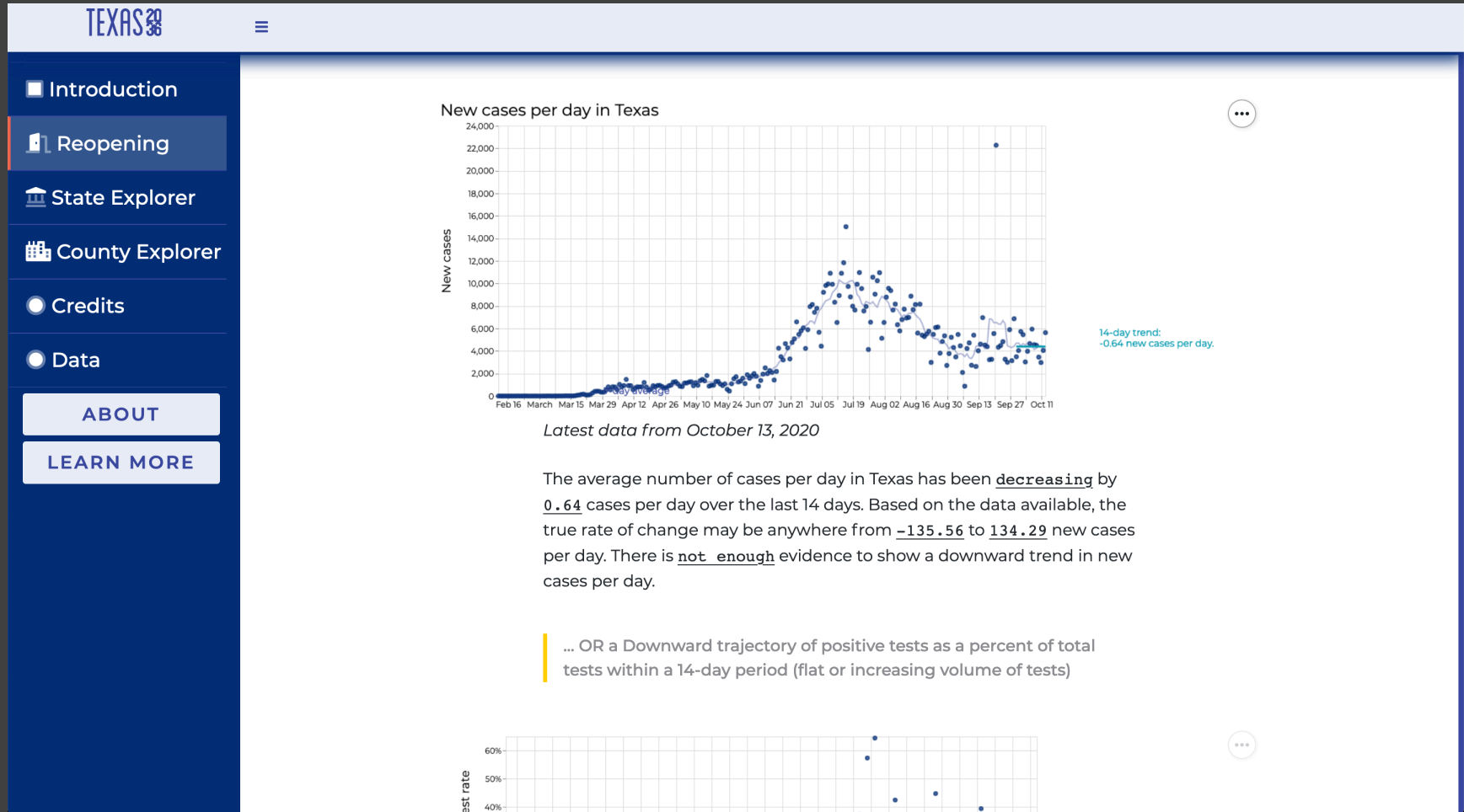
```
mathsonian in ~/projects/my-idyll-project
```



```
}
```

Examples

Texas 2020 COVID Reopening

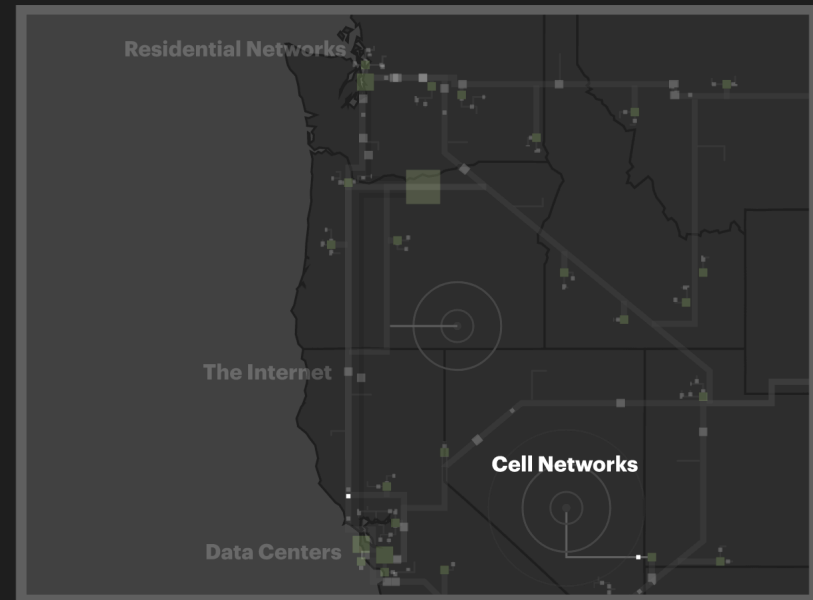


Examples



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Design Inquiry

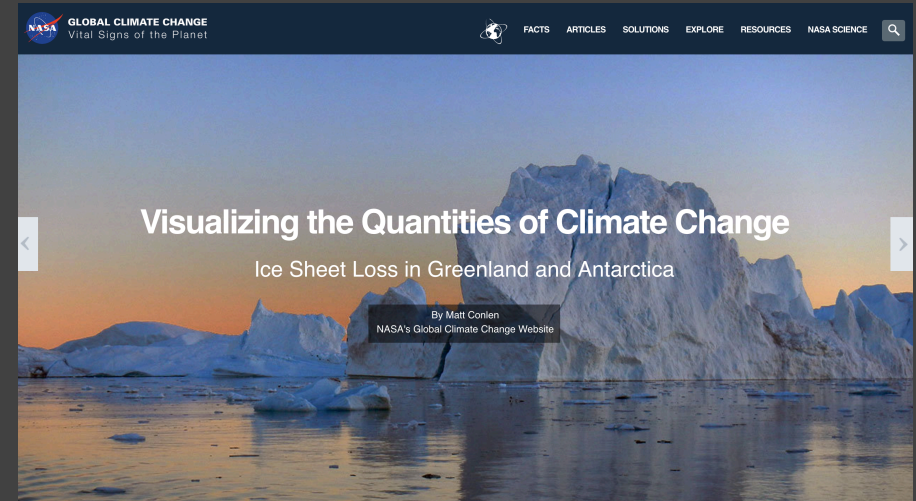
How to choose visual forms?

Design Inquiry CHOOSING VISUAL FORMS

What works well for one dataset or audience might be ineffective for another.



NYTimes Coronavirus data



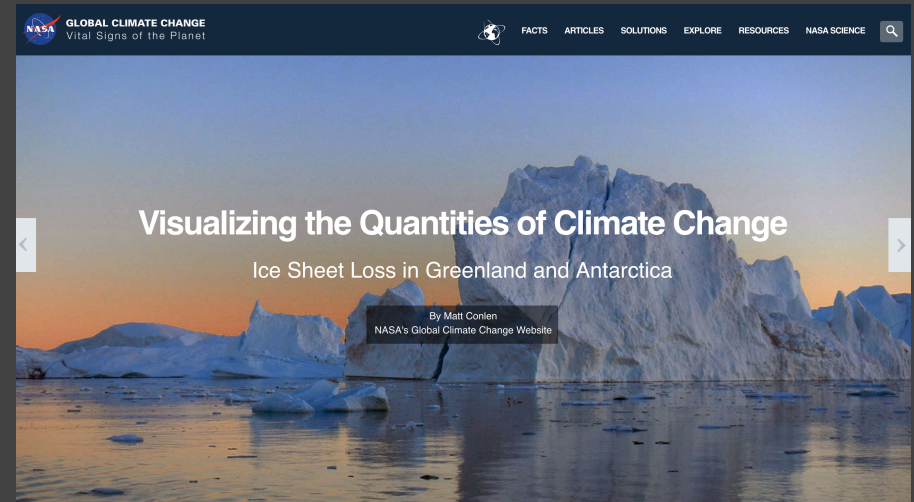
NASA Global Ice loss

Design Inquiry CHOOSING VISUAL FORMS

Both articles consider “serious” data on urgent topics. One uses simple, familiar forms. Why?



NYTimes Coronavirus data



NASA Global Ice loss

Thanks!

Feel free to reach out with questions:

mconlen@cs.washington.edu

@mathisonian
mathisonian.com