

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 data journalism but the material is more generally relevant (education, scientific publishing, policymaking).

Narrative Storytelling

Story:

The events or facts you want to convey

Narrative:

How you convey those facts

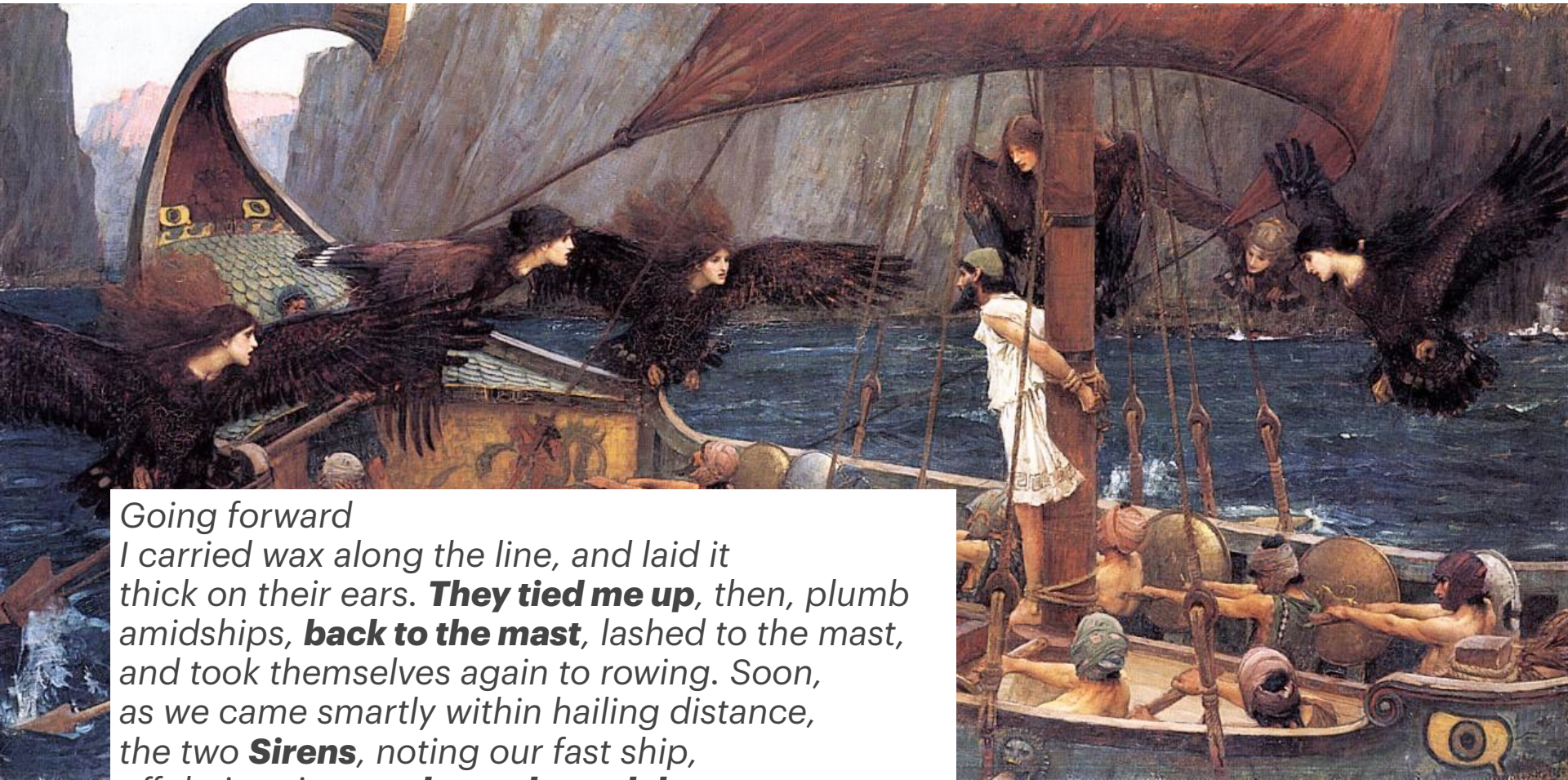
Narrative Storytelling

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

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

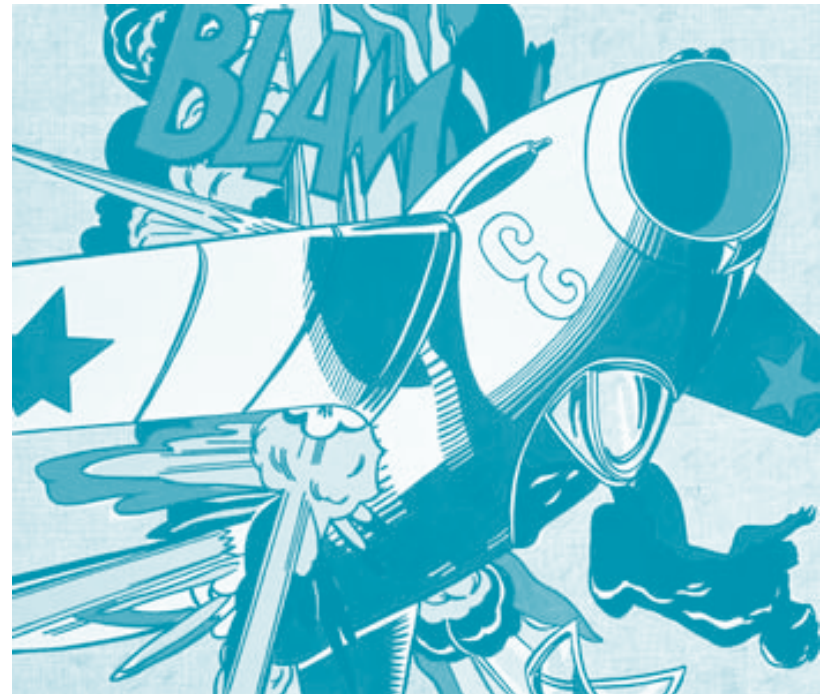
PEOPLE TELL STORIES

WORDS TELL STORIES

IMAGES TELL STORIES

COMICS TELL STORIES

MOVIES TELL STORIES





By Denise Grady and Carl Zimmer

April 14, 2021, 9:34 p.m. ET

The pause in the use of Johnson & Johnson's Covid-19 vaccine may continue for a week to 10 days, after expert advisers to the Centers for Disease Control and Prevention determined on Wednesday that they needed more time to assess a possible link to a rare but serious blood-clotting disorder.

The decision not to reinstate the vaccine has painful consequences, nationally and globally. It may further erode public confidence in vaccination in general and slow the rollout of desperately needed shots to rural and underserved areas and homebound people. The vaccine is considered ideal for hard-to-reach people and places because it requires only one shot and is more easily stored and shipped than the vaccines made by Moderna and Pfizer-BioNTech, which must be kept at very low temperatures.

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**Nut Graf
(nutshell paragraph)**

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Topics

Narrative visualization

Case Study: Coronavirus Testing

Design space

Interactive articles

Case Study: Carbon Footprint

Authoring tools

STORYTELLING

across various media

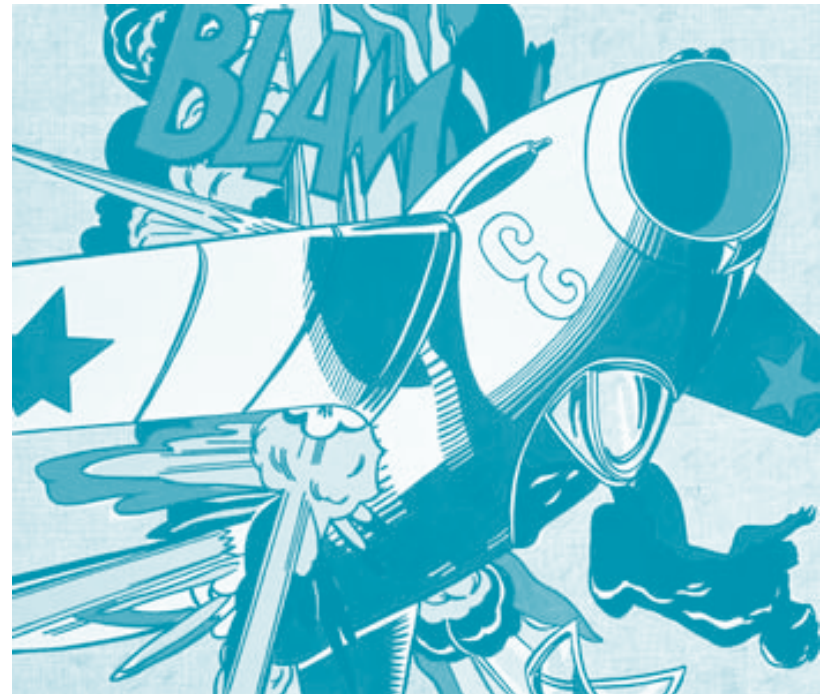
PEOPLE TELL STORIES

WORDS TELL STORIES

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COMICS TELL STORIES

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STORYTELLING

across various media

PEOPLE TELL STORIES

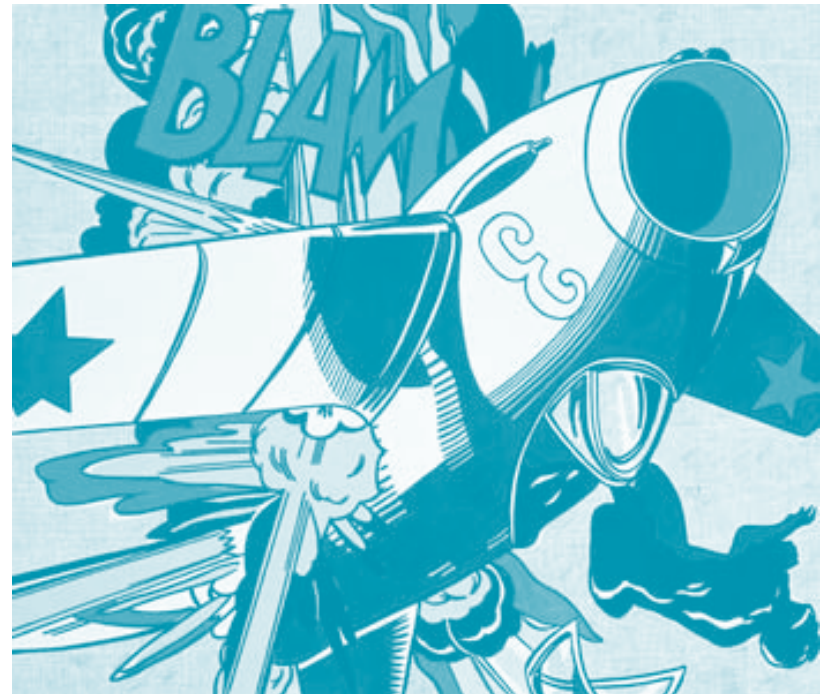
WORDS TELL STORIES

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COMICS TELL STORIES

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DATA TELLS STORIES?





Privacy and the internet

Lives of others

BY JAMES HAMILTON

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 about the social networking site struck a deal, 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 on 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, fearing 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 17th 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 Quora and Last.fm are warning of future investigations. May 2nd saw a mass Facebook "boycott".

There is a risk of toppling the momentum 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). Firm news has been mixed at the company's headquarters in Menlo Park, where bosses are mulling over how to respond. Several online folk are now hinting 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 heard.

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

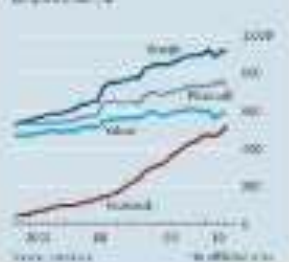
reportedly tough privacy policies in order to attract and increase users. But as more joint controls are gradually loosened to encourage more sharing, as people share more, Facebook can increase the traffic against which it sells advertising. And the more it learns about users' lives and habits, the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

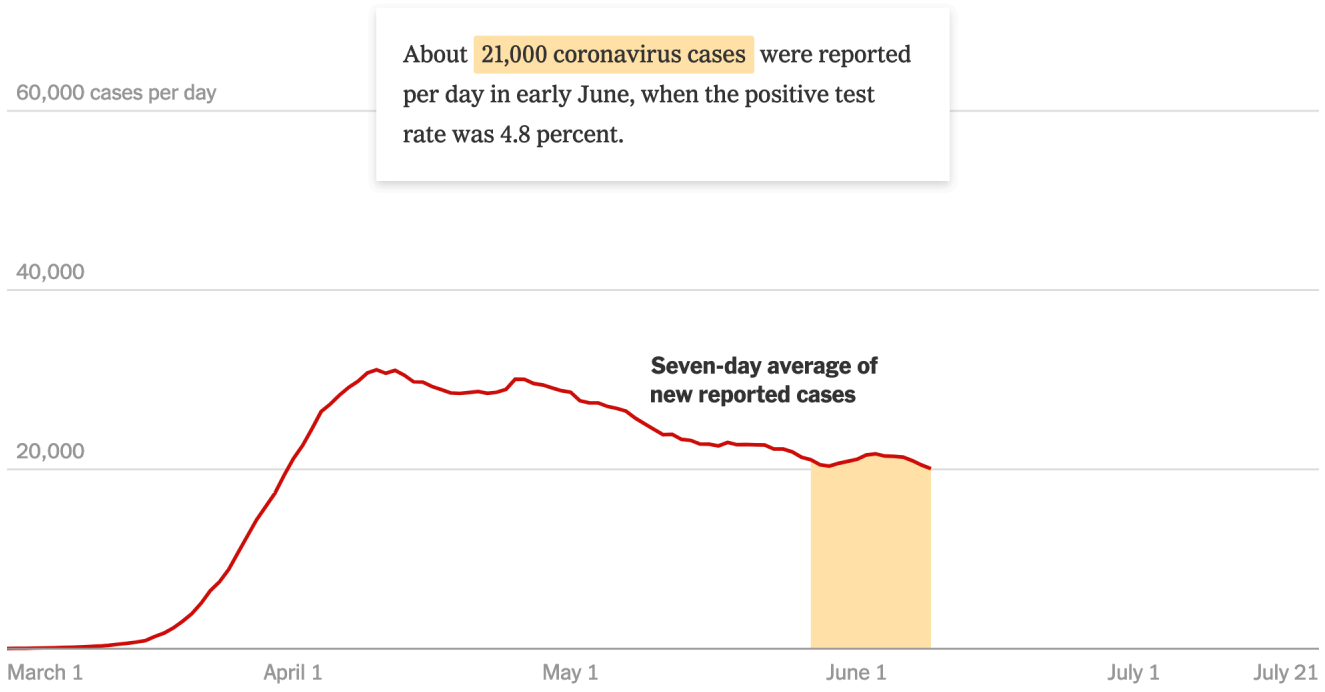
Privacy groups have been following a developer's conference last month at which Mark Zuckerberg, Facebook's boss, announced yet another series of policy changes. One that raised irritation was an "instant personalisation" feature that lets remote third-party websites access Facebook data when people 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 to look at the social network, calling it "at risk" because the default settings "are unadjustable". And as the

Not having fun

Facebook's net use





CASE STUDY COVID-19 TESTING

Input Data

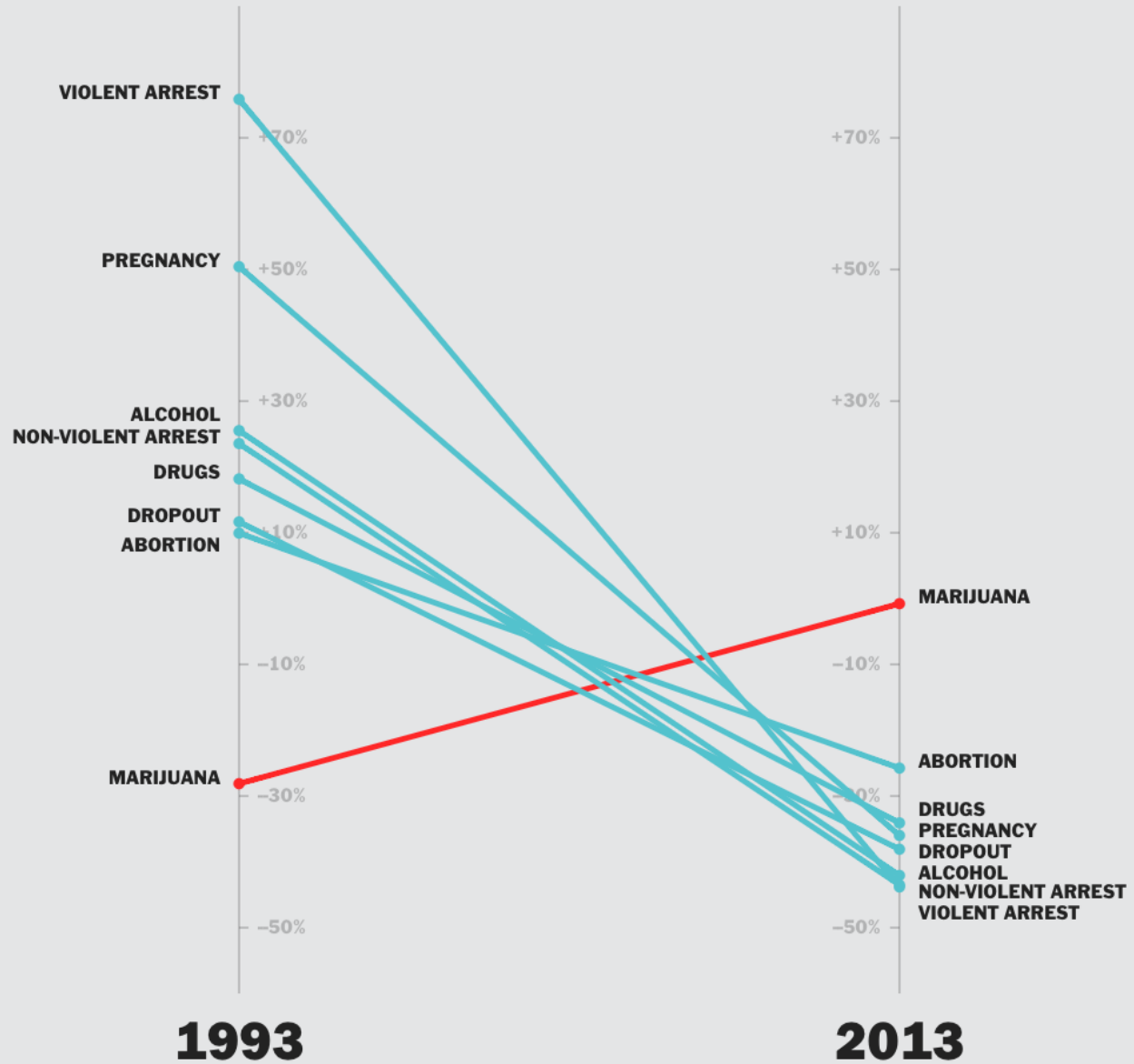
Daily case and test counts.

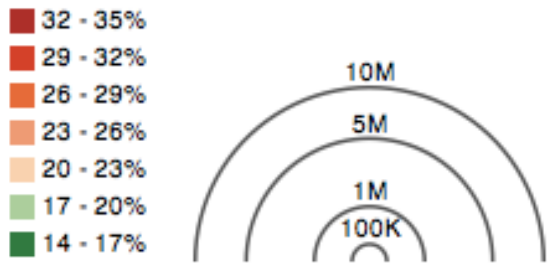
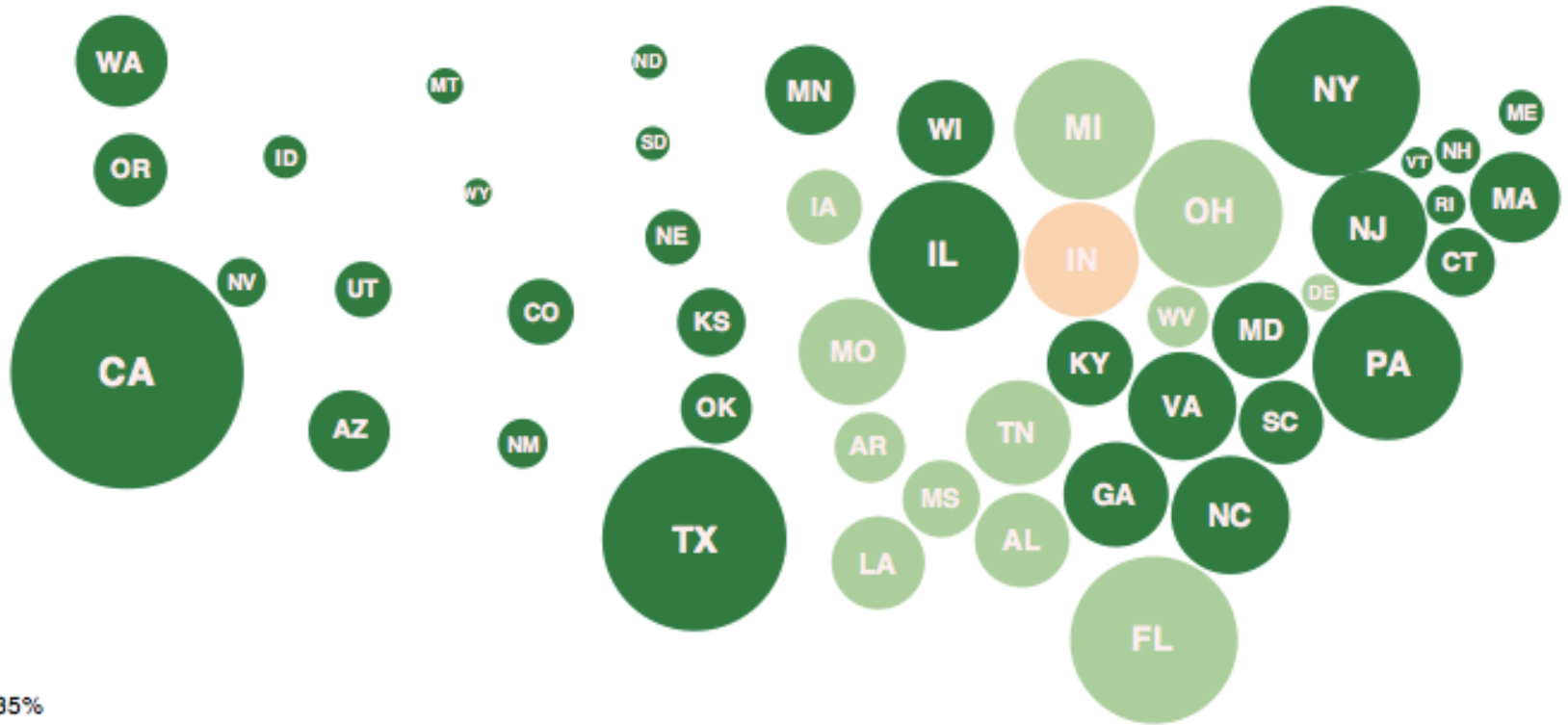
Points of Focus

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

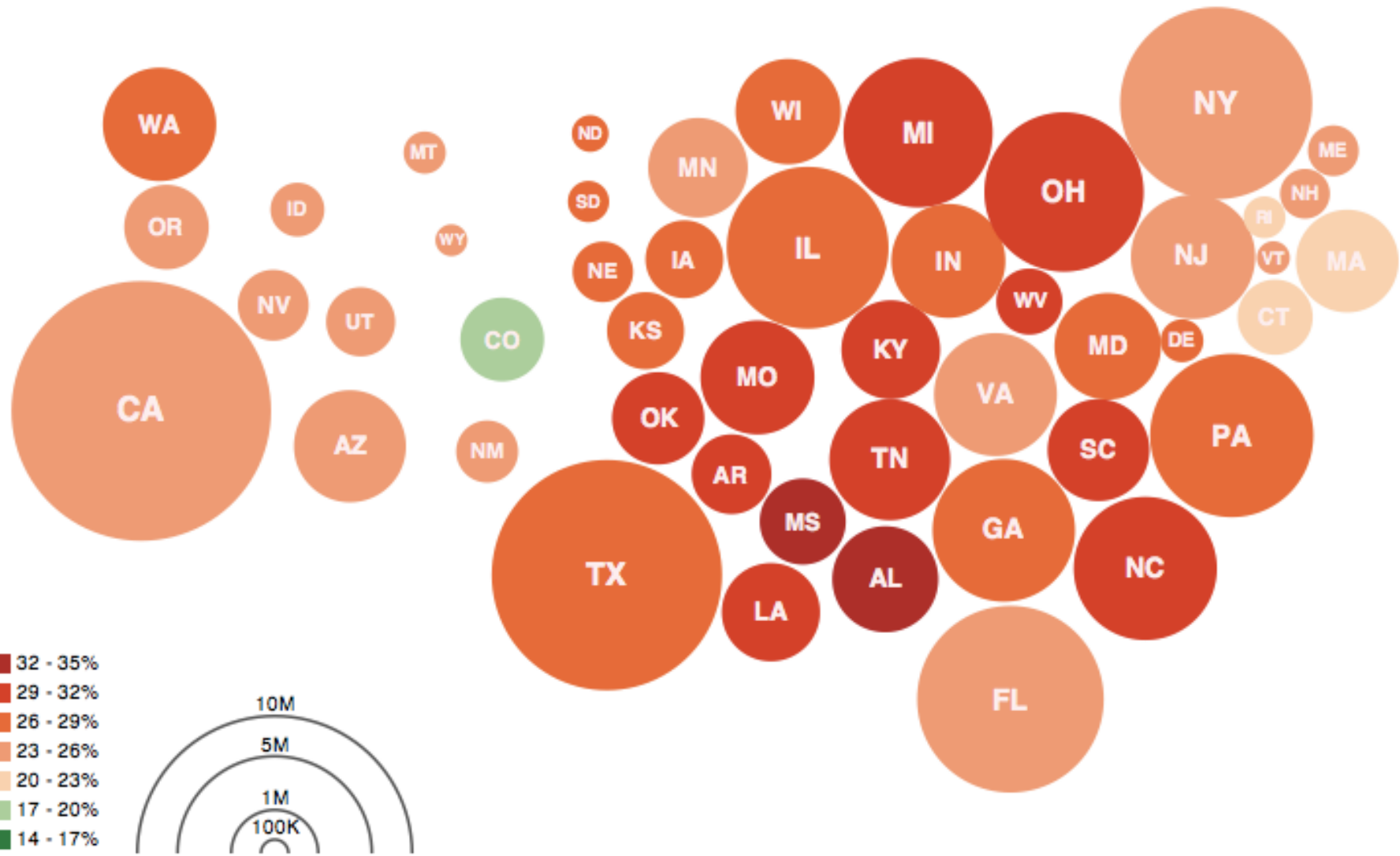
SHENANIGANS

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





Obesity Map Vadim Ogievetsky



Obesity Map Vadim Ogievetsky

Of the 7,666 times that police officers killed people in the U.S. between 2013 and 2019...

25 (0.3%) resulted in a conviction



74 (1.0%) resulted in a charge but no conviction >



and...



monachalabi • Follow

United States



monachalabi Total disbelief about the system doing the bare minimum. George Floyd deserved so much more than this, he deserved to live.

Some detail about those 25 sentences:

- Unknown sentence = 4 police killings
- Just probation = 3
- 3 months in jail = 1
- 1 year in jail, 3 years suspended = 1
- 1 year in prison = 1
- 18 months in prison = 1
- 2.5 years in prison = 1
- 4 years in prison = 1
- 5 years in prison = 1
- 6 years in prison = 1
- 16 years in prison = 1
- 20 years in prison = 1
- 30 years in prison = 2



22,976 likes

3 HOURS AGO

Log in to like or comment.

Narrative Devices

What devices communicates best?

Highly dependent on: audience, context, format

Format

Interactive Article

Animation

Lecture

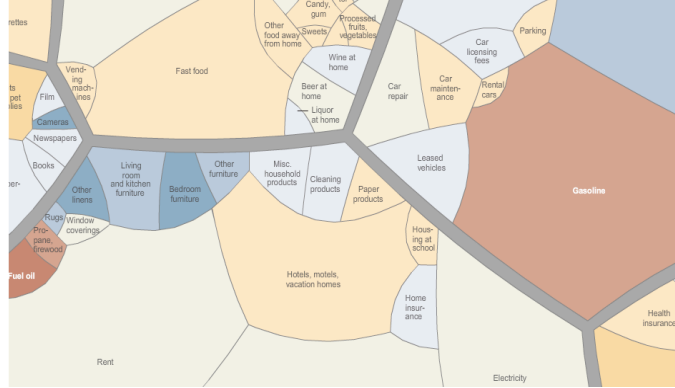
Still Image

Video

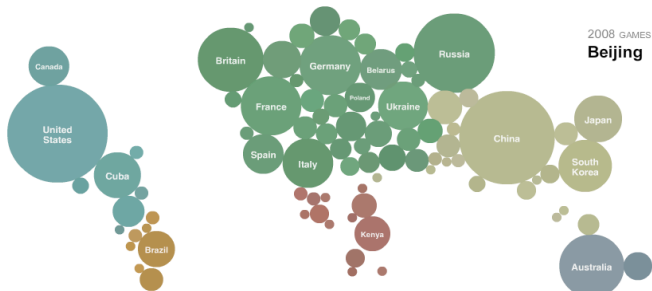
Narrative Visualization Design Space

58 CASE STUDIES

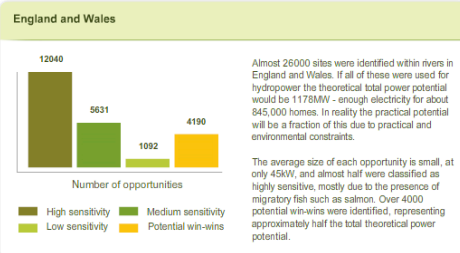
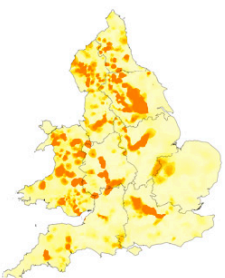
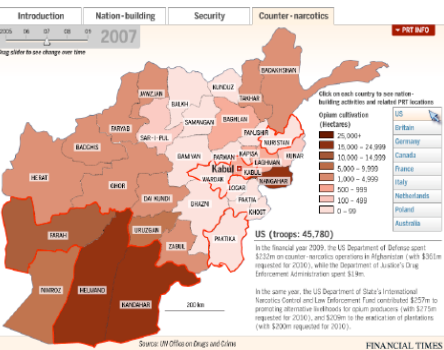
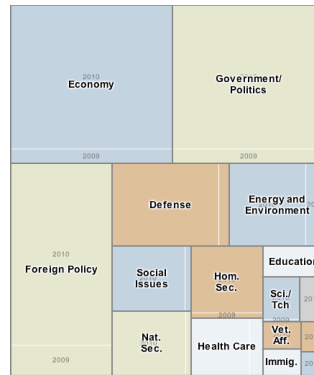
70% Journalism
20% Business
10% Research



GEOGRAPHIC VIEW BY RANKING
1896 1900 1904 1908 1912 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

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

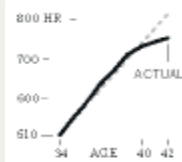
755
23 seasons
714
22 seasons
600
20 seasons
400
200

Bonds was injured last season. He played 14 games and hit 5 homers.

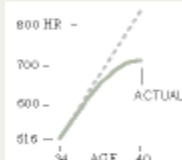
Homer Pace After Age 34

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.

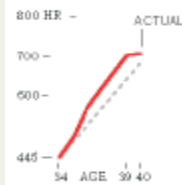
Aaron
Actual homers slightly outpace projected homers for five seasons.



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.

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.

Others Taking Aim



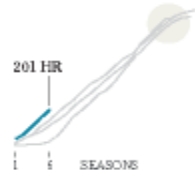
Alex Rodriguez

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



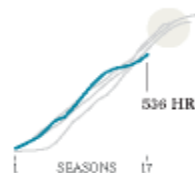
Albert Pujols

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



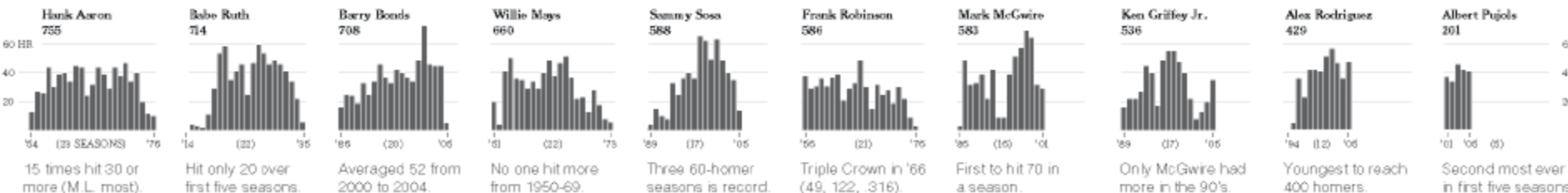
Ken Griffey Jr.

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



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).



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.

Barry Bonds

Hank Aaron
755 homers
23 seasons



Babe Ruth
714 homers
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Barry Bonds
708 homers
20 seasons

Bonds takes lead
Home runs after 16 seasons
Bonds 567
Aaron 554
Ruth 511

14th season

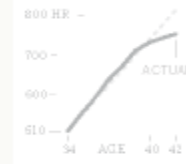
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Homer Pace After Age 34

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

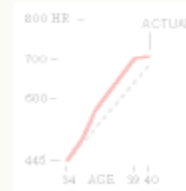
Aaron
Actual homers slightly outpace projected homers for five seasons



Ruth
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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.



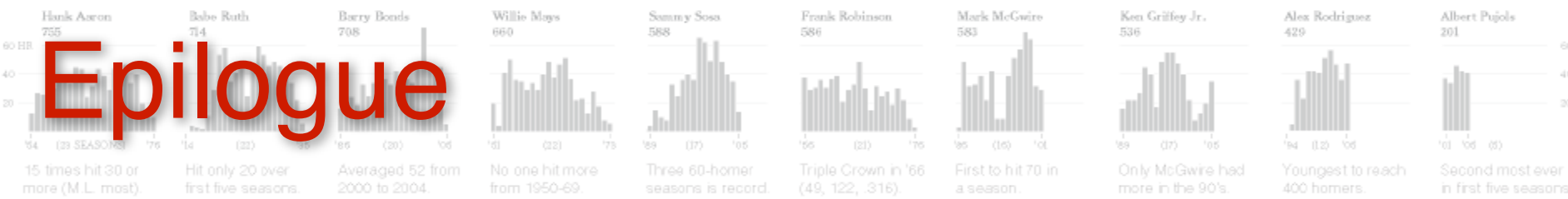
Ken Griffey Jr.
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



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 McCain abuse their free-mailing privileges before elections
Football (soccer) drawings
Pedestrians crossing the street
The Climate Agenda
What Did Your County's Jobs Disappear?
Academics House Price Index
Bar chart: earnings: How compensation relates to performance
Deathly offensive: Taliban attacks in Pakistan
Google Moves by Sector
UK Economic data
Budget 2010: Reaction from around the UK
Formula One 2010: driver's rankings
Lighting up Hadrian's wall
Mapping hydropower hotspots across the UK
Most metro bombs: interactive map
The world economy turns the corner
A Map of Olympic Medals
All about Inflation's Little Parts
Bar chart: Bonds visualization (Interactive)
Theebb and Flow of Money: Box Office Receipts 1986 - 2008
The Obesity Rate for People Like You
Advertisement: Bus
Advertisement: Helicopter
Analyzing Obama's schedule
Oscar 2010: the people nominees
The consumer and retail to include since 200
UK Voting Intentions
Bar chart: Bonds Visualization (Static Image)
Comparison of Bear Markets
How Americans Spend Their Day
Michelle Obama's Family Tree
Netflix Rentals
Van Cliburn's Olympic Venue
On the Map: Five Major North Korean Prison Camps
A Visual Guide to the Financial Crisis
Economic Meltdown of 2008-2009
What Did All the Money Go?
Life cycle of a beetle through a year
McDonald's "Making Comics"
How the Government Dealt with Past Recessions
Afganistan: Behind the front line
Toyota timeline: a company history
Gap's Under Human Development
Earthquakes: why they happen
Iran's nuclear programme
Shanghai White's Double McTwist
Toyota's stick accelerator problem
Alpine Skiing, From Technical Turns to Tucks and Speed
Budget Forecasts vs. Reality
Map: Orientation Video
Delaware Airplane Safety Video
"The Story of Stuff"
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						
Subject 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						

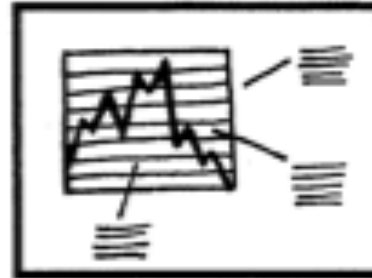
Observed Narrative Devices

Case Studies

Seven Genres



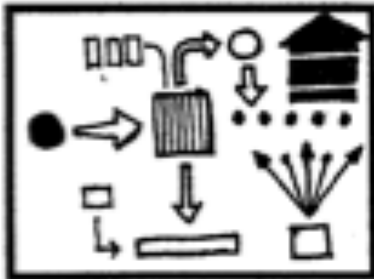
Magazine Style



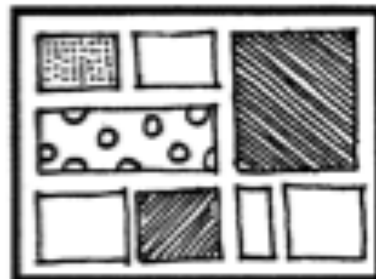
Annotated Chart



Partitioned Poster



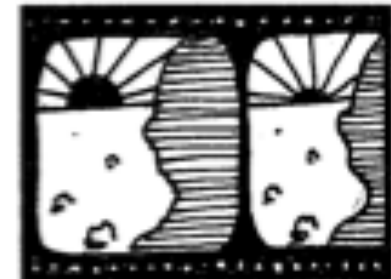
Flow Chart



Comic Strip



Slide Show



Film/Video/Animation

Genres for Narrative Visualization (2010)

Genres + Interactivity + Messaging =

DESIGN SPACE

STORYTELLING

CLARITY

SPEED

Author Driven

strong ordering
heavy messaging
limited interactivity

Reader Driven

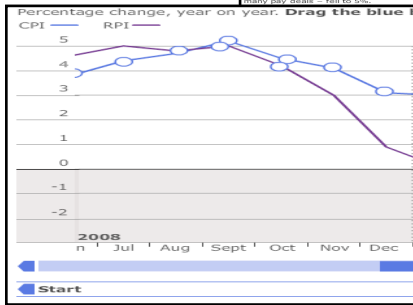
weak ordering
light messaging
free interactivity

ASK QUESTIONS

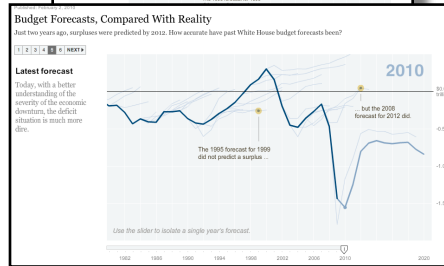
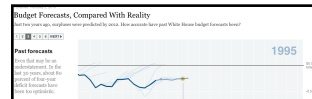
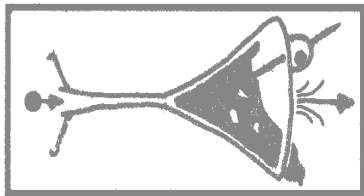
EXPLORE

FIND

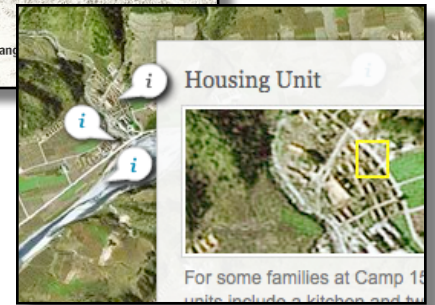
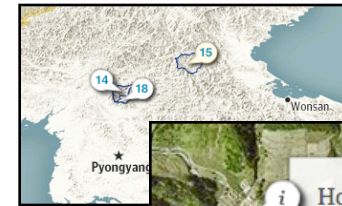
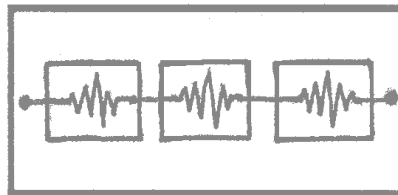
The consumer and retail price indices since 2008. The annual inflation rate fell from 4.5% to 0.2% in June. The Office for National Statistics said bargain offers on electronic goods helped drag inflation lower in June and pulled the government's preferred measure of the cost of living back towards its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



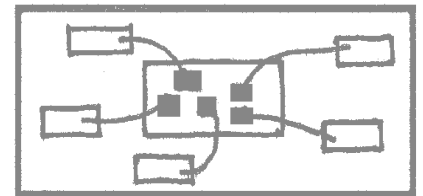
martini glass



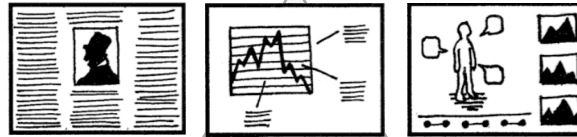
interactive slideshow



drill-down story



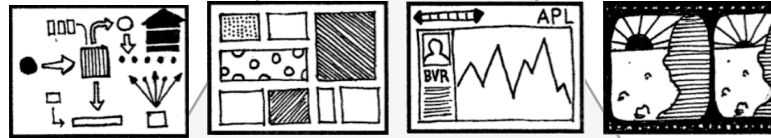
Visual Design



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

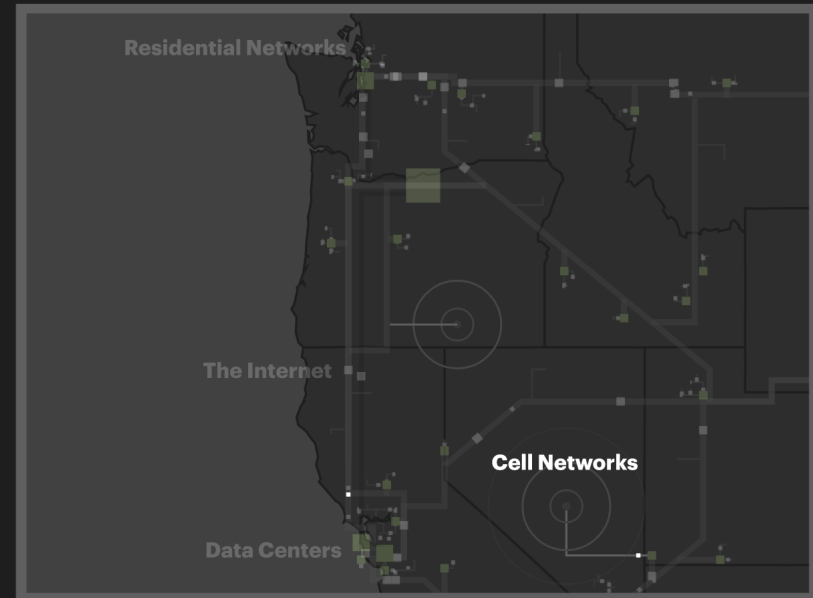
MORE

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

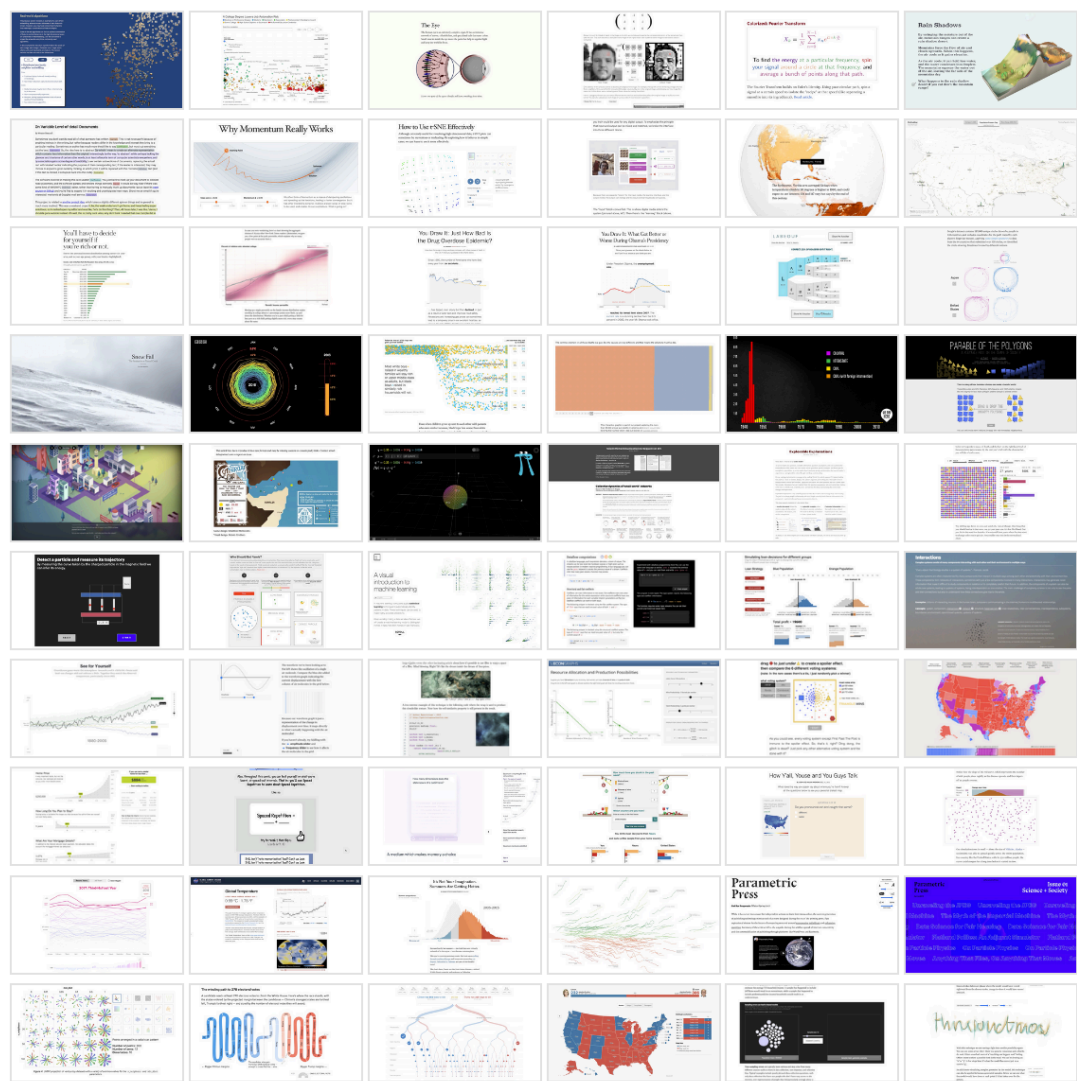
Examining the design of interactive articles by synthesizing theory from disciplines such as education, journalism, and visualization.

60+ Interactive Articles

NYTimes, WaPost

Distill, VisXAI

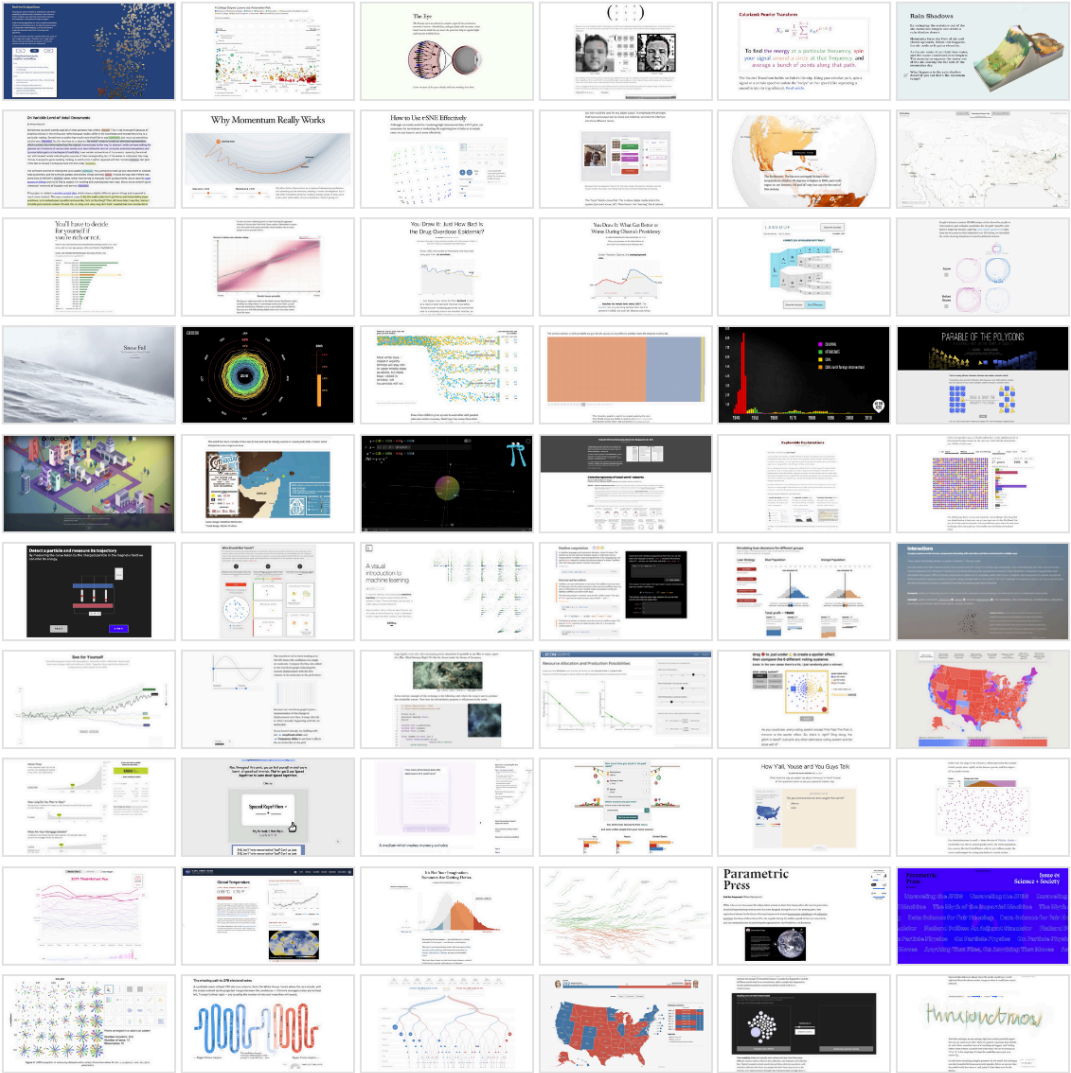
+more



Hohman, Conlen, Heer, Chau
2020

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5 affordances of the format

Connecting people and data

Making systems playful

Promoting self reflection

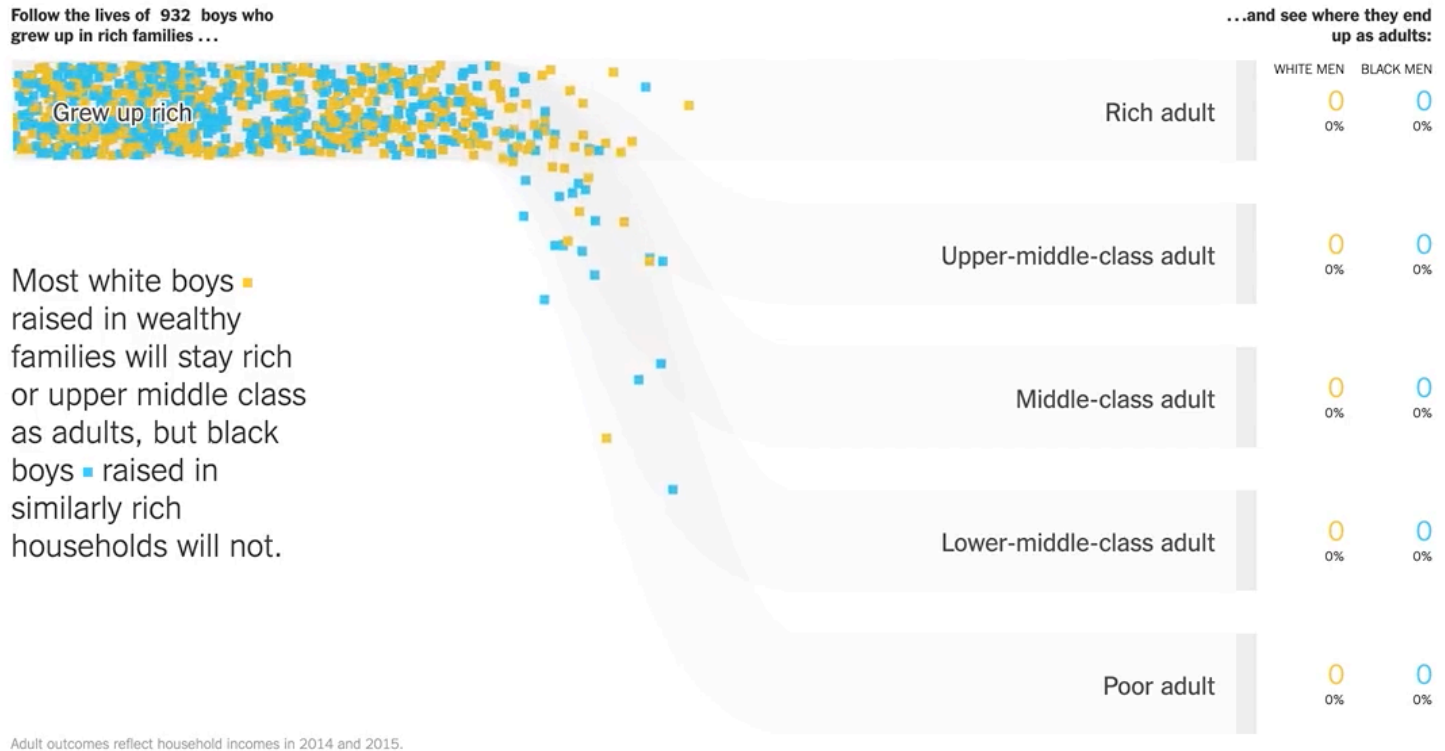
Personalizing reading

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



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

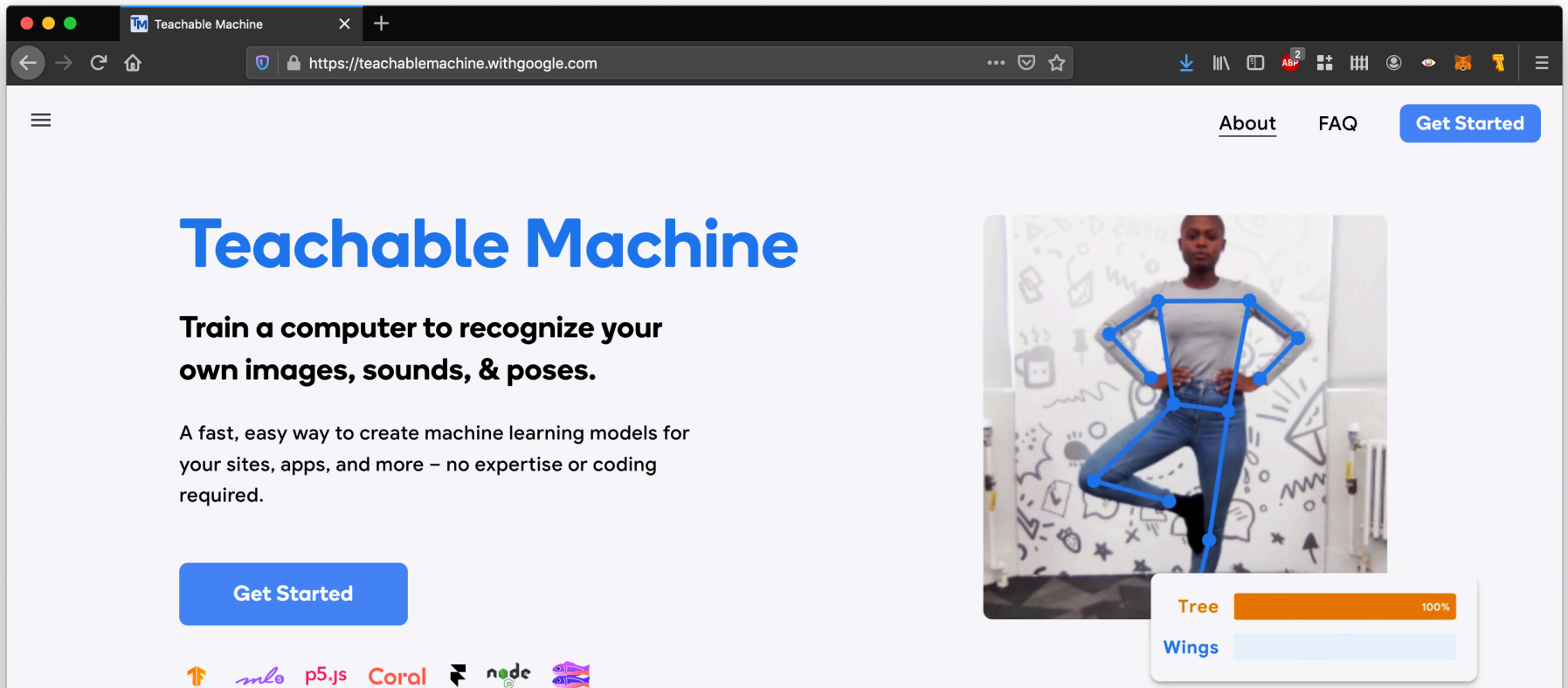
Connecting people and data

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Reducing cognitive load



The screenshot shows the Teachable Machine website interface. At the top, there's a navigation bar with 'About', 'FAQ', and a 'Get Started' button. The main heading is 'Teachable Machine' in large blue font. Below it, the text reads 'Train a computer to recognize your own images, sounds, & poses.' and 'A fast, easy way to create machine learning models for your sites, apps, and more – no expertise or coding required.' A 'Get Started' button is prominently displayed. At the bottom left, there are logos for TensorFlow, ml5.js, p5.js, Coral, Node.js, and Fish.js. On the right side, there's a video player showing a person in a white shirt and blue jeans striking a pose. A blue skeletal overlay is visible on the person's body. Below the video, a progress bar shows 'Tree' at 100% and 'Wings' at 0%.

What is Teachable Machine?

Connecting people and data

Making systems playful

5 AFFORDANCES OF THE FORMAT Promoting self reflection

Personalizing reading

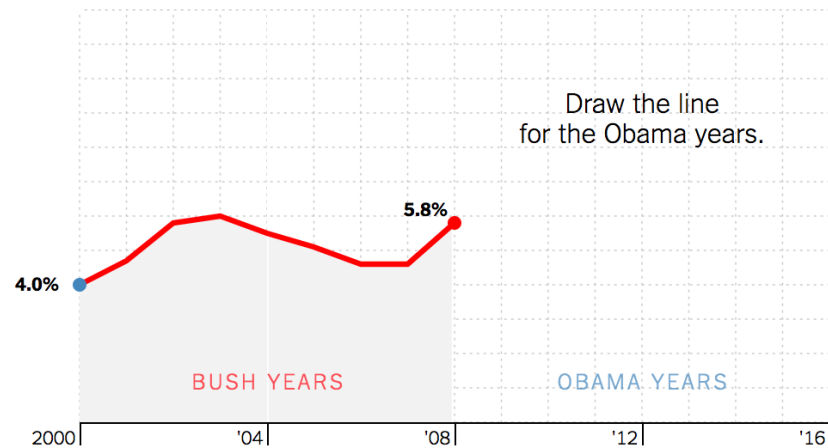
Reducing cognitive load

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 ...**



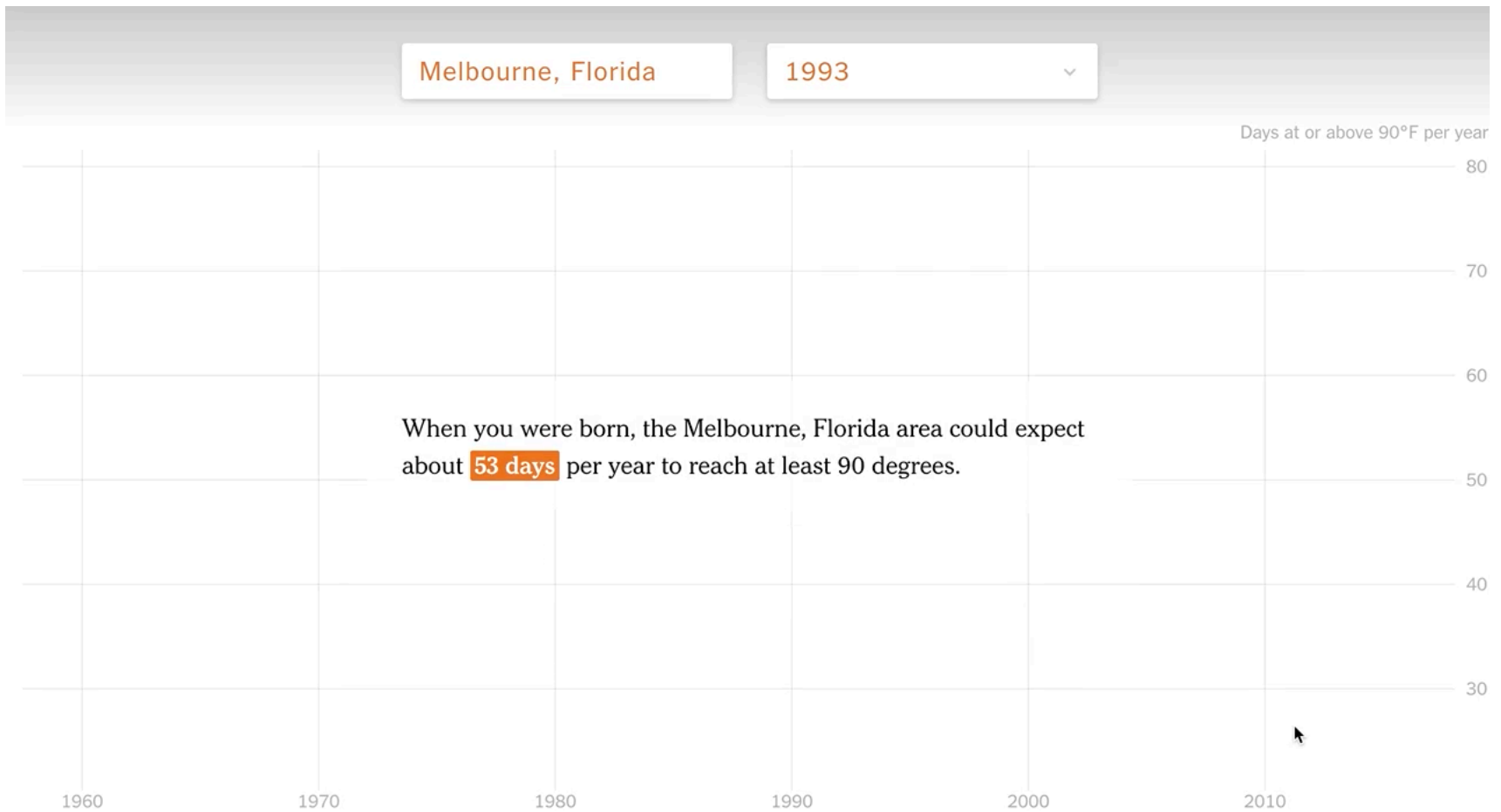
Show me how I did.

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

5 AFFORDANCES OF THE FORMAT

Personalizing reading

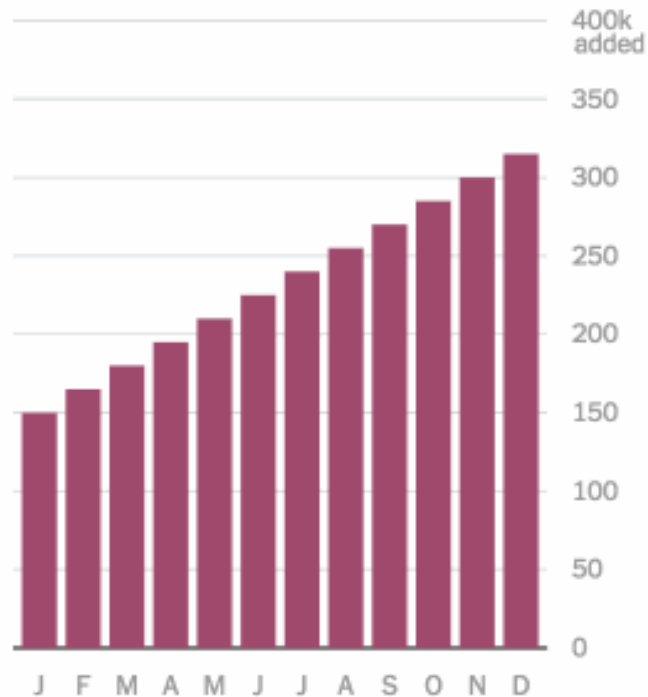
Reducing cognitive load



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

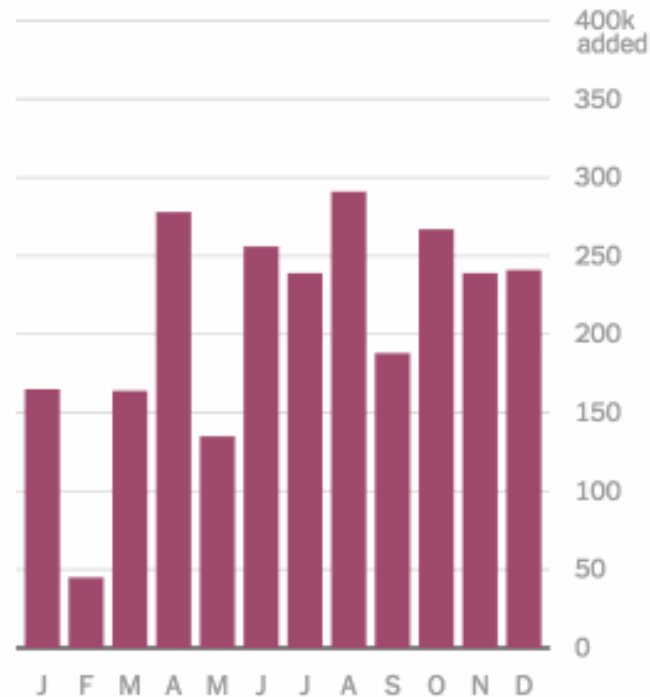
5 AFFORDANCES OF THE FORMAT **Reducing cognitive load**

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

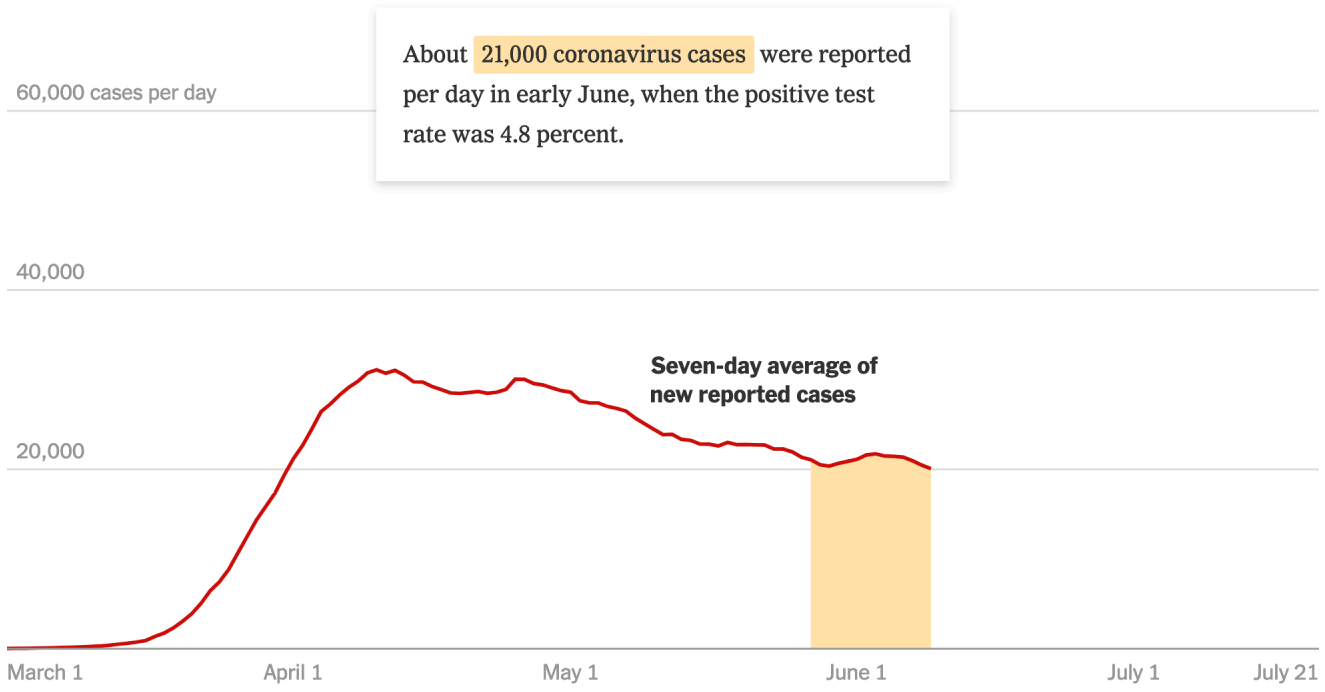
CLICK to advance



1 2 3 4 5 6 7 8 9 10 11 12

Stepper

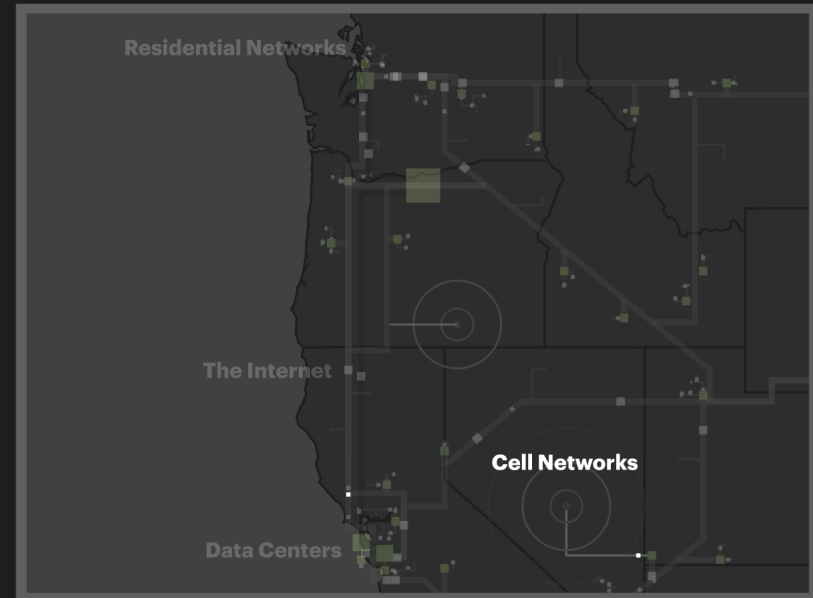
Explore the data for yourself »



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Parametric Press

CASE STUDY DIGITAL CARBON FOOTPRINT

Lin, Nirmal, Hathi, Liang, 2020

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

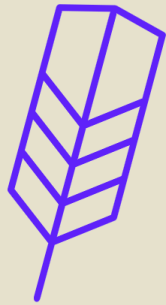
Monitor scroll position & element positions

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.

Text + Parameterized Graphics

Write articles in *markdown*.

Embed *parameterized* data visualizations.

Connect *reactive variables* to user input widgets to add interactivity.

INPUT (EDITABLE)

```
# Hello World
```

```
[var name:"x" value:5 /]
```

```
The value of x is [Display value:x format:"d" /].
```

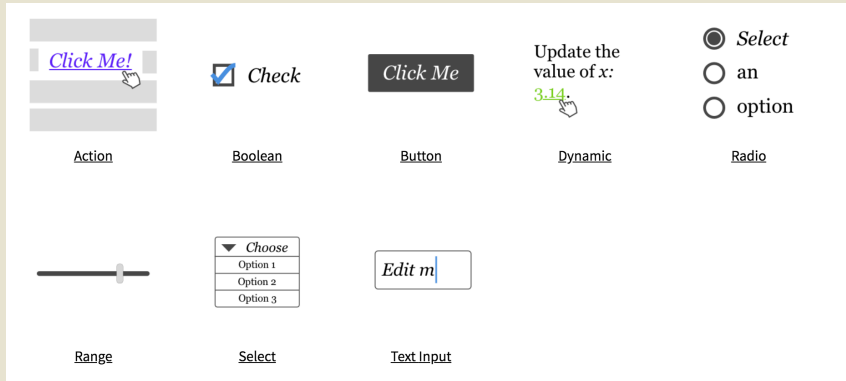
```
[Range value:x min:0 max:10 /]
```

Hello World

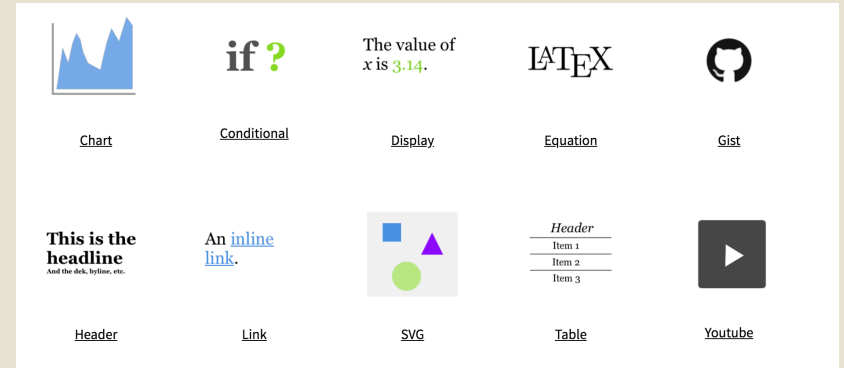
The value of x is 5.



28 Built-in Components



Input



Presentation



Layout



Helpers

Bring your own graphics

A JavaScript component API is exposed to end users.

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

```
[section]
```

```
# A Sad Guitar.
```

```
Take a second and strum the guitar. It doesn't sound  
so good, does it?
```

```
We've just taken it out of storage and *it's all out of tune ... *
```

```
[/section]
```

```
[section onViewFully:`guitarState = 'headstock'; playScale = false;`]
```

```
# Electric Tuner to the Rescue.
```

```
Tune the guitar using the tuner  
knobs on the right to tighten  
// Need a reward state to let
```

```
[Tuner selectedString:targetSt
```

```
[conditional if:isInTune]
```

```
Great work, scroll on.
```

```
[/conditional]
```

```
[/section]
```



Implementation

```
class Range extends Component {  
  
  handleChange(event) {  
    [var name:"x" value:5 /]  
    updateProps({  
      value: +event.target.value  
    # Hello World  
    }  
  }  
  The value of x is  
  [Display value;x format:"d" /].  
  render(props) {  
    return  
    [Range value:x min:0 max:10 /]  
    <input  
      type="range"  
      value={props.value}  
      onChange={handleChange} />  
  }  
}
```

Hello World

The value of x is 5.

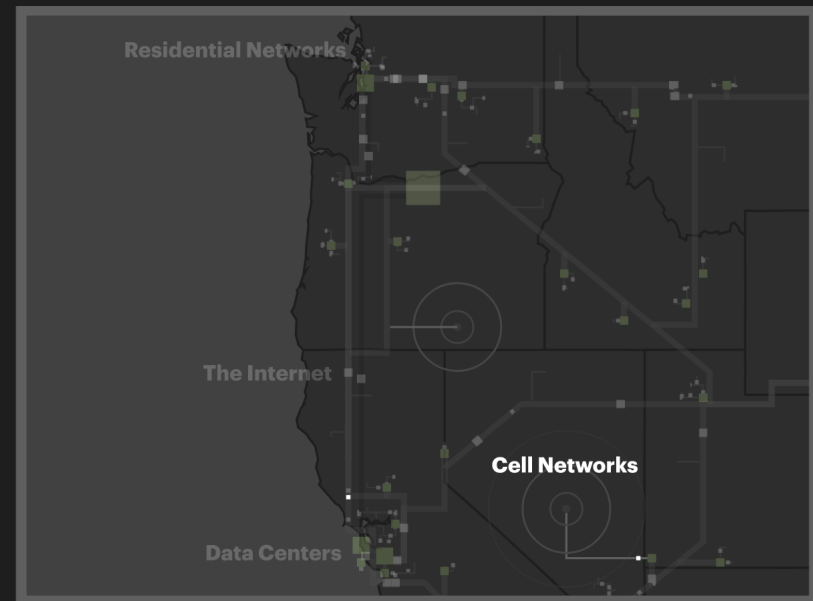


Examples



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Cellular Networks



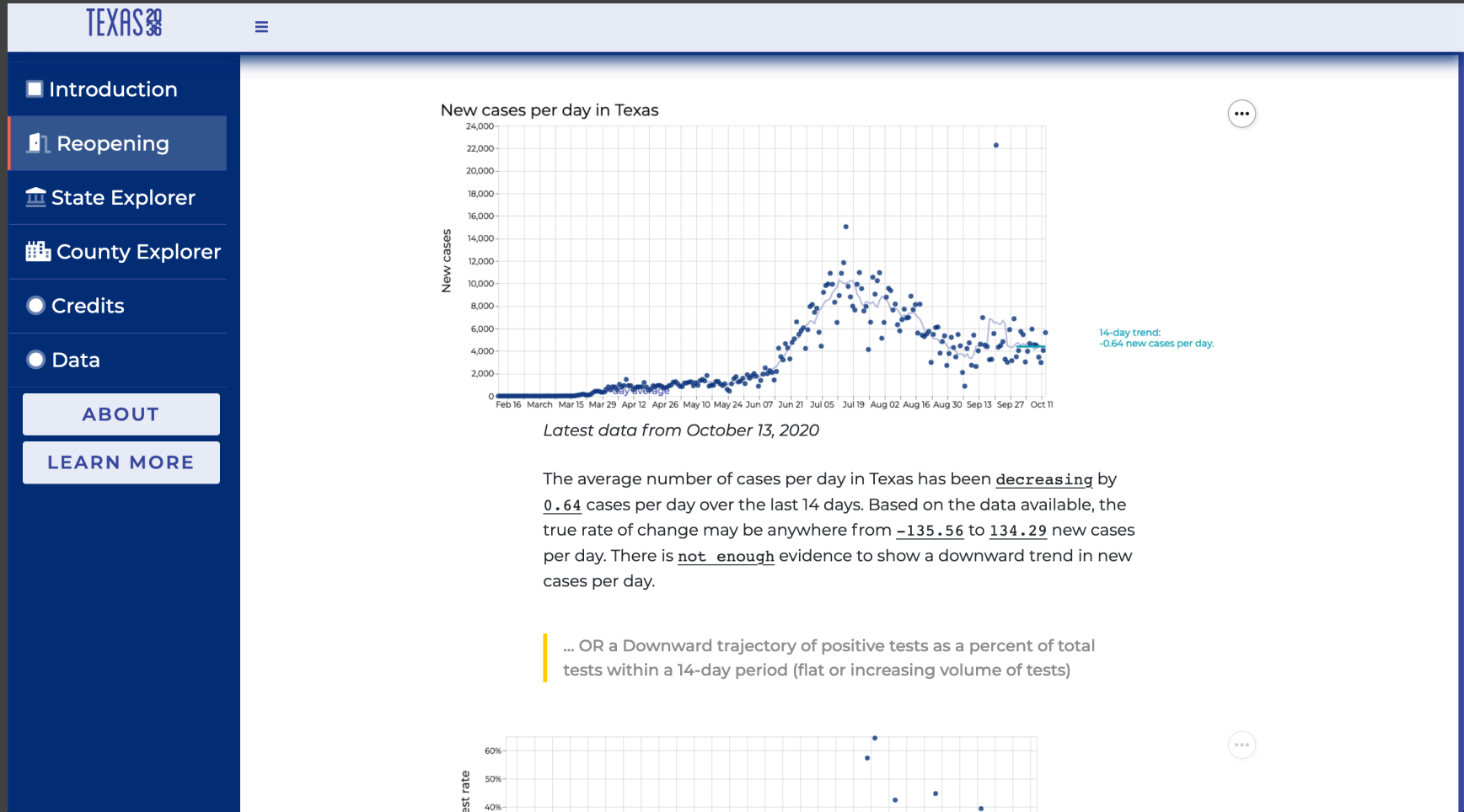
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Examples

Texas 2036 COVID Reopening



Examples

See full gallery online.

The screenshot shows a web browser window displaying the Idyll Example Gallery. The browser's address bar shows the URL <https://idyll-lang.org/gallery>. The website header features the Idyll logo on the left and navigation links for Docs, Tutorials, Gallery, and Editor on the right. Below the header, a section titled "Explorable explanations and interactive articles" displays a grid of article thumbnails. Each thumbnail includes a visual representation of the article's content, a title, a brief description, and two buttons: "Open" and "View Source".

Future of the Oxford Cambridge Arc
An interactive article about urban development modelling

What's an IP address?
How are they allocated? Are we running out?

The Barnes-Hut Approximation
Efficient computation of N-body forces

The thumbnails also show various visualizations: a map of the Oxford-Cambridge arc, a binary representation of IP addresses with toggle switches and equations like $2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0 = 168$ and 74 , a network diagram for the Barnes-Hut approximation, a card game layout, and a diagram of a neural network or eye-like structure.

Thanks!

Feel free to reach out:
mconlen@cs.washington.edu

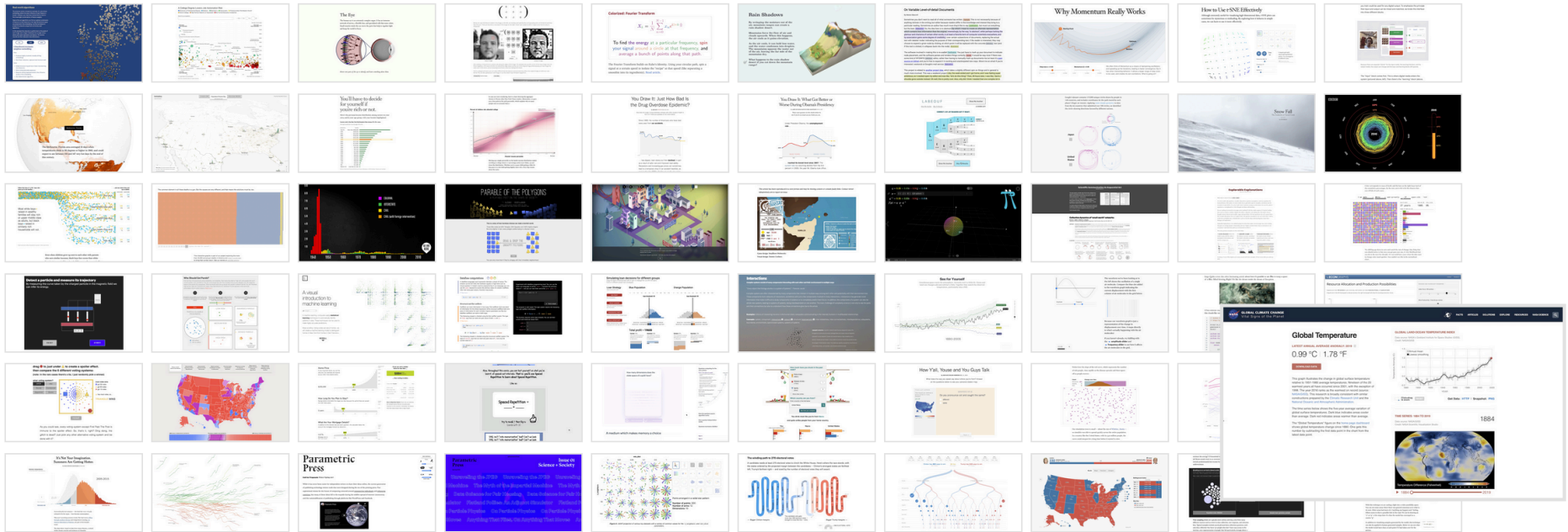


FIGURE 1: "Global Temperature." NASA. NASA Global Climate Change, 2020.

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