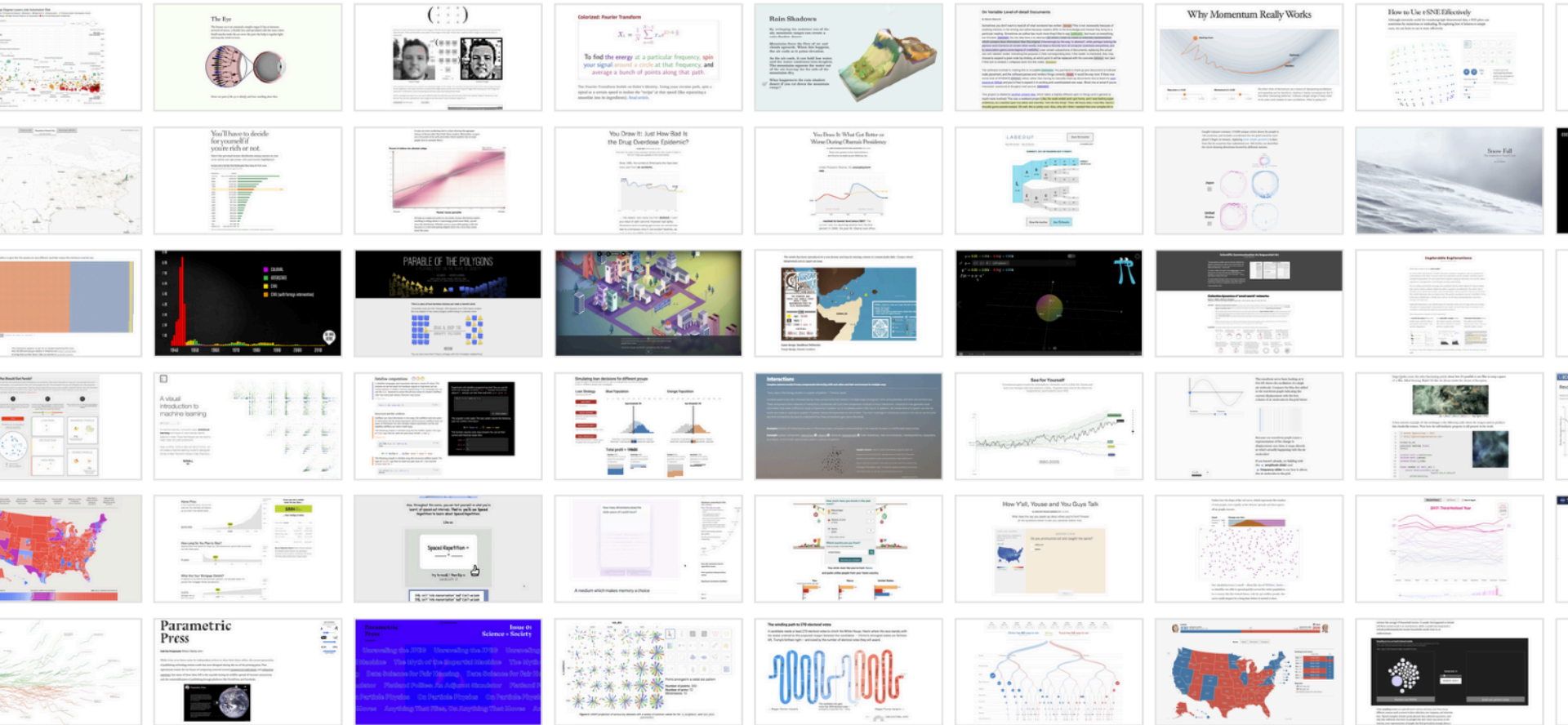


CSE 442

Narrative Visualization



Matthew Conlen

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

About Me

Ph.D. candidate @ UW computer science

Advised by Jeff Heer

Background in data journalism

FiveThirtyEight, CNN, New Yorker,

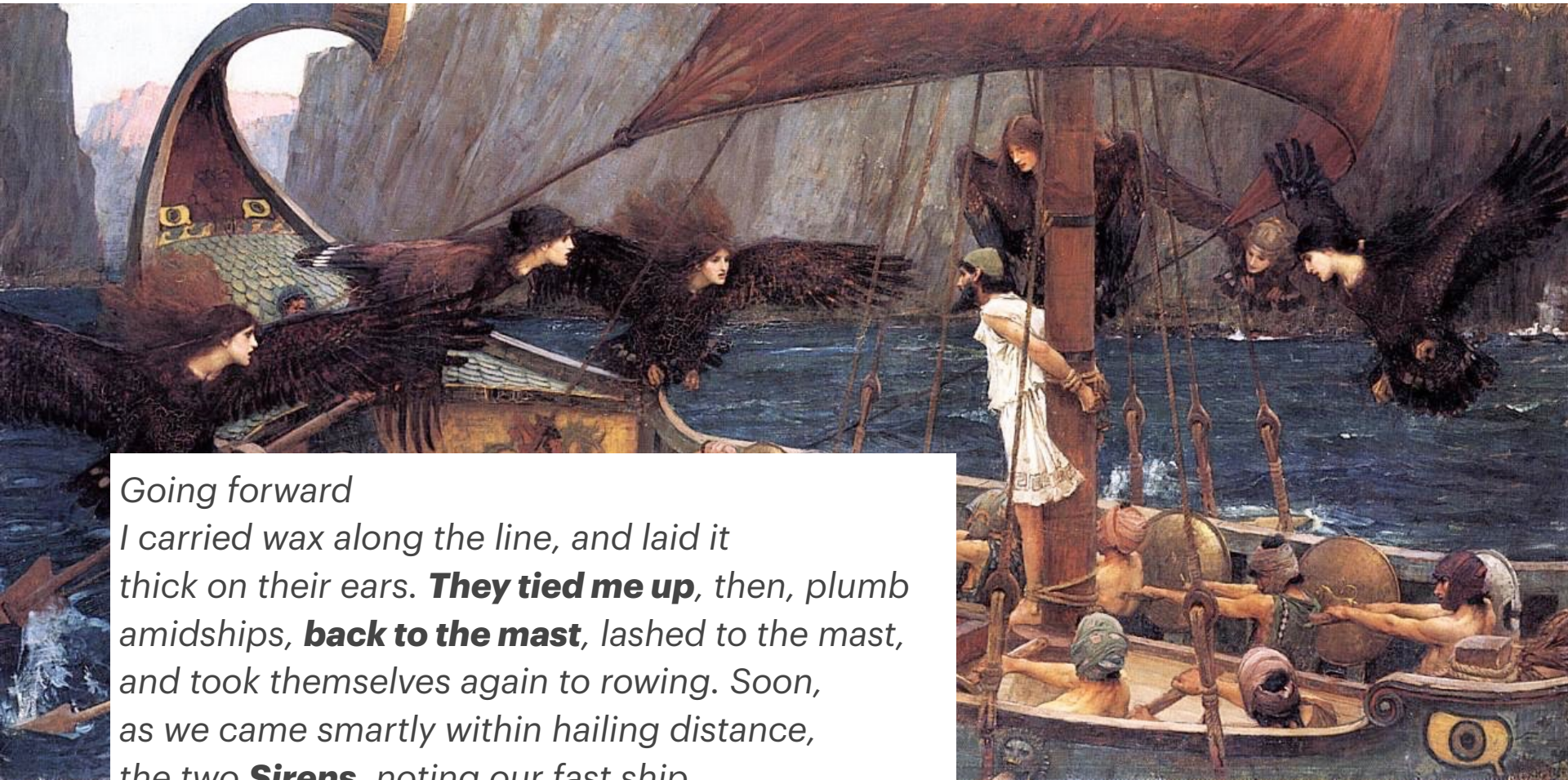
New York Times (Elections, Covid-19)

Lecture will be biased toward data journalism but the material is more generally relevant (education, scientific publishing, policymaking).

@mathisonian
mathisonian.com

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...***

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

across various media

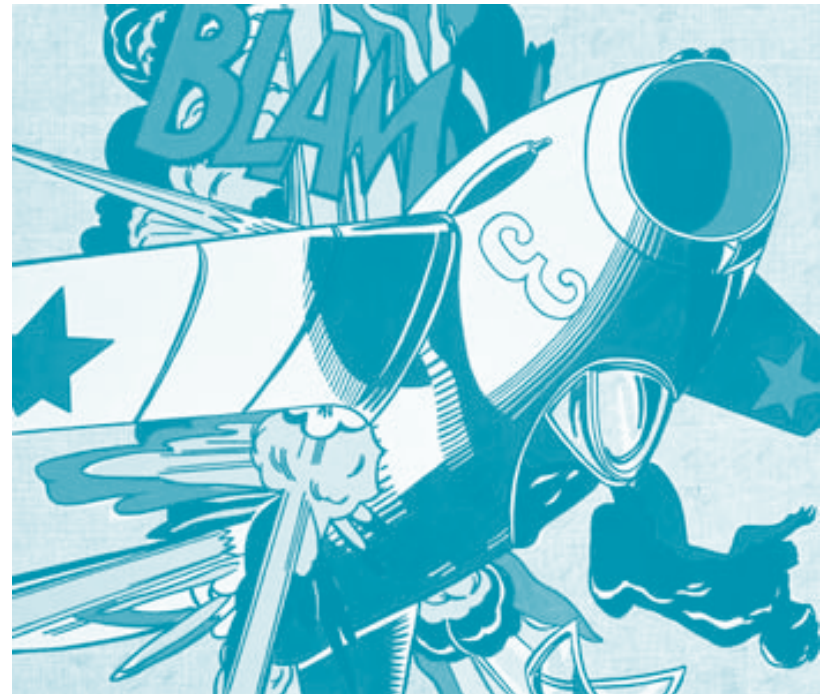
PEOPLE TELL STORIES

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: Herd Immunity

Affordances and challenges of the format

Research highlight

Authoring Tools

STORYTELLING

across various media

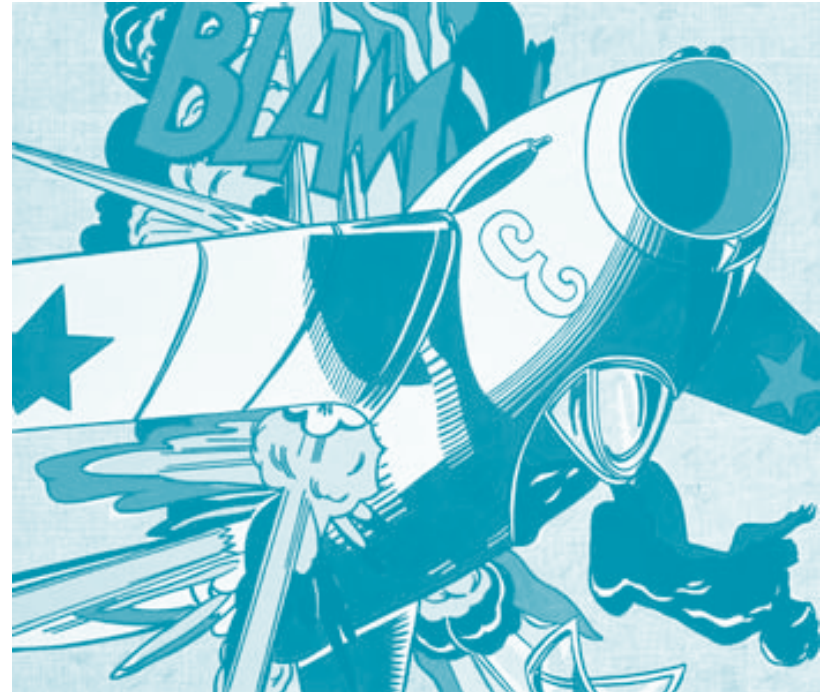
PEOPLE TELL STORIES

WORDS TELL STORIES

IMAGES TELL STORIES

COMICS TELL STORIES

MOVIES TELL STORIES



STORYTELLING

across various media

PEOPLE TELL STORIES

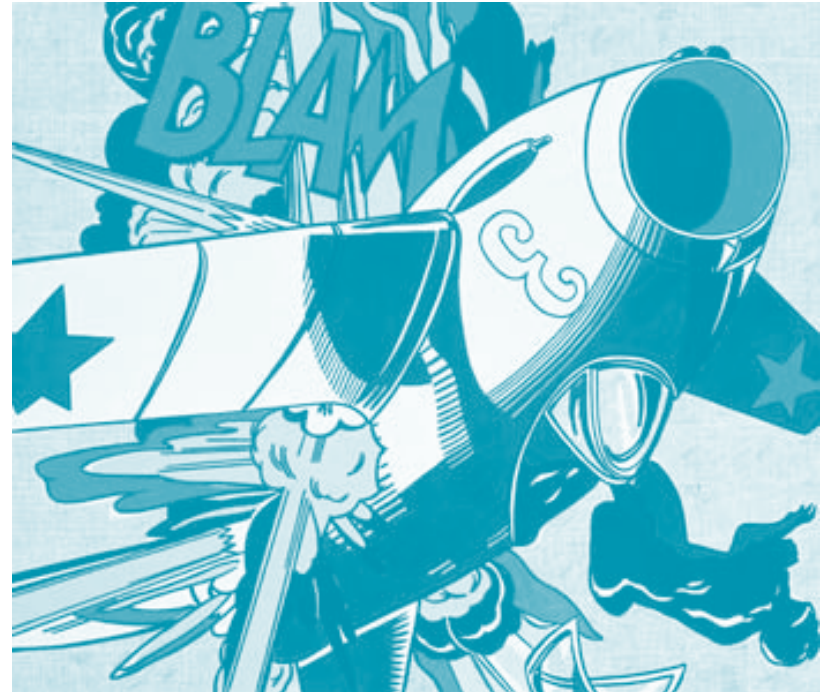
WORDS TELL STORIES

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MOVIES TELL STORIES

DATA TELLS STORIES?





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-understand 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, adding 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 Quia/Facebook Dismantle are urging others to do so, and linking May 20th 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 www.economist.com/business-theme

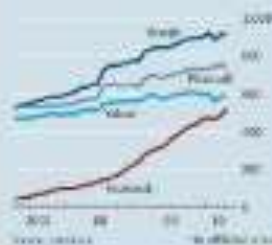
reportedly tough privacy policies in order to attract and increase users. But as more joint controls are gradually loosened to encourage more sharing, as people share more, Facebook can increase the traffic against which it sells advertising. And the more it learns about users' lives and habits, the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

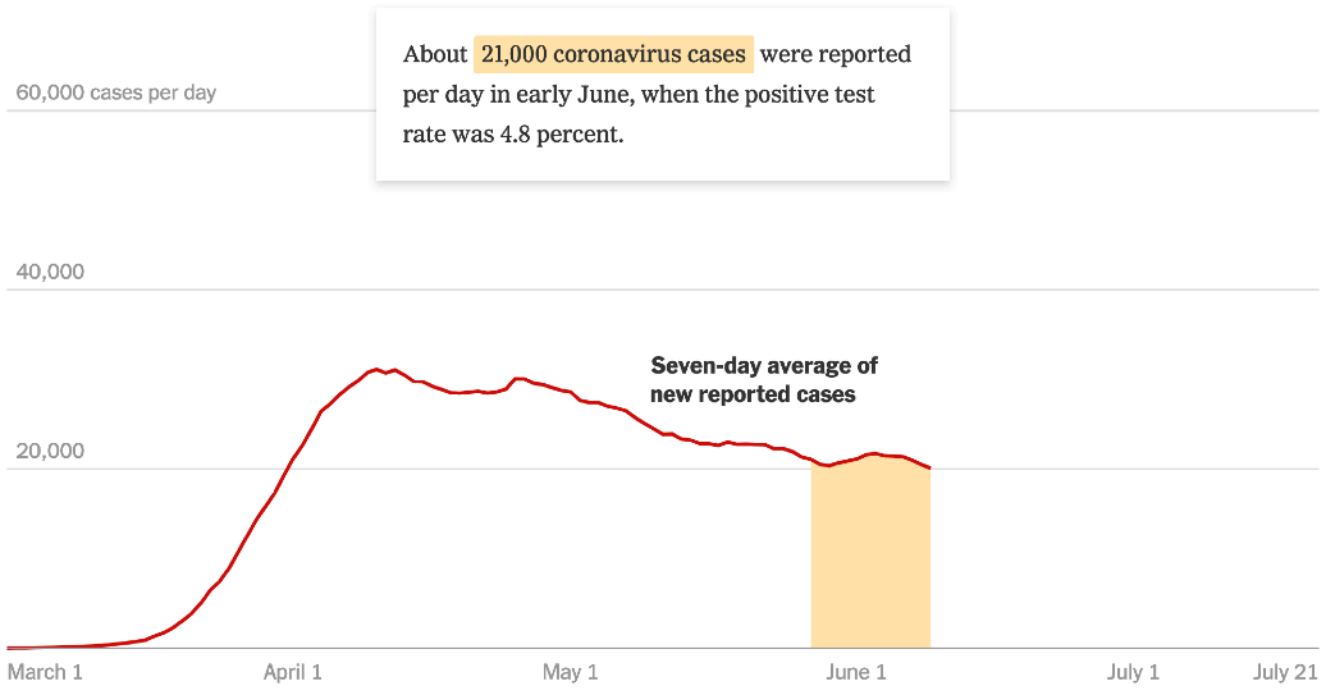
Privacy groups have been following a developers' conference last month at which Mark Zuckerberg, Facebook's boss, announced yet another series of policy changes. One that raised irritation was an "opt-out personalisation" feature that lets remote third-party websites access Facebook data when people 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 looking back

By David Foray





CASE STUDY COVID-19 TESTING

Input Data

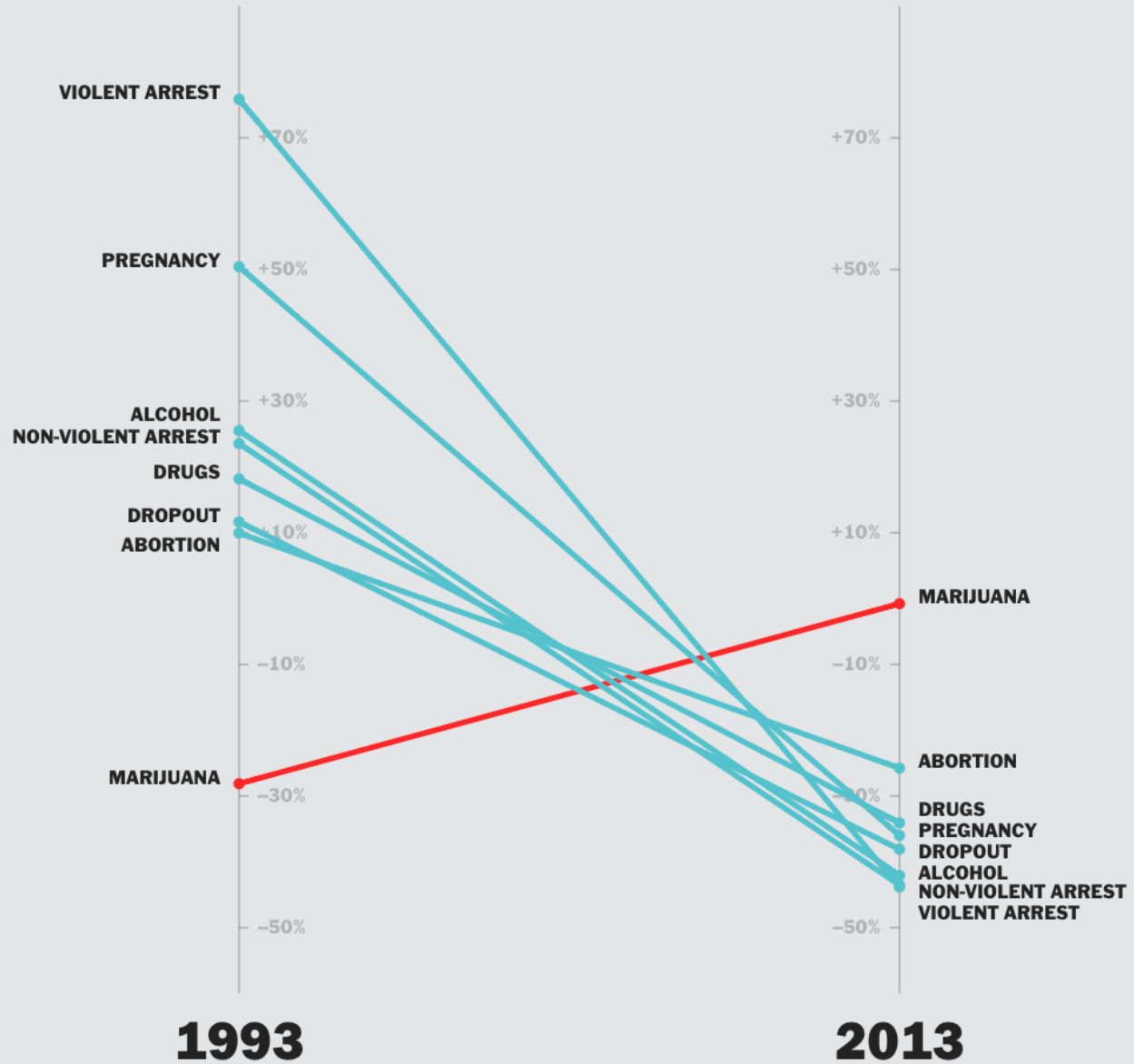
Daily case and test counts.

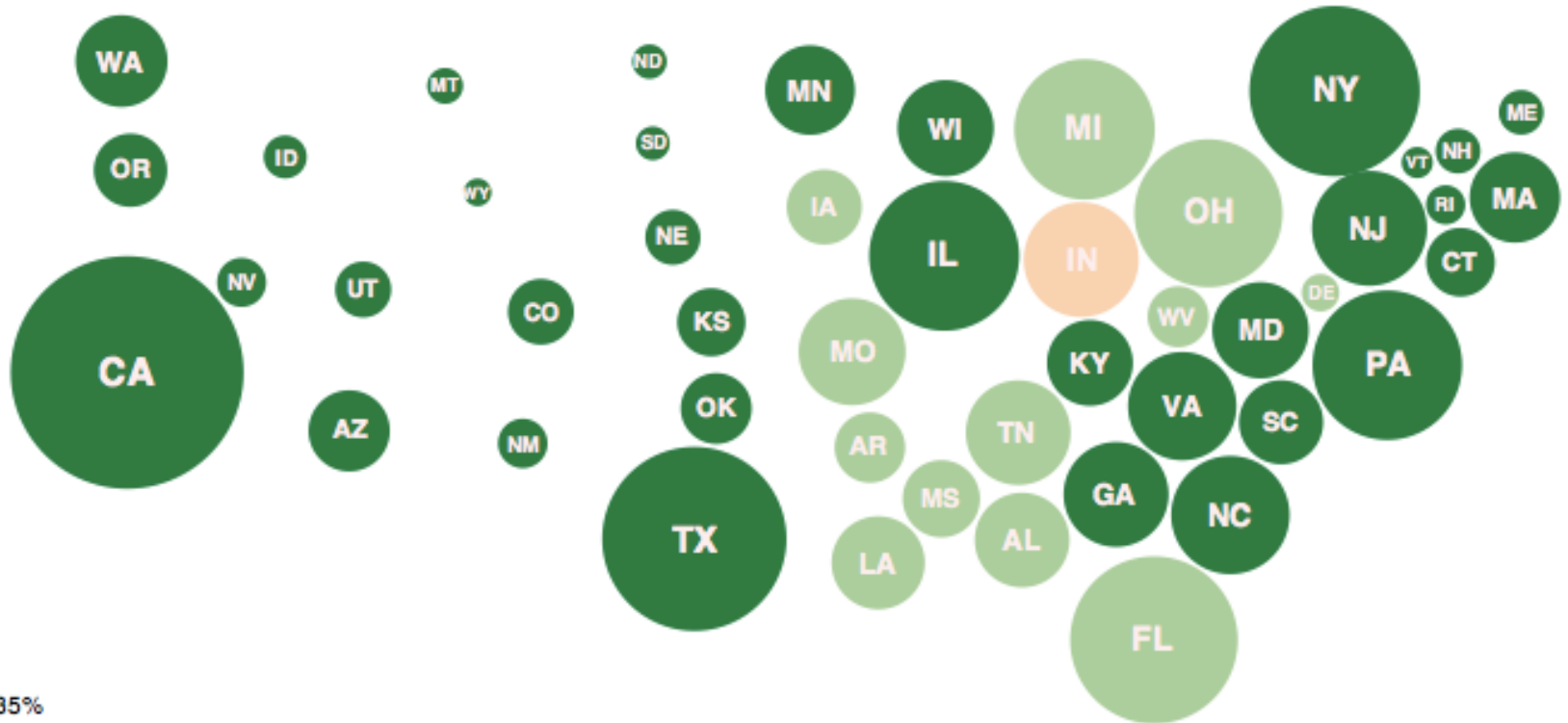
Points of Focus

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

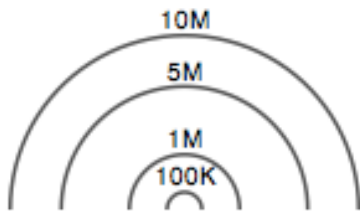
SHENANIGANS

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

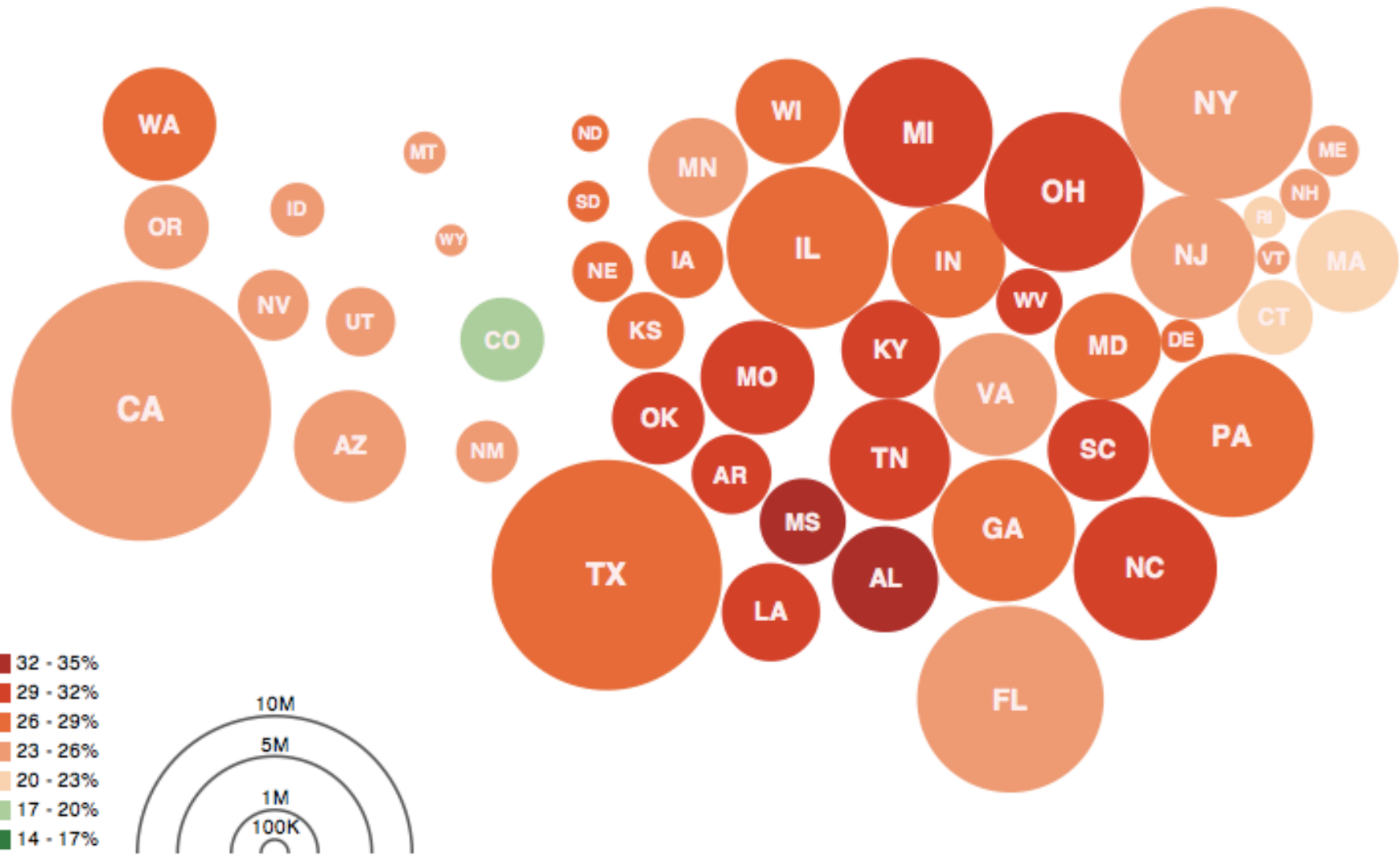




- 32 - 35%
- 29 - 32%
- 26 - 29%
- 23 - 26%
- 20 - 23%
- 17 - 20%
- 14 - 17%



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

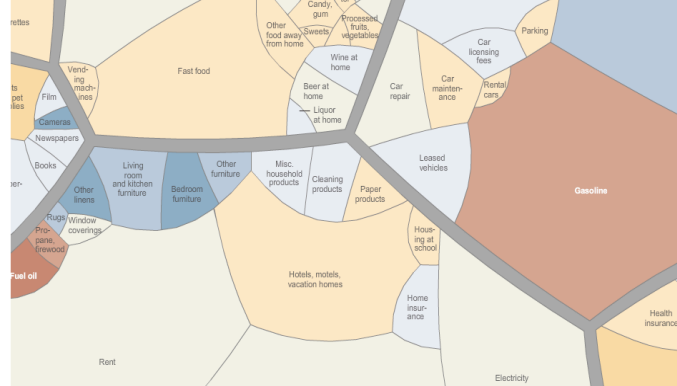
Animation

Lecture

Still Image

Video

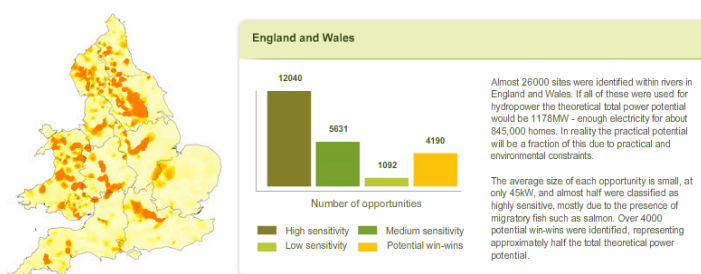
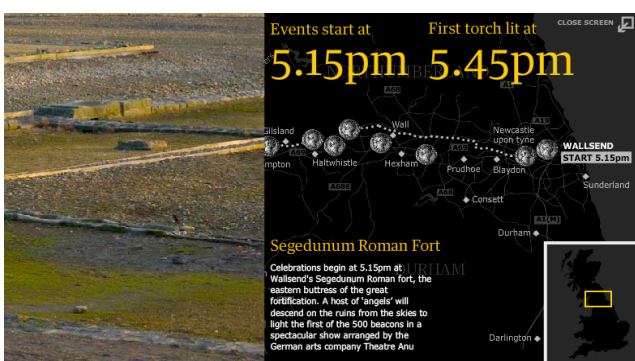
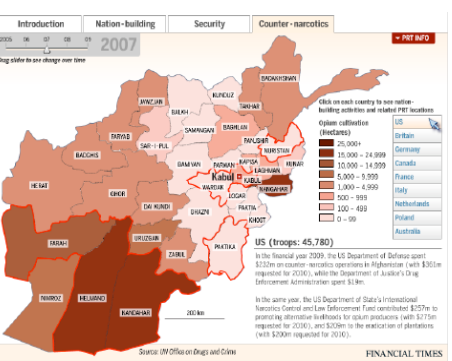
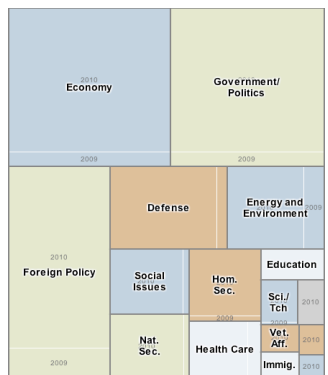
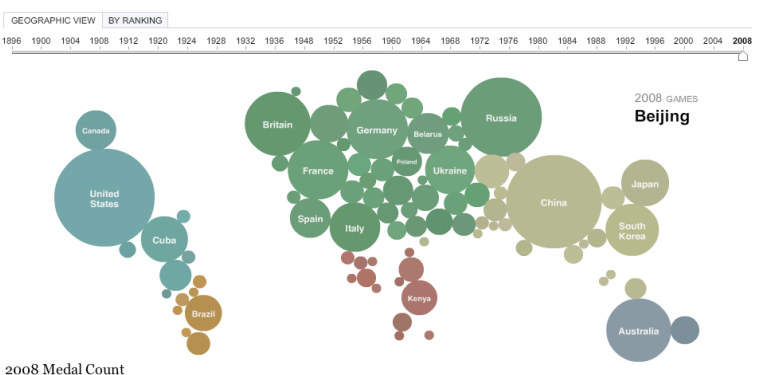
Narrative Visualization Design Space



58

CASE STUDIES

70% Journalism
20% Business
10% Research



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

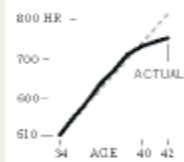
755
23 seasons
714
22 seasons
600
20 seasons
400
200
14th season

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

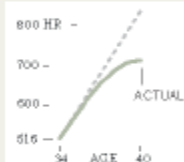
Homer Pace After Age 34

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.

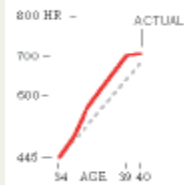
Aaron
Actual homers slightly outpace projected homers for five seasons.



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



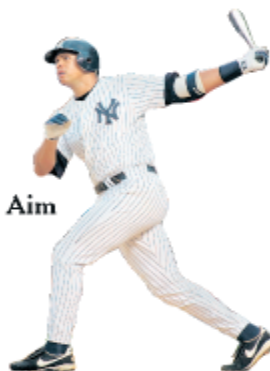
Bonds
From age 35 to 39, he averaged 14 more homers a season than projected.



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



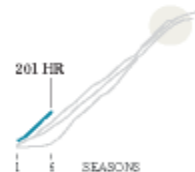
Alex Rodriguez

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



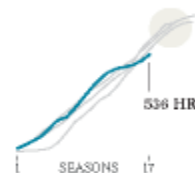
Albert Pujols

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



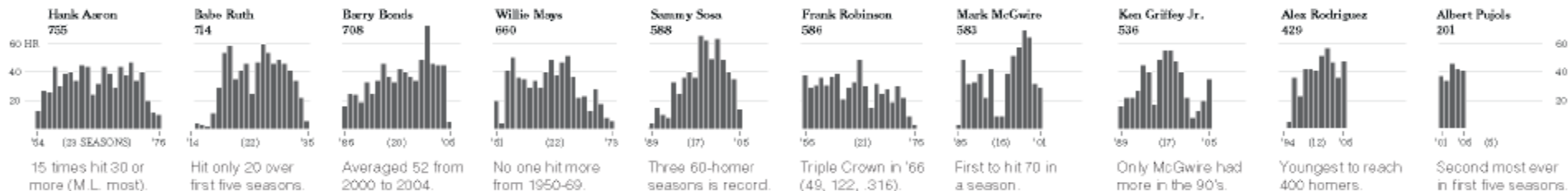
Ken Griffey Jr.

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
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.

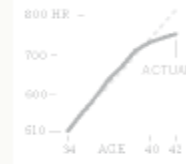
Homer Pace After Age 34

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

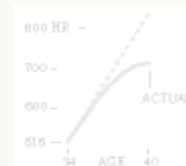
Aaron

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.



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.

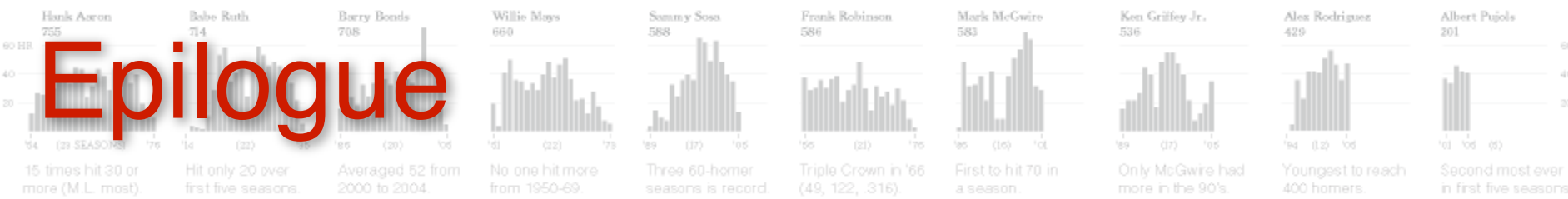
Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



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

Observed Narrative Devices

Visualization Description	Magazine Style	Visual Structuring	Highlighting	Transition Guidance	Ordering	Interactivity	Messaging
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	+	+	+	+	+	+	+
Why Did Your County's Jobs Disappear?	+	+	+	+	+	+	+
Academics: House Price Index	+	+	+	+	+	+	+
Bar chart: earnings: How compensation relates to performance	+	+	+	+	+	+	+
Deathly offensive: Taliban attacks in Pakistan	+	+	+	+	+	+	+
GDPI: 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 hypopower hotspots across the UK	+	+	+	+	+	+	+
Moscow 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: Bear Stearns Collapse 1996 - 2008	+	+	+	+	+	+	+
The jobless Rate for People Like Me	+	+	+	+	+	+	+
Advertisement: Bus	+	+	+	+	+	+	+
Advertisement: Helicopter	+	+	+	+	+	+	+
Analysing Obama's schedule	+	+	+	+	+	+	+
Oscar 2010: the top picture nominees	+	+	+	+	+	+	+
The consumer and retail spending in the UK	+	+	+	+	+	+	+
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	+	+	+	+	+	+	+
Online 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	+	+	+	+	+	+	+
McCormick's "Making Comics"	+	+	+	+	+	+	+
How the Government Dealt with Past Recessions	+	+	+	+	+	+	+
Afghanistan: Behind the front line	+	+	+	+	+	+	+
Toyota: a timeline: a company history	+	+	+	+	+	+	+
Gaps in Human Development	+	+	+	+	+	+	+
Earthquakes: why they happen	+	+	+	+	+	+	+
Iran's nuclear programme	+	+	+	+	+	+	+
Sharon 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's Airplane Safety Video	+	+	+	+	+	+	+
"The Story of Stuff"	+	+	+	+	+	+	+
Virgin America Airplane Safety Video	+	+	+	+	+	+	+

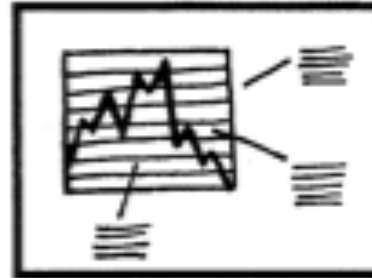
Case Studies

Visualization Description	Magazine Style	Visual Structuring	Highlighting	Transition Guidance	Ordering	Interactivity	Messaging
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McCormick's "Making Comics"	+	+	+	+	+	+	+
How the Government Dealt with Past Recessions	+	+	+	+	+	+	+
Afghanistan: Behind the front line	+	+	+	+	+	+	+
Toyota: a timeline: a company history	+	+	+	+	+	+	+
Gaps in Human Development	+	+	+	+	+	+	+
Earthquakes: why they happen	+	+	+	+	+	+	+
Iran's nuclear programme	+	+	+	+	+	+	+
Sharon 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's Airplane Safety Video	+	+	+	+	+	+	+
"The Story of Stuff"	+	+	+	+	+	+	+
Virgin America Airplane Safety Video	+	+	+	+	+	+	+

Seven Genres



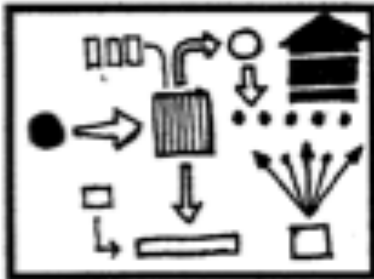
Magazine Style



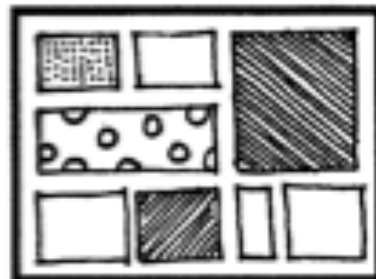
Annotated Chart



Partitioned Poster



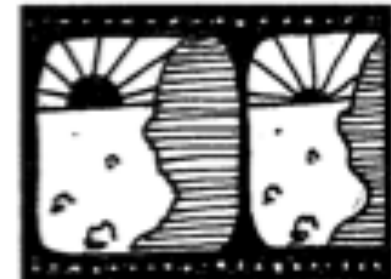
Flow Chart



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

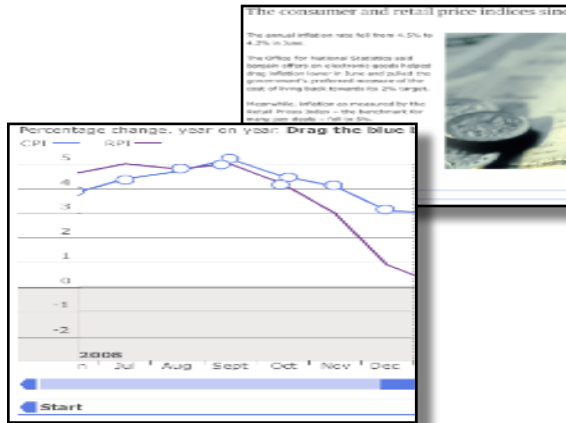
Reader Driven

weak ordering
light messaging
free interactivity

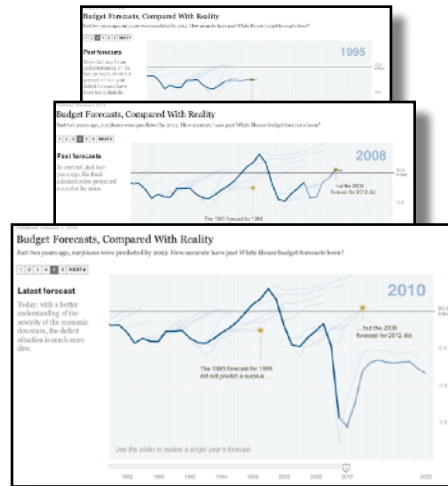
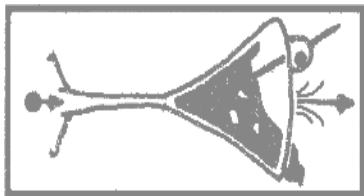
ASK QUESTIONS

EXPLORE

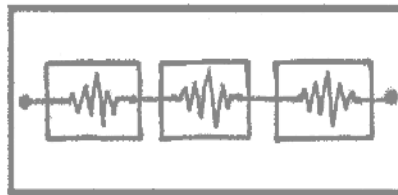
FIND



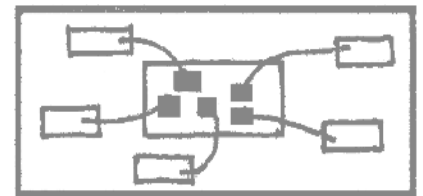
martini glass



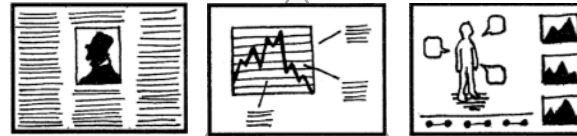
interactive slideshow



drill-down story



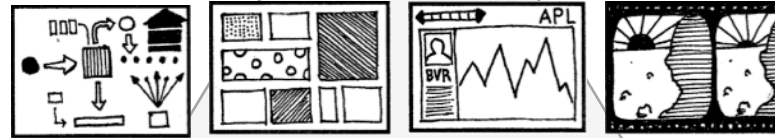
Visual Design



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

When Could the United States | X +

https://www.nytimes.com/interactive/2021/02/20/us/us-herd-immunity-covid.html

The New York Times

PLAY THE CROSSWORD Account

The Coronavirus Outbreak > | LIVE Latest Updates New | Maps and Cases | Vaccine Rollout | Outdoor Mask Guidance | Vaccines and Virus Variants

When Could the United States Reach Herd Immunity? It's Complicated.

By Matthew Conlen and Charlie Smart Feb. 20, 2021

With the [vaccine rollout](#) underway and [coronavirus cases](#) declining after a dark winter surge, it may seem as though the end of the pandemic is in sight. In reality, how soon could we get there?

One answer lies in herd immunity, the point when enough people are immune to the virus that it can no longer spread through the population. Getting there, however, depends not just on how quickly we can vaccinate but on other factors, too, like how many people have already been infected and how easily the virus spreads.

An estimate for the path to herd immunity

100% of population immune

80%

Herd immunity range

When Could the United States Reach Herd Immunity? It's Complicated.
Conlen & Smart, New York Times 2021

Motivation

- More engaged audience
Greussing & Boomgarden, *Digital Journalism 2019*
- Better learning outcomes
Mayer's Multimedia Principles, 2005
- Promote active reading
Bret Victor's "Explorable Explanations", 2011
- Transparency in journalism
"A sense of the tentativeness of truth."
- Philip Meyer, *Precision Journalism*, 2002

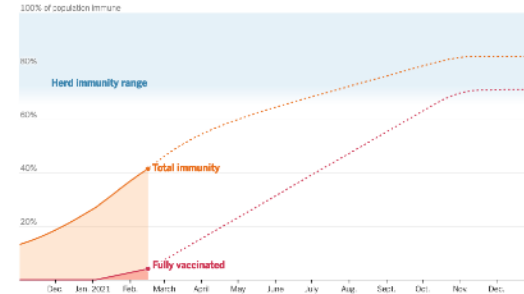
Herd Immunity? It's Complicated.

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This chart shows the current path to herd immunity in the United States, based on a model developed by [PHICOR](#), a public health research group. It looks at the number of people who have been **fully vaccinated** and combines that with an estimate of the number of people who have been infected and have recovered to measure **total immunity**.

When the orange line crosses into the blue area, that means we have entered the **herd immunity range**. The exact threshold for herd immunity for the coronavirus is unknown, but recent estimates range from 70 percent to 90 percent.

At first, this looks like pretty good news — under these assumptions, we could reach herd immunity as early as July. But a lot could happen between now and then. The speed and uptake of vaccination, and how long immunity lasts are big factors. The rise of new virus variants and how we respond to them will also affect the path to herd immunity.

In most scenarios, millions more people will become infected and tens or hundreds of thousands more will die before herd immunity is reached.

What if we speed up vaccinations?

More than 15 million people have been fully vaccinated, and the U.S. is currently administering about 1.7 million shots per day. Some experts say we could nearly **double that pace** by April as new vaccines are approved. (Because the current vaccines require two doses spaced weeks apart, the number of people fully vaccinated each day is smaller.)

The more people we vaccinate, the faster we could reach the threshold for herd immunity.



Challenges

- Integration between text and media
- Data-driven
- Computation
- Interactivity
- Multiple output targets (desktop, mobile, homepage, print, social)
- Many people working together
 - two authors, multiple editors, designers, researchers, interviewees

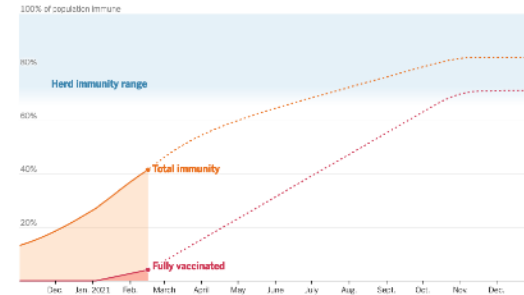
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The more people we vaccinate, the faster we could reach the threshold for herd immunity.

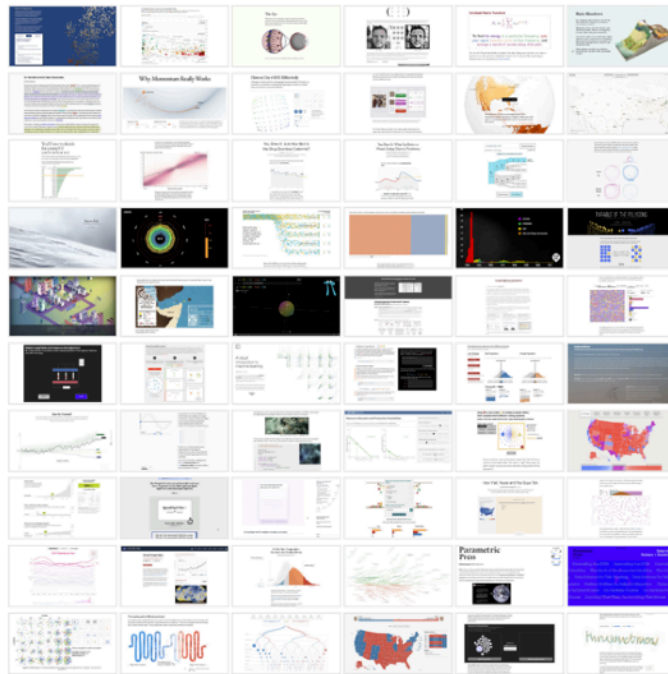


If the pace immediately increases to 3 million shots per day, we could reach the herd immunity threshold by **May**. In that time, **90,000** people could die from the virus.



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

Tied together research from HCI, multimedia learning, infovis, digital journalism

Hohman, Conlen, Heer, Chau, Distill, 2020

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60+ Interactive Articles
NYTimes, WaPost

Distill, VisXAI

+more




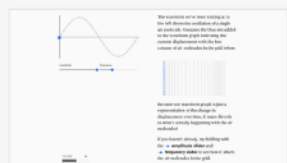

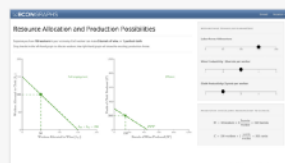
Areas of Application

Research Dissemination

Journalism

Education

Policy & Decision Making

		
<p>Attacking Discrimination with Smarter Machine Learning [13]</p> <p>A companion piece to a traditional research paper that uses interactive visualizations to let readers adjust a machine learning model's behavior and explore alternative fair strategies for a loan granting scenario.</p>	<p>Coefficients: Context-aware Programming Languages [14]</p> <p>A PhD thesis that contributes a programming language abstraction for understanding how programs access the context or environment in which they execute, and walks readers through the work using two simple context-aware languages with live in-browser demos.</p>	<p>What is Complexity Science? [16]</p> <p>A crash course in complex systems science, created by leading experts, practitioners, and students in the field, with accompanying interactive sandboxes to simulate, control, and visualize different complex systems.</p>
		
<p>Let's Learn About Waveforms [19]</p> <p>An interactive guide that introduces and explores waveforms without requiring prior knowledge. The article lets readers play with different waveforms using sound to understand their basic physics and relationship to music and harmony.</p>	<p>The Book of Shaders [20]</p> <p>A step-by-step guide that walks a reader through the notoriously challenging topic of computer graphics fragment shaders using interactive code examples.</p>	<p>EconGraphs [21]</p> <p>While most interactive textbooks are about mathematics, this collection of key concepts from economics using interactive visualization to help econ teachers illustrate important underlying relationships within economic models.</p>

Communicating with Interactive Articles

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60+ Interactive Articles

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+more

Connecting People and Data.

Make data pleasant to work with. Happy readers are engaged readers.

Making Systems Playful.

Run interactive simulations directly in the browser. No setup required.

Prompting Self-Reflection.

Help readers learn by asking them to reflect in a low pressure environment.

Personalizing Reading.

Let readers choose the content that is relevant to their own experience.

Reducing Cognitive Load.

Use effective representations to make complex topics more intuitive.

Five affordances of the format

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

Making systems playful

Promoting self reflection

Personalizing reading

Reducing cognitive load

Connecting
People and Data.

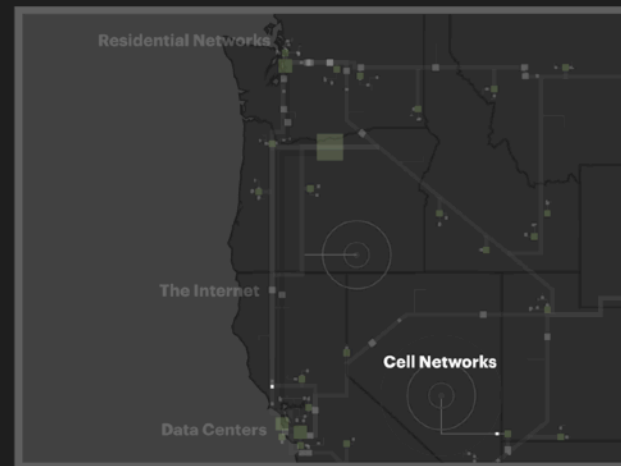
Make data
pleasant to work
with. Happy
readers are
engaged readers.

Parametric Press
The Climate Issue



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

5 AFFORDANCES OF THE FORMAT

Connecting people and data

Making systems playful

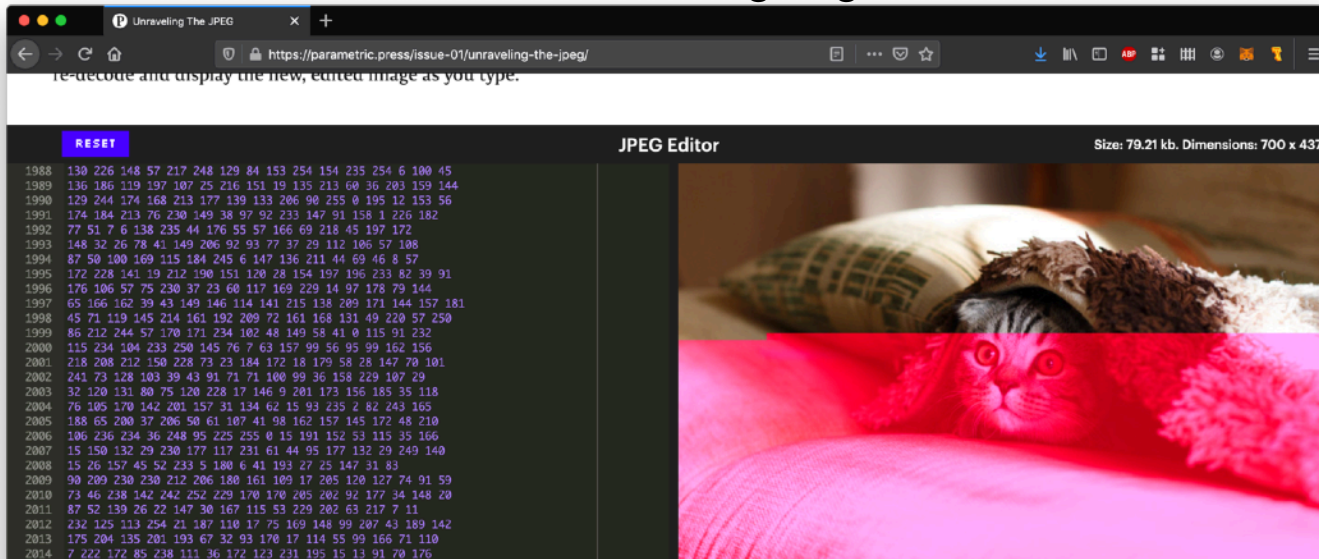
Promoting self reflection

Personalizing reading

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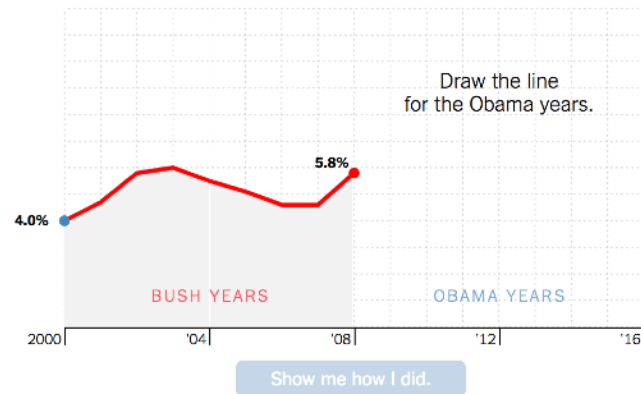
Reducing cognitive load

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** ...



Prompting Self-Reflection.

Help readers learn by asking them to reflect in a low pressure environment.

5 AFFORDANCES OF THE FORMAT

Connecting people and data

Making systems playful

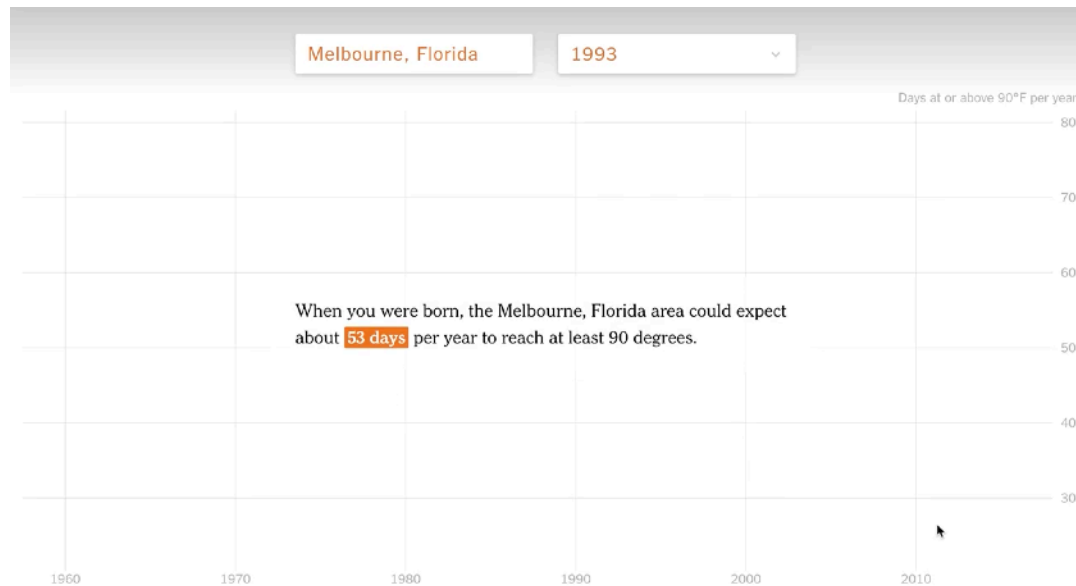
Promoting self reflection

Personalizing reading

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Personalizing reading

Reducing cognitive load

Reducing Cognitive Load.

Use effective representations to make complex topics more intuitive.

5 AFFORDANCES OF THE FORMAT

Explorable explanation

From Wikipedia, the free encyclopedia

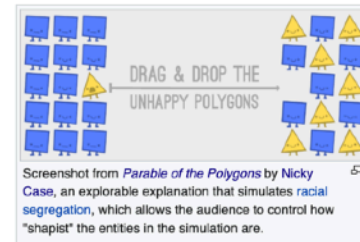
An **explorable explanation** (often shortened to *explorable*) is a form of informative media where an [interactive computer simulation](#) of a given concept is presented, along with some form of guidance. Explorable explanations encourage users to discover how a system can [learn](#) from the simulation. Explorable explanations encourage users to discover how their expectations of its behaviour against its actual behaviour, promoting a more [active](#)

Contents [hide]

- 1 Definition
- 2 History
- 3 Subject matter
- 4 Use in media
- 5 Structure
- 6 See also
- 7 References
- 8 External links



A **simulation** is the imitation of the operation of a real-world process or system over time. Simulations require the use of models; the model represents the key characteristics or behaviors of the selected system or process, whereas the simulation represents the evolution of the model over time. Often,



Screenshot from *Parable of the Polygons* by Nicky Case, an explorable explanation that simulates racial segregation, which allows the audience to control how "shapist" the entities in the simulation are.

Definition [edit]

The term "explorable explanation" was first used in passing by [essay](#)^[2] (the essay included an explorable explanation of a [dig](#)) deliberately guide the attention of their audience towards partic

er into common use until 2011, when [Bret Victor](#) published an eponymous [ss](#) from isolated interactive widgets and visualizations by the fact that they [ing](#) the concept, Victor explains:^[2]

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

Some of the ideas Victor espoused in the essay occurred to him while during work with [AI Gore](#) on the app version of the 2009 book [Our Choice](#).^[3] He had proposed that the app should contain interactive models, but this idea was rejected on the basis that all numerical values proposed regarding climate change needed to have a citation, and the interactive models would generate uncited numbers.^[4]

The term has since also been characterized as being about learning through play^[5] The related term "active essays" was used by [Alan Kay](#) to refer to text-based explorable explanations^[6] and a

Connecting people and data

Making systems playful

Promoting self reflection

Personalizing reading

5 AFFORDANCES OF THE FORMAT

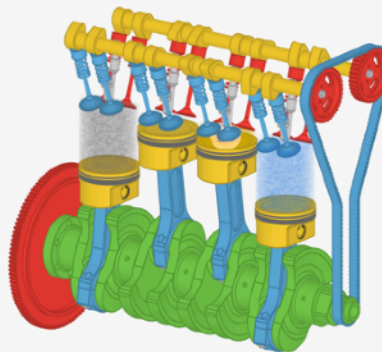
Reducing cognitive load

**Reducing
Cognitive Load.**

Use effective
representations
to make complex
topics more
intuitive.

Internal Combustion Engine

The invention of the [internal combustion engine](#) in the 19th century has revolutionized transportation over land, water, and air. Despite their omnipresence in modern day, the operation of an engine may be cryptic. Over the course of this article I'd like to explain the functionality of all the basic engine parts shown in the demonstration below. You can drag it around to see it from other angles:



5 AFFORDANCES OF THE FORMAT

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Making systems playful

Promoting self reflection

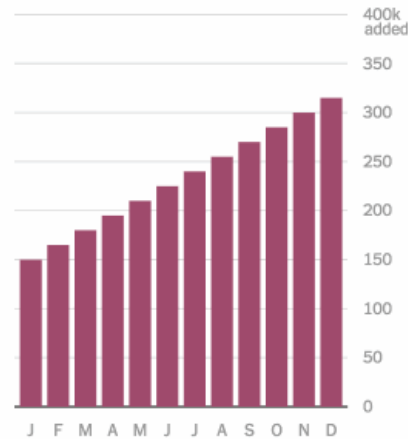
Personalizing reading

Reducing cognitive load

Reducing Cognitive Load.

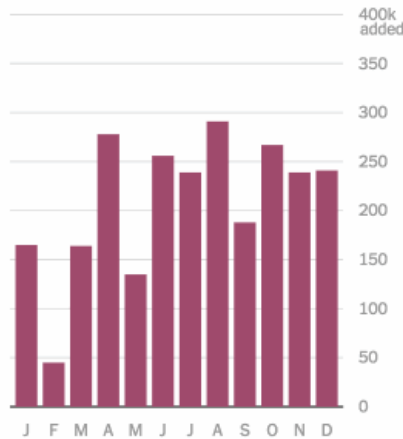
Use effective representations to make complex topics more intuitive.

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



...the jobs report
could look like this:

Pause



CHALLENGES Turned a writing task into a web development task

Breadth of skills required

Multiple output targets

Accessibility

Misaligned Incentives

Hard to evaluate success

CHALLENGES Turned a writing task into a web development task
Breadth of skills required
Multiple output targets
Accessibility
Misaligned Incentives
Hard to evaluate success

OPPORTUNITIES

	Research	Practice
Authoring	Next generation tooling	Evaluate in production setting, identify bugs
Designing	Developing theory, conducting laboratory studies	Evaluate specific design decisions in the wild, understand constraints
Publishing	Tools, guidelines, and best practices	Concrete examples for others to follow, available source code, accessible archives, DOI, branding

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.

48

Conlen & Heer, *UIST*, 2018

Text + Parameterized Visuals

Write articles in markdown.

Connect reactive variables to user input widgets to add interactivity.

Text + Parameterized Visuals

Write articles in markdown.

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" /].

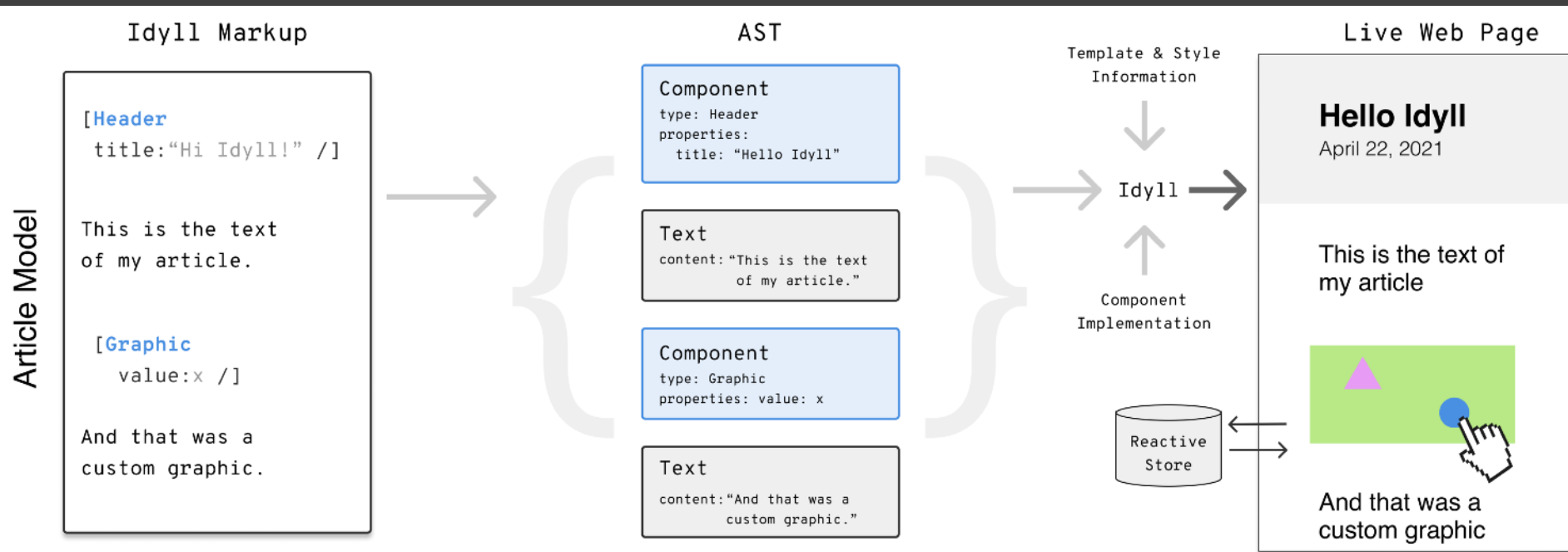
[Range value:x min:0 max:10 /]
```

Hello World

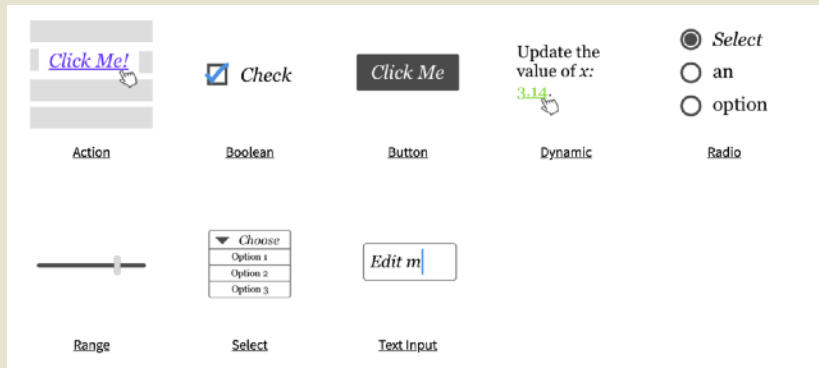
The value of x is 5.



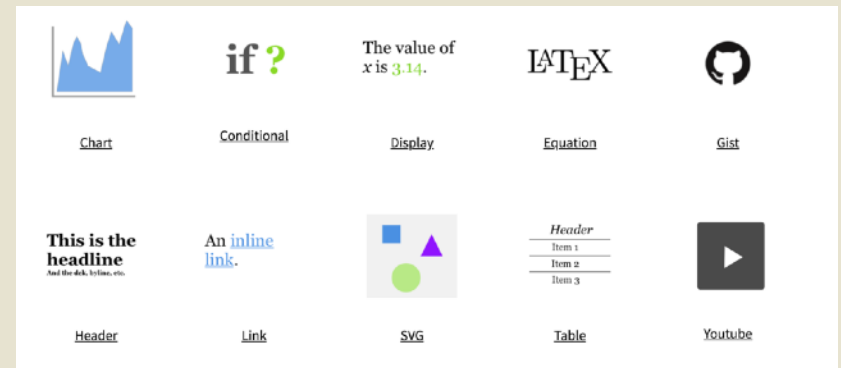
A Model of Interactive Articles



28 Built-in Components



Input



Presentation



Layout



Helpers

Bring your own graphics

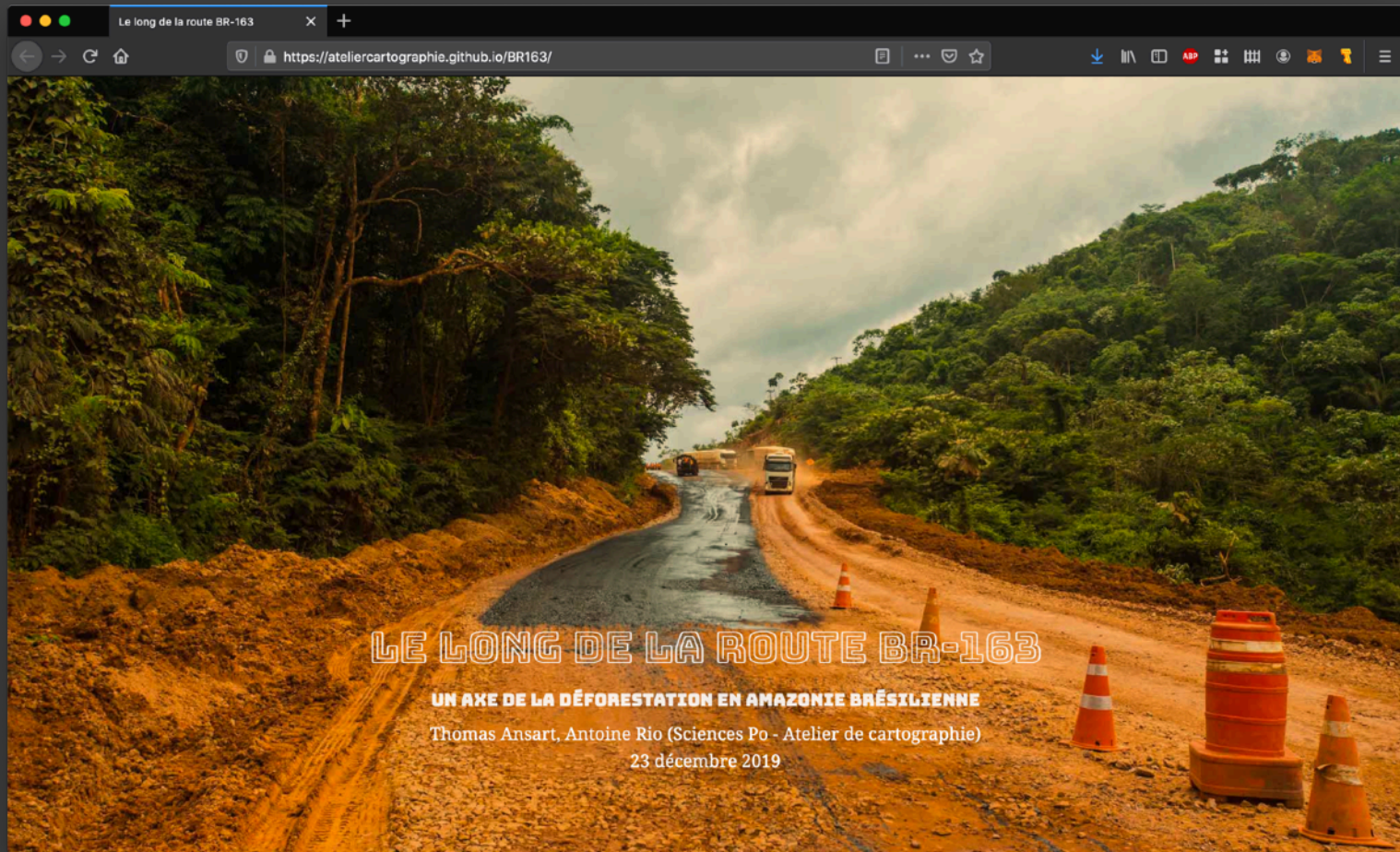
A JavaScript component API is exposed to end users.

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



Exemples

Le long de la route BR-163



Examples

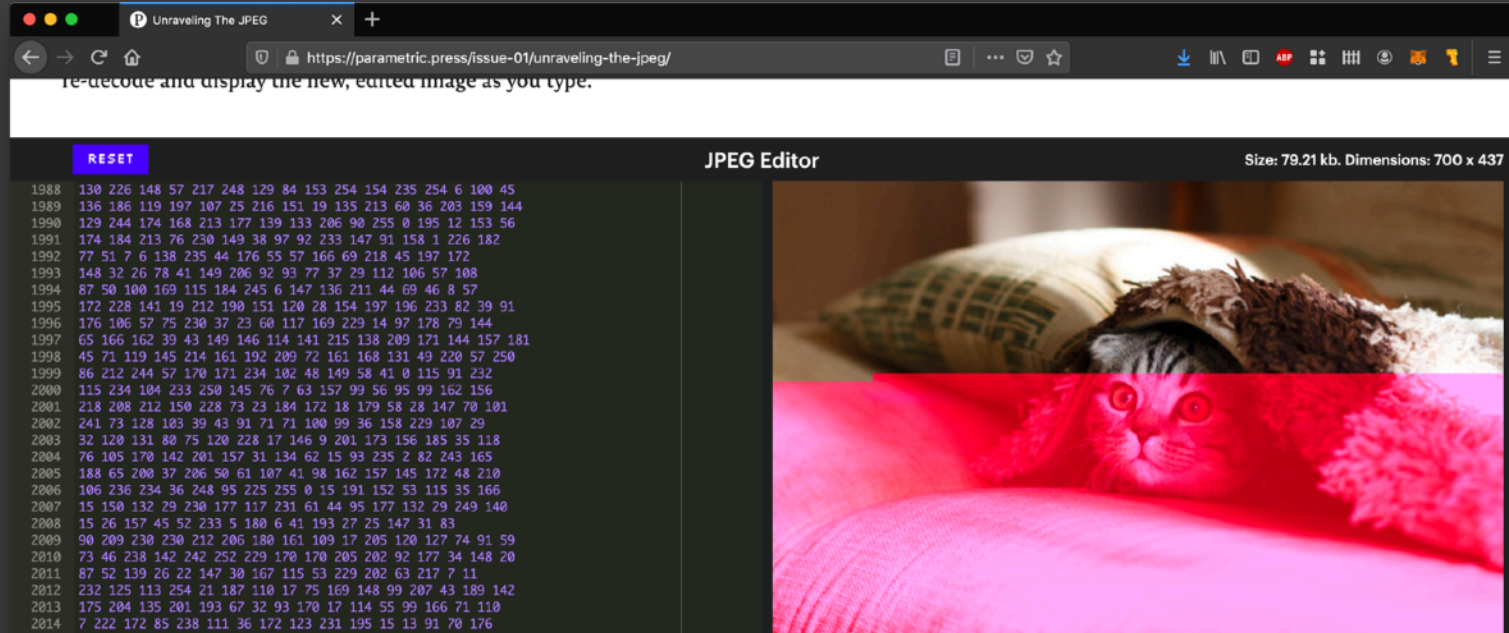
Unraveling the JPEG

re-encode and display the new, edited image as you type.

RESET

JPEG Editor Size: 79.21 kb. Dimensions: 700 x 437

```
1988 130 226 148 57 217 248 129 84 153 254 154 235 254 6 100 45
1989 136 186 119 197 107 25 216 151 19 135 213 60 36 203 159 144
1990 129 244 174 168 213 177 139 133 206 90 255 0 195 12 153 56
1991 174 184 213 76 230 149 38 97 92 233 147 91 158 1 226 182
1992 77 51 7 6 138 235 44 176 55 57 166 69 218 45 197 172
1993 148 32 26 78 41 149 206 92 93 77 37 29 112 106 57 108
1994 87 50 100 169 115 184 245 6 147 136 211 44 69 46 8 57
1995 172 228 141 19 212 190 151 120 28 154 197 196 233 82 39 91
1996 176 106 57 75 230 37 23 60 117 169 229 14 97 178 79 144
1997 65 166 162 39 43 149 146 114 141 215 138 209 171 144 157 181
1998 45 71 119 145 214 161 192 209 72 161 168 131 49 220 57 250
1999 86 212 244 57 170 171 234 102 48 149 58 41 0 115 91 232
2000 115 234 104 233 250 145 76 7 63 157 99 56 95 99 162 156
2001 218 208 212 150 228 73 23 184 172 18 179 58 28 147 70 101
2002 241 73 128 103 39 43 91 71 71 100 99 36 158 229 107 29
2003 32 120 131 80 75 120 228 17 146 9 201 173 156 185 35 118
2004 76 105 170 142 201 157 31 134 62 15 93 235 2 82 243 165
2005 188 65 200 37 206 50 61 107 41 98 162 157 145 172 48 210
2006 106 236 234 36 248 95 225 255 0 15 191 152 53 115 35 166
2007 15 150 132 29 230 177 117 231 61 44 95 177 132 29 249 140
2008 15 26 157 45 52 233 5 180 6 41 193 27 25 147 31 83
2009 90 209 230 230 212 206 180 161 109 17 205 120 127 74 91 59
2010 73 46 238 142 242 252 229 170 170 205 202 92 177 34 148 20
2011 87 52 139 26 22 147 30 167 115 53 229 202 63 217 7 11
2012 232 125 113 254 21 187 110 17 75 169 148 99 207 43 189 142
2013 175 204 135 201 193 67 32 93 170 17 114 55 99 166 71 110
2014 7 222 172 85 238 111 36 172 123 231 195 15 13 91 70 176
```



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Examples

idyll-lang.org/gallery

The screenshot shows a web browser window with the URL <https://idyll-lang.org/gallery>. The page features the idyll logo and navigation links for Docs, Tutorials, Gallery, and Editor. The main content is titled "Explorable explanations and interactive articles" and displays a grid of interactive examples:

- Future of the Oxford Cambridge Arc**: An interactive article about urban development modelling, featuring a map of the region.
- What's an IP address?**: An interactive article explaining IP address allocation, featuring a grid of toggle switches and the equation $2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0 = 168$.
- The Barnes-Hut Approximation**: An interactive article about efficient computation of N-body forces, featuring a network diagram.
- Card Game**: A 5-card stud game interface showing a hand of K♥, 4♥, A♦, J♣, 10♥, 10♠, 3♠, 7♣, K♦, A♥, 9♦, 7♥, 8♠, 2♣.
- Neural Network**: A diagram illustrating a neural network structure.
- Line Graph**: A line graph with a blue curve and a vertical axis of data points.

Usage

Open-source release

Pilot Studies

Usage in the wild

UK Infrastructure Transitions Research Consortium

Minneapolis Star Tribune

Vis courses in universities (UMD, UIUC, UW, CMU, ...)

Teaching materials (CU Denver, UBC)

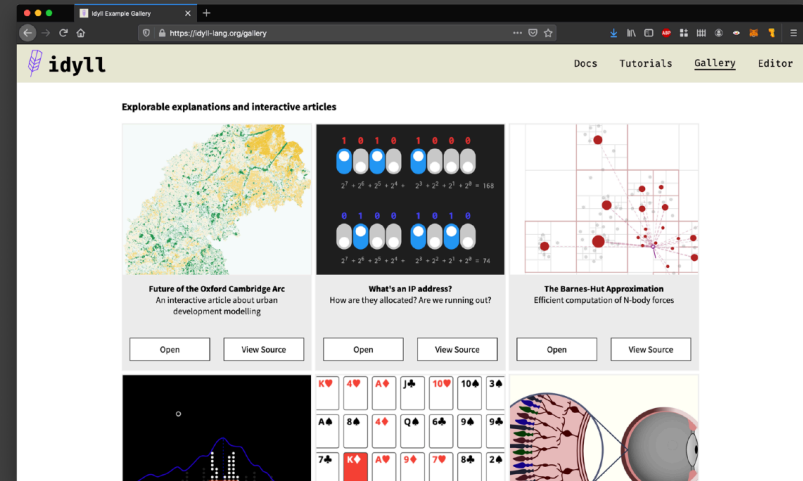
IEEE VisXAI

Texas2036

Recurse Center

Parametric Press - featured in FastCo Design

...and more!



Idvll...

Seems great but...

...still requires learning and writing markup syntax

...requires use of general-purpose programming tools, e.g. to make a new post, run development server

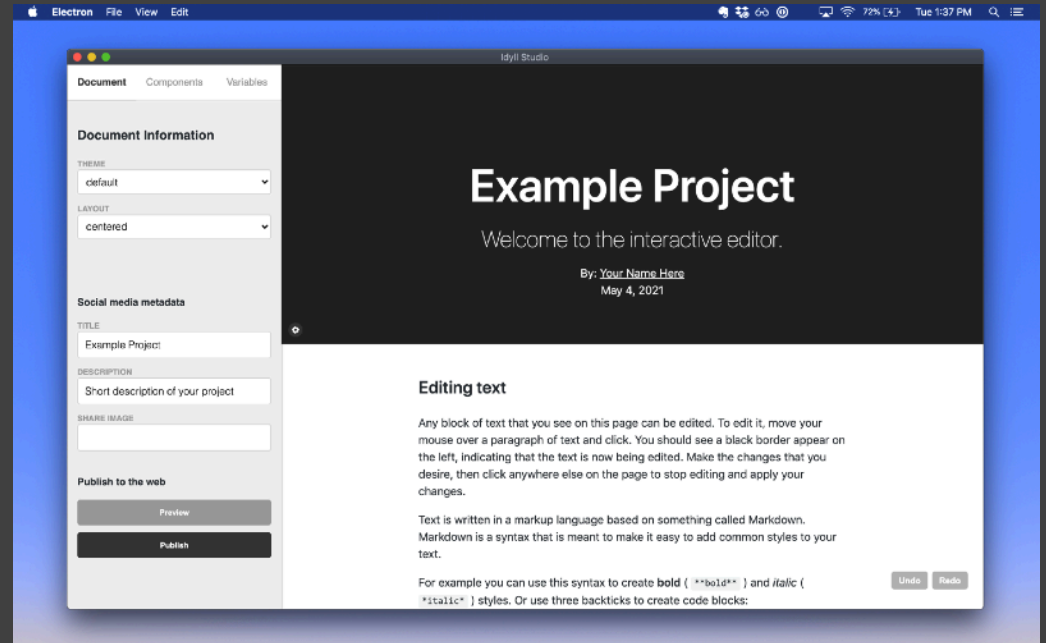
Idyll Studio

Built a **structured editor** for editing and creating Idyll programs

Reduce use of general-purpose programming tools.

Eliminate syntax errors.

Reify Idyll model.



Idyll Studio - Demo

The screenshot shows the Idyll Studio application running in an Electron window. The interface is split into two main sections: a left sidebar for document configuration and a main preview area.

Left Sidebar (Configuration):

- Document Information:** Includes dropdown menus for 'THEME' (set to 'default') and 'LAYOUT' (set to 'centered').
- Social media metadata:** Includes input fields for 'TITLE' (containing 'UIST Demo Video') and 'DESCRIPTION' (containing 'Introducing the structured editor.'). There is also a 'SHARE IMAGE' field.
- Publish to the web:** Contains 'Preview' and 'Publish' buttons.

Main Preview Area:

- Header: 'Idyll Studio Demo' with the subtitle 'Introducing UIST to the structured editor.'
- Section: 'Editing text' with a text input field containing 'Text can be e|'.
- Equation: A mathematical formula $y = mx + b$ is displayed.
- Text: A paragraph explaining that text is written in a markup language based on Markdown, used for adding styles like bold and italic.
- Code Block: A light blue box contains a list of items: '* lists', '* of', '* items,'.
- Footer: 'Undo' and 'Redo' buttons.

Thanks!

Feel free to reach out:
mconlen@uw.edu

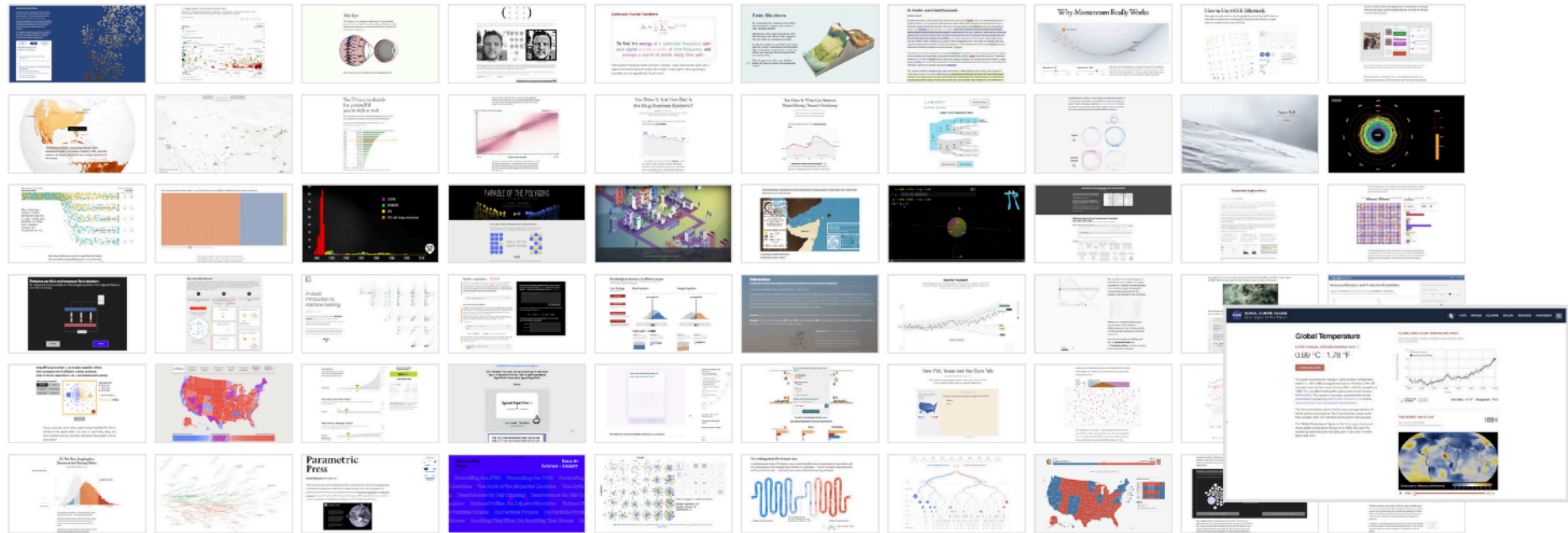


FIGURE 1: "Global Temperature." NASA. NASA Global Climate Change, 2020.

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