

VISUAL EXPLAINERS

CS 448B | Fall 2023

MANEESH AGRAWALA

1

The New York Times PLAY THE CROSSWORD 1000



See How the Dixie Fire Created Its Own Weather

This year's largest blaze generated powerful storm clouds. We show you in 3-D.

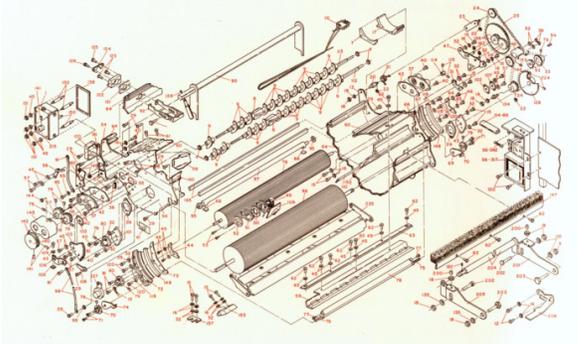
By Nadja Popovich, Noah Pisner, Nicholas Bartzokas, Evan Grothjan,
Daniel Mangosing, Karthik Pitarjalli and Scott Reinhard
Oct. 20, 2021

2

READING RESPONSE: QUESTIONS/THOUGHTS

The reading on **layering and separation was likewise interesting**, ... there was an example, in which vertical box and whisker plots were minimized to vertical lines and dots that represented the averages. While I agree that this reduces the noise in the plot, it makes comparing the plots much harder. ... **where should we draw the line between reducing noise and oversimplifying a visualization?**

... a question that I have is: **would drawing a diagram or map in 3D be another effective way to layer information?** I imagine that the extra layer of depth and perspective can enhance the sense of relation between multiple objects. If so, is modeling a visualization in 3D feasible?

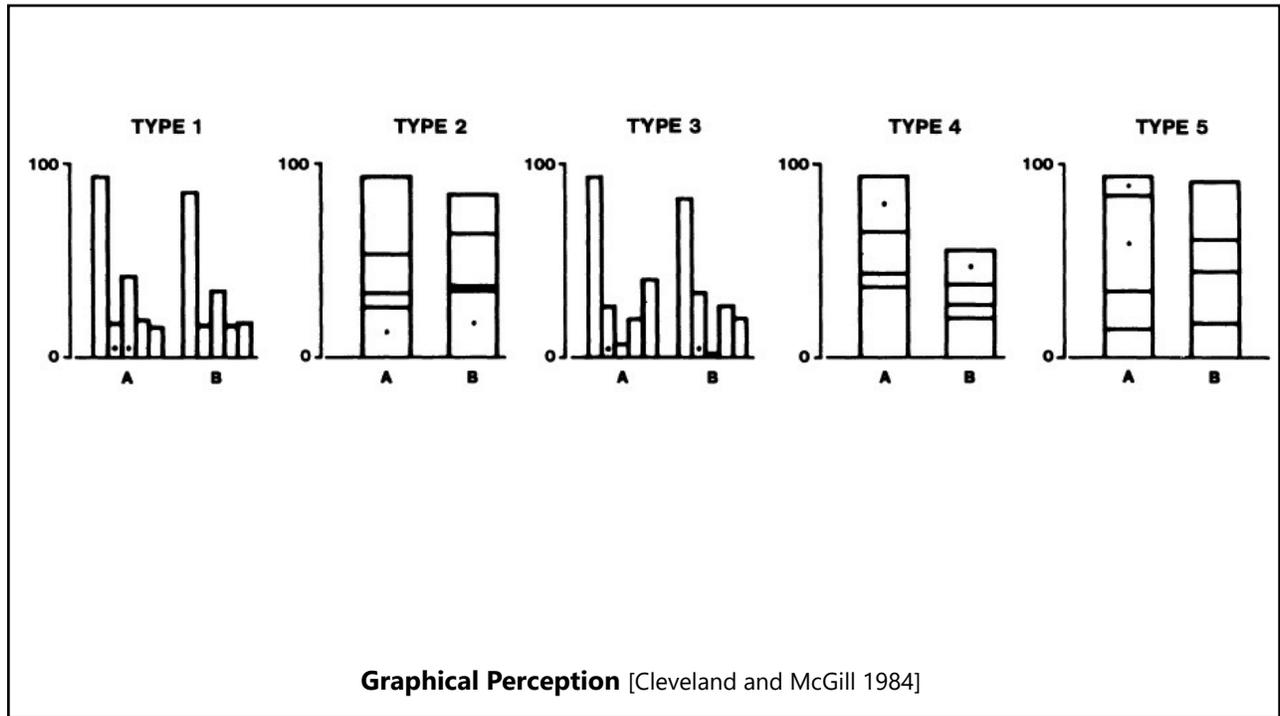


[Tufté 1990]

4

**LAST TIME:
PERCEPTION**

5



6



7

GESTALT PRINCIPLES

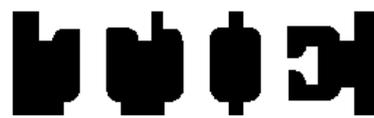
figure/ground
 proximity
 similarity
 symmetry
 connectedness
 continuity
 closure
 common fate
 transparency

8

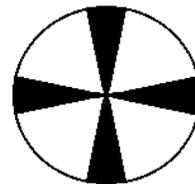
FIGURE/GROUND



Ambiguous



Principle of surroundedness



Principle of relative size

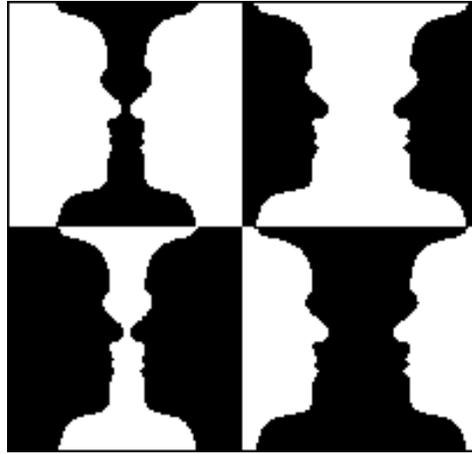
<http://www.aber.ac.uk/media/Modules/MC10220/visper06.html>

9

FIGURE/GROUND



Ambiguous

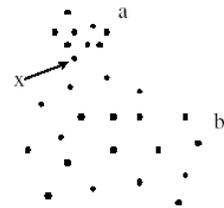
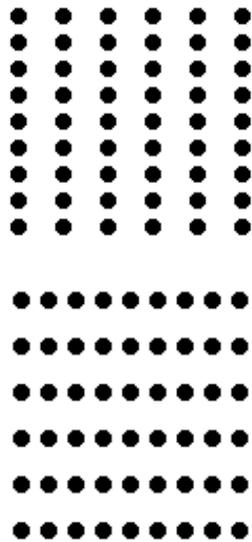


Unambiguous

<http://www.aber.ac.uk/media/Modules/MC10220/visper06.html>

10

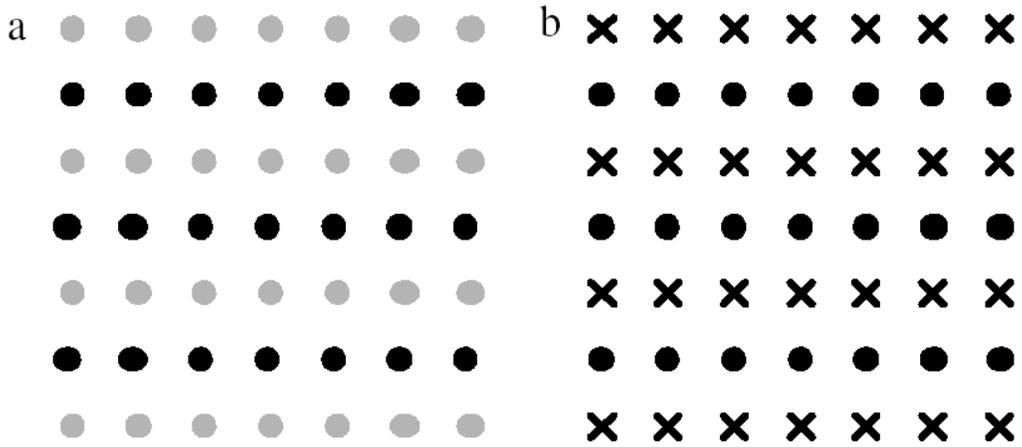
PROXIMITY



[Ware 2000]

11

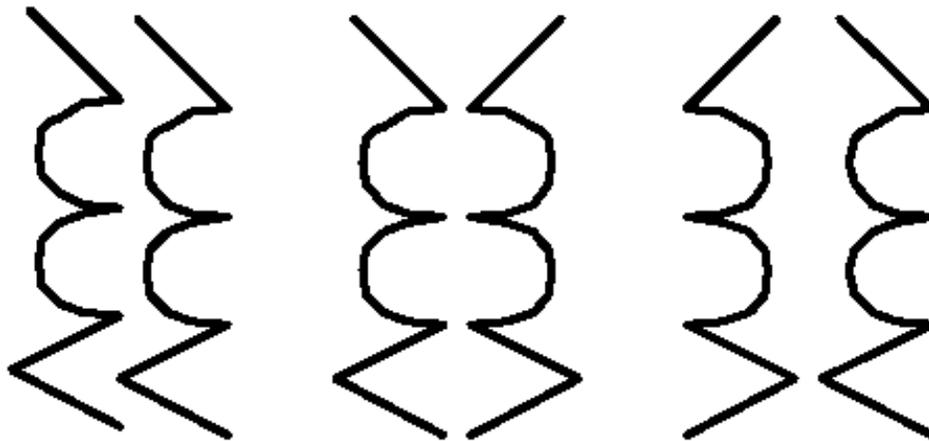
SIMILARITY



Rows dominate due to similarity [Ware 2004]

12

SYMMETRY

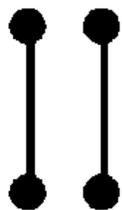


Bilateral symmetry gives strong sense of figure [Ware 2004]

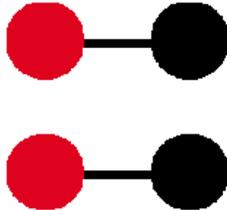
13

CONNECTEDNESS

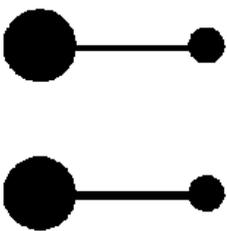
a



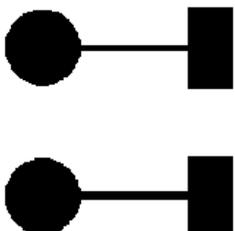
b



c



d

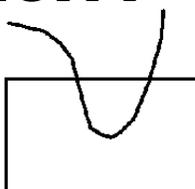


Connectedness overrules proximity, size, color shape [Ware 2004]

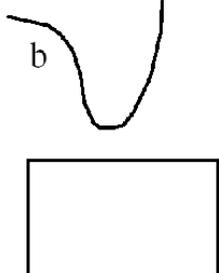
14

CONTINUITY

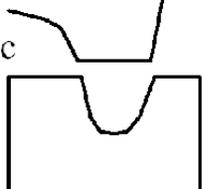
a



b

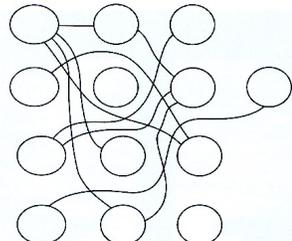


c

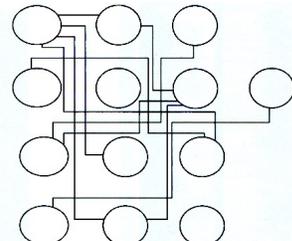


We prefer smooth not abrupt changes [Ware 2004]

a



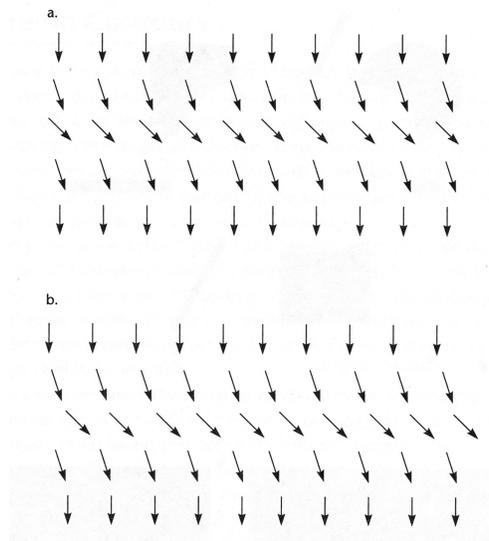
b



Connections are clearer with smooth contours [Ware 2004]

15

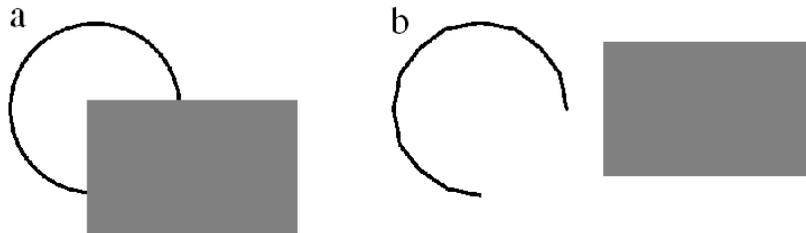
CONTINUITY: VECTOR FIELDS



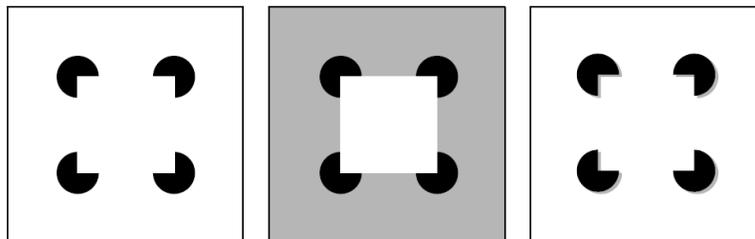
Prefer field that shows smooth continuous contours [Ware 2004]

16

CLOSURE



We see a circle behind a rectangle, not a broken circle [Ware 2004]



Illusory contours [from Durand 2002]

17

COMMON FATE



Dots moving together are grouped

<http://coe.sdsu.edu/eet/articles/visualperc1/start.htm>

18

TRANSPARENCY

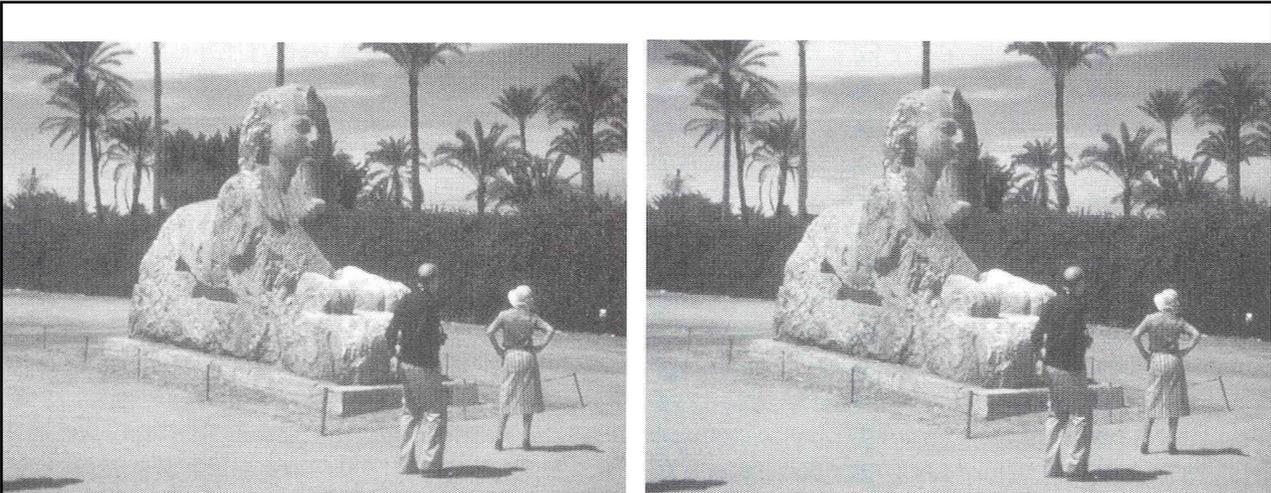


Requires continuity and proper color correspondence [Ware 2004]

19

CHANGE BLINDNESS

20



Example from Palmer 1999, originally due to Rock

21



22



23

RENSINK'S DEMONSTRATIONS



<https://www.csc2.ncsu.edu/faculty/healey/PP/>

24

SUMMARY

Choosing effective visual encodings requires knowledge of visual perception

Visual features/attributes

Individual attributes often preattentive

Multiple attributes may be separable, often integral

Gestalt principles provide higher level design guidelines

We don't always see everything that is there

25

ANNOUNCEMENTS

26

ASSIGNMENT 3: INTERACTION

Due Today

Create a small interactive dynamic query application similar to HomeFinder, but for local software companies data.

1. Implement interface
2. Submit the application as a website and a short write-up on canvas

Can work alone or in pairs



27

FINAL PROJECT

Proposal due 11/6 11:30am

Data analysis/explainer

Analyze dataset in depth & make a visual explainer

Deliverables

An article with multiple different interactive visualizations
Short video (2 min) demoing and explaining the project

Schedule

Project proposal: **Mon 11/6**
Design Review and Feedback: **9th week of quarter**
Final code and video: **Sun 12/10 8pm**

Grading

Groups of up to 3 people, graded individually
Clearly report responsibilities of each member

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TODAY

Learning Objectives

1. How stories are constructed in journalism and especially with data.
2. Using interactivity and sequencing to visually convey narrative.

29



30

ALL MEDIA TELL STORIES

- PEOPLE** TELL STORIES
- WORDS** TELL STORIES
- IMAGES** TELL STORIES
- COMICS** TELL STORIES
- MOVIES** TELL STORIES
- VISUALIZATIONS** TELL STORIES

32

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

"... require[s] skills like those familiar to movie directors, beyond a technical expert's knowledge of computer engineering and science."

- Gershon & Page '01

33

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.

34

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Anecdotal Lead (1st paragraph called Lede)

35

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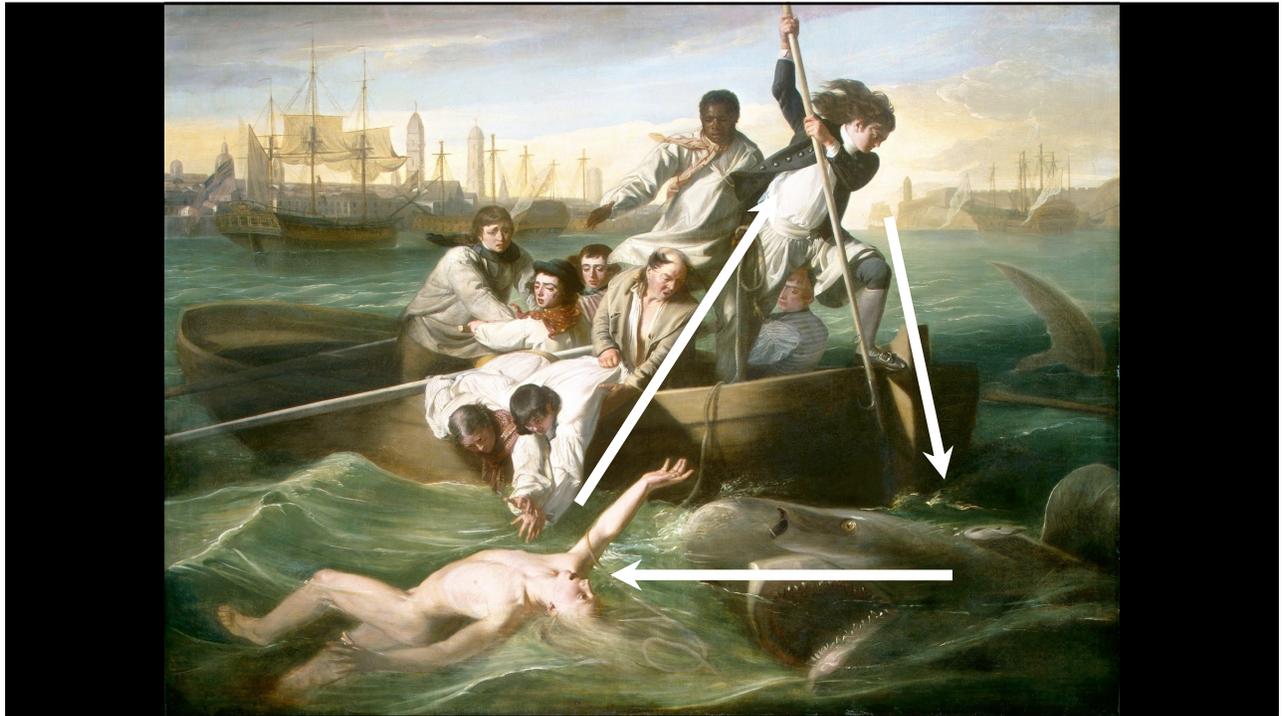
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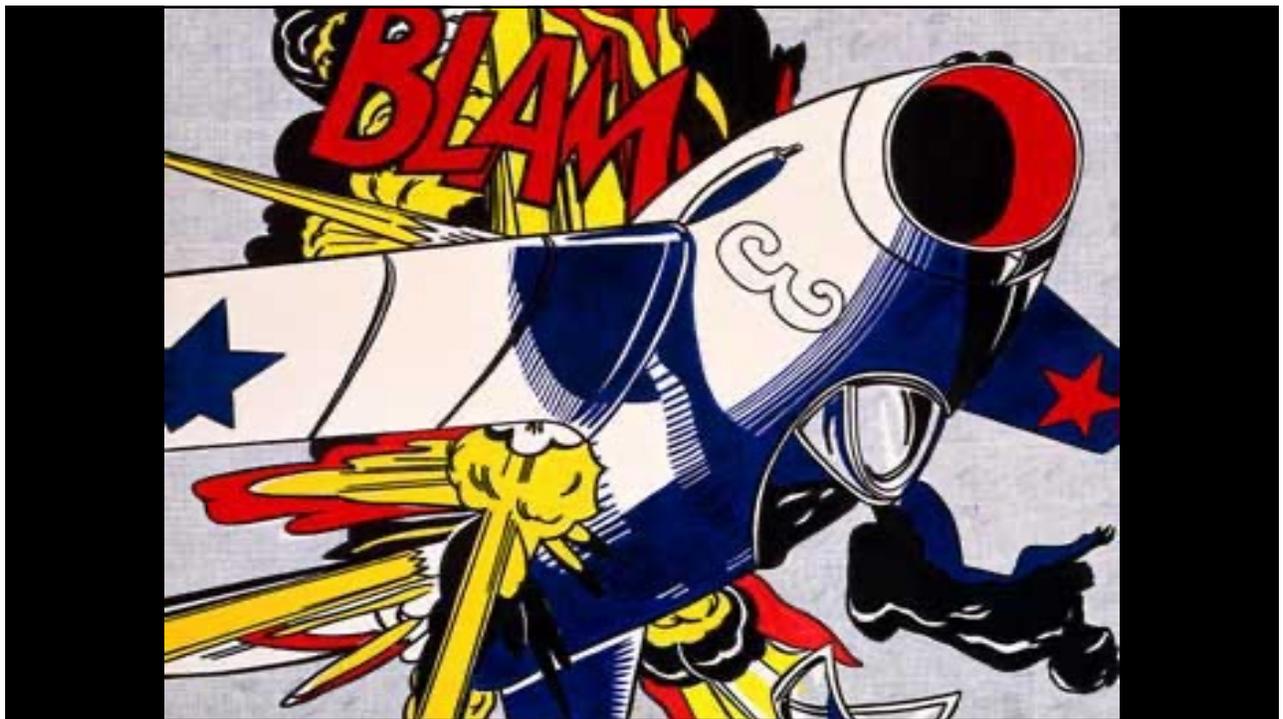
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Nut Graph

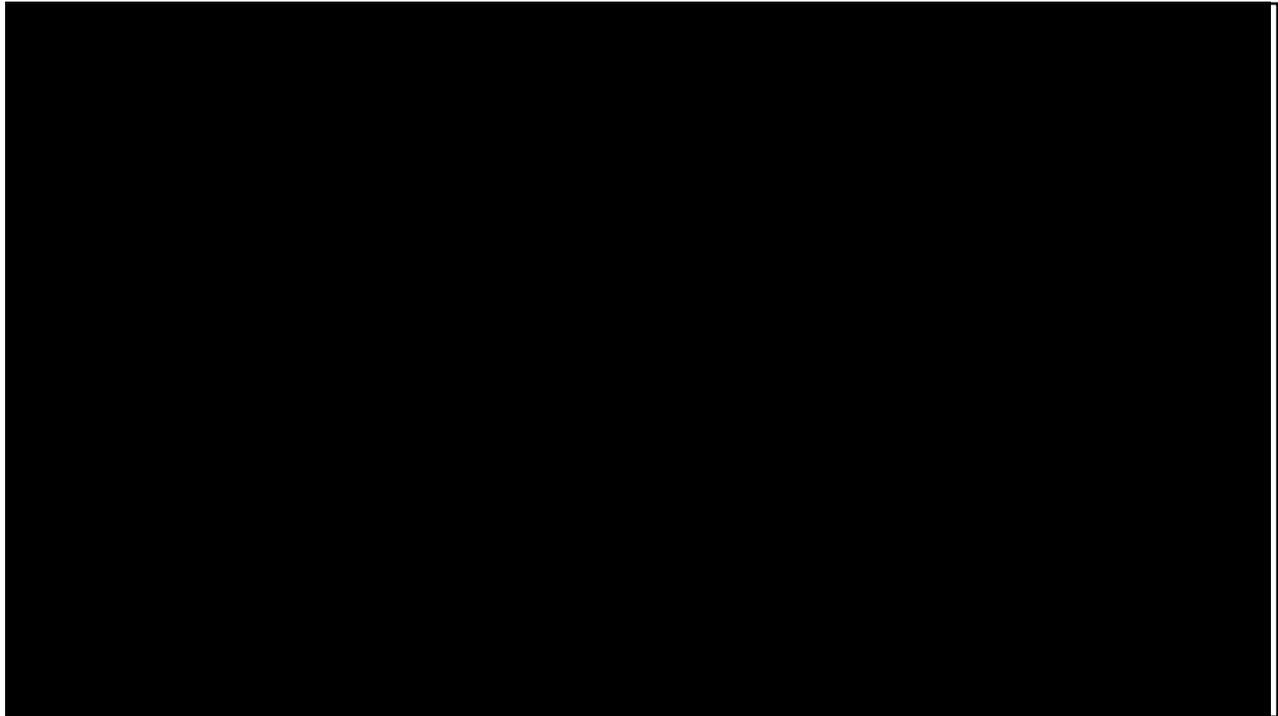
36



37



38



41



Montage / editing

- Prescribed order
- Where you look explicitly directed
- Little reader/viewer agency



Ensemble staging / direction

- Less prescribed order
- Salience, structure nudges you to look
- More reader/viewer agency

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DESIGN SPACE OF NARRATIVE VISUALIZATION

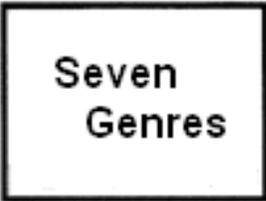
43

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CASE STUDIES

- 70% Journalism
- 20% Business
- 10% Research

[Segel & Heer 2010]

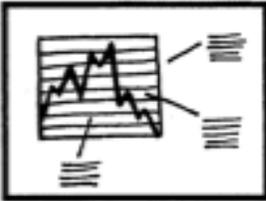
44



Seven Genres



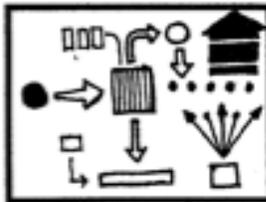
Magazine Style



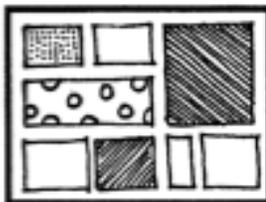
Annotated Chart



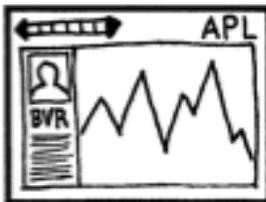
Partitioned Poster



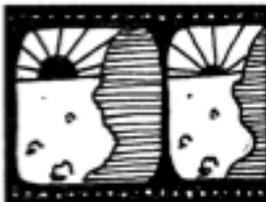
Flow Chart



Comic Strip



Slide Show



Film/Video/Animation

Genres for Narrative Visualization [Segel & Heer 2010]

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MAGAZINE STYLE

Graphic detail

Space launches
To Earth orbit or higher, at October 17th 2018

Launch failures, shown in a lighter color, were common in the early years of spaceflight. Today, success rates are above 95%, even for private firms.

Soviet satellites were highly unreliable. Even in the 1960s, they lasted only a year and a half on average, compared with nine years for their American counterparts. Thus, the cost required for more launches to keep up.

State launch providers

Commercial launch providers

Cost to reach low-Earth orbit in 2018
\$ per kg of cargo, principal launch vehicles

ULA's Atlas V	\$11,400
Russia Soyuz 2.1a	\$11,400
Arianespace Ariane 5	\$8,800
China Long March 2D	\$12,000
India PSLV	\$12,000
SpaceX Falcon 9*	\$12,900

New entrants in the space race have surged ahead by cutting prices while maintaining reliability. Chinese and Indian rockets are considerably cheaper than aging Russian and American designs. SpaceX, a new American firm, charges less than a quarter as much.

Seize MS-10
Failed to carry crew to International Space Station on October 17th

A modern space race

The next generation

Private businesses and rising powers are replacing the cold-war duopoly

SOME 4,500 satellites circle Earth, providing communications services and navigational tools, monitoring weather, observing the universe, spying and doing more besides. Getting them there was once the business of the superpowers' armed forces and space agencies. Now it is mostly done by companies and the governments of developing countries.

During the early years of the space race reaching orbit was hard. Between 1957 and 1962, 24% of American launches and just 10% of Soviet ones failed. Accidents still happen: on October 17th a Russian rocket aborted its ascent shortly after launch, both crew members landed unharmed. Only states could assume such risks—and even if American firms had wanted to bear them, its government would not let them on national-security grounds. Companies eager to send objects into space, including telecom firms, had to hitch a ride with NASA.

This changed when European countries started building launchers through a mostly state-owned company called ArianeSpace, which touted for custom among satellite-makers around the world. When the space shuttle Challenger exploded in 1986, NASA got out of the satellite-launching business. It and, later, the Pentagon be-

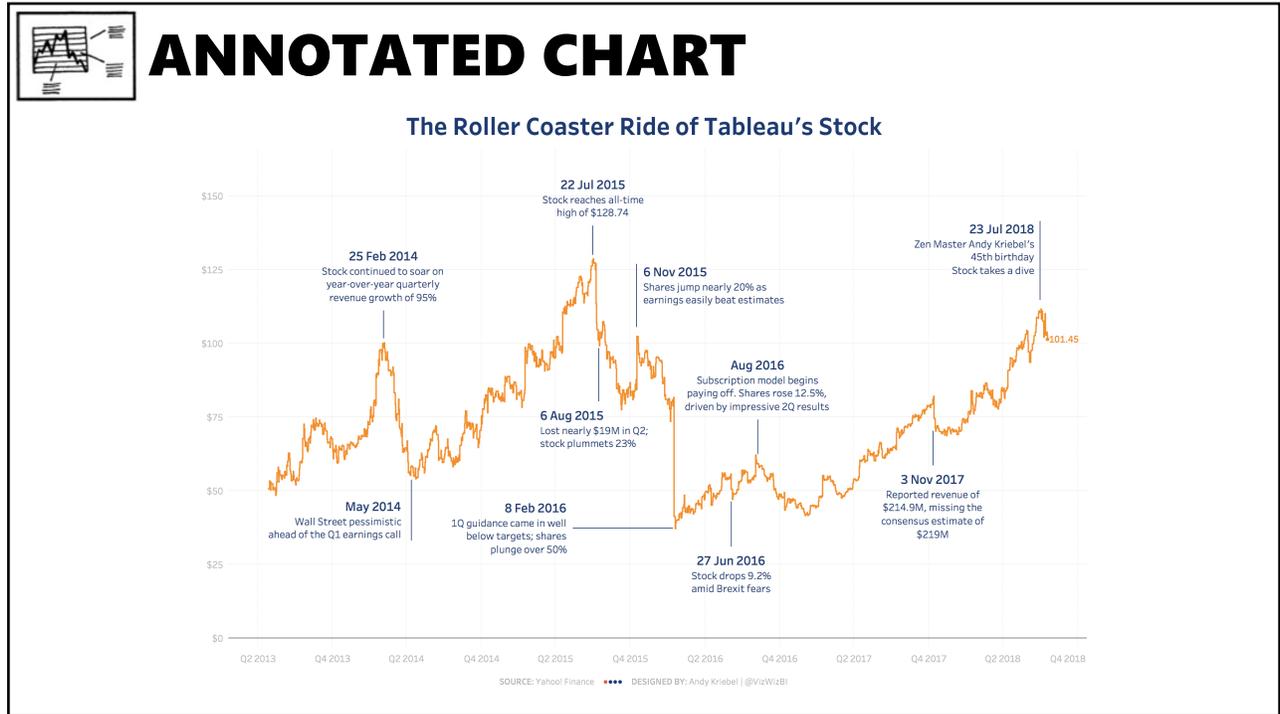
came new customers for private launch firms, alongside the satellite operators.

In the past decade the West's space-launch market has become more competitive thanks to an innovative new entrant, SpaceX. But state-run programmes still lead the way in emerging markets. In 2003 China became the third country to put a person into orbit; India plans to follow suit in 2022. Both sell launch services to private clients. China did legislate private space flight in 2020, but no companies based there have yet reached orbit on their own.

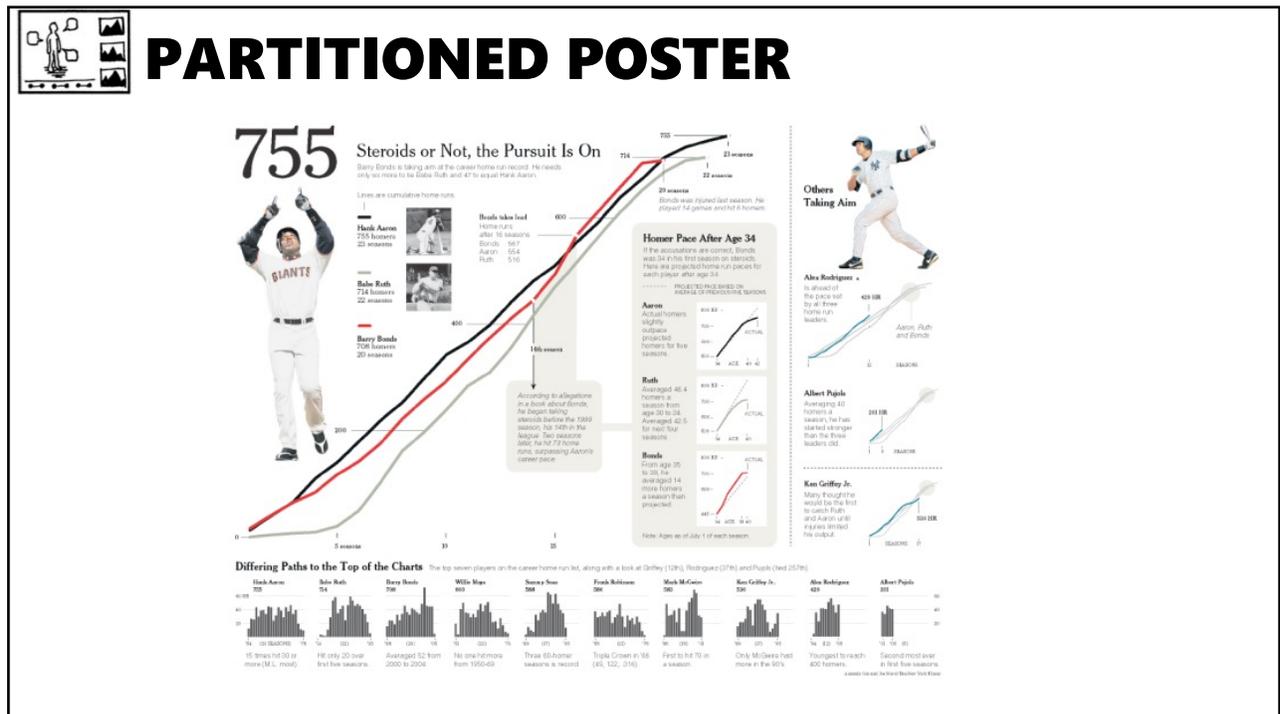
Like their cold-war predecessors, these Asian titans have strategic goals as well as a thirst for publicity. They need independent access to space for communications, intelligence and navigation. However commercial space gets, the competition will never be solely economic. ■

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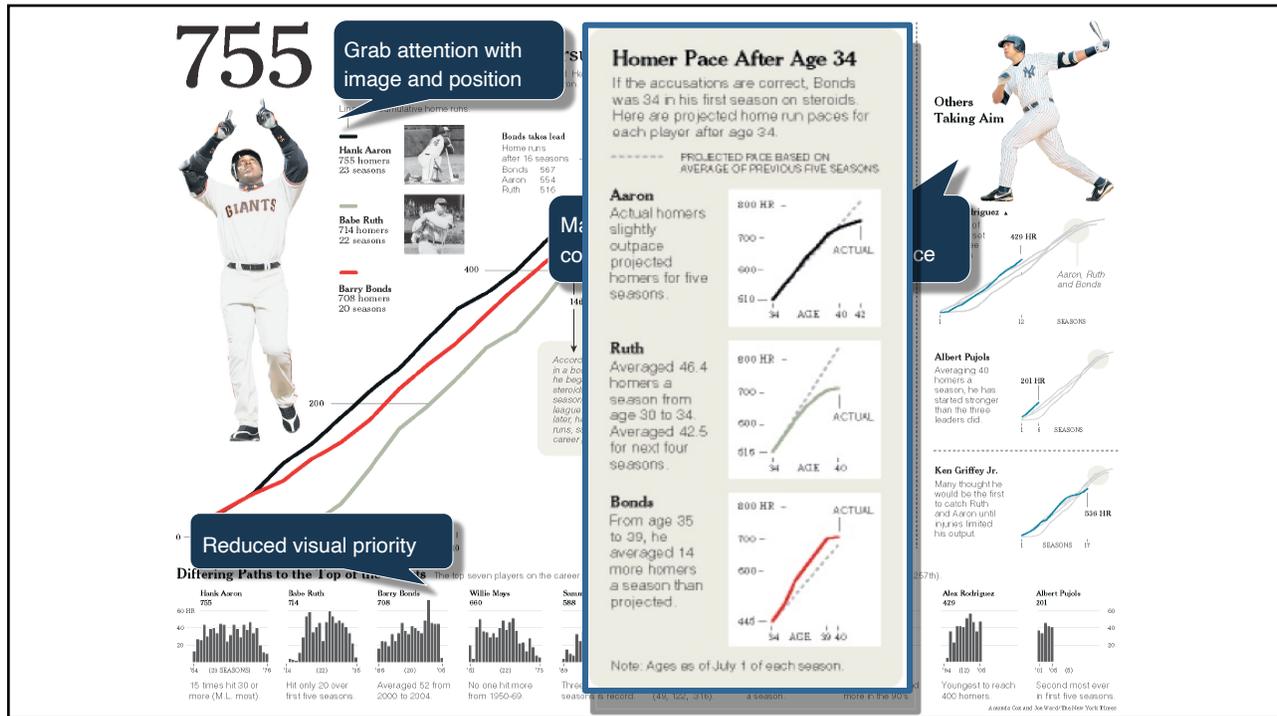
21



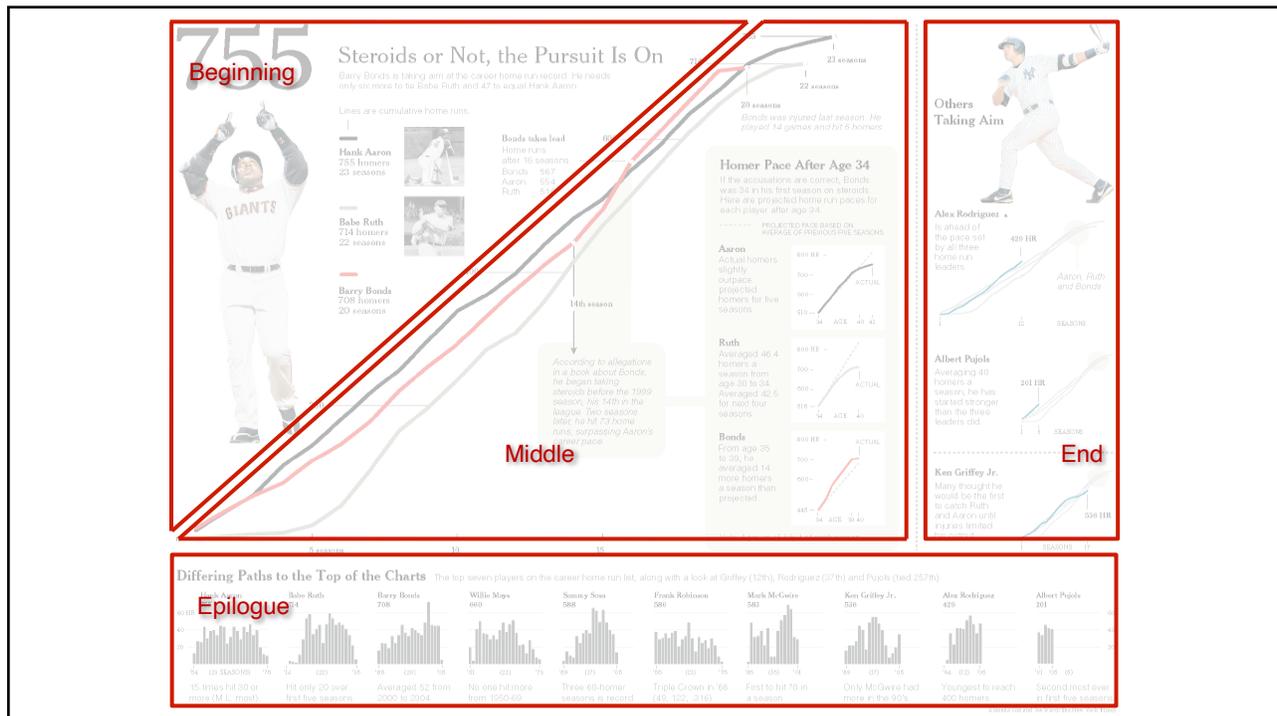
47



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FLOW CHART

WHERE DID ALL THE MONEY GO?

The infographic illustrates the flow of money during the 2008 financial crisis. It starts with a pair of pants representing the money supply. Key sections include:

- Easy Credit:** Shows how easy credit led to a housing bubble and mortgage securitization.
- Securitization of Debt:** Explains how mortgages were packaged into securities, leading to a credit crunch.
- Debt Turns Toxic:** Describes how mortgage-backed securities became toxic assets.
- Investors:** Shows how investors' demand lowered standards, leading to a credit crunch.
- Crisis Spreads:** Illustrates how the crisis spread from the housing market to the broader financial system.
- Money Supply:** Discusses the impact of the Federal Reserve's actions on the money supply.

What is money?

Barter	Commodity Money	Representative Money	Credit Money	Fiduciary Money
Money is a commodity that is used as a medium of exchange.	Money is a commodity that is used as a medium of exchange.	Money is a commodity that is used as a medium of exchange.	Money is a commodity that is used as a medium of exchange.	Money is a commodity that is used as a medium of exchange.

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<http://www.r2d3.us/visual-intro-to-machine-learning-part-1/>

These ultimate branches of the tree are called **leaf nodes**. Our decision tree models will classify the homes in each leaf node according to which class of homes is in the majority.

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COMIC STRIP

Population Pyramid data for US baby boom in 1960s. Pink-Female Blue-Male

THE US CENSUS POPULATION DATA

BABIES BORN IN 1960S
In 1960, the babies born reached 1st peak for both female (pink) and male (blue), and formed a generation of baby boom.

BABIES BORN IN 1970S
In 1970, babies born dropped to a normal level.

BABIES BORN IN 1980S
In 1980s, babies born kept dropping.

BABIES BORN IN 2000S
In 2000, the number of babies born recovered a bit.

BIRTH RATE 1960-2000
The birth rate dropped in 1960s and 1970s, and then increased in 2000s again.

<https://datacomics.github.io/>

53

The number of flights was dramatically decreased in 2020. But do you remember how many flights you took in 2019? (Move the slider to input the times)

In 2019, you travel times, a total of km by plane.

Which produced around tons of CO2.

That's about times around the globe.

How much is tons of CO2 indicate? Click one panel from following options to compare the amount:

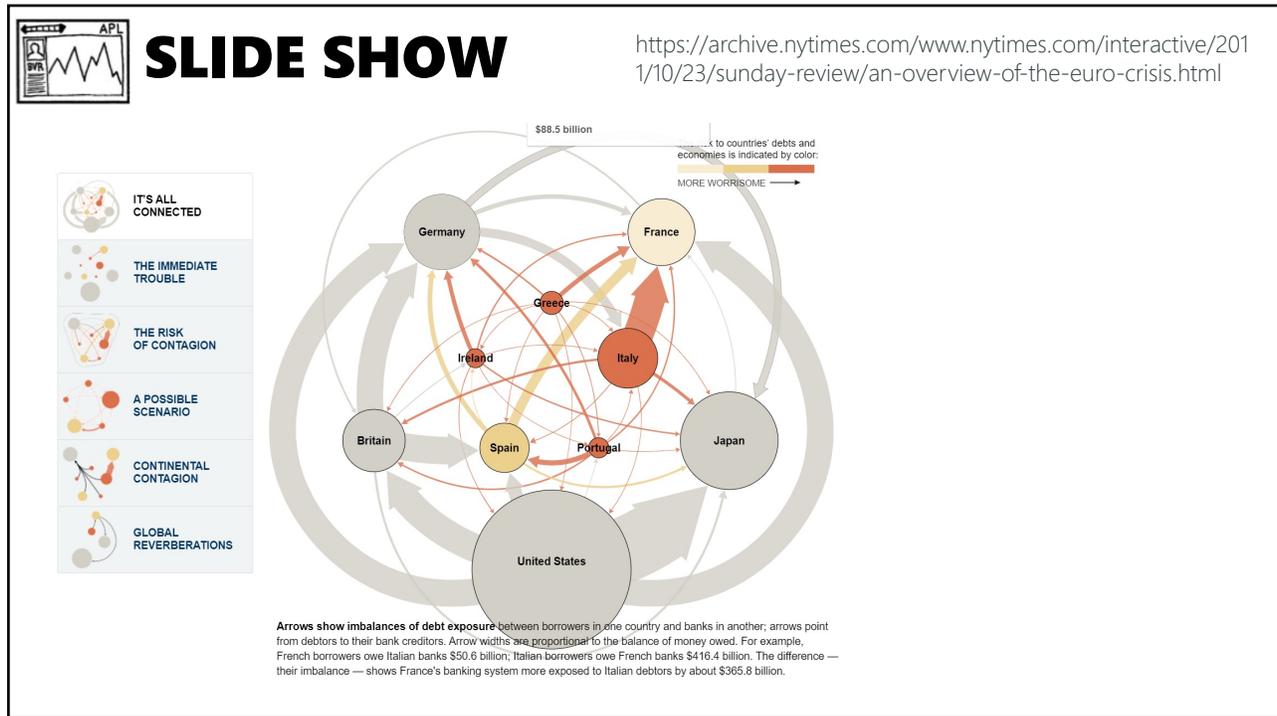
Average CO2 production by human

CO2 absorbed by trees

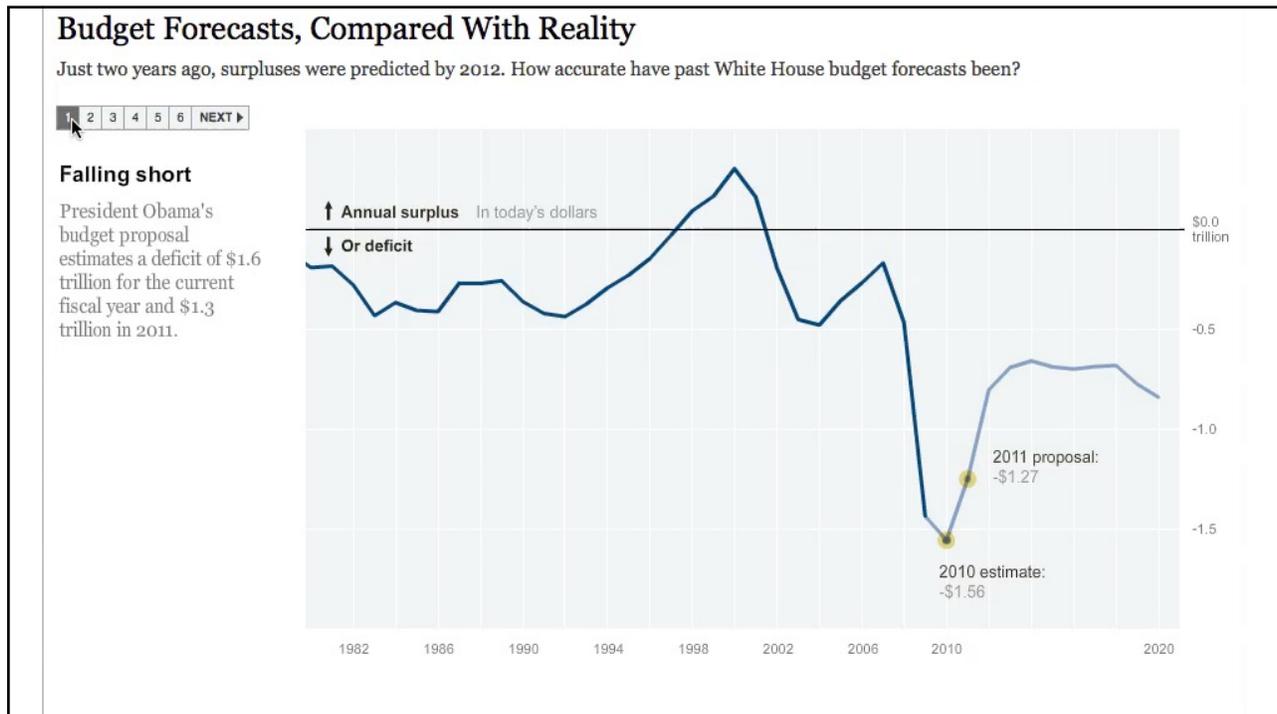
Equivalent greenhouse gasses by cows' farts and burps

<https://interactivedatacomics.github.io/examples.html>

54



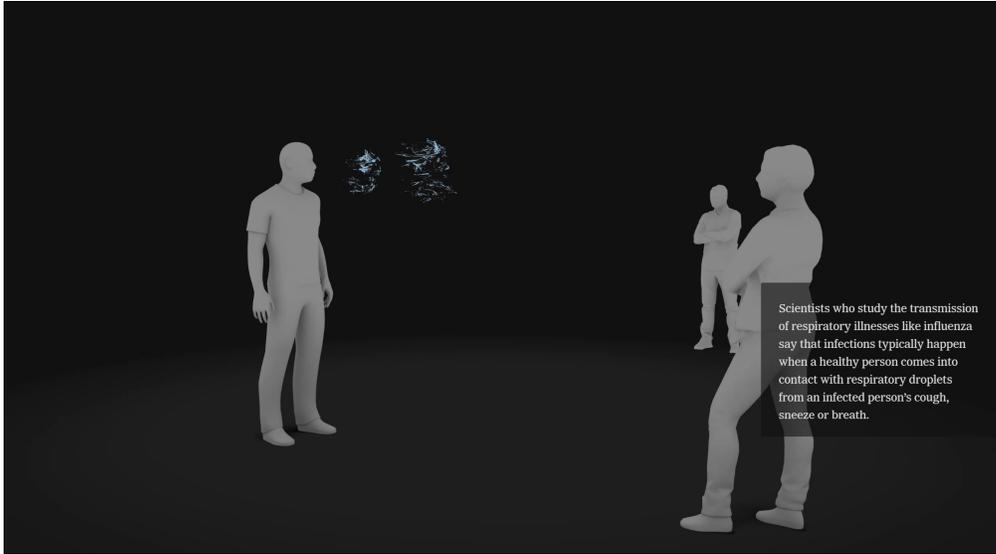
56



57



FILM/VIDEO/ANIMATION

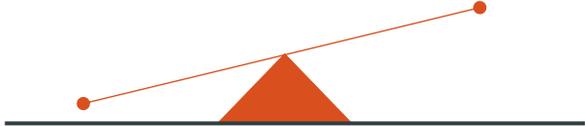


<https://www.nytimes.com/interactive/2020/04/14/science/coronavirus-transmission-cough-6-feet-ar-ul.html>

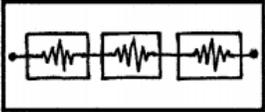
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GUIDANCE

61



Author driven
Prescribed ordering
Stronger messaging
Limited interactivity



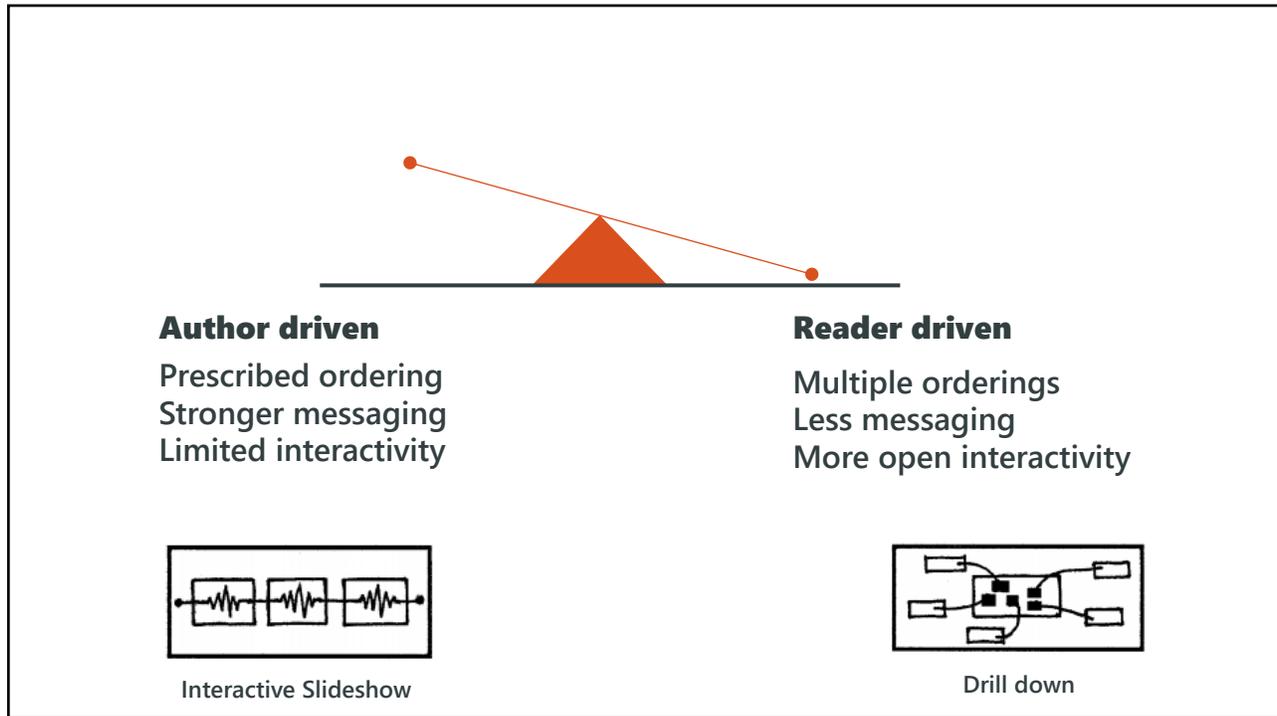
Interactive Slideshow

63



<https://archive.nytimes.com/www.nytimes.com/interactive/2013/10/09/us/yellen-fed-chart.html>

64



65

Now Viewing: Overview Up Close: Camp 15

Major Prison Camps

The existence of five main camps has been confirmed by survivors, escapees and former guards. Most prisoners work 12-hour days, making military uniforms, felling trees or tilling fields until they die of malnutrition-related illnesses, usually before the age of 50. North Korea allows no outsiders into the remote, mountainous camps.

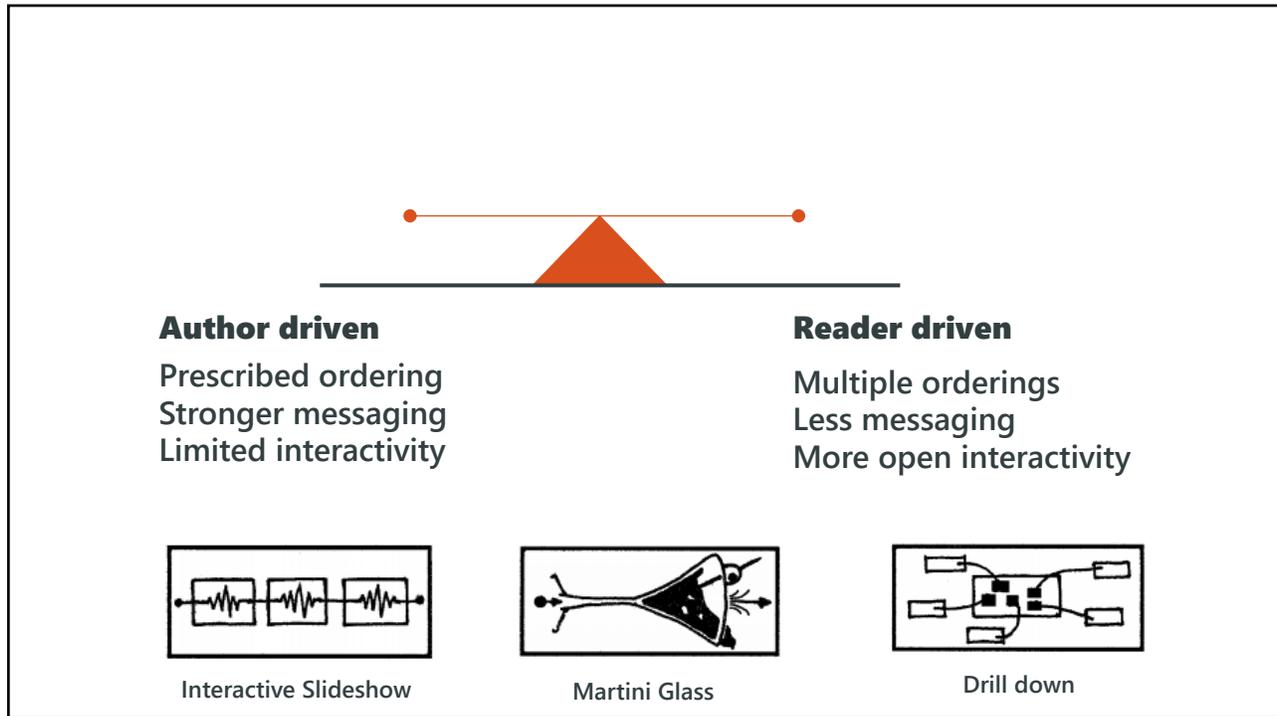
Learn more about five major prison camps at right, or take a closer look at life in Camp 15.



Scale varies in this perspective.
Distances from Pyongyang: 120 miles to Seoul, 427 miles to Vladivostok

<https://www.washingtonpost.com/wp-srv/special/world/north-korean-prison-camps-2009/>

66



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DRAW YOUR EXPECTATIONS

TheUpshot



You Draw It: How Family Income Predicts Children's College Chances

By GREGOR AISCH, AMANDA COX and KEVIN QUEALY MAY 28, 2015

How likely is it that children who grow up in very poor families go to college? How about children who grow up in very rich families?

We'd like you to **draw your guess** for every income level on the chart below.

If you think the chances of enrolling in college (or vocational school) are about the same for everyone, you should draw something like this: . If you think the odds are especially harsh for children from the poorest families, but higher for middle- and higher-income children, your drawing would instead look like this: . Or here is one for a situation in which chances level off after a certain income threshold: . Or for one that spikes  or dips  for the very richest.

When you've finished drawing, we'll compare your line to the reality for children born in the early 1980s, based on research by a team of

<https://www.nytimes.com/interactive/2015/05/28/upshot/you-draw-it-how-family-income-affects-childrens-college-chances.html>

70

TheyDrawIt! An authoring tool to create belief-driven visualizations

Visualize **Predict** **Social** **Publish & Share**

Date/Time Column

Season

Label

All lines

Choose one or more lines to plot on the chart.

Line	Label	Color
Honor	Honor	#1f77b4
Power	Power	#ff7f0e
Family	Family	#d62728
Death	Death	#d13725

[Add Line](#)

Configure Hint

Prediction Measure

Family

This is the data you want readers to predict.

Prediction Label

Prediction Color

Range

By default, the user will predict the entire line selected.

Display other predictions

All predictions will be saved and can be shown to readers. Choose how you would like to display others' predictions to the reader.

Choose an option to see a simulated preview of what other predictions might look like.



No Other Predictions



Other Predictions As Lines



Other Predictions As Heatmap

Publish

Click the button to publish your project.

[Publish Project](#)

Warning: If you make any changes to your project, you must click on the "Publish Project" button again to publish your changes.

Share

Link

Use this to share a direct link to your TheyDrawIt visualization.

https://localhost/via/cak7DF0eD1cx2GP50or80qWslm2/-LhkF6ds_81h80u0V98

Embed

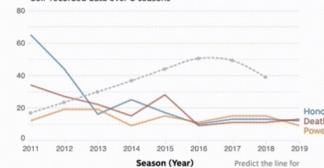
Copy the embed code and paste it on your site where you want your visualization to appear.

```
<iframe
  src="https://localhost/via/cak7DF0eD1cx2GP50or80qWslm2/-LhkF6ds_81h80u0V98"
  width="700px"
  height="560px">
</iframe>
```

Chart Preview

Game of Thrones over the Years

Self-recorded data over 8 seasons



Predict the trend for family given the other lines.

<https://theydrawit.mucollective.co/>

71



I'm comfortable if a social media website ...

collects detailed personal information about me, like my gender and interests

... and uses things my friends post about to send me targeted advertisements

[Click here to draw the line where shown](#)

... and lets companies upload customer lists, matching my phone or email with the one I've added to my profile, so they can send me targeted advertising

... and buys information about me from third parties, like my purchase history, to augment their profile about me

... and receives details about my activity from other websites on the internet, like things I buy and sites I visit

... and receives information on what I buy in physical stores

... and lets third parties download basic information on my friends without their consent

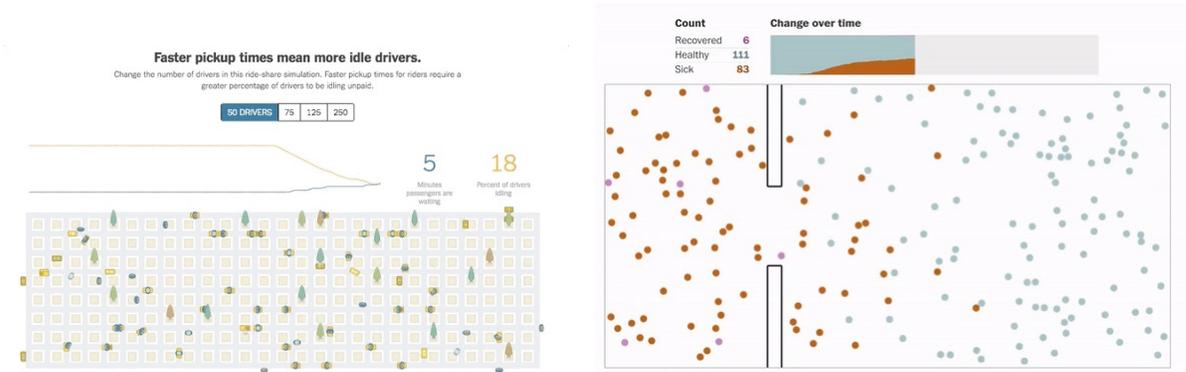
... and lets third parties download detailed information on my friends, like their relationship status and interests, without their consent

... and serves me targeted ads on a smart TV app that has a relationship with the website

<https://www.nytimes.com/interactive/2019/04/10/opinion/privacy-survey.html>

72

SIMULATIONS



<https://getdolphins.com/blog/interactive-data-visualizations-new-york-times/>
<https://www.washingtonpost.com/graphics/2020/world/corona-simulator/>

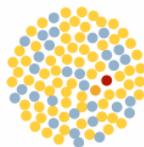
74

Watch how the measles outbreak spreads when kids get vaccinated - and when they don't

● vaccinated
 ● susceptible
 ● vaccinated but susceptible
 ● infected
 ● contact with an infected person



NOT PROTECTED
 10.0% vax rate



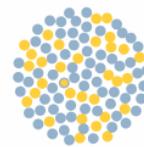
NOT PROTECTED
 30.0% vax rate



50.0% vax rate



58.5% vax rate, similar to Okanagan County, WA



68.9% vax rate, similar to Thurston County, WA



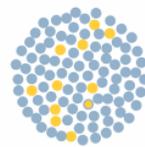
74.4% vax rate, similar to Island County, WA



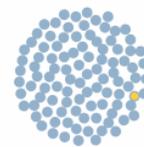
83.8% vax rate, similar to Santa Cruz County, CA



86.0% vax rate, similar to Los Angeles County, CA



90.0% vax rate, similar to Orange County, CA



99.7% vax rate, similar to Gadsden County, FL

75

Who Should Get Parole?

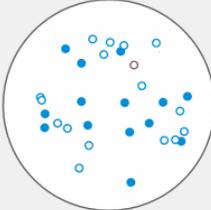
Even the best risk assessments yield probabilities, not certainties. That means they label as "high risk" some people who won't commit another crime and label as "low risk" some people who will. This simulation lets you sort offenders into risk categories based on the results of an assessment. Think we should rarely lock up anyone who wouldn't reoffend? Set the "low risk" threshold high and the "high risk" threshold even higher. Have little tolerance for recidivism? Try the opposite. In the real world, policymakers have to strike a balance. [Read more »](#)

1

The prisoners in this simulation are up for parole. Some will reoffend if released and some won't. They each take an assessment, which estimates the chance they will reoffend.

Stop

PAROLE-ELIGIBLE PRISONERS



● - Will reoffend
○ - Will not reoffend

2

Prisoners are placed in one of three categories based on these estimates. **Move the slider** to change the cutoffs for each category. "Low risk" prisoners will be awarded parole. "High risk" prisoners will be denied.



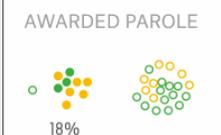
3

Some people you let out reoffended. Some people you left in prison wouldn't have. **Are you OK with the results?**

LOW RISK



AWARDED PAROLE



18%
AWARDED PAROLE AND THEN REOFFENDED

MEDIUM RISK



DENIED PAROLE



14%
DENIED PAROLE BUT WOULDN'T HAVE REOFFENDED

HIGH RISK

