

Visual Explainers

Maneesh Agrawala

**CS 448B: Visualization
Fall 2021**

with material from Matthew Conlen and Jessica Hullman

1

The New York Times



See How the Dixie Fire Created Its Own Weather

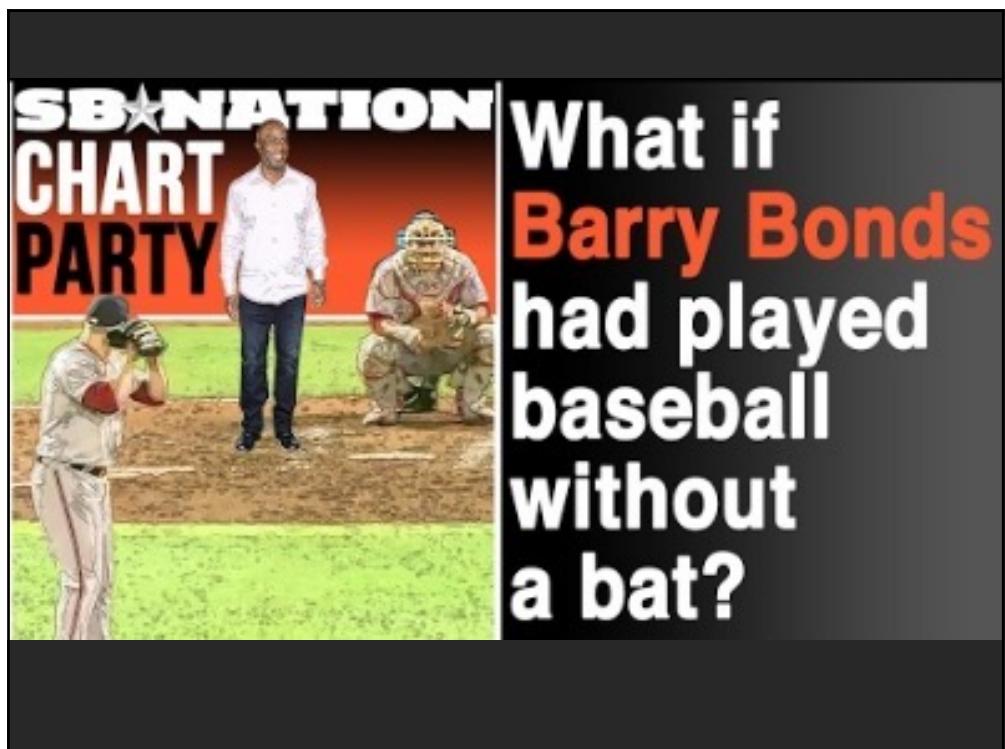
This year's largest blaze generated powerful storm clouds. We show you in 3-D.

By Nadja Popovich, Noah Pisner, Nicholas Bartokas, Evan Grethian,
Daniel Mangosing, Karthik Patanjali and Scott Reinhart

Oct. 20, 2021

2

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3



4

Principles

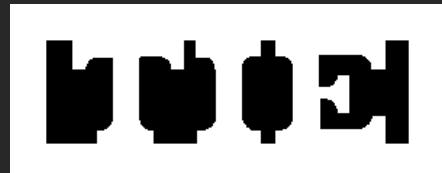
- **figure/ground**
- **proximity**
- **similarity**
- **symmetry**
- **connectedness**
- **continuity**
- **closure**
- **common fate**
- **transparency**

5

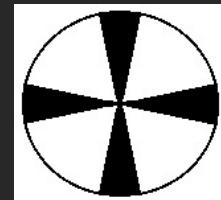
Figure/Ground



Ambiguous



Principle of surroundedness



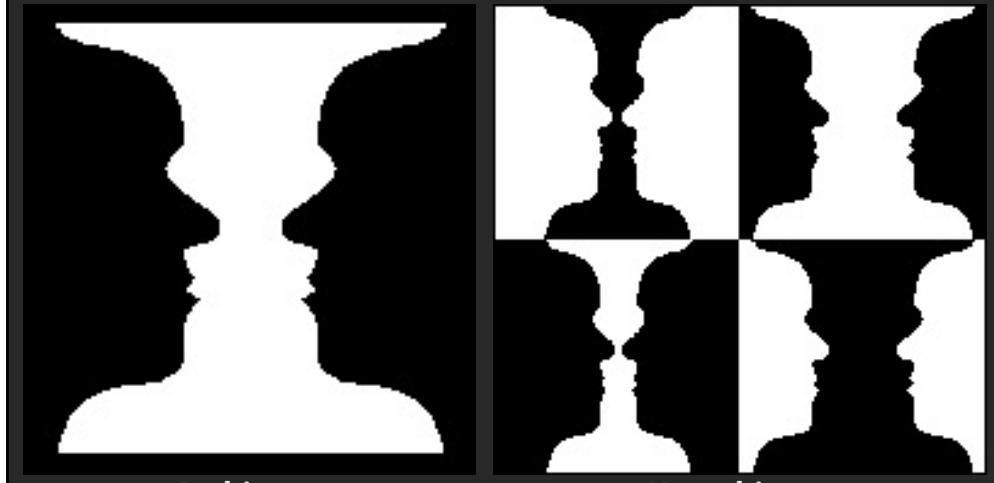
Principle of relative size

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

6

3

Figure/Ground



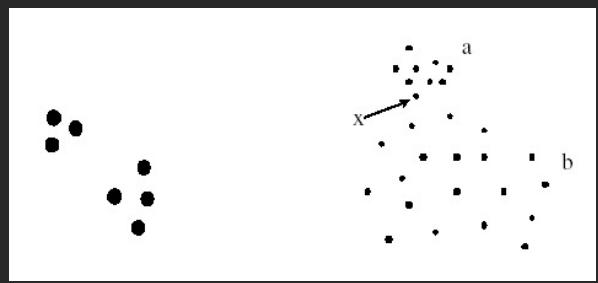
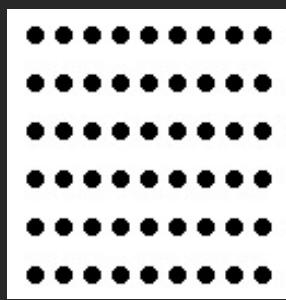
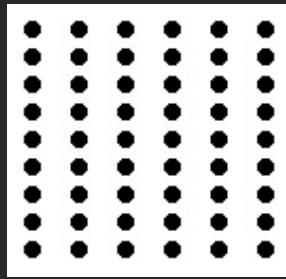
Ambiguous

Unambiguous

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

7

Proximity

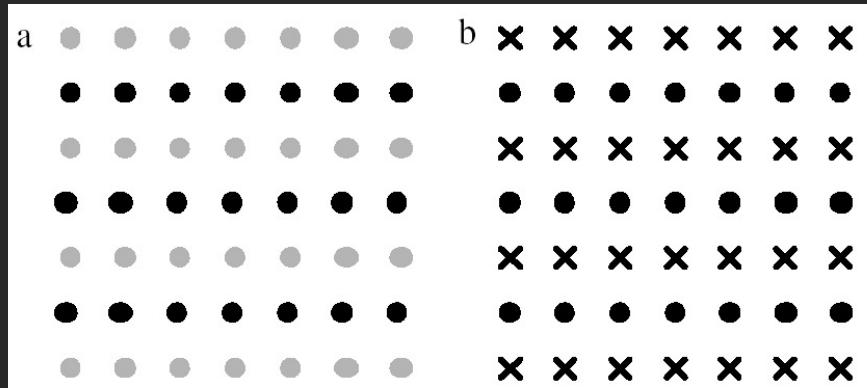


[Ware 00]

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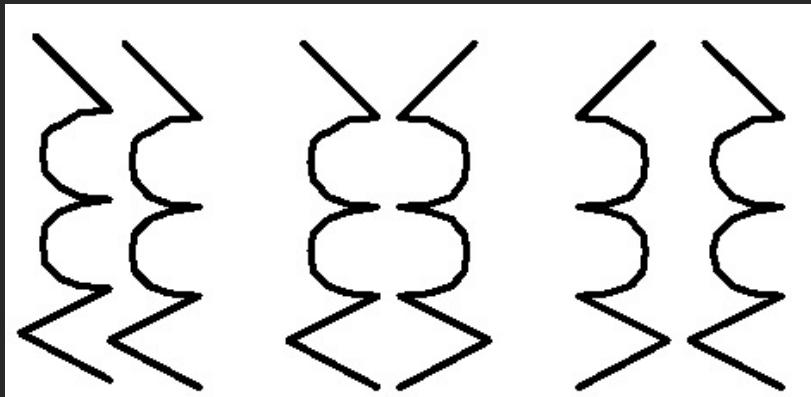
Similarity



Rows dominate due to similarity [from Ware 04]

9

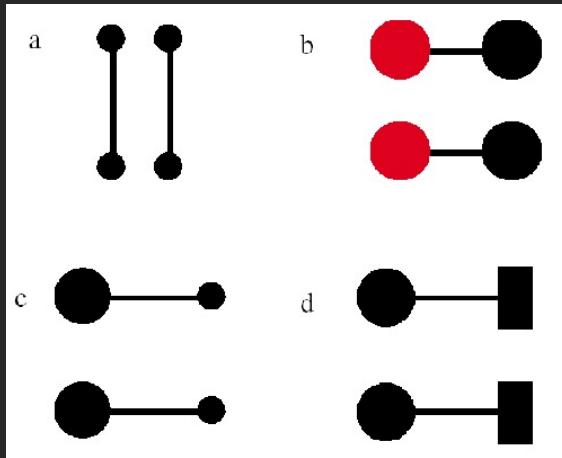
Symmetry



Bilateral symmetry gives strong sense of figure [from Ware 04]

10

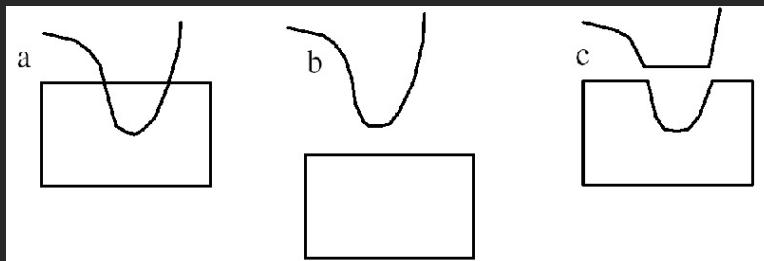
Connectedness



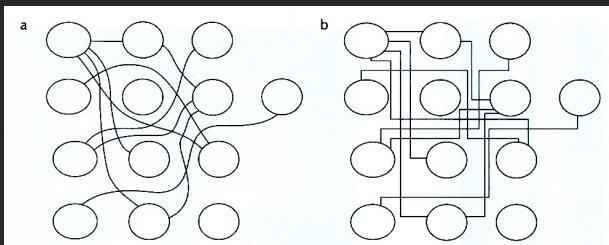
Connectedness overrules proximity, size, color shape [from Ware 04]

11

Continuity



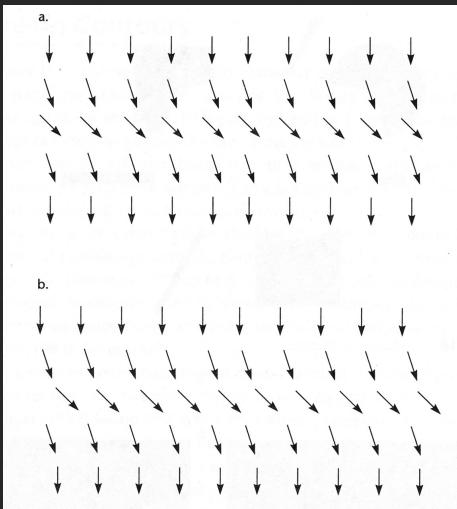
We prefer smooth not abrupt changes [from Ware 04]



Connections are clearer with smooth contours [from Ware 04]

12

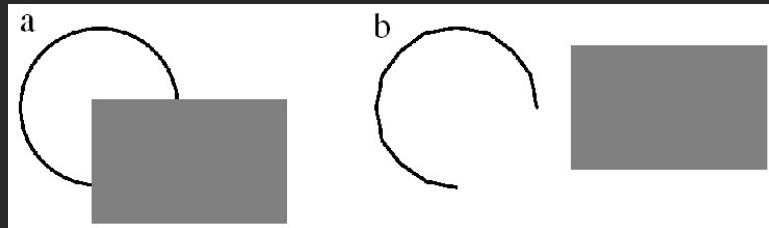
Continuity: Vector fields



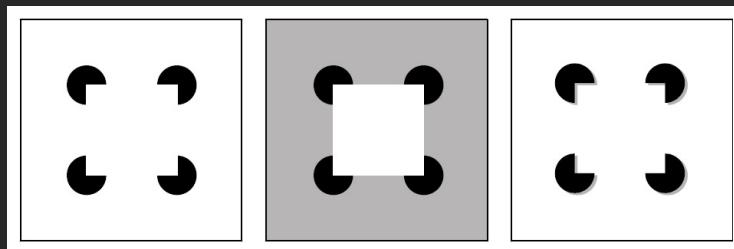
Prefer field that shows smooth continuous contours [from Ware 04]

13

Closure



We see a circle behind a rectangle, not a broken circle [from Ware 04]



Illusory contours [from Durand 02]

14

Common fate



Dots moving together are grouped

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

15

Transparency



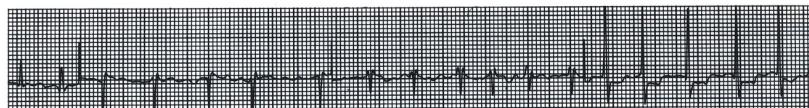
Requires continuity and proper
color correspondence [from Ware 04]

16

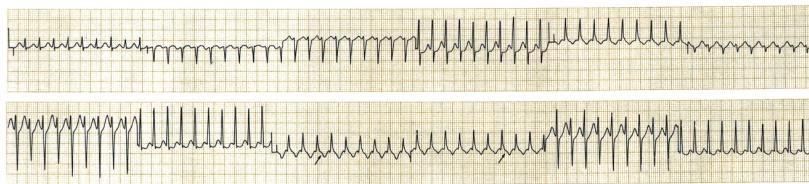
Layering and Small Multiples

17

Layering: Gridlines



Signal and background compete above, as an electrocardiogram trace line becomes caught up in a thick grid. Below, the screened-down grid stays behind traces from each of 12 monitoring leads:⁴



Electrocardiogram tracelines [from Tufte 90]

18

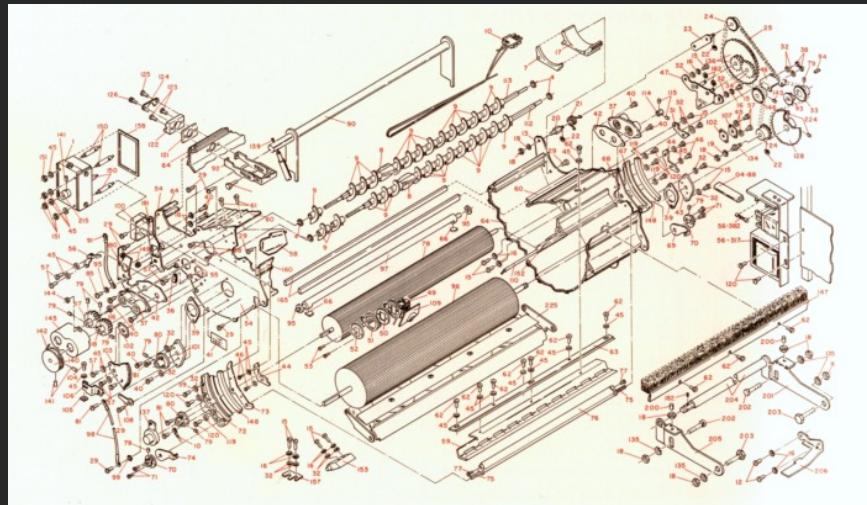
Layering: Gridlines



Stravinsky score [from Tufte 90]

19

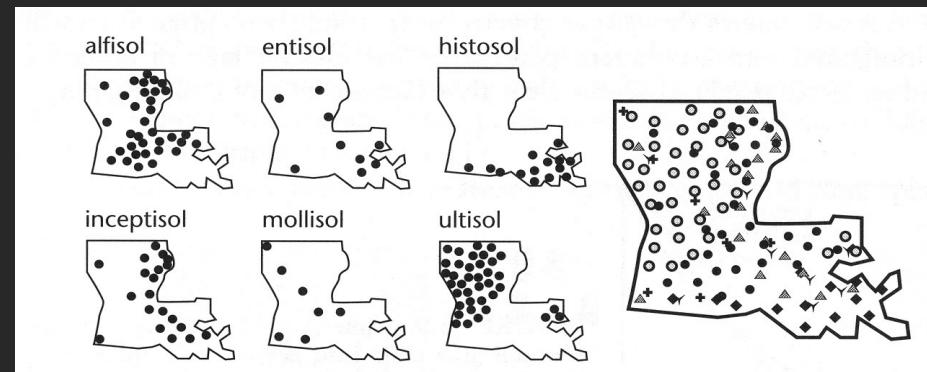
Layering: Color and line width



IBM Series III Copier [from Tufte 90]

21

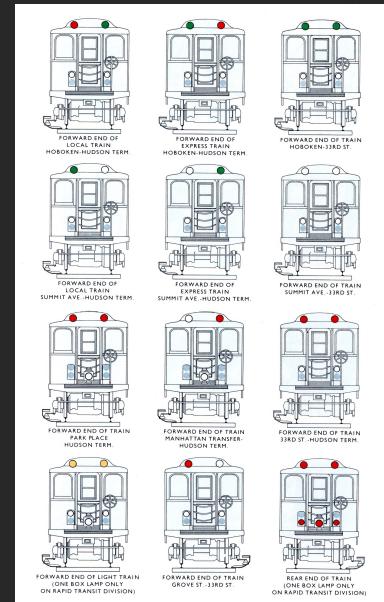
Small multiples



[Figure 2.11, p. 38, MacEachren 95]

22

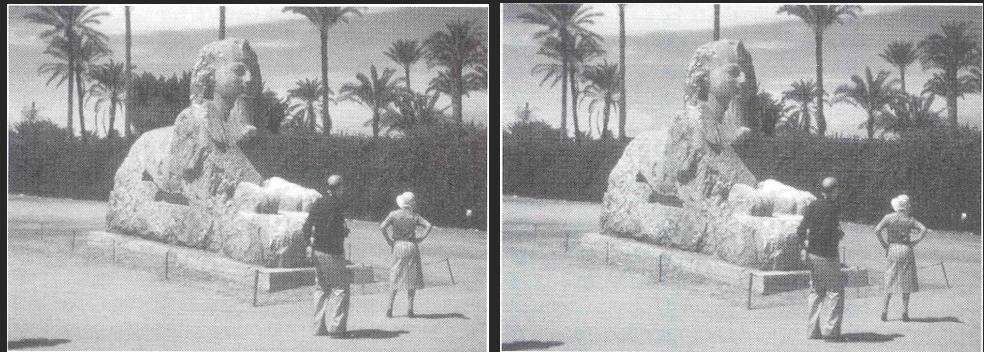
Small multiples



Operating trains. Redrawn by Tufte to emphasize colored lights. [fromTufte 90]

23

Change blindness



[Example from Palmer 99, originally due to Rock]

24

Change detection



25

Change detection



26

Rensink's demonstration



<http://www.csc.ncsu.edu/faculty/healey/PP/index.html>

27

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

28

Announcements

29

14

Assignment 3: Dynamic Queries

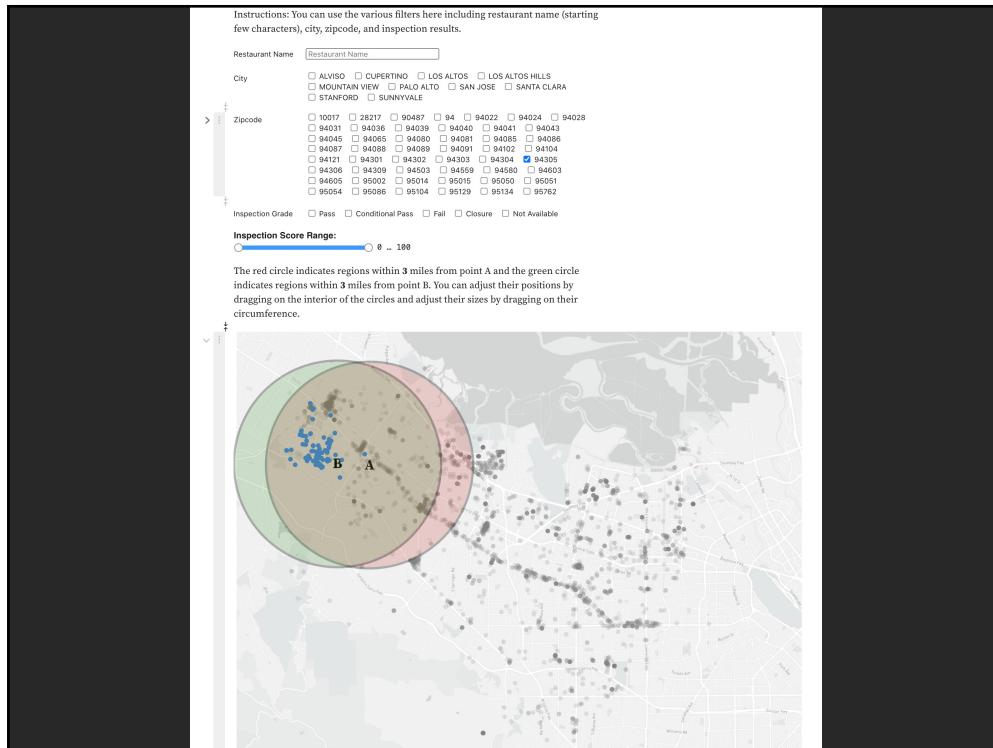
Create a **small** interactive dynamic query application similar to HomeFiner, but for restaurants data.

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



Can work alone or in pairs
Due before class on **Oct 25, 2021**

30



31

Discussing notebooks

Stay tuned for extra office hours

We are happy to discuss your code

- But, do **not** publish your notebook
- Instead **enable link sharing in Observable** and share the link with us privately through Slack

32

Visual Explainers

33

Topics

- 1. Storytelling**
- 2. Design space of narrative visualization**
- 3. Interactive documents**
- 4. Chart sequences**

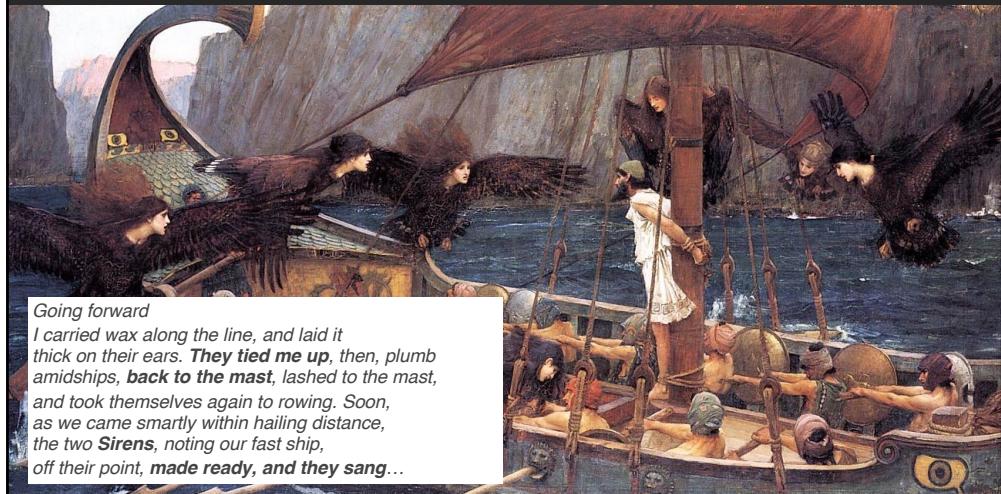
34

Storytelling

35

17

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...*

36

All media tell stories

PEOPLE TELL STORIES

WORDS TELL STORIES

IMAGES TELL STORIES

COMICS TELL STORIES

MOVIES TELL STORIES

VISUALIZATIONS TELL STORIES

37

18

Narrative Storytelling

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

38

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.

39

19

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Anecdotal Lead

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40

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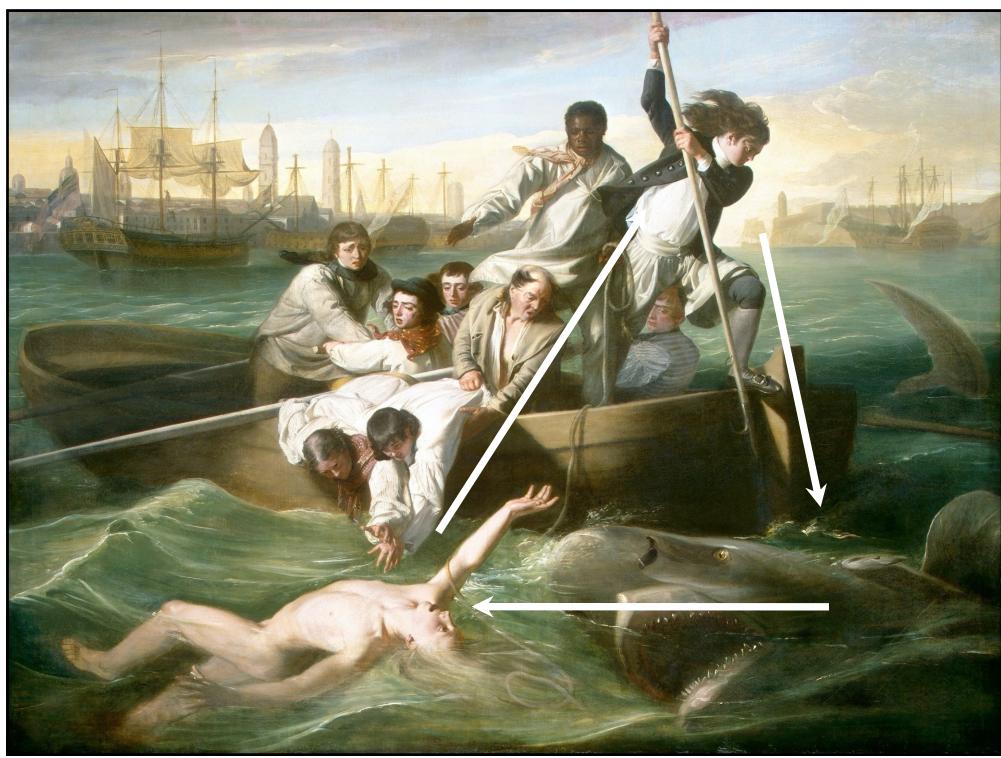
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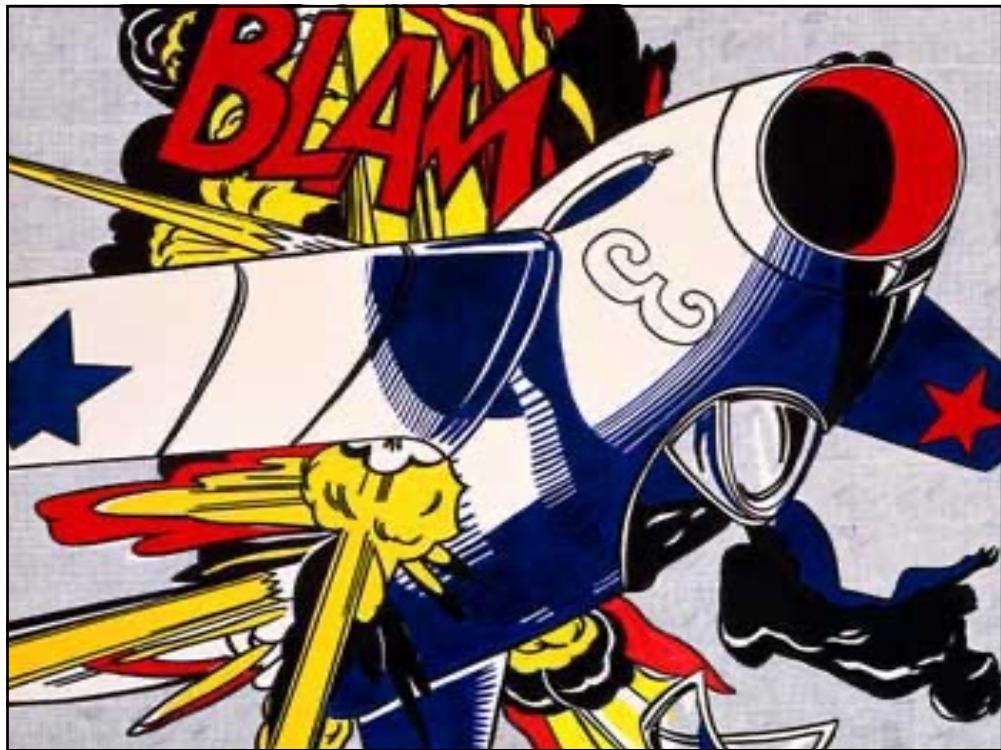
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41

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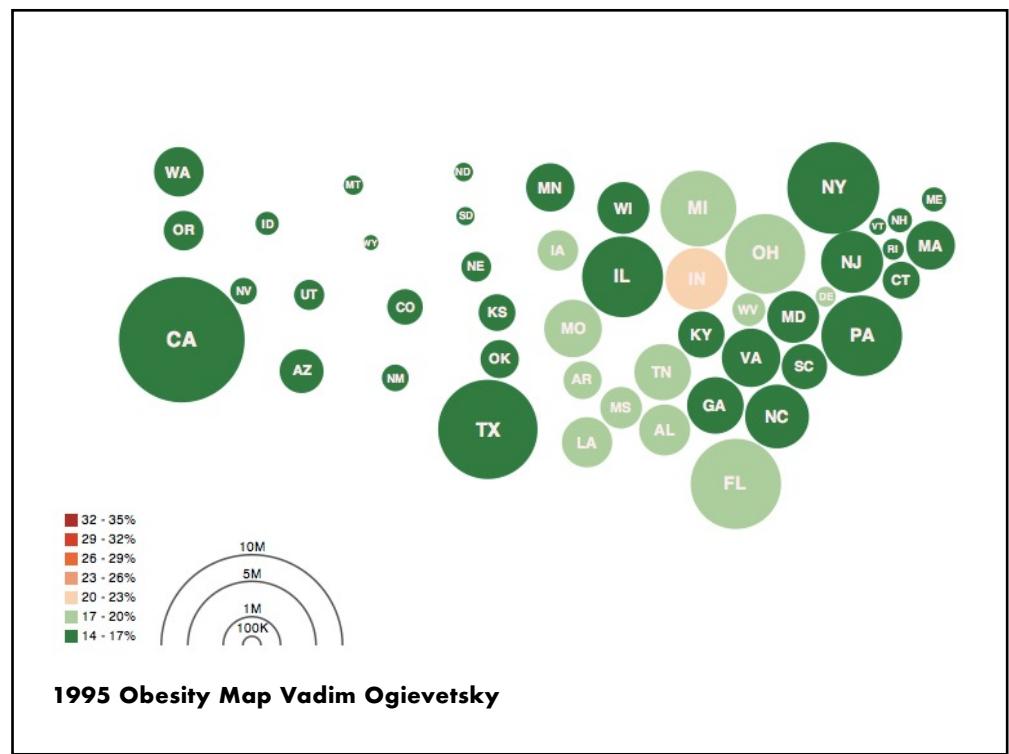
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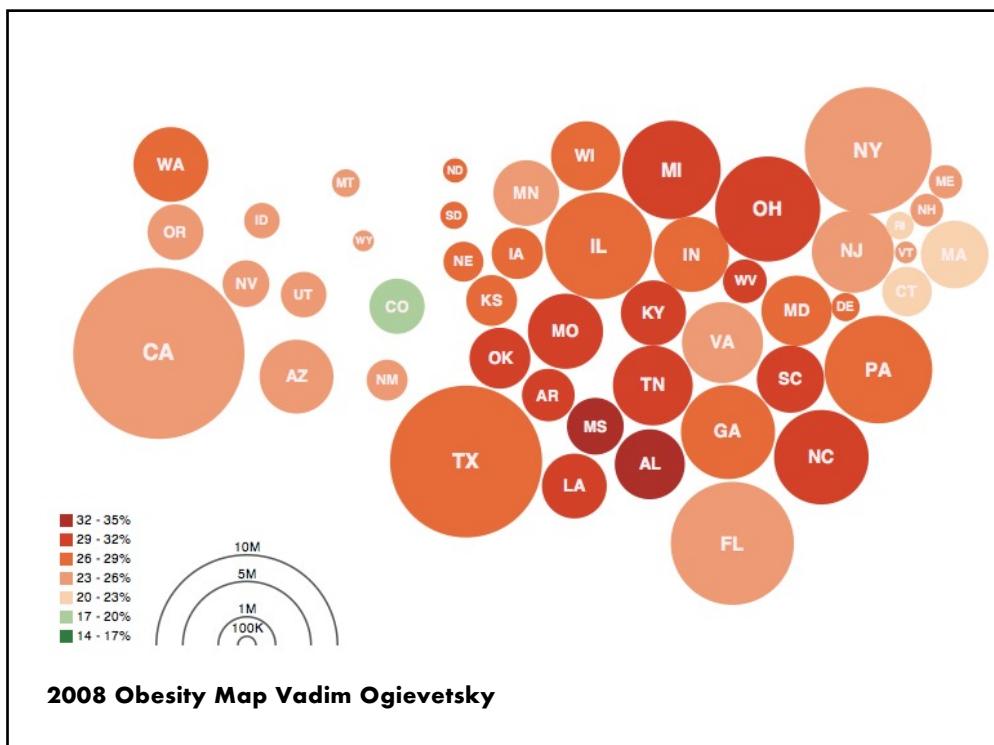
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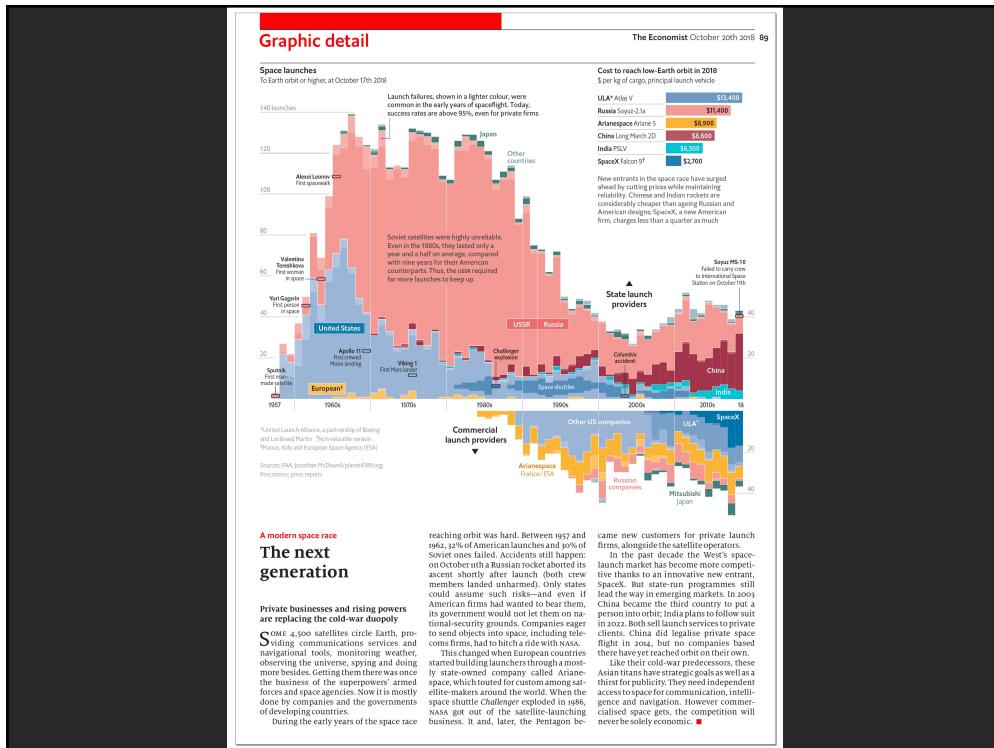
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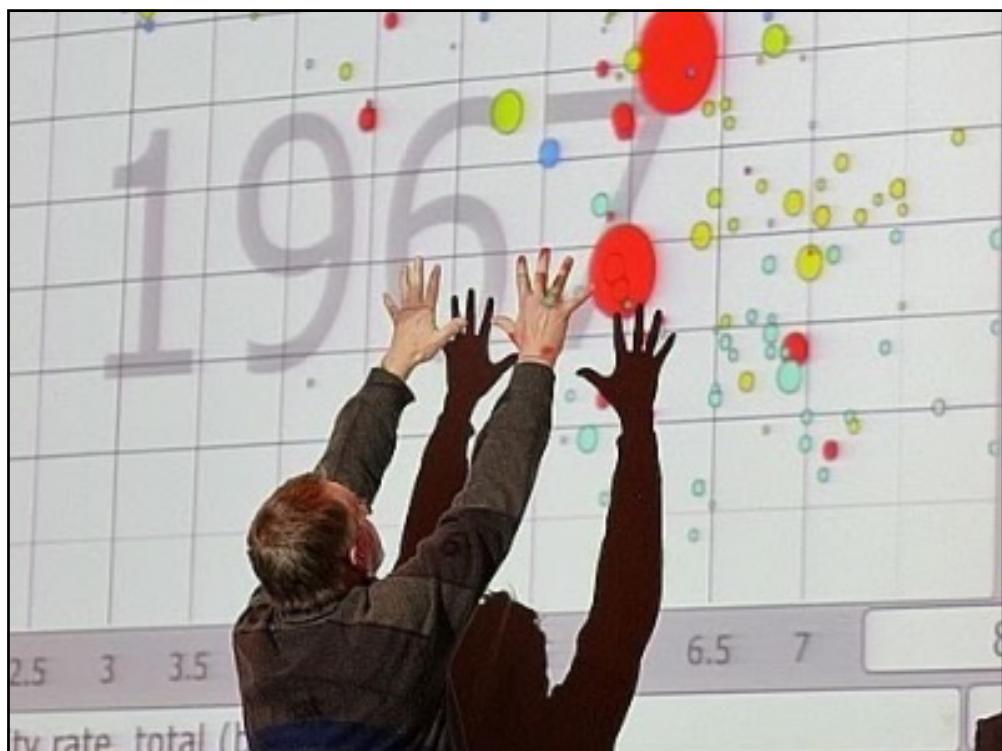
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46



47



51

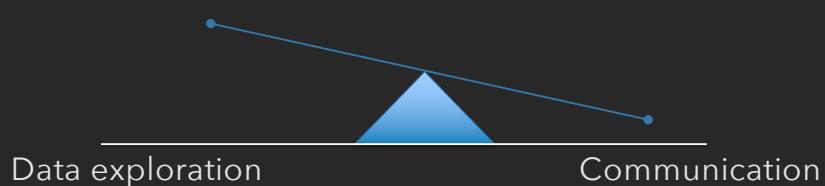
Design Space of Narrative Visualization

52

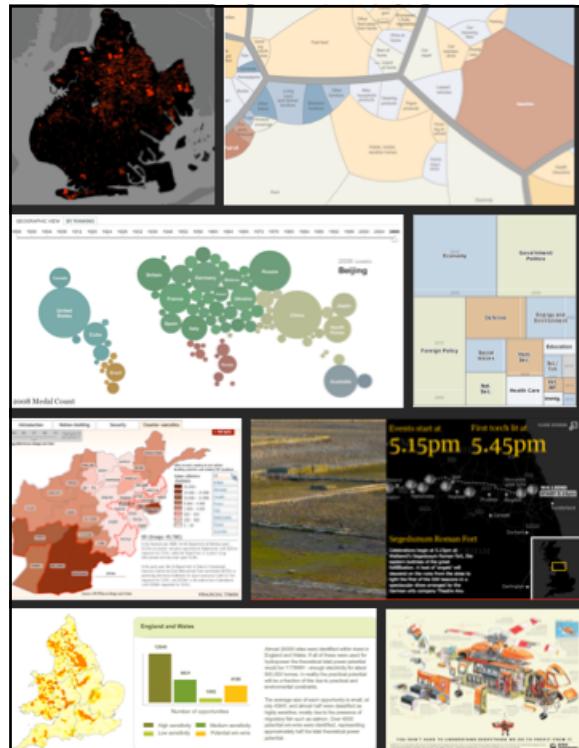
Value of storytelling [Gershon and Page 2001]

A way of structuring information

- Easier to understand than lists
 - Uncertainty, conflict, resolution
 - Text and visuals can be complementary



53



58

CASE STUDIES

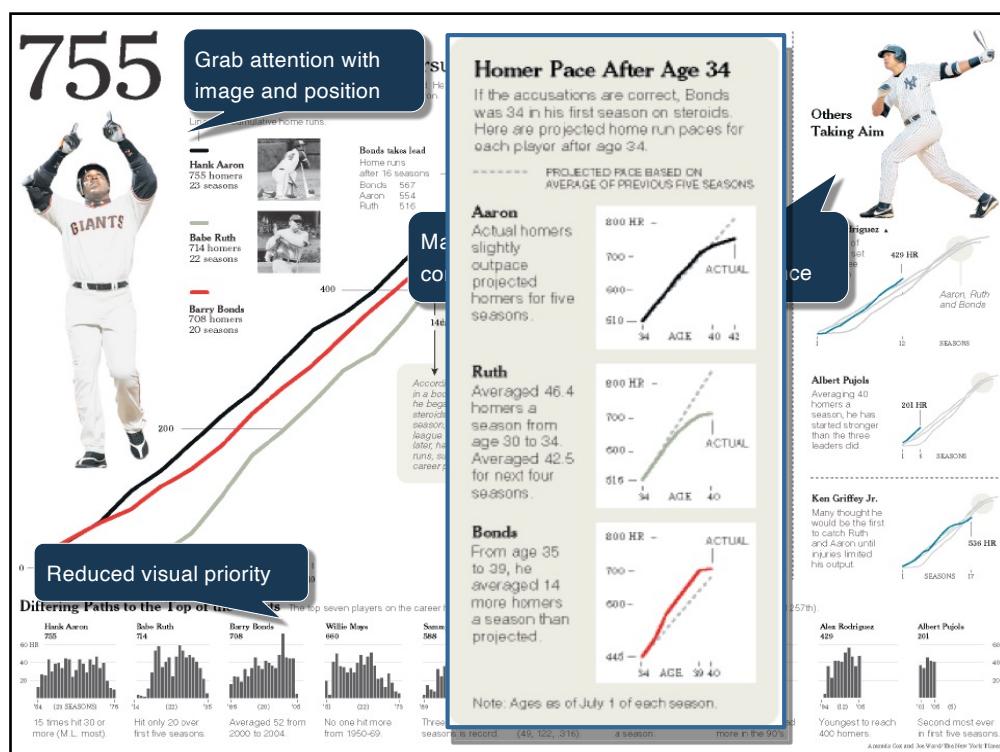
70% Journalism

20% Business

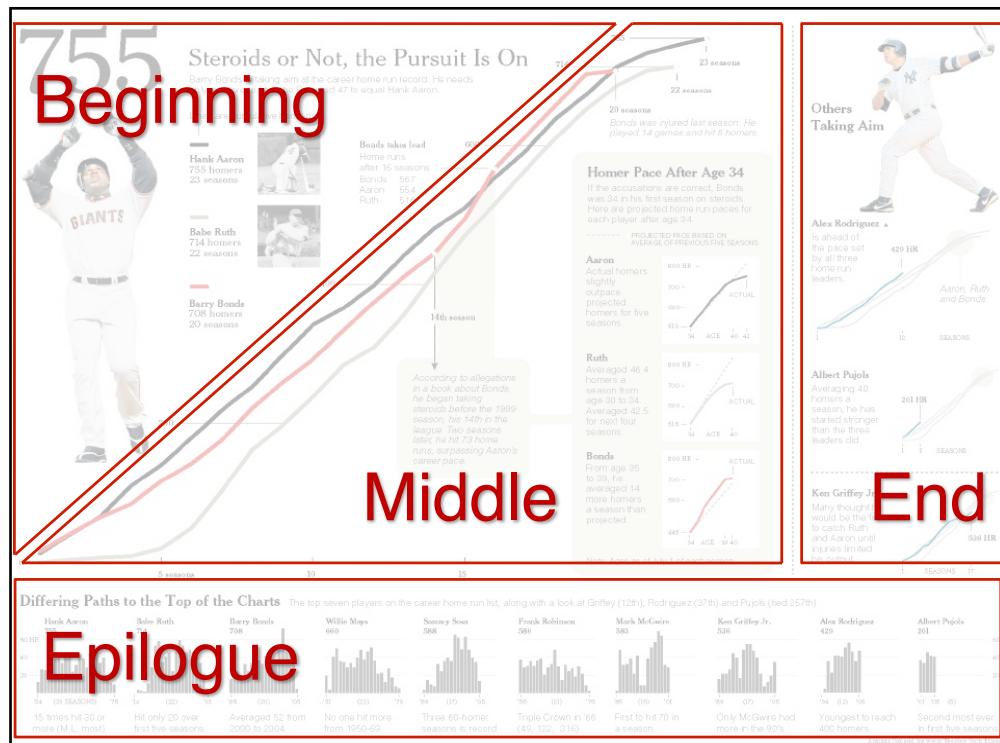
10% Research

[Segel & Heer 2010]

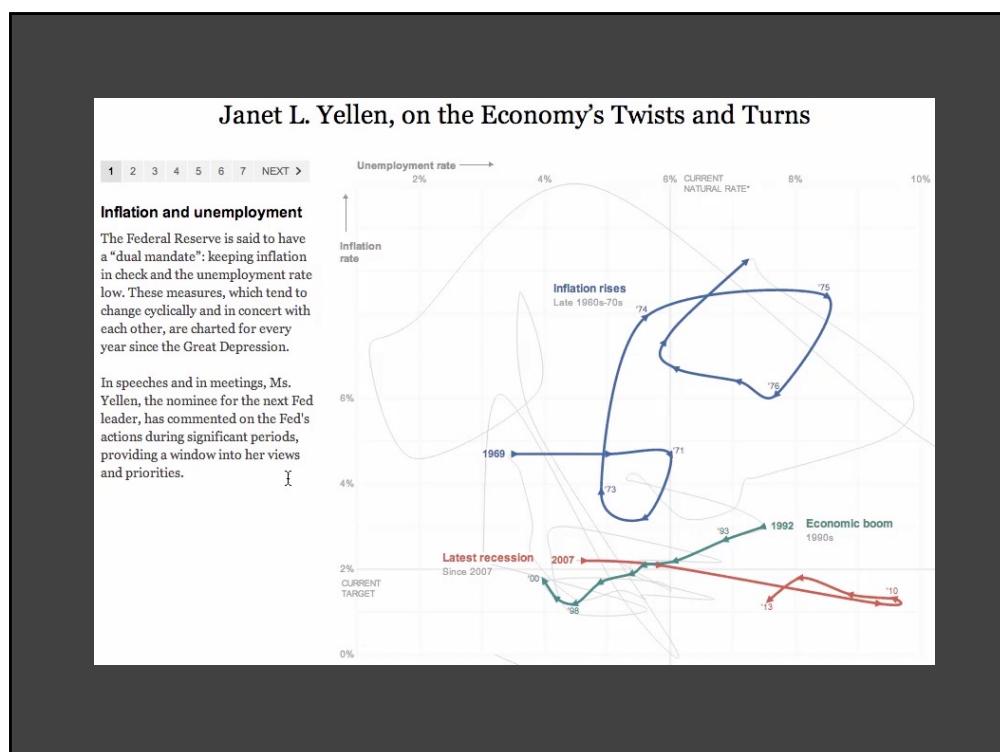
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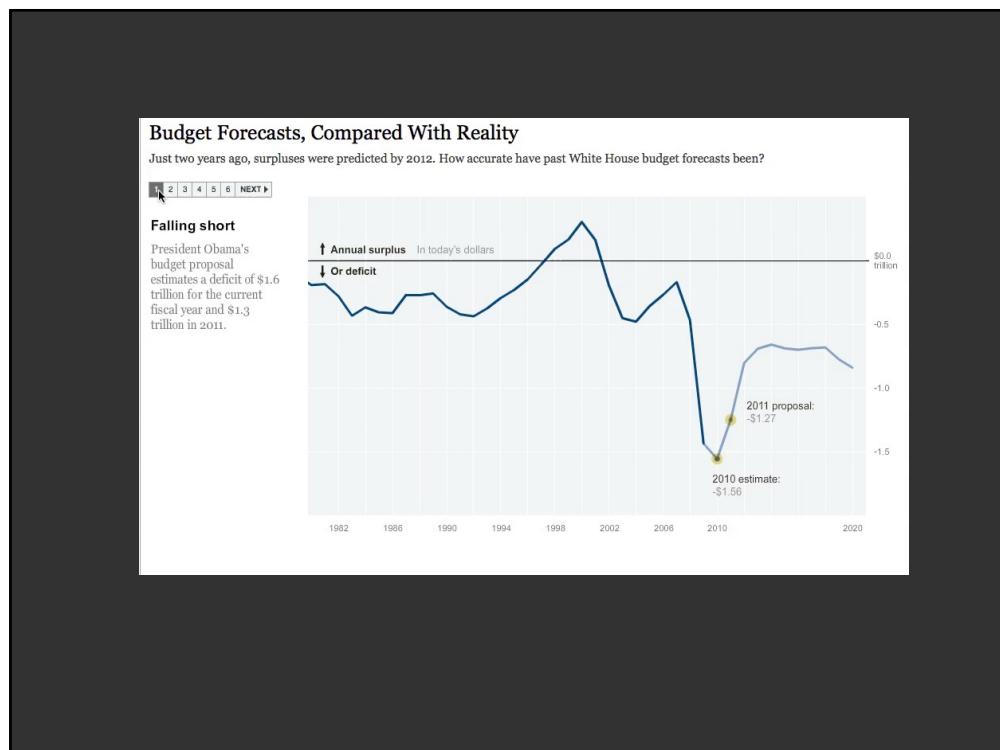
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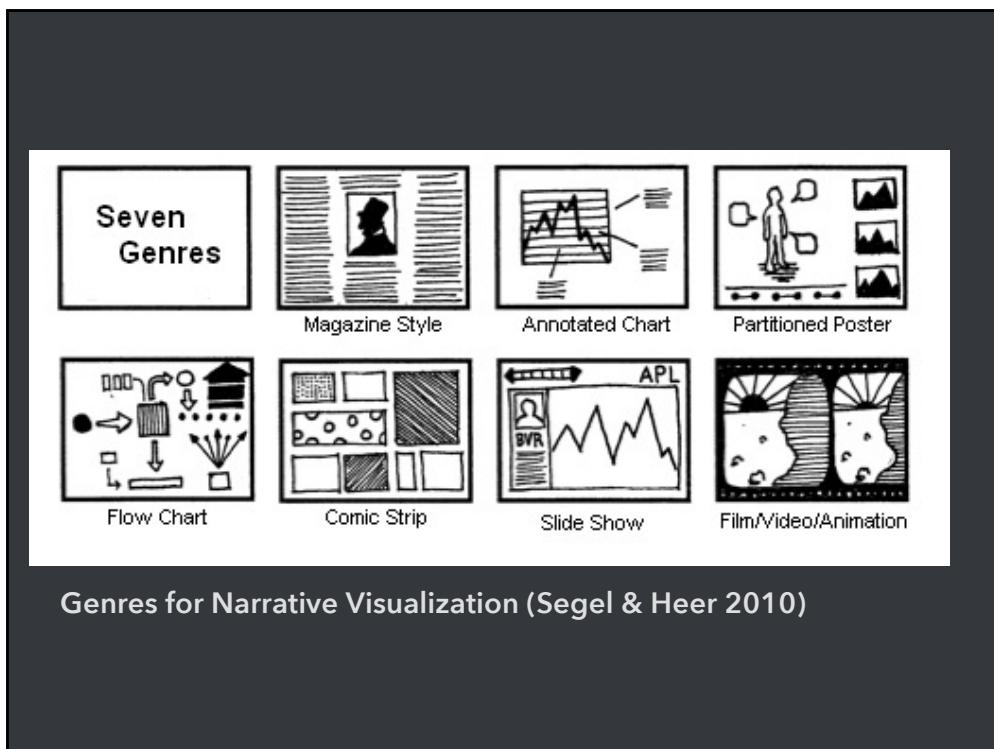
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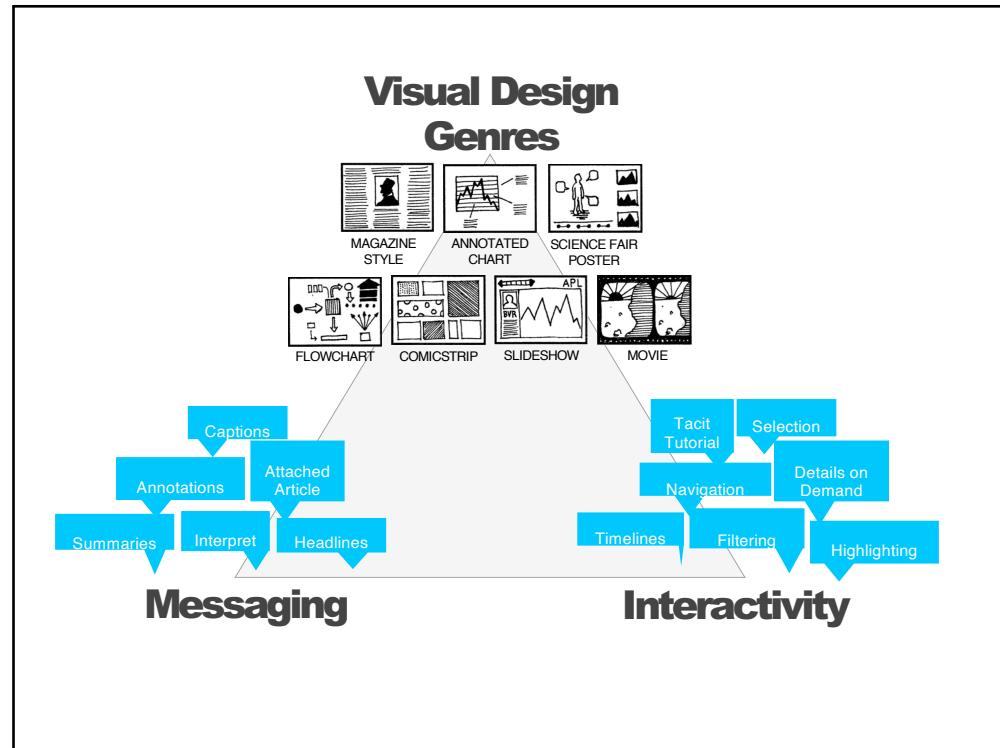
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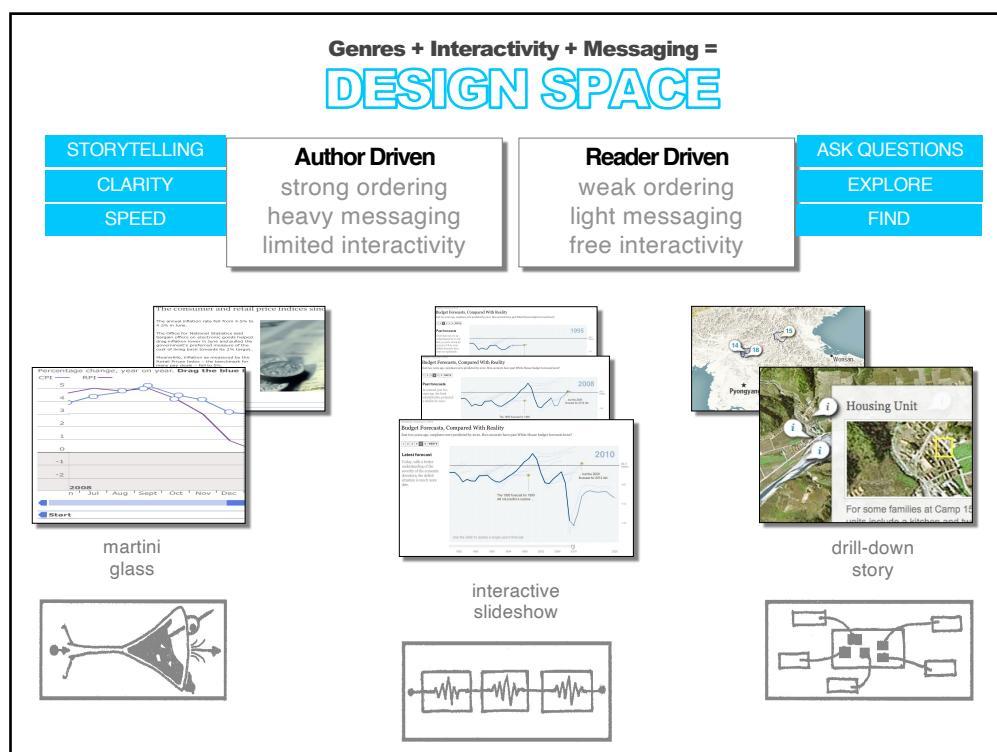
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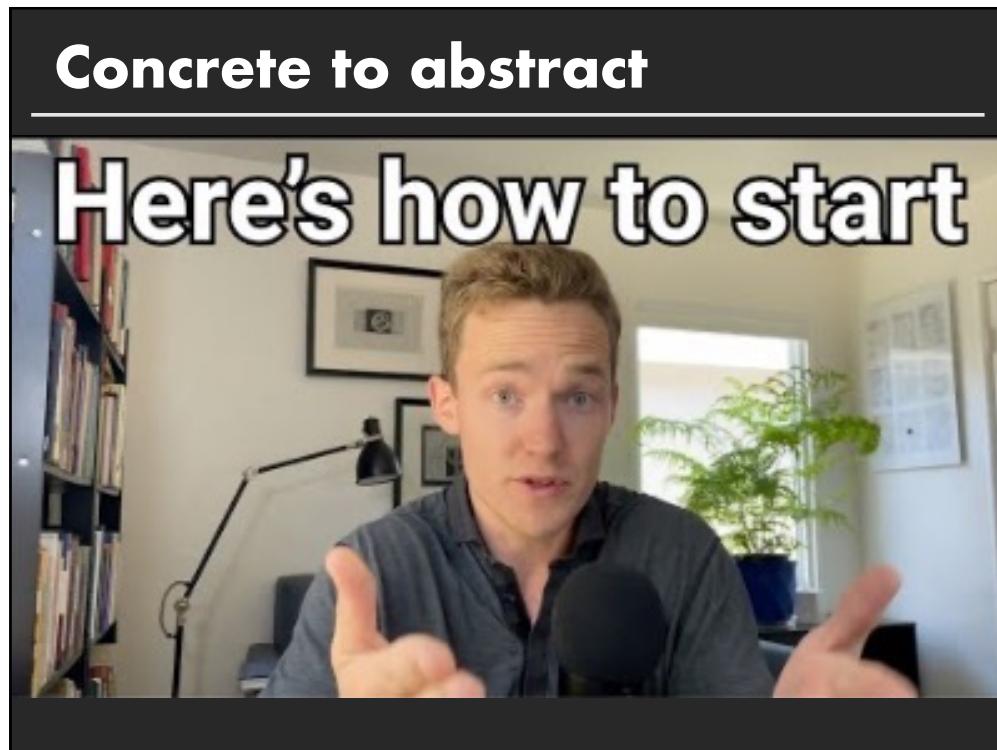
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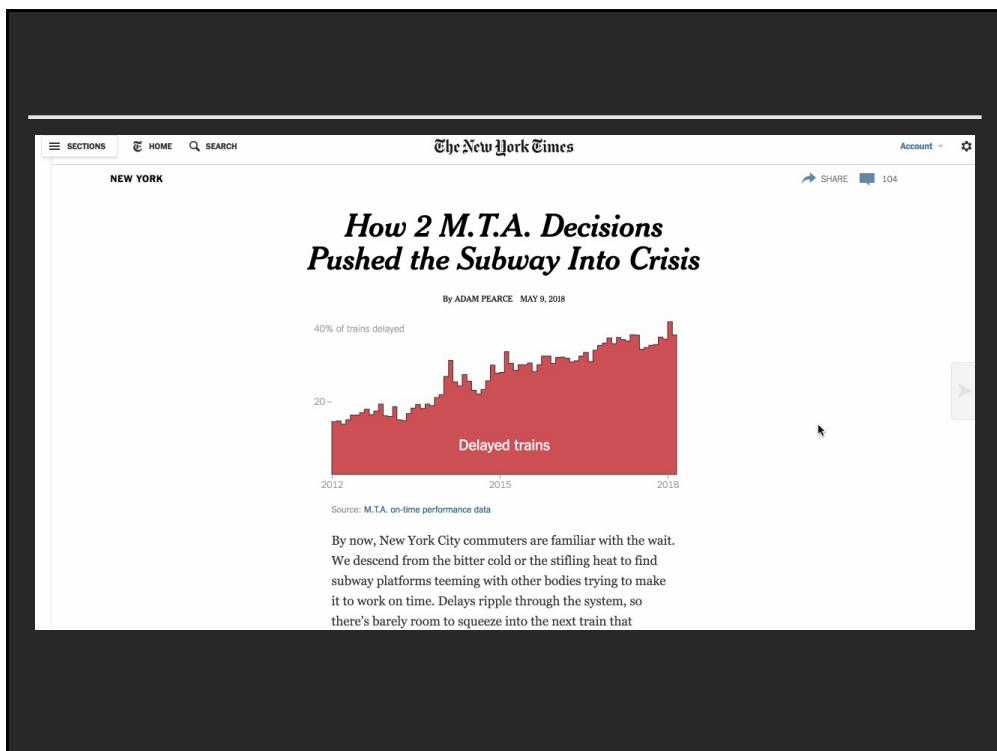
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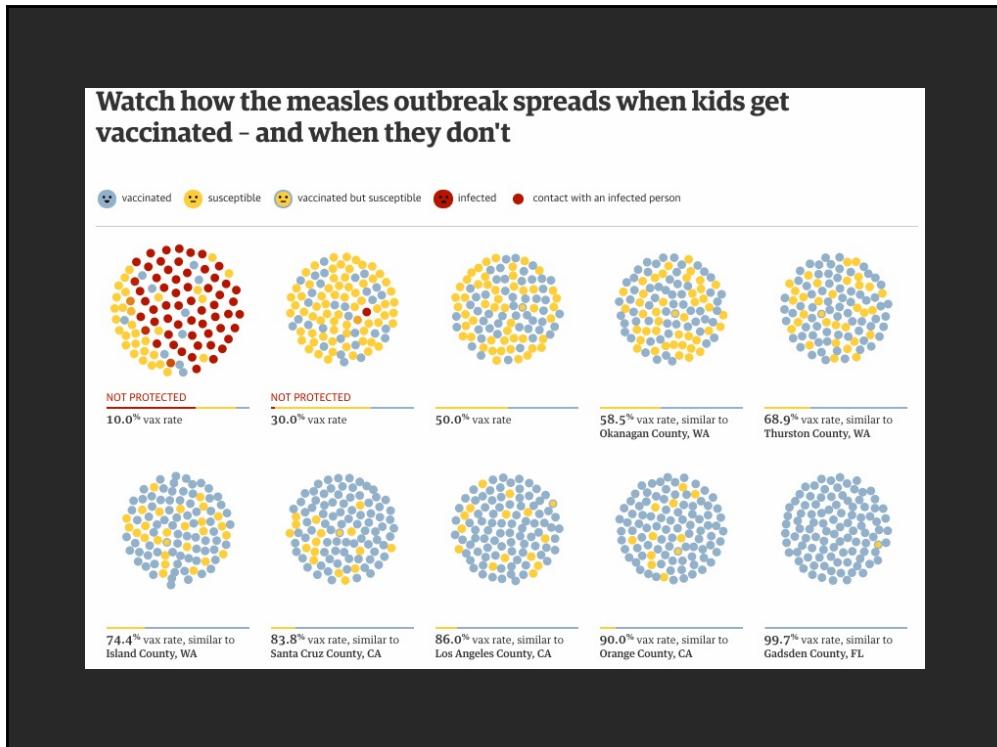
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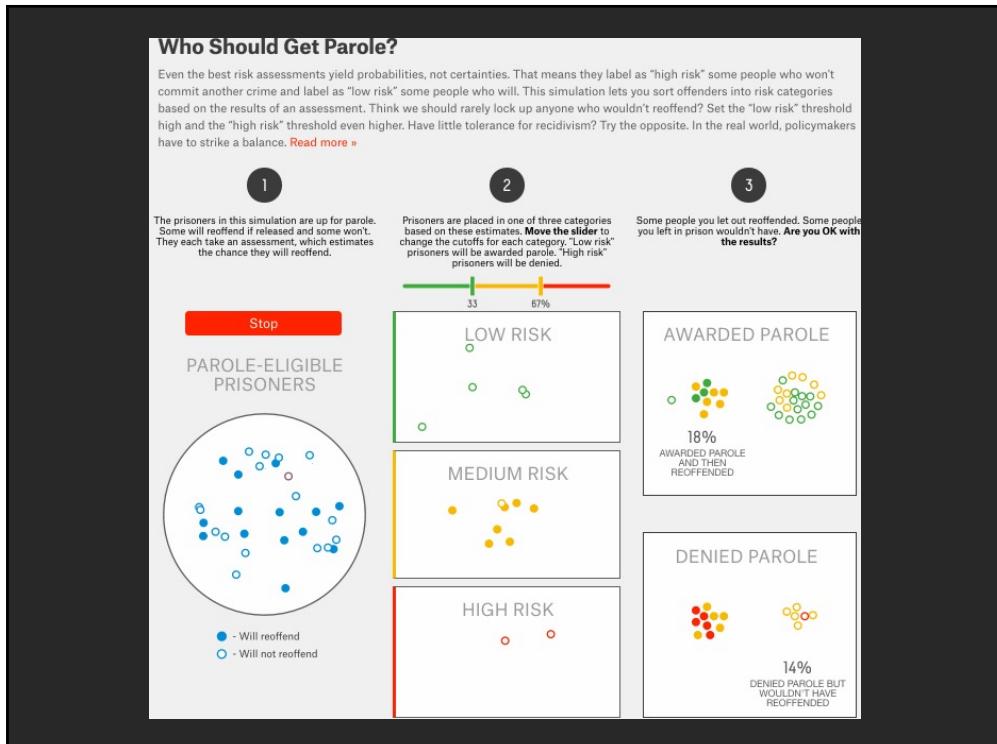
71

Interactive Documents

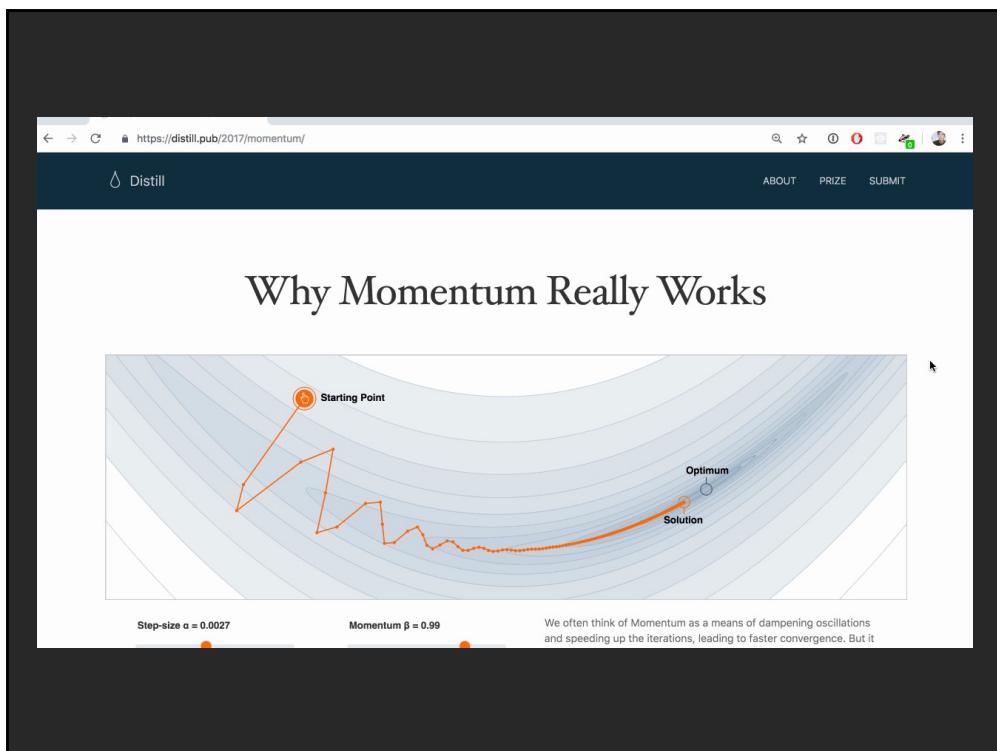
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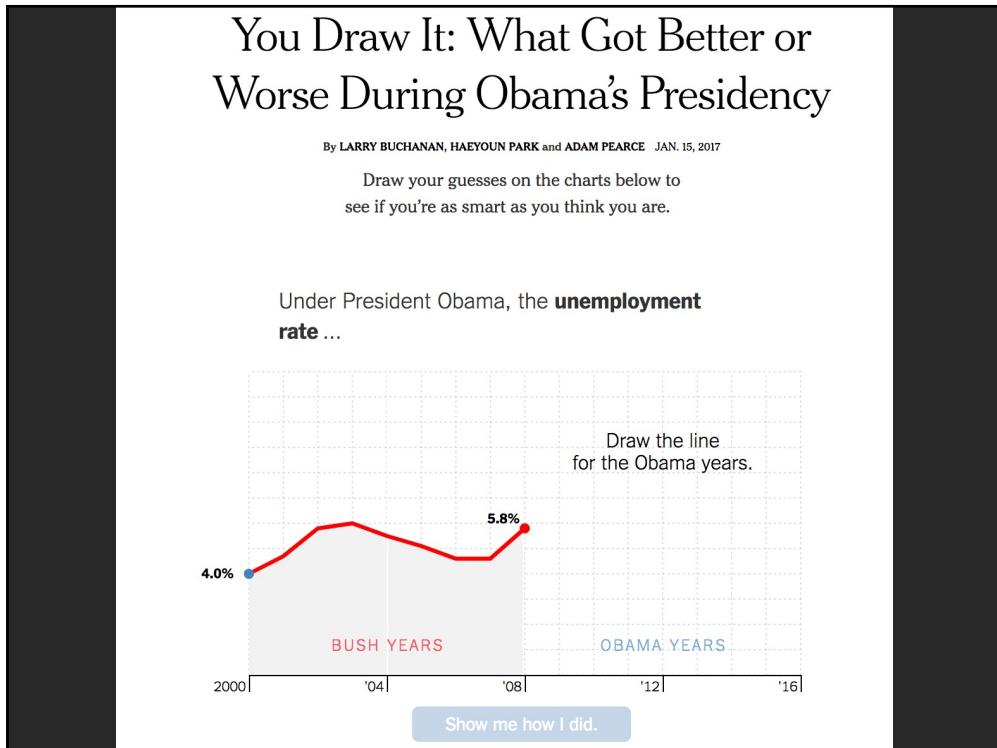
73



74



75



77

Chart Sequences

84