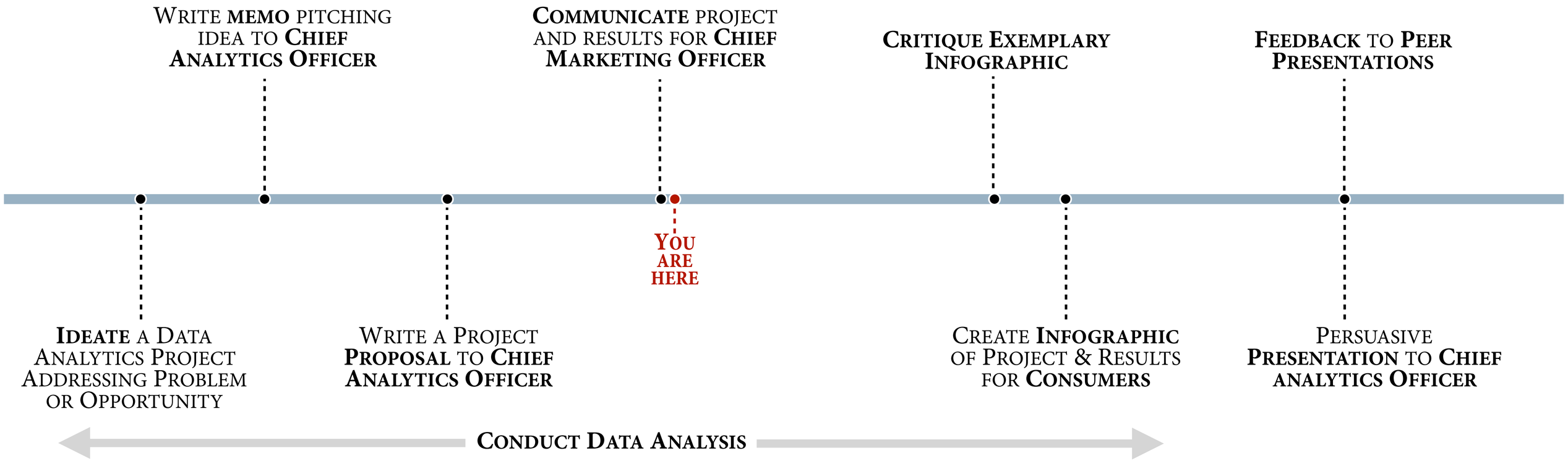
Storytelling With Data

# The storytelling process, and designing data graphics

Scott Spencer | Columbia University

# Conceptual project timeline

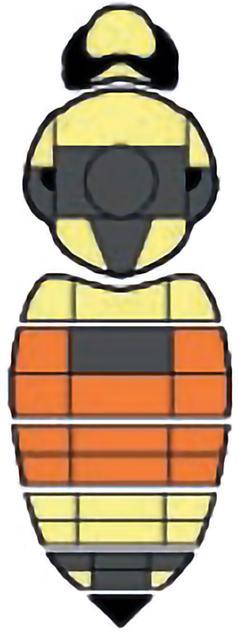


# (more on) storytelling

See, Think, Design, Produce

understand explain

Corum, Jonathan

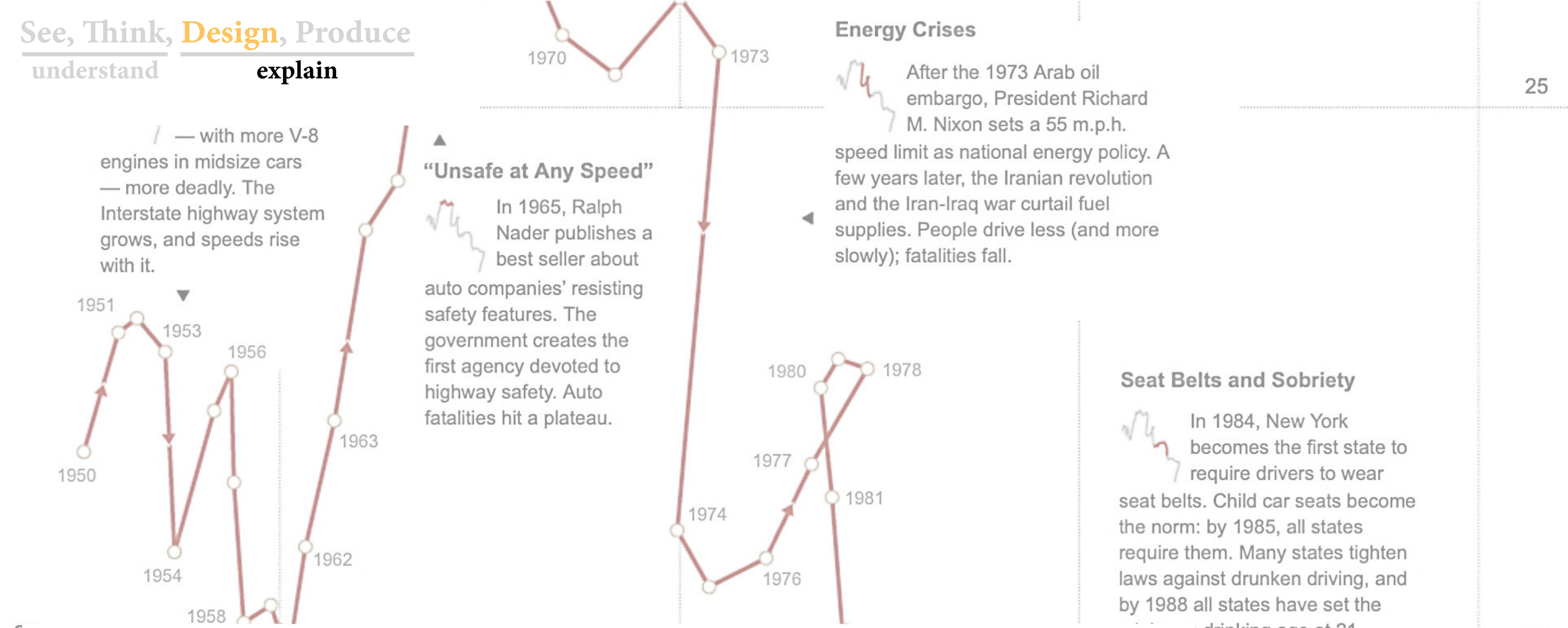


## Search for patterns by comparing

Visualization is not counting. Search for meaningful patterns, try to understand patterns, visualize patterns and try to explain them. Part of this is comparing. Another part is finding what's possible. Look at more ideas than you can use. Finally, practice — a lot!

## Sketch until your aha! moment

Finding a clear thought through visualization can begin with sketching, on either paper or screen. Sketching is visual problem solving, not a commitment. It's much easier to begin with an ugly sketch and make it prettier as you work on design.



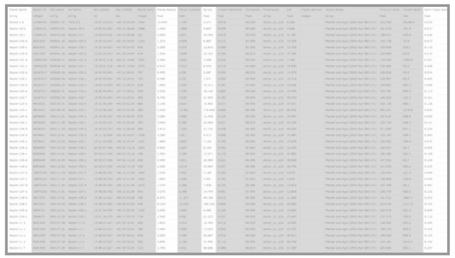

**Design for someone else, show varying details**

E.T. said "Good design is clear thinking made visible." The goal of design is to elegantly show your clear thought. Try to use a range of scales, or viewpoints, in what you show. Very important — show change, not trivia! Annotate.

# See, Think, Design, Produce

understand — **explain**

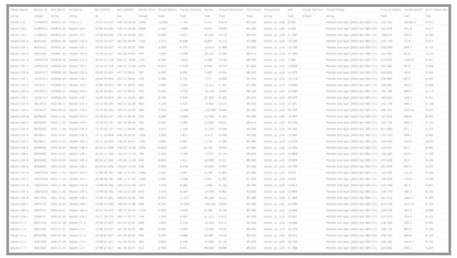
*one of Corum's project process examples*



source data

→ IP[y] →

iPython notebook



processed data

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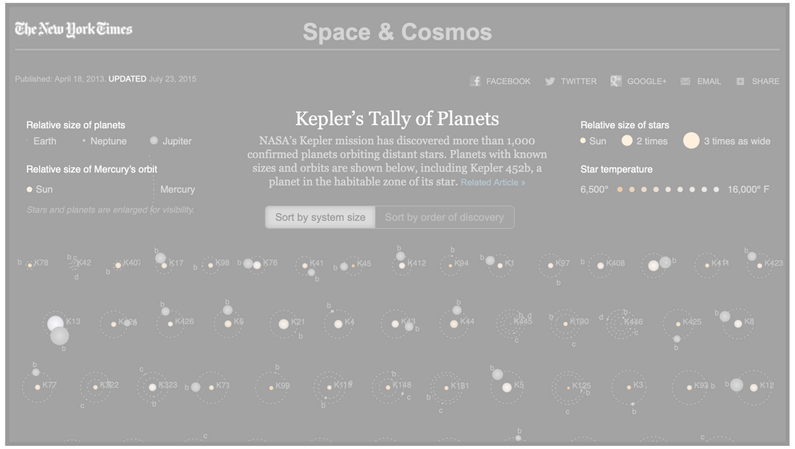


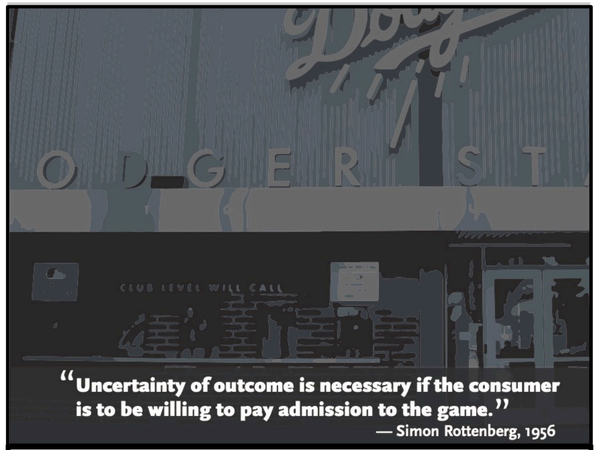

## Hone ideas within limitations

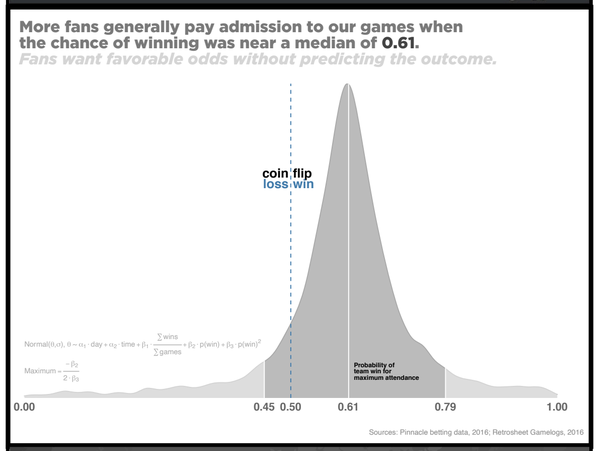
Embrace limitations; use them to hone your ideas. Understand every step—leave nothing to magic—in your production. Design is cumulative decision making. Remember what it is like to not understand.

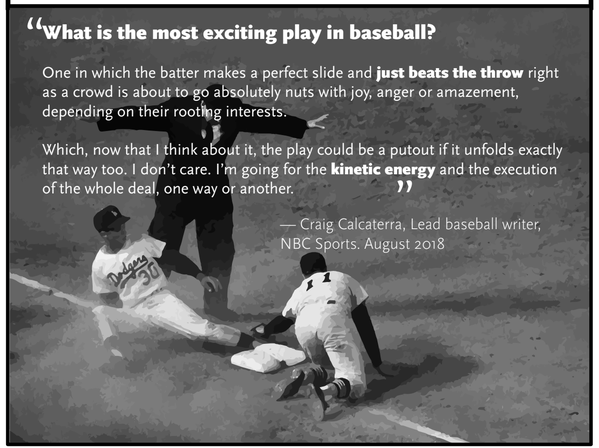
# storyboards — (another draft) example

Storyboard | We can generate more excitement to market with our new probability model of game events. | Date: 2019 February 29 | To: Larry Rosen, CMO | From: Scott Spencer

## Visual narrative




## Written narrative

### 1

We dread an empty ticket booth. Our average game attendance hovers around mid-80 percent capacity — we have seats to fill, despite having winning seasons.

To draw more fans, consider the words of famed economist Simon Rotternberg, who said "uncertainty of outcome" is necessary for consumers to pay admission to ball games. While winning is important, it's the not-knowing that creates excitement. Have we maximized winning with uncertainty of outcome?

### 2

Simon's statement held true at our stadium, too, last year.

We modeled attendance as a function of the uncertainty of outcome, attempting to account for other factors like day of the week, time of day, and our cumulative fraction of wins.

We learned that attendance was associated with a win probability — as measured by betting markets — near 0.62.

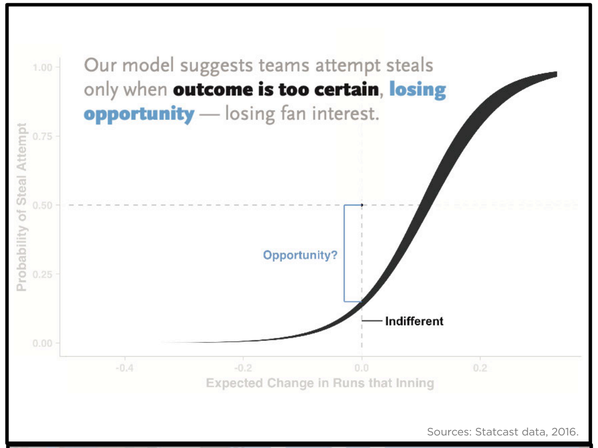
Game uncertainty, of course, comes from play uncertainty.

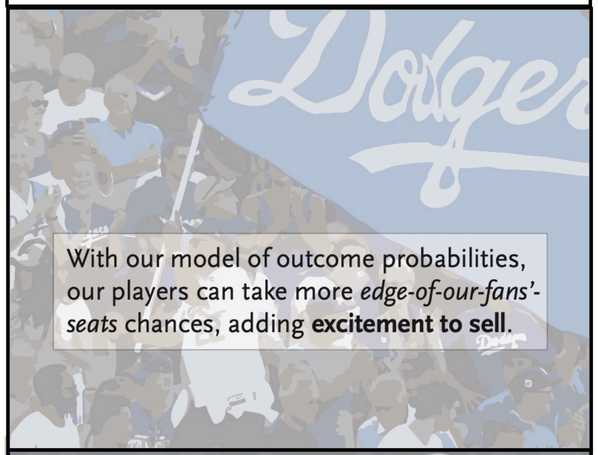
### 3

Let's focus, then, on an event that lead baseball writer for NBC sports, Calcaterra, said is potentially the most exciting play in baseball. He says that the most exciting play may be one where the baserunner just beats the catcher's throw when stealing a base.

Using our model, we asked whether we are maximizing base-stealing excitement. We considered running speed of the player on first base, catcher throw time to second base, the latent talents of the specific pitcher, catcher, and baserunner, and estimated the probability of successfully stealing second.

## Visual narrative





## Written narrative

### 4

As we know, our wins come from runs. From a game outcome perspective — whether teams win — managers should be indifferent if a baserunner steals when the expected change in runs is zero. Our model suggests baserunners on all teams are too conservative. And us? We ranked 13th in uncertainty of outcome on base stealing.

### 5

Following the model, our baserunners will know to steal more often, when the outcome is less certain, but the probability still favors our team.

We still have room to take more risks — with *all plays*, not just base stealing. With this knowledge and marketing, we can help consumers experience more uncertainty in what happens, to enticing more fans into seats.

### 6

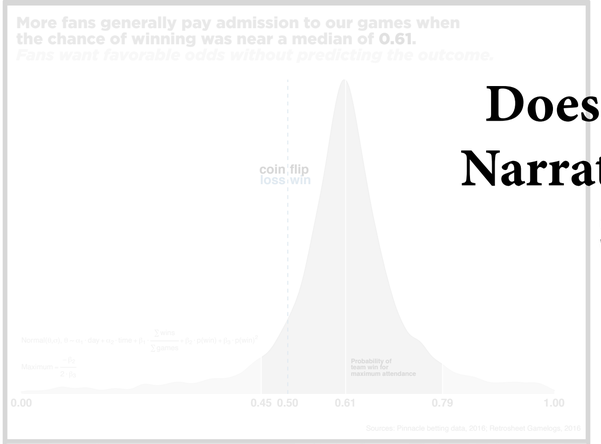
By accessing our model, marketing can make better content even before games start. While the model is proprietary, marketing will know ahead of time what matchups may be more interesting and can use our estimates to build anticipation. Along with pre-game insights, marketing can better engage with fans on social media, and stream better highlights. Marketing better content will add post-game buzz.

Storyboard | We can generate more excitement to market with our new probability model of game events. | Date: 2019 February 29 | To: Larry Rosen, CMO | From: Scott Spencer

Visual narrative



"Uncertainty of outcome is necessary if the consumer is to be willing to pay admission to the game."
— Simon Rottenberg, 1956







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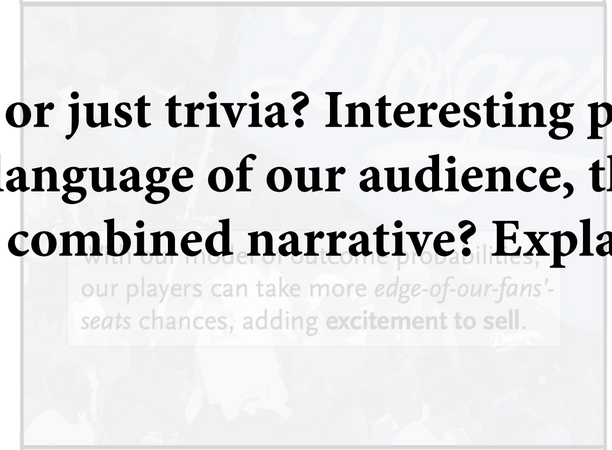
Visual narrative







Written narrative

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**Does the storyboard show change or just trivia? Interesting patterns?**
**Narrative and annotations use the language of our audience, the CMO?**
**Storyboard help evaluate the combined narrative? Explain.**

# Establishing *context* for your data

**Who What When Where Compare**

**Poor:** **“There were 25 million deaths.”**

**Better:** **“During the fourteenth century, 25 million people died in Europe.”**

**Best:** **“When the Black Plague hit Europe in the latter half of the fourteenth century, it took the lives of 25 million people, young and old, city dwellers and those living in the countryside. The disease killed about one-quarter of Europe’s total population at the time (Mack, n.d.).”**

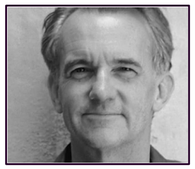
# (more on) data graphics

# (un)helpful encodings

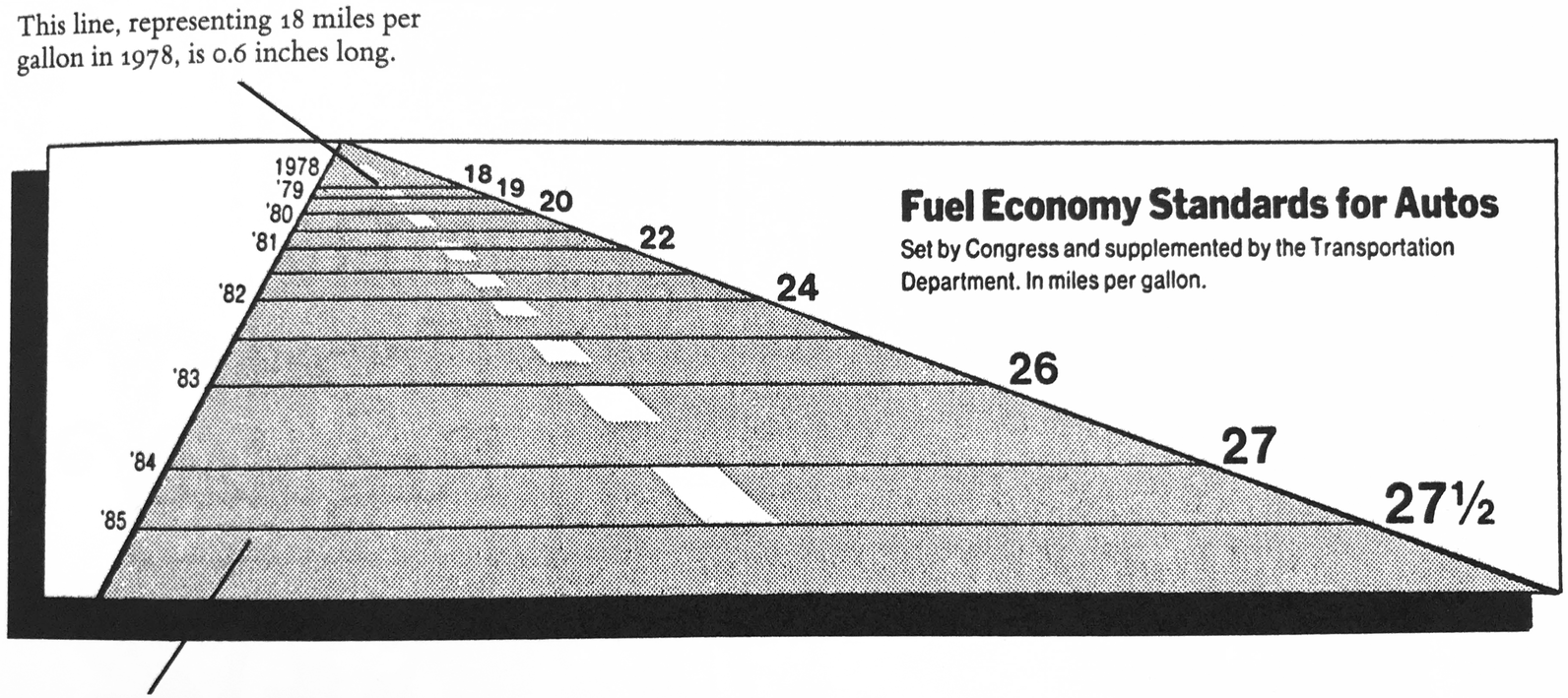
Fuel economy difference between 1985 and 1978

Numerical
**14.8** percent

Graphical
**783** percent

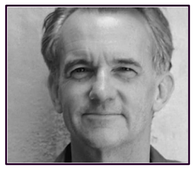


Tufte, Edward

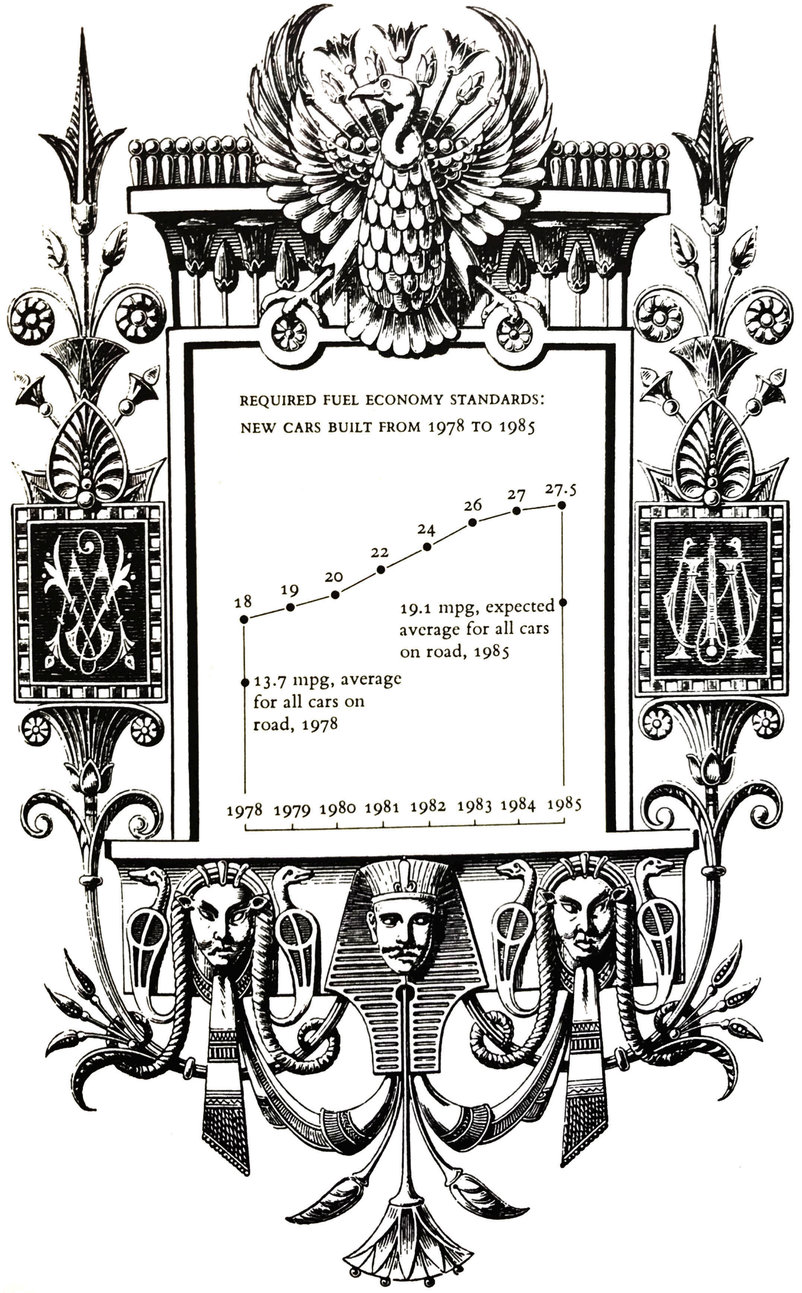


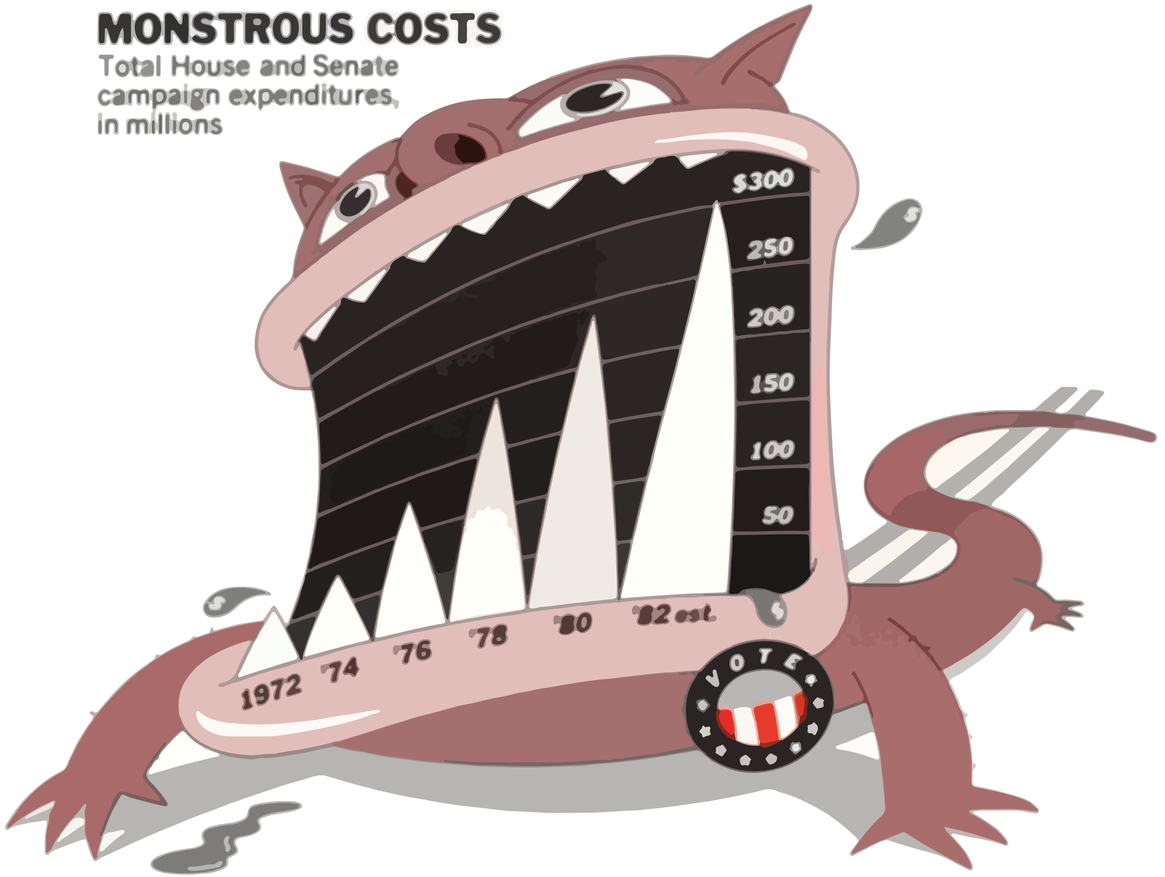

*New York Times*, August 9, 1978, D-2.

# (more on) data graphics | *chart junk and unhelpful encodings?*



Tufte, Edward



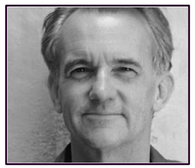



Holmes, Nigel

$$\text{data-ink ratio} = \frac{\text{data-ink}}{\text{total ink used to print the graphic}}$$

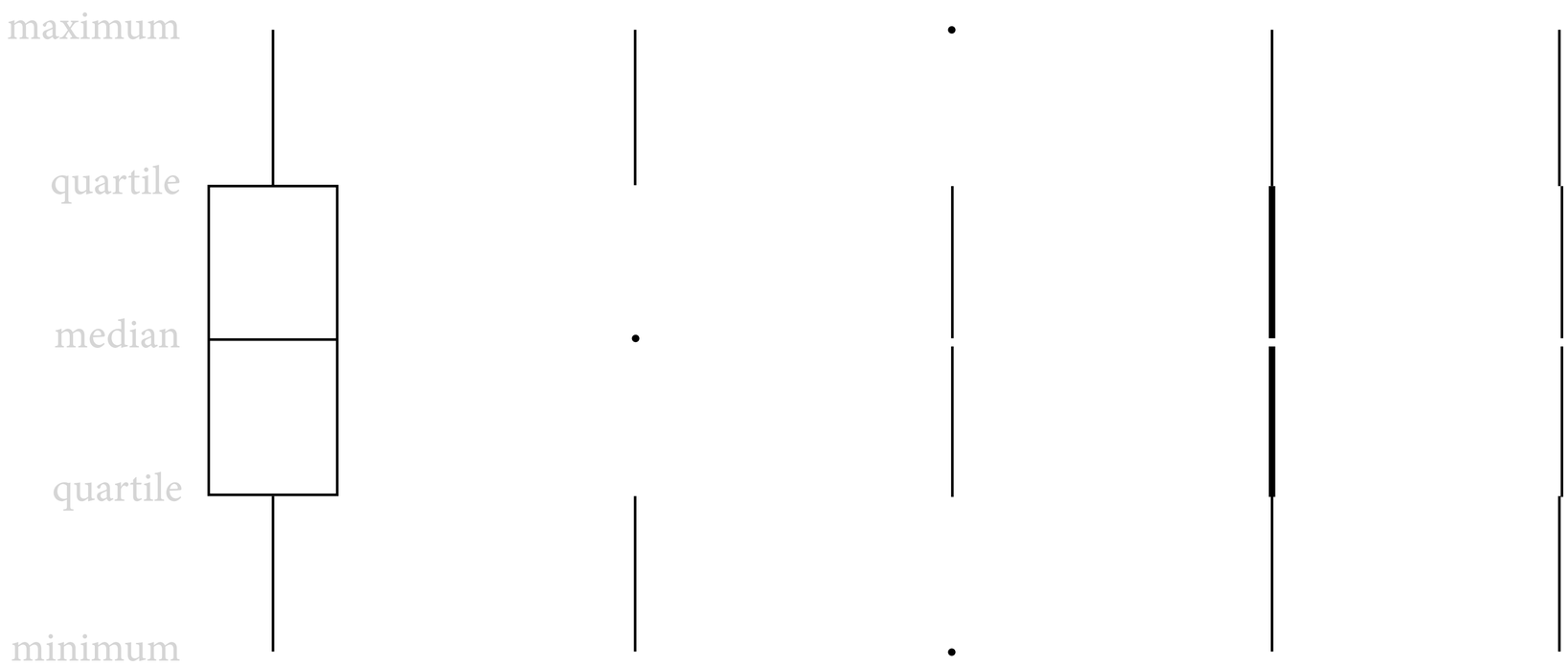
$$= \text{proportion of a graphic's ink devoted to the non-redundant display of data-information}$$

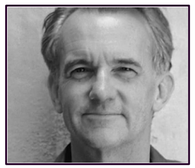
$$= \text{1.0 – proportion of a graphic that can be erased without loss of data-information}$$



Tufte, Edward

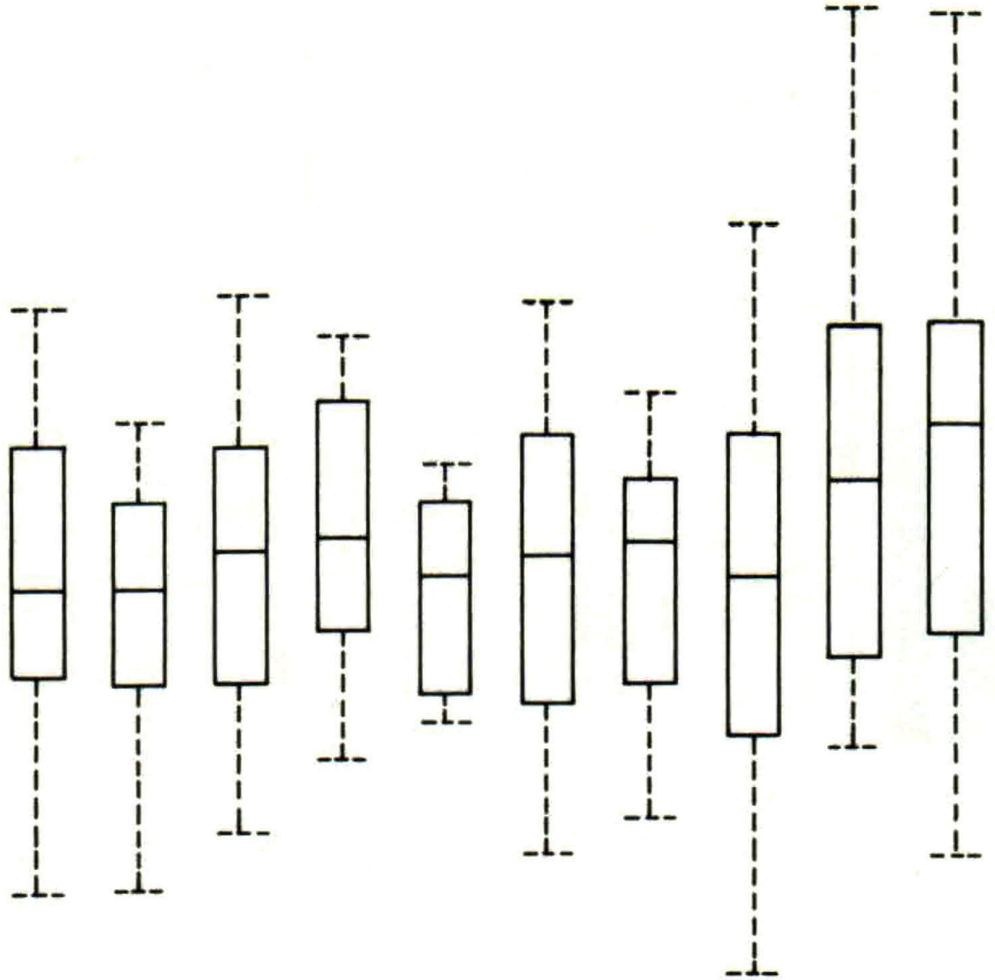
# Experimenting with data graphics

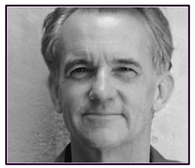


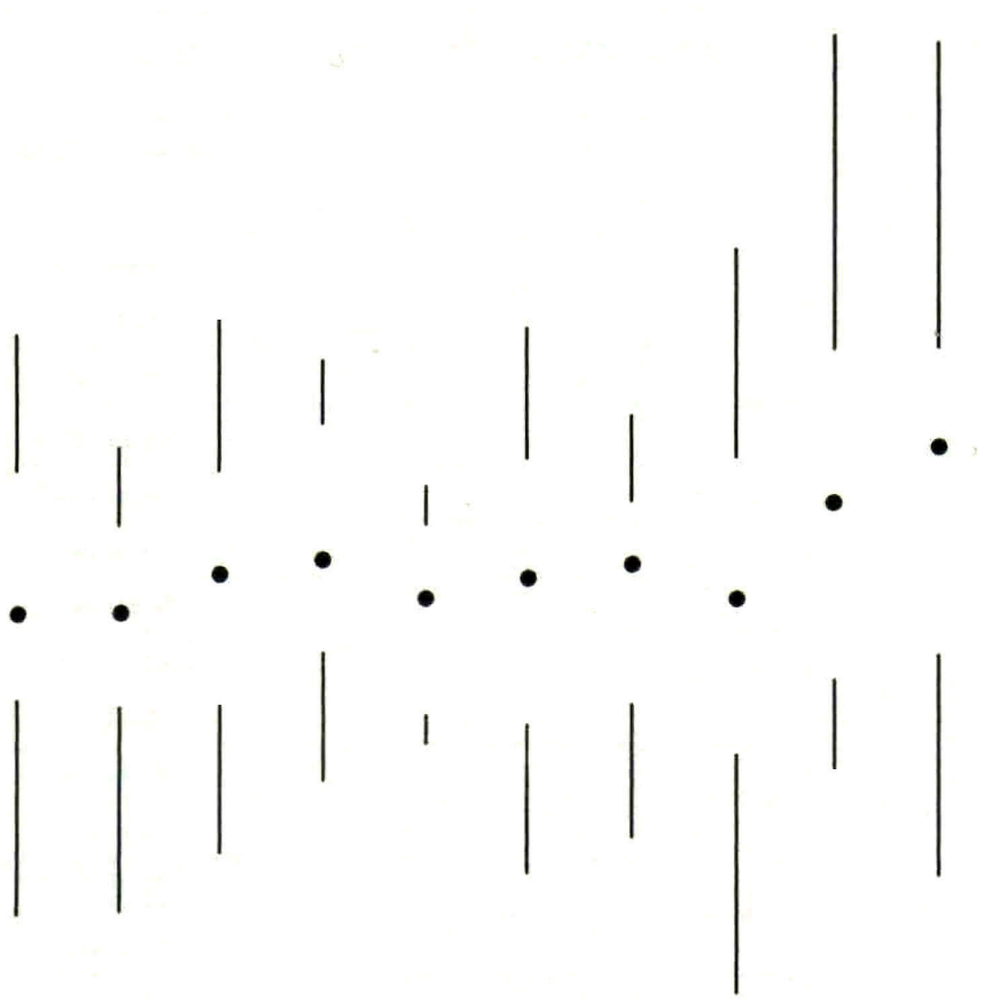
In these revisions of the box plot, . . . the best overall arrangement naturally also rests on statistical and aesthetic criteria — in other words, the procedure is one of *reasonable* data-ink maximizing.

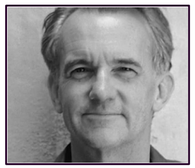
Tufte, Edward





Tufte, Edward





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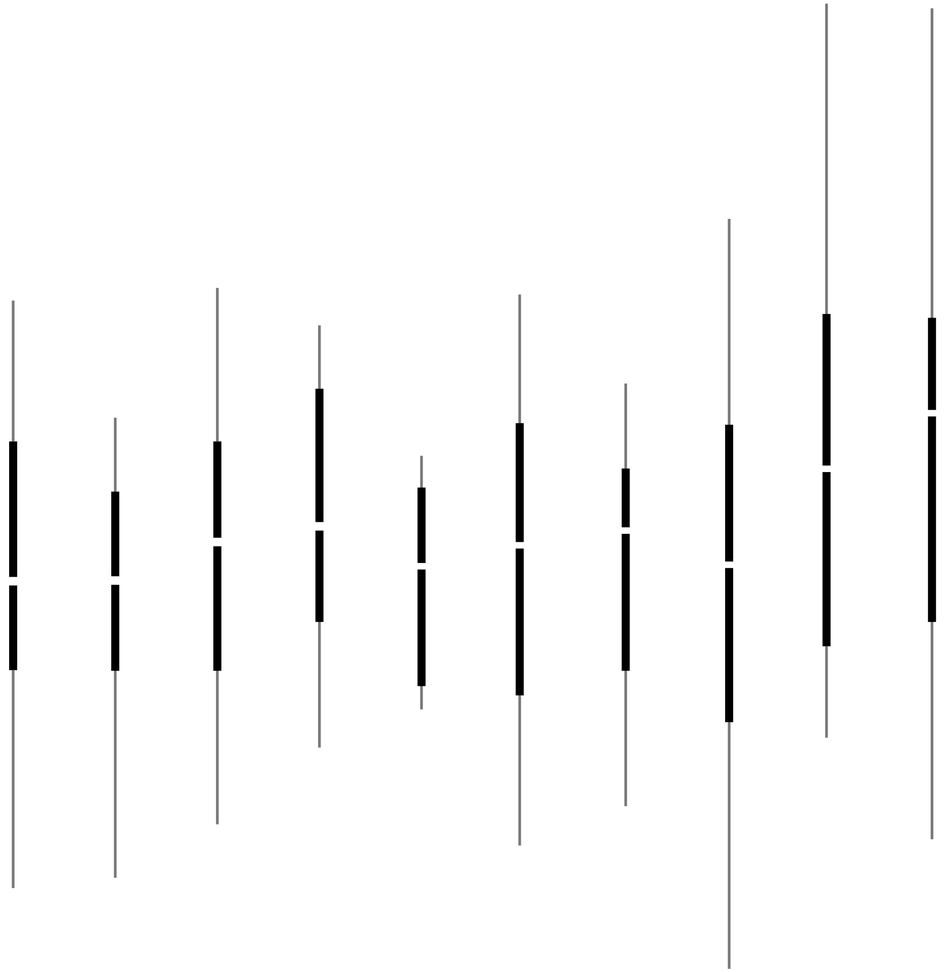

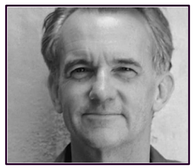

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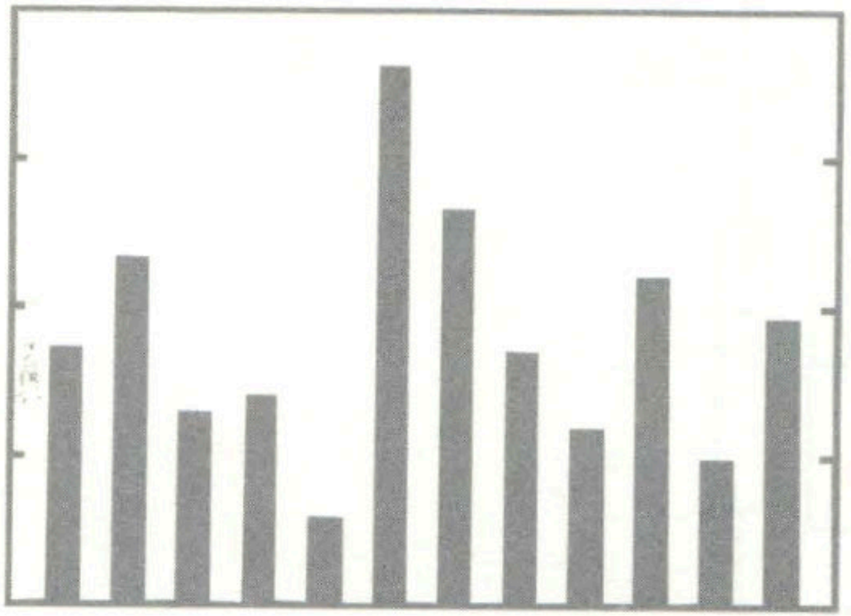

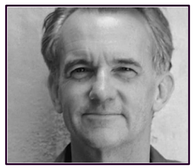

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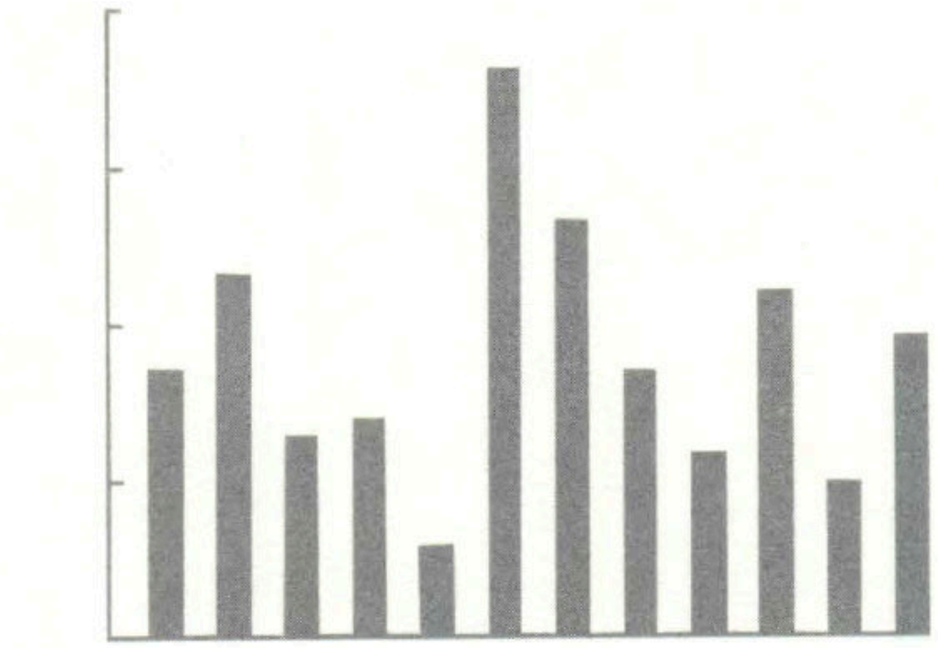

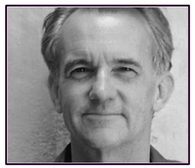

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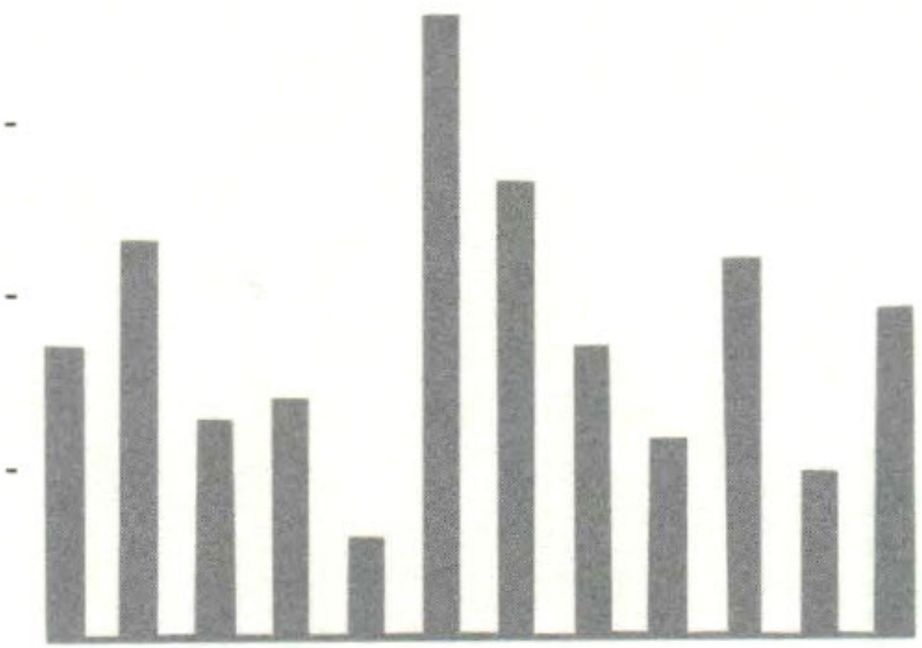

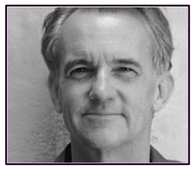

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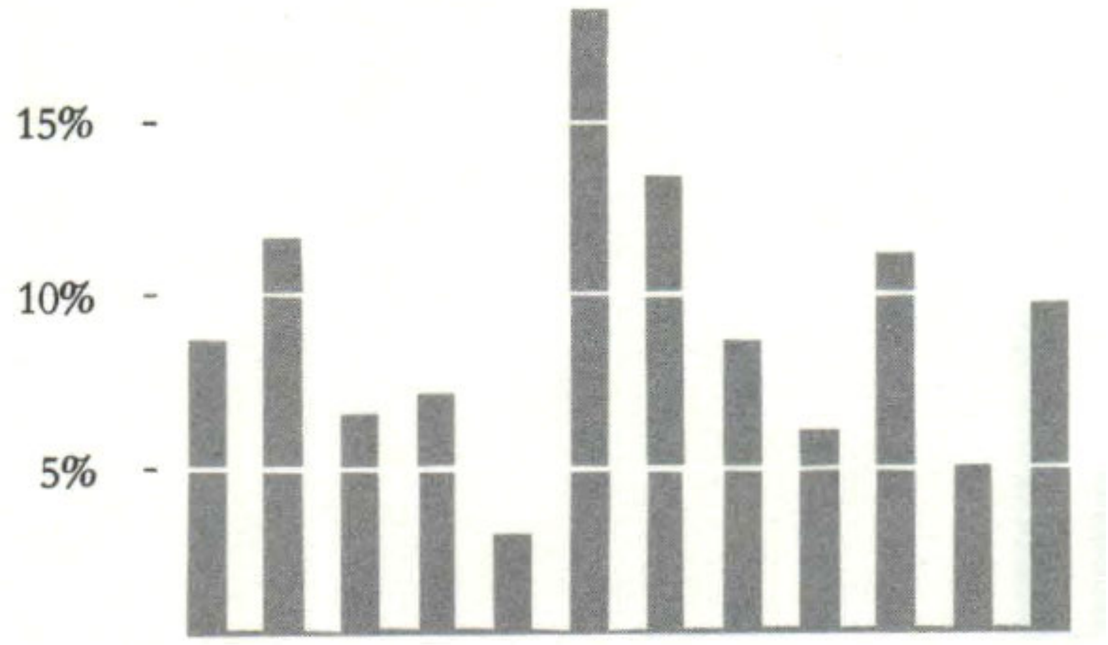
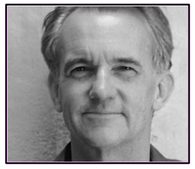
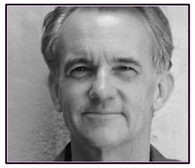


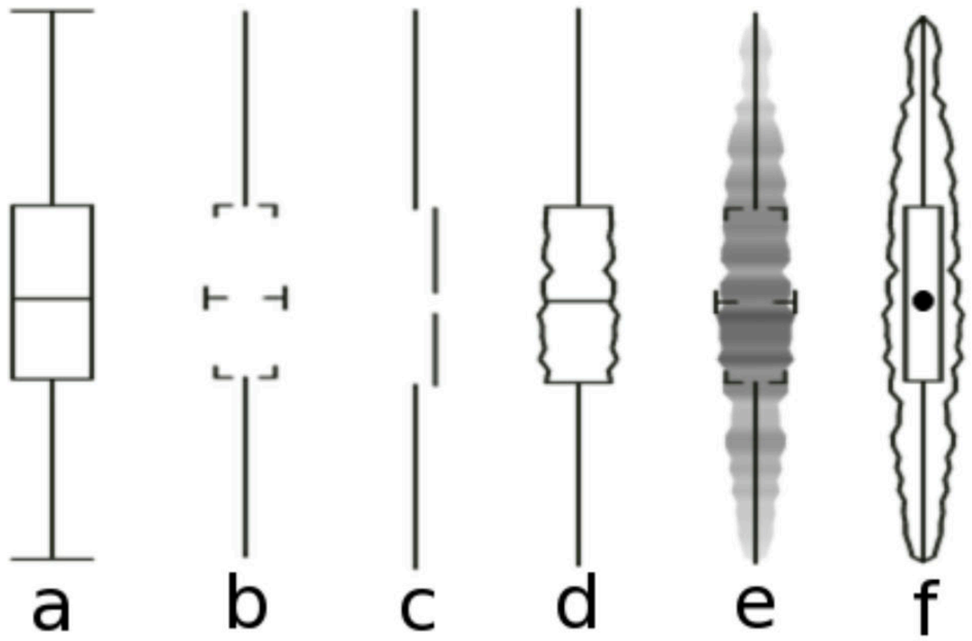
Tufte, Edward

> Maximizing data ink (within reason) is but a single dimension of a complex and multivariate design task.
>
> The principle helps conduct **experiments in graphical design**.
>
> Some of those experiments will succeed.
>
> There remain, however, many **other considerations** in the design of statistical graphics — not only of efficiency, but also of **complexity**, **structure**, **density**, and even **beauty**.



Tufte, Edward

**How might we decide which data graphics from experiments to use?**




Anderson et al. (2011) found that, of the four kinds of boxplot shown in Figure 1.7, the minimalist version from Tufte's own work (option C) proved to be the most cognitively difficult for viewers to interpret.

Cues like labels and gridlines, together with some strictly superfluous embellishment of data points or other design elements, may often be an aid rather than an impediment to interpretation.

Healy, Kieran

**Design is a search problem**

**Prototypes should emphasize speed over polish.**

**Get fresh eyes frequently. Invite criticism.**

**Move from exploring to refining.**

Bostock, Mike

SECTIONS HOME SEARCH The New York Times Account

Joe Biden, in Video, Says He Will Be 'More Mindful' of Personal Space

Senate Republicans Go 'Nuclear' to Speed Trump Confirmations

Subpoena for Mueller Report and Documents Approved by House Judiciary Committee

House Intelligence Committee Seeks Documents From Trump's Inaugural

In Rare S… Leader S…

POLITICS | ONE-PARTY RULE SHARE

# Taking the Battle to the States

By HAEYOUN PARK, JEREMY ASHKENAS and MIKE BOSTOCK JAN. 11, 2014

Republicans or Democrats have single-party control of both the legislature and the governor's office in 36 states, the most in six decades. Lawmakers in these states have been seeking to reshape government policy in recent years, from legalizing same-sex marriage to restricting labor unions. Some of these laws were passed after the rapid rise of single-party control in 2010; others have been in place for years. Below is a look at where states stand on some key issues.

88 million people live in states with **Democratic** control of both legislatures and the governor's office.

69 million people live in states with **mixed** control.

157 million people live in states with **Republican** control.

**Did not pass** new restrictions in 2013

CO MN MA CA IL KY WA NY NJ TN FL AZ

## Abortion

Twenty-two states — all but six controlled by Republicans — enacted 70 abortion restrictions in 2013, according to the Guttmacher Institute, a research group. Laws ranged from bans on abortions 20 weeks after fertilization to limitations on insurance coverage of abortions.

**Passed** new restrictions in 2013

MD VA MO MI GA OH NC TX PA IN WI AL SC LA

**Expanded** Medicaid

CO MN MD MA CA IL KY WA NY NJ AZ OH MI

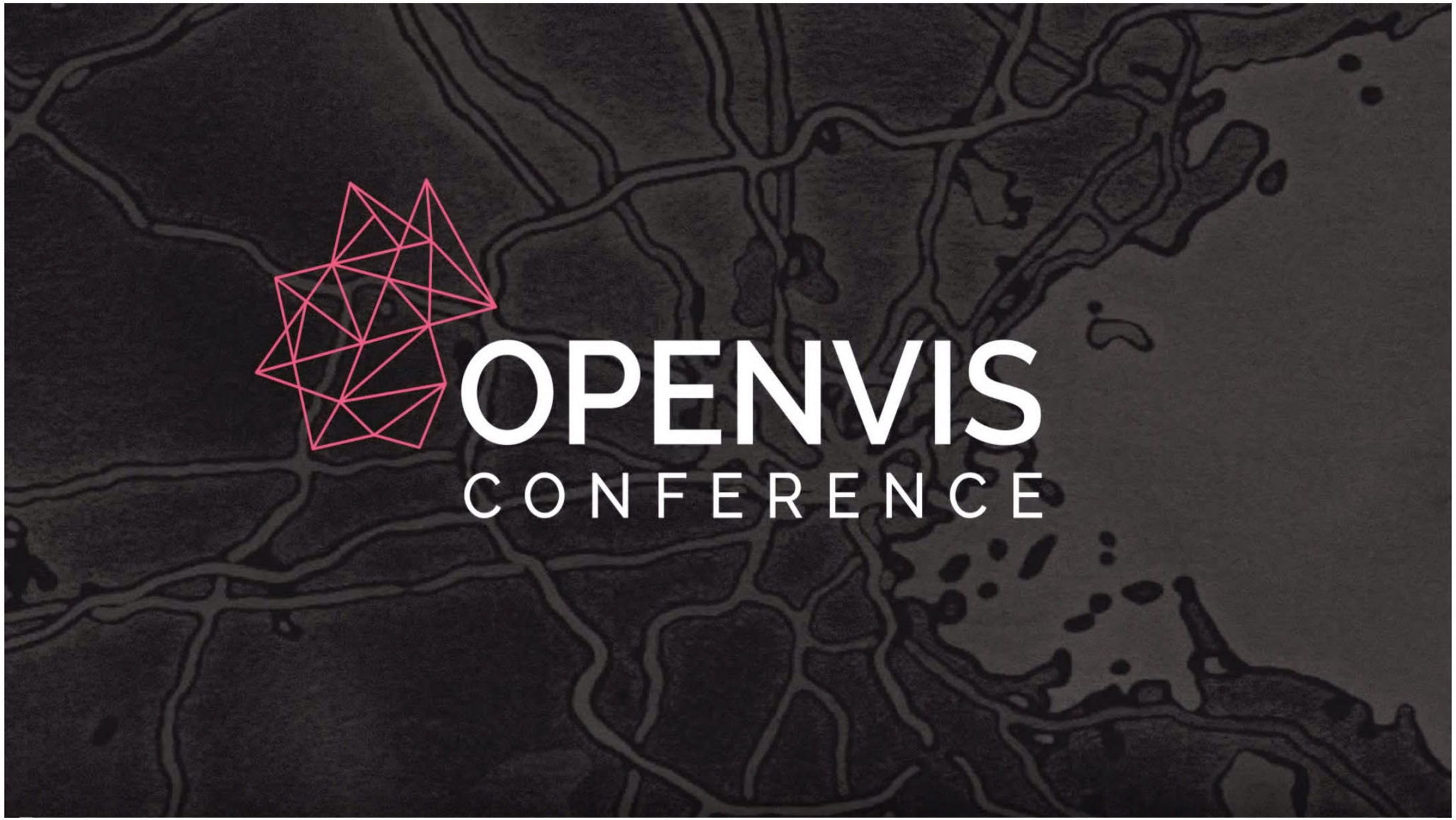
## Medicaid

A 2012 Supreme Court decision allowed states to decide whether to expand Medicaid to more low-income adults under the Affordable Care Act. All 13 Democratic states have expanded the program. Most Republican states did not. Pennsylvania, Indiana and Tennessee have not expanded it but may do so.

**Have not expanded** at this time

VA MO GA PA NC IN TX FL TN WI AL SC LA

Bostock, Mike




Bostock, Mike

The New York Times **SPORTS**

Published: November 30, 2013

# Tracing the History of N.C.A.A. Conferences

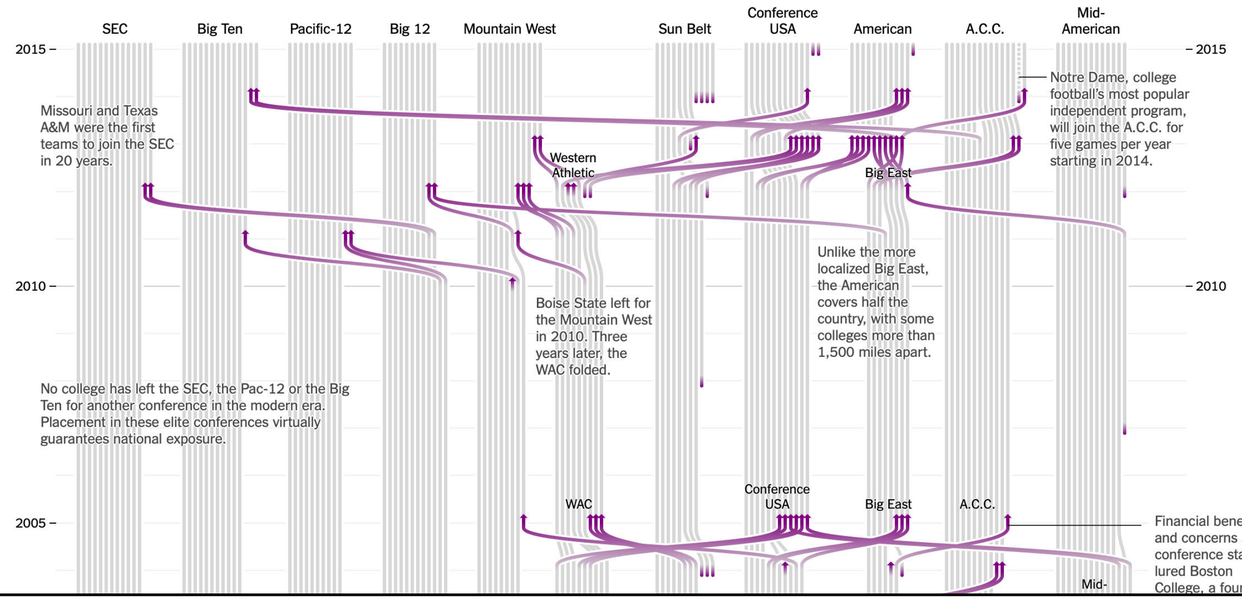
By MIKE BOSTOCK, SHAN CARTER and KEVIN QUEALY

A frenzy of realignment has transformed college athletics: about one in four major football programs has switched conferences since 2010. The effects are only starting to play out as programs build new infrastructure to televise and market their programs, especially in up-and-coming conferences. As conferences have become essential to stay competitive, the number of unaffiliated major schools has declined sharply. Here, how major college football programs have shifted since 1965.

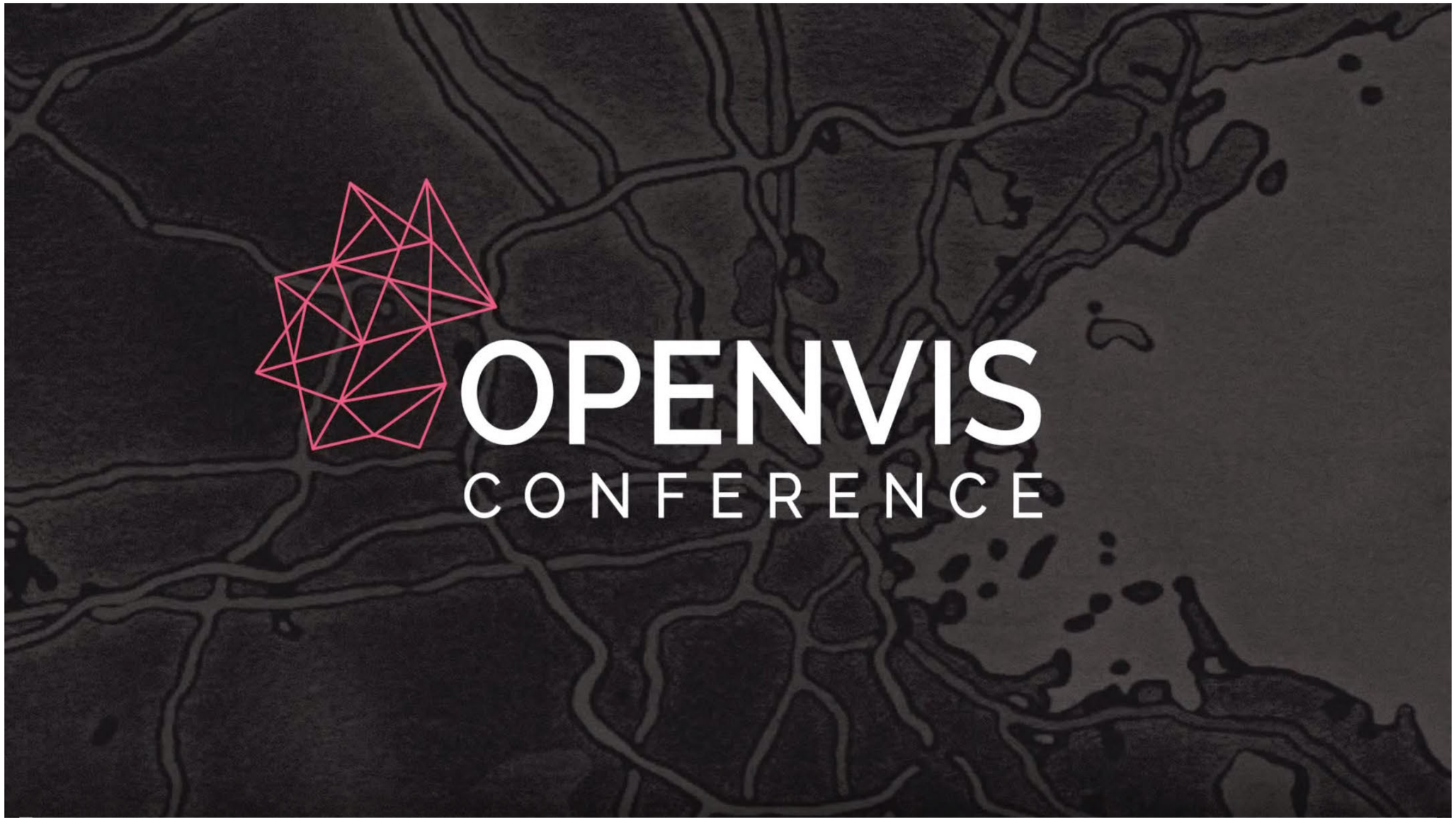
**Major college football programs since 1965**

Schools switching conferences are highlighted

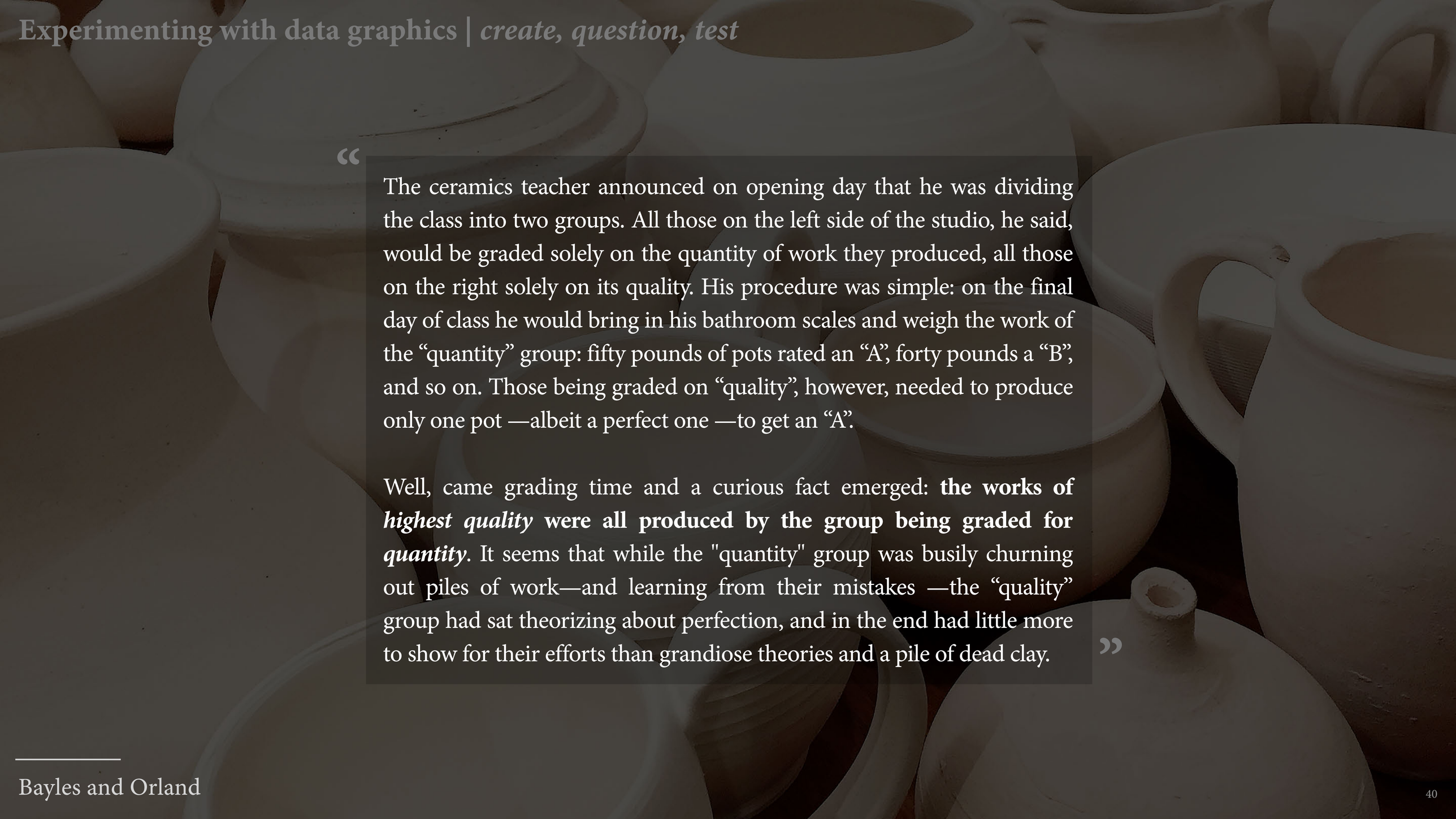
Select a team to highlight.




Bostock, Mike



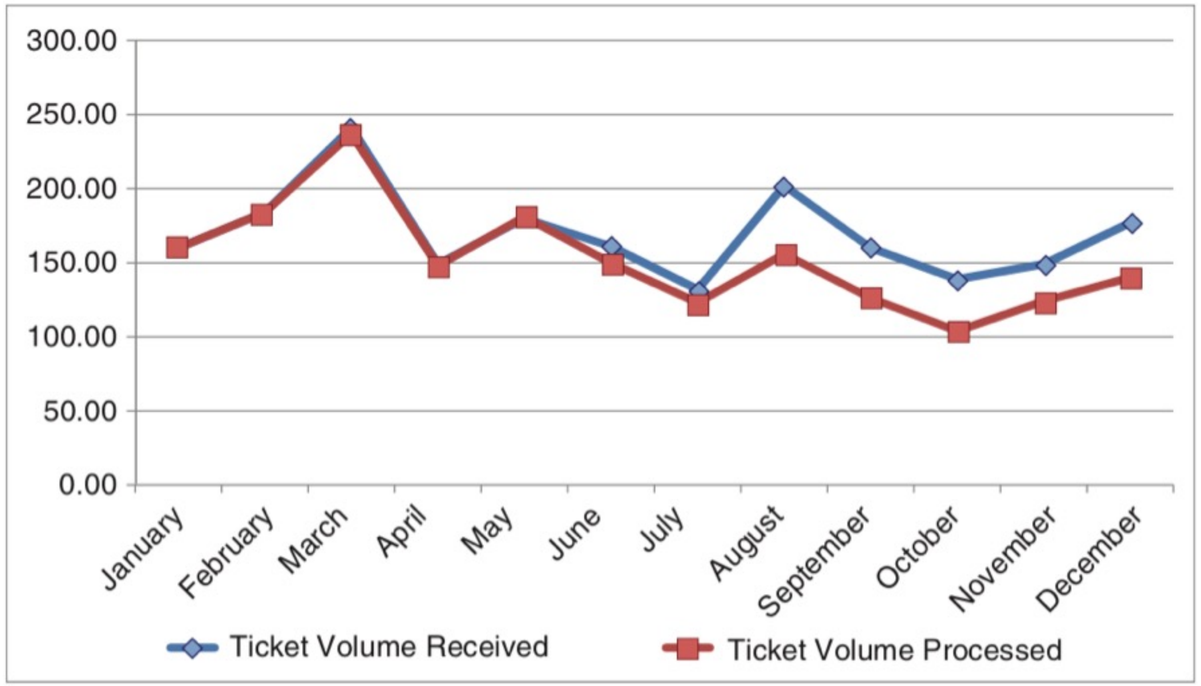

Bostock, Mike



> The ceramics teacher announced on opening day that he was dividing the class into two groups. All those on the left side of the studio, he said, would be graded solely on the quantity of work they produced, all those on the right solely on its quality. His procedure was simple: on the final day of class he would bring in his bathroom scales and weigh the work of the "quantity" group: fifty pounds of pots rated an "A", forty pounds a "B", and so on. Those being graded on "quality", however, needed to produce only one pot —albeit a perfect one —to get an "A".
>
> Well, came grading time and a curious fact emerged: **the works of *highest quality* were all produced by the group being graded for *quantity***. It seems that while the "quantity" group was busily churning out piles of work—and learning from their mistakes —the "quality" group had sat theorizing about perfection, and in the end had little more to show for their efforts than grandiose theories and a pile of dead clay.

Bayles and Orland

# From exploring to explaining
## *examples for discussion*



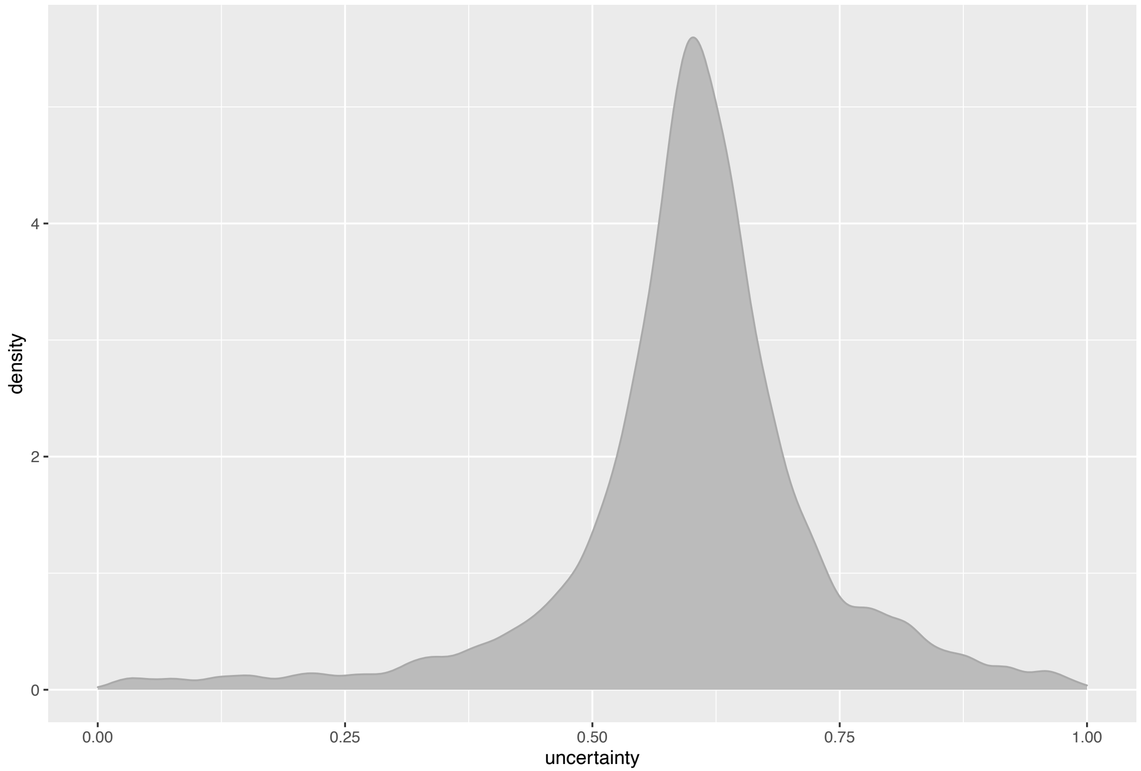

# Please approve the hire of 2 FTEs

to backfill those who quit in the past year

## Ticket volume over time

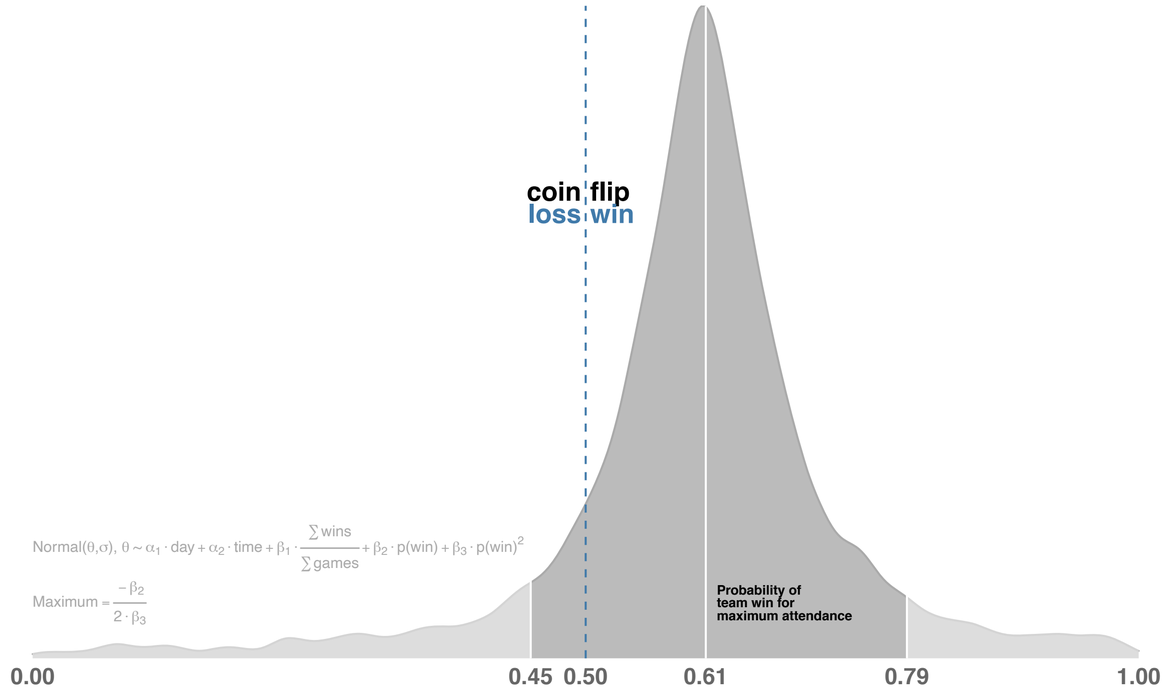

Data source: XYZ Dashboard, as of 12/31/2014 | A detailed analysis on tickets processed per person and time to resolve issues was undertaken to inform this request and can be provided if needed.

# From exploring to explaining | *Dodgers's example*



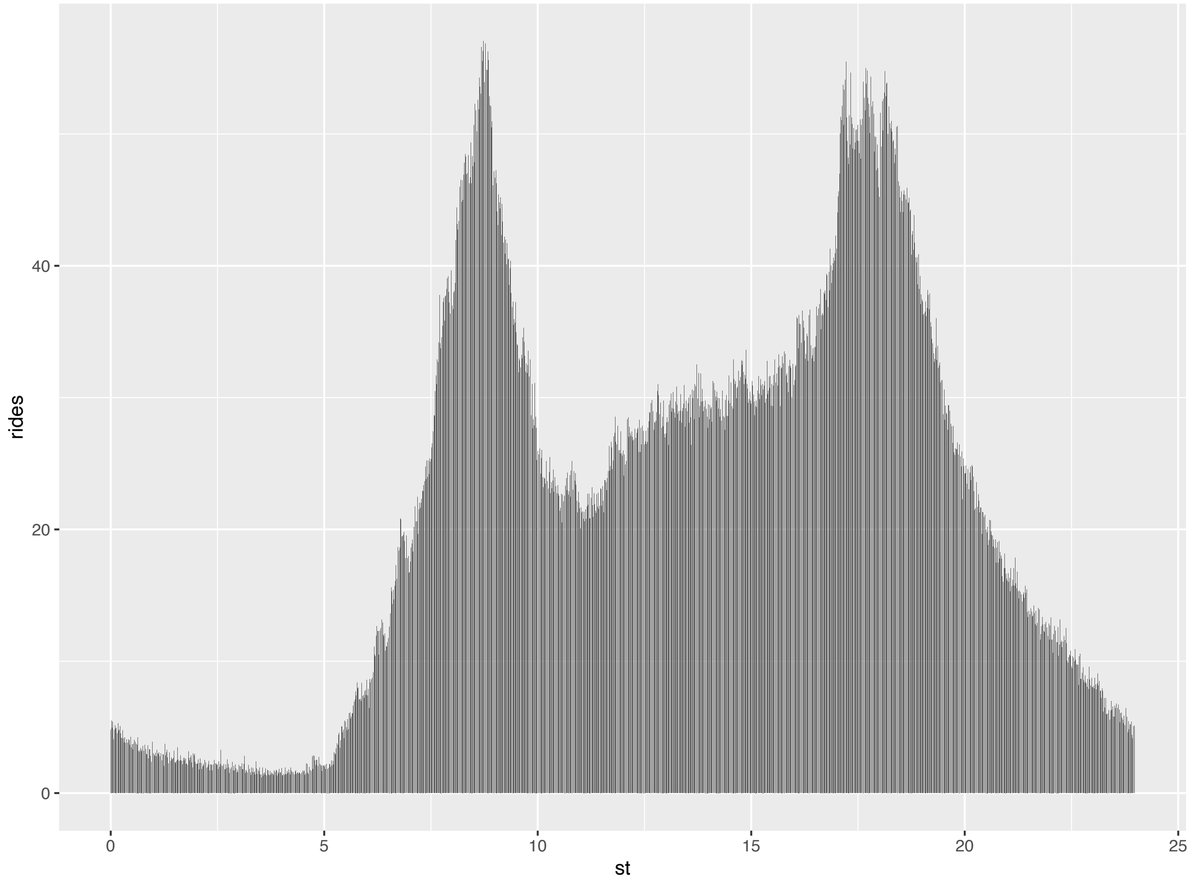

**More fans generally pay admission to our games when the chance of winning was near a median of 0.61.**

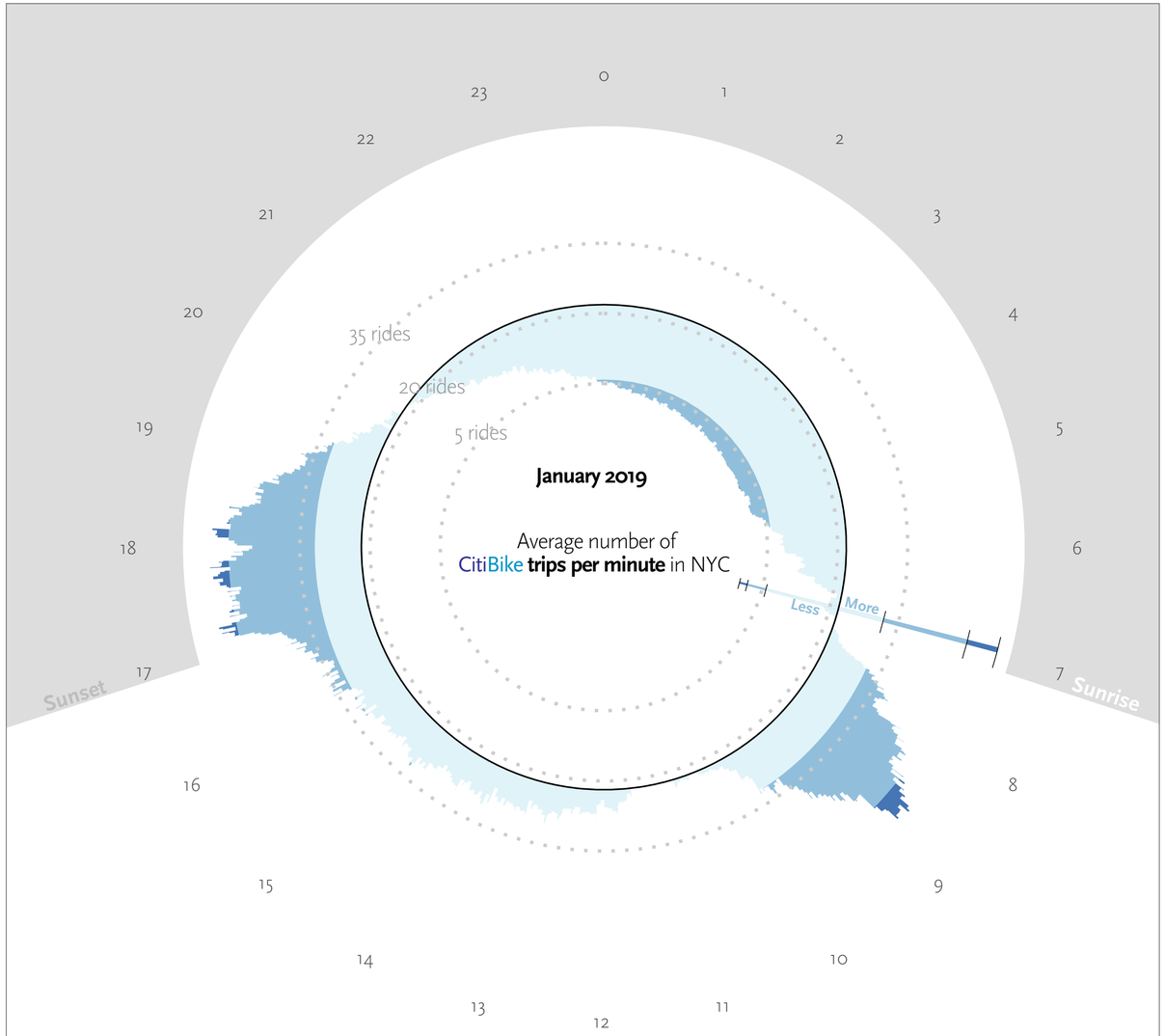
*Fans want favorable odds without predicting the outcome.*




Sources: Pinnacle betting data, 2016; Retrosheet Gamelogs, 2016

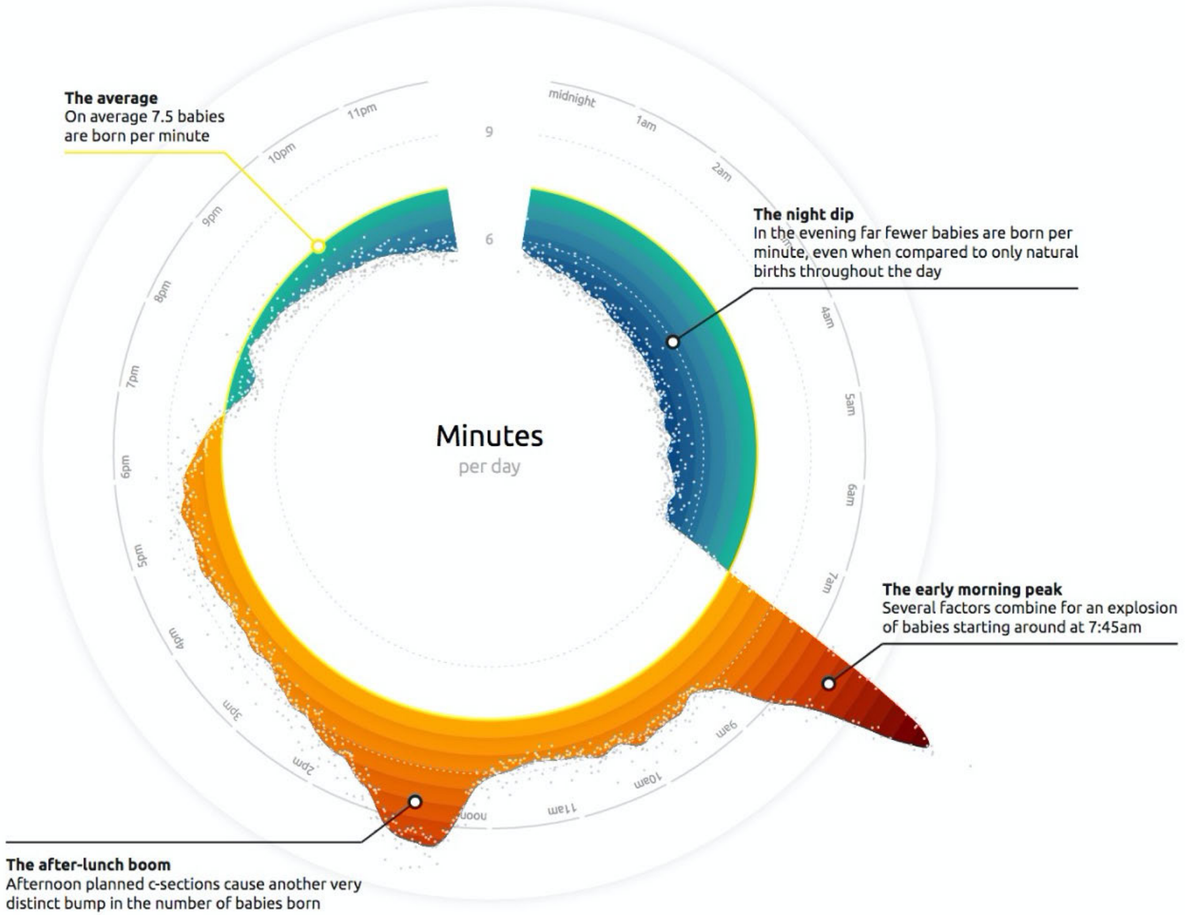
# From exploring to explaining | *Citibike example*

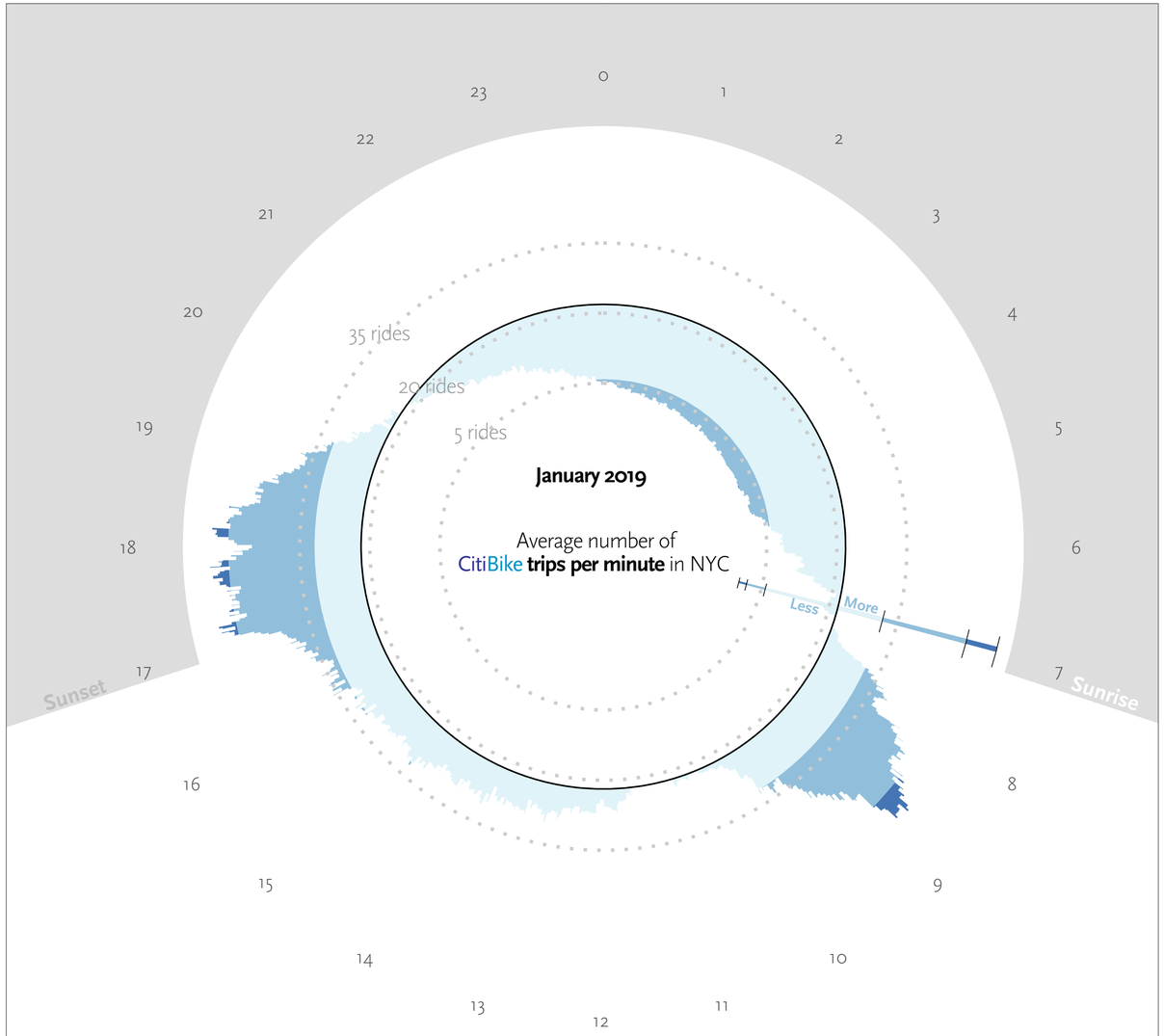



Our rebalancing work should be mindful that — in January — our customers most compete for bikes *after sunset*, **in the dark.**

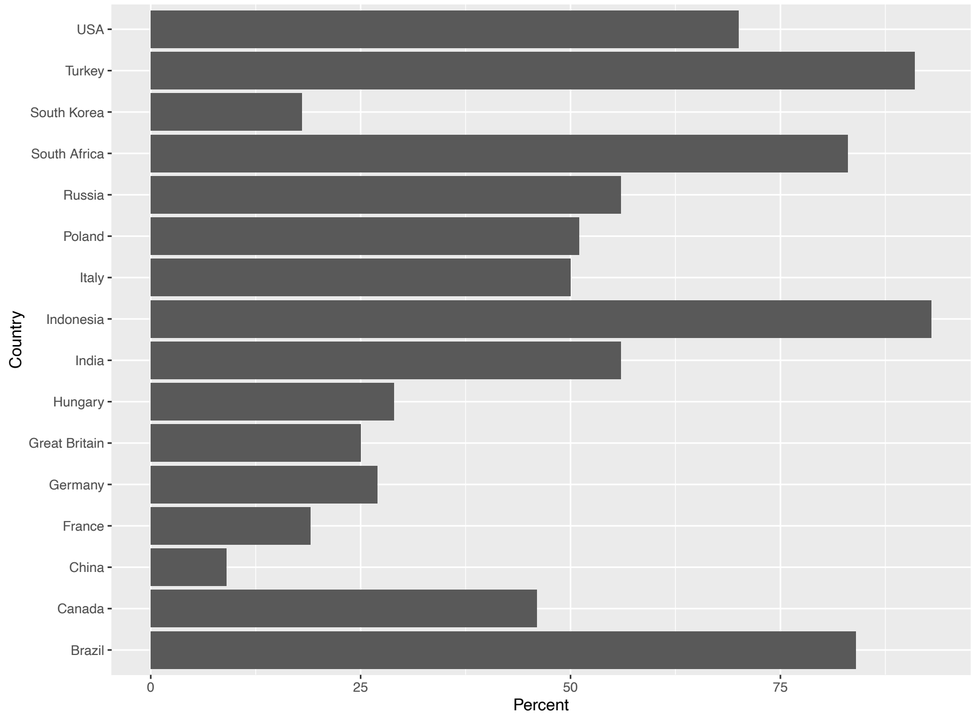
# From exploring to explaining | *Citibike example*



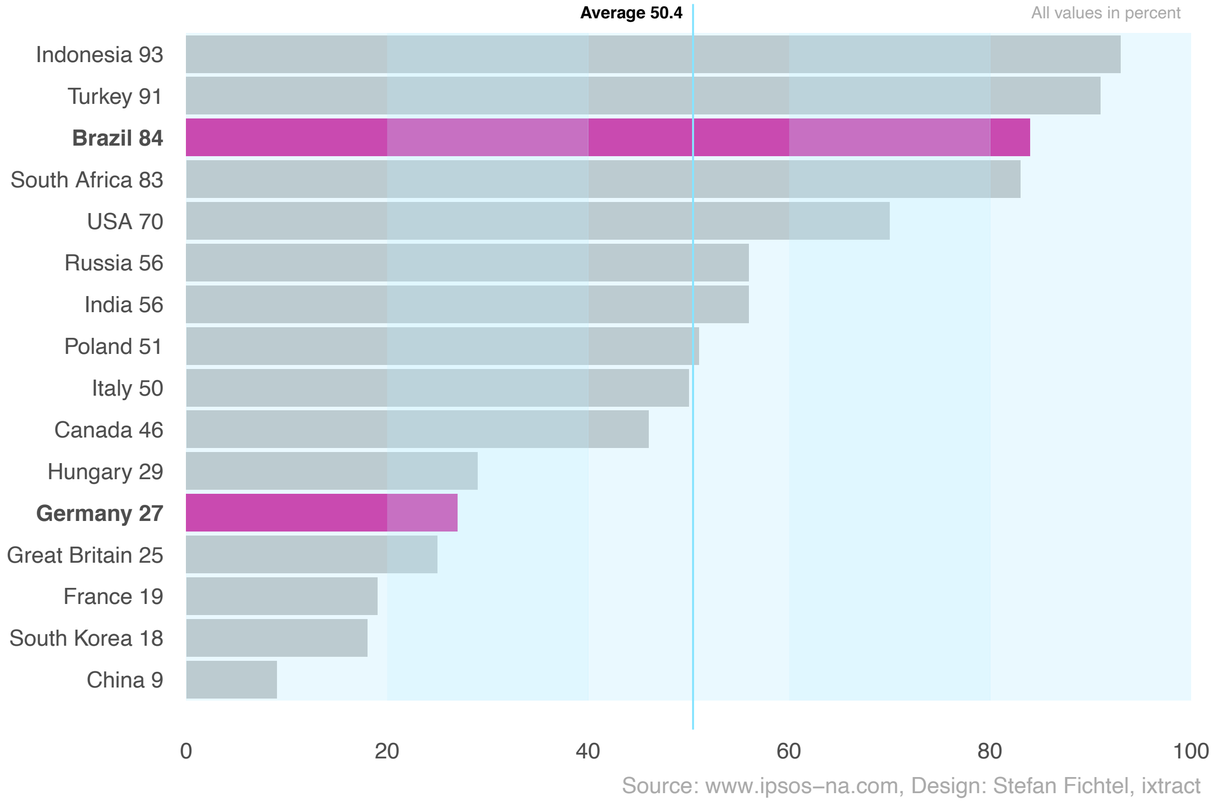




Our rebalancing work should be mindful that — in January — our customers most compete for bikes *after sunset*, **in the dark.**

# From exploring to explaining | adapted from *Rahlf example*



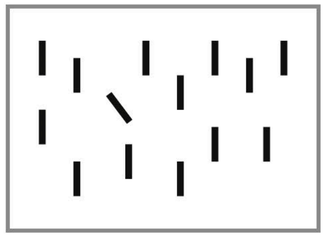

'I definitely believe in God or a Supreme Being'
was said in 2010 in:



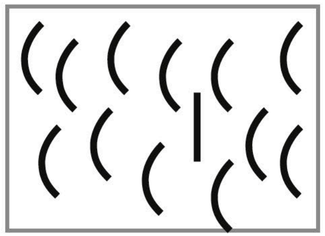

Source: www.ipsos–na.com, Design: Stefan Fichtel, ixtract

# focusing visual attention

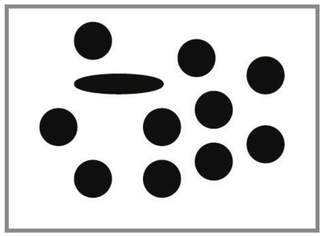
Orientation



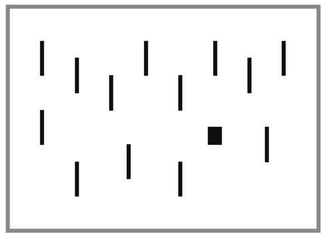
Curved straight



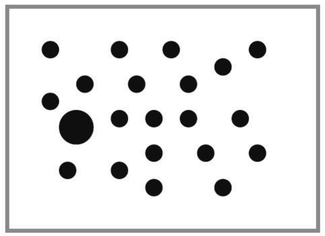
Shape



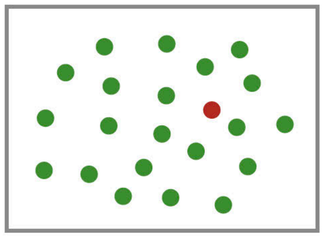
Shape



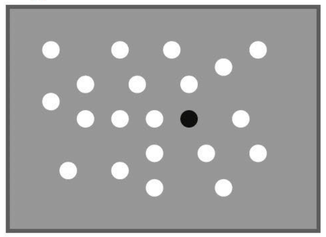
Size



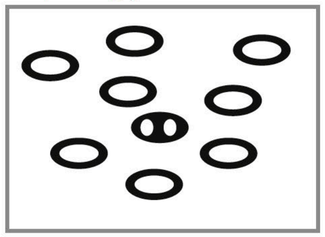
Color



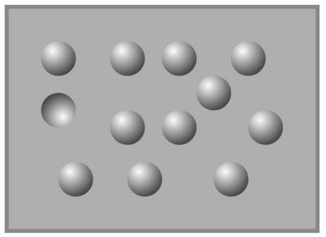
Light/dark



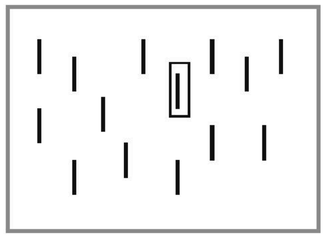
Topology (or count)

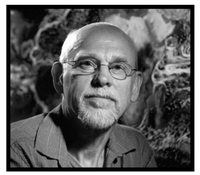


Convex/concave

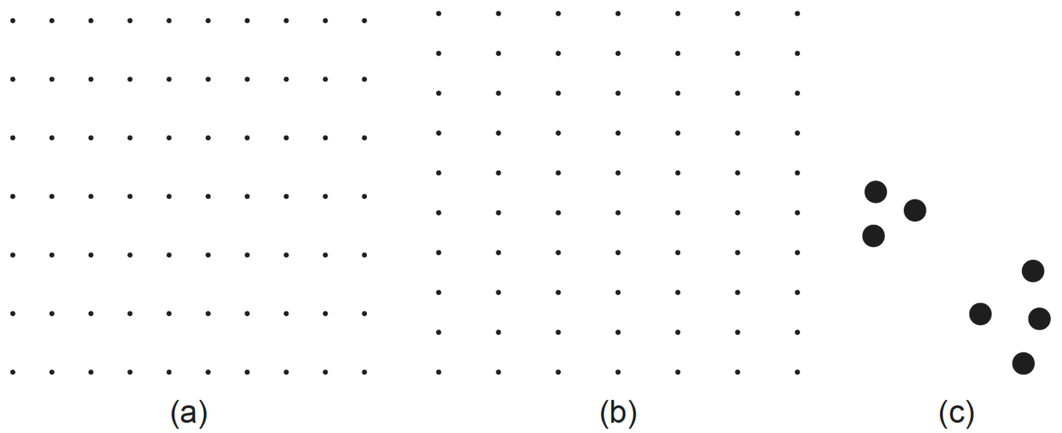


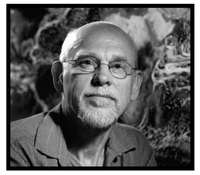
Addition





Ware, Colin



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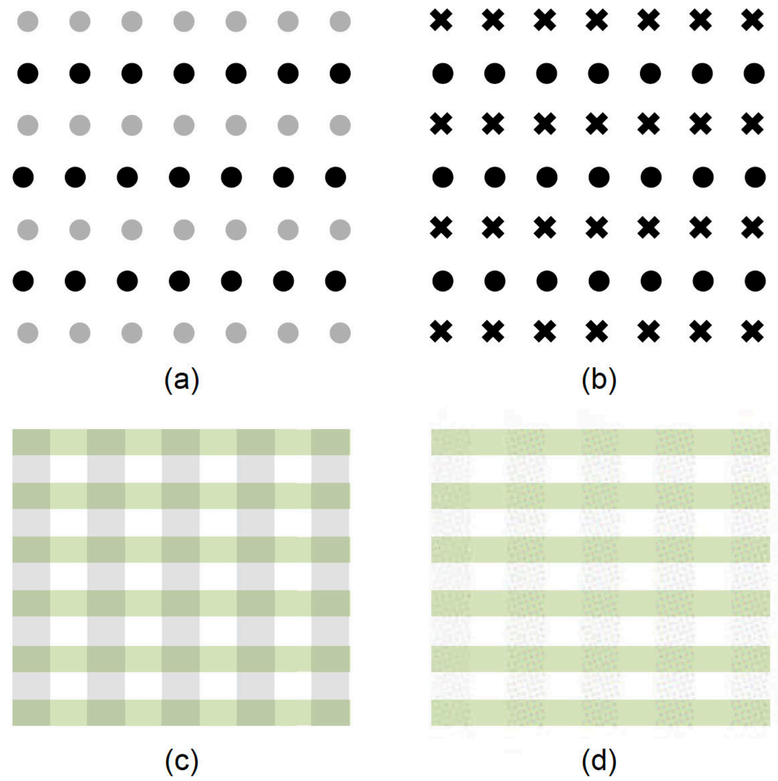


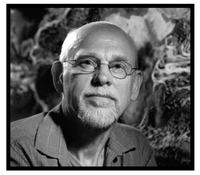

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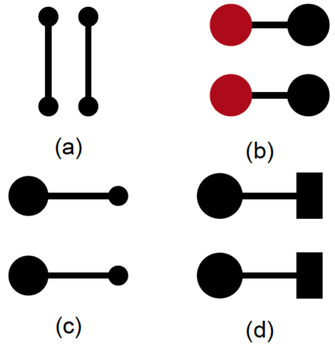
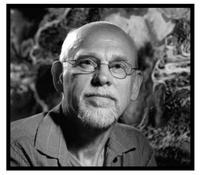
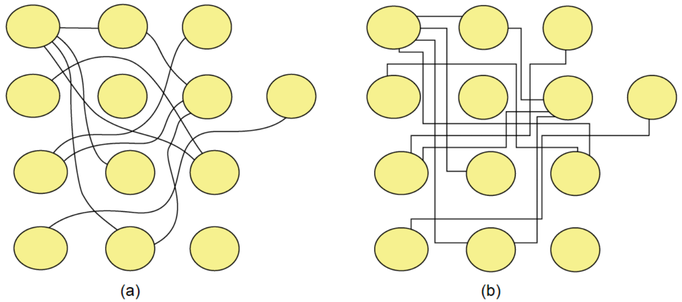
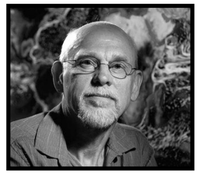


Ware, Colin



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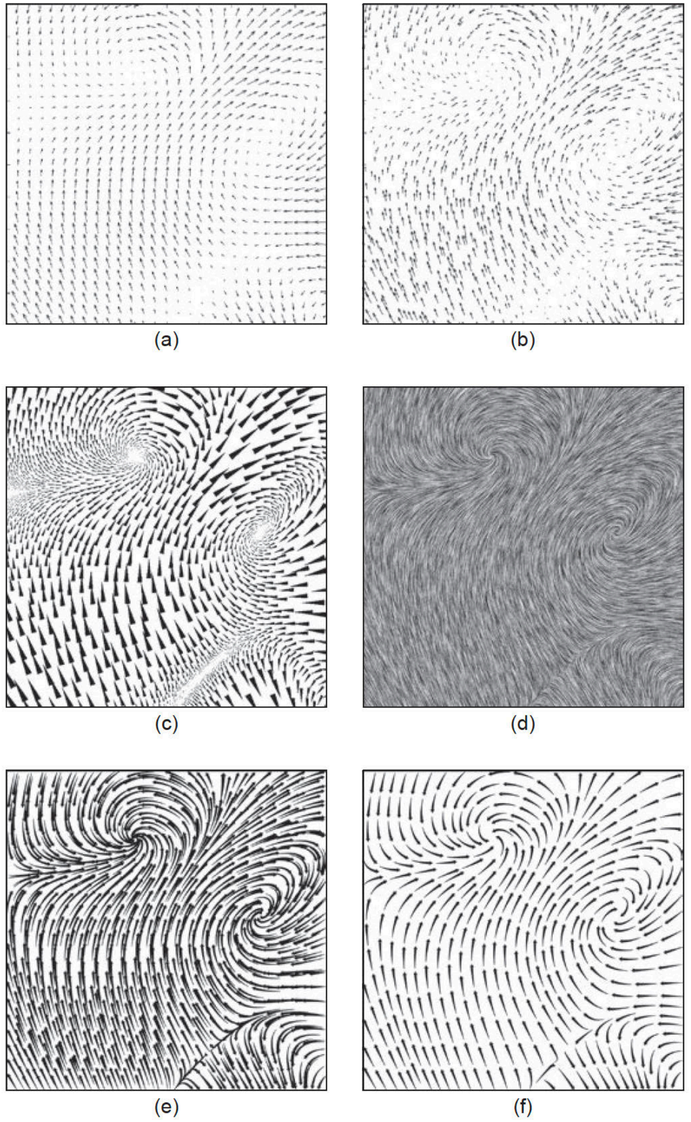


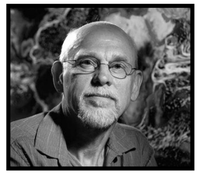

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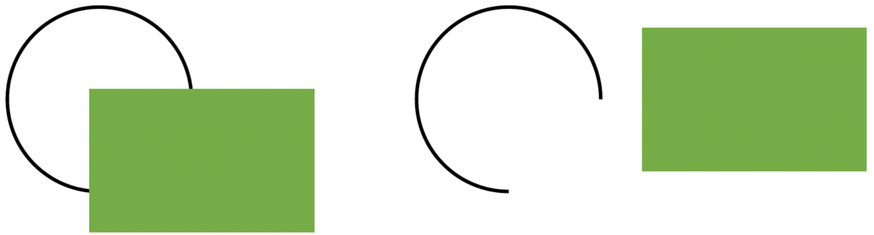
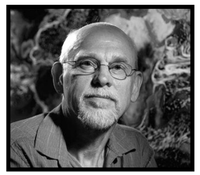
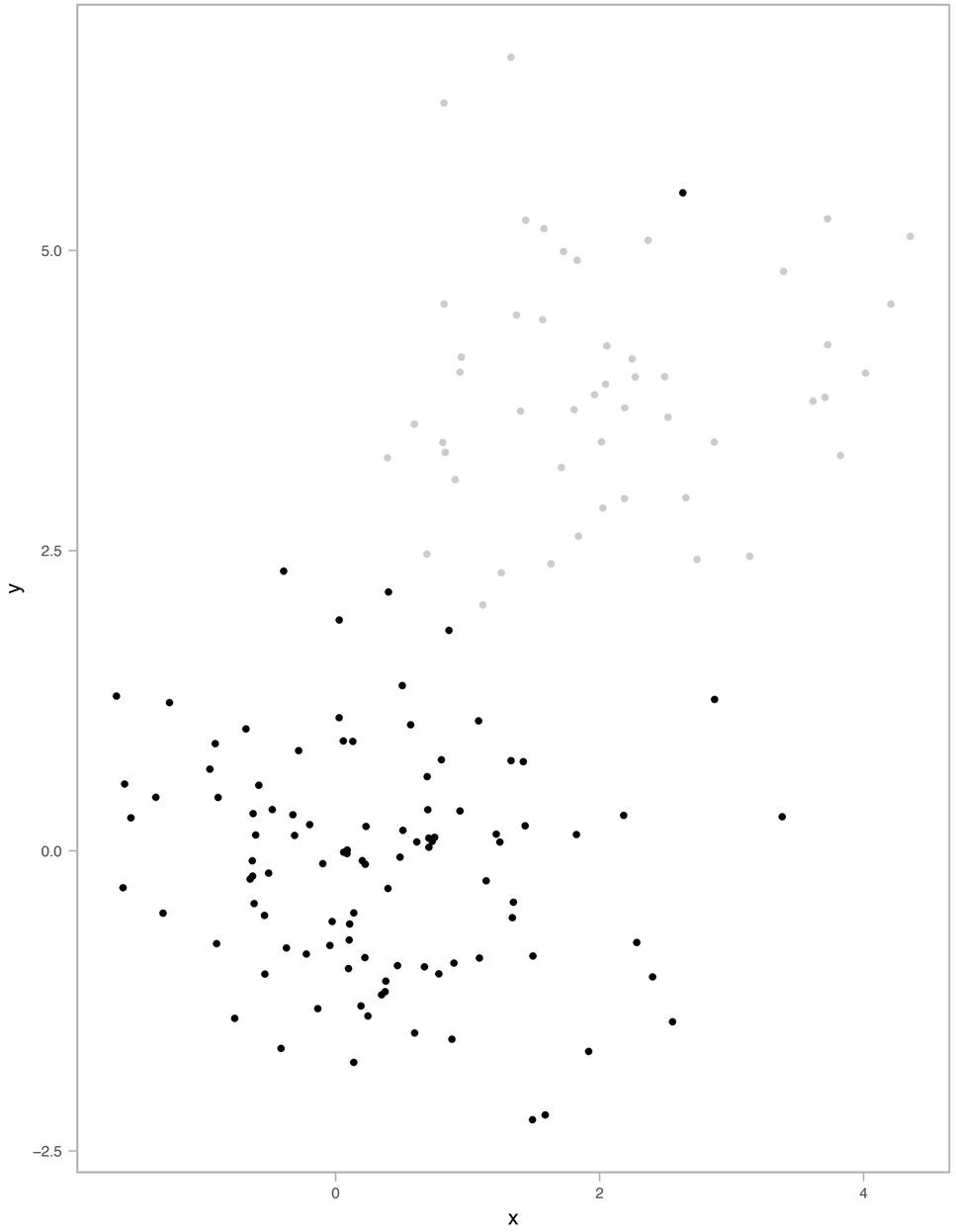


(a) (b)



Ware, Colin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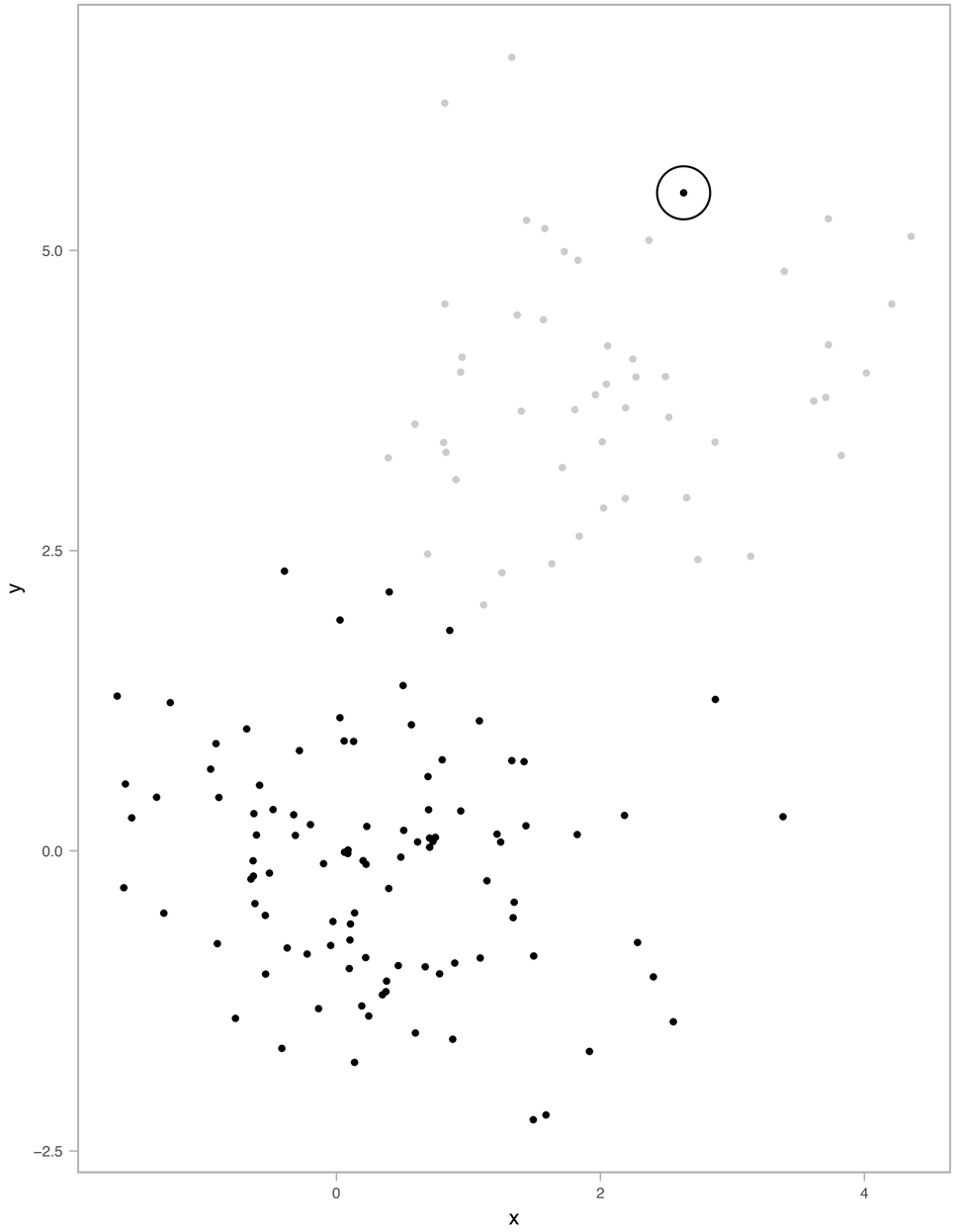
2.5
0.0
−2.5
y
0
2
4
x


5.0
2.5
0.0
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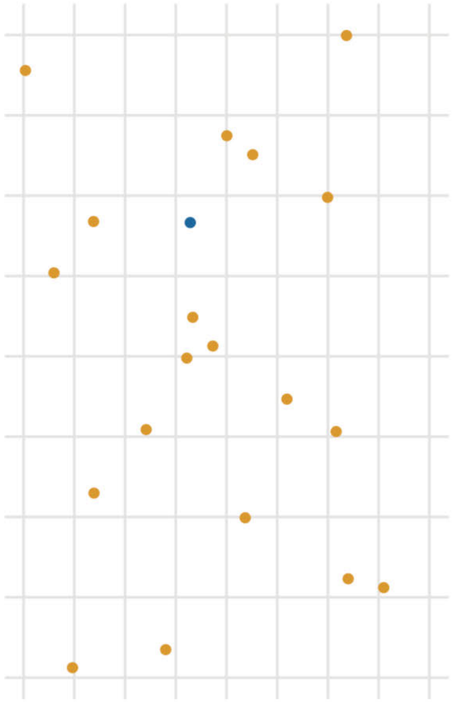
y
0
2
4
x

Color only, $N = 20$



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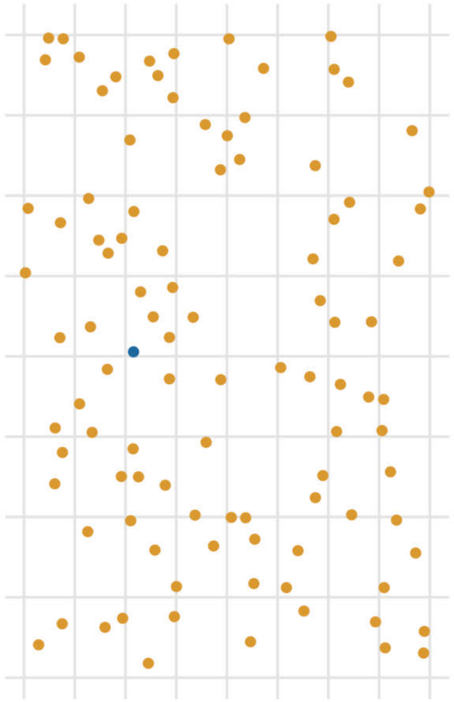
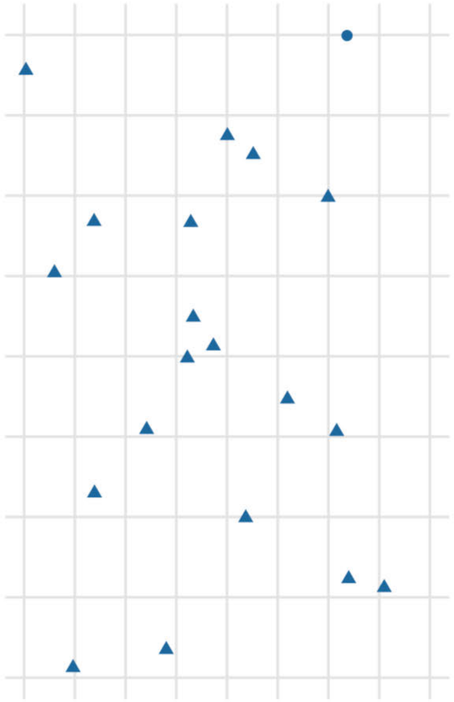


Shape only, $N = 20$



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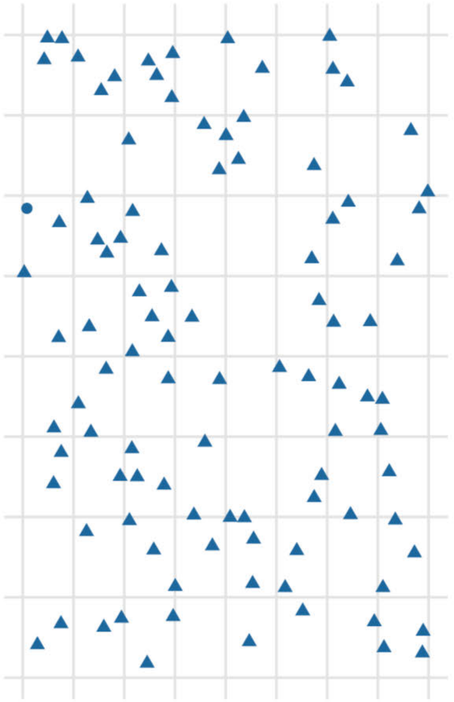
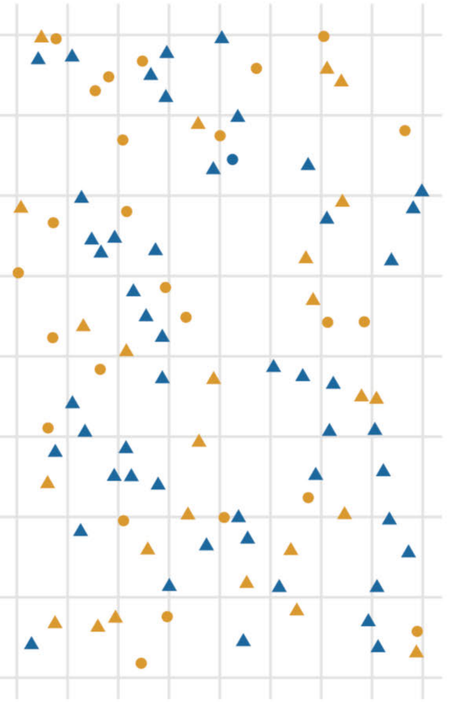
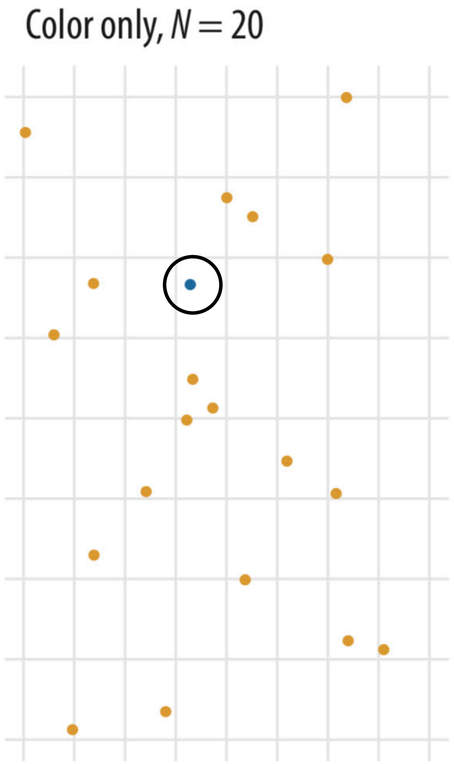


Color & shape, $N = 100$

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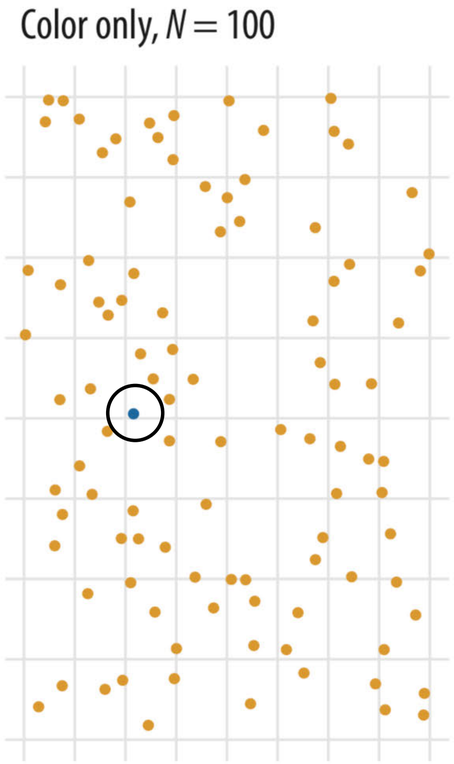
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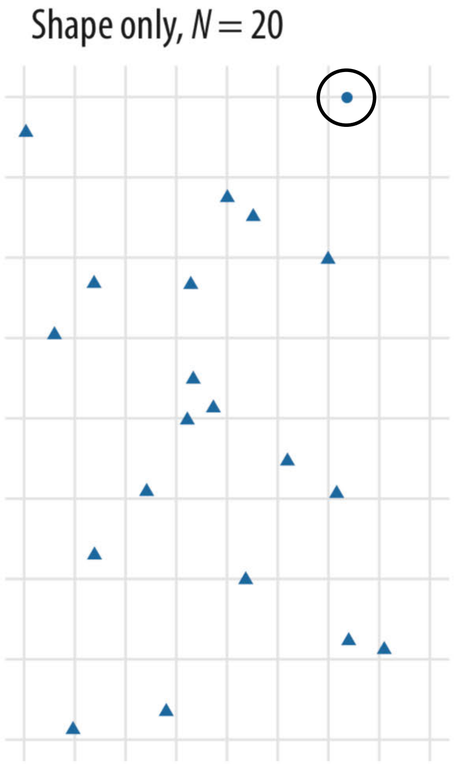
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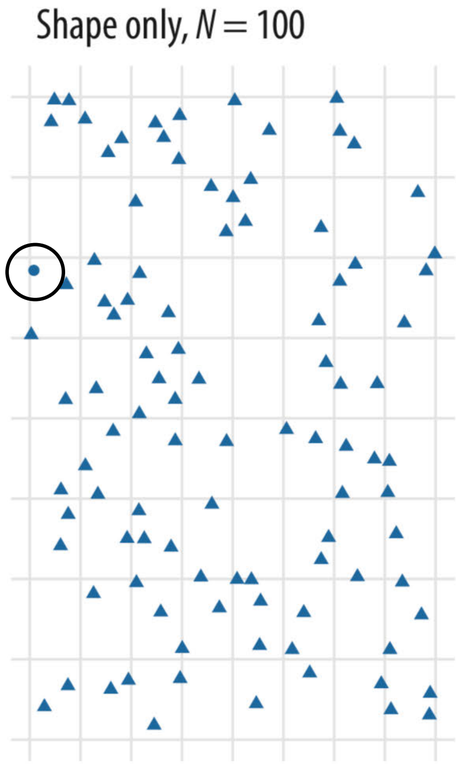
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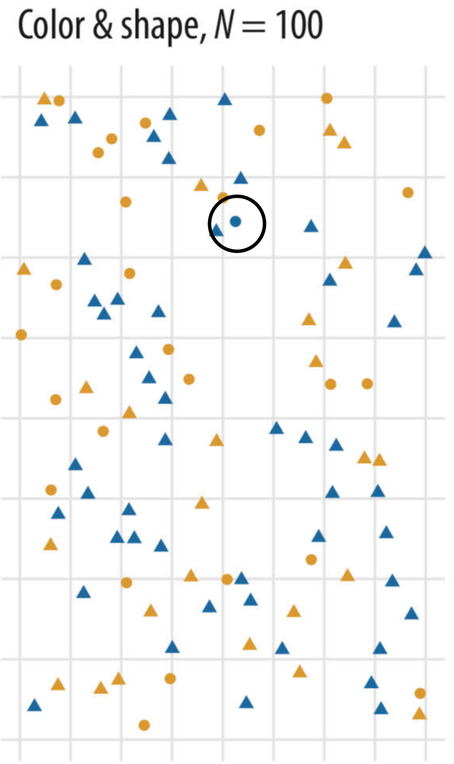
Color & shape, N = 100

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