

# VISUALIZATION

Exploration and communication: A truthful Art

Alberto Cairo, School of Communication, University of Miami

Dropbox > MaterialsGeneral2016



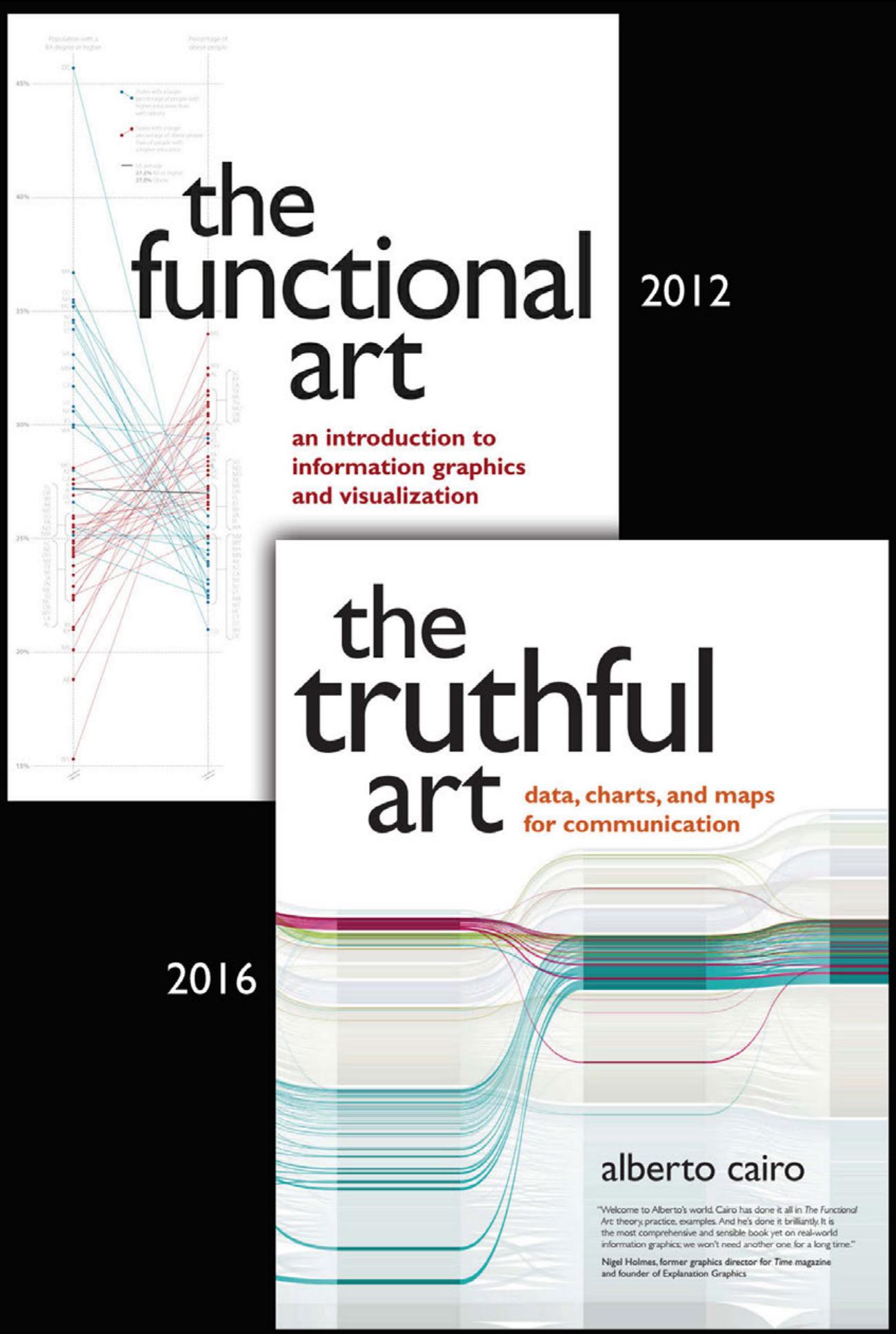
Search



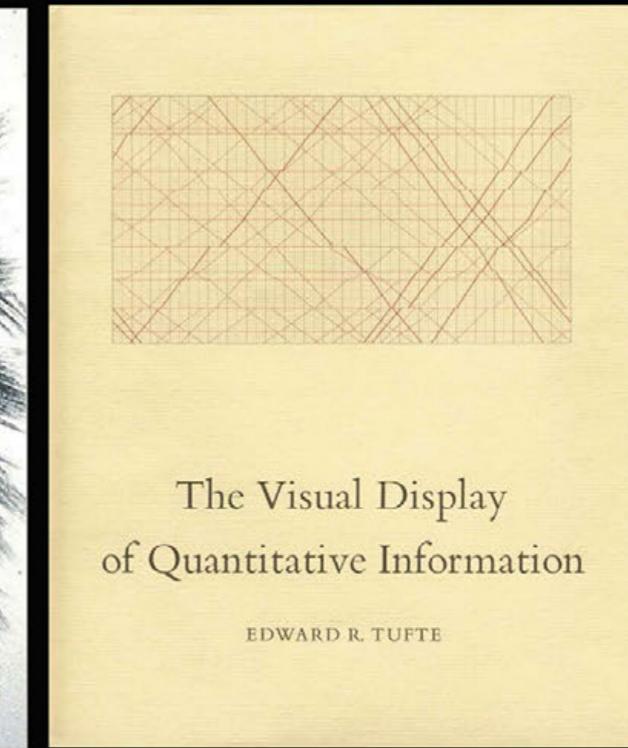
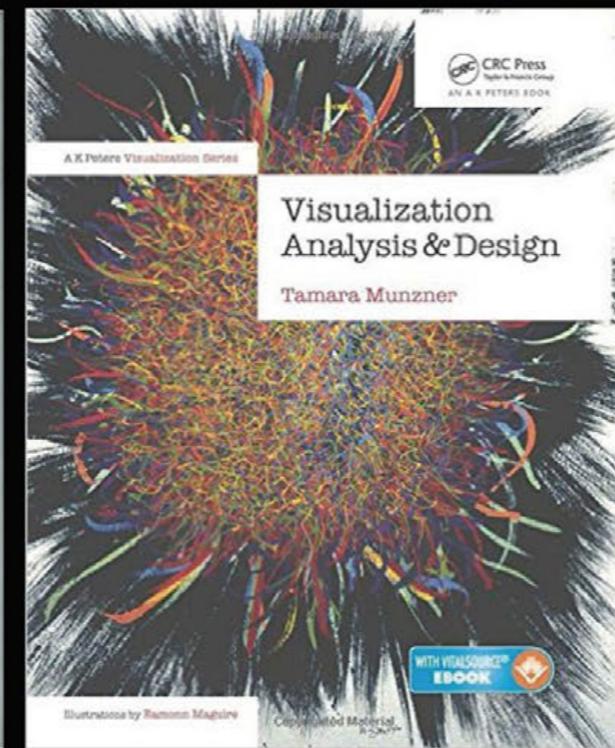
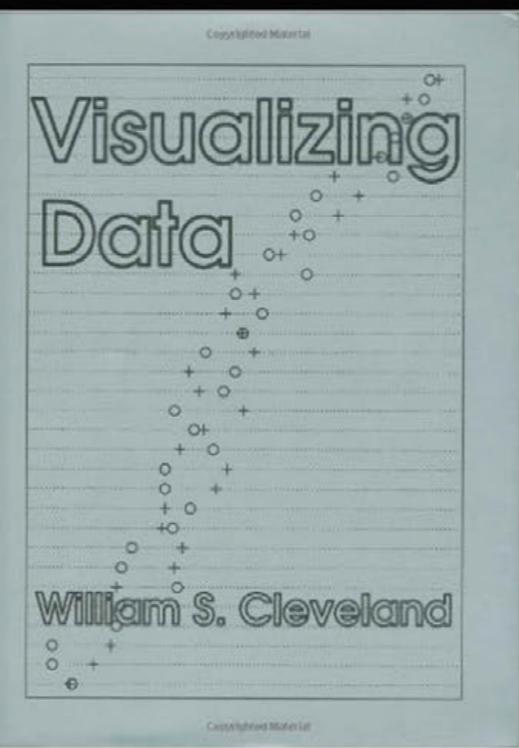
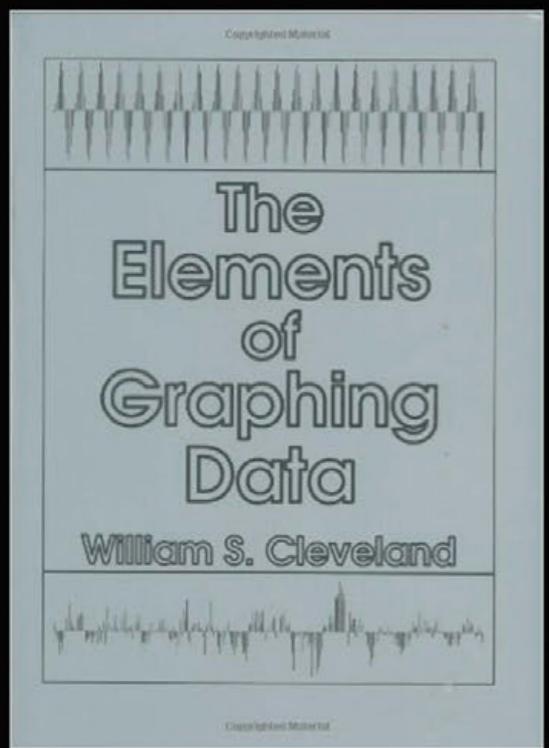
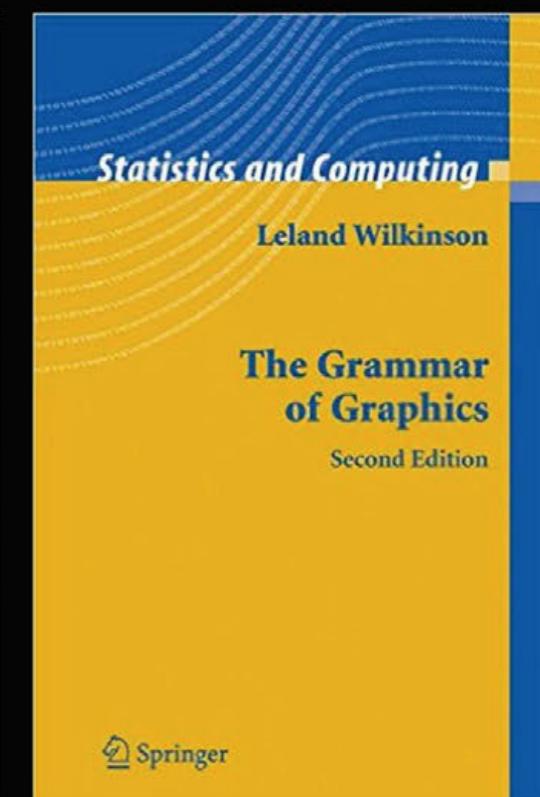
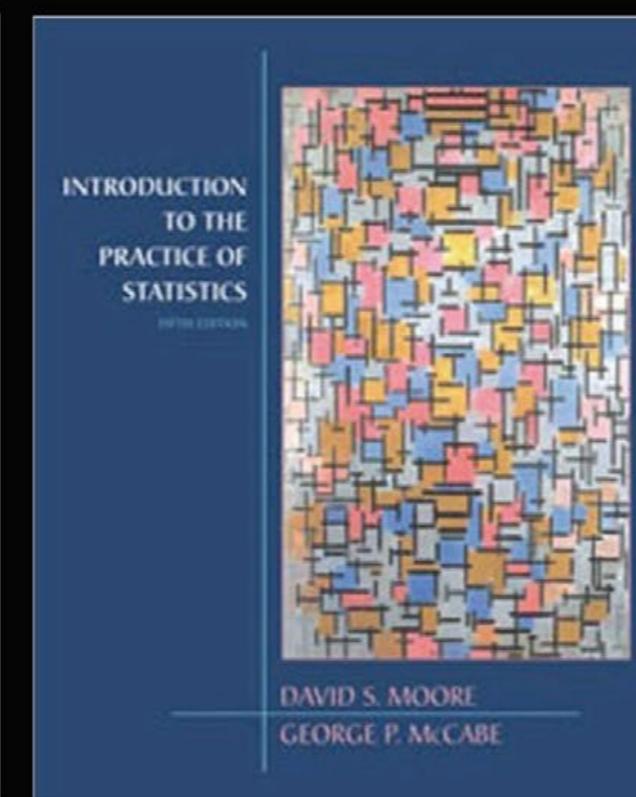
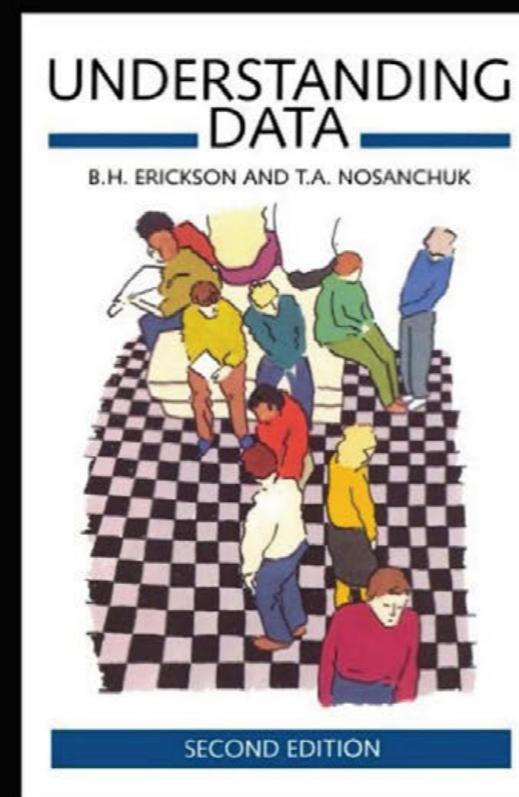
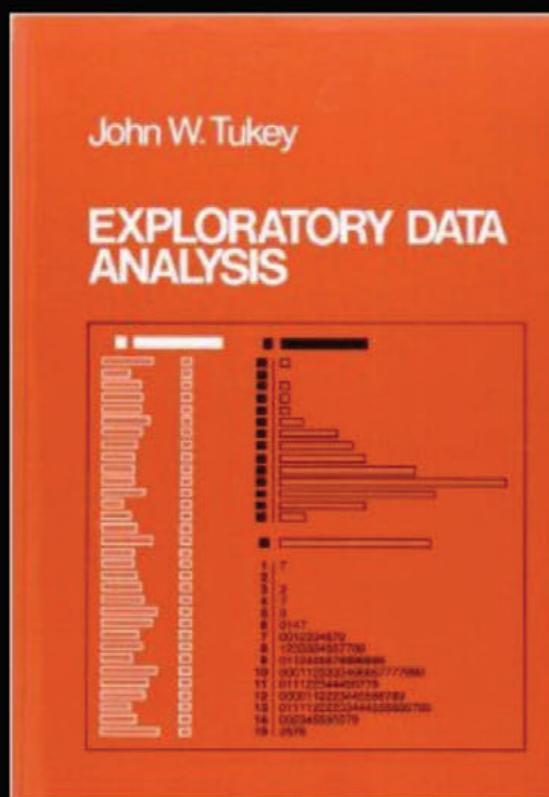
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1Part1	--	--
2Part2	--	--
3Part3	--	--
4Part4	--	--
5Part5	--	--
SCIENCECOMMUNICATION	--	--
STYLE_GUIDES	--	--

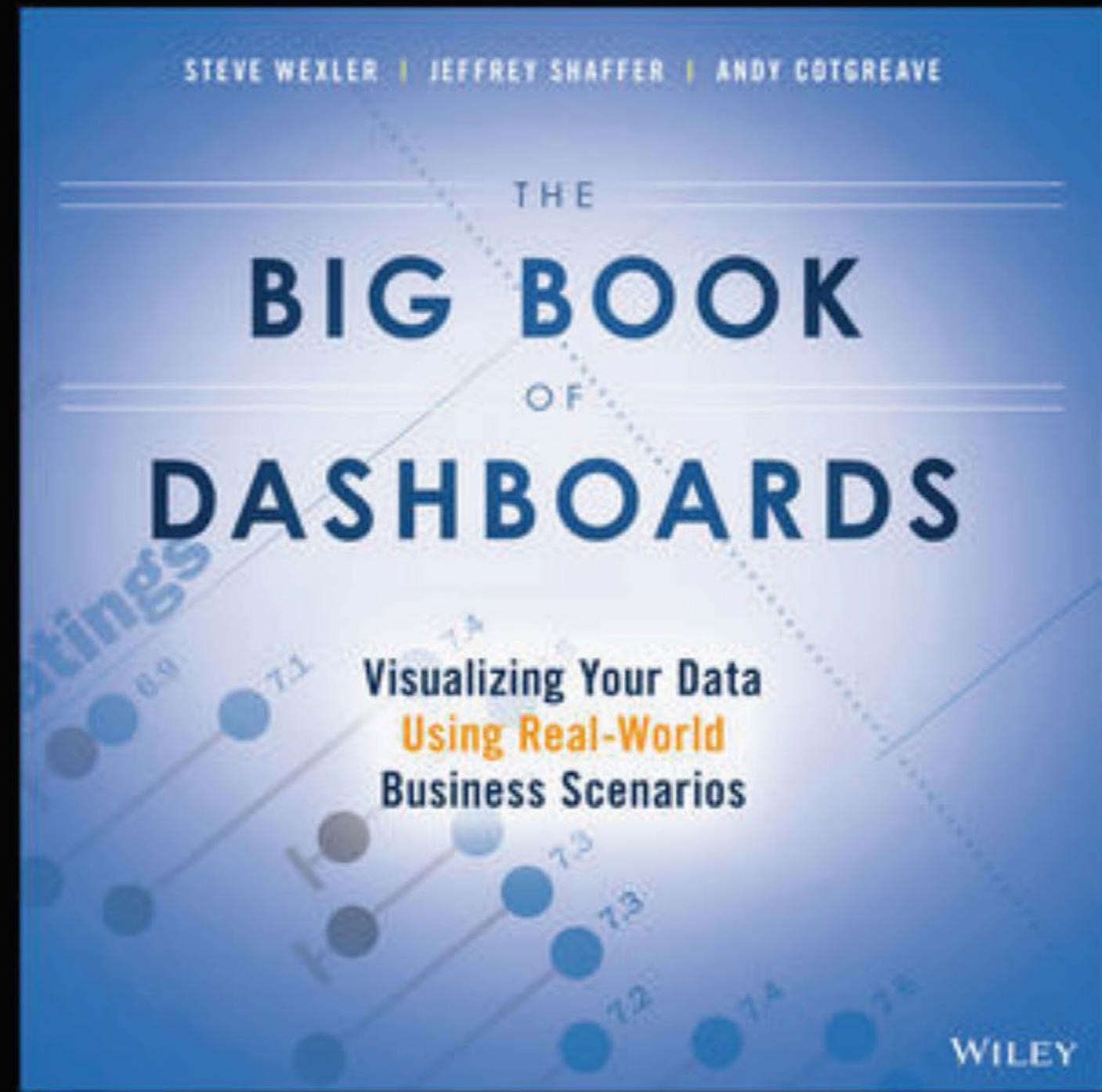
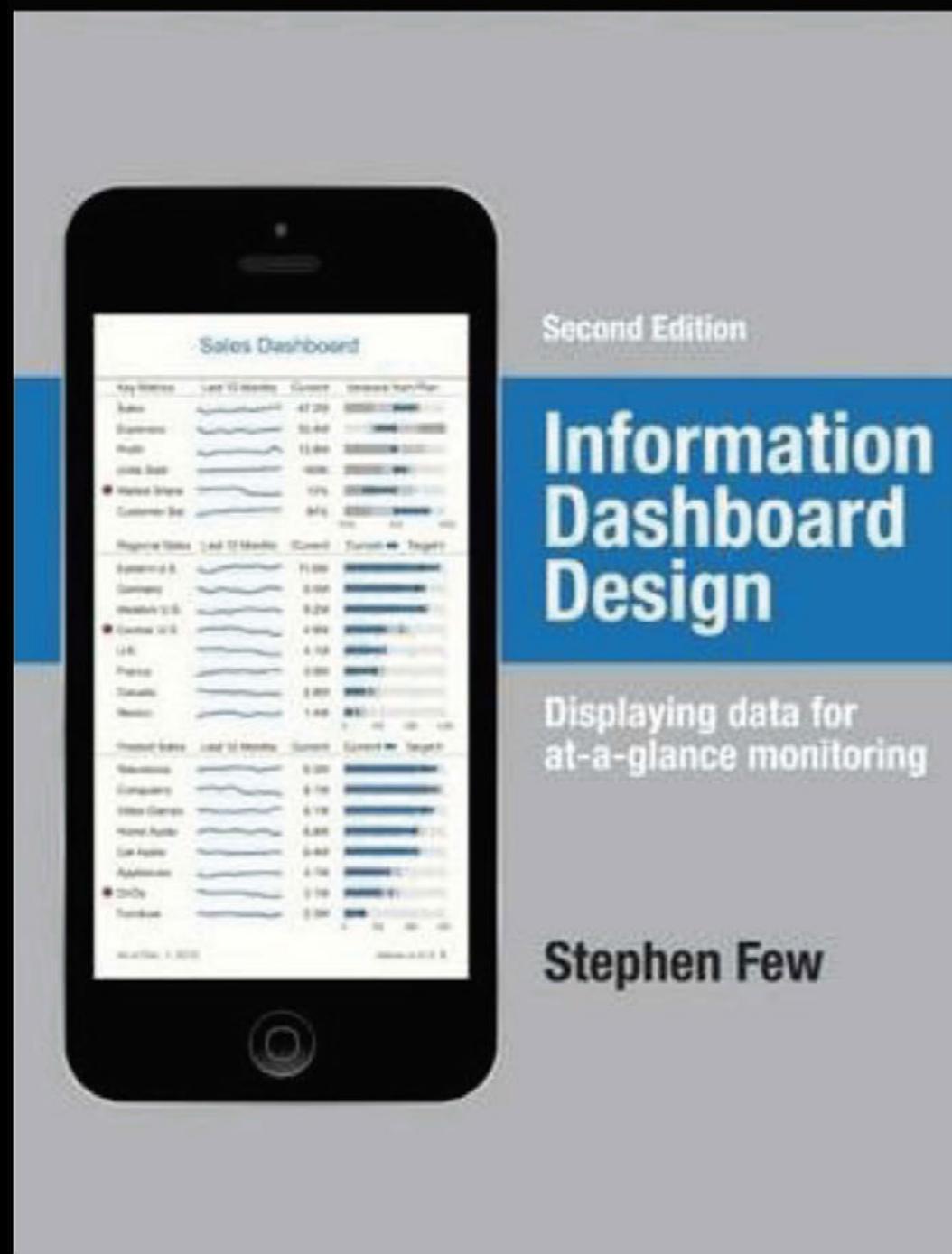
[https://www.dropbox.com/sh/c0rg7lv90eg0bmm/AAB1gUGt9L9EYKWwSSla6\\_Pga?dl=0](https://www.dropbox.com/sh/c0rg7lv90eg0bmm/AAB1gUGt9L9EYKWwSSla6_Pga?dl=0)

Why visualization?



A visualization is a graphical representation designed to enable exploration, analysis, or communication



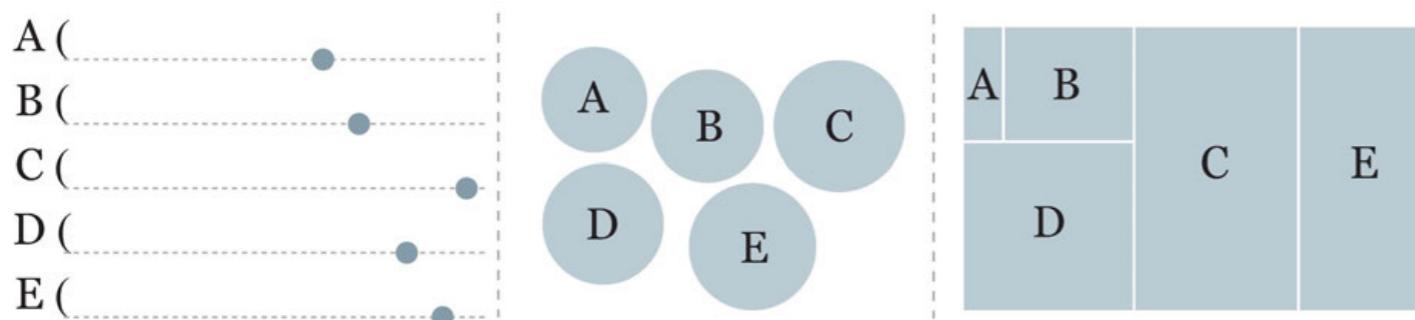


<http://www.wiley.com/WileyCDA/WileyTitle/productCd-1119282713.html>

## *Length or height'*

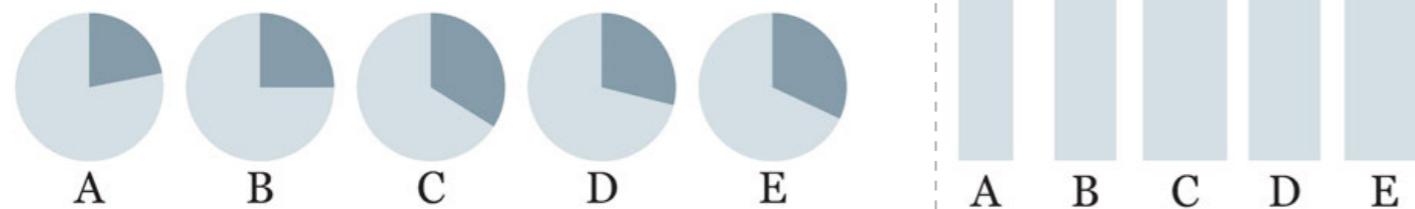


## *Position*



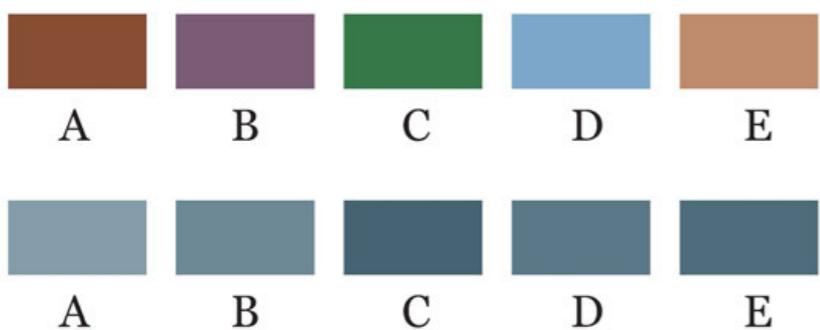
## *Area*

## *Angle/area'*



## *Line weight*

## *Hue and shade*



“The median score is 72 over 100”  
Result: Unhappy students

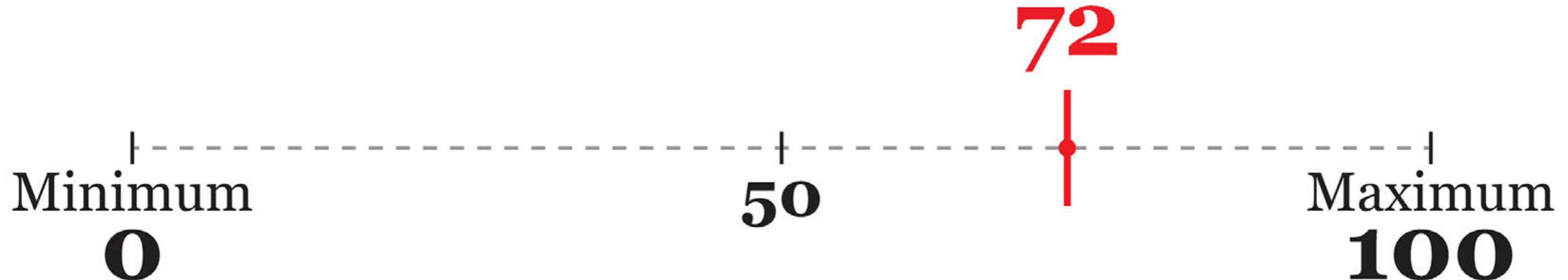
Based on Richard Thaler’s “Misbehaving: The Making of Behavioral Economics”

“The median score is 72 over 100”  
Result: Unhappy students

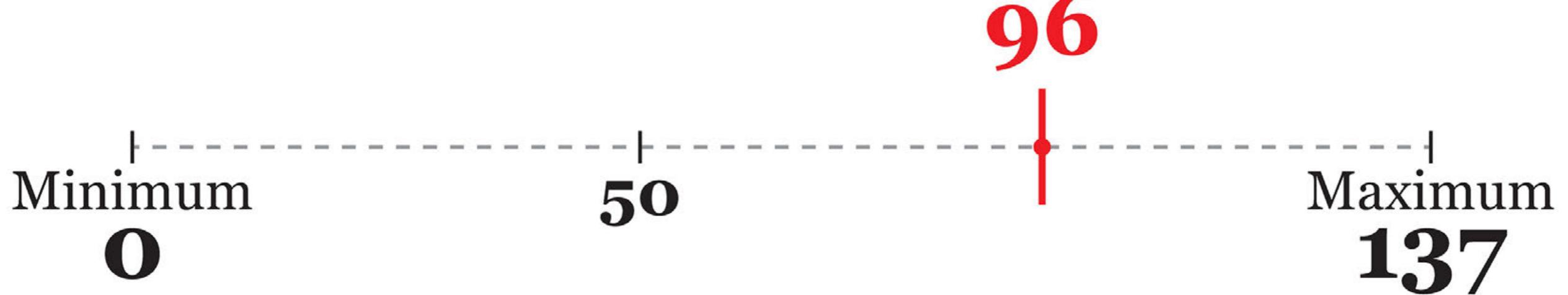
“The median score is 96 over 137”  
Result: Happy students!

Based on Richard Thaler’s “Misbehaving: The Making of Behavioral Economics”

## FIRST EXAM



## SECOND EXAM



Based on Richard Thaler's "Misbehaving: The Making of Behavioral Economics"

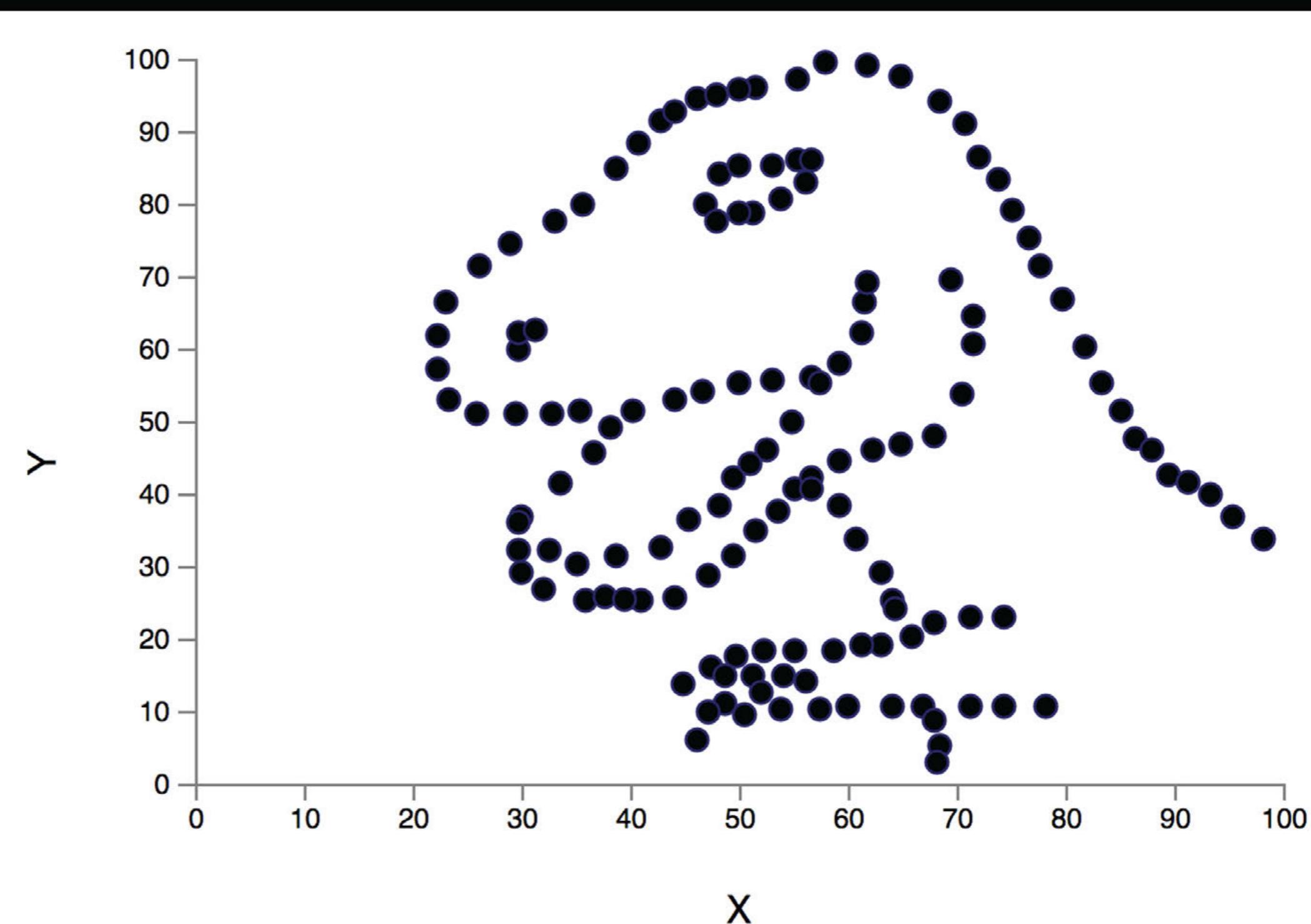
<http://robertgrantstats.co.uk/drawmydata.html>

N = 142 ; X mean = 54.2633 ; X SD = 16.7651 ; Y mean = 47.8323 ; Y SD = 26.9354 ; Pearson correlation = -0.0645

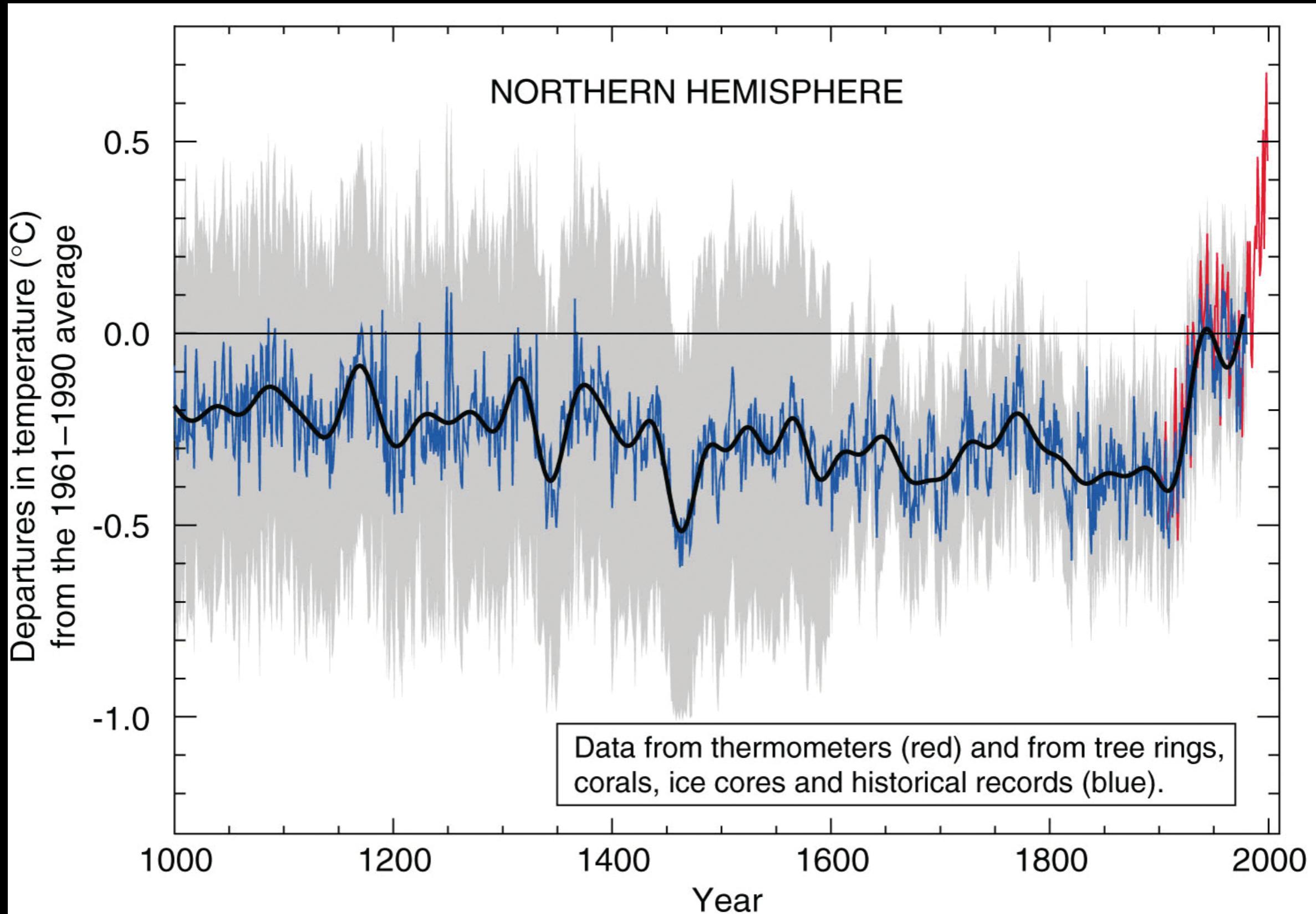
55.3846	97.1795
51.5385	96.0256
46.1538	94.4872
42.8205	91.4103
40.7692	88.3333
38.7179	84.8718
35.641	79.8718
33.0769	77.5641
28.9744	74.4872
26.1538	71.4103
23.0769	66.4103
22.3077	61.7949
22.3077	57.1795
23.3333	52.9487
25.8974	51.0256
29.4872	51.0256
32.8205	51.0256
35.3846	51.4103
40.2564	51.4103

N = 142 ; X mean = 54.2633 ; X SD = 16.7651 ; Y mean = 47.8323 ; Y SD = 26.9354 ; Pearson correlation = -0.0645

55.3846	97.1795
51.5385	96.0256
46.1538	94.4872
42.8205	91.4103
40.7692	88.3333
38.7179	84.8718
35.641	79.8718
33.0769	77.5641
28.9744	74.4872
26.1538	71.4103
23.0769	66.4103
22.3077	61.7949
22.3077	57.1795
23.3333	52.9487
25.8974	51.0256
29.4872	51.0256
32.8205	51.0256
35.3846	51.4103
40.2564	51.4103



	A	B	C	D	E	F	G	
1	YEAR	TEMP	YEAR	1 SIGMA	2 SIGMA			
2	1000	0.0659	1000	0.240346	0.480693	0.206137	0.123588	
3	1001	-0.1241	1001	0				
4	1002	-0.1208	1002	0				
5	1003	-0.1801	1003	0				
6	1004	-0.0711	1004	0				
7	1005	-0.1334	1005	0				
8	1006	-0.0644	1006	0				
9	1007	0.0042	1007	0				
10	1008	-0.1288	1008	0				
11	1009	-0.0296	1009	0				
12	1010	0.1187	1010	0				
13	1011	-0.1252	1011	0				
14	1012	-0.1634	1012	0				
15	1013	-0.0791	1013	0				
16	1014	-0.1120	1014	0				
17	1015	-0.1146	1015	0				
18	1016	-0.1206	1016	0				
19	1017	-0.0815	1017	0				
20	1018	-0.2031	1018	0				
21	1019	0.0305	1019	0				
22	1020	0.1098	1020	0				
23	1021	0.0244	1021	0				
24	1022	-0.0743	1022	0				
25	1023	-0.0323	1023	0				
26	1024	-0.0434	1024	0				
	878	1876	-0.1891	1876	0.113228	0.226456	8.25297E-02	7.75207E-02
	879	1877	-0.0140	1877	0.113228	0.226457	8.25299E-02	7.75209E-02
	880	1878	-0.0873	1878	0.113228	0.226457	8.25298E-02	7.75209E-02
	881	1879	-0.2959	1879	0.113229	0.226458	8.25302E-02	7.75212E-02
	882	1880	-0.2368	1880	0.113229	0.226457	8.25300E-02	7.75210E-02
	883	1881	-0.1977	1881	0.113229	0.226458	8.25302E-02	7.75212E-02
	884	1882	-0.2036	1882	0.113229	0.226457	8.25300E-02	7.75210E-02
	885	1883	-0.2489	1883	0.113228	0.226455	8.25293E-02	7.75204E-02
	886	1884	-0.2125	1884	0.113229	0.226457	8.25301E-02	7.75211E-02
	887	1885	-0.1896	1885	0.113228	0.226457	8.25299E-02	7.75210E-02
	888	1886	-0.1084	1886	0.113228	0.226456	8.25298E-02	7.75208E-02
	889	1887	-0.3265	1887	0.113228	0.226456	8.25296E-02	7.75206E-02
	890	1888	-0.1694	1888	0.113228	0.226457	8.25298E-02	7.75209E-02
	891	1889	-0.1339	1889	0.113228	0.226456	8.25298E-02	7.75208E-02
	892	1890	-0.3107	1890	0.113229	0.226457	8.25301E-02	7.75211E-02
	893	1891	-0.1754	1891	0.113229	0.226457	8.25300E-02	7.75210E-02
	894	1892	-0.3186	1892	0.113228	0.226456	8.25295E-02	7.75205E-02
	895	1893	-0.3236	1893	0.113228	0.226456	8.25297E-02	7.75207E-02
	896	1894	-0.1970	1894	0.113228	0.226456	8.25295E-02	7.75205E-02
	897	1895	-0.1578	1895	0.113228	0.226456	8.25297E-02	7.75207E-02
	898	1896	-0.0804	1896	0.113228	0.226456	8.25298E-02	7.75208E-02
	899	1897	-0.0537	1897	0.113228	0.226456	8.25298E-02	7.75208E-02
	900	1898	-0.2195	1898	0.113229	0.226457	8.25301E-02	7.75211E-02
	901	1899	-0.3486	1899	0.113228	0.226456	8.25297E-02	7.75207E-02
	902	1900	-0.1253	1900	0.113229	0.226457	8.25300E-02	7.75210E-02
	903	1901	-0.1575	1901	0.113228	0.226456	8.25296E-02	7.75206E-02



Michael E. Mann, Raymond S. Bradley, and Malcolm K. Hughes  
Intergovernmental Panel on Climate Change (IPCC), Third Report, 2001

A visualization is a display intended  
to make the invisible visible

A visualization is a display intended  
to make the invisible visible

Information shaped as a graphic  
functions as a cognitive aid

A visualization is a **display intended**  
**to make the invisible visible**

Information shaped as a graphic  
functions as a **cognitive aid**

The nature of the information can guide  
you when choosing **the most appropriate**  
**ways** of telling the story

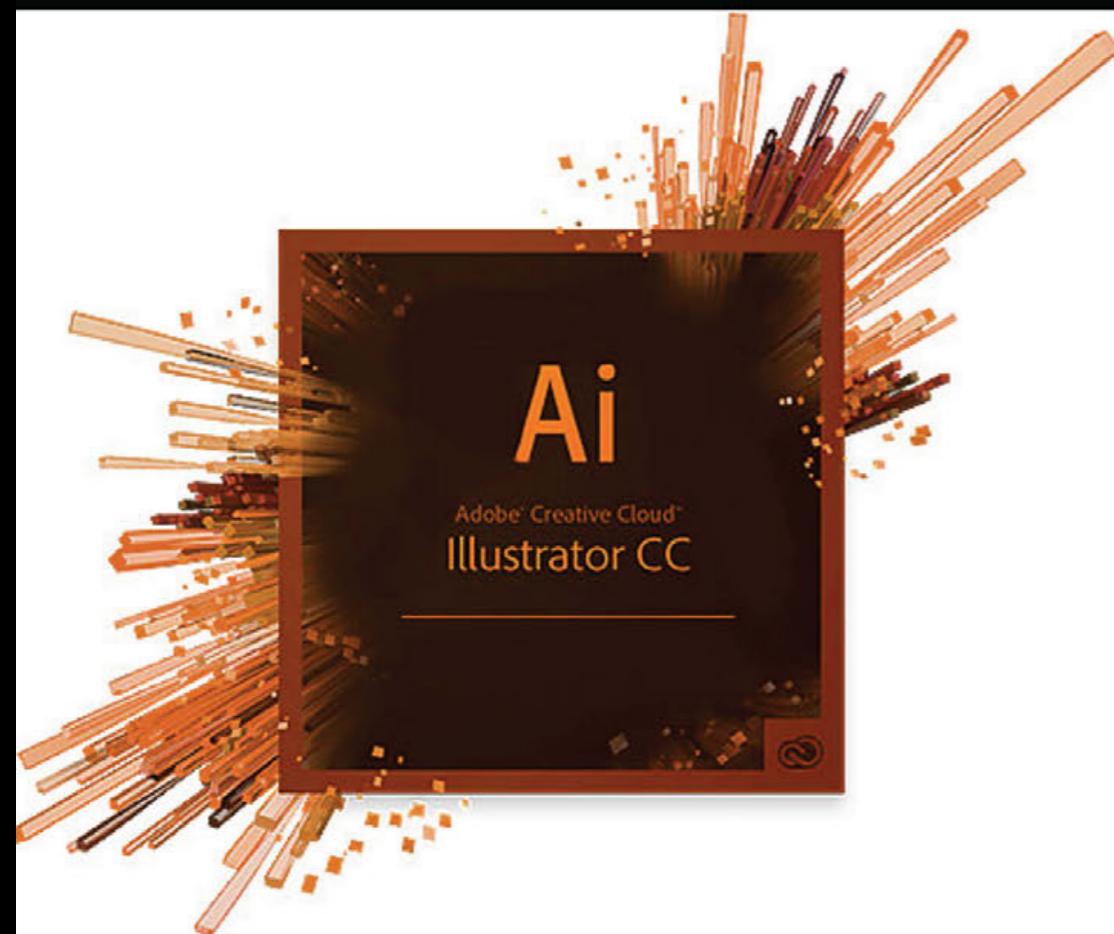
A visualization is a display intended  
to make the invisible visible

Information shaped as a graphic  
functions as a cognitive aid

The nature of the information can guide  
you when choosing the most appropriate  
ways of telling the story

Visualization doesn't simplify.  
It clarifies

Visualization is becoming  
mainstream



## The R Project for Statistical Computing

### Getting Started:

- R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS. To [download R](#), please choose your preferred [CRAN mirror](#).
- If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

### News :

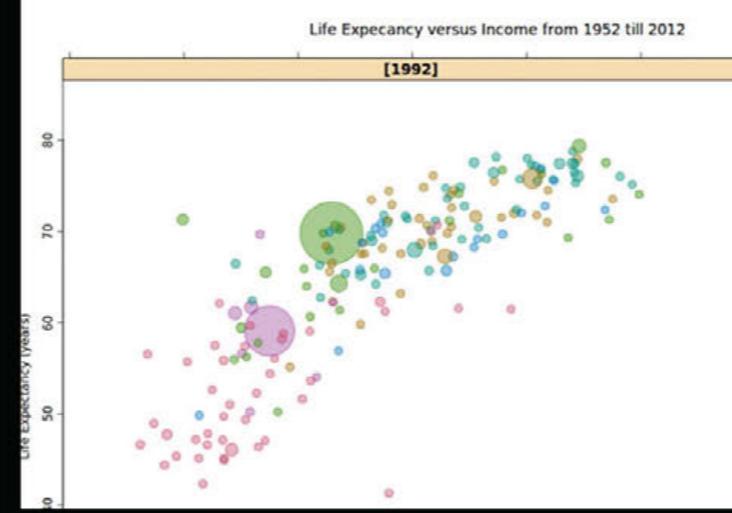
- R version 3.1.2** (Pumpkin Helmet) has been released on 2014-10-31.
- The R Journal Volume 6/1** is available.
- useR! 2014**, took place at the University of California, Los Angeles, USA June 30 - July 3, 2014.
- R version 3.0.3** (Warm Puppy) has been released on 2014-03-06.
- useR! 2015**, will take place at the University of Aalborg, Denmark, June 30 - July 3, 2015.

This server is hosted by the [Institute for Statistics and Mathematics](#) of [WU](#) ([Wirtschaftsuniversität Wien](#)).

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Easily explore data and discover trends  
without learning complex software

Life Expectancy versus Income from 1952 till 2012  
[1992]



Region

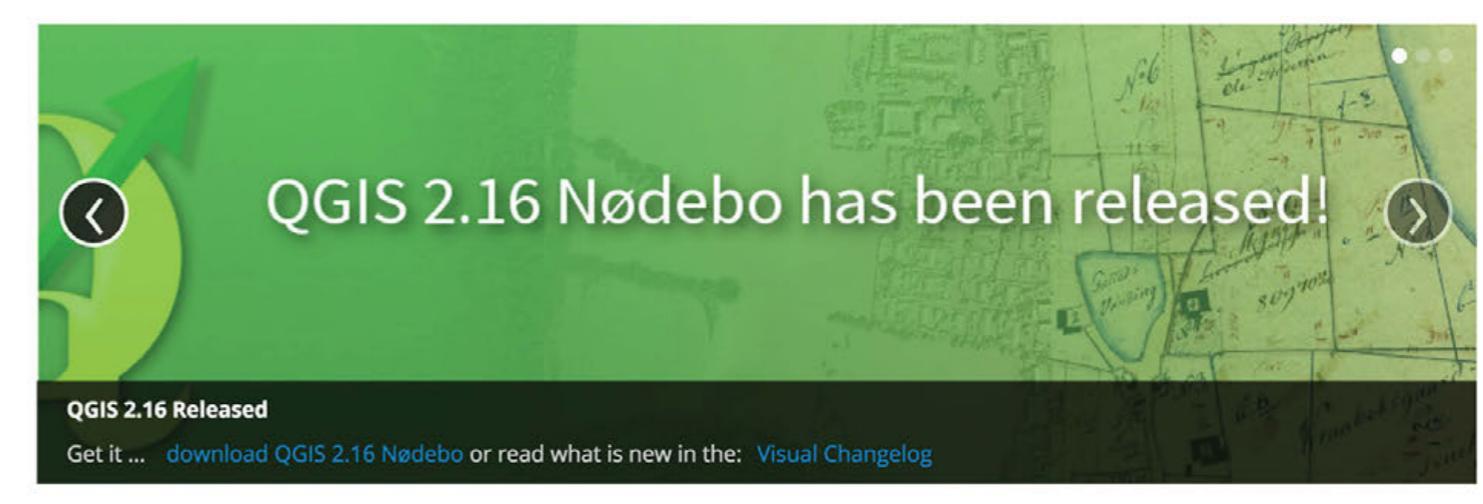
- America
- East Asia & Pacific
- Europe & Central Asia
- Middle East & North Africa
- South Asia
- Sub-Saharan Africa
- Other

 2.16.3    2.14.7 (LTR)    [DISCOVER QGIS](#)    [FOR USERS](#)    [GET INVOLVED](#)    [DOCUMENTATION](#)    [Search](#)    English

2.17 in feature freeze since 9/16/2016, 8:00:00 AM  
Time until packaging 2016-10-21 12:00:00 UTC 22d  
Time until next pointrelease 2016-10-21 12:00:00 UTC 22d

# QGIS

## A Free and Open Source Geographic Information System



QGIS 2.16 Nødebo has been released!

QGIS 2.16 Released

Get it ... [download QGIS 2.16 Nødebo](#) or read what is new in the: [Visual Changelog](#)



alberto cairo's weblog on visualization, infographics, and data journalism



Home

Contact the author

Speaking & Consulting

The Truthful Art book

The Functional Art book

Reviews

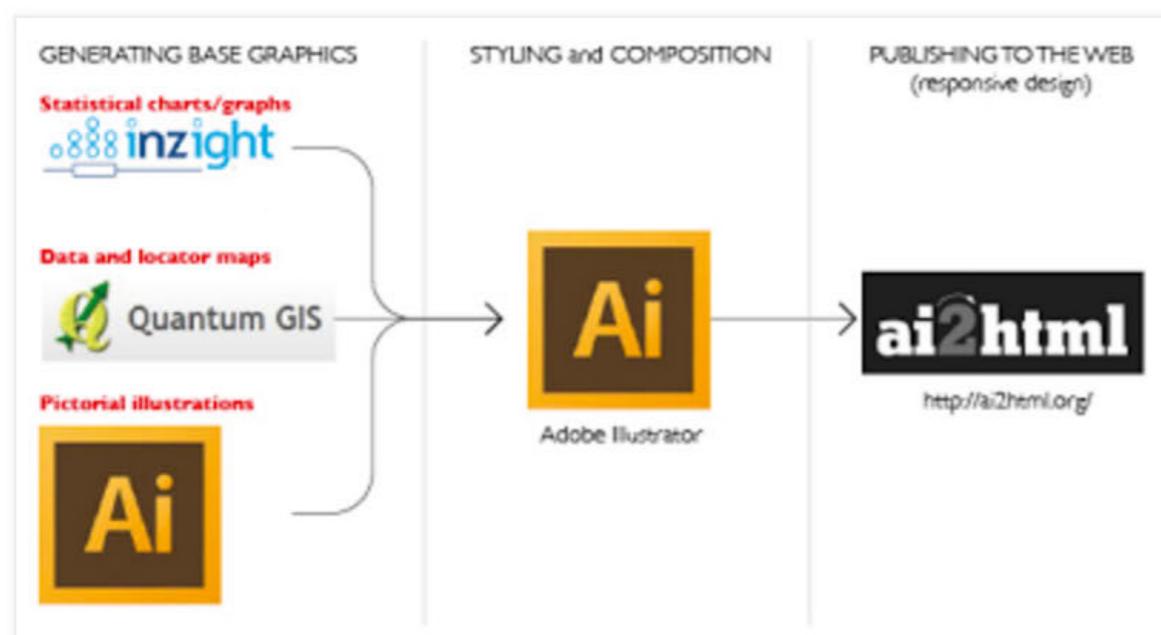
Tutorials & Resources

Reading now

## Tutorials & Resources

### Video tutorials

These videos will show you how I designed several of the graphs and maps showcased in *The Truthful Art*. This is the workflow I will outline:



Digital Humanities+Data Journalism Symposium



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NEW BOOK AVAILABLE

the

<http://www.thefunctionalart.com/p/instructors-guide.html>

# In Global Health

Hans Rosling, [www.gapminder.org](http://www.gapminder.org)

<http://www.gapminder.org/videos/200-years-that-changed-the-world-bbc/>



GAPMINDER WORLD

VIDEOS

DOWNLOADS

TEACH

IGNORANCE

DATA



## Refresh your world

Pour the sparkling fresh numbers into your eyes and upgrade your worldview.

EXAMPLES:

- [Wealth & Health of Nations ▶](#)
- [CO<sub>2</sub> emissions since 1820 ▶](#)
- [Africa is not a country! ▶](#)
- [Is child mortality falling? ▶](#)
- [Where is HIV decreasing? ▶](#)

[BUBBLE CHART ▶](#)



[MAMMALS](#)[REPTILES](#)[AMPHIBIANS](#)[BIRDS](#)[SOURCES](#)

# MAMMALS



1,469 AT RISK 3,125 HEALTHY

835 UNKNOWN

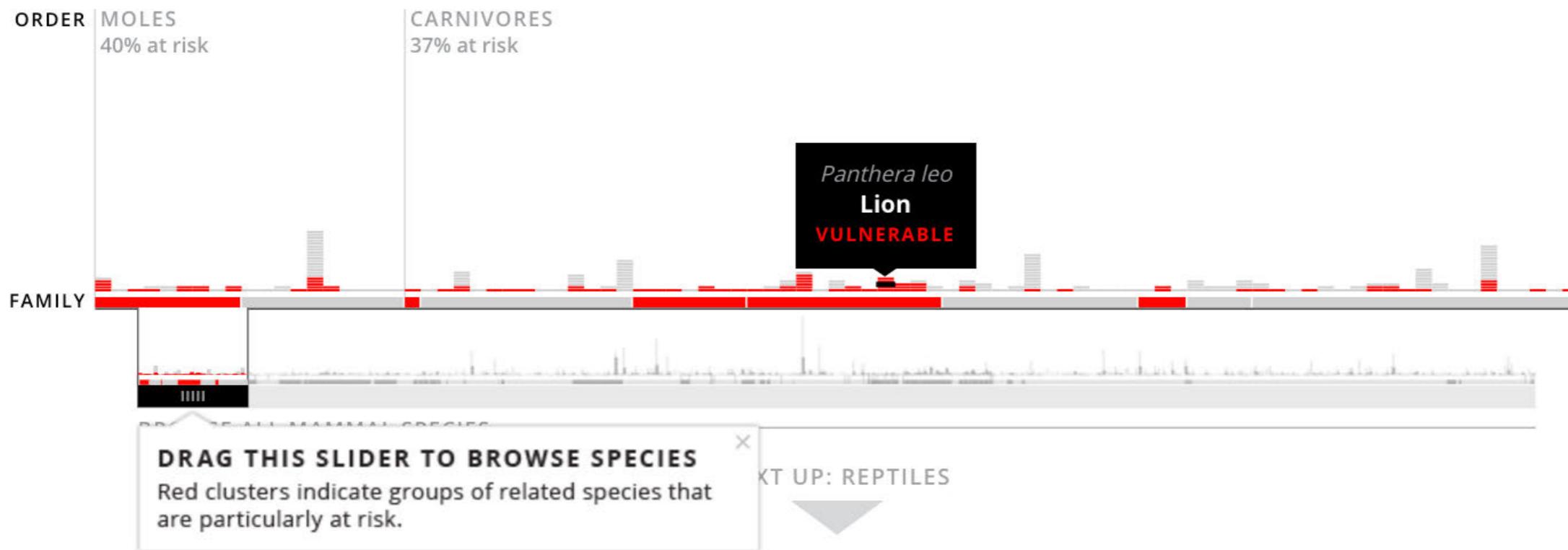
COMPARED TO ONE OR LESS NATURAL EXTINCTIONS PER CENTURY

Given the historical extinction rate, we would not expect more than one mammal species to go extinct each century. According to scientists, however, 1,469 are currently in danger of becoming extinct over the next 100 years. Note the red cluster at **primates**, especially **lemurs**. **Rhinos**, **bears** & **big cats** are also at risk.

How do I read this graphic?

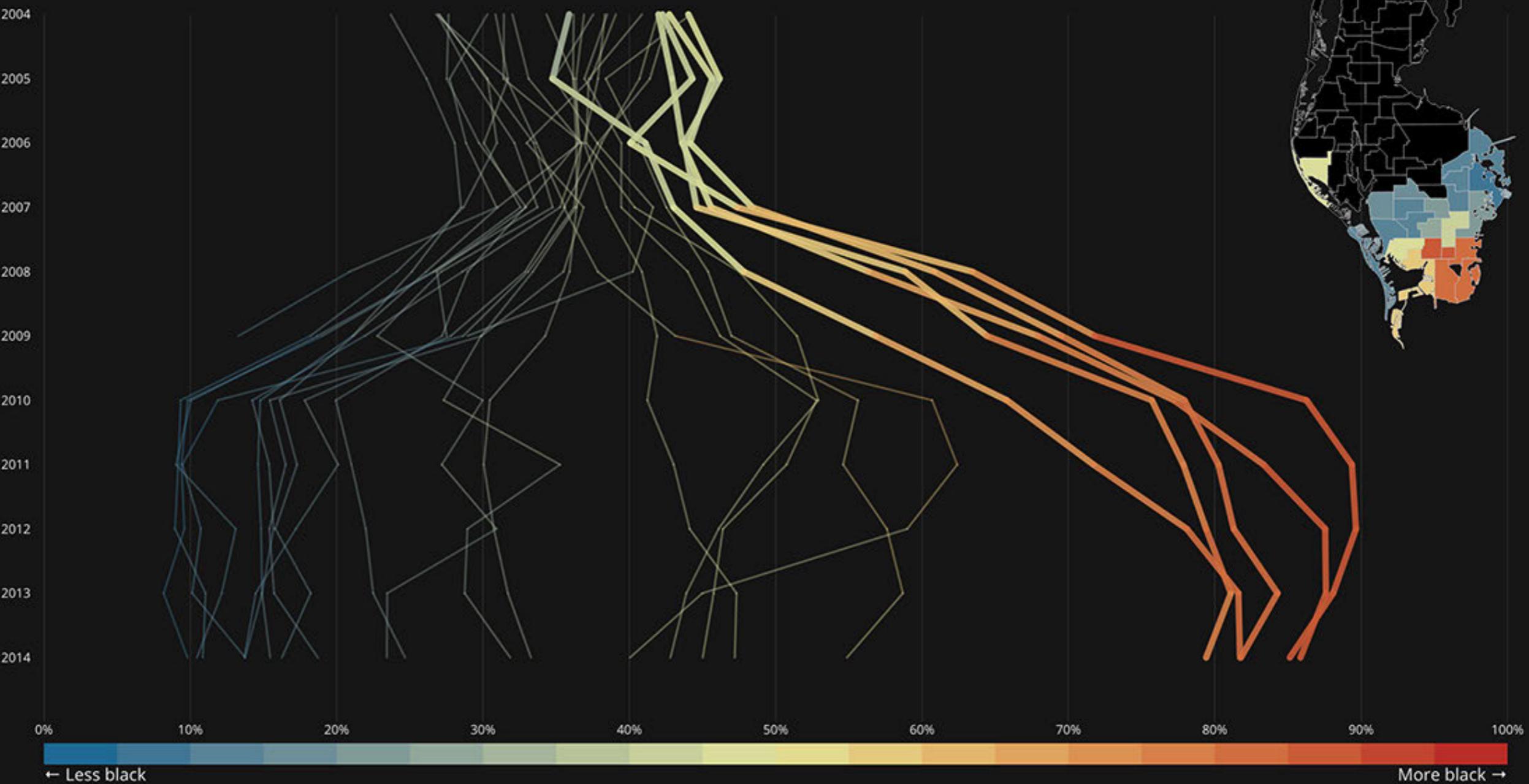
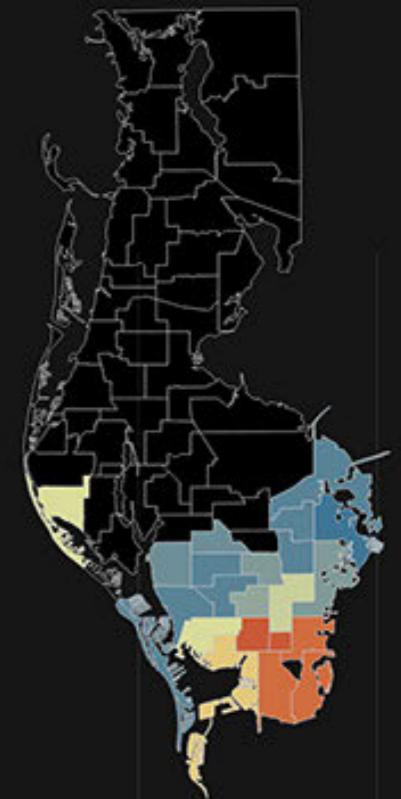
— HEALTHY SPECIES    — AT RISK SPECIES

Search for a mammal



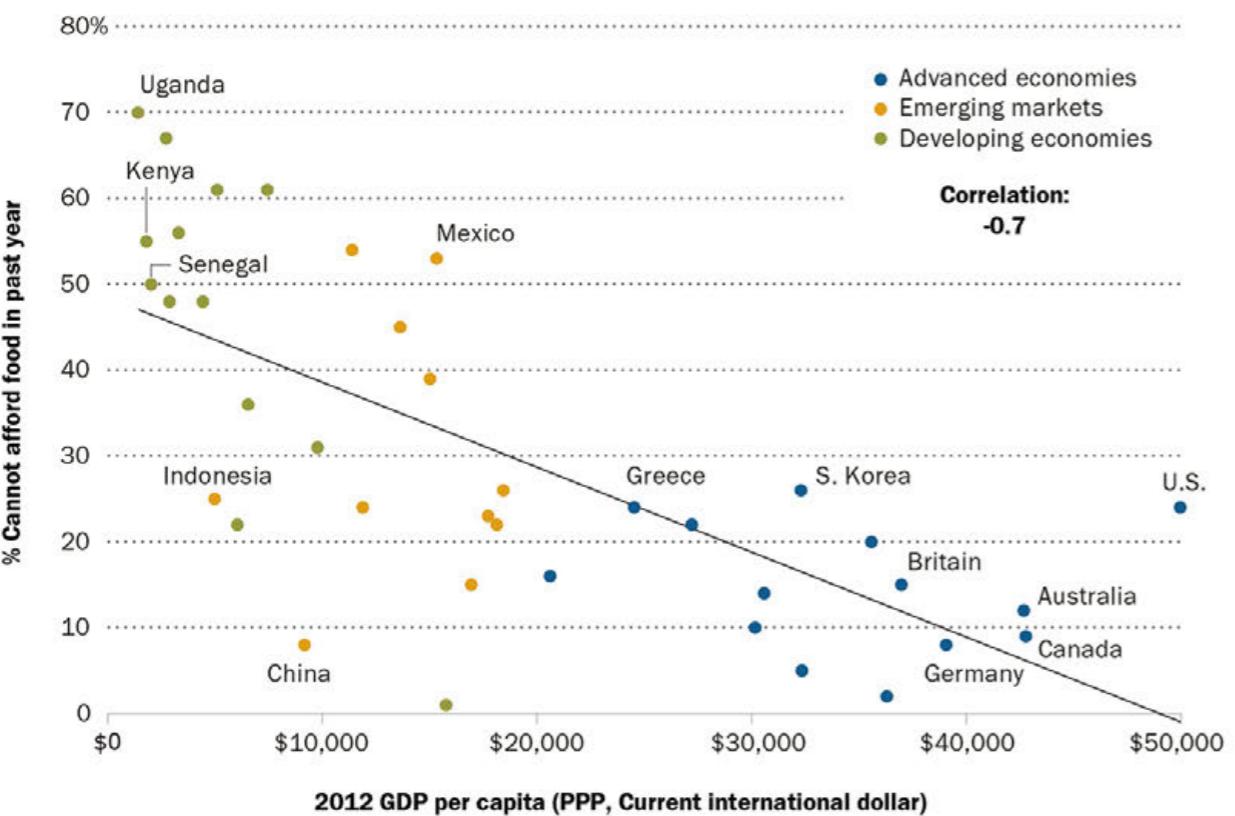
<http://projects.propublica.org/extinctions/>

Today, **Campbell Park, Fairmount Park, Lakewood, Maximo and Melrose** are the **most segregated** schools in Pinellas.



<http://www.tampabay.com/projects/2015/investigations/pinellas-failure-factories/chart-failing-black-students/>

## Many in Developing Nations Struggle to Afford Food

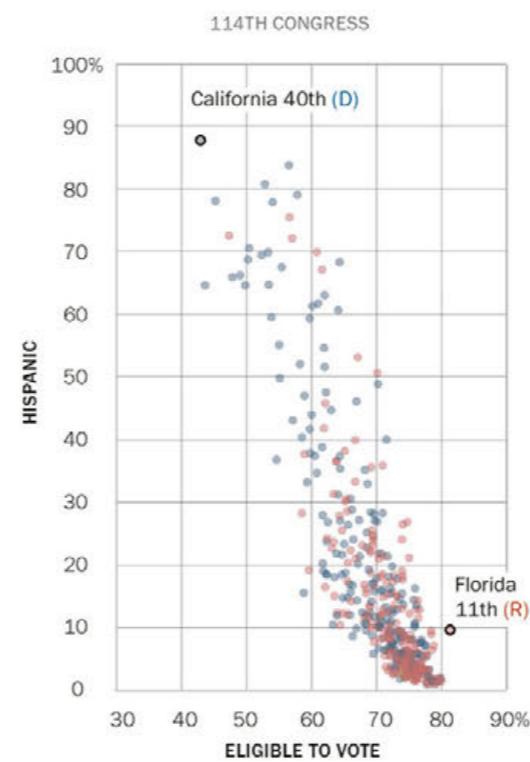


Source: GDP per capita (PPP) from IMF World Economic Outlook Database, April 2013. Data not available for Palestinian territories.

PEW RESEARCH CENTER

## Districts with Fewest Eligible Voters Have Large Hispanic Populations and Are Represented by Democrats

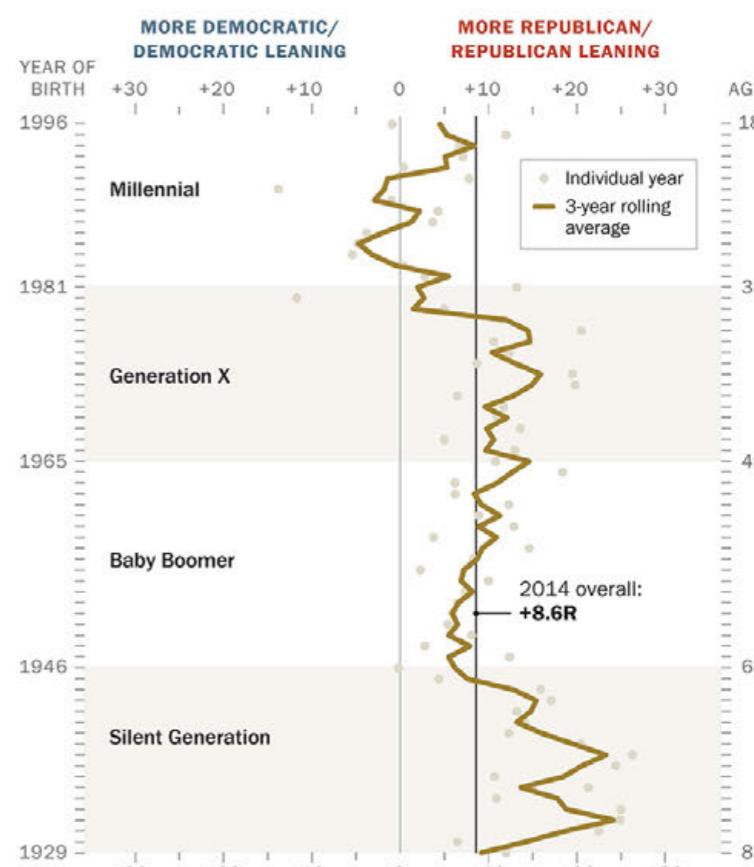
% of congressional district population that is ...



Note: Eligible voters are defined as U.S. citizens, ages 18+.  
Source: Pew Research Center analysis of U.S. Census Bureau's 2013 American Community Survey

PEW RESEARCH CENTER

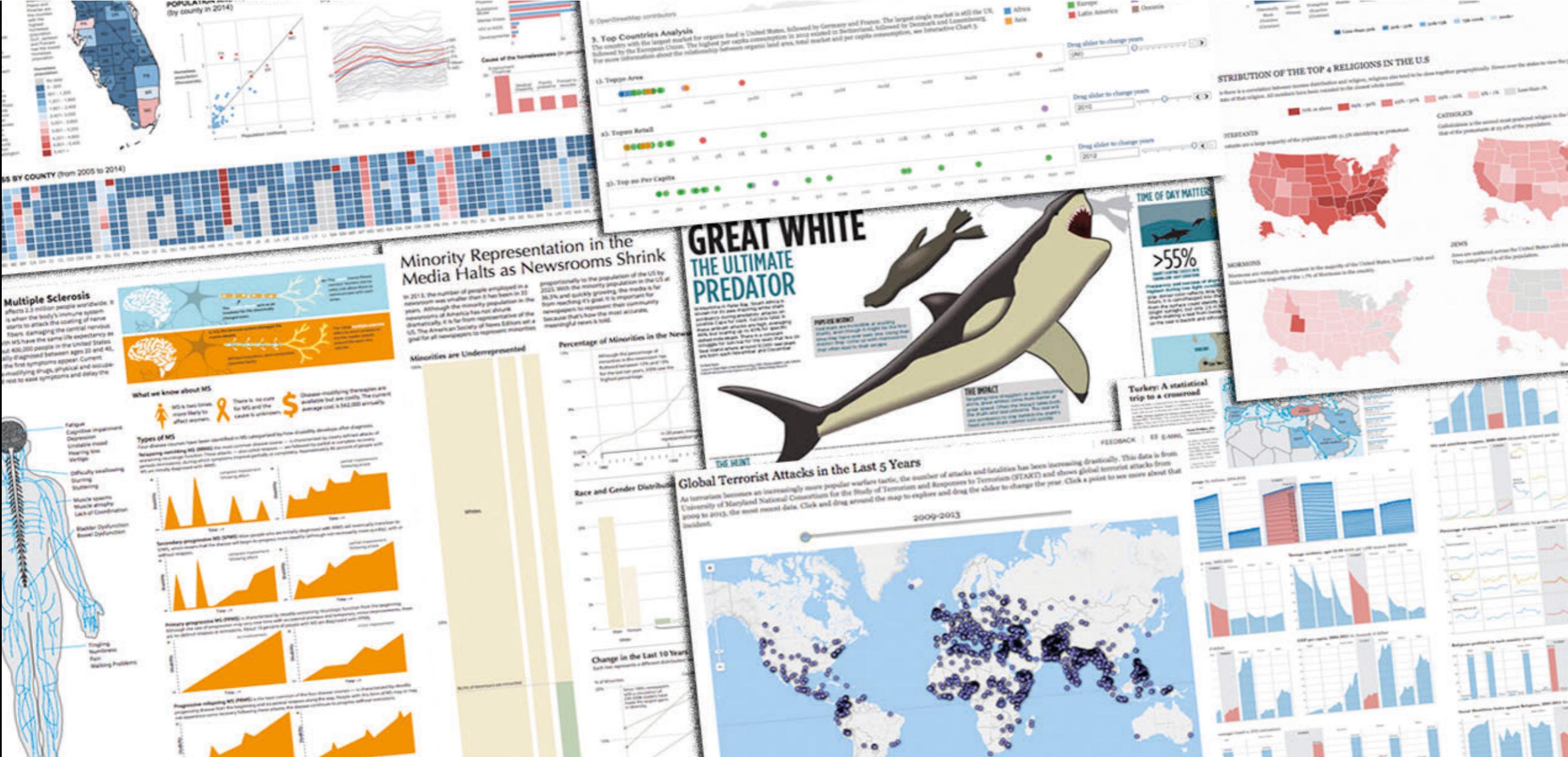
## 2014 Partisan Advantages Among Whites, by Year of Birth



Source: Merged Pew Research Center surveys conducted in 2014.

PEW RESEARCH CENTER

# Pew Research Center



# PART |

## The core principles

# A summary

# A summary

Good graphics...

1. They are based on good data

# A summary

## Good graphics...

1. They are based on good data
2. They attract readers' attention

# A summary

## Good graphics...

1. They are based on good data
2. They attract readers' attention
3. They don't frustrate readers

# A summary

## Good graphics...

1. They are based on good data
2. They attract readers' attention
3. They don't frustrate readers
4. They show the right amount of data

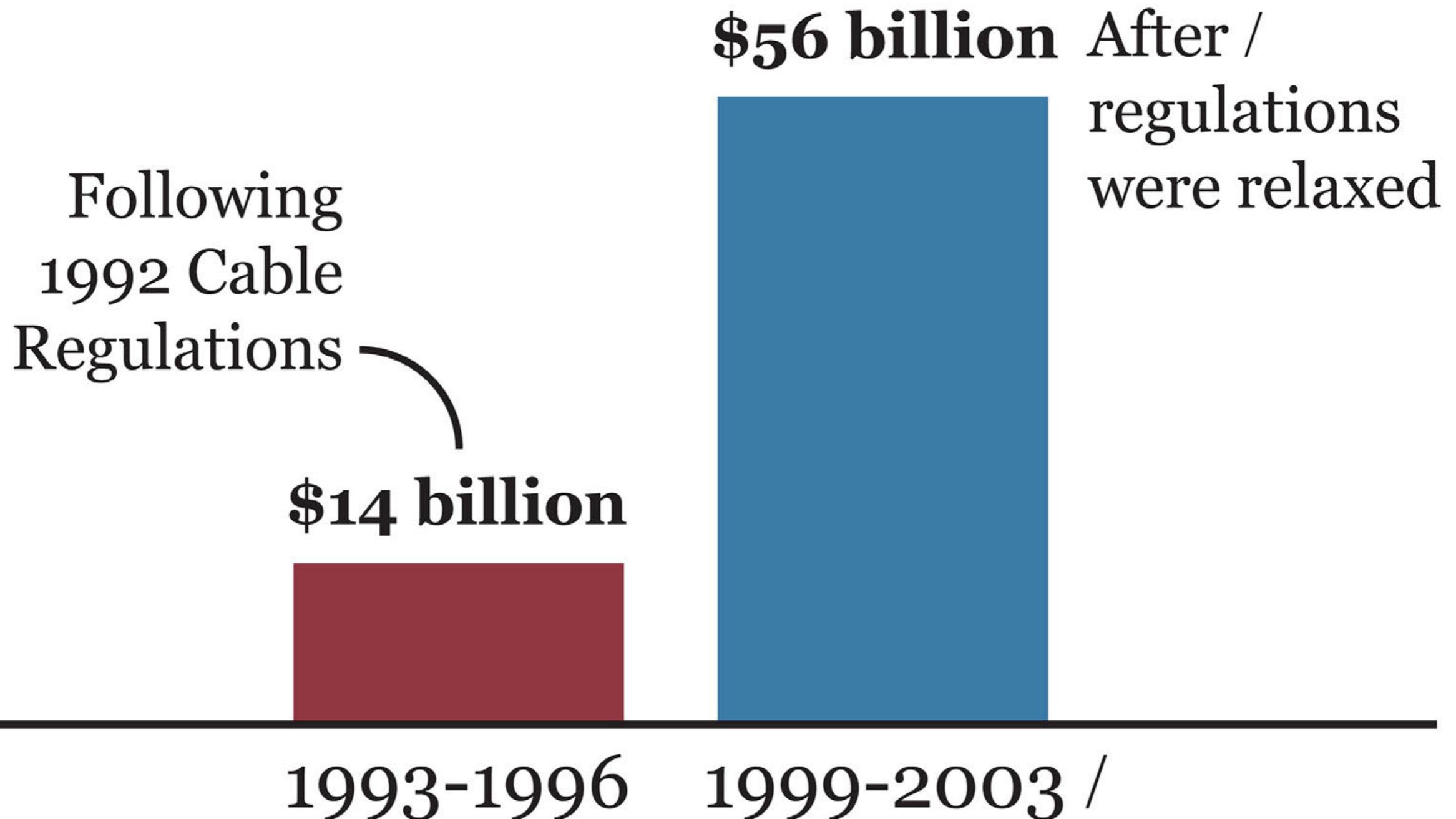
# A summary

## Good graphics...

1. They are based on good data
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3. They don't frustrate readers
4. They show the right amount of data

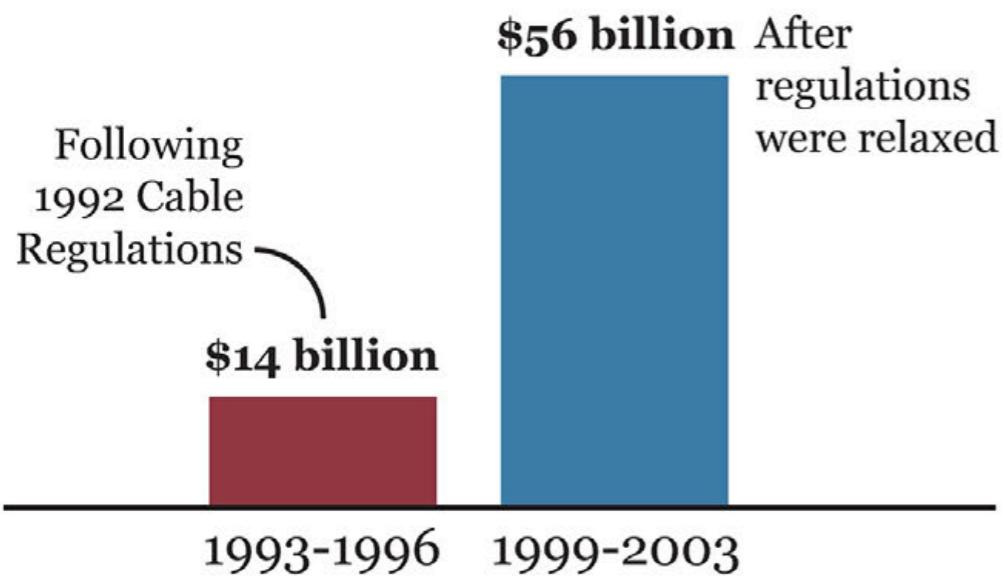
# Less regulation = More Industry Investment \$

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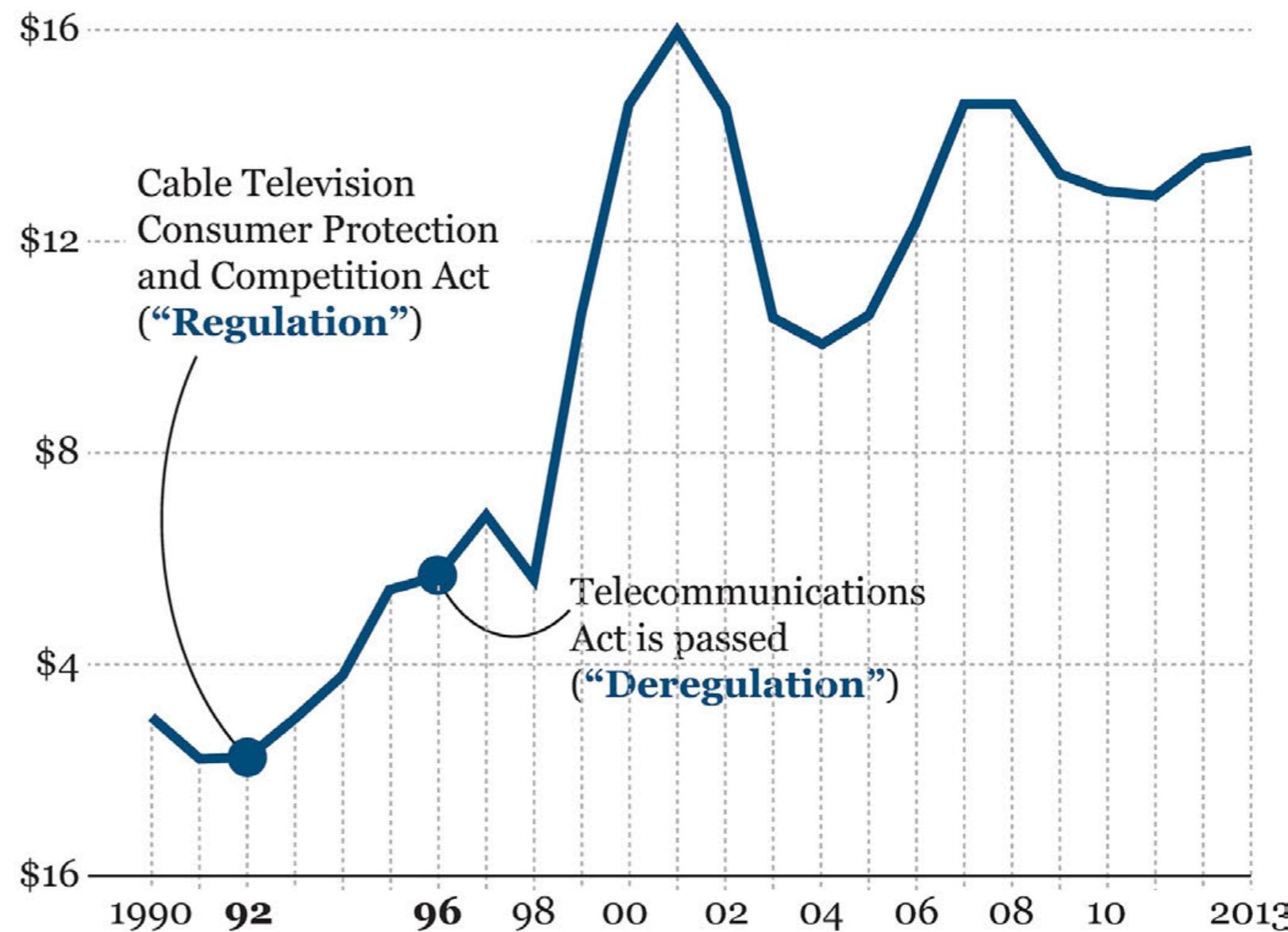
Based on a chart by the National Cable & Telecommunications Association

**Less regulation =  
More Industry Investment**



## Cable Industry Infrastructure Expenditures

*In billions*



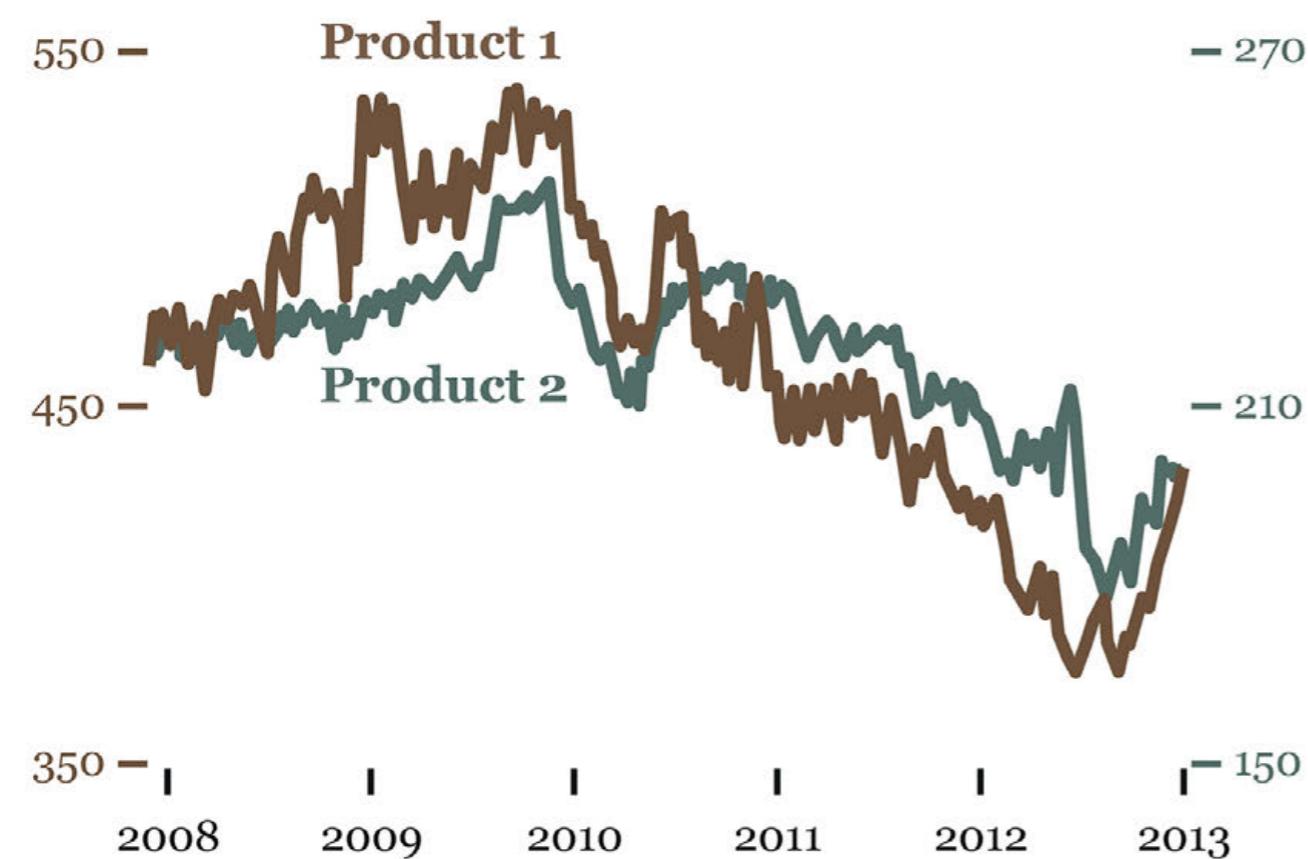
## PRODUCTION COSTS

*U.S. dollars per unit*



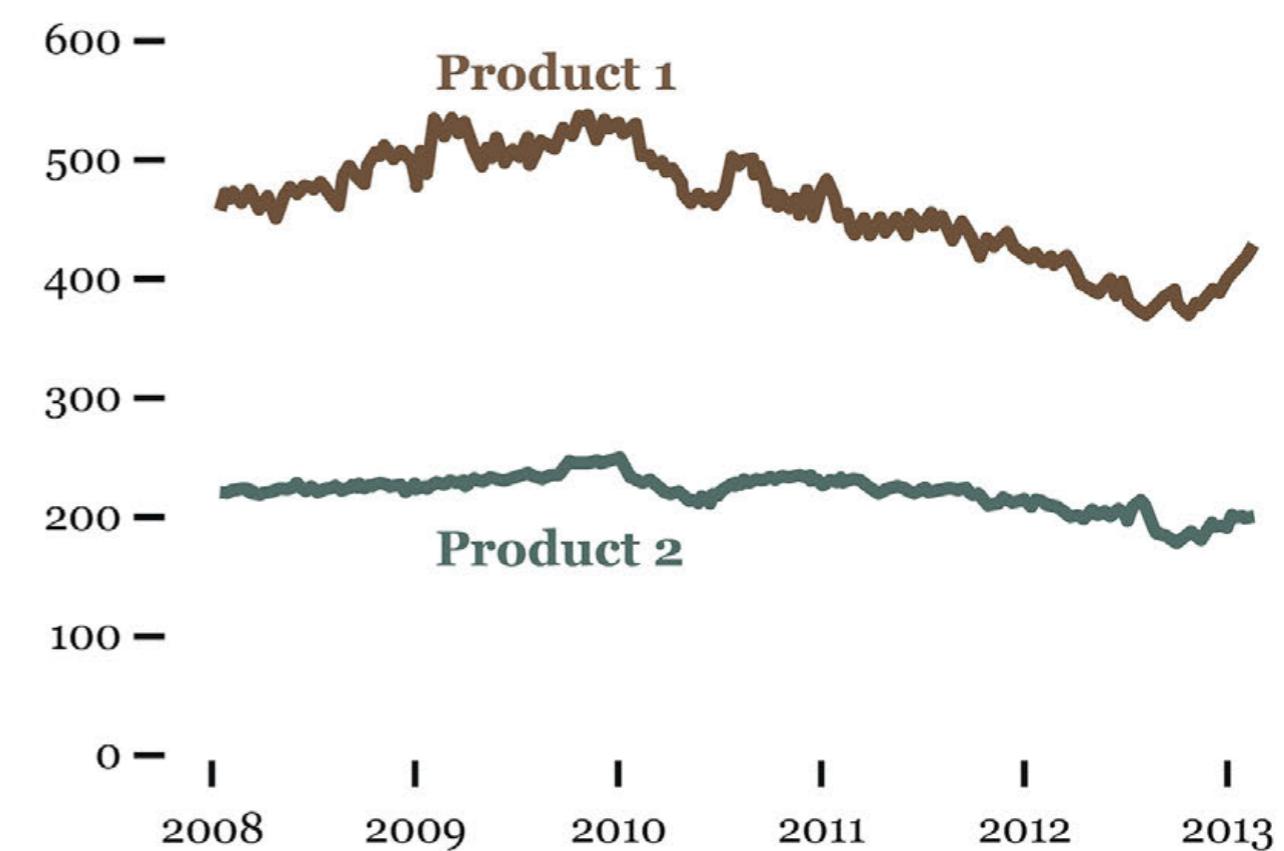
## PRODUCTION COSTS (

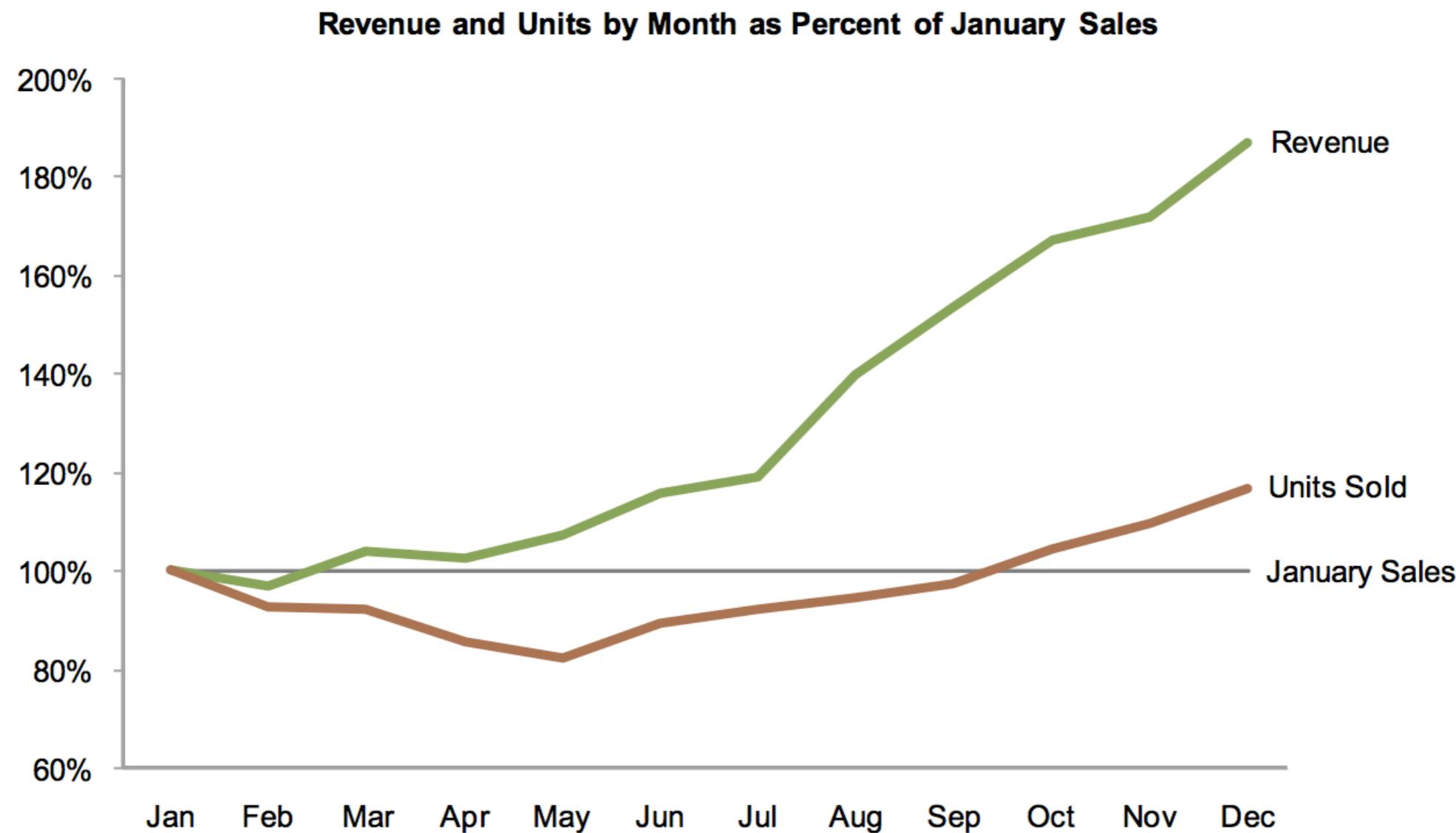
*U.S. dollars per unit*



## PRODUCTION COSTS

*U.S. dollars per unit \$*





This gives us a way to compare the data sets' patterns of change in a single graph along a common scale, so magnitude comparisons are appropriate and the intersections of lines are meaningful.

I certainly cannot conclude, once and for all, that graphs with dual-scaled axes are never useful; only that I cannot think of a situation that warrants them in light of other, better solutions. I invite you to propose viable exceptions, which I will welcome with open arms.

[https://www.perceptualedge.com/articles/visual\\_business\\_intelligence/dual-scaled\\_axes.pdf](https://www.perceptualedge.com/articles/visual_business_intelligence/dual-scaled_axes.pdf)

# A summary

## Good graphics...

1. They are based on good data
2. They attract readers' attention
3. They don't frustrate readers
4. They show the right amount of data

# Original

## From first published to masterpieces

Visualized are the authors of the 100 best English novels of 1960 according to the Modern Library ranking.

Authors are represented through circles showing their life span where their debut novel, their masterpiece(s) according to the ranking are positioned.

Authors' order points out the time-gap between the debut novel and the first published novel selected from the Modern Library ranking (masterpiece).

Debut novel and first masterpiece correspond for the first 22 authors.

Information about authors' hometown and novels' ranking are reported as well.

Sources:  
biography.com, britannica.com, modernlibrary.com

### How to read it?

Authors are ordered from the earliest success to the last one.

colour  
Asia, North America  
Europe, South America

Author name  
85 - Hometown  
100 years birth

death -  
age  
circumference =  
life span

age at debut novel  
distance between  
debut novel and first masterpiece  
age at first masterpiece  
age at second masterpiece  
age at third masterpiece  
age at fourth masterpiece

● - first masterpiece  
coincide with debut  
author still alive  
novel published posthumous



<http://www.thefunctionalart.com/2014/11/redesigning-visualizations.html>

# Original

## From first published to masterpieces

Visualized are the authors of the 100 best english novels of 1900 according to the Modern Library ranking.

Authors are represented through circles showing their life span where their debut novel, their masterpiece(s) according to the ranking are positioned.

Authors' order points out the time-gap between the debut novel and the first published novel selected from the Modern Library ranking (masterpiece).

Debut novel and first masterpiece correspond for the first 22 authors.

Information about authors' hometown and novels' ranking are reported as well.

Sources:

biography.com, britannica.com, modernlibrary.com

### How to read it?

Authors are ordered from the earliest success to the last one.

color: Asia, North America  
Europe, South America

Author name  
55 - Hometown  
100 years birth

death - age  
circumference = lifespan

age at debut novel  
distance between debut novel and first masterpiece  
age at first masterpiece  
age at second masterpiece  
age at third masterpiece  
age at fourth masterpiece

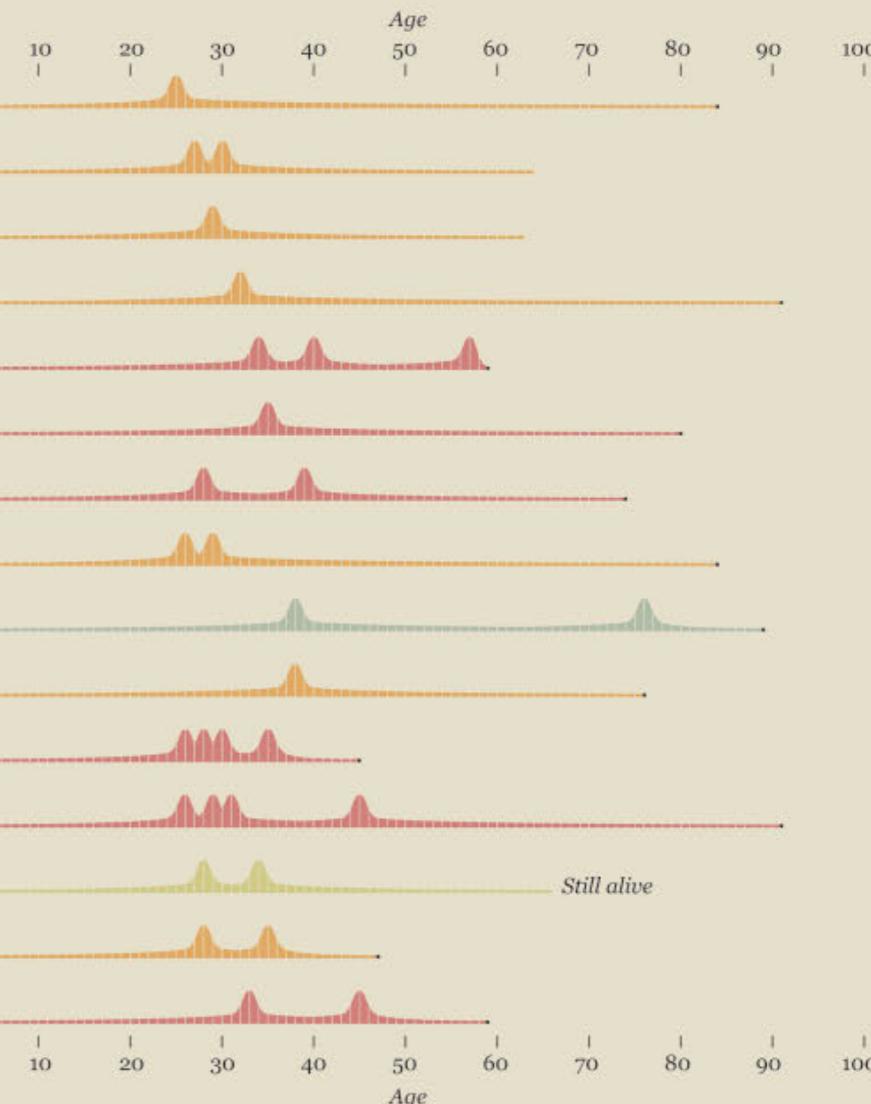
first masterpiece  
coincide with debut  
author still alive  
novel published posthumous



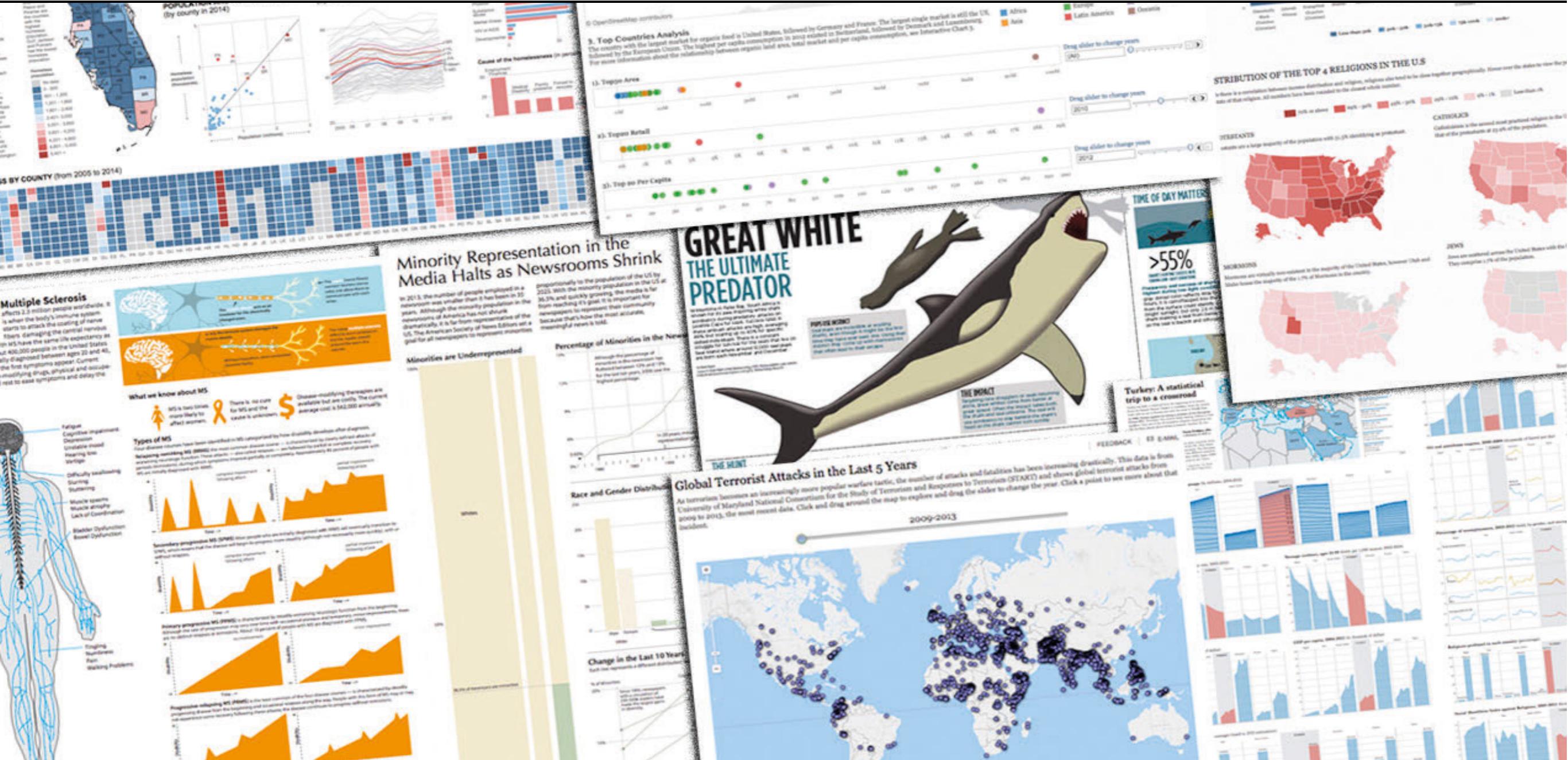
# Quick redesign

## How to read

Masterpiece according to the Modern Library  
Death



<http://www.thefunctionalart.com/2014/11/redesigning-visualizations.html>



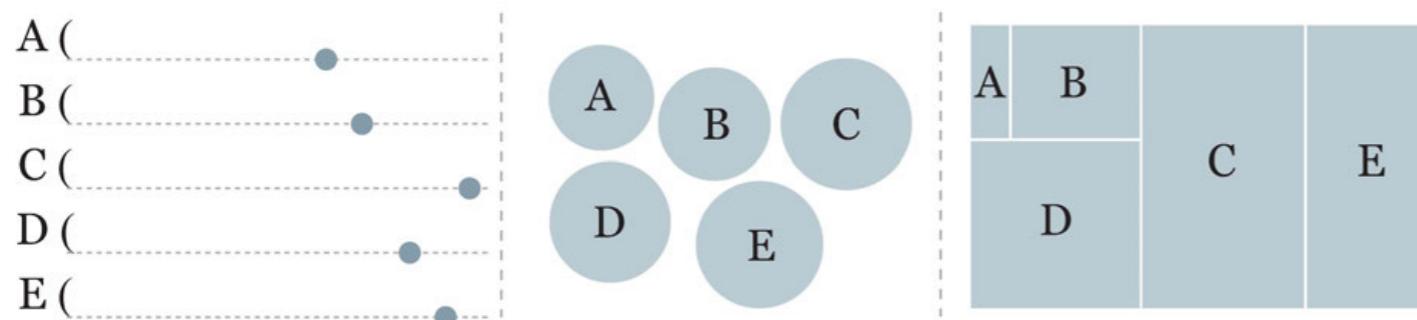
# PART II

## Choosing graphic forms

## *Length or height'*



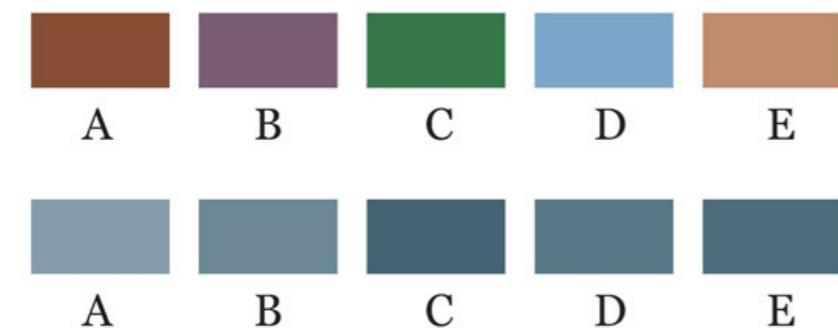
## *Position*



## *Angle/area'*



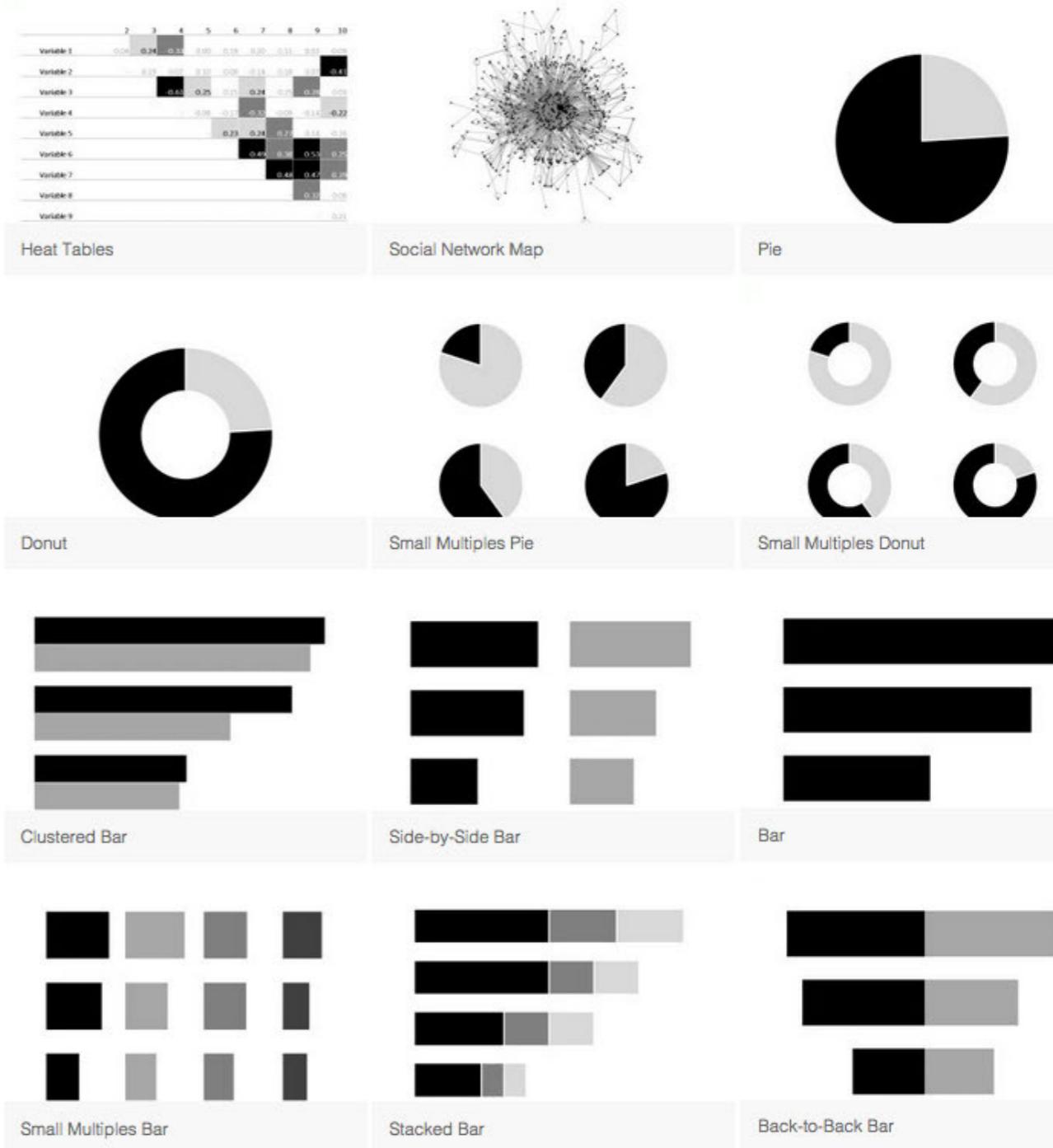
## *Hue and shade*



Figures represented  
in all these graphics:  
22%, 25%, 34%, 29%, 32%

## EMERY'S ESSENTIALS Chart Choosing Tool

ALL / SMALL MULTIPLES / COMPARING 2 OR MORE CATEGORIES / RANGES OR DISPERSION / PART TO WHOLE / DO-ABLE IN EXCEL /  
GEOGRAPHIC MAPS / RELATIONSHIPS / COLLAGES / QUALITATIVE / EXPLORATORY / CORRELATION / 1 POINT IN TIME / 2 POINTS IN TIME /  
3+ POINTS IN TIME

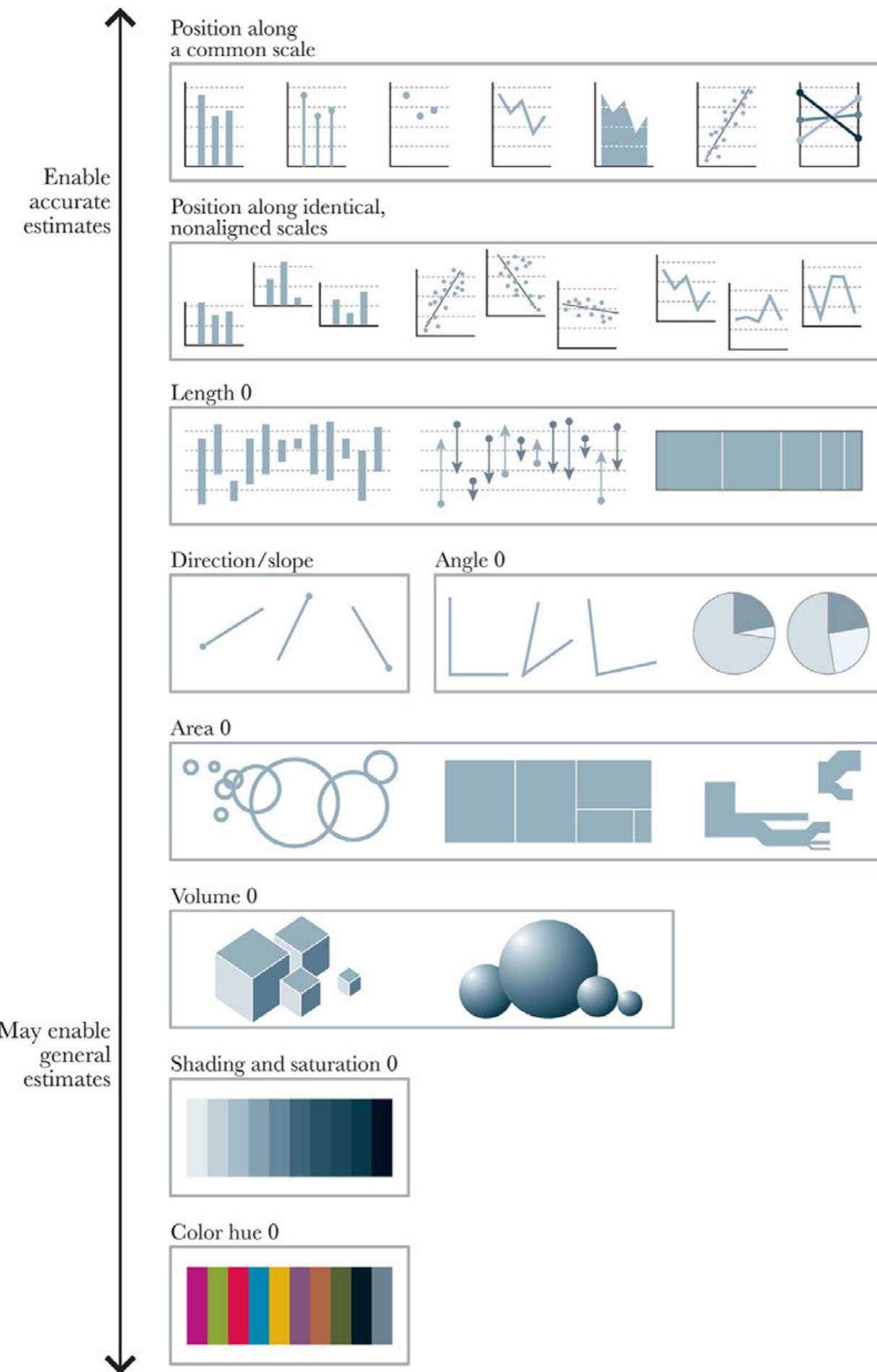


<http://www.datavizcatalogue.com/>

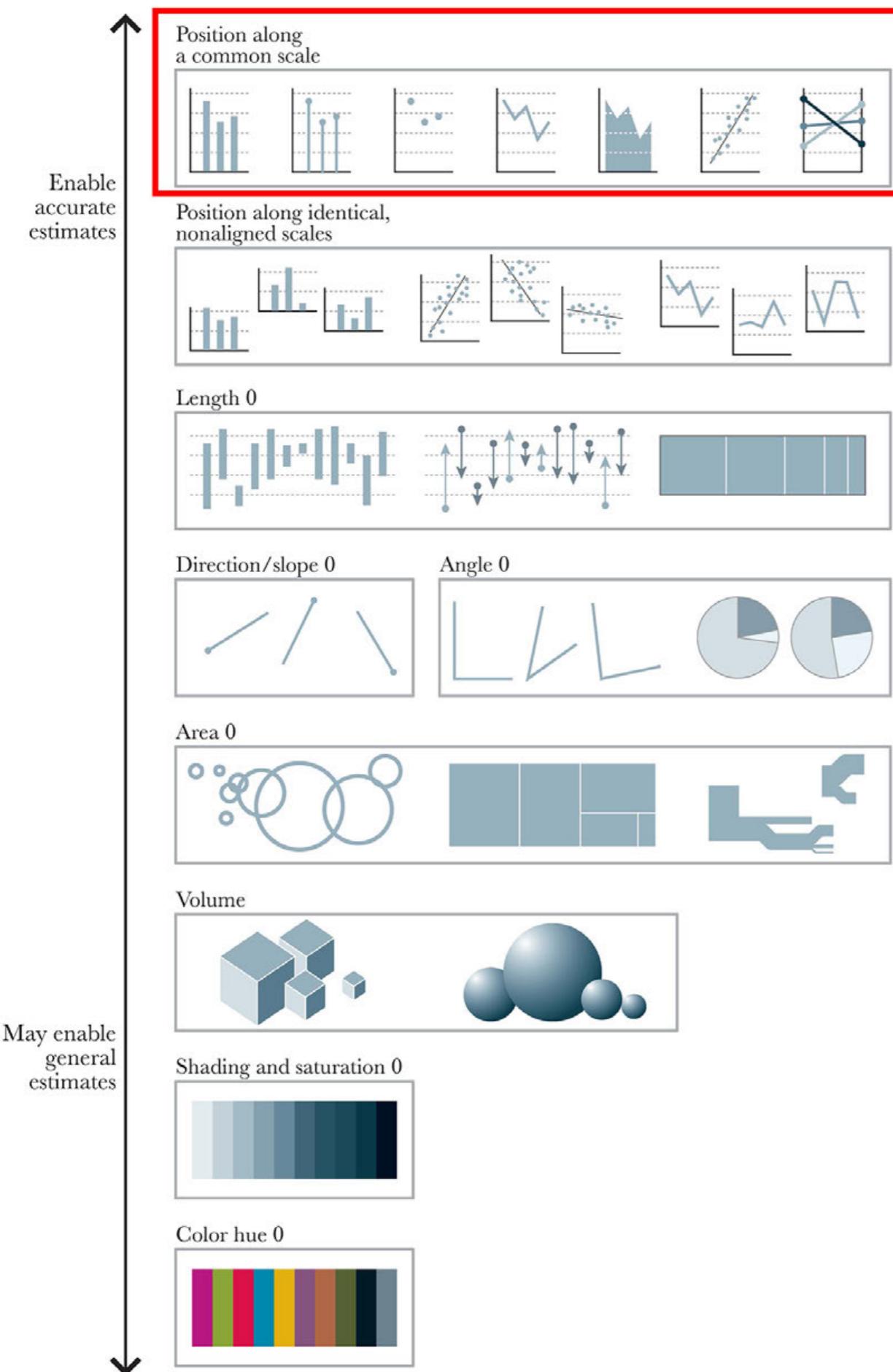
<http://annkemery.com/essentials/>

# What graphic forms are more appropriate to represent your data?

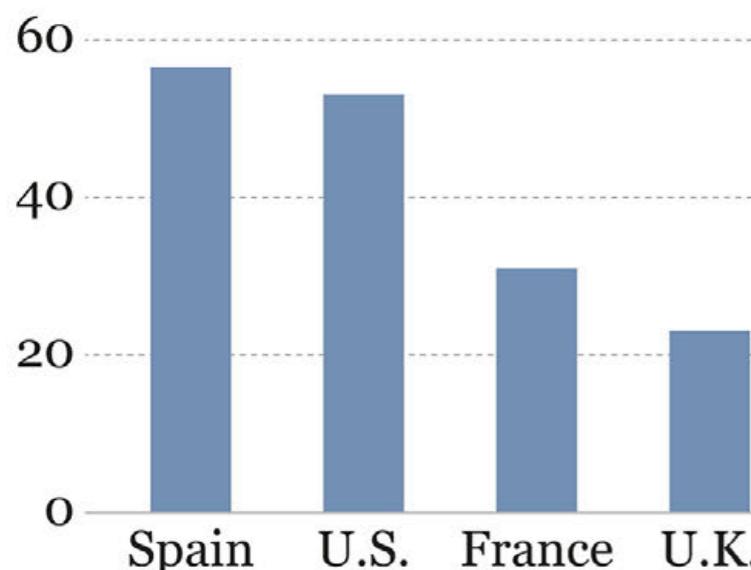
1. Think about the audience and the publication
2. Think of the questions your graphic should help readers answer
3. Can you understand it without reading every single figure?



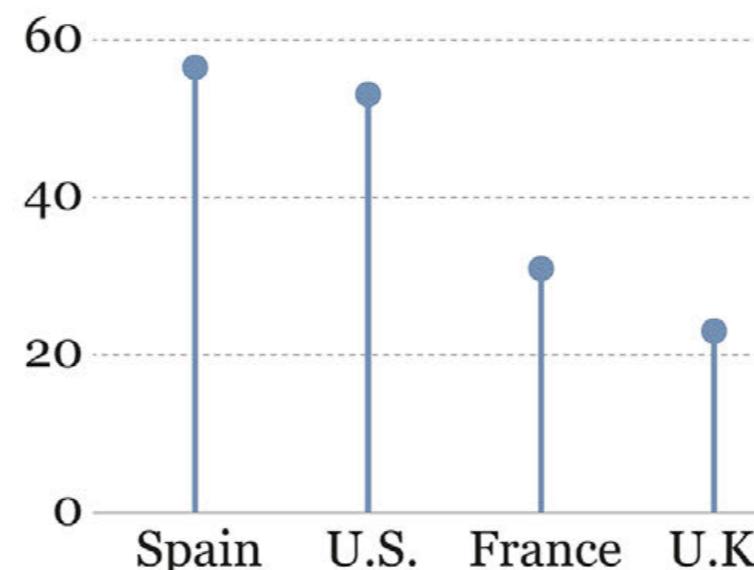
Based on Cleveland  
and Robert McGill (1984)



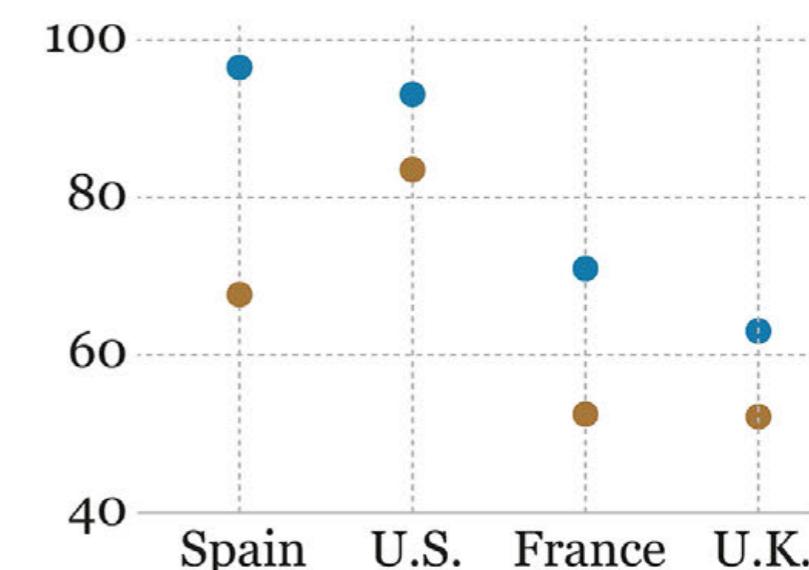
Based on Cleveland  
and Robert McGill (1984)



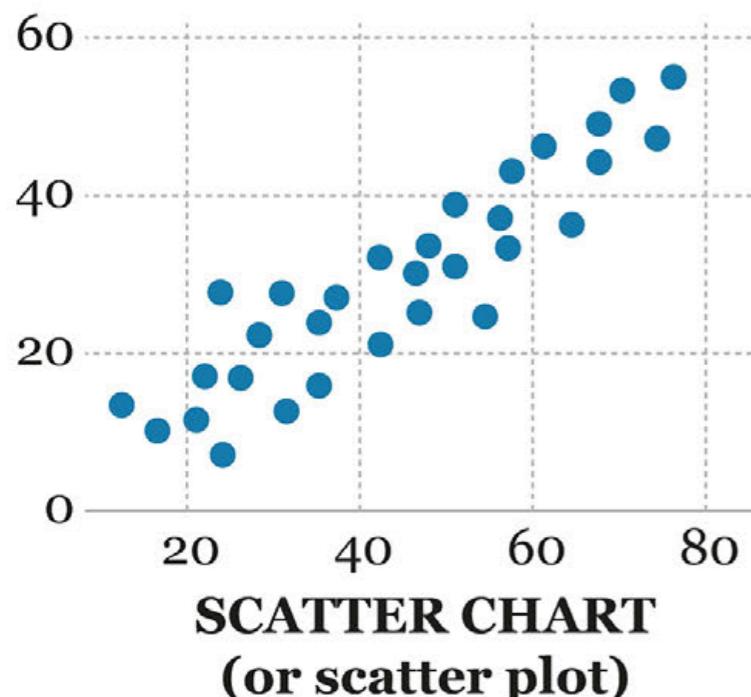
**BAR CHART**



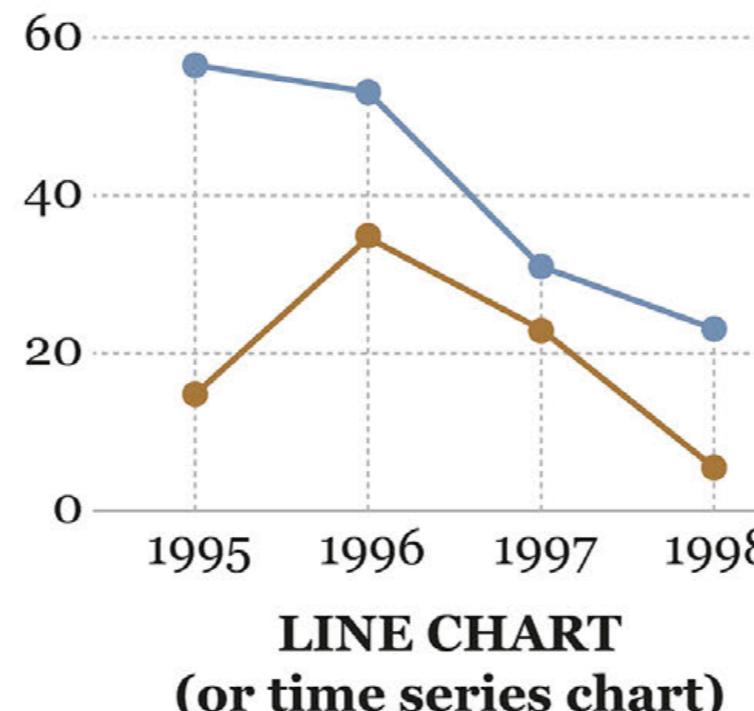
**LOLLIPOP CHART \$**



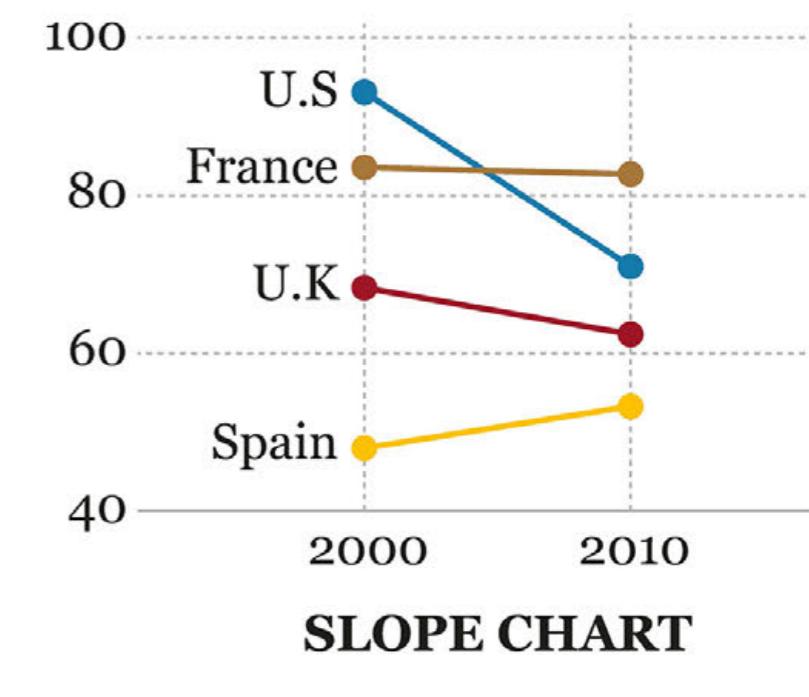
**DOT CHART  
(or dot plot)**



**SCATTER CHART  
(or scatter plot)**

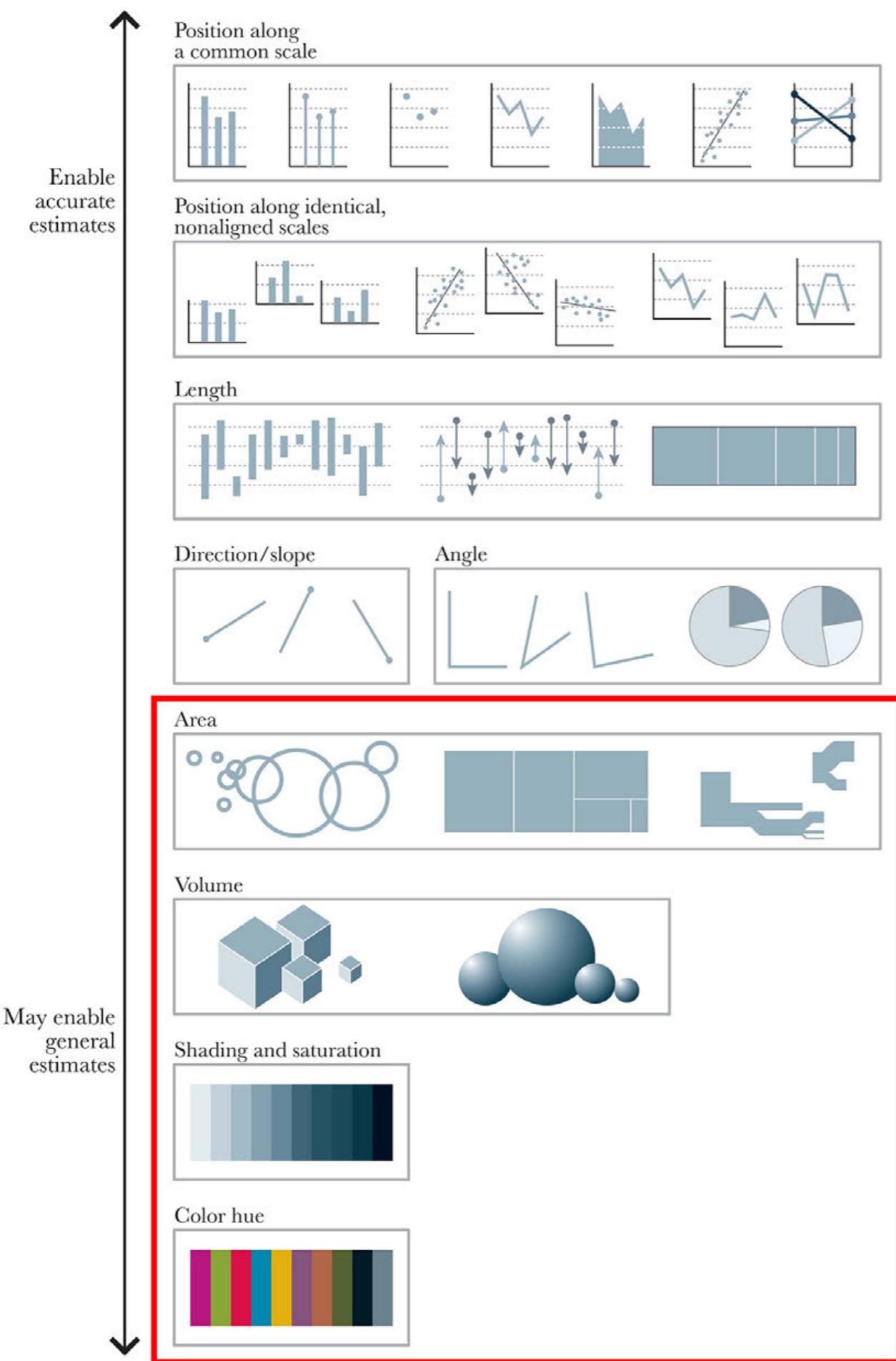


**LINE CHART  
(or time series chart)**



**SLOPE CHART**

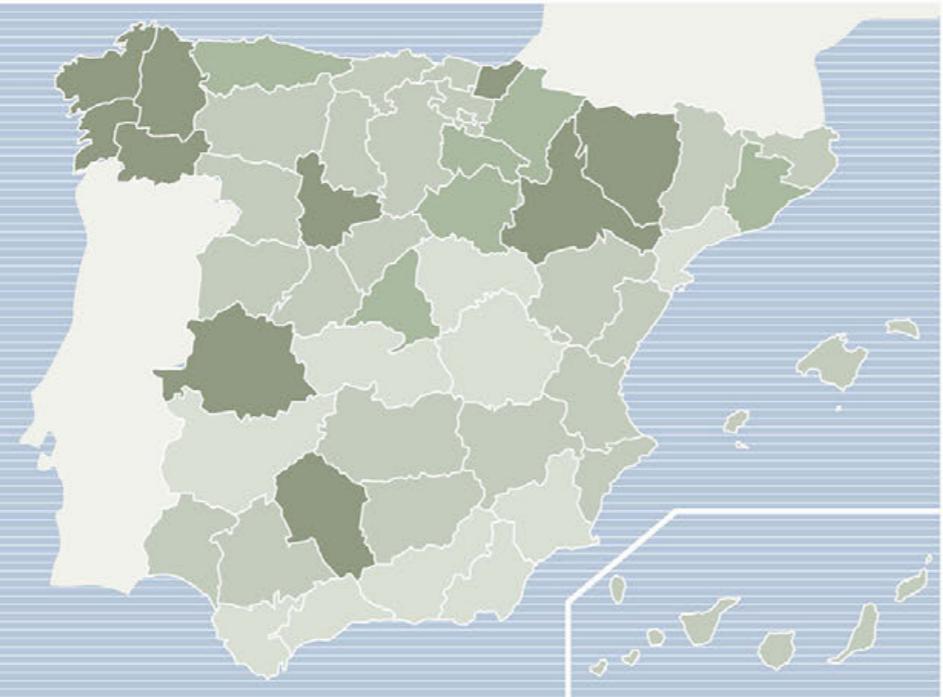
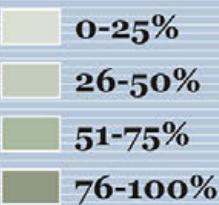
Great for accurate judgments:  
Comparisons, relationships, etc.



Based on Cleveland  
and Robert McGill (1984)

## CHOROPLETH MAP

Percentage of people who ate at least one serving of boiled octopus last year



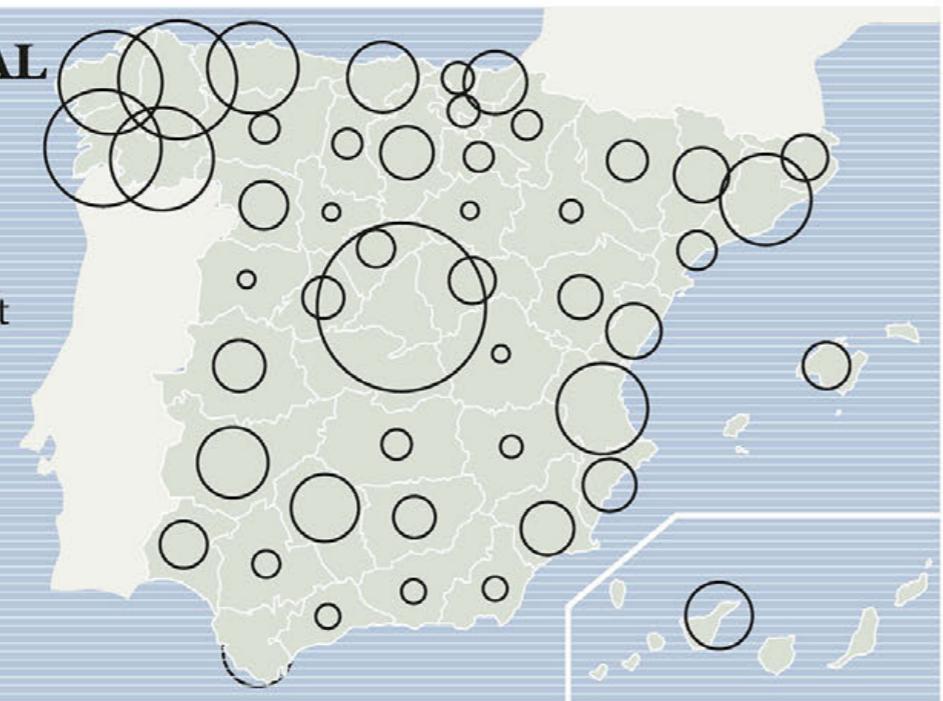
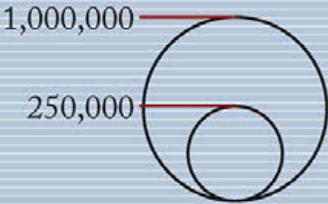
## DOT MAP

Every dot represents a restaurant that served boiled octopus at least once last year



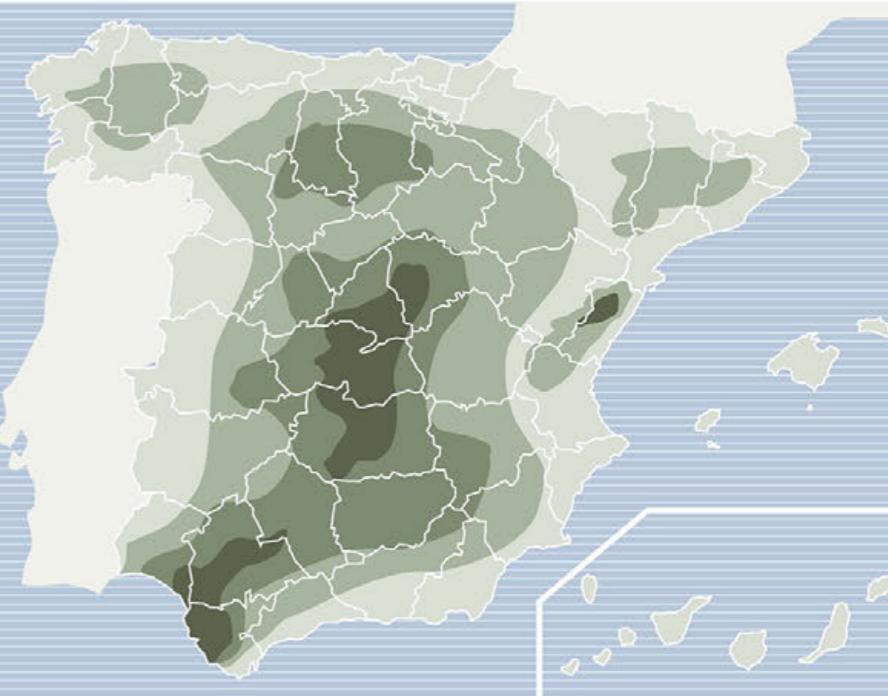
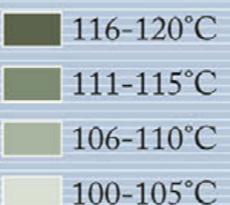
## PROPORTIONAL SYMBOL MAP

People who ate at least one serving of boiled octopus last year

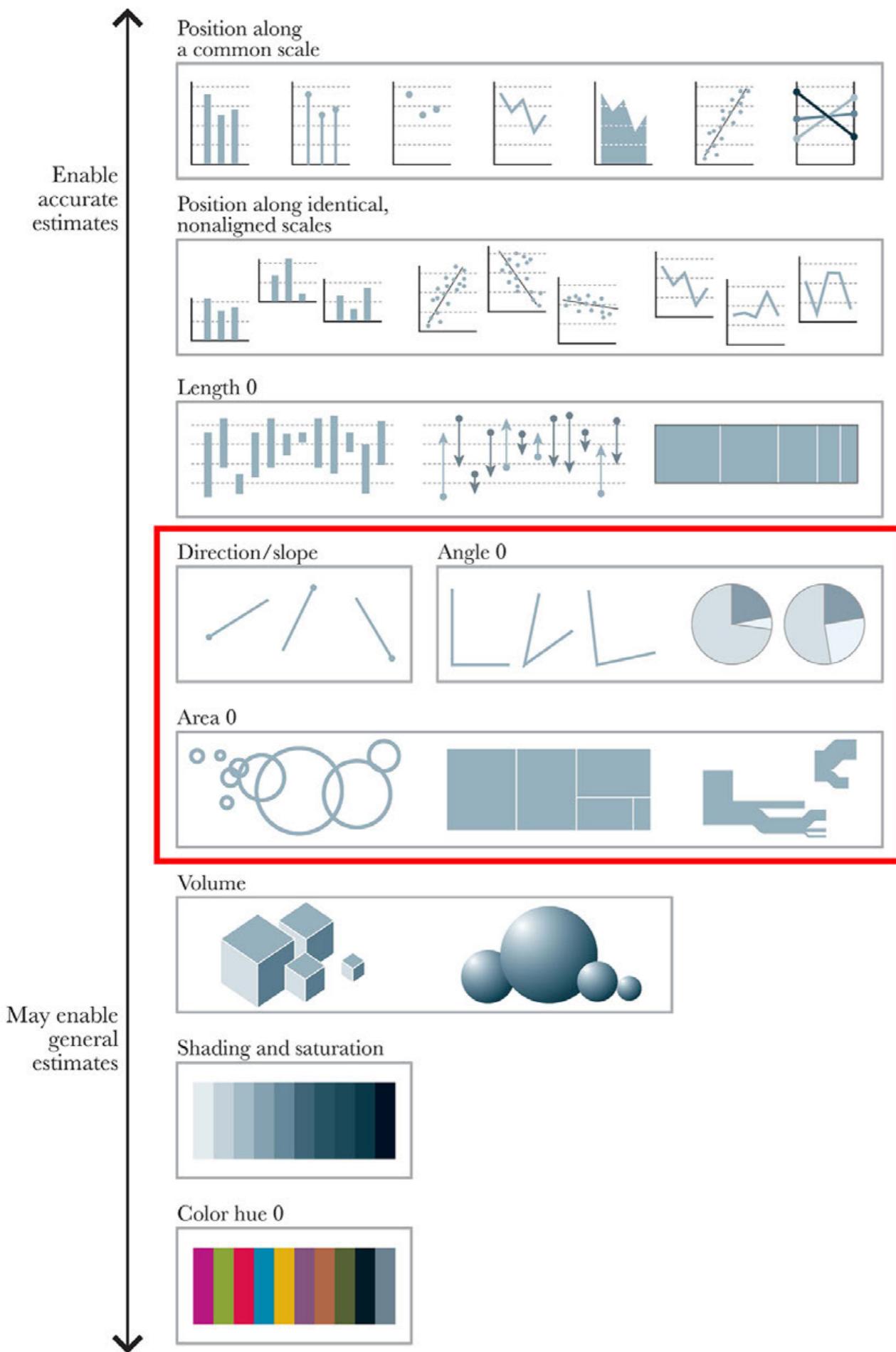


## ISOPLETH MAP

Most common temperature at which octopuses are boiled



Great for general patterns, trends, etc.



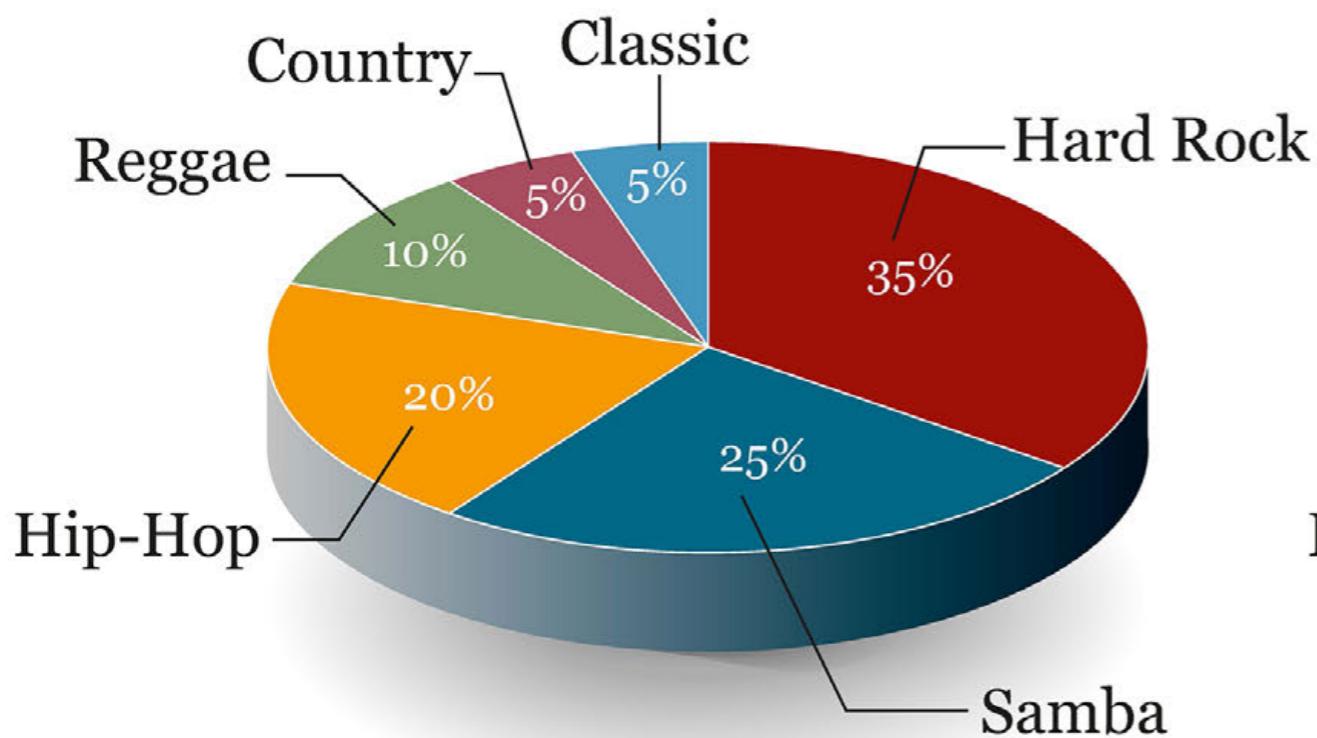
# Using graphic forms erroneously

# How Music Preferences Have Changed in Two Decades \$

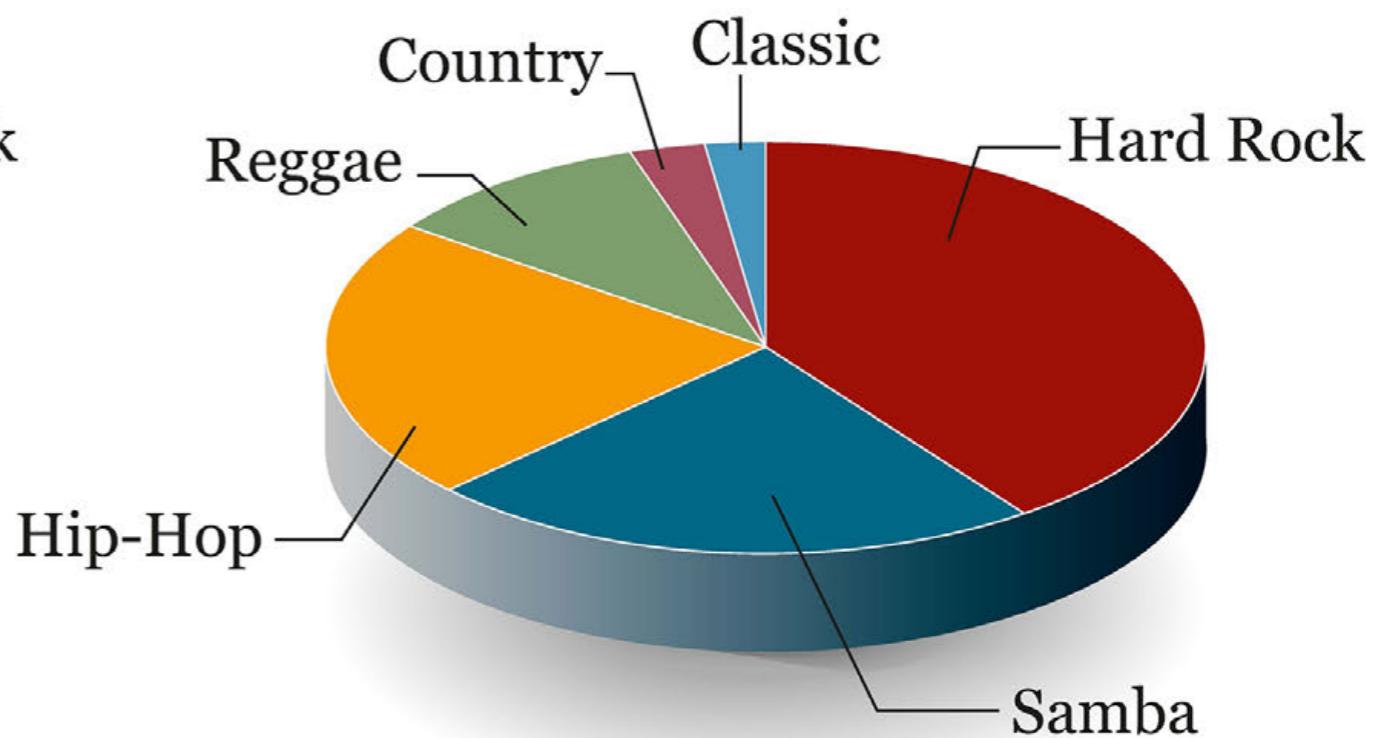
Music styles preferred by University of Miami students. Survey based on interviews with 1,000 students. \$

**SOURCE: WishfulThinkingData Inc.**

**1994**



**2014**

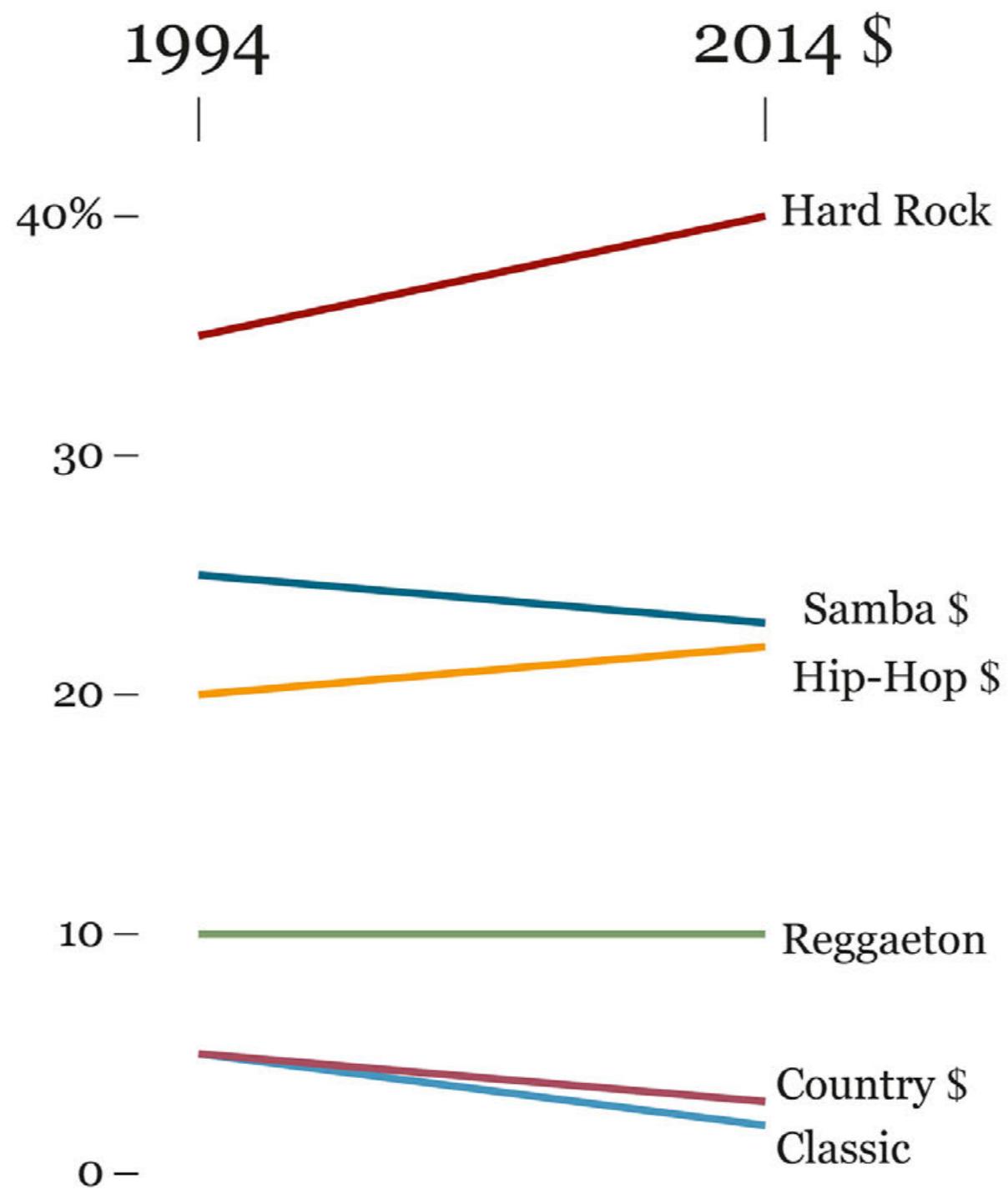


# How Music Preferences Have Changed in Two Decades

Music styles preferred by University of Miami students.

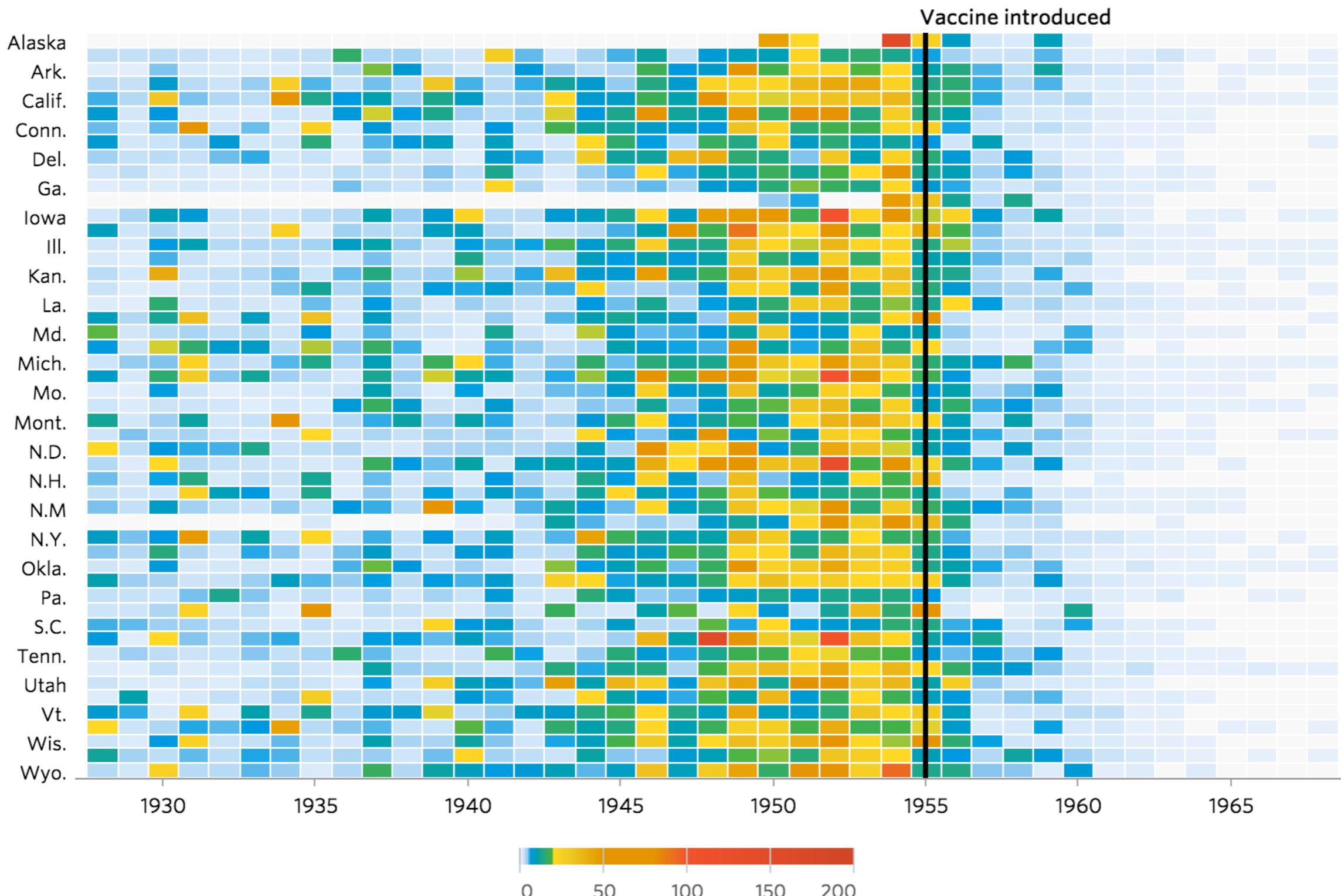
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**SOURCE: WishfulThinkingData Inc.**



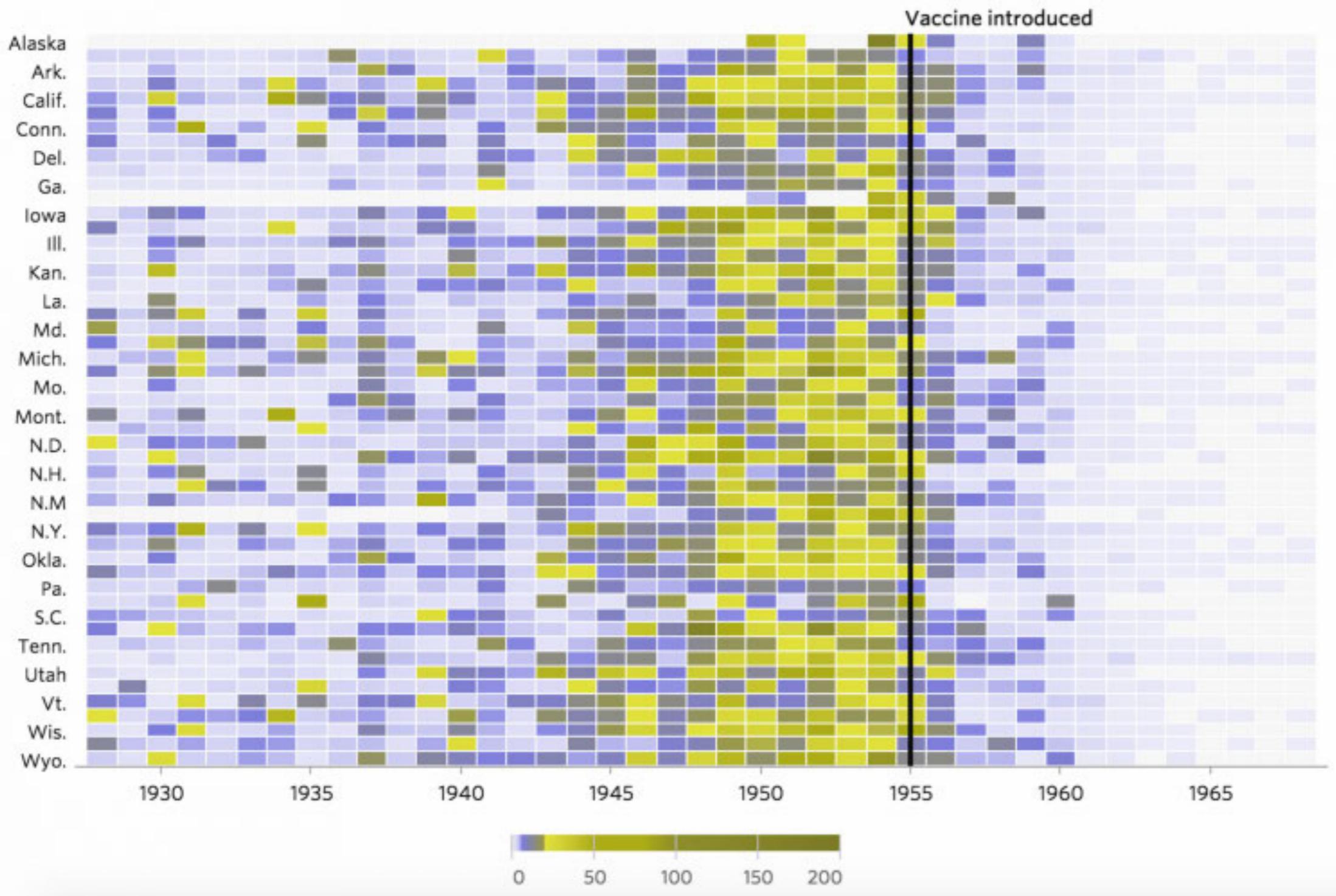
Choosing graphic forms is  
largely dependent on the  
messages you wish to convey,  
or the insights you want to get

# Polio



<http://graphics.wsj.com/infectious-diseases-and-vaccines/>

# Polio



Color blindness simulator: <http://www.color-blindness.com/coblis-color-blindness-simulator/>  
Randy Olson: <http://www.randalolson.com/2016/03/04/revisiting-the-vaccine-visualizations/>

## CVD Simulator

Image: Screen Shot 2016-05-08 at 1.50.26 PM.png

Select

Upload Image

### DIAGRAM NEWS IN PERSPECTIVE

#### Brazil's Demographic Opportunity

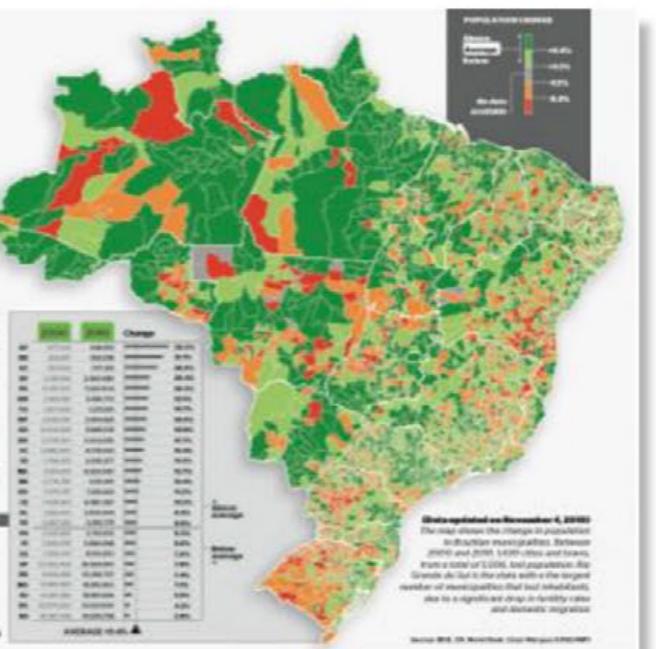
How Brazil can take advantage of a future with fewer children per couple.

Alberto Cairo, Francesco Lanza,  
Marco Vergani

**PRELIMINARY DATA FROM THE 2010 CENSUS**  
create an interesting picture of the changes that the Brazilian population has gone through in the past ten years. Brazil's population grew on average 0.9% between 2000 and 2010, but the fertility rate declined 2.1 children per woman, the minimum to keep a population from shrinking. According to the 2010 Census, the Brazilian demographic is closer to that of Germany than that of India. Brazil will face in the future a choice to maintain a healthy society and welfare system if the number of older and infirm people will grow too much faster than it is today. Here are some details about all the variables of this study.

**BRAZIL'S POPULATION CHANGES**  
The 2010 Census has revealed a 0.9% population increase between 2000 and 2010. This difference is between states, as you can see on the chart on the right, are noticeable. Most rich states, such as São Paulo and Rio de Janeiro, grew as fast as the ones in the north-east.

Source: IBGE, 2010, Brazilian Census Report 2010-2011



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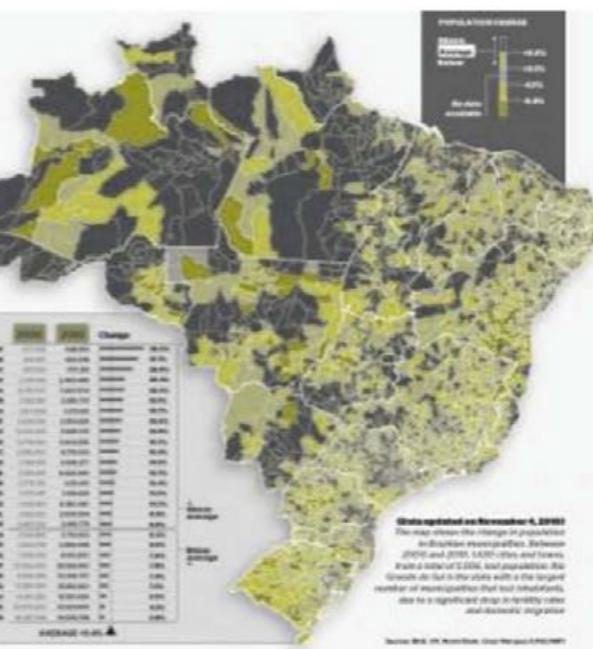
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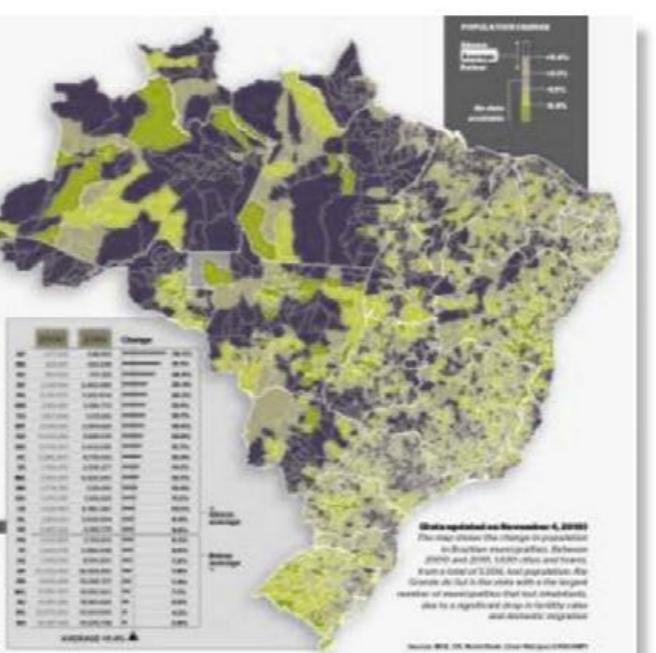
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Select

Upload Image

### DIAGRAM NEWS IN PERSPECTIVE

#### Brazil's Demographic Opportunity

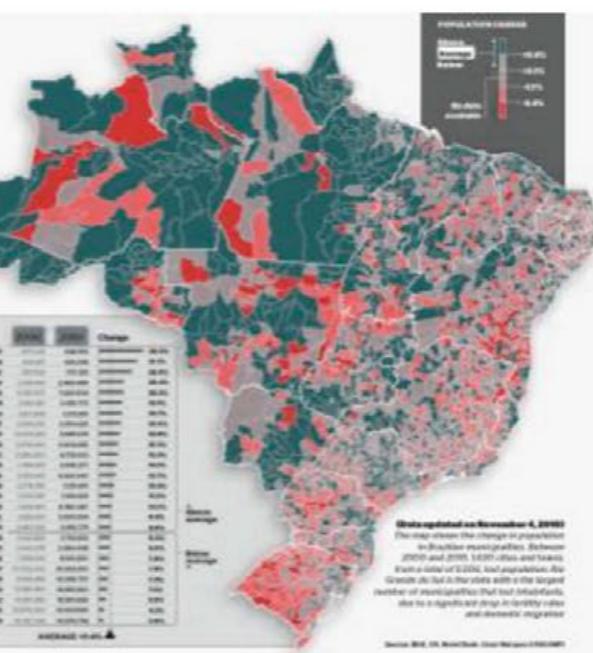
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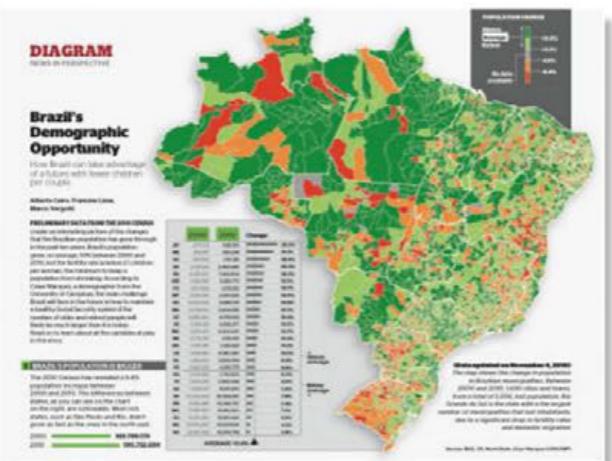


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Color blindness simulator: <http://www.color-blindness.com/coblis-color-blindness-simulator/>

## CVD Simulator

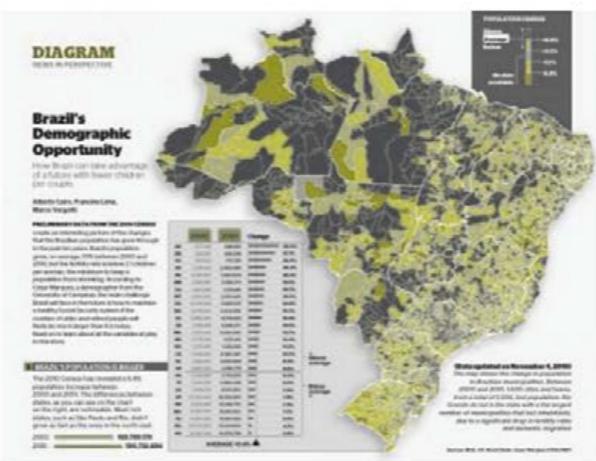
Image: Screen Shot 2016-05-08 at 1.50.26 PM.png Select Upload Image



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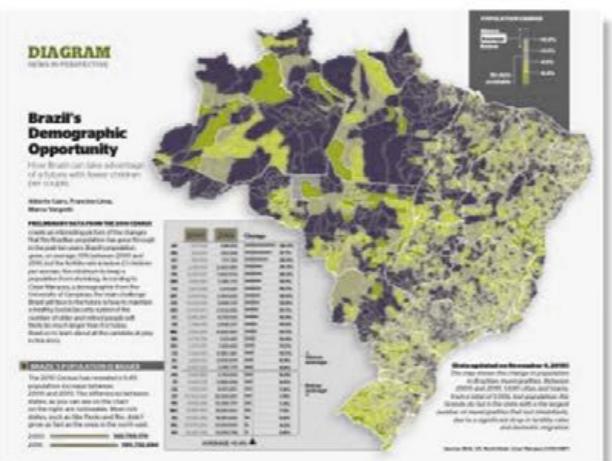
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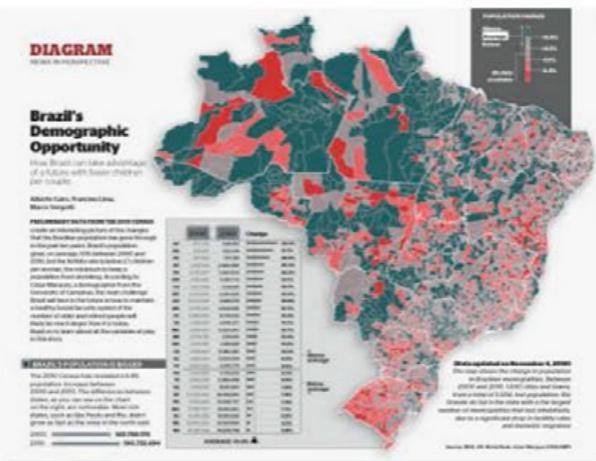
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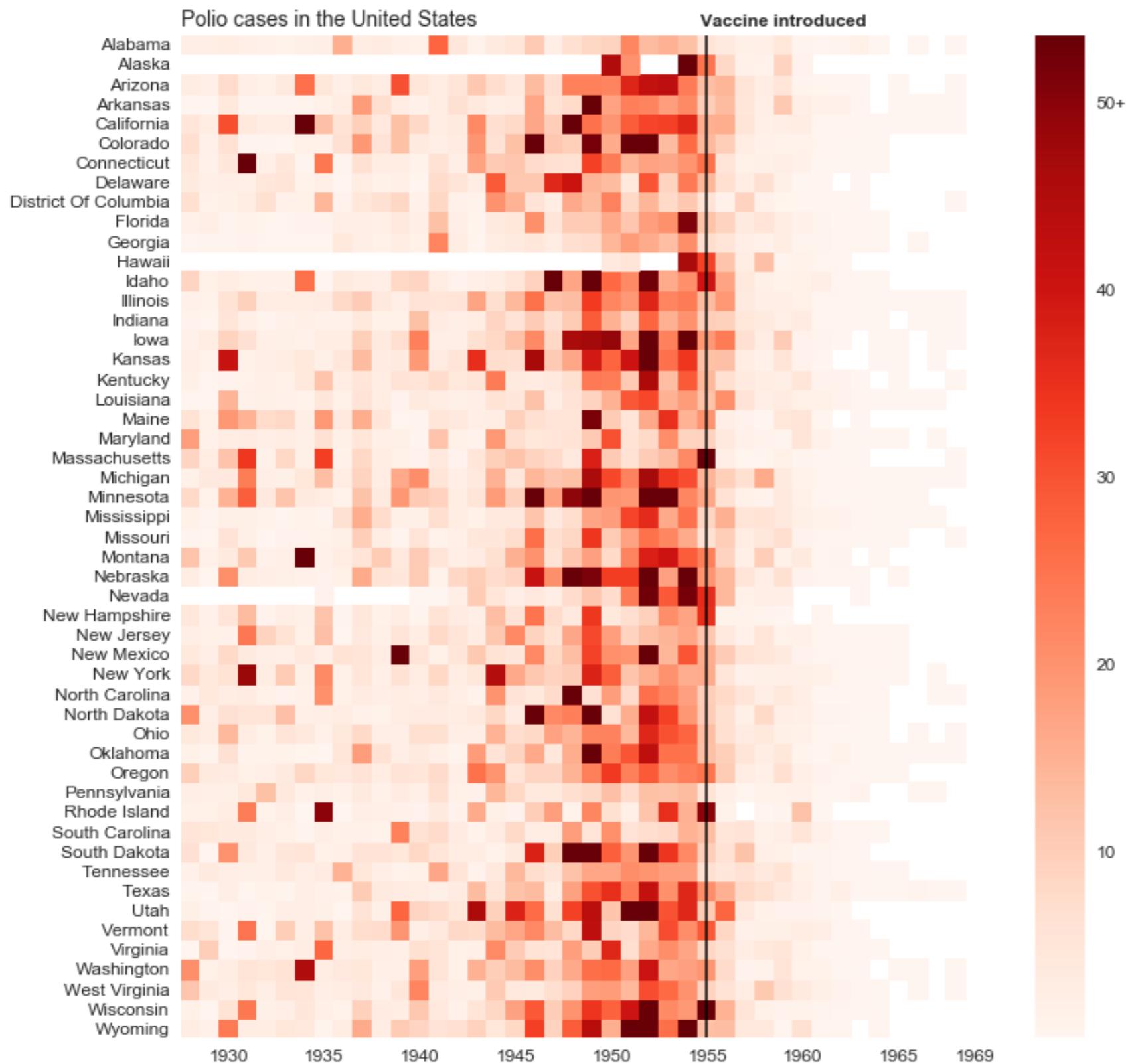
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## Resources about color:

<http://mkweb.bcgsc.ca/colorblind/>

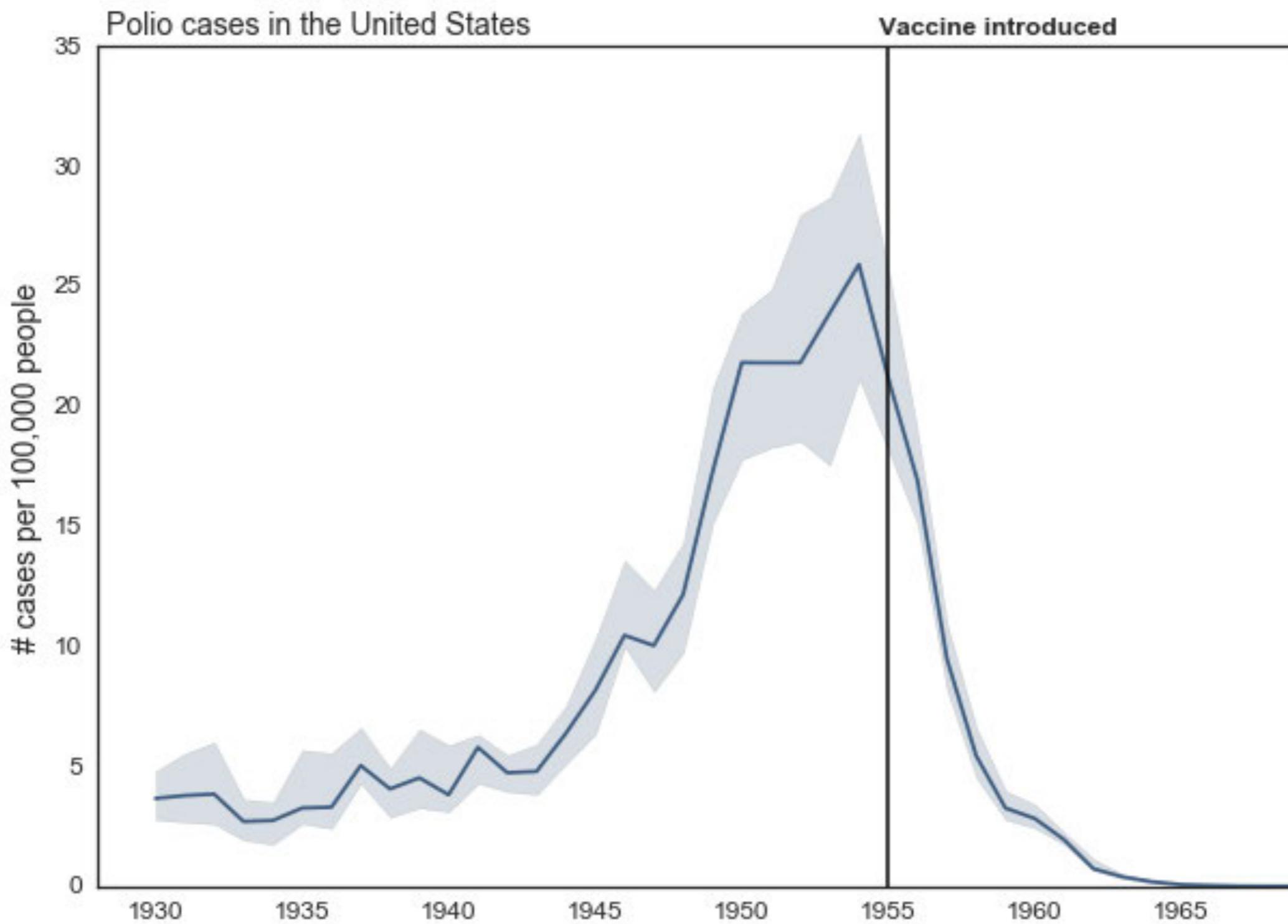
<http://earthobservatory.nasa.gov/blogs/elegantfigures/2013/08/05/subtleties-of-color-part-1-of-6/>

<http://colorbrewer2.org/>



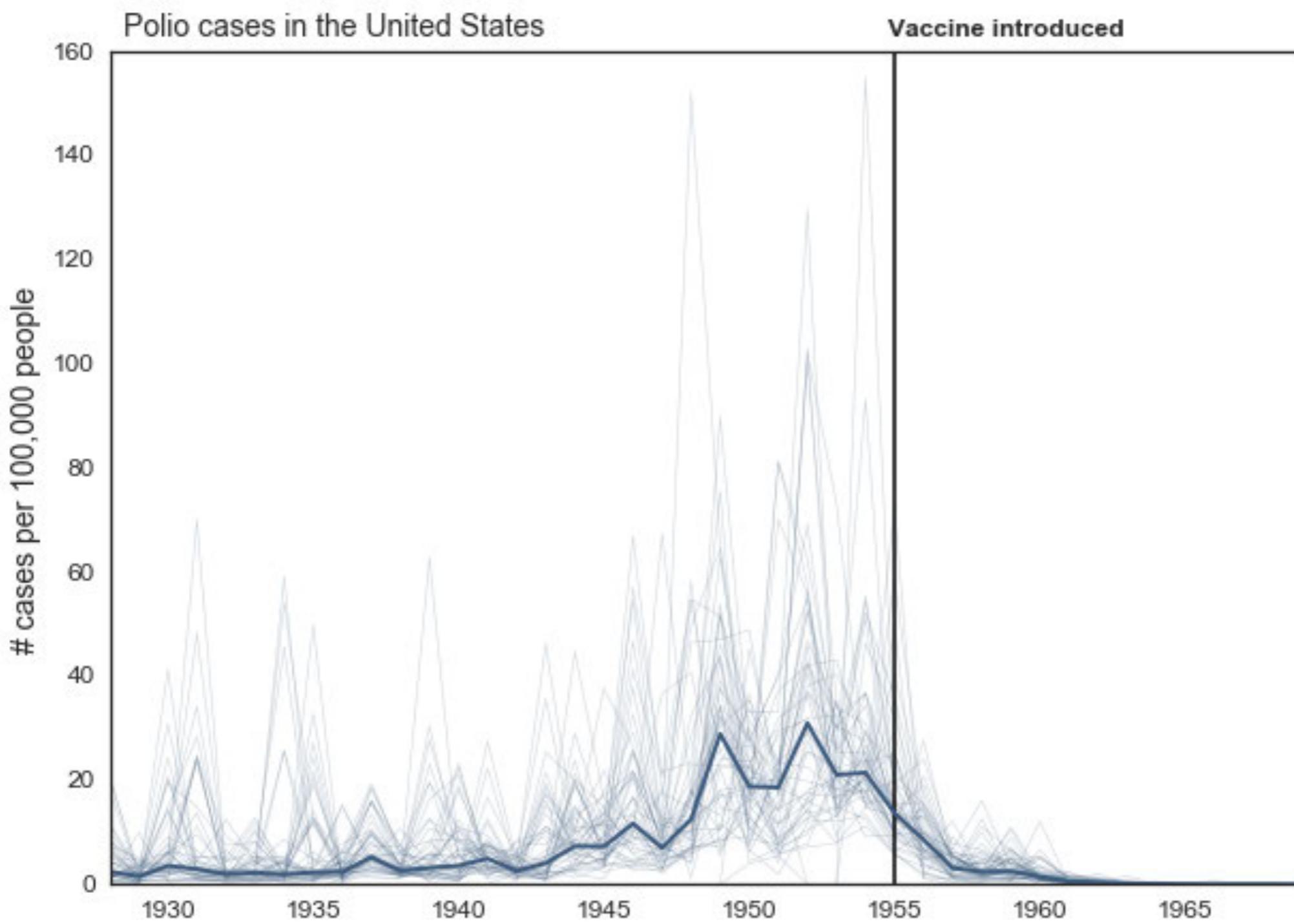
Data source: Project TYCHO (tycho.pitt.edu) | Author: Randy Olson (randalolson.com / @randal\_olson)

Randy Olson: <http://www.randalolson.com/2016/03/04/revisiting-the-vaccine-visualizations/>



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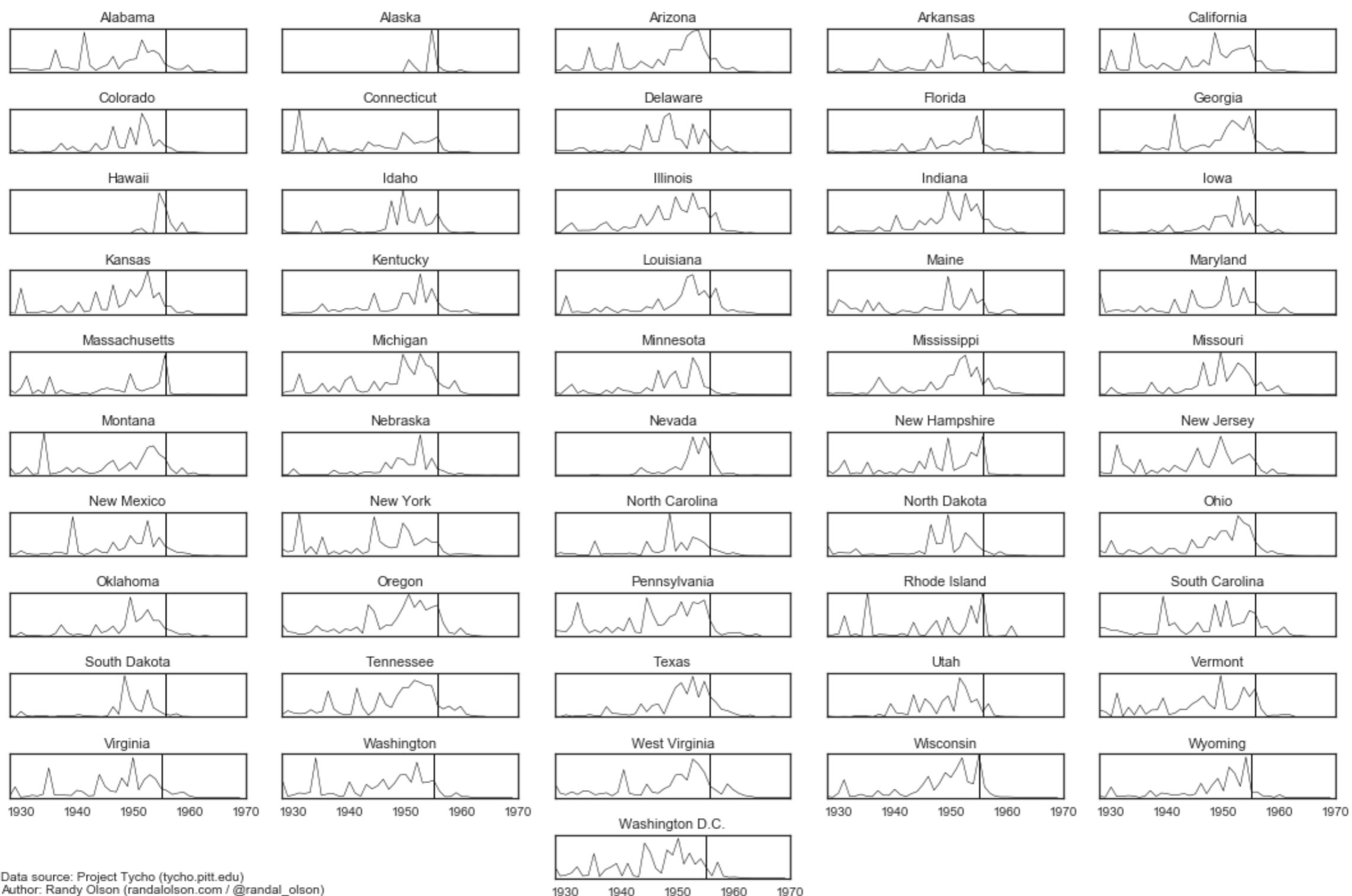
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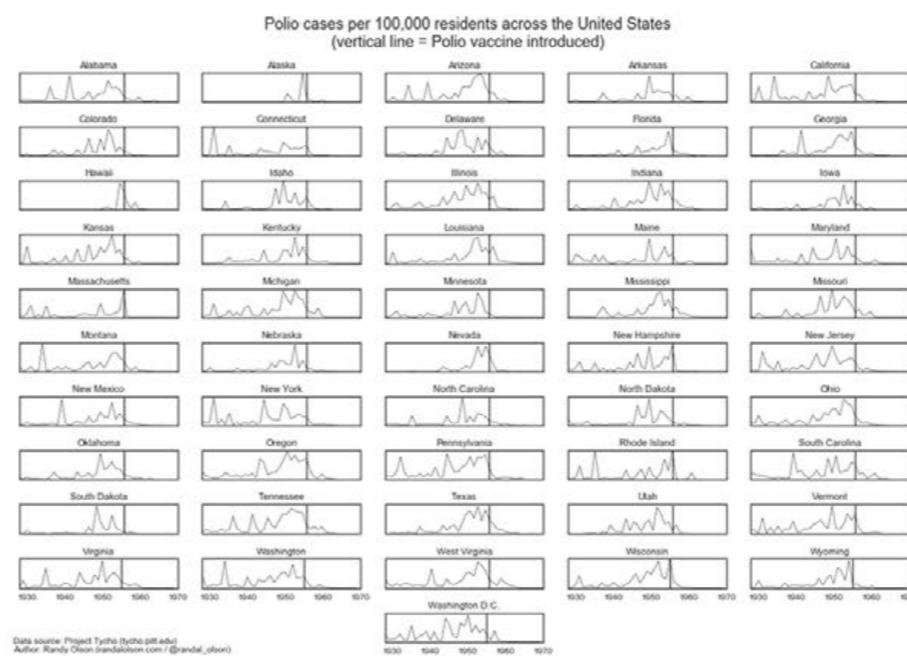
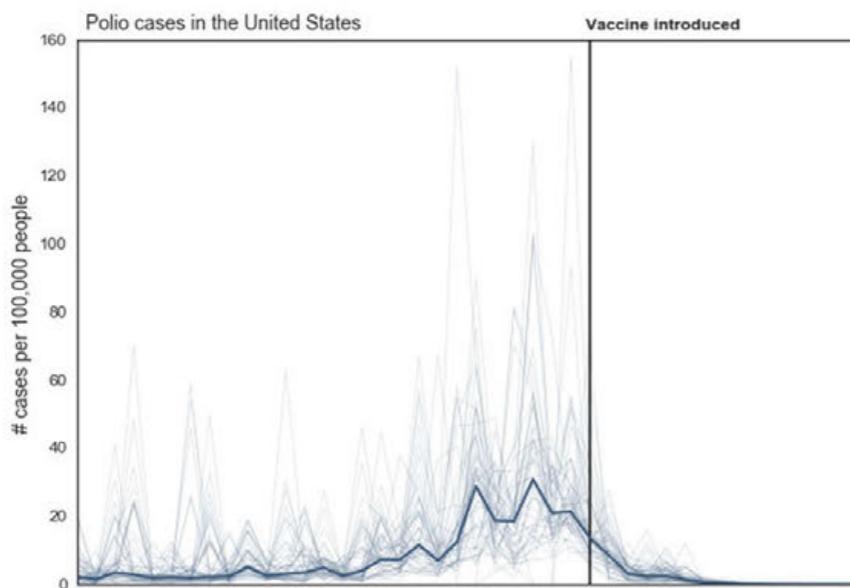
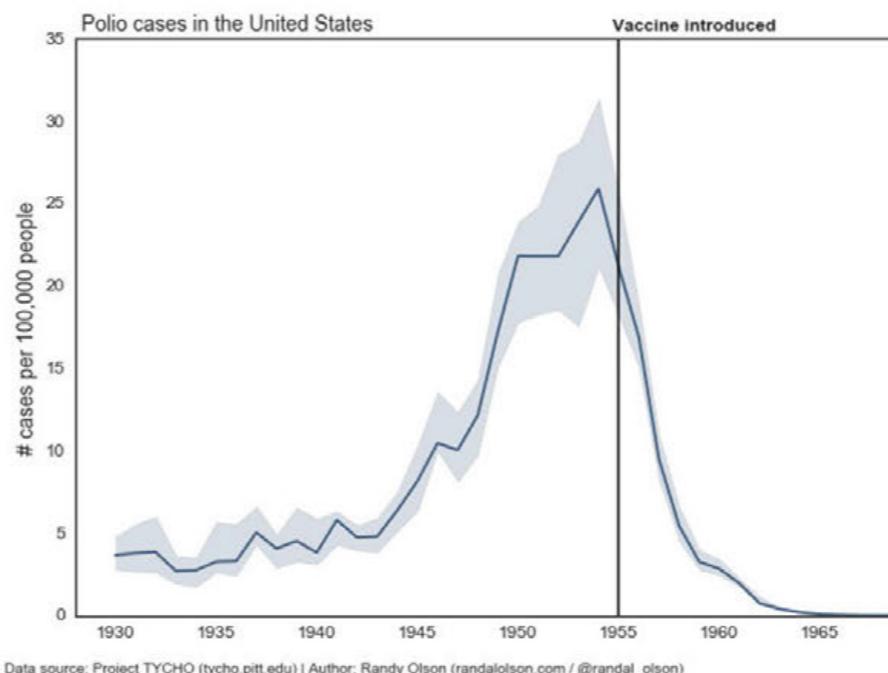
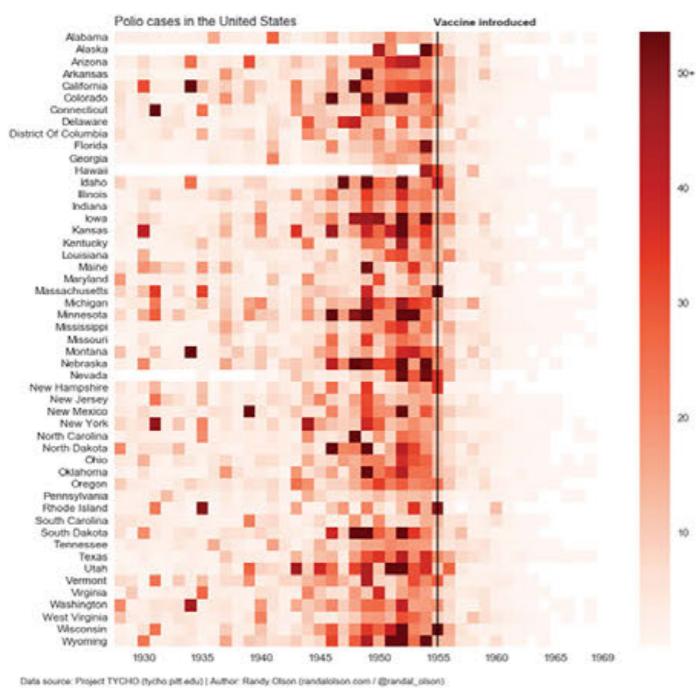
Polio cases per 100,000 residents across the United States  
(vertical line = Polio vaccine introduced)



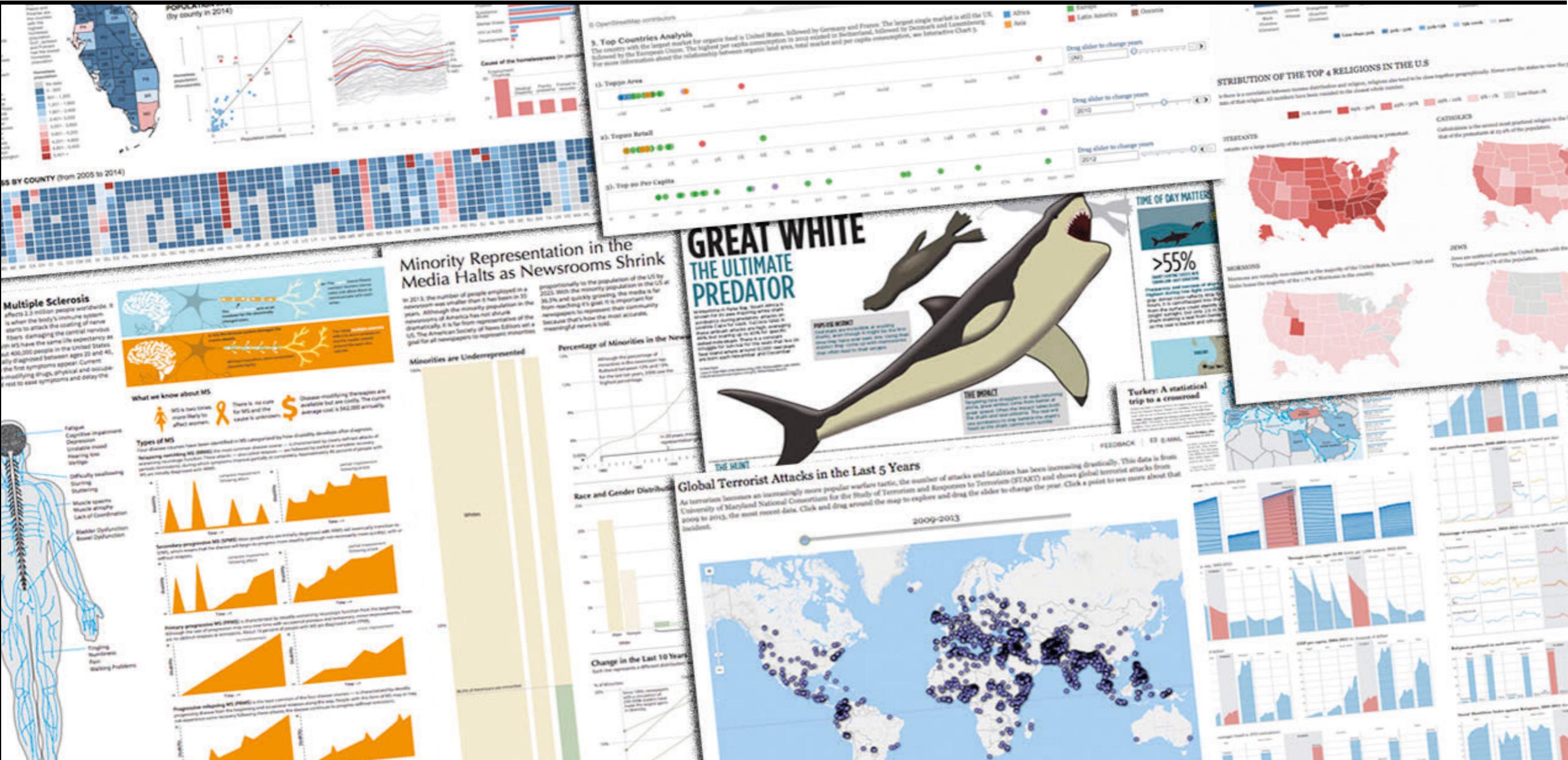
Data source: Project Tycho ([tycho.pitt.edu](http://tycho.pitt.edu))  
Author: Randy Olson ([@randal\\_olson](http://randalolson.com))

Randy Olson: <http://www.randalolson.com/2016/03/04/revisiting-the-vaccine-visualizations/>

# Which one is “better”? It depends!



Randy Olson: <http://www.randalolson.com/2016/03/04/revisiting-the-vaccine-visualizations/>



# PART III

## Visual Design

	C	M	Y	K
LAND	0	0	10	15
WATER	15	0	0	0
NEIGHBOR	0	0	10	25
PARK	10	0	10	20
COUNTRY	0	0	15	35
PINK	0	20	20	20
SILVER	5	0	0	15
RED	0	100	100	25
BLUE	50	0	0	35
BEIGE	0	0	30	20
OCRE	0	20	70	20
GREEN	25	0	40	55
ORANGE	0	50	100	0

### Maps

These colors can be converted to black and white automatically. But always double check automatic conversions.

### Charts

## WHY DOES IT MATTER?

- Color palette is not just a rule. Colors are essential to build a family structure to the graphics at the DMN. Use these colors as a starting point for every graphic you do.

## CREATING VARIATIONS

- On Illustrator, go to Filter, Colors, Saturate.
- Always double-check automatic conversions to grayscale.

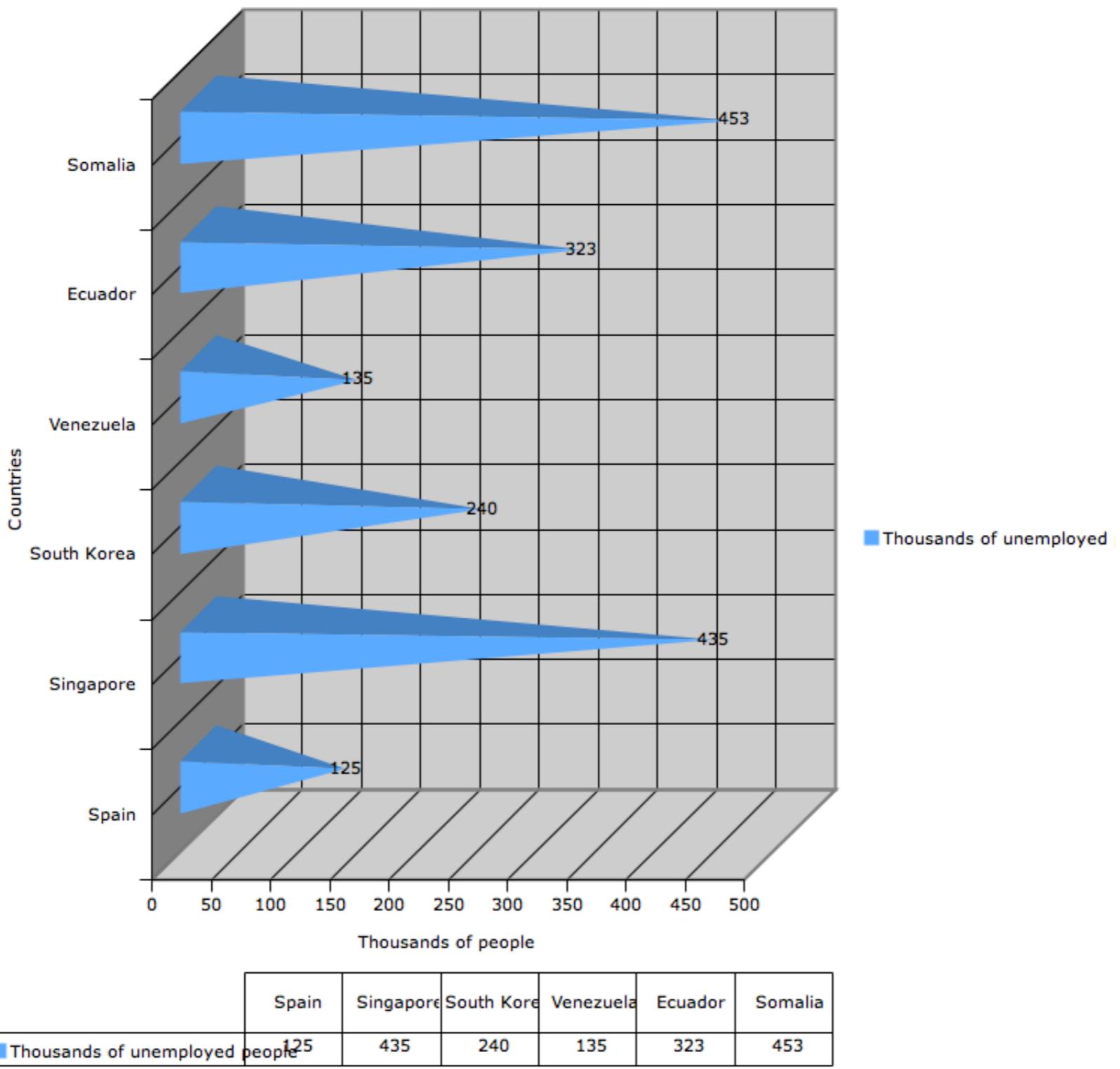
# Graphics style guides

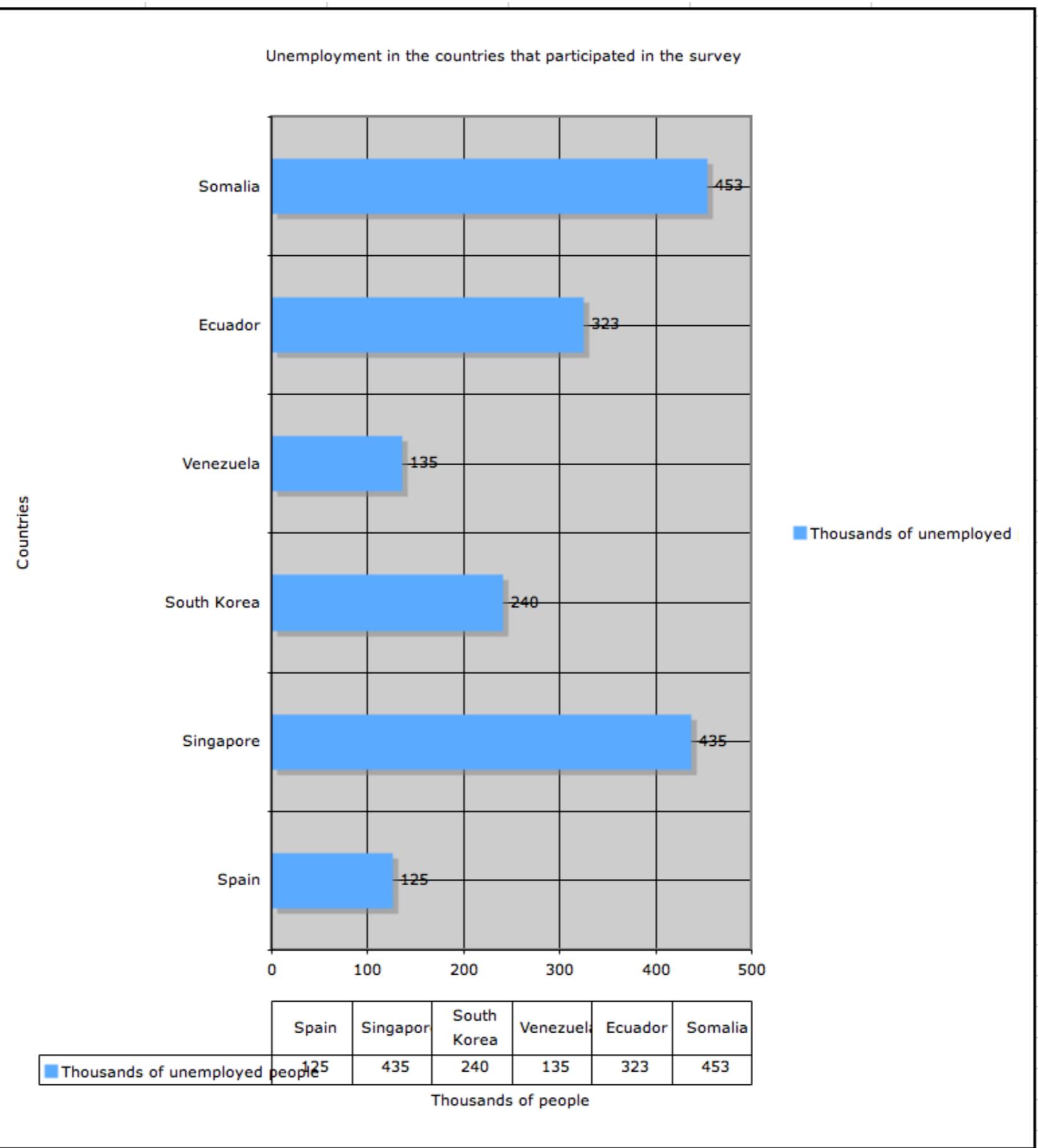
The key to any visual design is  
the presentation of a **cohesive,**  
**structured,** **readable,** and  
**understandable** composition.

Simplicity is about subtracting the obvious and adding the meaningful.

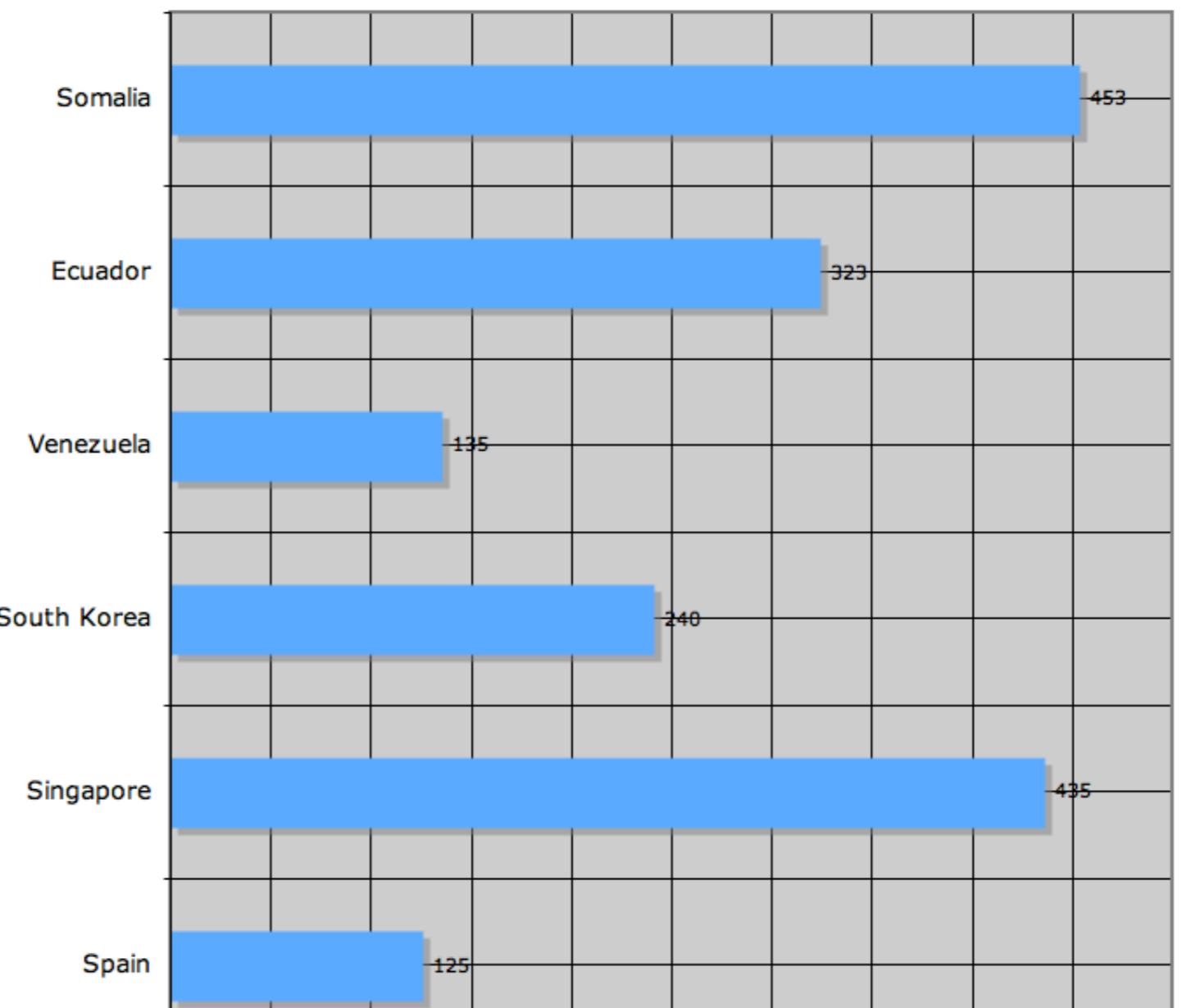
John Maeda, *The Laws of Simplicity*

Unemployment in the countries that participated in the survey





## Unemployment in the countries that participated in the survey (*thousands of people*)



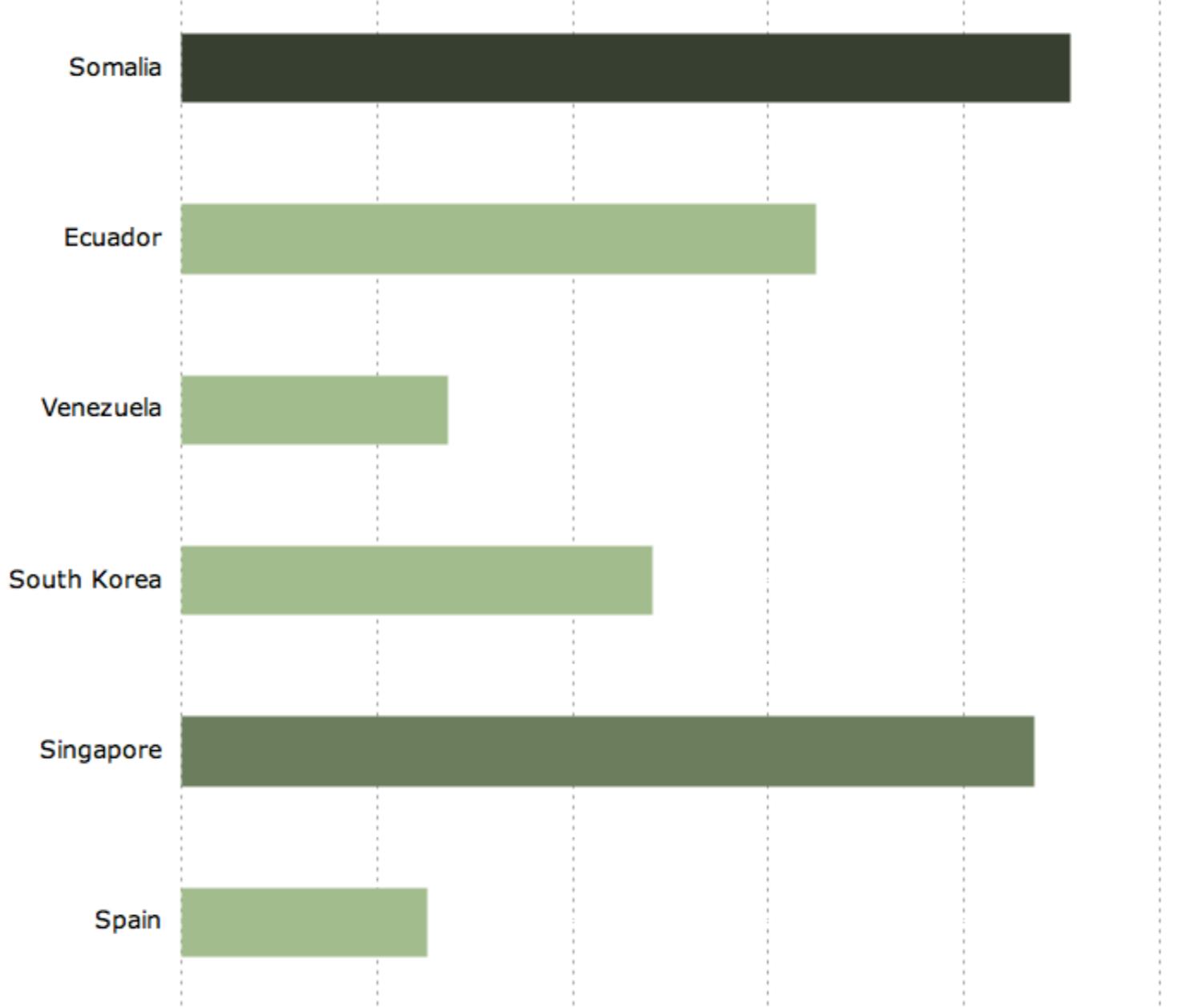
	Spain	Singapore	South Korea	Venezuela	Ecuador	Somalia
Thousands of unemployed people	125	435	240	135	323	453

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	Spain	Singapore	South Korea	Venezuela	Ecuador	Somalia
Thousands of unemployed people	125	435	240	135	323	453

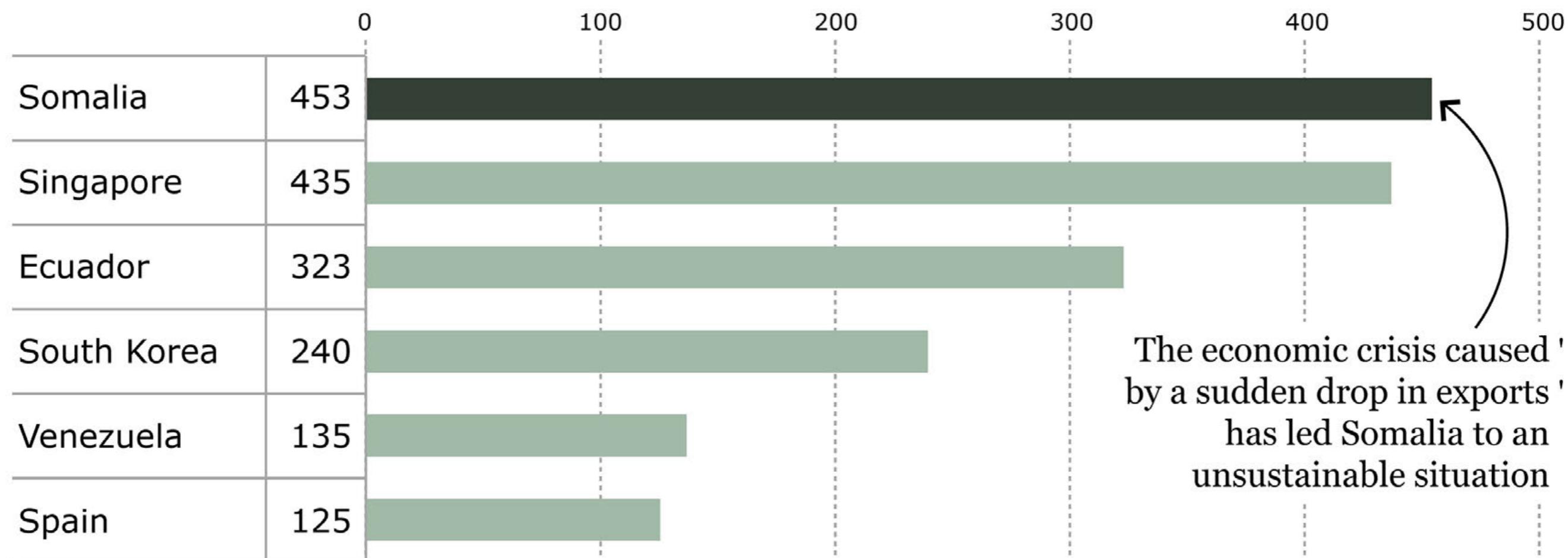
## Unemployment in the countries that participated in the survey (*thousands of people*)



	Spain	Singapore	South Korea	Venezuela	Ecuador	Somalia
Thousands of unemployed people	125	435	240	135	323	453

## Somalia leads the countries that participated in the survey '

*Thousands of unemployed people*



Source: CompletelyFakeData Inc.

Graphic by ACME '

# Multi-scale Modeling and Assessment of Malaria Risk in Northern South America



Alimi, T. O.<sup>1</sup>; Fuller, D. O.<sup>1,2</sup> and Beier, J.C.<sup>1,3</sup>

<sup>1</sup> Abess Center for Ecosystem Science and Policy; <sup>2</sup> Department of Geography and Regional Studies; <sup>3</sup> Department of Epidemiology and Public Health, University of Miami

## 1. Introduction

The public health problem posed by malaria has made it a top priority for control efforts and the general consensus globally, is that its elimination is crucial for continued international development. Consequently, there is ongoing research in different regions including South America (SA) to better understand the disease dynamics with the intent that findings may establish scientific framework that would support the development of new intervention strategies for malaria elimination in areas with seasonal malaria. One of such investigations is undertaken by the International Centers of Excellence in Malaria Research (ICEMR) under a National Institutes of Health (NIH) grant.

While only about 3% of the global malaria burden is borne by SA<sup>1</sup>, undertaking malaria research in the region is currently important because an estimated 23million people are still at risk<sup>2</sup> and approximately about 80% of clinical cases are found in Northern South America (NSA)<sup>3</sup>. A key factor limiting effective control is lack of data and uneven implementation of control measures, including use of bed-nets, sprays, early diagnosis, and treatment. As part of the ICEMR investigation, this project seeks to model the spatial patterns of malaria risk in NSA through vector distribution and land-use changes. Furthermore, I intend to investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.

## 2. Significance

Spatial distribution of malaria risk is still perceived as broadly categorized by the WHO's traditional risk maps which are highly generalized, of low resolution and have broad categories with uncertain boundaries (see da Nunes-Silva et al. 2012). There is need for up-to-date high resolution risk maps which can aid malaria control efforts. Secondly, modeling distribution of principal malaria vectors and land use changes which may explain the observed distribution and risk are useful tools which would guide future management strategies. Finally, understanding the perceptions of at risk populations may help address barriers to adoption of interventions and influence policies. Overall, findings will empower NMCPs to achieve effective control and move them closer to elimination.

## 3. Specific Aims

- Specific Aim 1: Model the spatial patterns of malaria risk through vector distribution and land use changes
  - Hypothesis 1.1: GIS-based Multi-Criteria Evaluation (MCE) model can accurately predict spatial extent of malaria risk areas. Objective: Generate risk maps that represent risk of malaria transmission.
  - Hypothesis 1.2: The Maximum Entropy (Maxent) model can accurately depict actual and predict potential distribution of three *Anopheles* species. Objective: Model observed and potential spread of *An. albimanus*, *An. darlingi*, and *An. nuneztovari*.
  - Hypothesis 1.3: Land-use changes can explain the variations in predicted malaria risk. Objective: Characterize land use land cover (LULC) and investigate changes in areas of risk.
- Specific Aim 2: Investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.
  - Hypothesis 2.1: Knowledge of perception of malaria risk can aid design of malaria control strategies. Objective: Obtain and analyze data on subjective perceptions of risk.
  - Hypothesis 2.2: Identification of barriers to adoption of malaria control interventions provide means of tackling them. Objective: Analyze data addressing perceived barriers and policy implications

\*Only ongoing work on Hypothesis 1.1 in presented here

## 4. Materials and Methods

- Study Area: is NSA comprising of ten countries- Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Panama, Peru, Suriname and Venezuela. These countries account for approximately 90% of clinical cases in the region hence, the choice as study area (Fig. 1).



Figure 1: Map of study area

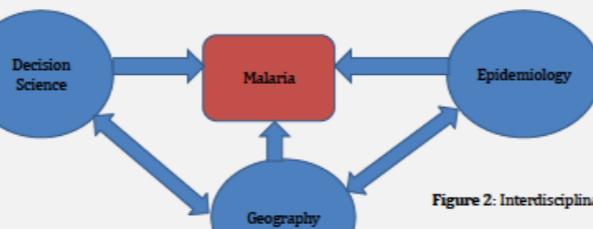


Figure 2: Interdisciplinary approach

- Materials: Raster data layers of environmental, climatic and anthropogenic parameters from satellite imageries, weather monitoring stations, global land cover and population data were collected from Worldclim, Digital Charts of the World, Globcover and Landsat. Vector data was collected from field sampling by our collaborators and the Walter Reed Biosystematics Unit. Sociological data would be collected through questionnaires to be administered in one of the study area. Other data will be collected as needed.
- Procedure: To test hypothesis 1.1, raster data of parameters that influence mosquito distribution (rivers, wetlands, urban areas, roads, population and elevation) were combined using a Multi-Criteria Evaluation in Idrisi GIS package. This produced a map of potential exposure to malaria vectors which is used as a proxy for risk of malaria transmission. All the data layers were gridded at 1km spatial resolution. A set of distance layers had been created for discrete factors using standard GIS operations. All factors were subsequently standardized into a continuous common numeric range on a byte 0-255 probability scale using a fuzzy function based on knowledge of mosquito interaction with the factor. Weights were generated for each factor based on the importance of the factor to malaria transmission by expert opinions and then assigned using Analytical Hierarchy Process. The risk maps produced were validated statistically using data on *An. darlingi* distribution and malaria case data from some parts of the study area. See preliminary results (Fig. 3,4,5)

## 5. Preliminary Results

- Areas of high to moderate risk corresponded with locations of some of the anophelines collected.

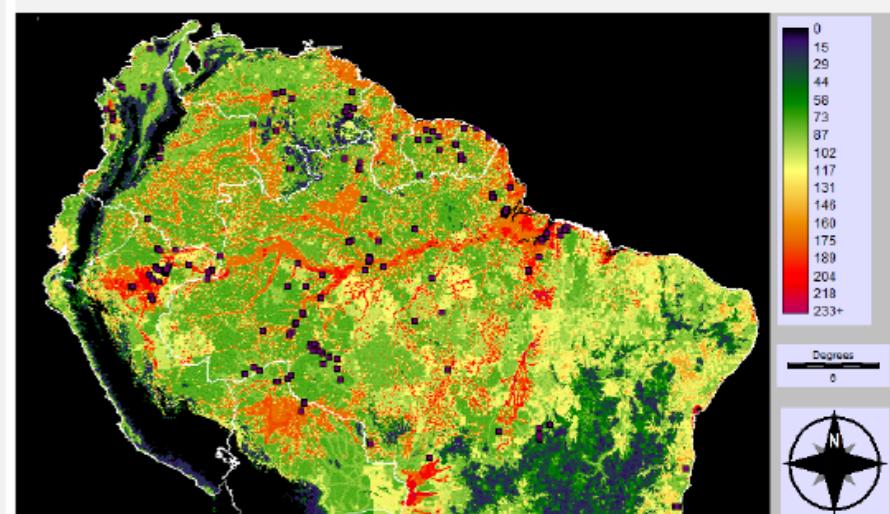


Figure 3: Potential risk of exposure to malaria vectors across NSA (0 indicate little or no risk while 233 indicate high risk)

- Risk scores for mosquito occurrence points were significantly higher than those generated randomly (Fig. 4).

Comparing mean of random and DV points for MCE risk map

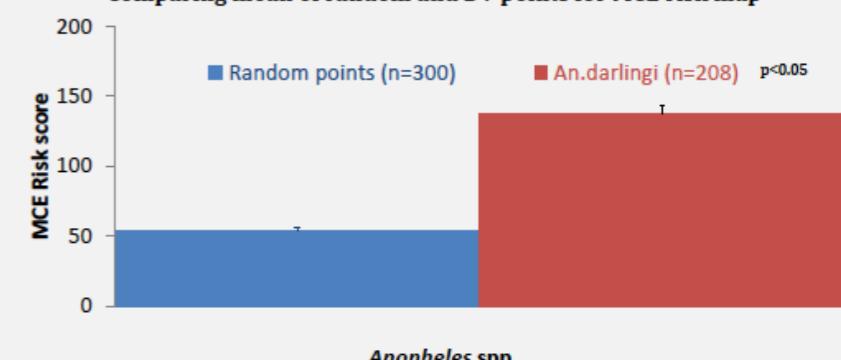


Figure 4: Plot showing the MCE risk values for randomly sampled points and for occurrence points of a DV, *An. darlingi*

## 6. Conclusion

Findings from preliminary results suggest that the MCE approach is a viable method to modeling spatial risk. The high resolution risk map produced aligned well with sampled vector points and may therefore be used to plan control of malaria vectors. Further analysis is planned to generate and validate risk maps with actual measures of malaria transmission, results of which could be used to plan containment of future outbreaks.

## References

1. WHO. (2007). MALARIA ELIMINATION: A field manual for low and moderate endemic countries
2. PAHO (2012) PAHO Honors 2012 Malaria Champions of the Americas. Available: [http://new.paho.org/hq/index.php?option=com\\_content&view=article&id=7429&Itemid=39639](http://new.paho.org/hq/index.php?option=com_content&view=article&id=7429&Itemid=39639)
3. Gusmao R. (1999) Overview of malaria control in the Americas. Parasitologia 41:355-60.
4. Da Silva-Nunes, M., Moreno, M., Conn, J.E., Gamboa, D., Abeles, S., Vinetz, J.M., and Ferreira, M.U. (2012) Amazonian malaria: Asymptomatic human reservoirs, diagnostic challenges, environmentally driven changes in mosquito vector populations, and the mandate for sustainable control strategies. Acta Tropica 121 (3): 281-29

# Multi-scale Modeling and Assessment of Malaria Risk in Northern South America



Alimi, T. O.<sup>1</sup>; Fuller, D. O.<sup>1,2</sup> and Beier, J.C.<sup>1,3</sup>

## 1 Introduction

Malaria as a public health problem has become a priority for control efforts worldwide. The global consensus is that its elimination is crucial for continual development. Ongoing research projects in different regions, including South America (SA), try to improve our understanding of the disease dynamics. Their goal is to establish a new framework that would lead to new intervention strategies for malaria elimination in areas where the disease is seasonal. One of such investigations is undertaken by the International Centers of Excellence in Malaria Research (ICEMR) under a National Institutes of Health grant.

While only about 3% of the global malaria burden is borne by SA, undertaking malaria research in the region is currently important because an estimated 23 million people are still at risk<sup>2</sup> and approximately about 80% of clinical cases are found in **Northern South America (NSA)**. A key factor limiting effective control is lack of data and uneven implementation of control measures, including use of bednets, sprays, early diagnosis, and treatment. As part of the ICEMR investigation, this project seeks to model the spatial patterns of malaria risk in NSA through vector distribution and land-use changes. Furthermore, I intend to investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.

## 2 Significance

Spatial distribution of malaria risk is still perceived as broadly categorized by the WHO's traditional risk maps which are highly generalized, of low resolution and have broad categories with uncertain boundaries (see da Nunes-Silva et al. 2012). There is need for up-to-date high resolution risk maps which can aid malaria control efforts. Secondly, modeling distribution of principal malaria vectors and land use changes which may explain the observed distribution and risk are useful tools which would guide future management strategies. Finally, understanding the perceptions of at-risk populations may help address barriers to adoption of interventions and influence policies. Overall, findings will empower NMCPs to achieve effective control and move them closer to elimination.

## 3 Aims

**Specific Aim 1:** Model the spatial patterns of malaria risk through vector distribution and land use changes

- Hypothesis 1.1: GIS-based Multi-Criteria Evaluation (MCE) model can accurately predict spatial extent of malaria risk areas. **Objective:** Generate risk maps that represent risk of malaria transmission
- Hypothesis 1.2: The Maximum Entropy (Maxent) model can accurately depict actual and predict potential distribution of three Anopheles species. **Objective:** Model observed and potential spread of *An. albimanus*, *An. darlingi*, and *An. nuneztovari*.
- Hypothesis 1.3: Land-use changes can explain the variations in predicted malaria risk. **Objective:** Characterize land use/land cover (LULC) and investigate changes in areas of risk.

**Specific Aim 2:** Investigate the perceptions of malaria risk in order to identify barriers to adoption and how they can be circumvented.

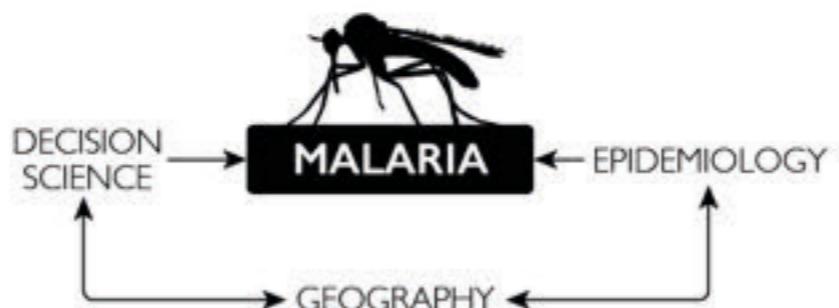
- Hypothesis 2.1: Knowledge of perception of malaria risk can aid design of malaria control strategies. **Objective:** Obtain and analyze data on subjective perceptions of risk.
- Hypothesis 2.2: Identification of barriers to adoption of malaria control interventions provide means of tackling them. **Objective:** Analyze data addressing perceived barriers and policy implications

<sup>2</sup>Only ongoing work on Hypothesis 1.1 is presented here

## 4 Materials and methods



**Research approach:** Due to the complexity of malaria problem, I'm employing an interdisciplinary approach to address the problem.

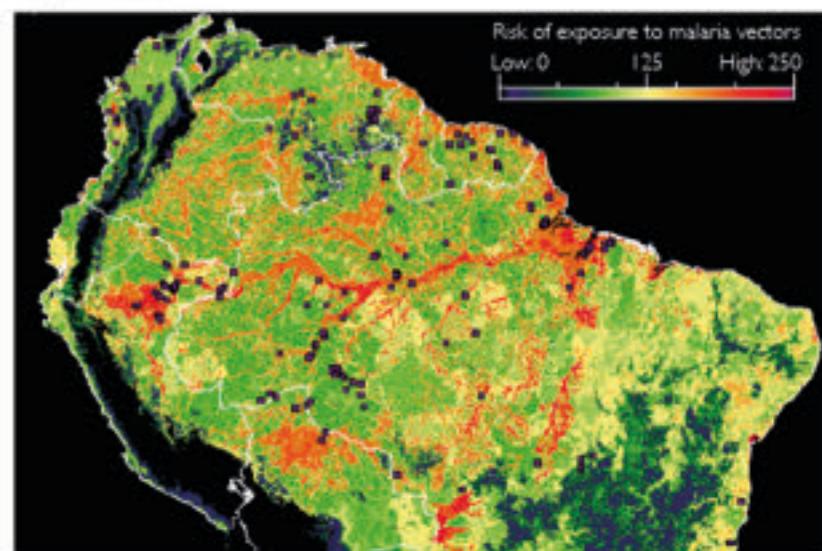


**Materials:** Raster data layers of environmental, climatic and anthropogenic parameters from satellite imageries, weather monitoring stations, global land cover and population data were collected from Worldclim, Digital Charts of the World, Globcover and Landsat. Vector data was collected from field sampling by our collaborators and the Walter Reed Biosystematics Unit. Sociological data would be collected through questionnaires to be administered in one of the study area. Other data will be collected as needed.

**Procedure:** To test hypothesis 1.1, raster data of parameters that influence mosquito distribution (rivers, wetlands, urban areas, roads, population and elevation) were combined using a Multi-Criteria Evaluation in ArcGIS package. This produced a map of potential exposure to malaria vectors which is used as a proxy for risk of malaria transmission. All the data layers were gridded at 1km spatial resolution. A set of distance layers had been created for discrete factors using standard GIS operations. All factors were subsequently standardized into a continuous common numeric range on a byte 0-255 probability scale using a fuzzy function based on knowledge of mosquito interaction with the factor. Weights were generated for each factor based on the importance of the factor to malaria transmission by expert opinions and then assigned using Analytical Hierarchy Process. The risk maps produced were validated statistically using data on *An. darlingi* distribution and malaria case data from some parts of the study area. See preliminary results

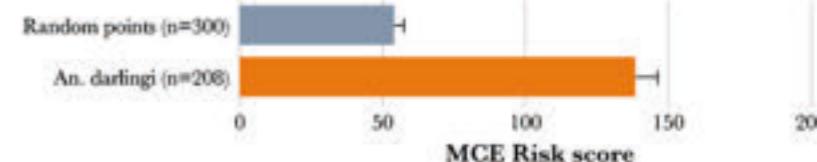
## 5 Preliminary results

**Areas of high to moderate risk** corresponded with locations of some of the anophelines collected.



**Risk scores for mosquito occurrence points** were significantly higher than those generated randomly.

Comparing mean of random and DV points for MCE risk map -  $p < 0.05$



## 6 Conclusion

Findings from preliminary results suggest that the MCE approach is a viable method to model spatial risk. The high resolution risk map produced aligned well with sampled vector points and may therefore be used to plan control of malaria vectors. Further analysis is planned to generate and validate risk maps with actual measures of malaria transmission, results of which could be used to plan containment of future outbreaks.

## References

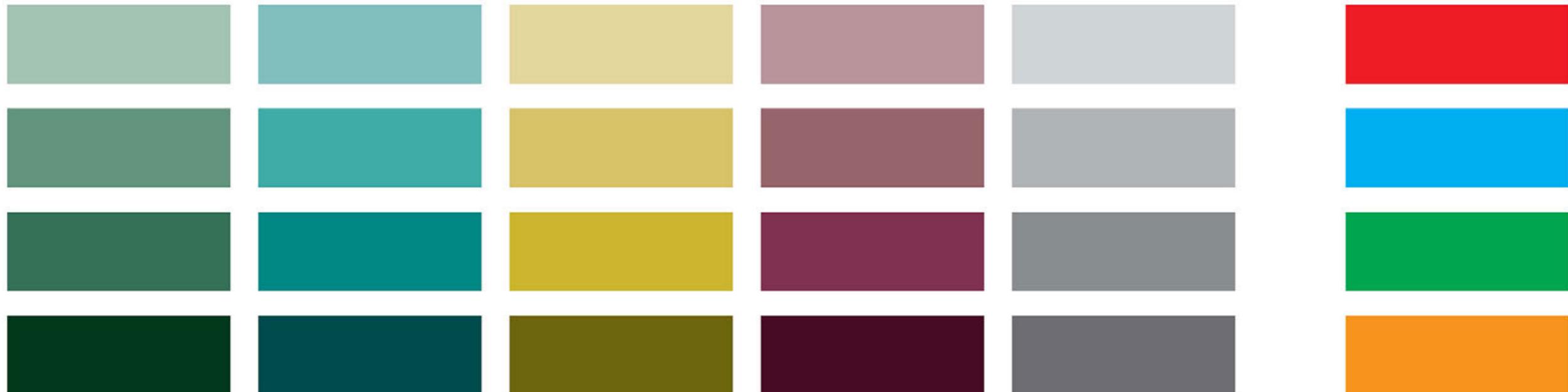
1. WHO. (2007). MALARIA ELIMINATION : A field manual for low and moderate endemic countries
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The golden rule for using  
**type** and **color** effectively:  
Elements that have the  
same nature must look alike

Choosing colors: Begin with just one color (plus black and white.) and play with its shades. Increase the variety of colors only if it's necessary.

Use neutral colors for most objects

Use accent colors to highlight the most important information



(We can make exceptions to this rule when we do need to have many different colors, just to identify elements in the visualization)

## Diagram

NEWS IN PERSPECTIVE

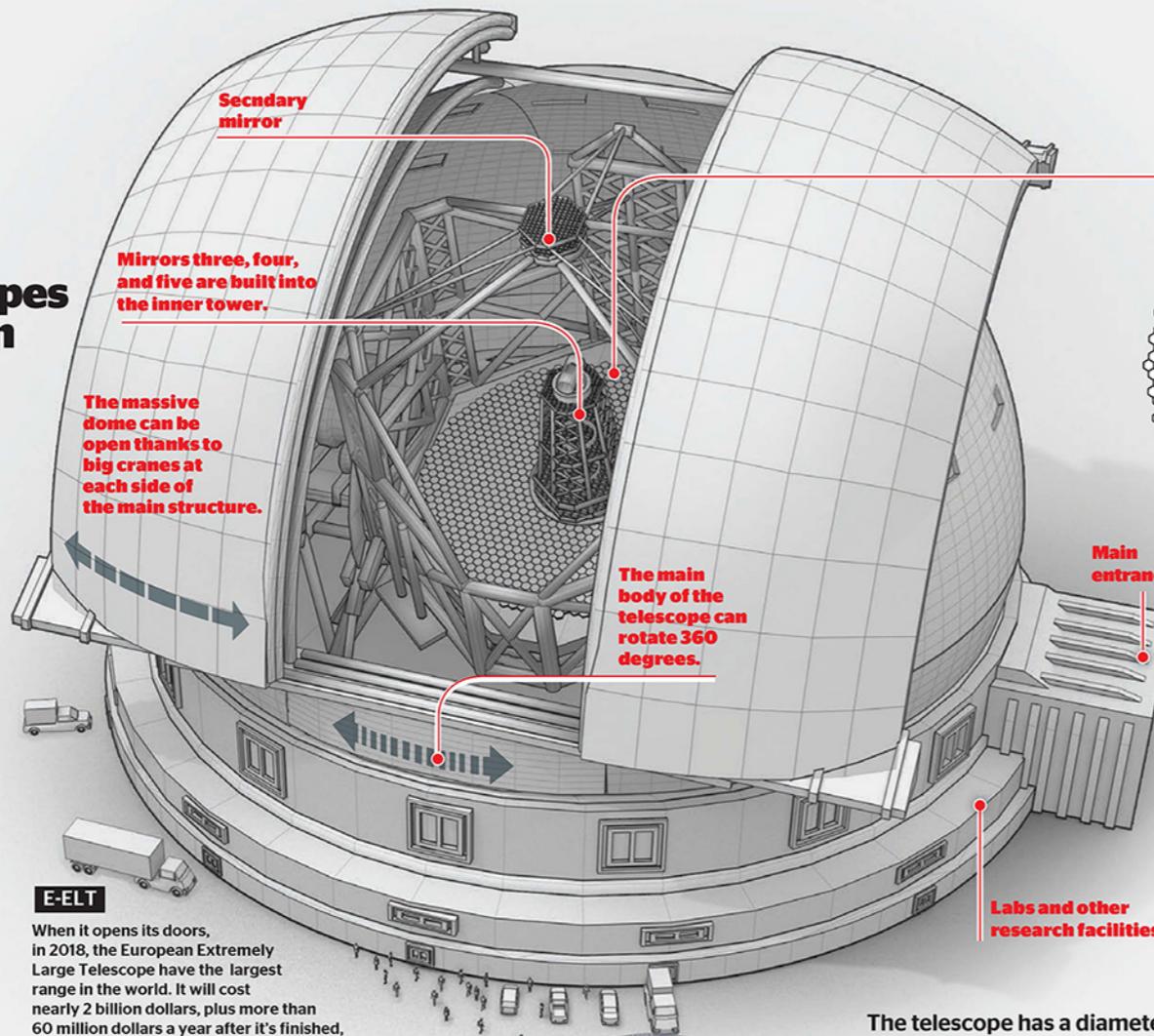
### 400 years after Galileo, mega-telescopes rule space exploration

A new generation of observatories is under construction. Brazil needs to decide if it's going to be part of this new revolution in astronomy.

Peter Moon, Alberto Cairo, Gerson Mora

In 1609, Galileo Galilei perfected the telescope, created in 1608 by Hans Lippershey. Galileo's telescope had a lens of 6 inches. Today, the largest telescopes are in Hawaii and northern Chile. Equipped with mirrors 24 to 35 feet in diameter, they allow the observation of galaxies billions of light years away from us, but with little clarity. So a new generation of mega-telescopes is being built. The largest is the European Extremely Large Telescope (E-ELT), an initiative of the European Space Agency that is under construction in the Atacama Desert in Chile, and will open in 2018. The Ministry of Science and Technology of Brazil defends participation in the project, but the huge investment has unleashed concerns in other areas of the government. The total cost for Brazil would be \$650 million over 20 years.

Sources: Southern European Observatory (ESO), TMT, Gemini, Soar

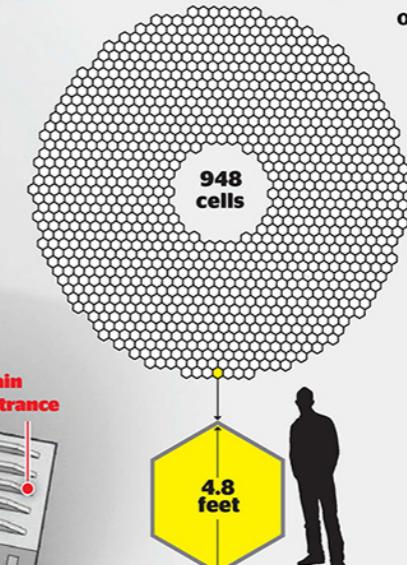


The telescope has a diameter of 330 feet and a height of 260 feet.

#### HOW THE E-ELT GATHERS HIGH-RESOLUTION IMAGES

The E-ELT will be the first telescope able to shoot pictures of planets outside the solar system, which will be useful for analyzing their atmospheres.

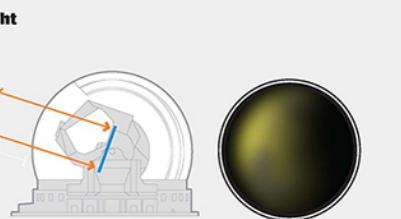
#### PRIMARY MIRROR



#### Why is the telescope so large?

The sensitivity and acuity of a telescope depend on how well it gathers light reflected by objects that sometimes are many light years away from Earth. The larger the reflecting surface of the telescope's primary mirror, the more photons of light it will be able to capture.

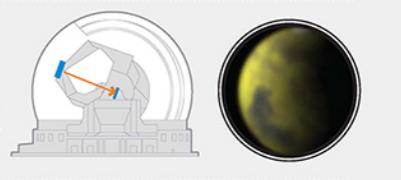
- Light reflected by planets and other objects hits the primary mirror.



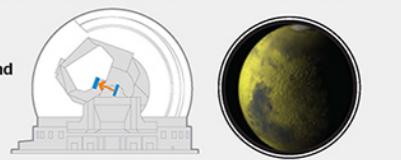
- The hexagonal mobile cells of the primary mirror focus the light and send it to a secondary mirror with a diameter of 20 feet.



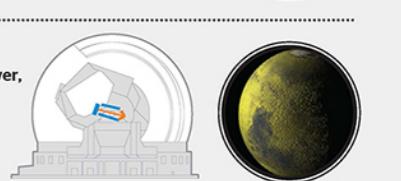
- The secondary mirror reflects light and sends it to the tertiary mirror, placed at the center of the primary mirror.



- The fourth mirror changes shape up to 1,000 times a second to eliminate atmospheric distortions and focus the rays of light even further.



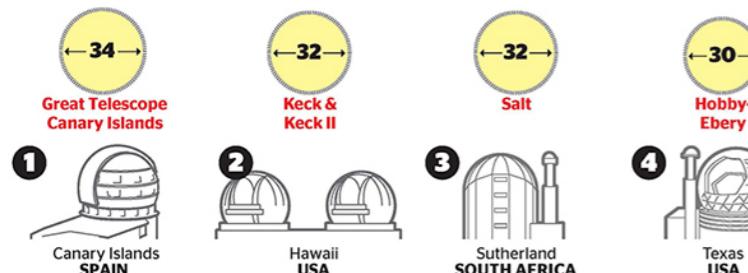
- The fifth mirror, inside the central tower, stabilizes the image and sends light to the cameras in the central body of the telescope.



#### THE SUPER TELESCOPE RANKING

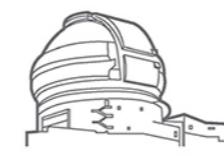
The E-ELT is a giant compared to the existing mega-telescopes. Its primary mirror is four times the size of the one in the largest telescope, in the Canary Islands, Spain.

Mirror diameter in feet



#### TELESCOPES WITH BRAZILIAN INVOLVEMENT

Brazil participates on just two of the largest telescopes.



Gemini

Built in Cerro Pachón, Chile, and the Mauna Kea volcano, Hawaii, these twin telescopes have mirrors with a diameter of 26.5 feet. Brazil participates by covering 2.4% of the total cost in exchange for the right of using them for observations.



Soar

Built in Cerro Pachón, Chile, the Southern Astrophysical Research Telescope has a mirror with a diameter of 13.5 feet. The Brazilian National Scientific Development Council covers a great portion of its costs.

#### OTHER LARGE TELESCOPES UNDER CONSTRUCTION

Besides the E-ELT, there are other projects in development.



Thirty Meters Telescope (TMT)

**Opening:** 2018  
**Cost:** \$1 billion  
**Mirror:** 98 feet  
**Place:** Hawaii  
**Built by:** USA, Canada, China, India



Telescopio Gigante Magalhães (GMT)

**Opening:** 2018  
**Cost:** \$600 million  
**Mirror:** 80.4 feet  
**Place:** Chilean Andes  
**Built by:** USA, Australia, South Korea



Atacama Large Millimeter Array (ALMA)

**Opening:** 2012  
**Cost:** \$1.3 billion  
**Mirror:** 66 antennas  
**Place:** Atacama, Chile  
**Built by:** European Union, USA, Canada, Japan, Taiwan, Chile

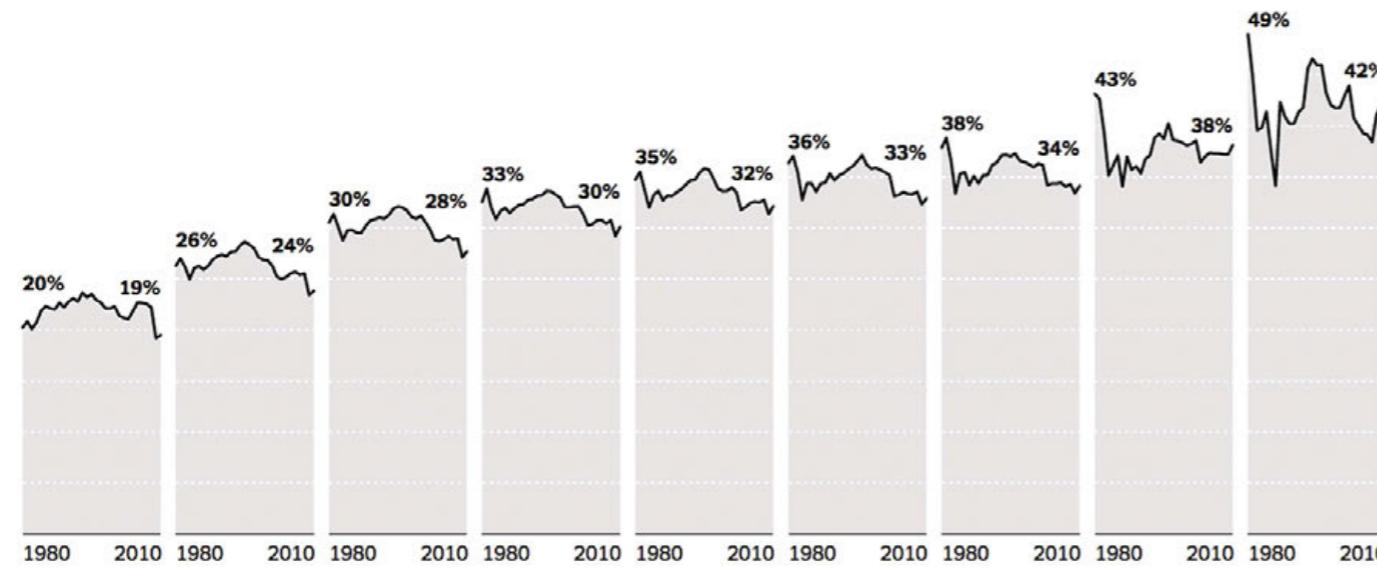
# How the Tax Burden Has Changed

Most Americans paid less in taxes in 2010 than people with the same inflation-adjusted incomes paid in 1980, because of cuts in federal income taxes. At lower income levels, however, much of the savings was offset by increases in federal payroll taxes, state sales taxes and local property taxes. About half of households making less than \$25,000 saved nothing at all. [About the Data »](#) | [Related Article »](#)



## Tax rates have fallen for most Americans, especially high earners.

Share of yearly income paid in federal, state and local taxes, by income bracket.



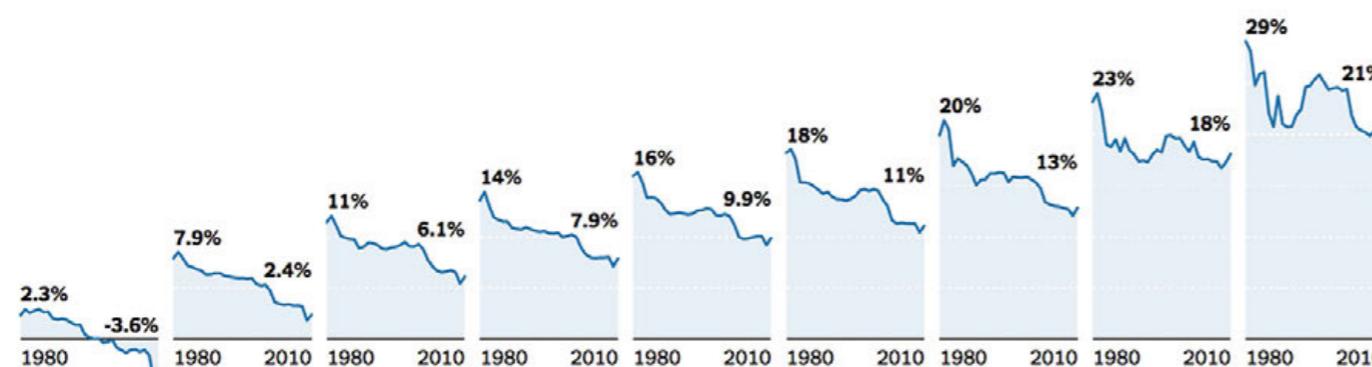
Average tax rates were lower for every income group in 2010 compared with 1980, but rates fluctuated during the intervening decades. Savings from federal income tax cuts in 1981 and 1986, under President Ronald Reagan, eroded as other taxes increased. New federal cuts in 2001 and 2003, under President George W. Bush, again reduced the total tax burden. Tax revenues rose in 2010 as the economy recovered from the recession.

# THE IMPORTANCE OF TEXT

<http://www.nytimes.com/interactive/2012/11/30/us/tax-burden.html>

## What's driven the changes? Federal income tax rates have declined ...

Share of income paid in federal income taxes.



Federal income tax rates fell in the 1980s after decades of relative stability. The cuts were partly reversed in 1993 under President Bill Clinton, before rates fell again in the early 2000s. For households earning less than \$25,000, the tax rate in recent years has been negative because the expansion of government payments like the earned income tax credit exceeded the amount of taxes paid.

# Sequencing and layering

## DIAGRAM

NEWS IN PERSPECTIVE

### Brazil's Demographic Opportunity

How Brazil can take advantage of a future with fewer children per couple.

Alberto Cairo, Francine Lima,  
Marco Vergotti

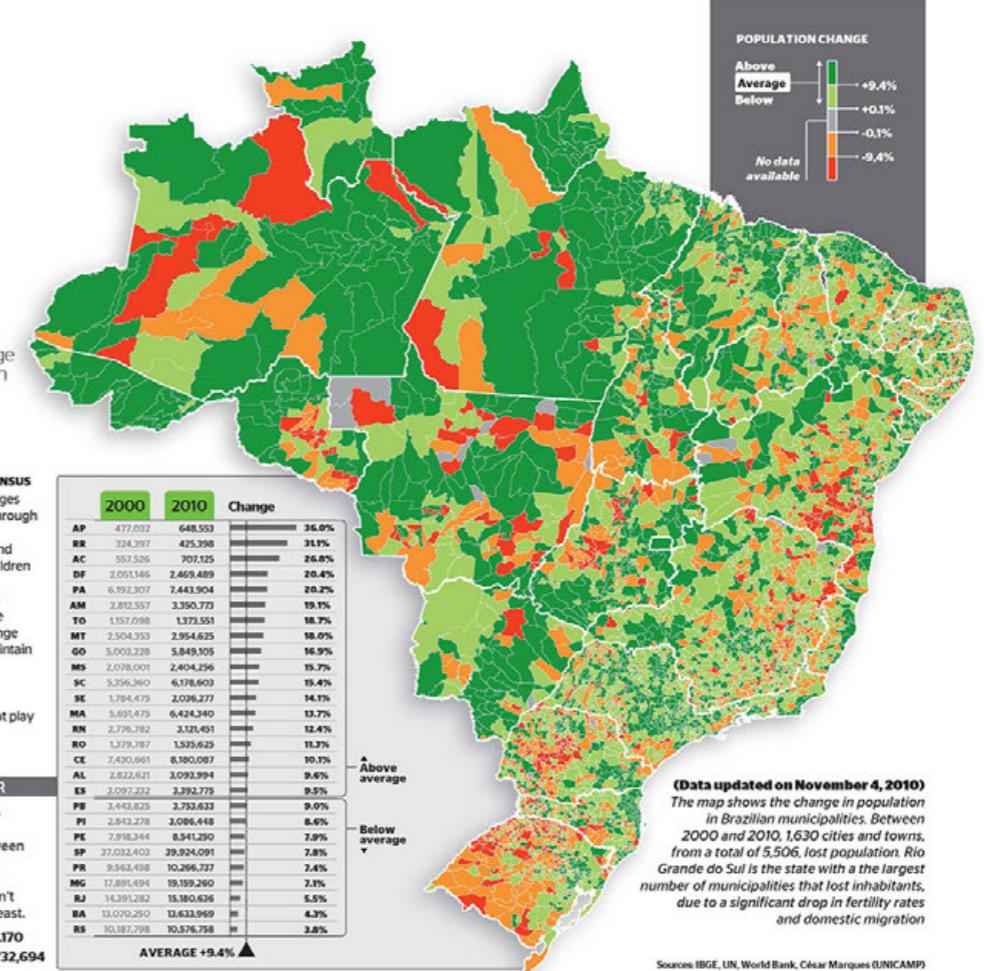
**PRELIMINARY DATA FROM THE 2010 CENSUS**  
create an interesting picture of the changes that the Brazilian population has gone through in the past ten years. Brazil's population grew, on average, 10% between 2000 and 2010, but the fertility rate is below 2.1 children per woman, the minimum to keep a population from shrinking. According to César Marques, a demographer from the University of Campinas, the main challenge Brazil will face in the future is how to maintain a healthy Social Security system if the number of older and retired people will likely be much larger than it is today. Read on to learn about all the variables at play in this story.

#### 1 BRAZIL'S POPULATION IS BIGGER

The 2010 Census has revealed a 9.4% population increase between 2000 and 2010. The differences between states, as you can see on the chart on the right, are noticeable. Most rich states, such as São Paulo and Rio, didn't grow as fast as the ones in the north east.

	2000	2010	Change
AP	477,032	648,553	36.0%
RR	324,397	425,398	31.1%
AC	557,526	707,125	26.6%
DF	2,051,146	2,469,489	20.4%
PA	6,192,307	7,443,904	20.2%
AM	2,812,557	3,350,773	18.1%
TO	1,157,098	1,373,551	16.7%
MT	2,504,353	2,954,625	16.0%
GO	5,003,228	5,849,305	14.9%
MS	2,078,001	2,404,156	13.7%
SC	5,356,360	6,178,603	13.4%
SE	1,784,479	2,036,277	14.1%
MA	5,651,475	6,424,240	13.7%
RN	2,736,782	3,121,491	12.4%
RO	1,379,787	1,535,623	11.3%
CE	7,430,661	8,180,087	10.1%
AL	2,622,621	3,093,994	9.6%
ES	3,097,232	3,392,775	9.5%
PB	3,432,823	3,732,633	9.0%
PI	2,843,276	3,096,448	8.6%
PE	7,918,344	8,511,290	7.9%
SP	37,032,403	39,924,091	7.8%
PR	9,963,494	10,266,737	7.4%
MG	17,891,494	19,159,260	7.1%
RJ	14,391,282	15,180,636	5.5%
BA	13,070,250	13,633,969	4.3%
RS	10,187,798	10,576,758	3.8%

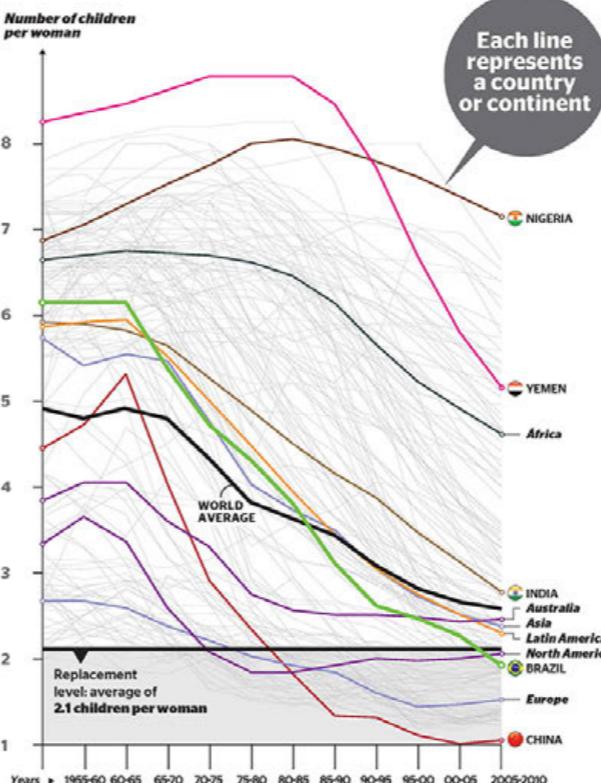
AVERAGE +9.4% ▲



Sources: IBGE, UN, World Bank, César Marques (UNICAMP)

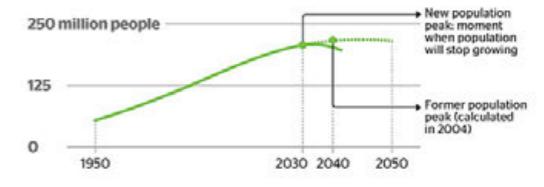
#### 2 — BUT THE FERTILITY RATE IS MUCH LOWER THAN EXPECTED

A study in 2004 estimated that in 2010, the fertility rate would be 2.4 children per woman, on average. But new data collected by the IBGE prove that the fertility rate is already 1.9, below the threshold called "replacement rate". When the fertility rate drops below this number, the population of a country will eventually start to shrink and grow older.



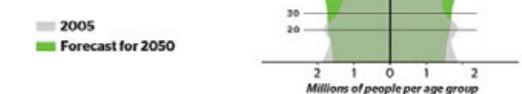
#### 3 AS A CONSEQUENCE, POPULATION WILL STOP GROWING—

Forecasts made in 2004 anticipated that Brazil's population would stop growing in 2040. But the most recent data from the IBGE suggests that this could happen much earlier, in 2030.



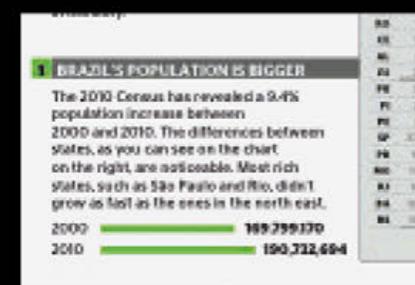
#### 4 — AND IT WILL BECOME OLDER

Comparing the current population pyramid with the one predicted for 2050



#### How Brazil can transform the population challenge into an opportunity

- As the population ages, the proportion of people of working age increases. The country will therefore have more people producing wealth (if the labor market can absorb them) and fewer children to consume investments. It is a window of opportunity, because in some cases the number of people of working age to fall back when older people are leaving the market.
- The population under 15 years of age is falling today. A smaller number of students in public schools will facilitate the quality of teaching, if the amount invested in education stays the same.
- Educational policy focused on low-income youth favors the formation of more skilled workforce and greater social mobility.
- In the future, Brazil will reach the stage of Europe and Japan, which struggle to support their elders. This is why it's so important to prepare a more balanced retirement system, which will include retirement at a later age.



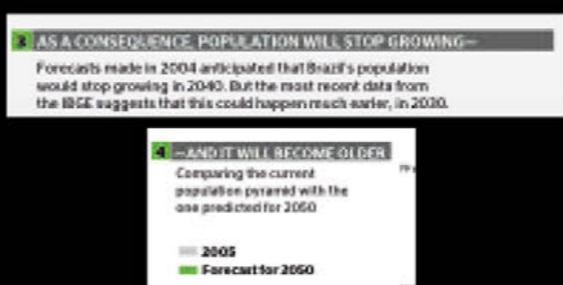
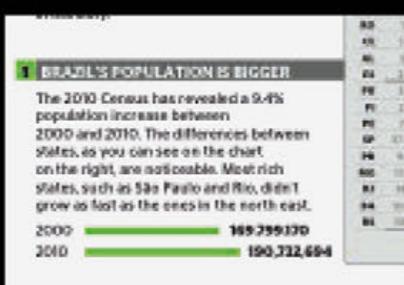
## How Brazil can transform the population challenge into an opportunity

- As the population ages, the proportion of people of working age is projected to decline.
- The country will therefore have more people producing wealth than those consuming it.

## Sequencing



"The upper layer"



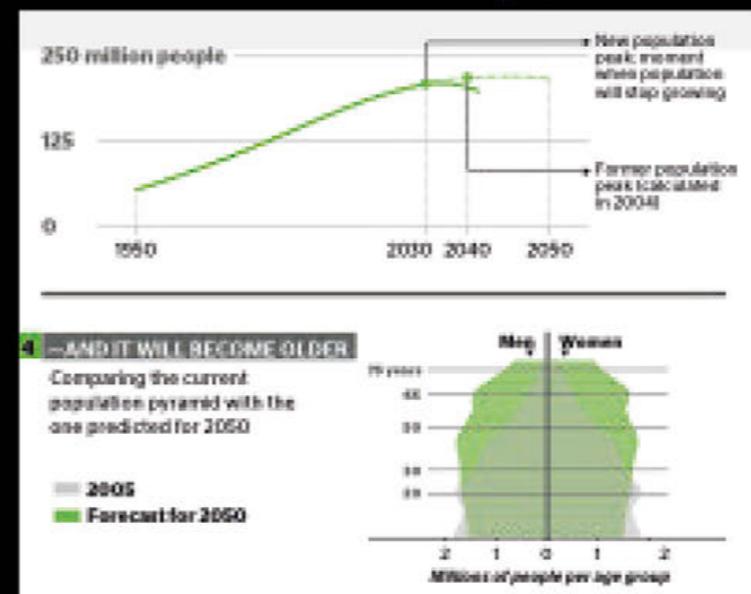
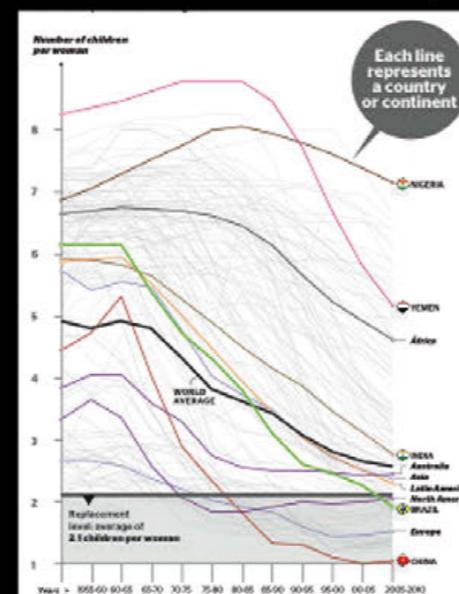
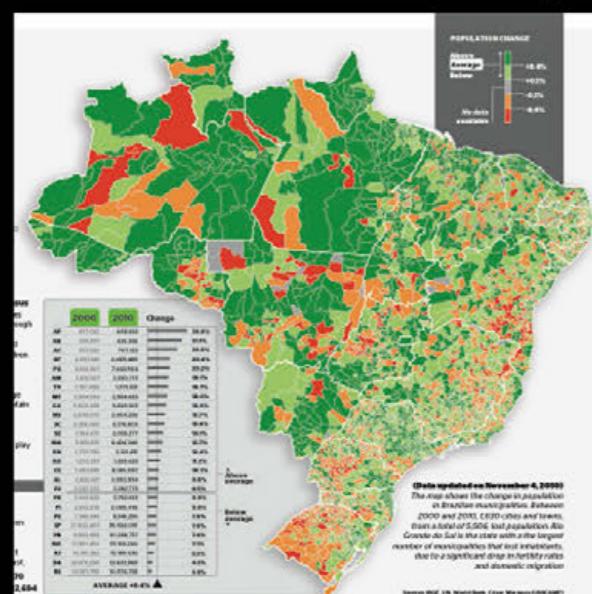
## How Brazil can transform the population challenge into an opportunity

- As the population ages, the proportion of people of working age increases. The country will therefore have more people producing wealth (the labor market can absorb them) and fewer children to consume investments. It is a window of opportunity, because in some cases the number of people of working age is falling back when older people are leaving the market.

- The population under 15 years of age is falling today. A smaller number of students in public schools will facilitate the quality of teaching, if the amount invested in education stays the same.
- Educational policy focused on low-income youth favors the formation of more skilled workforce and greater social mobility.
- In the future, Brazil will reach the stage of Europe and Japan, which struggle to support their elders. This is why it's so important to prepare a more balanced retirement system, which will include retirement at a later age.

**Sequencing**  
“The upper layer”

**Layering**  
“Drilling down”





## Louisiana is drowning, quickly.

In just 80 years, some 2,000 square miles of its coastal landscape have turned to open water, wiping places off maps, bringing the Gulf of Mexico to the back door of New Orleans and posing a lethal threat to an energy and shipping corridor vital to the nation's economy.

And it's going to get worse, even quicker.

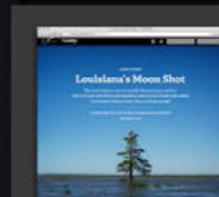
Scientists now say one of the greatest environmental and economic disasters in the nation's history is rushing toward a catastrophic conclusion over the next 50 years, so far unabated and largely unnoticed.

### Explore Delacroix, La.

At the current rates that the sea is rising and land is sinking, National Oceanic and Atmospheric Administration scientists say by 2100 the Gulf of Mexico could rise as much as 4.3 feet across this landscape, which has an average elevation of about 3 feet. If that happens, everything outside the protective levees — most of Southeast Louisiana — would be underwater.

The effects would be felt far beyond bayou country. The region best known for its self-proclaimed motto "*laissez les bons temps rouler*" — let the good times roll — is one of the nation's economic linchpins.

This land being swallowed by the Gulf is home to half of the country's oil refineries, a matrix of pipelines that serve 90 percent of the nation's offshore energy production and 30 percent of its total oil and gas supply, a port vital to 31 states, and 2 million people who would need to find other places to live.



**Louisiana's Moon Shot**

This story is first in a two-part series on Louisiana's rapidly disappearing coastline.

[Read part two »](#)

<http://projects.propublica.org/louisiana/>

exercise



<http://www.brookings.edu/~media/press/books/2013/affordableexcellence/affordableexcellencepdf.pdf>

## LIFE EXPECTANCY AT BIRTH IN 1990, 2000, and 2010 ,

— Women    — Men    — Both sexes 8

