

INTRO TO DATA VISUALIZATION

Andrew Heiss, PhD
Brigham Young University
September 19, 2018
@andrewheiss

PLAN FOR TODAY

Why visualize data?

Types of visualizations

Aesthetics and design

How do I do all this?

WHY
VISUALIZE DATA?

PROVING TRUTH

Theories are only stories
until you have data.

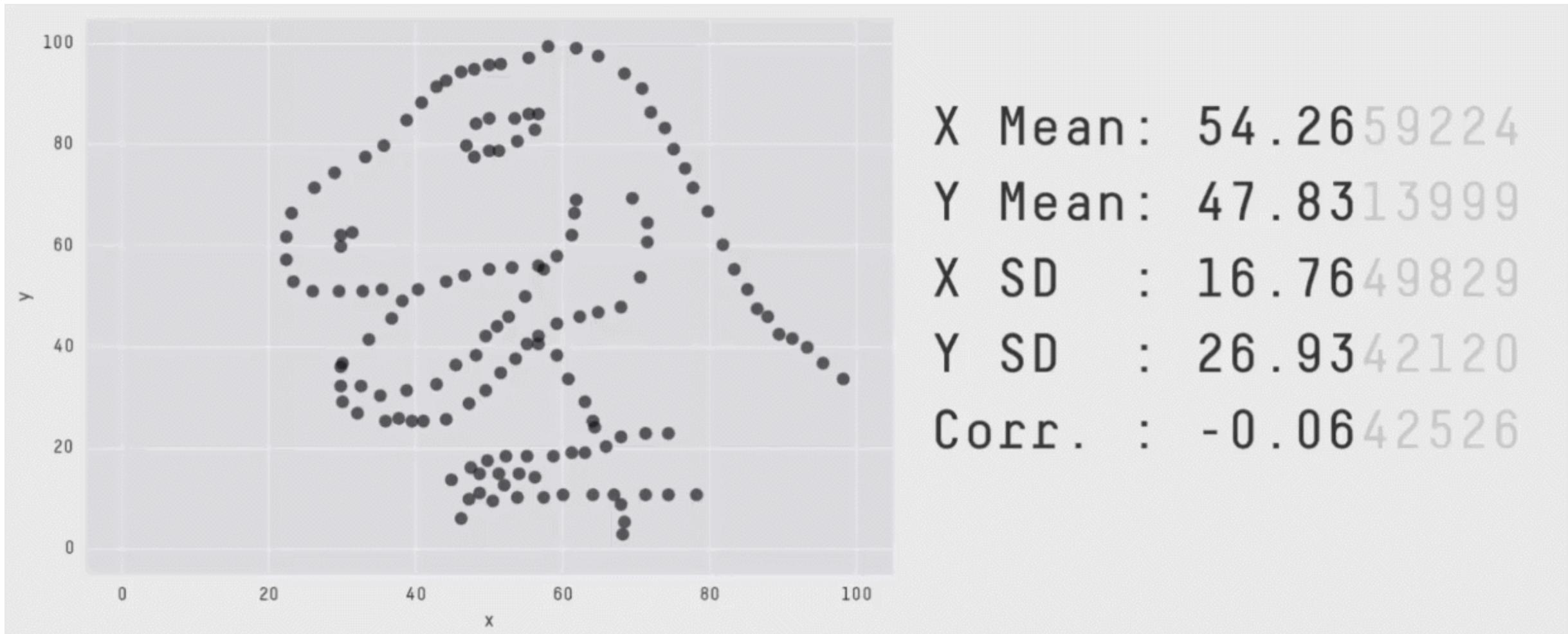
ALL WE NEED IS RAW DATA

x	y
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
44.1026	52.9487
46.6667	54.1026
50.0	55.2564
53.0769	55.641
56.6667	56.0256
59.2308	57.9487
61.2821	62.1795
61.5385	66.4103
61.7949	69.1026

```
> mean(new_data$x)
[1] 54.26327
> mean(new_data$y)
[1] 47.83225
> sd(new_data$x)
[1] 16.76514
> sd(new_data$y)
[1] 26.9354
> cor(new_data$x, new_data$y)
[1] -0.06447185
```

No correlation!

J K L O L



DATA IS NOT ENOUGH

Theories are only stories
until you have data.

Data alone cannot tell
stories or prove theories.

HUMANS LOVE PATTERNS

frontiers in
NEUROSCIENCE

REVIEW ARTICLE
published: 22 August 2014
doi: 10.3389/fnins.2014.00265

Superior pattern processing is the essence of the evolved human brain

Mark P. Mattson^{1,2*}

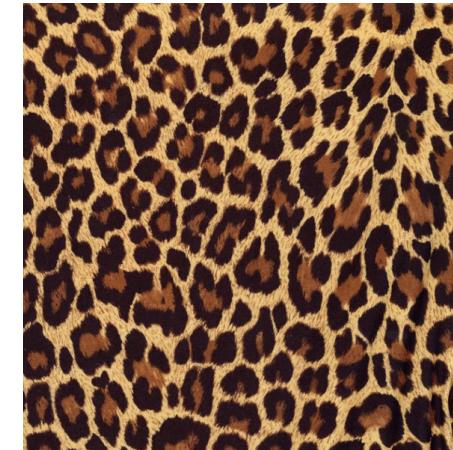
¹ Laboratory of Neurosciences, National Institute on Aging Intramural Research Program, Baltimore, MD, USA

² Department of Neuroscience, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Edited by:

J. Michael Williams, Drexel University, USA

Humans have long pondered the nature of their mind/brain and, particularly why its capacities for reasoning, communication and abstract thought are far superior to other species, including closely related anthropoids. This article considers superior pattern



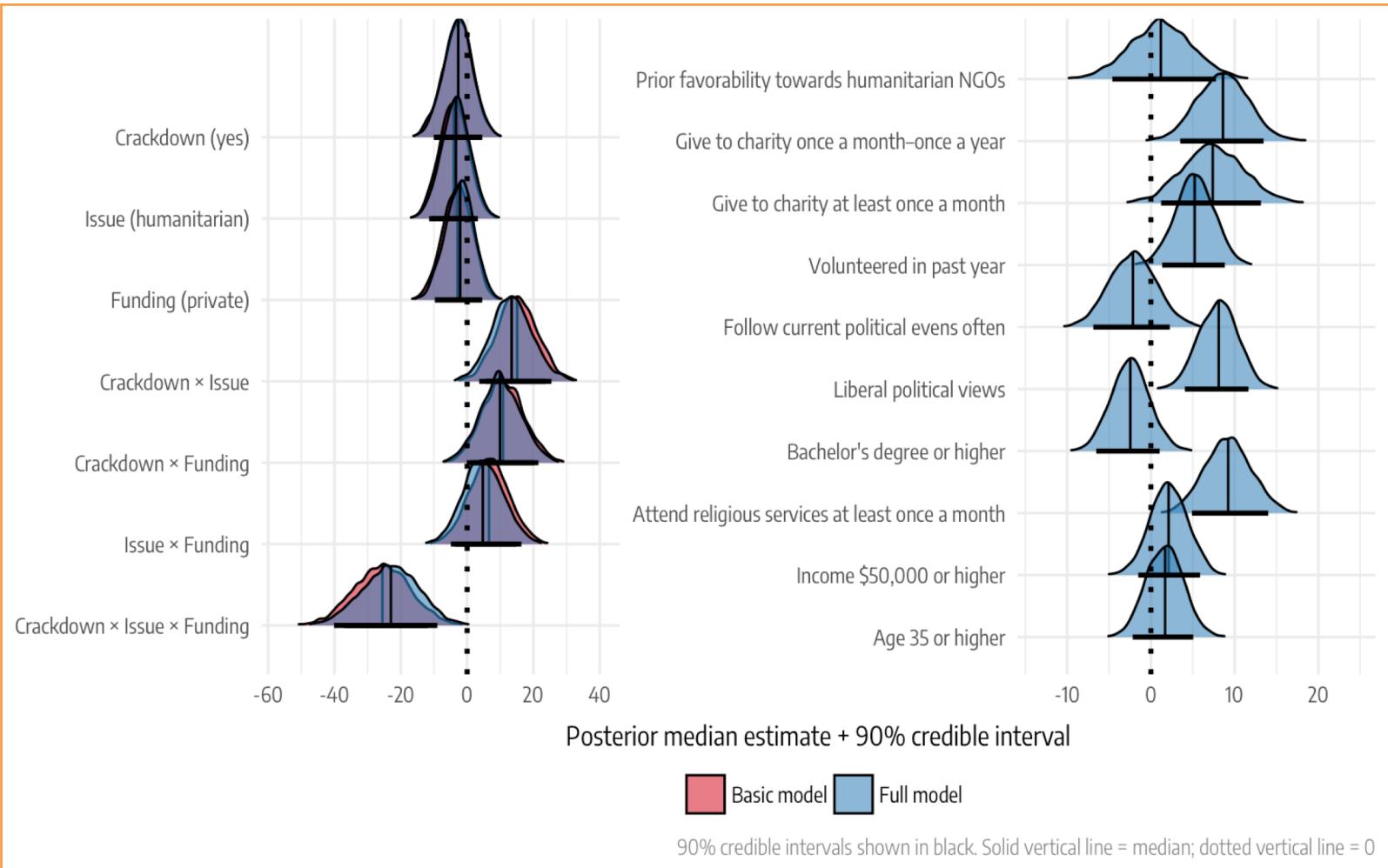
WHY VISUALIZE DATA?

Graphs let us see patterns in our data

Sometimes graphs alone are sufficient for telling a story and drawing inference from data

PLOTS > RAW TABLES

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	20.207	20.641	22.033	4.324	4.740	6.146
	(1.597)	(2.239)	(3.049)	(4.514)	(4.938)	(5.207)
Crackdown (yes)	3.797	2.636	-2.692	3.178	2.349	-2.676
	(2.254)	(3.055)	(4.337)	(2.108)	(3.057)	(4.227)
Issue (humanitarian)	-0.993	-4.030		-1.138		-3.359
	(3.094)	(4.312)		(3.059)		(4.245)
Funding (private)		-2.867			-2.108	
		(4.444)			(4.279)	
Crackdown × Issue	2.418	15.090		1.851	13.427	
	(4.366)	(5.969)		(4.263)	(6.023)	
Crackdown × Funding		10.831			9.920	
		(6.274)			(6.090)	
Issue × Funding	6.595			4.747		
	(6.013)			(6.082)		
Crackdown × Issue × Funding	-25.544			-22.980		
	(8.628)			(8.702)		
Prior favorability towards humanitarian NGOs		1.220	1.340	1.177		
		(3.691)	(3.739)	(3.762)		
Give to charity once a month–once a year		8.650	8.667	8.608		
		(3.184)	(3.150)	(3.083)		
Give to charity at least once a month		7.435	7.470	7.388		
		(3.696)	(3.875)	(3.669)		
Volunteered in past year		5.480	5.519	5.230		
		(2.293)	(2.359)	(2.264)		
Follow current political events often		-2.809	-2.728	-2.152		
		(2.798)	(2.933)	(2.822)		
Liberal political views		8.270	8.267	8.105		
		(2.340)	(2.291)	(2.386)		
Bachelor's degree or higher		-2.445	-2.536	-2.464		
		(2.218)	(2.263)	(2.236)		
Attend religious services at least once a month		9.817	9.833	9.230		
		(2.696)	(2.724)	(2.796)		



PLOTS > RAW TABLES

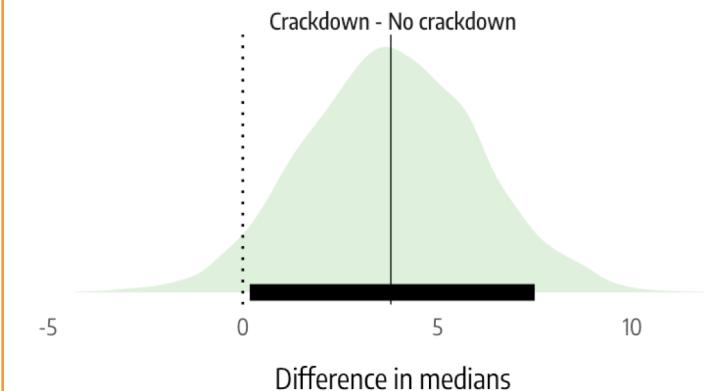
Issue	Funding	Δ_{median}	% Δ_{median}	$p(\Delta > 0)$	$p(\Delta < 0)$	$p(\Delta \neq 0)$
—	—	3.8	0.188	0.958	0.042	0.958
Human rights	—	2.64	0.128	0.802	0.198	0.802
Humanitarian assistance	—	5	0.255	0.945	0.055	0.945
Human rights	Government	-2.69	-0.123	0.261	0.739	0.739
Human rights	Private	8.2	0.434	0.975	0.025	0.975
Humanitarian assistance	Government	12.2	0.677	0.998	0.002	0.998
Humanitarian assistance	Private	-2.33	-0.108	0.291	0.709	0.709

PLOTS > RAW TABLES

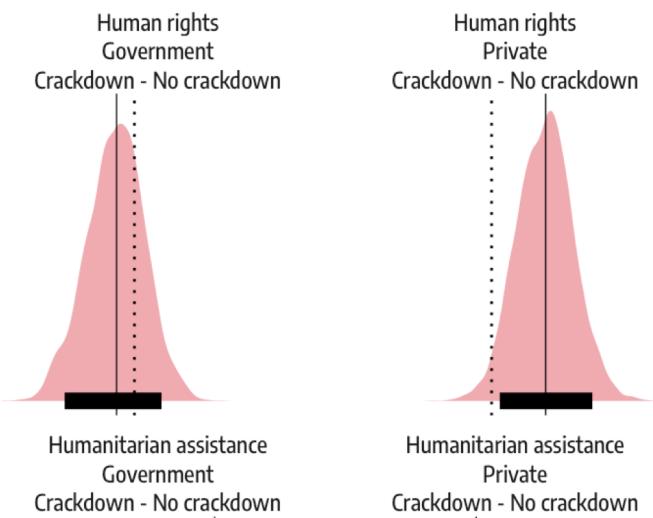
Differences in median amount donated in control and crackdown groups, conditioned by other experimental groups

90% credible intervals shown in black. Solid vertical line = median; dotted vertical line = 0

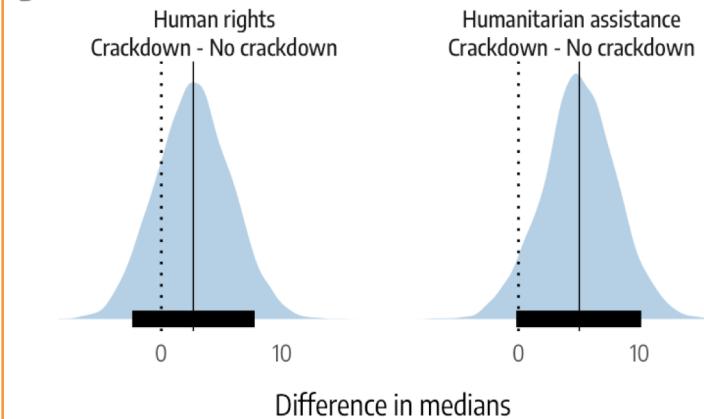
A



C



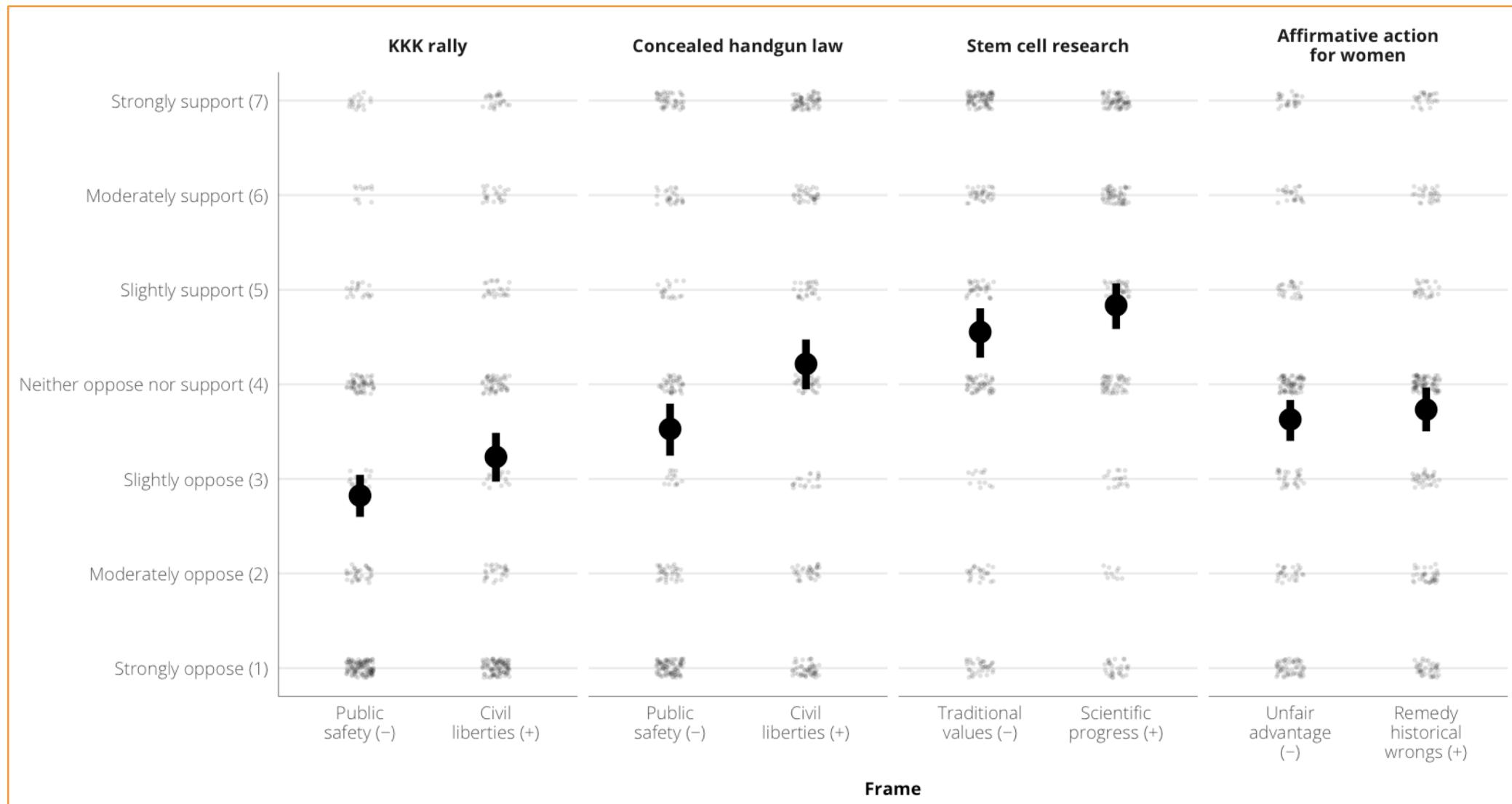
B



PLOTS > RAW TABLES

Issue	Frame	N	Mean	SD	Sig.
KKK rally	Public safety (-)	273	2.67	1.88	
	Civil liberties (+)	267	3.25	2.17	0.001
Concealed handgun law	Public safety (-)	273	3.39	2.27	
	Civil liberties (+)	269	4.22	2.26	0
Stem cell research	Traditional values (-)	273	4.43	2.19	
	Scientific progress (+)	267	4.72	2	0.111
Affirmative action for women	Unfair advantage (-)	267	3.73	1.99	
	Remedy historical wrongs (+)	269	3.71	1.79	0.851

PLOTS > RAW TABLES





THIS IS DIFFICULT

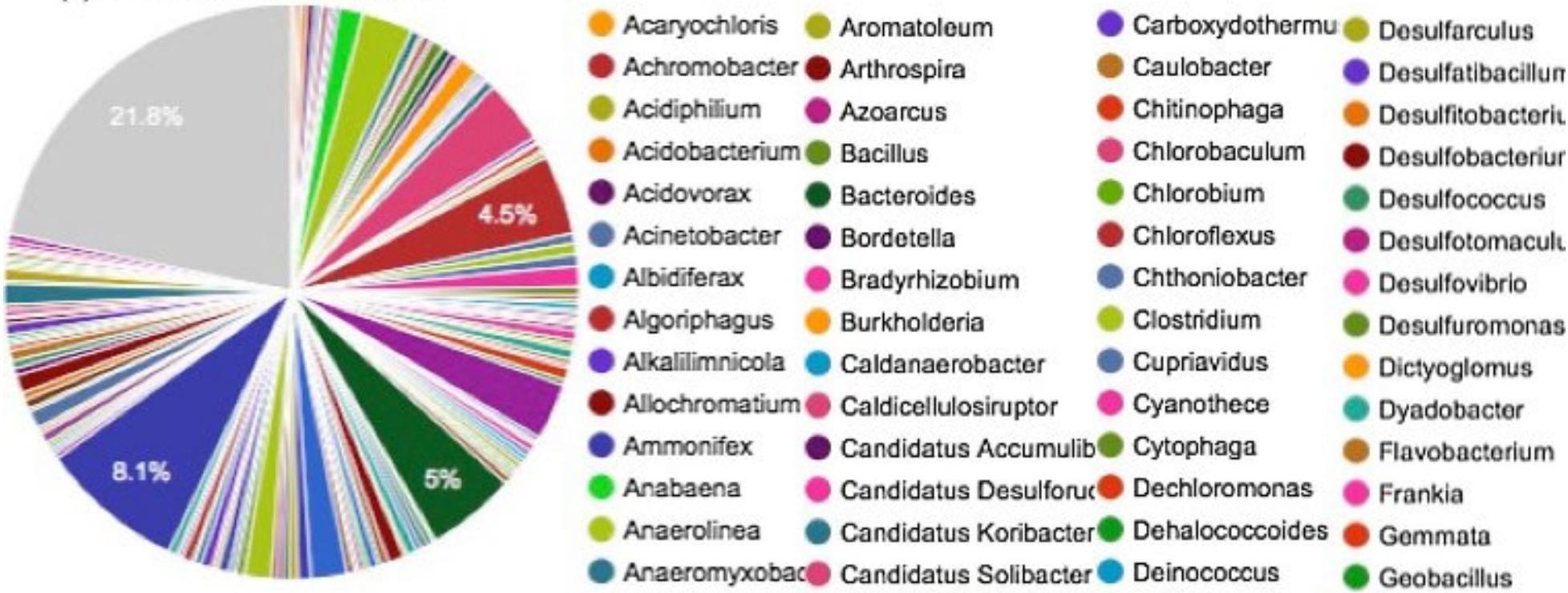


Incompetence

Deceit

Complexity

(f) Distribution of Genus



Geobacter	Methylacidiphilum	Nodularia	Pseudomonas	Sphingomonas	Thermodesulfovibrio
Gloeobacter	Methylibium	Nostoc	Ralstonia	Spirochaeta	Thermomicrobium
Haliangium	Methylobacterium	Opitutus	Rhizobium	Spirosoma	Thermosinus
Heliobacterium	Methylococcus	Oscillatoria	Rhodopirellula	Stigmatella	Thermosynechococcus
Herpetosiphon	Microcoleus	Oscillochloris	Rhodopseudomonas	Streptomyces	Thermotoga
Isosphaera	Microcystis	Paenibacillus	Rhodospirillum	Symbiobacterium	Xanthomonas
Ktedonobacter	Microscilla	Pedobacter	Rhodothermus	Synechococcus	Thermus
Leadbetterella	Moorella	Pedosphaera	Roseiflexus	Synechocystis	Thioalkalivibrio
Leptospira	Mycobacterium	Pelobacter	Roseomonas	Syntrophobacter	Thiobacillus
Leptothrix	Myxococcus	Pelotomaculum	Rubrobacter	Syntrophus	Trichodesmium
Lyngbya	Nitrosococcus	Pirellula	Shewanella	Thermaerobacter	Truepera
Magnetospirillum	Nitrosomonas	Planctomyces	Sideroxydans	Variovorax	Other
					unclassified from Bacteria
					unclassified Deltaproteobacteria
					Verminephrobacter

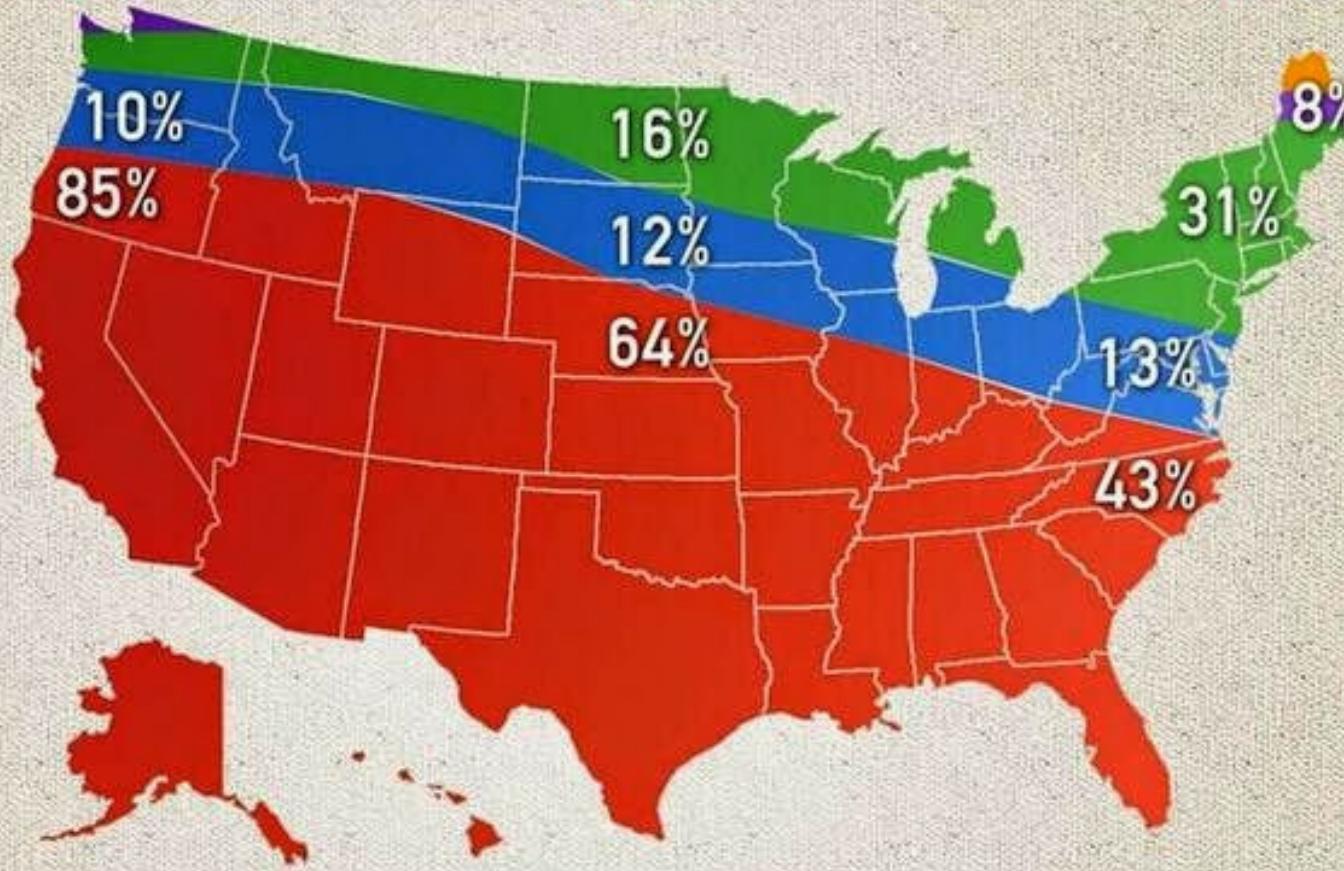
CHANGING FACE OF AMERICA

Percent of total U.S. population by race and ethnicity, 1960–2060

1960

2010

2060



OTHER

ASIAN

HISPANIC

BLACK

WHITE

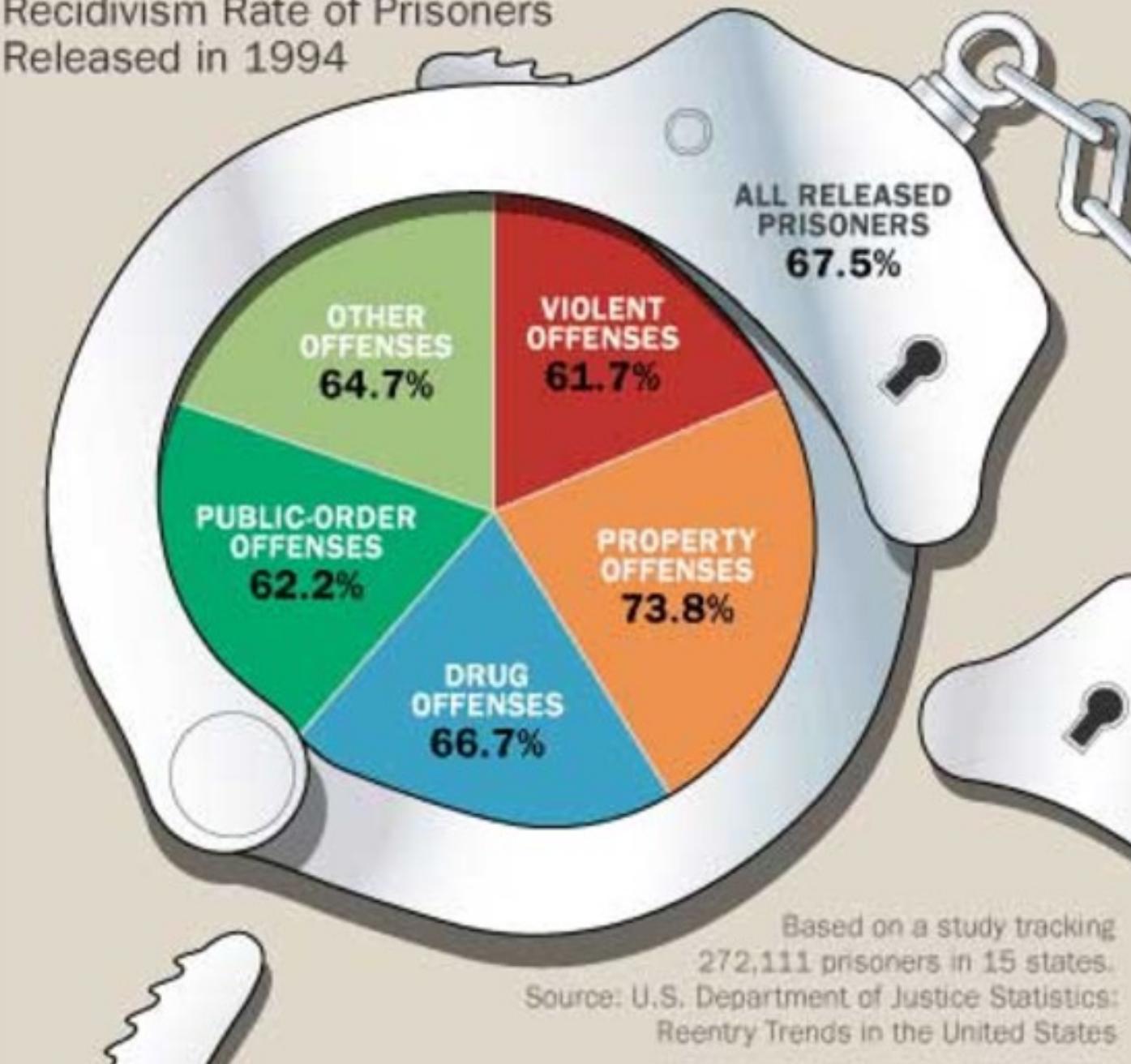
SOURCE: PEW RESEARCH CENTER

NIGHTLY NEWS
with BRIAN WILLIAMS

How Prison Works

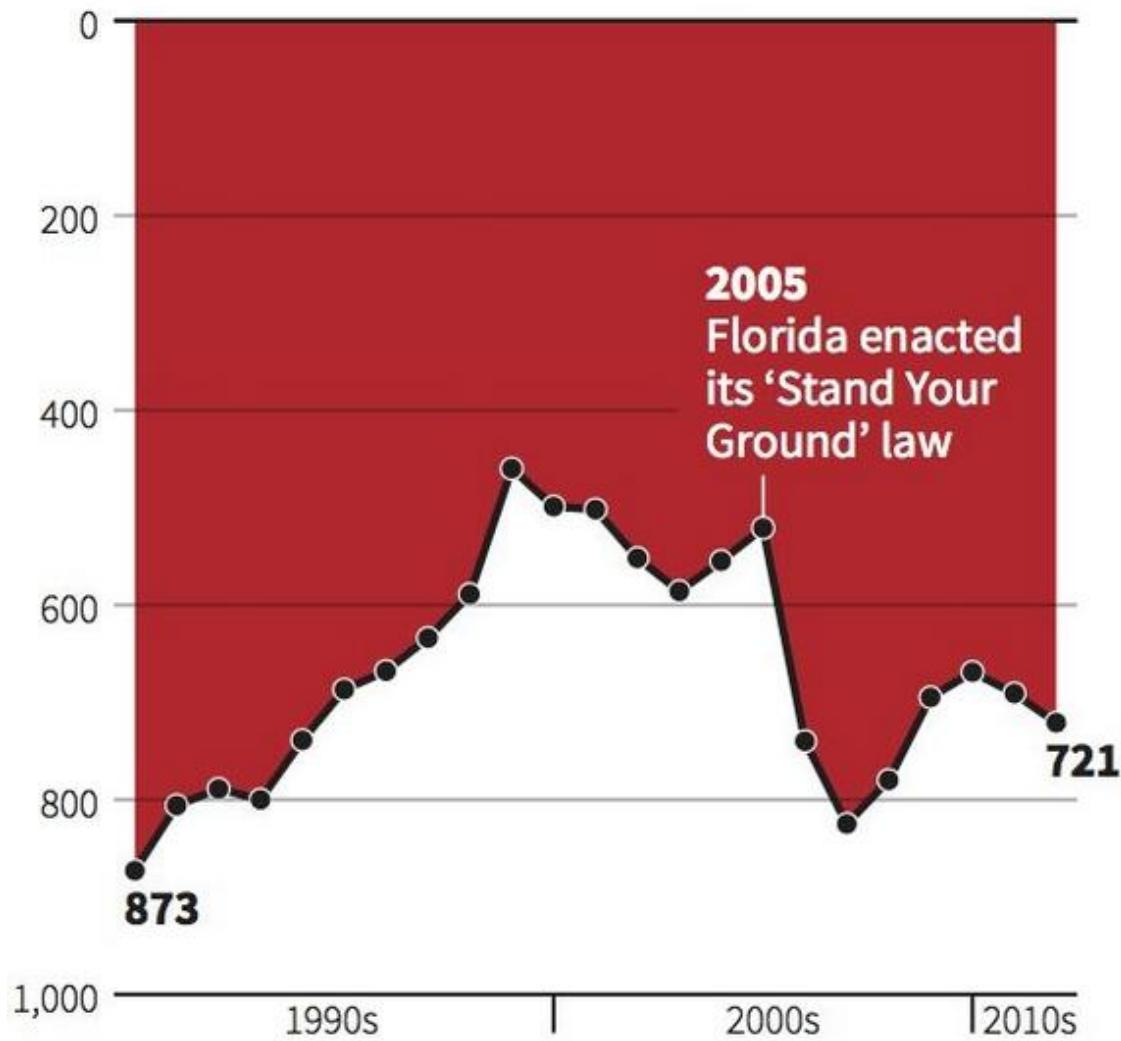
©2007 HowStuffWorks

Recidivism Rate of Prisoners
Released in 1994



Gun deaths in Florida

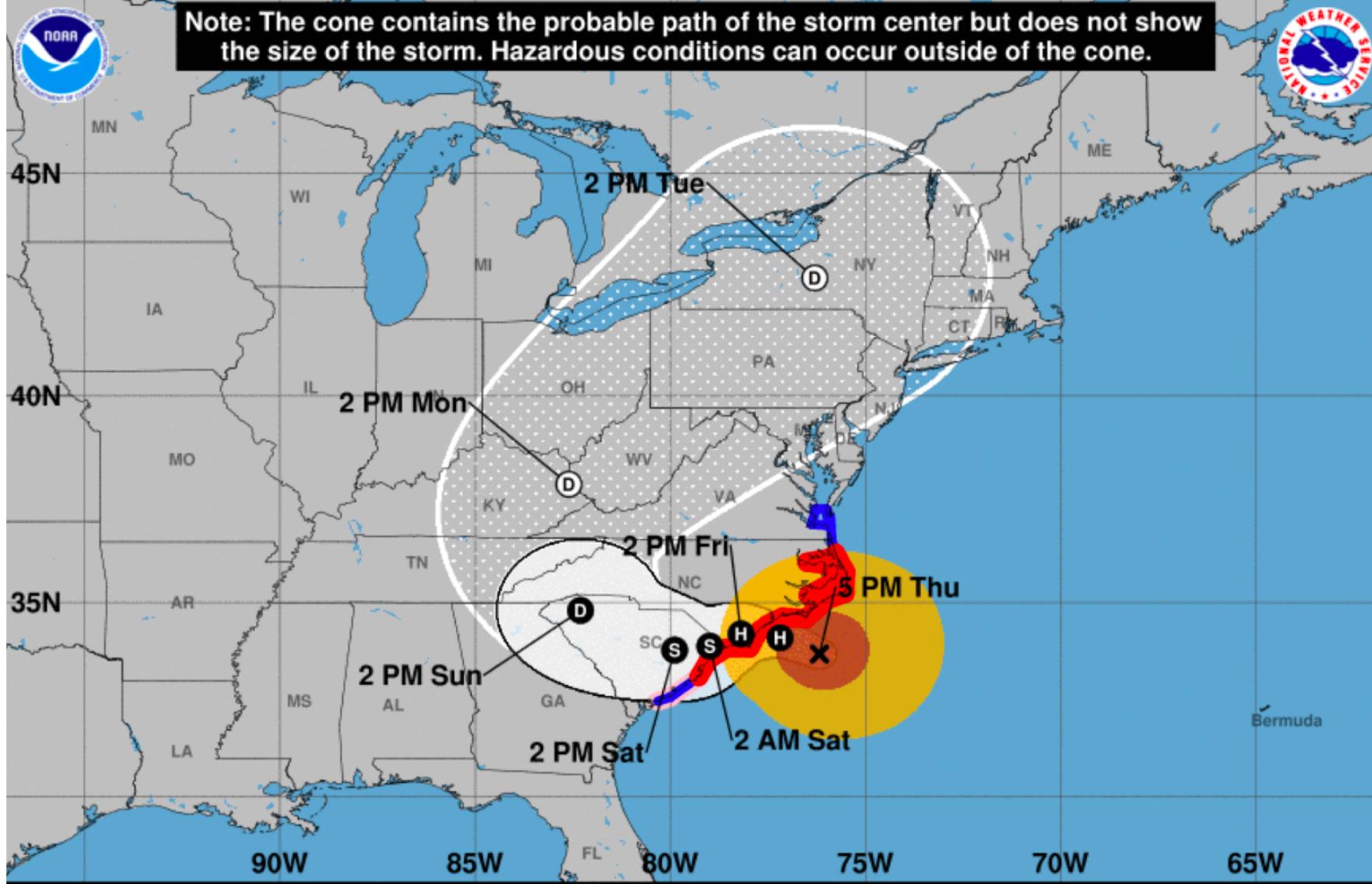
Number of murders committed using firearms



Source: Florida Department of Law Enforcement



Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.



Hurricane Florence

Thursday September 13, 2018

5 PM EDT Advisory 58

NWS National Hurricane Center

Current information: **X**

Center location 33.7 N 76.2 W

Maximum sustained wind 100 mph

Movement WNW at 5 mph

Forecast positions:

● Tropical Cyclone ○ Post/Potential TC

Sustained winds: D < 39 mph

S 39-73 mph H 74-110 mph M > 110 mph

Potential track area:



Day 1-3



Day 4-5

Watches:

Hurricane Trop Stm

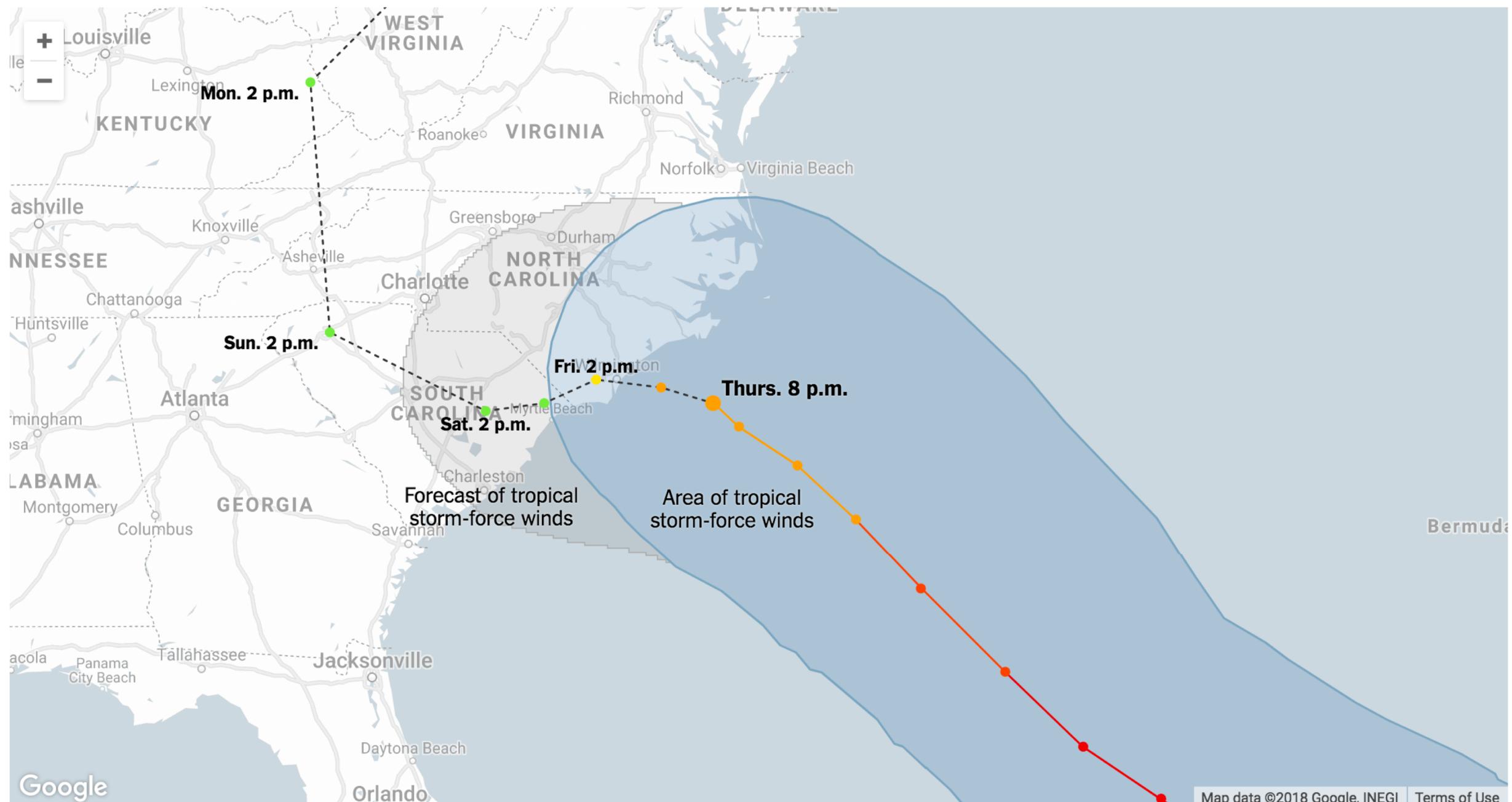
Warnings:

Hurricane Trop Stm

Current wind extent:

Hurricane Trop Stm

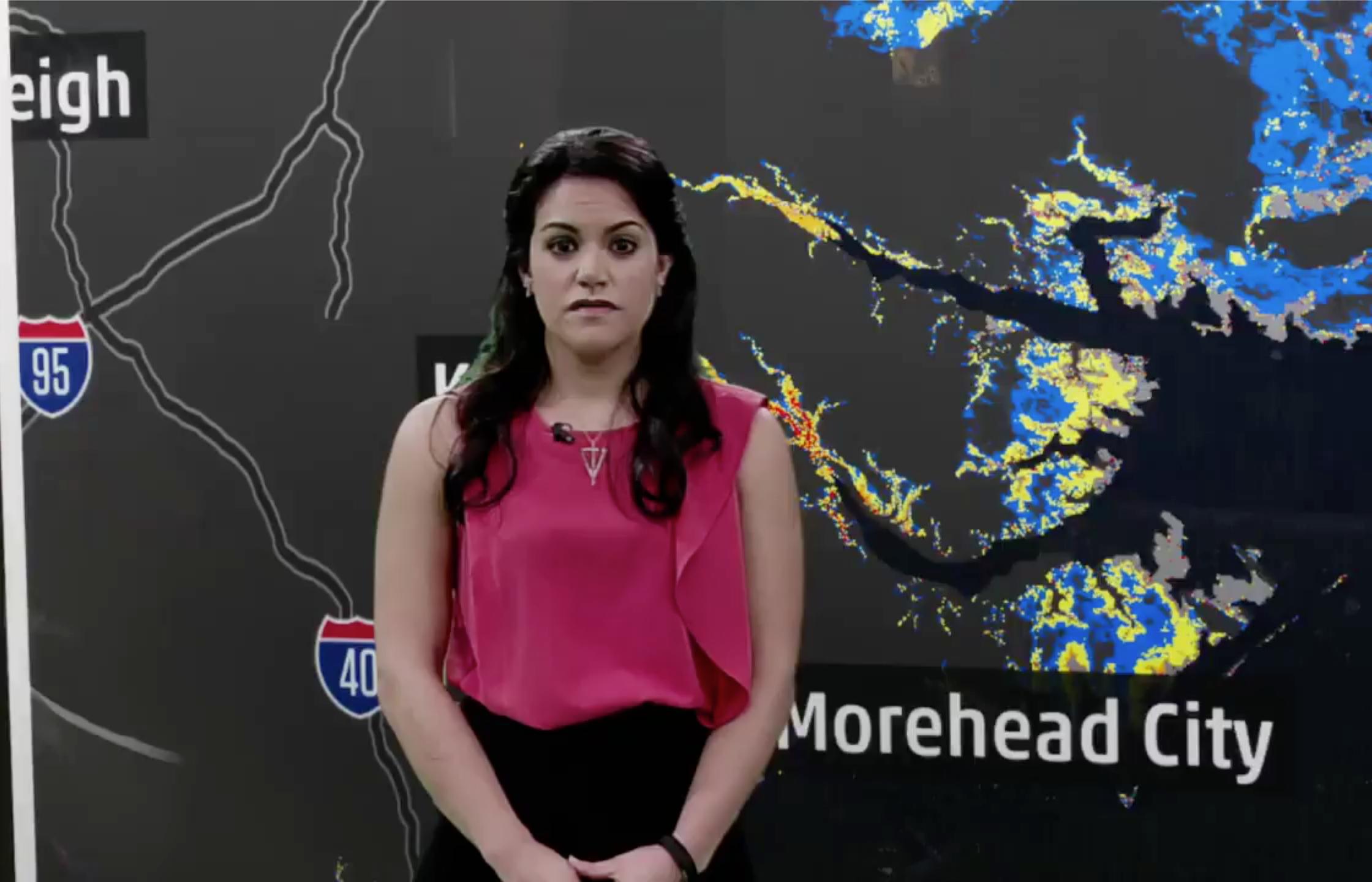
Category 2 Max. Wind Speed **100 m.p.h.**



9 FT
The Weather Channel

6 FT

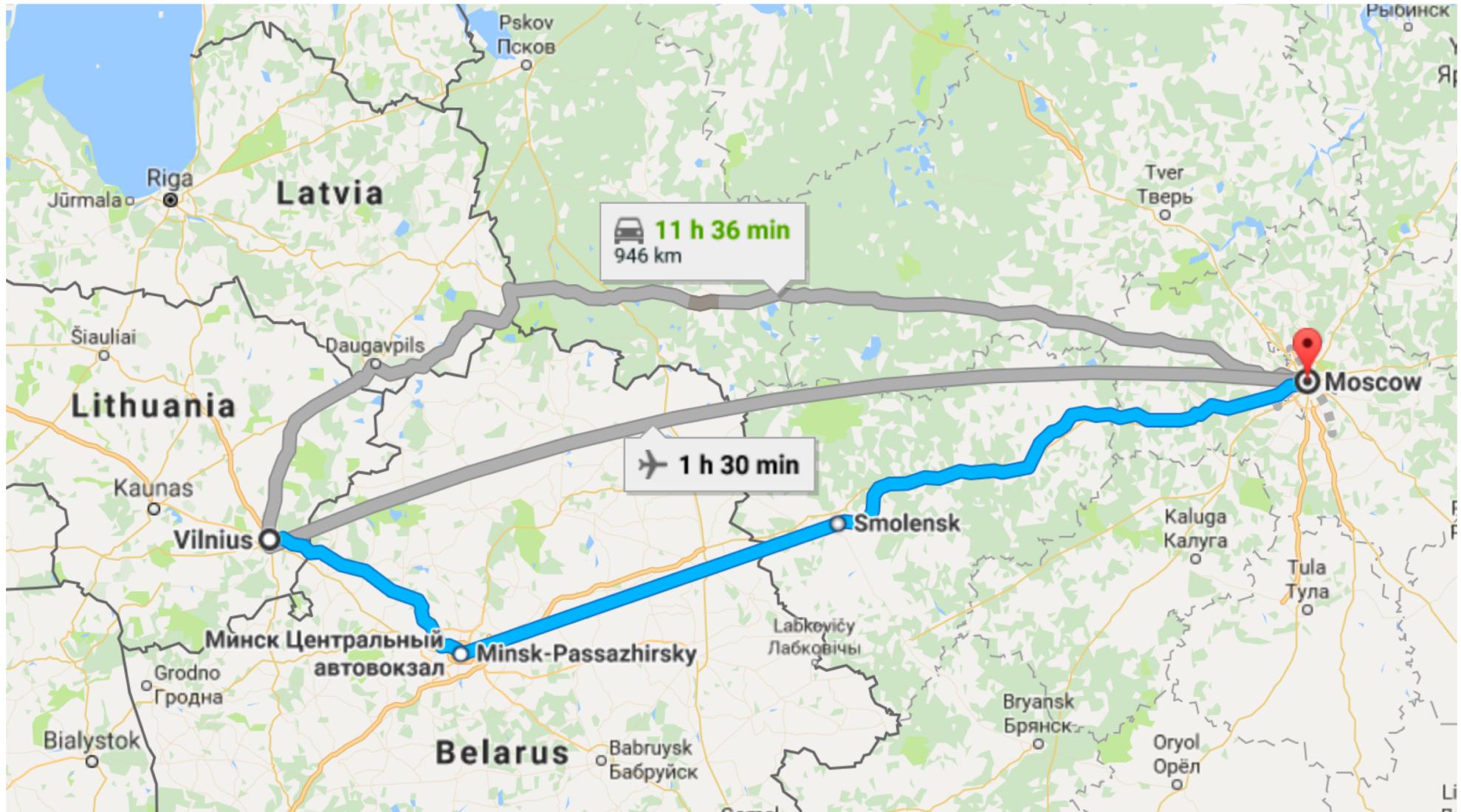
3 FT



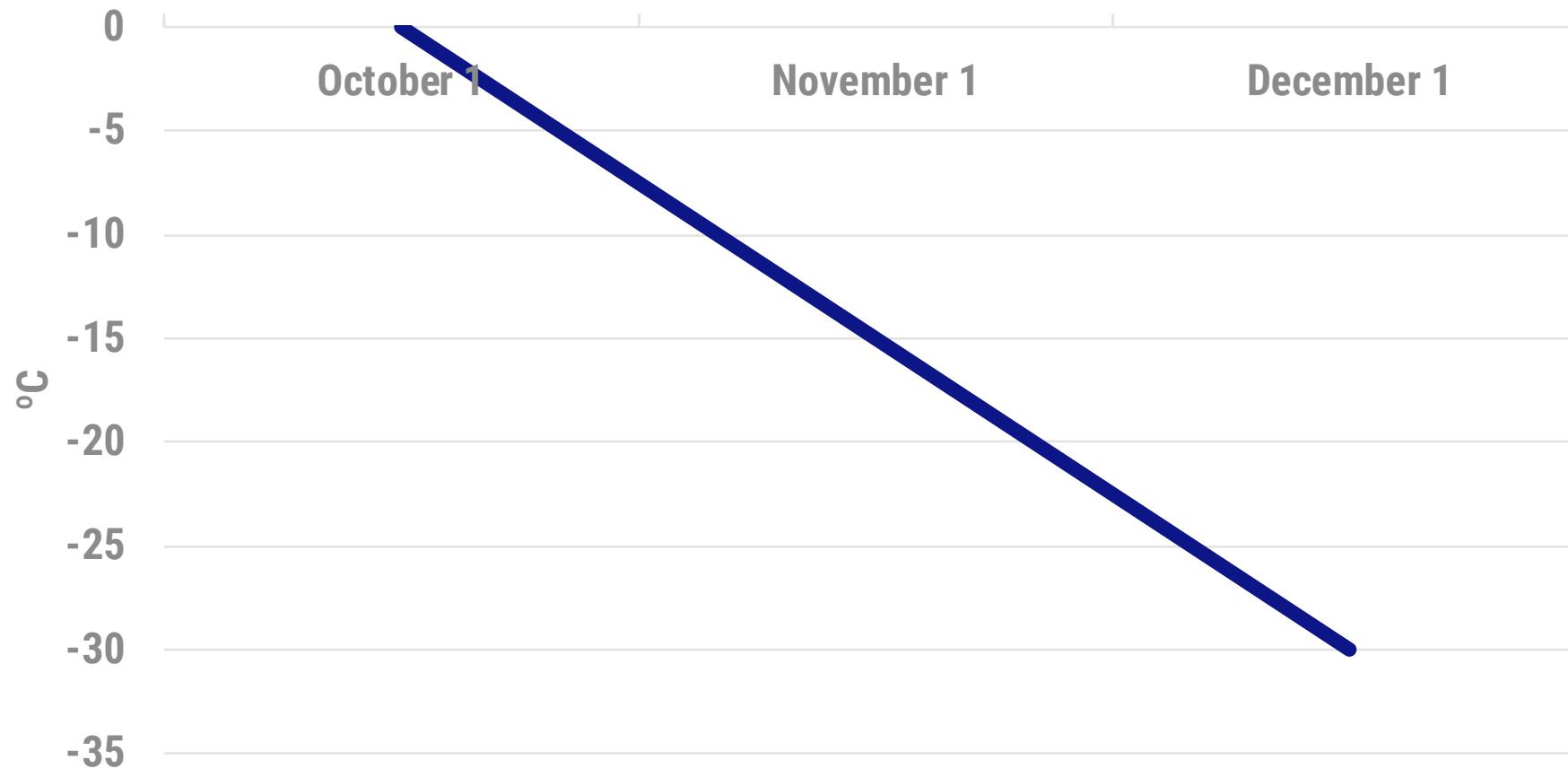
**WHAT MAKES A GOOD
VISUALIZATION?**



THE WAR OF 1812

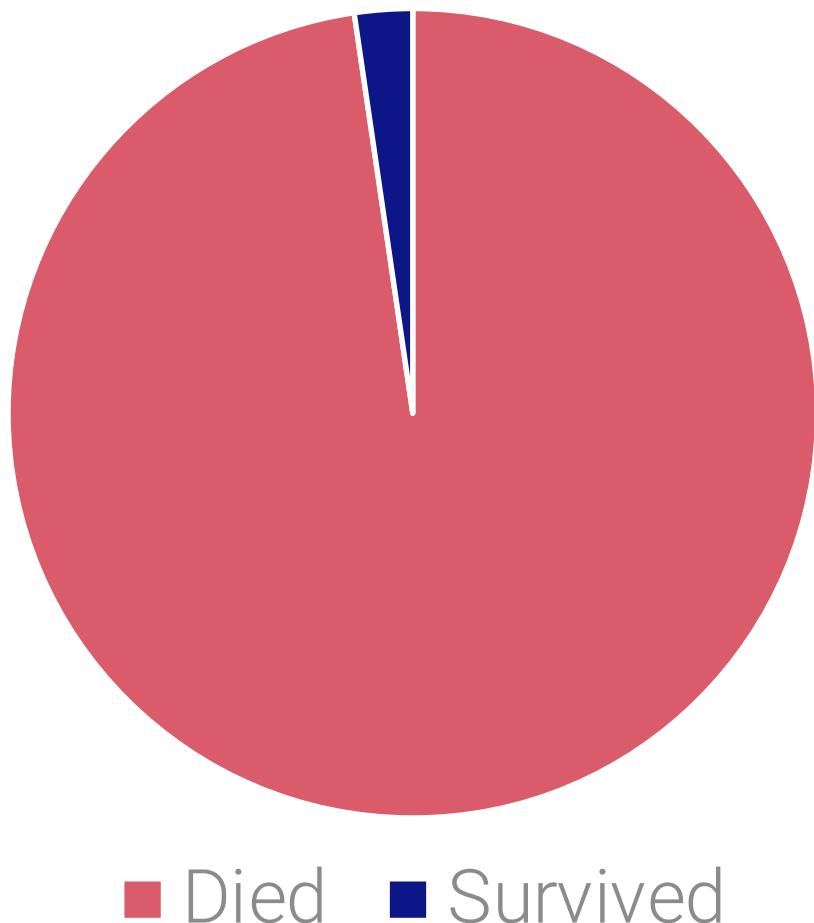


THE WAR OF 1812



THE WAR OF 1812

Napoleon's Grande Armée



Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussees en retraite
Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie; le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Séguir, de Fézensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout qui avaient été détachés sur Minsk en Mohilow et se rejoignaient vers Orscha en Wilebsk, avaient toujours marché avec l'armée.

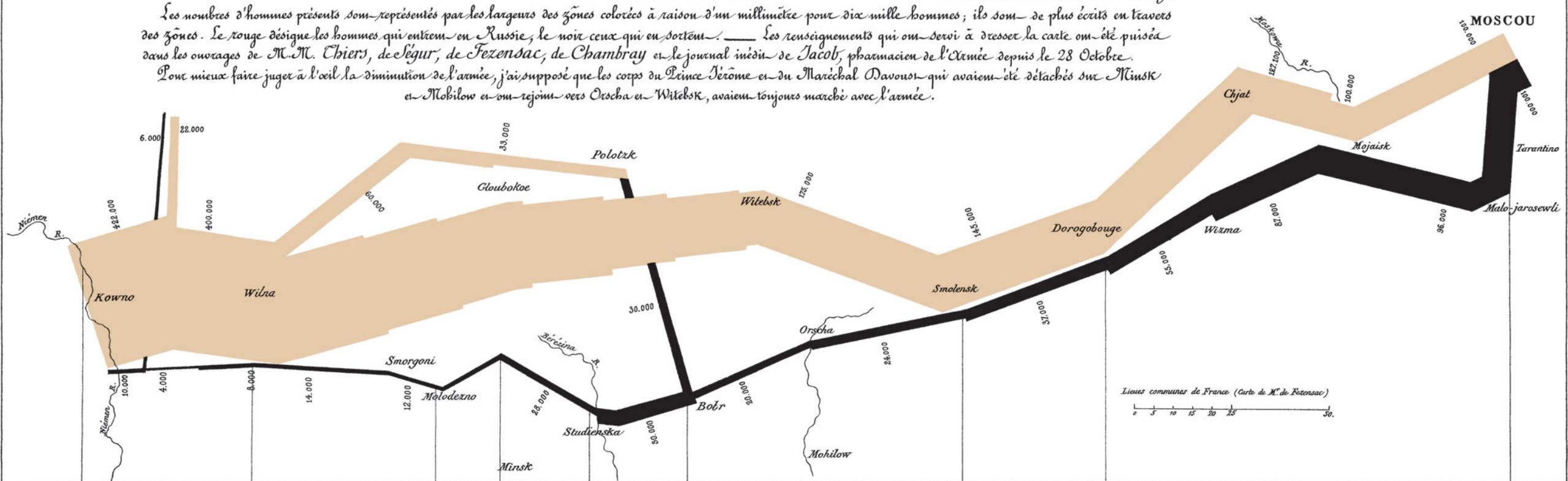


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.

Les Cosaques passent au galop
le Niemen gelé.



CHARACTERISTICS OF GRAPHICAL EXCELLENCE

1. "... the well-designed presentation of interesting data—a matter of substance, statistics, and design."

2. Complex ideas communicated with clarity, precision, and efficiency.

3. That which gives the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.

4. Nearly always multivariate.

5. Requires telling the truth about the data.

MOST IDEAS, SHORTEST TIME,
LEAST INK, SMALLEST SPACE

$$\text{Data:Ink ratio} = \frac{\text{Ink}_{\text{Data}}}{\text{Ink}_{\text{Total}}}$$

TYPES OF VISUALIZATIONS

TWO GENERAL TYPES

Exploratory

Academic-ish

Quick scatterplots,
histograms, other charts to
help understand your data

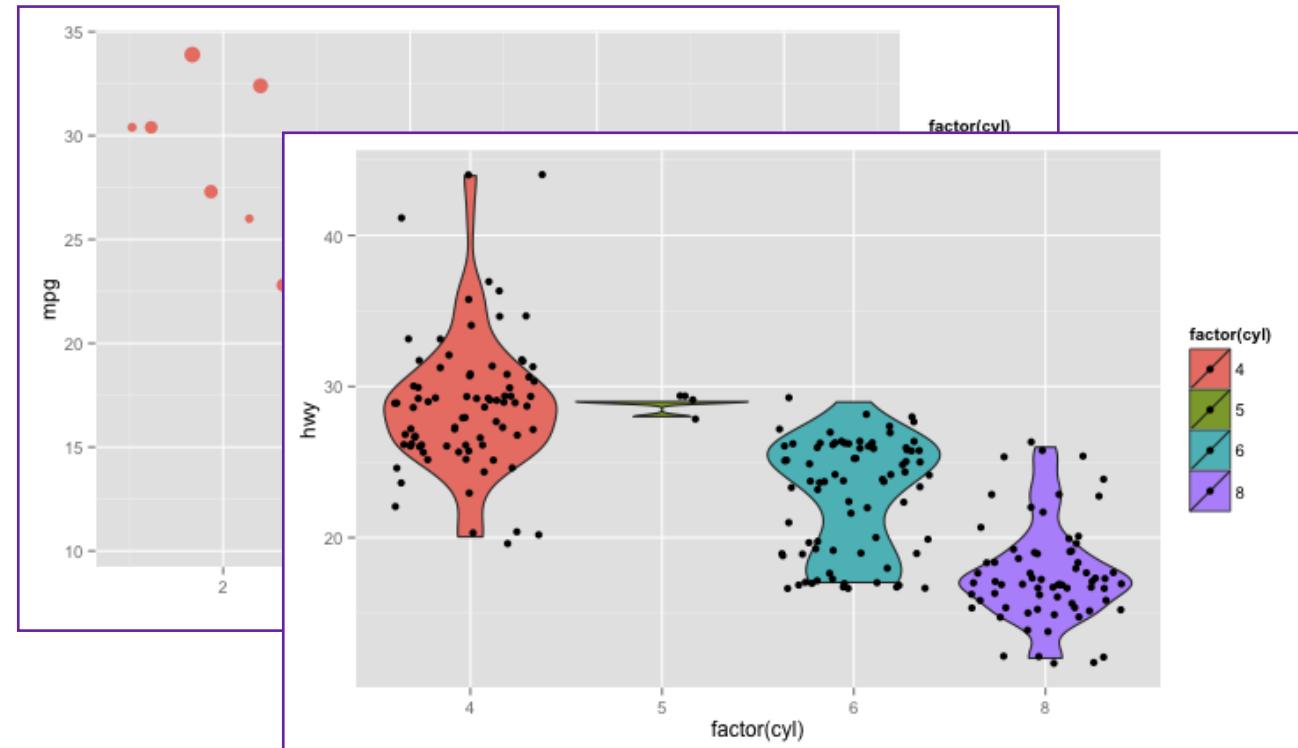
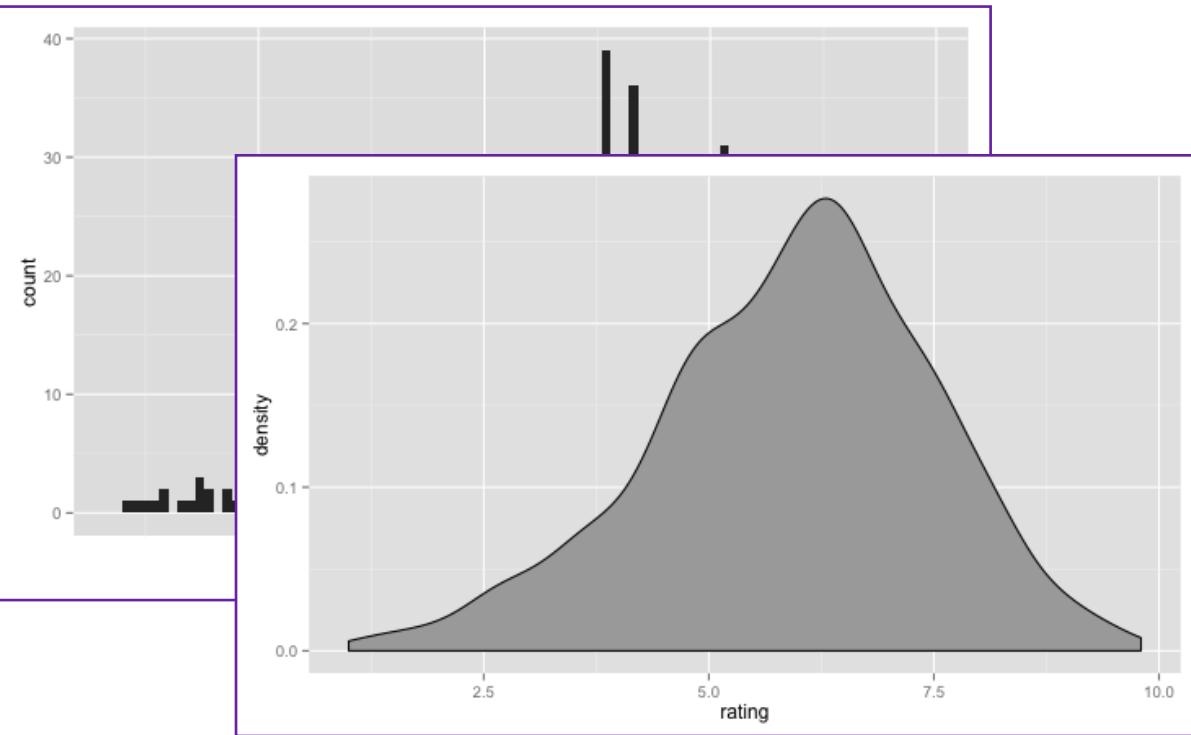
Explanatory

Publishable

Consumable by the general
public; Vox, NYT, Washington
Post, FiveThirtyEight, etc.

EXPLORATORY DATA ANALYSIS

Find analytical insight in data (even causal inference 😱)

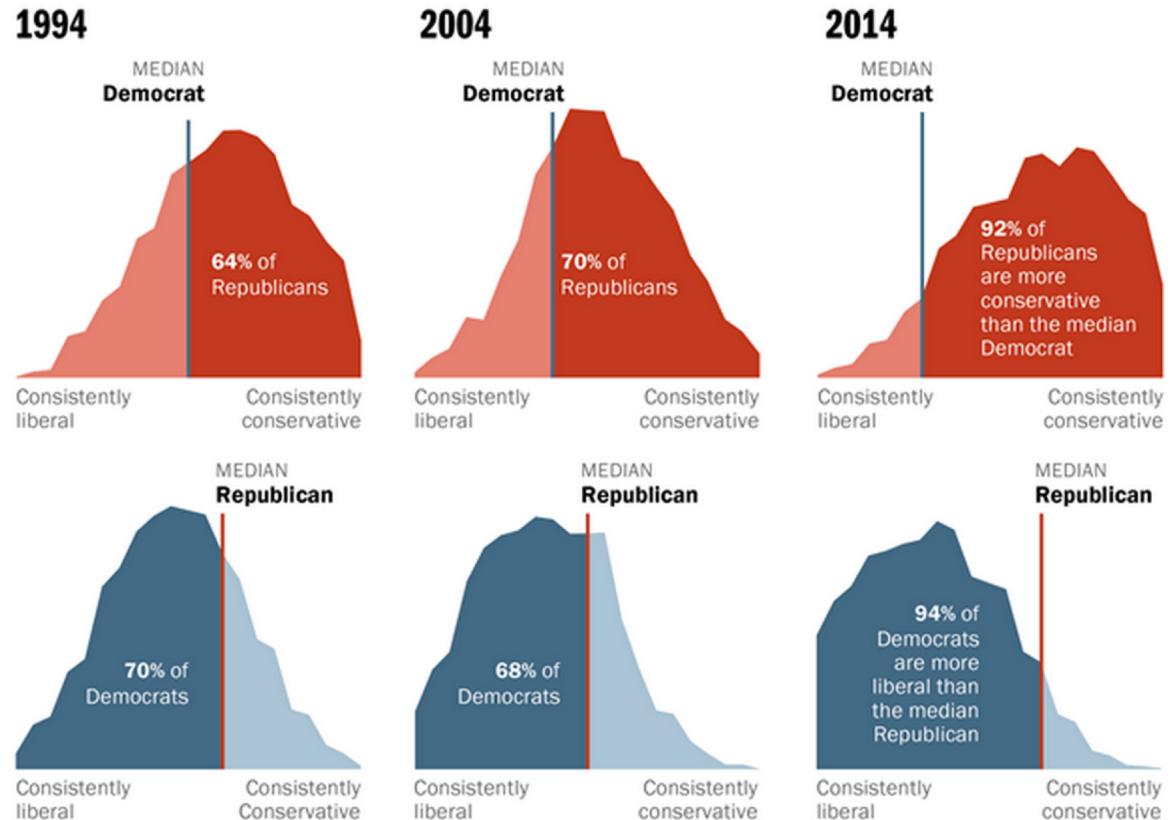


EXPLANATORY DATA ANALYSIS

Annotate and tell a story

Republicans Shift to the Right, Democrats to the Left

Distribution of Republicans and Democrats on a 10-item scale of political values



Source: 2014 Political Polarization in the American Public.

Notes: Ideological consistency based on a scale of 10 political values questions (see Appendix A). Republicans include Republican-leaning independents; Democrats include Democratic-leaning independents (see Appendix B).

PEW RESEARCH CENTER

WHICH CHART TYPE DO I USE?

ONE NUMERIC VARIABLE

Distribution

Correl

HISTOGRAM

DENSITY PLOT

Numeric Categoric Num & Cat Maps Network Time series

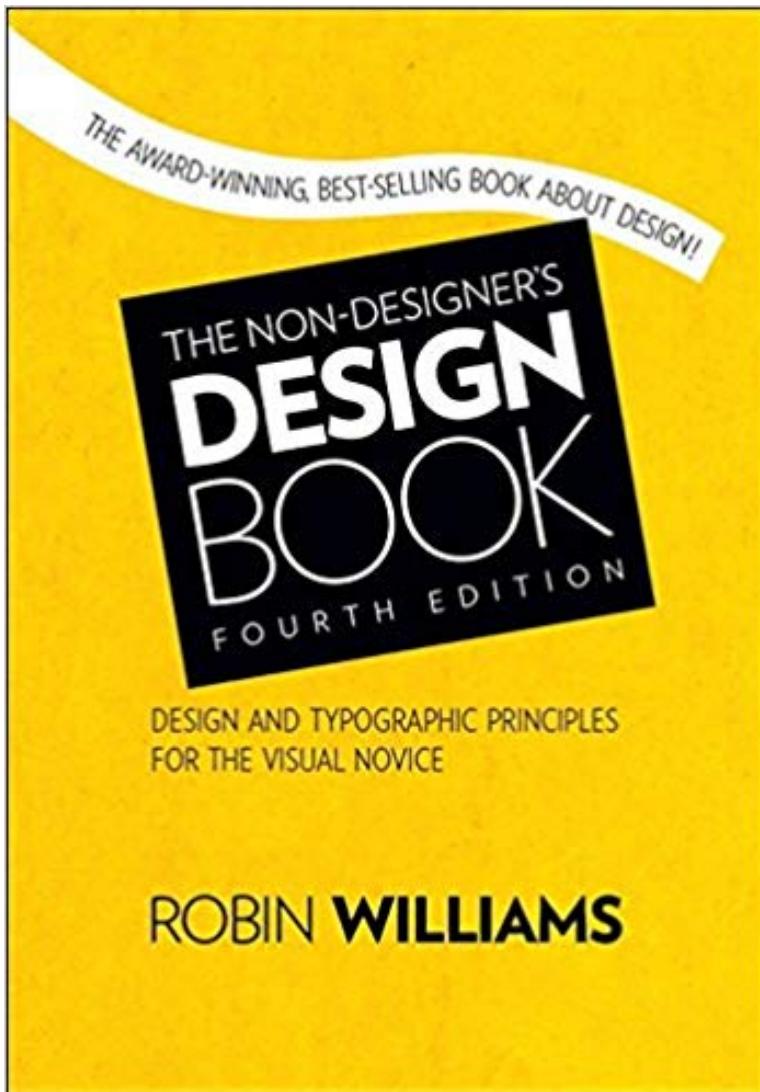
Filter by chart name or AKA

Reference Type: ● Example ○ Solution | Chart Families: ● Categorical ○ Hierarchical

	Amazon QuickSight	ArcGIS	ChartJS	D3.js	Data Illustrator	Datawrapper	Flourish	FusionCharts	Gephi	Google Charts
Bar chart	●			●●●	○	●●●	○	○		●●
Clustered bar chart	●			●	○	●●●○	○	○		●●
Bullet chart				●		●●		○		○
Connected dot plot				●●		●●○				

AESTHETICS AND DESIGN

FOUR CORE DESIGN PRINCIPLES



Contrast

Repetition

Alignment

Proximity

CONTRAST

“If two items are not exactly
the same, make them different.
Really different.”

Don’t be a wimp.

TYPOGRAPHIC CONTRAST

Serif

Lorem ipsum dolor sit amet

Sans Serif

Lorem ipsum dolor sit amet

Slab Serif

Lorem ipsum dolor sit amet

Script

Lorem ipsum dolor sit amet

Decorative

Lorem ipsum dolor sit amet

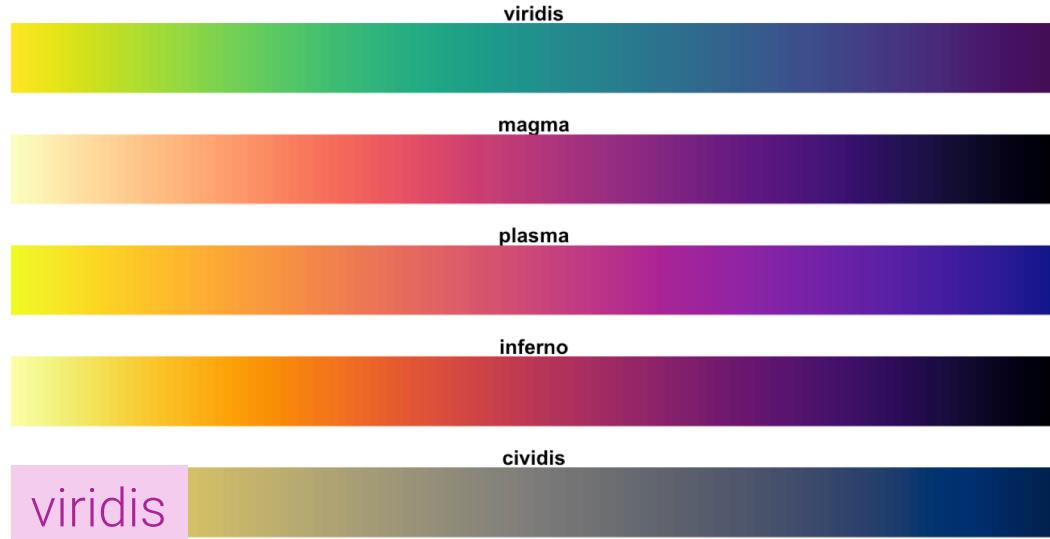
COLOR CONTRAST



<https://color.adobe.com/>



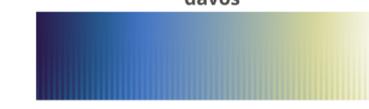
<http://colorbrewer2.org/>



viridis



devon



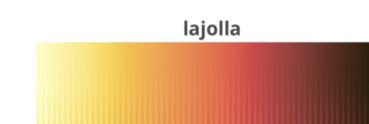
davos



oslo



bilbao



lajolla



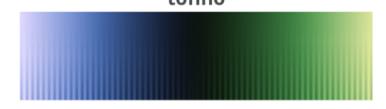
grayC



broc



lisbon



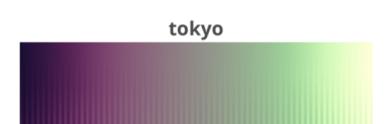
tofino



berlin



turku



tokyo

Scientific Colour-Maps

<https://github.com/thomasp85/scico>

James Clifton Thomas

123 Penny Lane
Portland, OR 97211
(888) 555-1212

**PROFILE:**

A multi-talented, hard-working young man, easy to get along with, dependable, and joyful.

ACCOMPLISHMENTS:

January 2006-present Web designer and developer, working with a professional team of creatives in Portland.

May 2000-January 2006 Pocket Full of Posies Day Care Center. Changed diapers, taught magic and painting, wiped noses, read books to and danced with babies and toddlers. Also coordinated schedules, hired other teachers, and developed programs for children.

Summer 2006 Updated the best-selling book, *The Non-Designer's Web Book* with my mom (Robin Williams) and John Tollett.

1997-2000 Developed and led a ska band called Lead Veins. Designed the web site and coordinated a national tour.

EDUCATION:

2002-2005 Pacific Northwest College of Art, Portland, Oregon: B.A. in Printmaking

1999-2000 Santa Rosa High School, Santa Rosa, California

1997-1998 Santa Fe High School, Santa Fe, New Mexico

1982-1986 Poppy Creek Daycare Center, Santa Rosa, California

PROFESSIONAL AFFILIATIONS:

Grand National Monotype Club, Executive Secretary, 2000-2002

Jerks of Invention, Musicians of Portland, President, 1999-present

Local Organization of Children of Robin Williams, 1982-present

HOBBIES:

Snowboarding, skateboarding, tap dancing, cooking, magic, music (trumpet, drums, vocals, bass guitar), portrait drawing

References available on request.

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REPETITION

“Repeat some aspect
of the design throughout
the entire piece.”

Jamba Whirl

DISCOVER MORE

• FRESH SQUEEZED •

Start The Day

Delicious!

Bored with breakfast?
Skipping it altogether?
Wake up to a new way to start your day:

Jamba Juice!

Jamba is the perfect place to pick up that all-important morning meal. First, our fruit-filled products are overflowing with vital vitamins and minerals to give your body the breakfast boost it needs. Even better, you can grab them on the go—and they taste great, too!

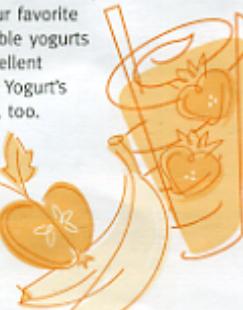
New Fantastic Functional Smoothies. Still sleepy? Get Up & Mango™! This new energy smoothie blends brilliant mangos and perky peaches with soymilk, nonfat frozen yogurt and our special Energy Boost™—a potent combination of ginseng ginkgo biloba, and other fatigue-fighting herbs, as well as four energy-essential B vitamins. Get Up & Mango™ will get you moving—and give you plenty of potassium, calcium and vitamins C and A, as well as 15 grams of protein*.

Want more protein? Our Blue Banana Blast™ smoothie is bursting with blueberries and bananas, plus soymilk, nonfat plain yogurt, nonfat frozen yogurt, and Jamba's Protein Boost™. You get 22 grams of protein, plus lots of dietary fiber, calcium and vitamin D. Drink up!

New Yummy Yogurt Blends. These sweet and creamy creations blend nonfat plain yogurt and soymilk with your favorite fresh fruits and fruit juices. These drinkable yogurts are a good source of protein and an excellent source of calcium and vitamins C and D. Yogurt's "friendly bacteria" helps aid in digestion, too. Choose from Sunrise Strawberry™, Bright Eyed & Blueberry™ and Pick-Me-Up Peach™.

Tomorrow morning, don't let the first meal of the day put you to sleep! Go to Jamba—and give yourself a fresh start!

* Nutritional information based on Original size smoothie.



Visit jambajuice.com for a complete list of store locations!

• FUEL FACTS •

Rise and Shine With Breakfast

Your mother was right: You shouldn't skip breakfast.

But eating any old morning meal won't do. To start the day right, you need to feed your body the vitamins and nutrients it craves.

"You don't want to waste calories," explains Suzanne Havala Hobbs, a registered dietitian and member of Jamba's Wellness Advisory Board. "If you load up on empty calories for breakfast, by the end of the day, you're more likely to have missed some important nutrients."

A nutritious breakfast offers a bounty of benefits. For one, you'll have more energy and will probably perform better at work or school. Why? When you wake up in the morning, your body's energy stores are low. After all, you haven't eaten anything in eight to 12 hours. If you don't refuel with breakfast, you'll probably be starved by lunch—and more likely to overeat and make impulsive food choices.

(Continued on back page)

• BEHIND THE BLENDER •

The Secret To Jamba Smoothies

Ever wonder why Jamba smoothies taste so terrific? The secret is in the fruit—and how we pick it.

It starts in the fields. Jamba's suppliers pick produce at the peak of perfection, and within hours, that fruit is "individually quick frozen" to lock in its fresh flavor, juices and nutrients. Soon, it's on its way to Jamba stores, ready to be mixed into one of our splendid smoothies!

Of course, not all fruits are created equal. And when Jamba searches the globe for the best bananas, berries, peaches and more, we're pretty hard to please. We're not only picky about the fruit itself—we insist on a specific variety of strawberry, and each one must adhere to our strict standards for color and flavor—we're also choosy about the people who supply it.

Our suppliers must meet a long list of stringent standards for ensuring quality and food safety. We require vendors to detail all of their quality and safety processes and pass a rigorous third-party audit before we'll even agree to taste-test their fruit. In addition, Jamba officials visit supplier facilities and continue reviewing processes even after a contract is signed. Many of our vendors have been our trusted partners for years.

Why all the fuss? Jamba is committed to providing only the highest quality products to our customers. After all, the better the fruit, the better the smoothie!

FRESH CROP Opening This Fall!

Rancho Cucamonga, California
Ft. Lauderdale, Florida
Charlotte, North Carolina
Honolulu, Hawaii
Fifth Avenue, New York
Orland Park, Illinois

• JAMBATUDE •

Spreading The Jamba Spirit

Jamba General Manager Ray Sterling is a big believer in supporting the local community. So when Ray, who manages the Jamba store at 9th and Irving streets in San Francisco, saw that the 2004 AIDS Walk San Francisco fundraising event was approaching, he sprang into action.

Ray volunteered to captain a team of walkers and, with the help of the Jamba's Northern California marketing department, quickly spread the word about the event to all the stores in Northern California. His goal: Raise \$10,000 for AIDS Walk, which benefits the San Francisco AIDS Foundation and other organizations that provide services, support and education to AIDS patients.

His enthusiasm turned out to be contagious. On July 18, the day of the walk, he found himself leading a team of more than 40 people, including Jamba team members, customers and friends and family. Two team members donned BananaMan costumes, and the rest of the team sported bright yellow Jamba t-shirts as they walked 6.2 miles through Golden Gate Park. Total money raised: \$16,019.

"I think it's so important to support the local community," Ray explains. "This is a big event in San Francisco, and the money goes to help people and children right here. I felt it was essential for Jamba to be a part of it."

The AIDS Walk isn't the only community project Ray has been involved with since joining Jamba two-and-a-half years ago. He also works with a local chapter of The Arc, an organization that helps people with developmental disabilities. Through The Arc, Ray has hired several people with disabilities to work for him at Jamba. For his efforts, he was recognized as an "Employer of the Year" last year by the San Francisco Mayor's Committee for Employment of Persons with Disabilities.

"Ray exemplifies everything that Jamba stands for," says Gail DiSantis, a Jamba District Manager for San Francisco and Ray's boss. "He's friendly, fun and energetic, and when it comes to helping the community, he doesn't just talk. He's a doer."

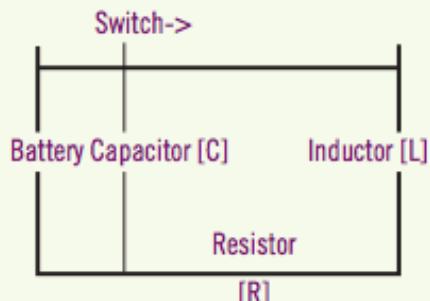


ALIGNMENT

“Every item should have a visual connection with something else on the page.”

Example 6: Value of a resistor in an electrical circuit.

Find the value of a resistor in an electrical circuit which will dissipate the charge to 1 percent of its original value within one twentieth of a second after the switch is closed.

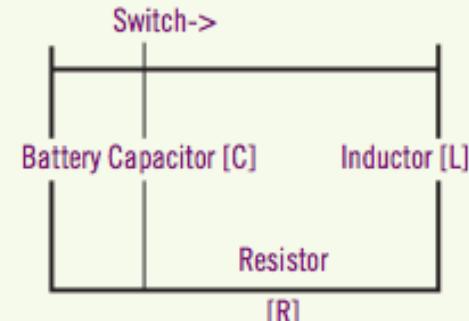


q0=	9	volts
q(t)=	0.09	volts
t=	0.05	seconds
L=	8	henrys
C=	0.0001	farads
R=	300	ohms
q(t)=	0.253889	

1/[L*C_]	1250
[R_/(2*L)]^2	351.5625
SQRT(B15-B16)	29.973947
COS(T*B17)	0.07203653
-R_*T/(2*L)	-0.9375
Q0+EXP (B 19)	3.52445064

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Fewer/Less

The Controversy: Some usage dictionaries state that fewer and less can be used synonymously while others say that there is a distinct difference in the usage between the two. Fewer cannot be used in place of less, but can less be used in place of fewer?

The Traditional Rule: Fewer refers to number among things that are counted, or readily distinguishable units (fewer people, ships, houses.) Less refers to quantity or amount among things that are measured (less sugar, time, energy).

History: The rule first originated in 1770 as a rule on less, "this word is commonly used in speaking of a number; where fewer would do better. Essentially less has been used of countables in English just about as long as there has been a written English language. After about 900 years Robert Baker opined that fewer might be more elegant and proper. Almost every usage writer since Baker has followed Baker's lead, and generations of English teachers have swelled the chorus. "No fewer than a hundred appears to me not only more elegant than no less than a hundred, but strictly more proper." - Baker 1770

Consensus: A substantial majority of panel members advocates retaining this distinction between less and fewer. The general consensus favors the traditional rule that fewer refers to countable things while less refers to things measured, though strong forces are pushing against it.

Examples:

"However fewer and fewer writers observe it, so the distinction is becoming less and less." -Vermont Royster

"...Dudek's car has fewer than 600 miles on the odometer." - Rick Reilly

"...has never gained fewer than 1,222 yards in a season." -Rick Telander

"The odometer showed less than ten thousand miles." - E.L. Doctoerow

"I was never in Europe for less than fourteen months at a time." - James Thurber

not very important history

CONJUNCTIVE ADVERBS

CONJUNCTIVE ADVERBS

Conjunctive adverbs are adverbs that are used to connect two phrases or clauses. They can be used after a semicolon to connect two independent clauses or after a period to introduce a new sentence.

accordingly	furthermore	moreover
also	hence	nevertheless
anyhow	however	otherwise
anyway (informal)	incidentally	still
besides	indeed	then
consequently	likewise	therefore

The above words become conjunctive adverbs when they join two phrases or clauses together, providing a connection.

ADVERB: Though the danger was great, the policy was nevertheless adopted.

CONJUNCTIVE ADVERB: The action proposed by the government meant risking military action; nevertheless, public opinion supported it.

Style

- Formal Writing: conjunctive adverbs with three or four syllables are usually used in sentences of length and complexity.
- Informal Writing: shorter adverbs are more appropriate. They are better used as transitional devices between sentences than to connect clauses within a sentence.

Position

- Place the conjunctive adverb according to the word, phrase, or clause you want to emphasize. Place it at the beginning to emphasize what follows; place it in the middle (refer to example below) to emphasize what was previously mentioned.

EXAMPLE: The action proposed by the government meant risking military action; public opinion, however, supported it.

Punctuation

- Whether a conjunctive adverb introduces or comes inside of the second independent clause of a compound sentence, the two independent clauses are separated by a semicolon. In either position, it is sometimes but not always set off by a comma or commas.

Examples (of however)

- Susie is only one of five admitted last night. Two of these, however, are on medical wards.
- The man himself, however, was not greatly put out by the experience.
- (mid-sentence, after a clause) As time passed, however, I slowly began to see the originality of the resistance you offered.
- (at end of sentence) Lanzmann's tone over-generalized, however.

Bibliography

- Burchfield, R. W. *The New Fowler's Modern English Usage*, 2000.
- Ebbitt, Wilma R. and Daved R. Ebbitt. *Index to English*, 1990.
- Garner, Bryan A. *A Dictionary of Modern American Usage*, 1998.
- Webster's Dictionary of English Usage.

PROXIMITY

“Group related items together.”

Ralph Roister Doister

(717) 555-1212

Mermaid Tavern

916 Bread Street

London, NM

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London, NM

(717) 555-1212

C R A P

Your Attitude is Your Life

Lessons from
raising three children
as a single mom

Robin Williams
October 9

Your Attitude is Your Life ▾

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Contrast

Repetition

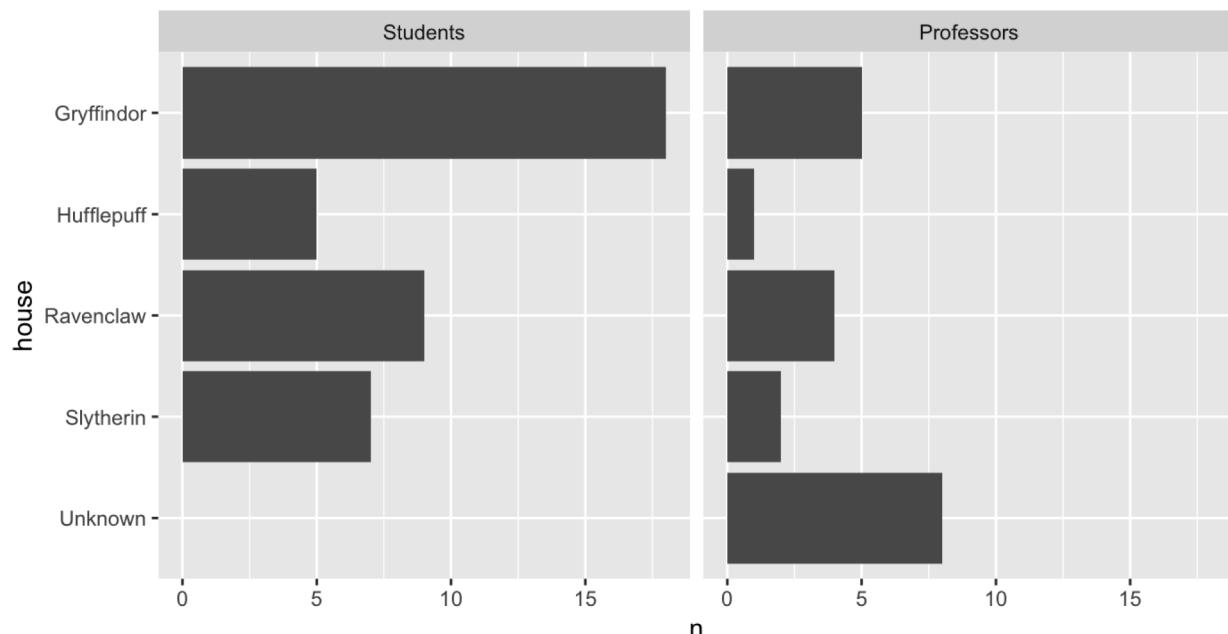
Alignment

Proximity

CRAP AND DATAVIZ

Gryffindor and Ravenclaw dominate Hogwarts

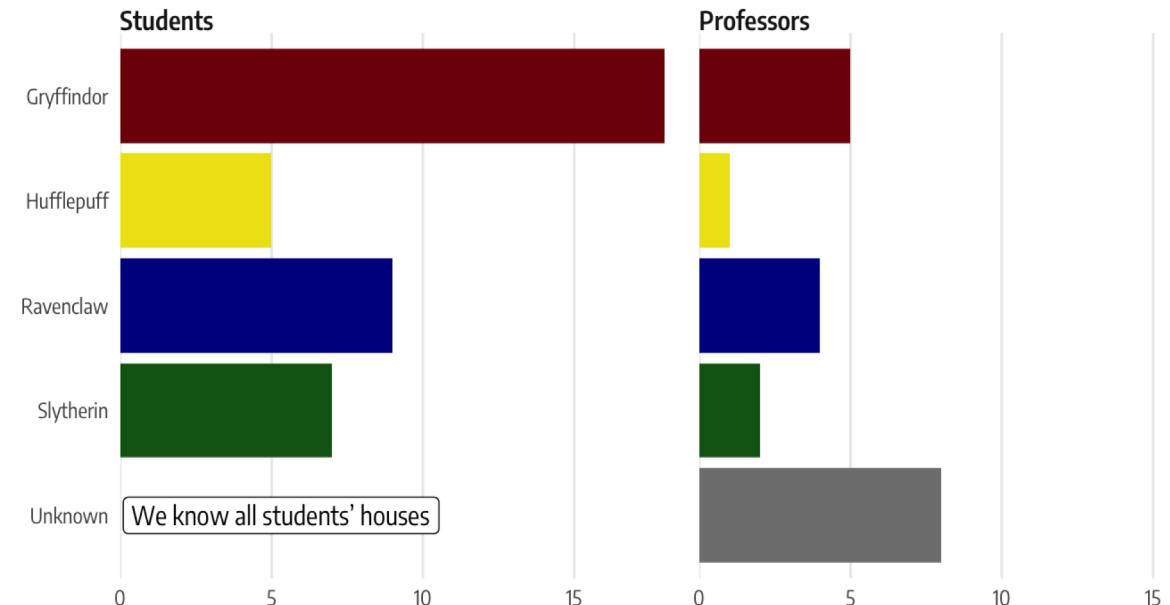
At least according to JK Rowling, whose account is clearly biased



Source: potterapi.com

Gryffindor and Ravenclaw dominate Hogwarts

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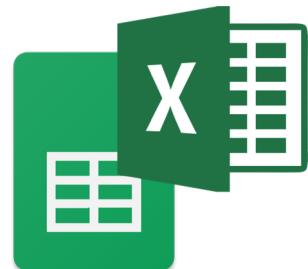


Source: potterapi.com

HOW DO I
DO ALL THIS?

SOFTWARE

Flexibility
and
power



Barrier to entry (amount of coding required)

INTRO TO DATA VISUALIZATION

Andrew Heiss, PhD
Brigham Young University
September 19, 2018
@andrewheiss