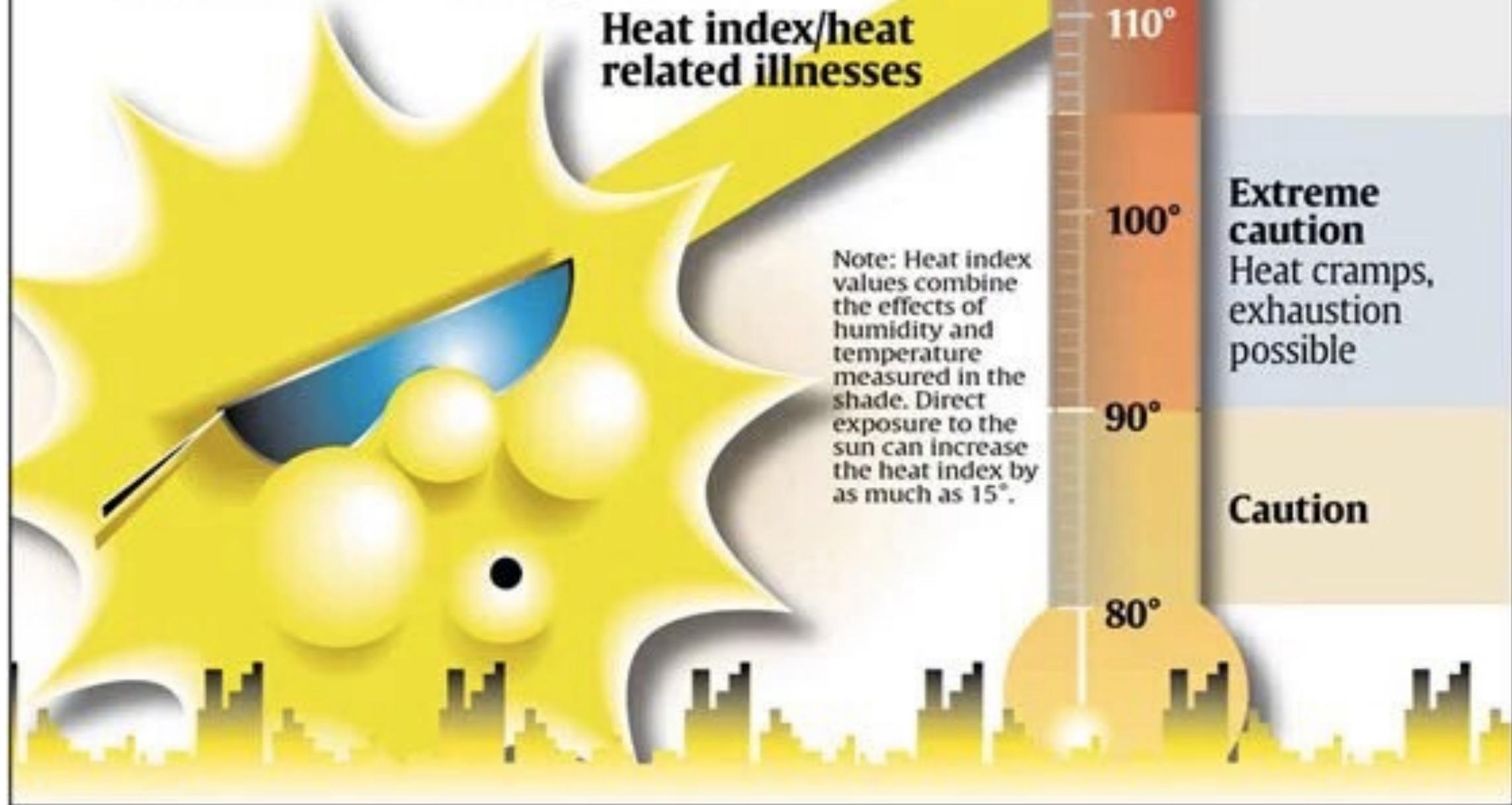
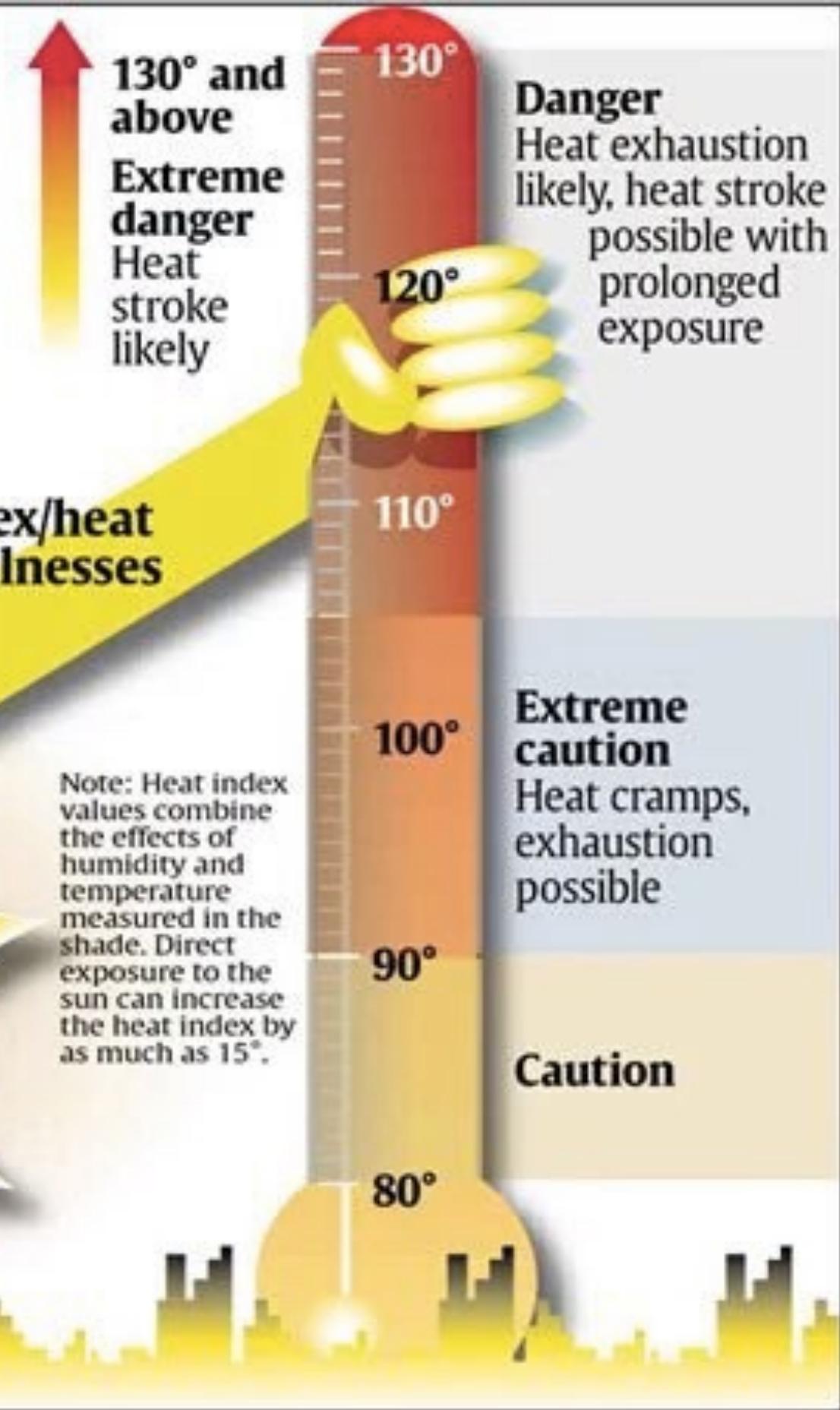


Excessive heat can take a toll

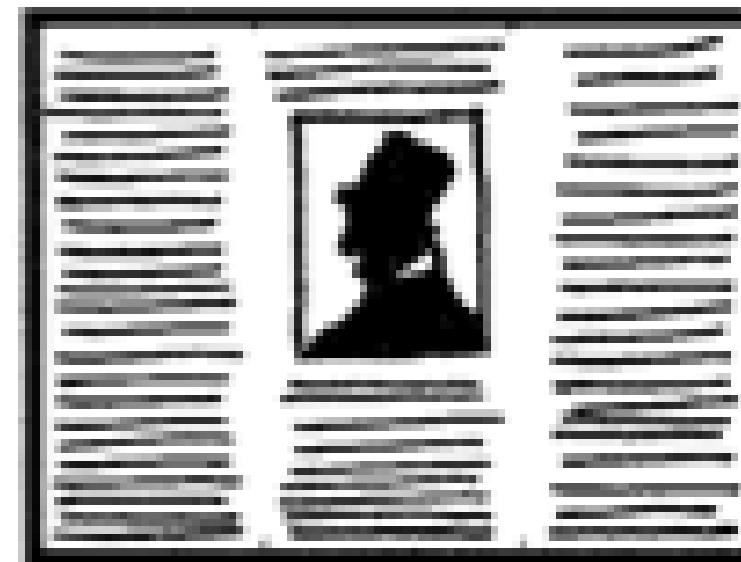
Summer heat will continue to sizzle across the southern USA today and through the weekend. Temperatures will soar into the upper 90s to above 100 degrees in many spots. During these dog days of summer, make sure animals have shade and adequate water. Pets should not be left in parked cars.

Heat index/heat related illnesses

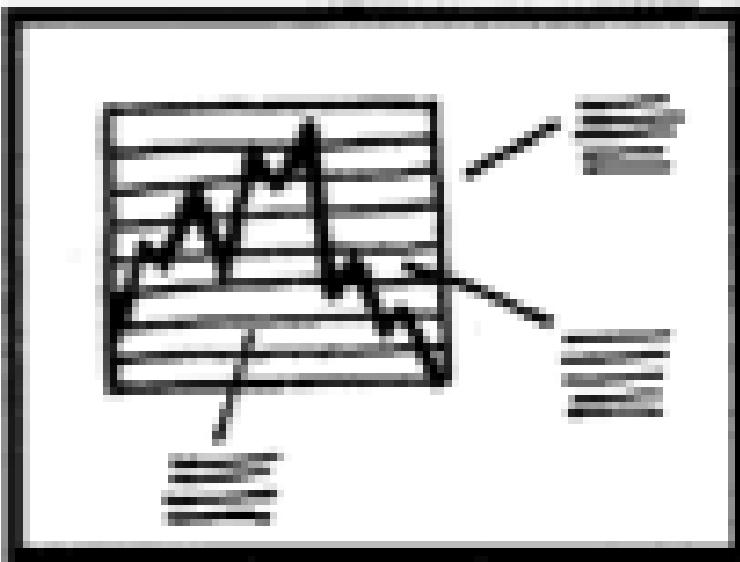


Narrative
Techniques

Seven Genres



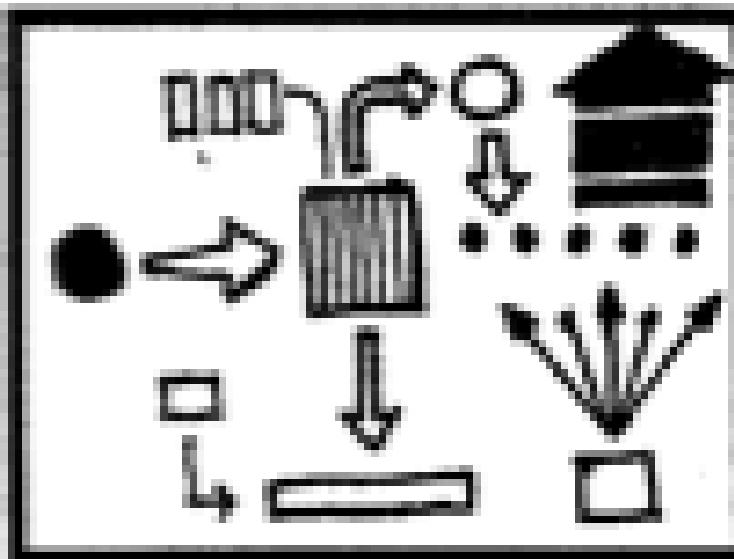
Magazine Style



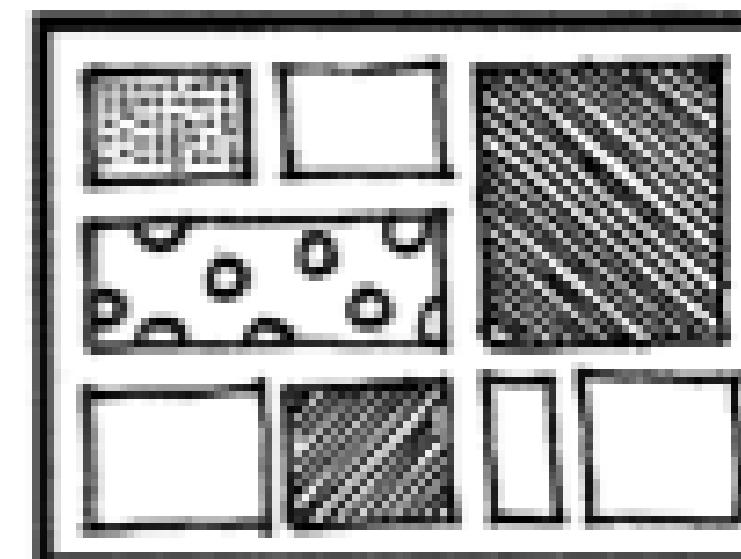
Annotated Chart



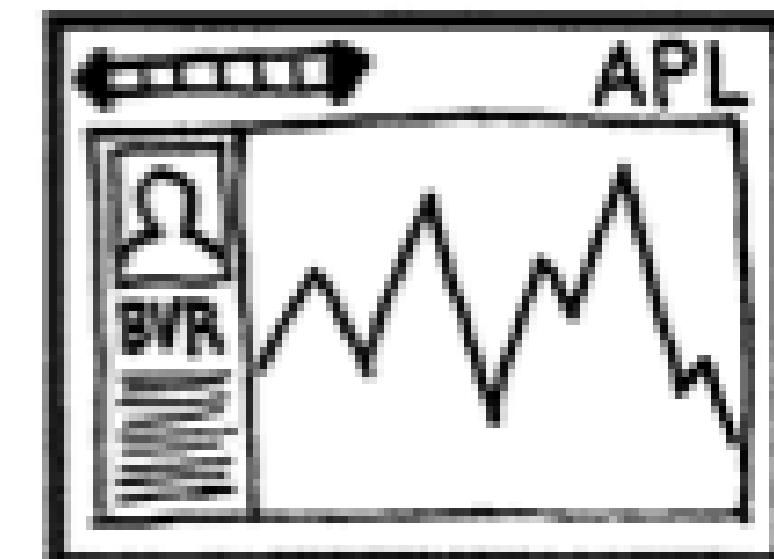
Partitioned Poster



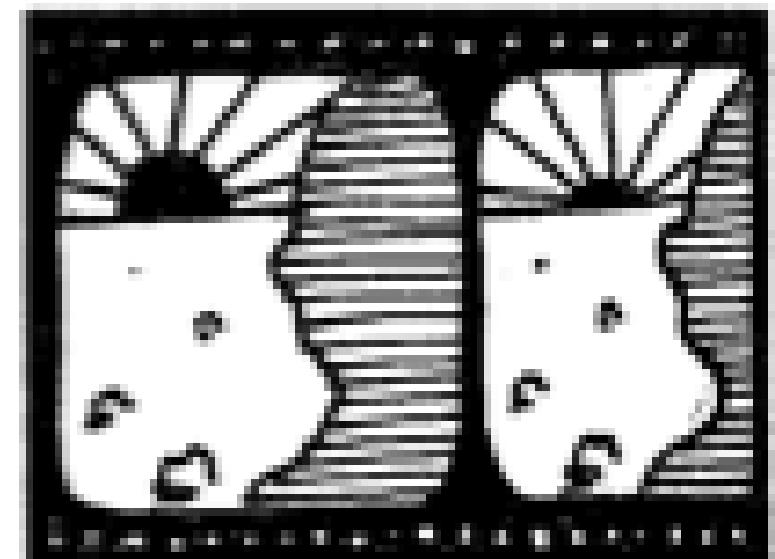
Flow Chart



Comic Strip



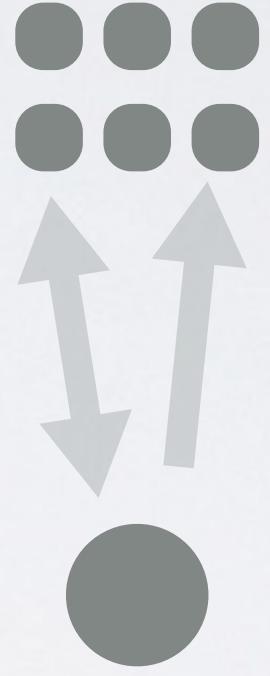
Slide Show



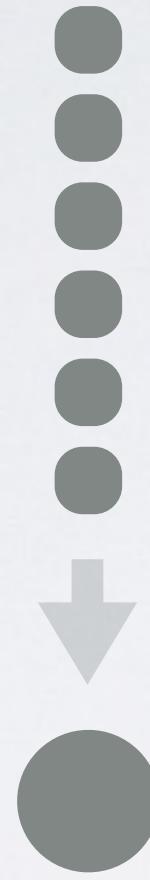
Film/Video/Animation



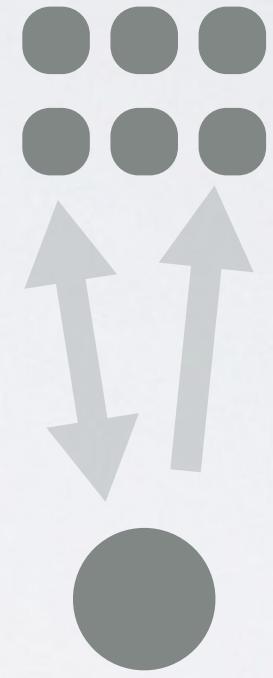
**Author
control**



**Reader
control**

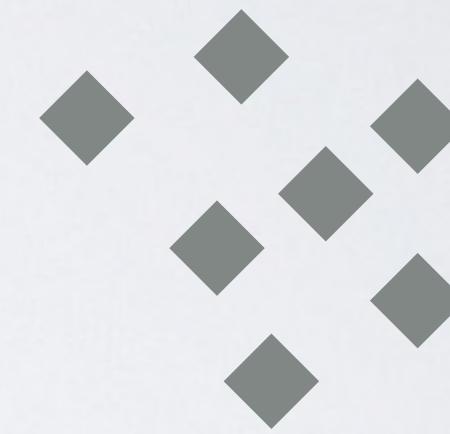
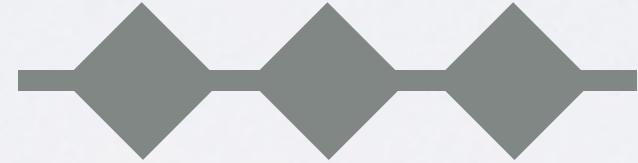
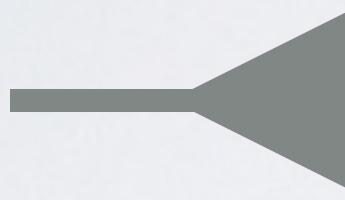


Explicative



Exploratory

Hybrid narrative arcs



How to tell a (data) story in 5 easy steps

How to tell a (data) story

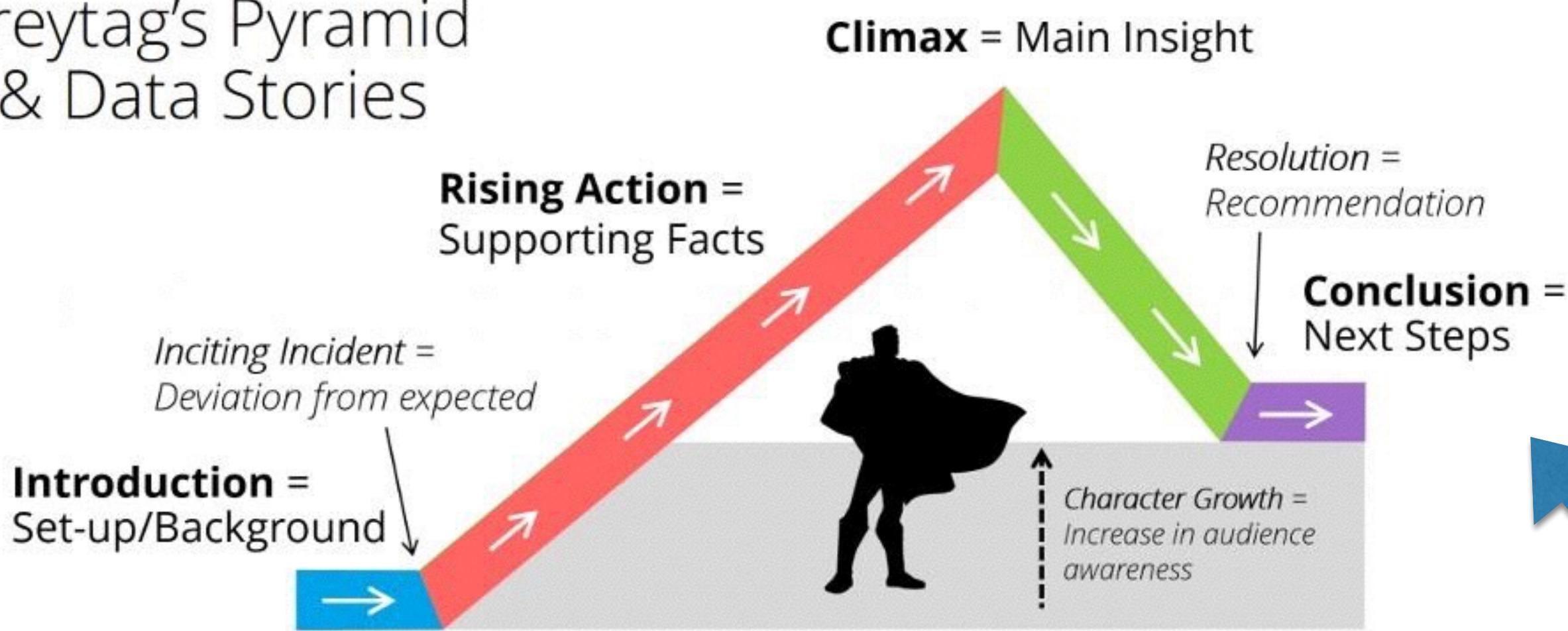
1. Decide what is the story about
2. Delineate the story arc
3. Prioritise and filter
4. Make your charts tell the story points
5. Design a visual hierarchy

I. Decide what is the story about

It's never about the data!

2. Delineate the story arc (e.g. beginning, middle, and end)

Freytag's Pyramid & Data Stories



Think about
the audience

3. Prioritise and filter

List all your points

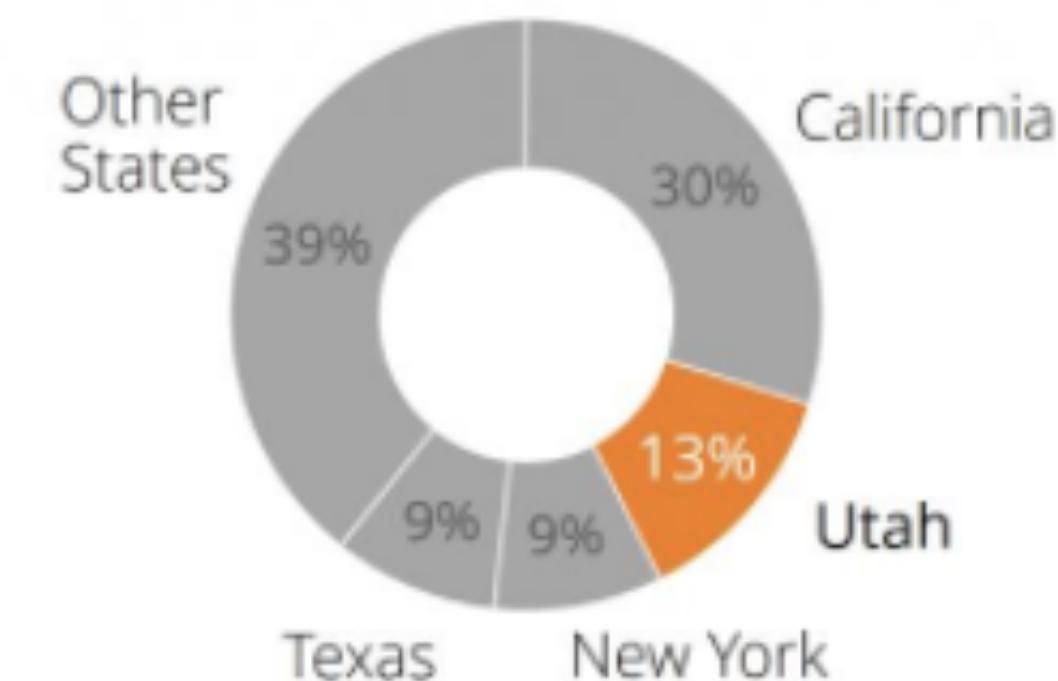
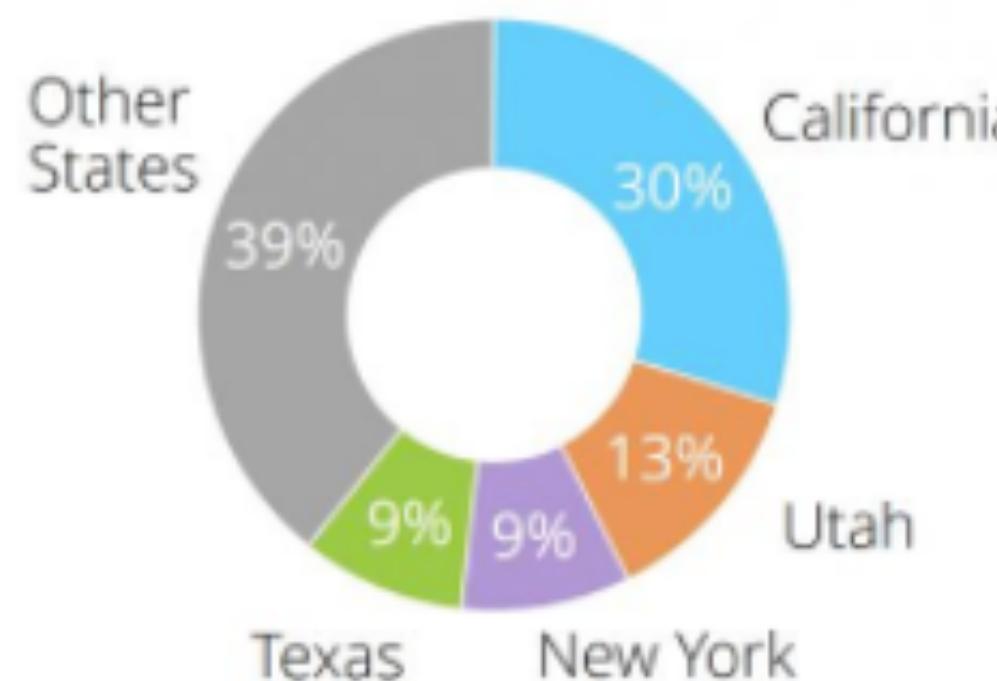
Separate main from supporting/alternate ones

Through away the rest

Highlight relevant info

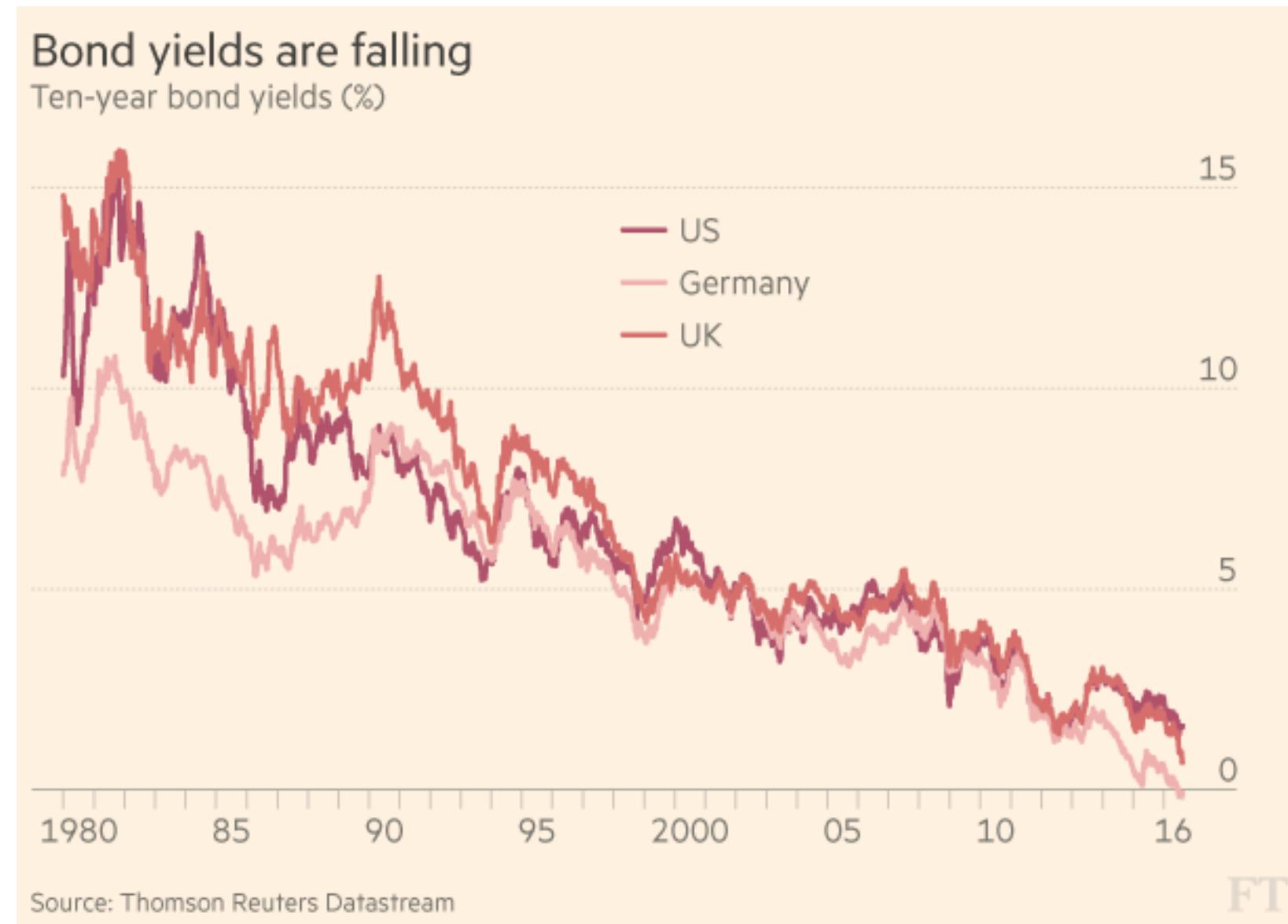
Subdue accessory

Add context



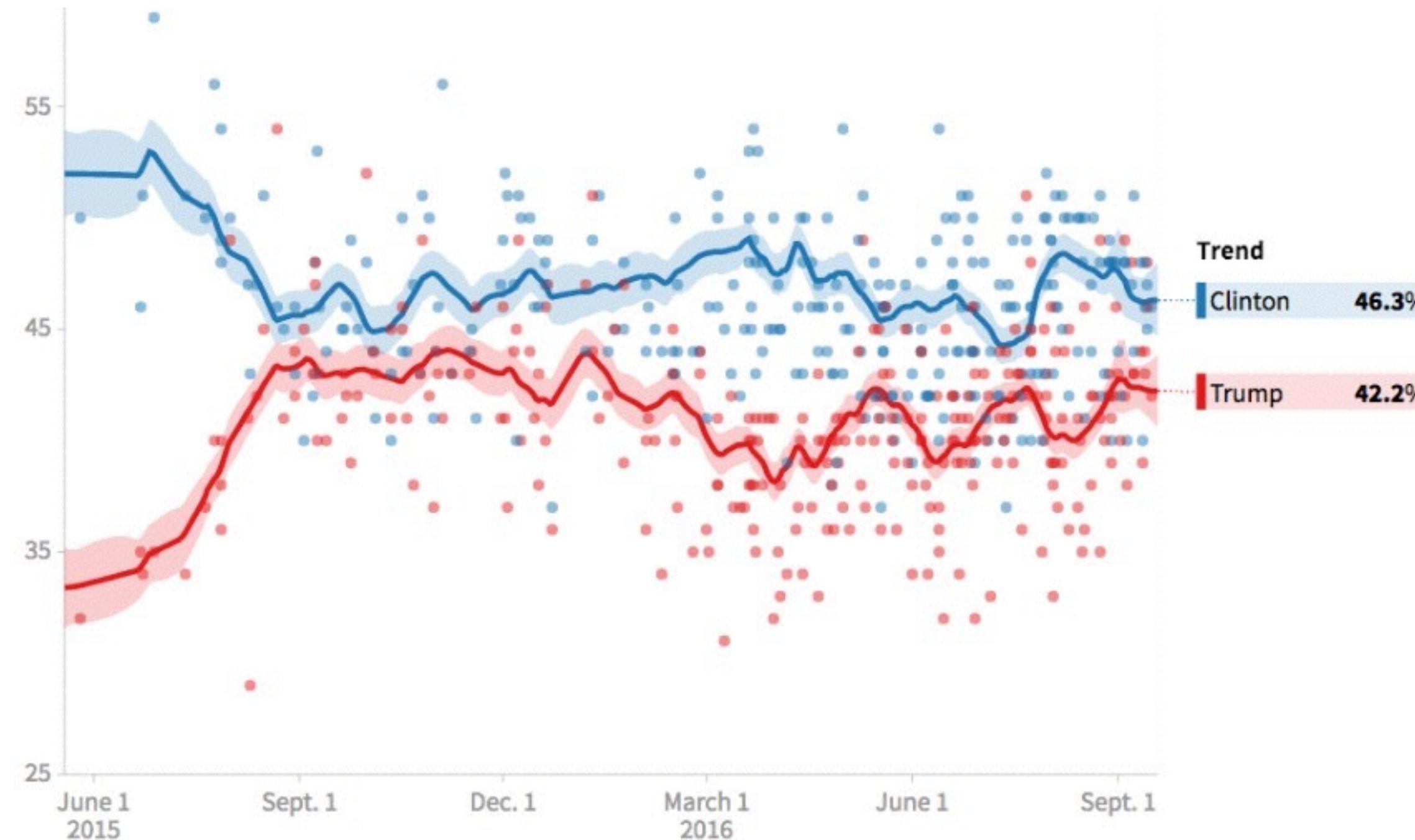
4. Make your charts tell the story points

4. Make your charts tell the story points



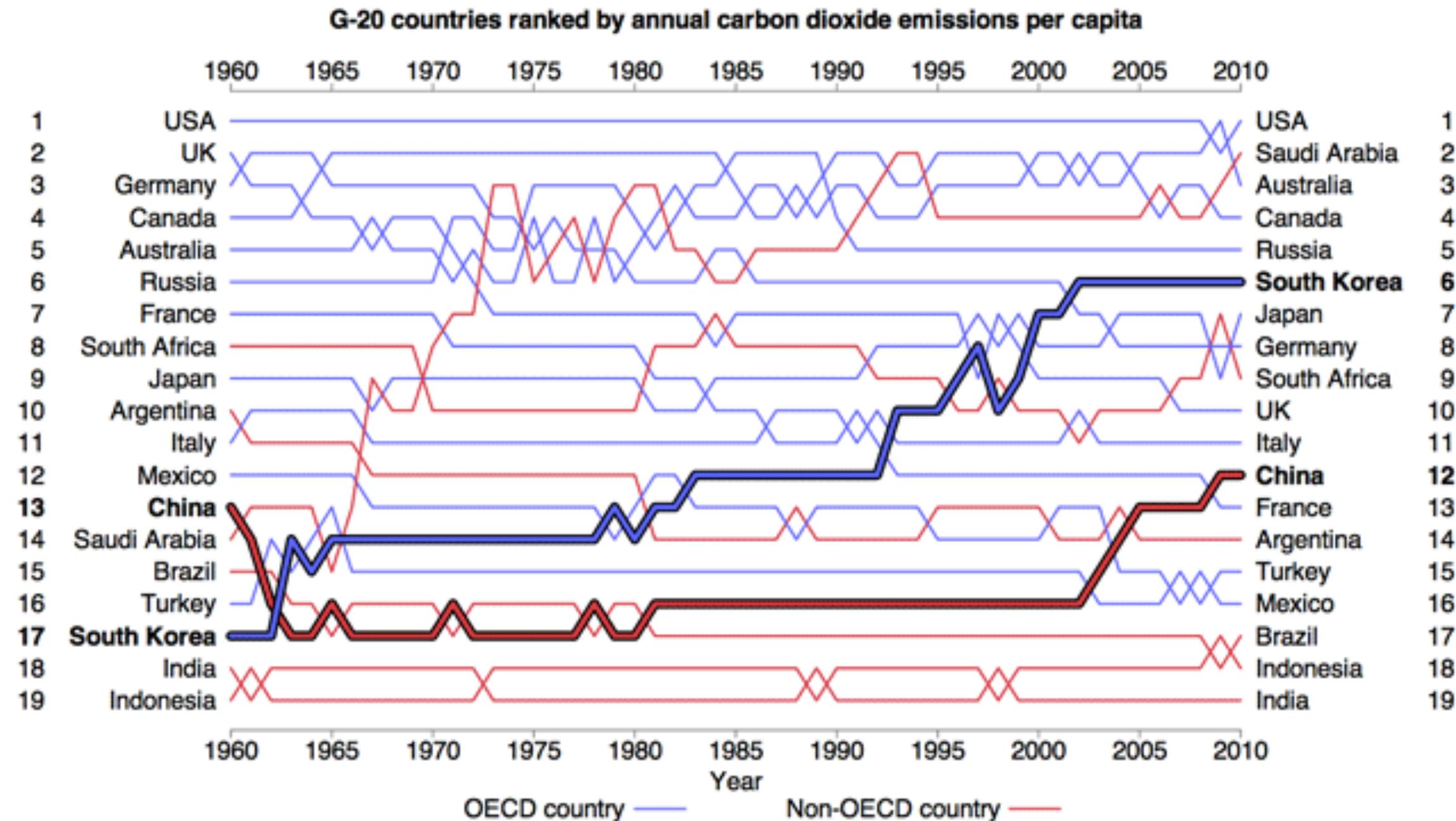
Trends

4. Make your charts tell the story points



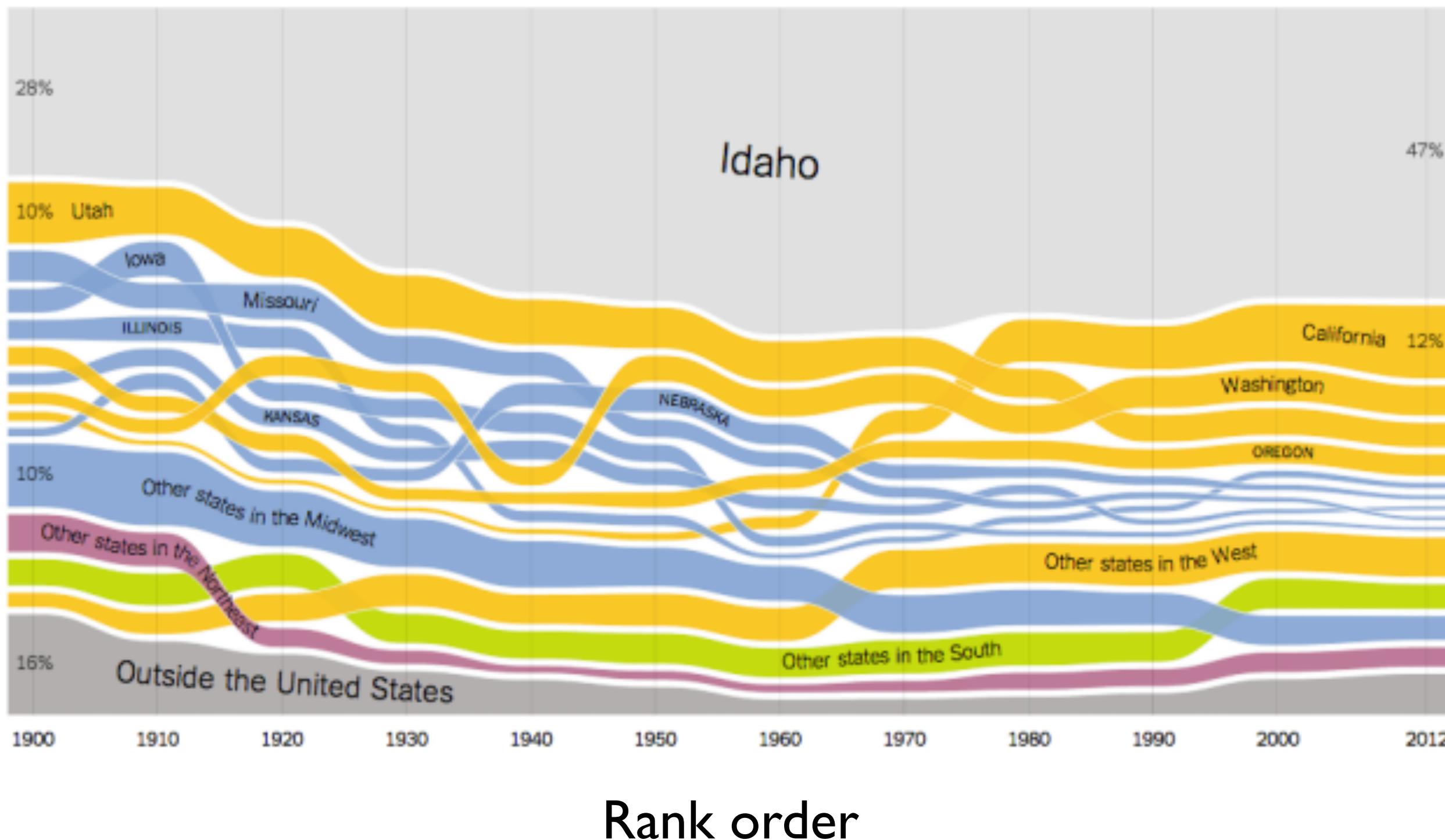
Comparisons

4. Make your charts tell the story points

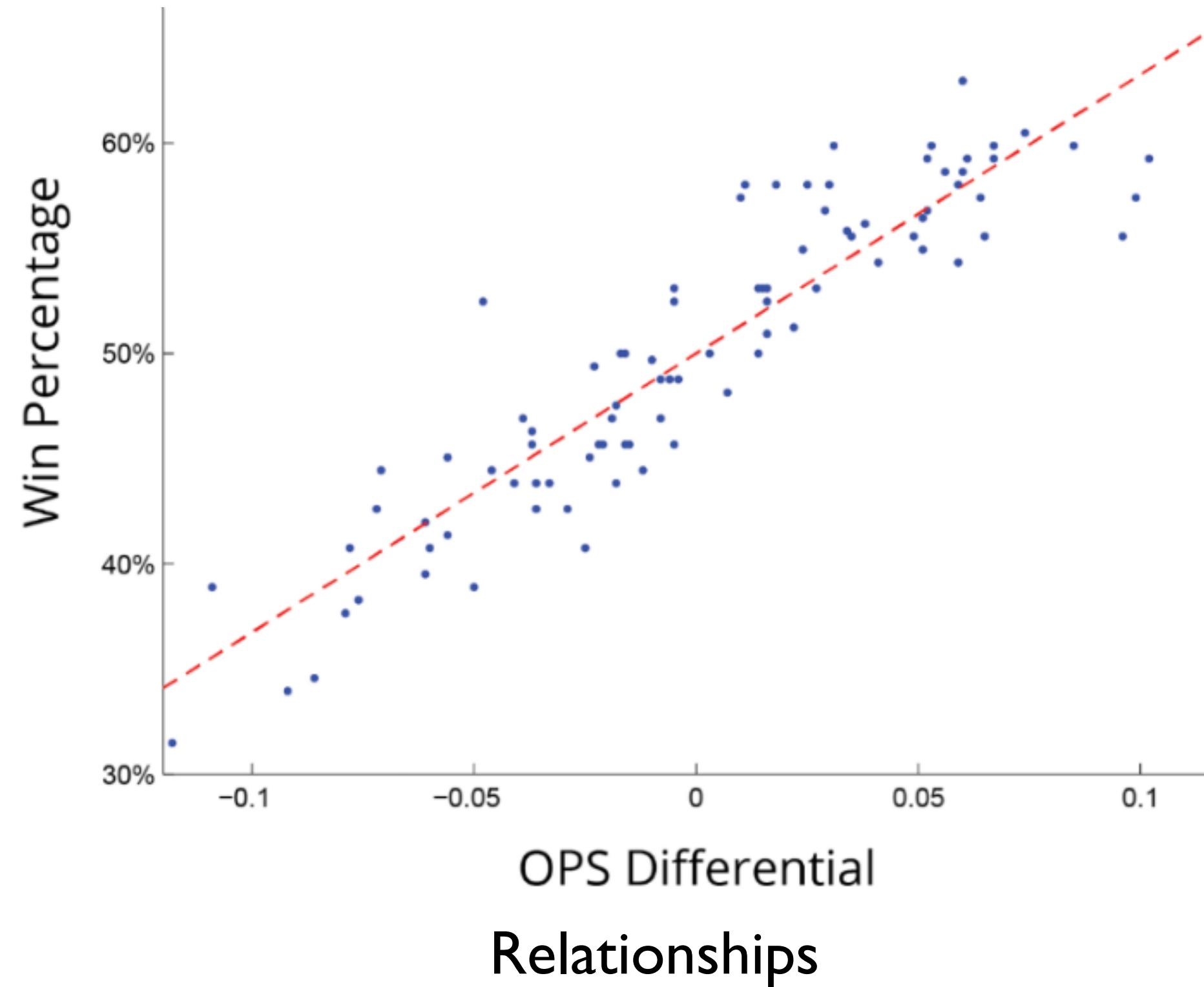


Rank order

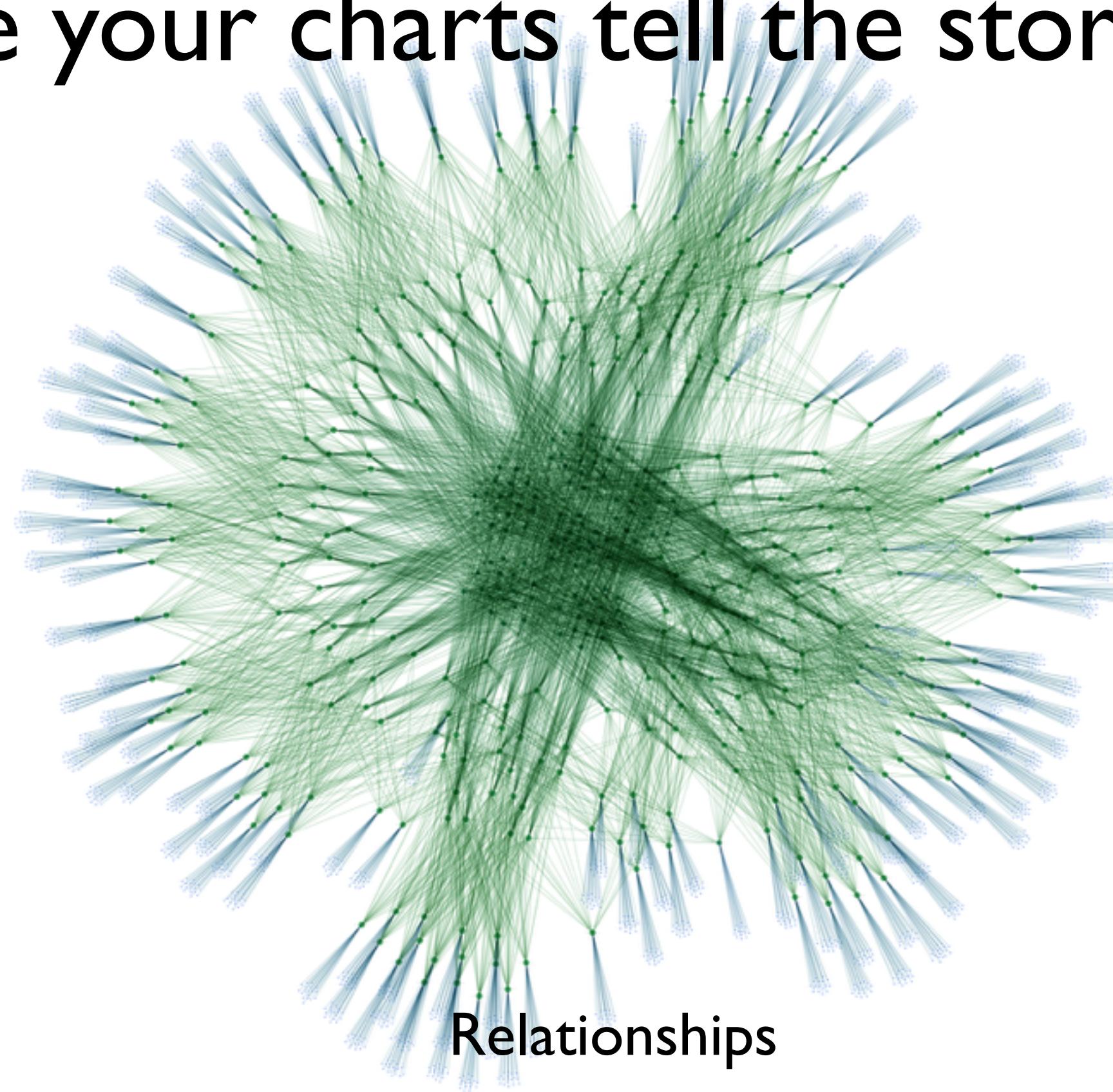
4. Make your charts tell the story points



4. Make your charts tell the story points



4. Make your charts tell the story points



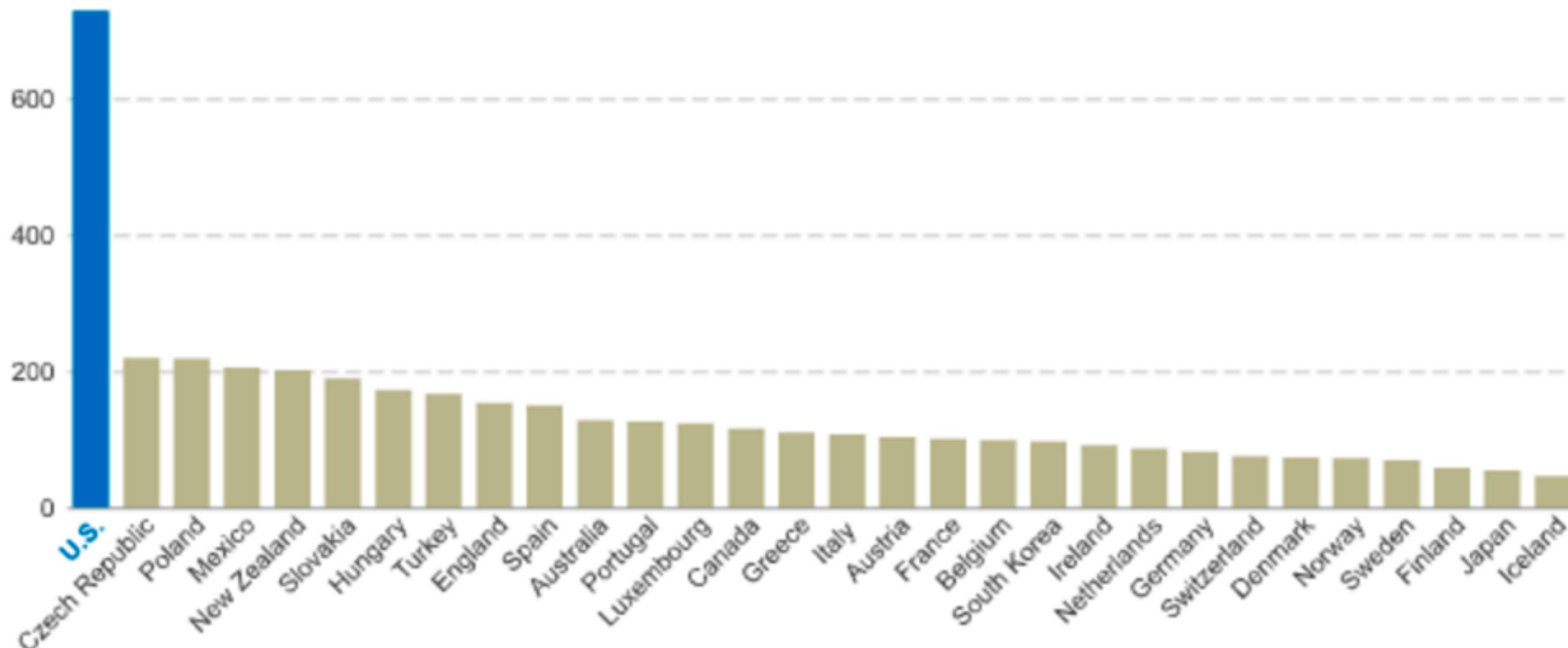
4. Make your charts tell the story points

The U.S. has the highest incarceration rate of any country in the world, imprisoning about 730 out of every 100,000 citizens.

Incarceration Rates for Countries in the OECD

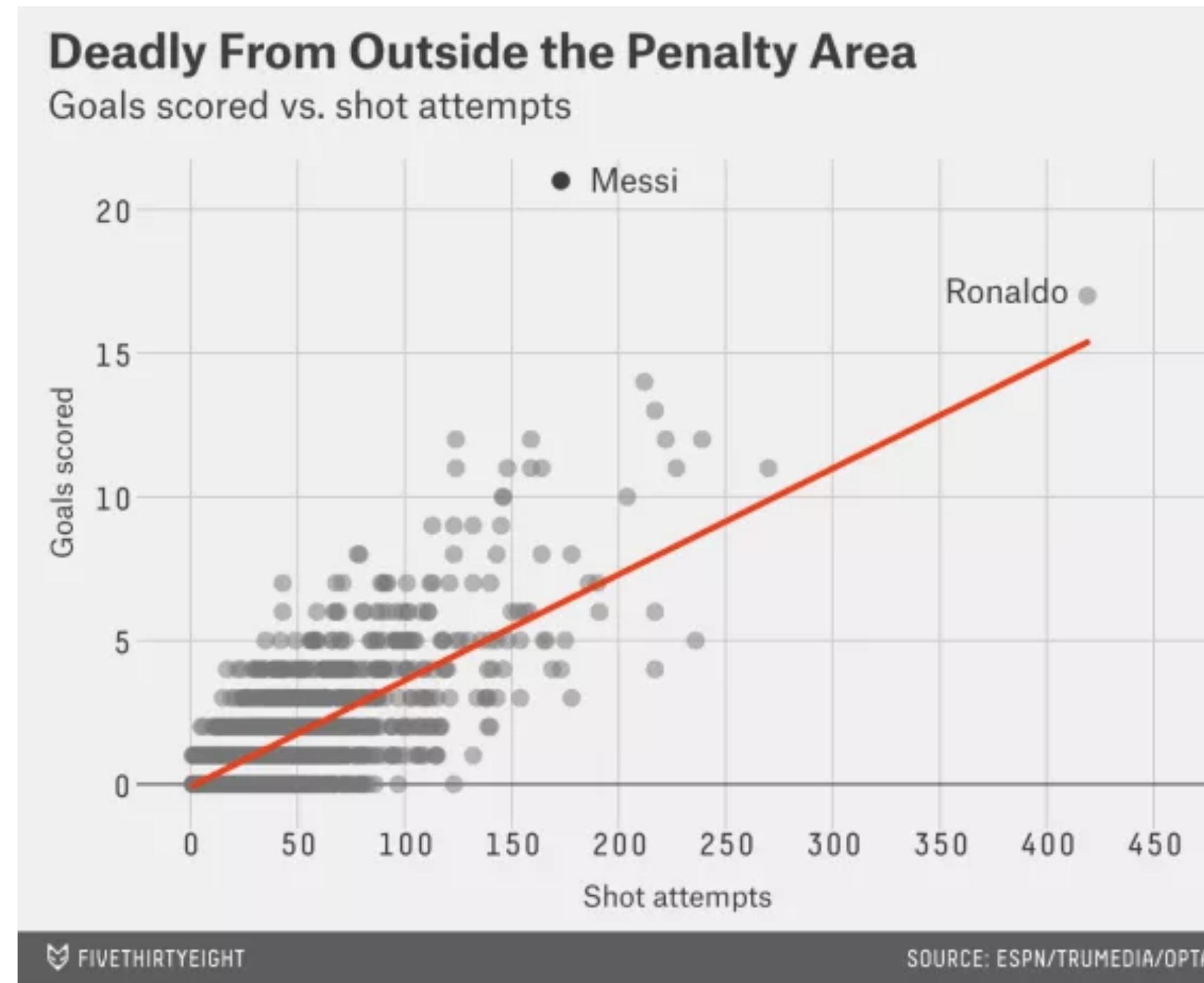
800 prisoners per every 100,000 citizens

Source: International Centre for Prison Studies



Outliers/Trend breaks

4. Make your charts tell the story points



Outliers/Trend breaks

5. Design a visual hierarchy

You have to answer:

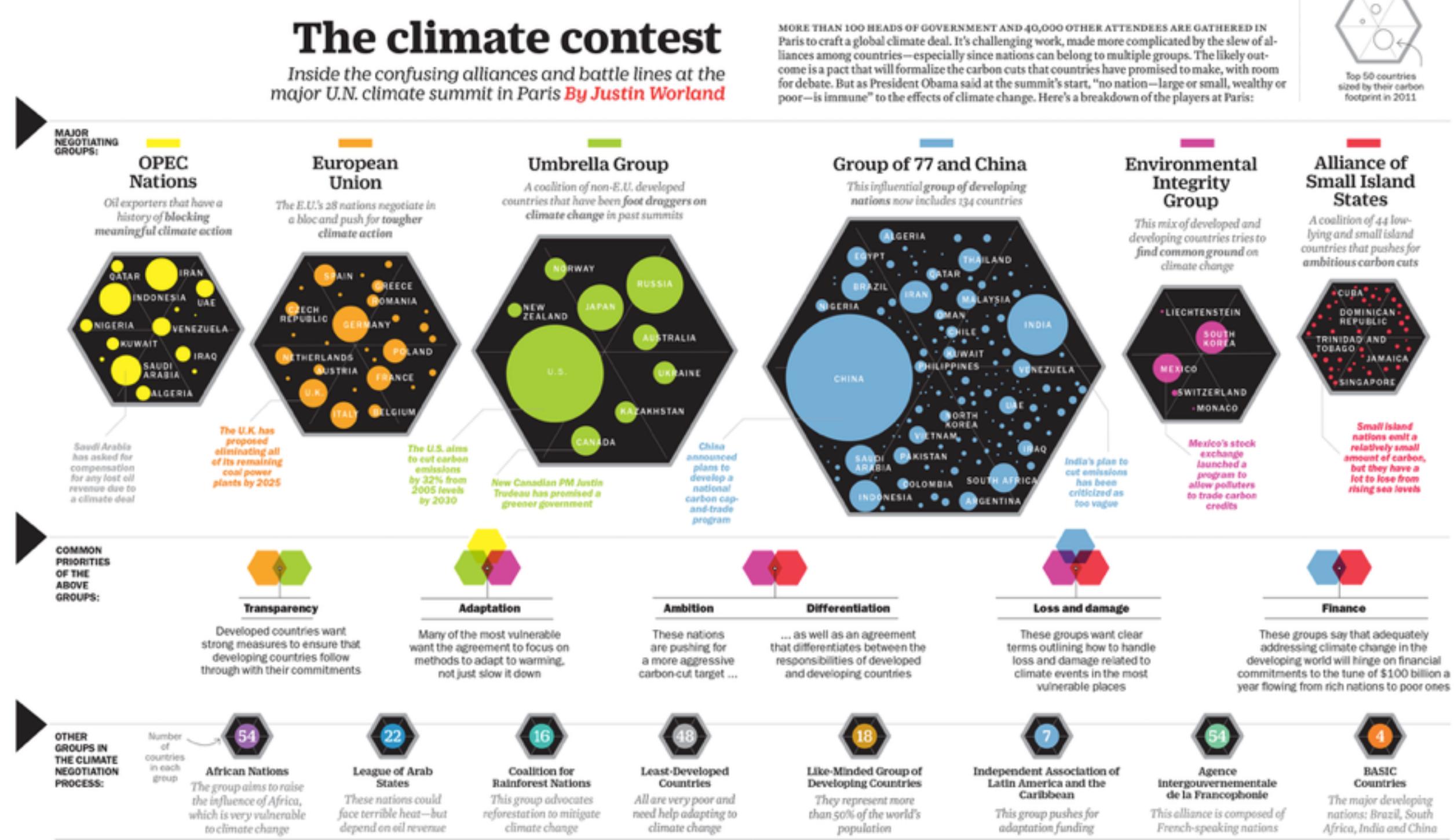
- Is what I'm looking for on this page?
- Where is it?
- How do I complete my task?



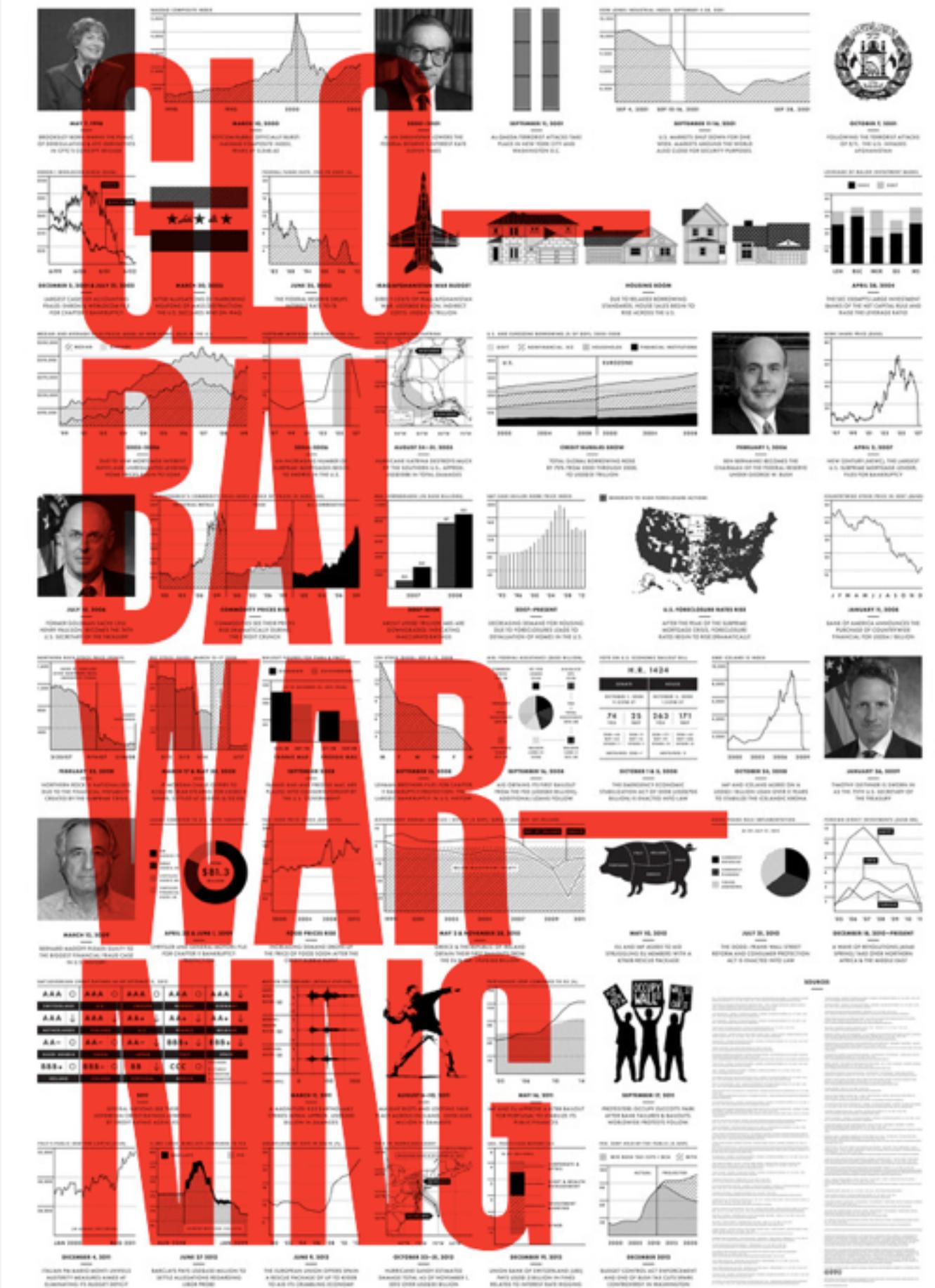
Visual importance can't be applied
to too many design elements,
or else everything becomes equal.

The 5 pillars of visual hierarchy

I. Size: Bigger is more noticeable (but not always better)



2. Color



2. Color

CREATIVE ROUTINES

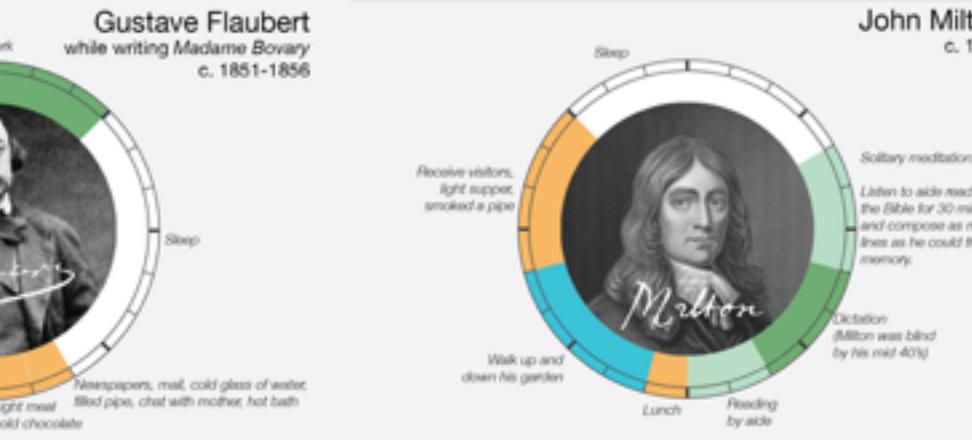
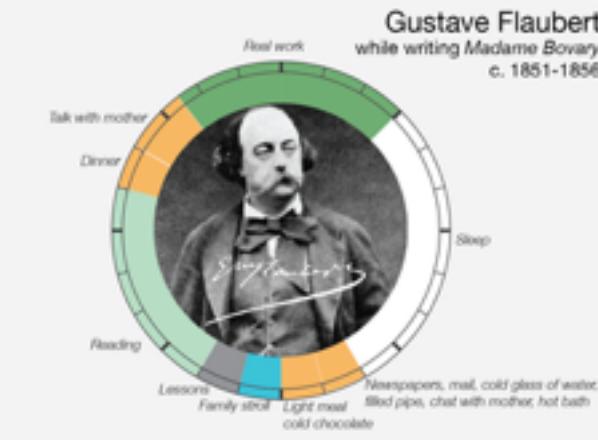
"In the right hands, it can be a finely calibrated mechanism for taking advantage of limited resources... a solid routine fosters a well-worn groove for one's mental energies...." -Mason Currey, author of the inspiring book, DAILY RITUALS



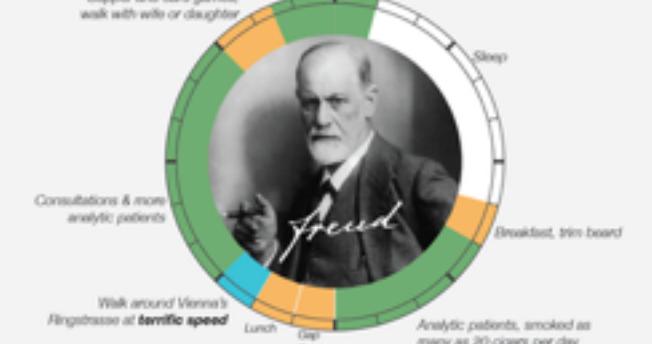
Ludwig van Beethoven
c. 1822-1827



Wolfgang Amadeus Mozart
Vienna, c. 1781



Sigmund Freud
c. 1910



Immanuel Kant
c. 1764-1804



Maya Angelou
c. 1983



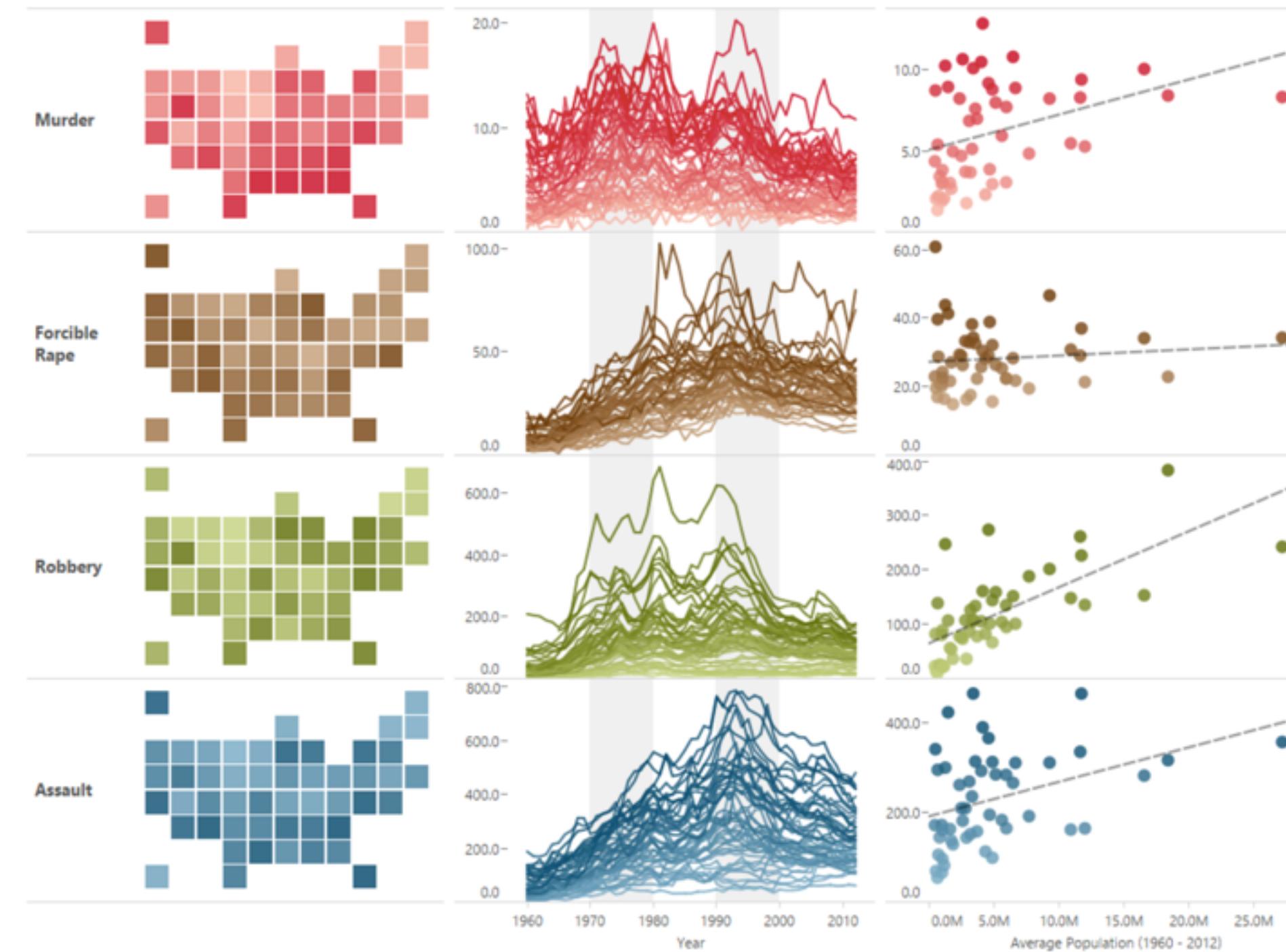
Pyotr Ilyich Tchaikovsky
c. 1885-1893



Le Corbusier



3. Layout

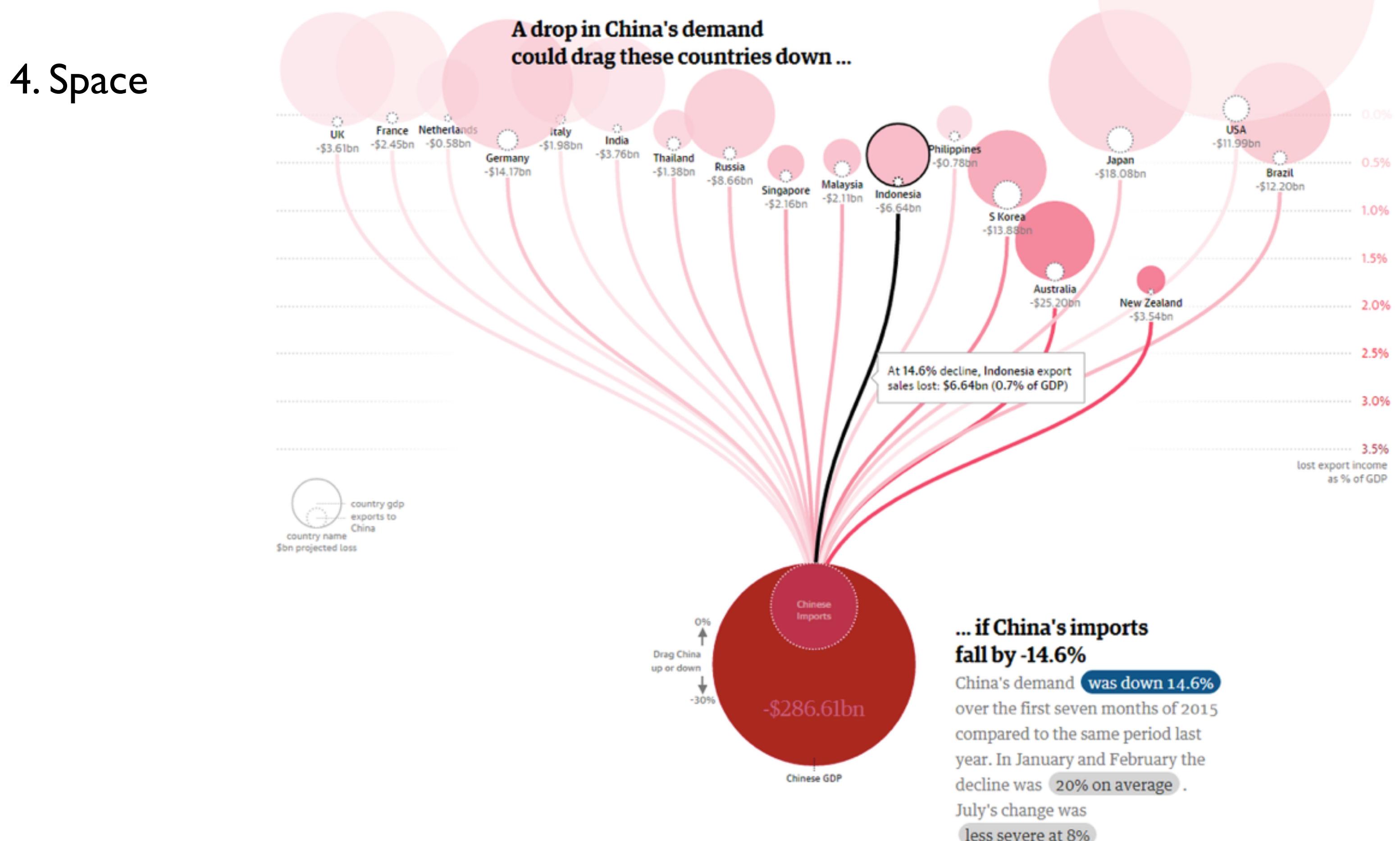


Repetition attaches meaning to new elements: they are at the same level in the hierarchy
Alignment creates order. It allows you to quickly connect elements across the page
A single element that breaks the established alignment calls attention to itself and its importance

4. Space

- * Gestalt (Proximity groups elements within a hierarchy and creates new sub hierarchies)
- * Negative space: the less elements you have, the more potent. Also positive space weighs more than negative space

4. Space



4. Space

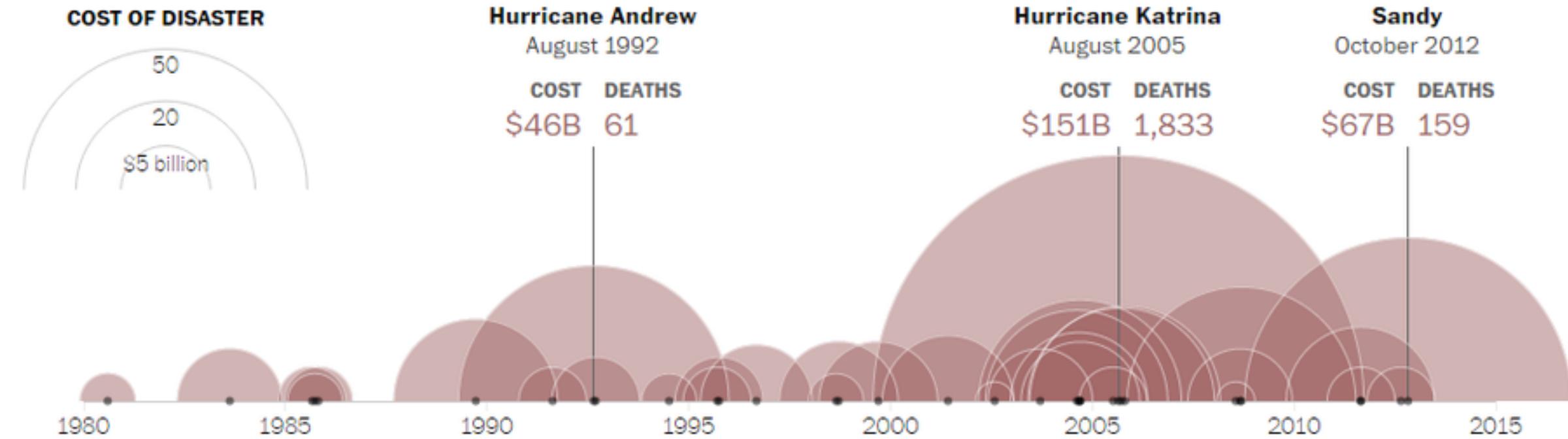


5. Style



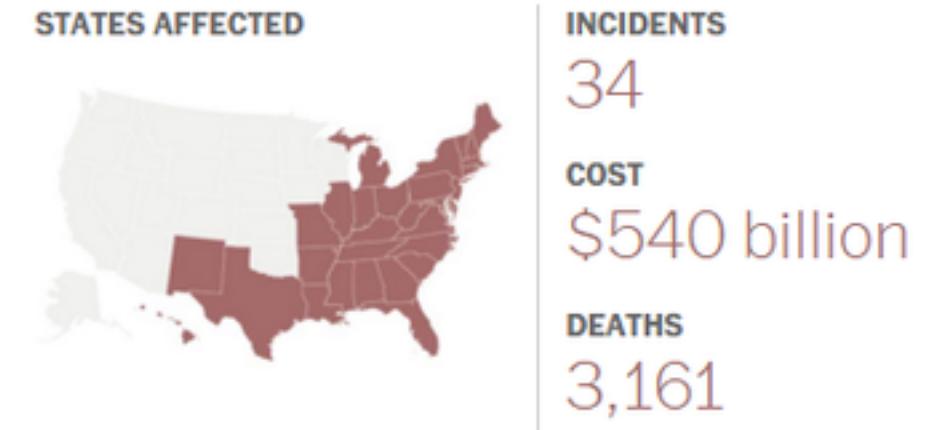
Recommendation: keep no more than 3 levels of typographic hierarchy
Value – A darker object will have more weight than a lighter object

5. Style



Hurricanes

The most expensive and deadly type of climate disaster, tropical storms occur mostly in the Eastern Shore and states along the Gulf. Katrina initially made landfall in Florida as a Category 1 hurricane in 2005, evolving to a Category 3 as it moved through the Gulf Coast and caused devastating effects in New Orleans. In 2012, Hurricane Sandy rocked New York City and much of the Northeast as it merged with a developing Nor'easter, causing major network breakdowns and the New York Stock Exchange to close for two business days.



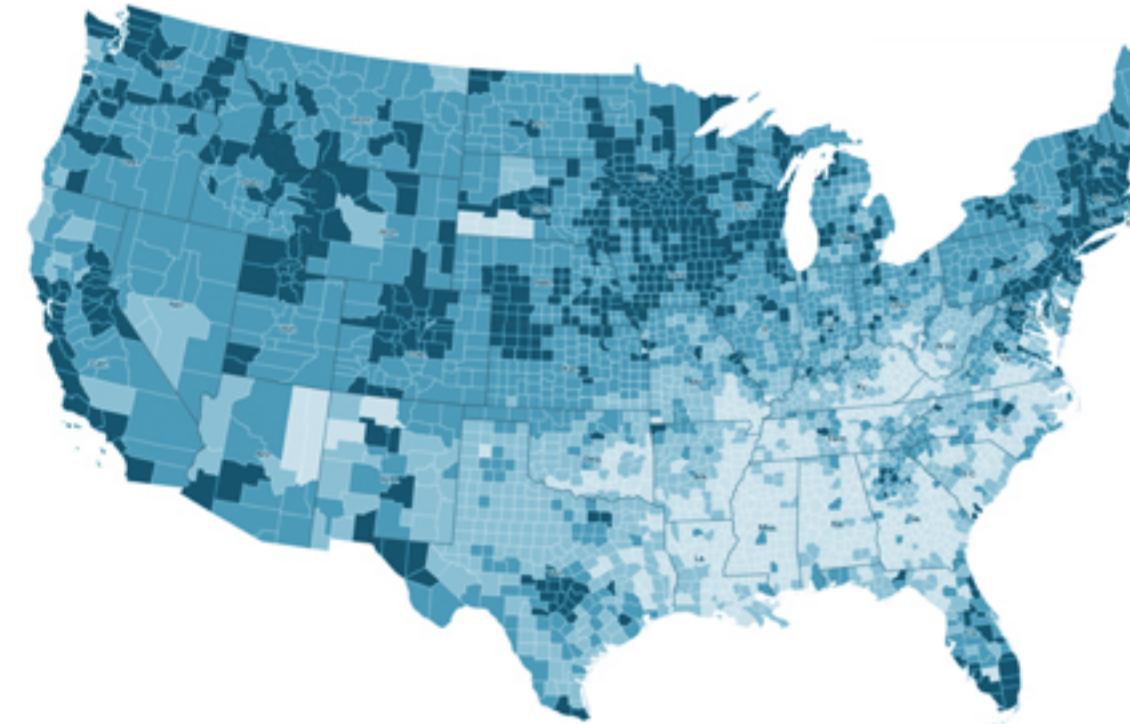
Recommendation: keep no more than 3 levels of typographic hierarchy
Value –A darker object will have more weight than a lighter object

Life Expectancy in the US

Comparing life expectancy across our nation and the State of Virginia

Created by Boost Labs using US Census Bureau Data available as of June, 2001

US Male Life Expectancy by County



Legend

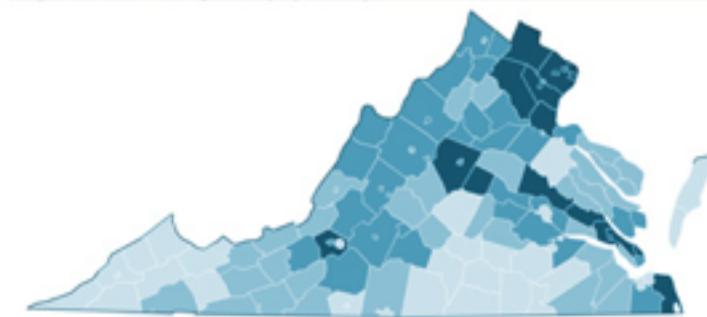
Male Life Expectancy

- 70–72 yrs
- 72–74 yrs
- 74–76 yrs
- 76–78 yrs

Female Life Expectancy

- 70–72 yrs
- 72–80 yrs
- 80–82 yrs
- 82–84 yrs

Virginia Male Life Expectancy by County



US Quick Stats

US Average Life Expectancy in Years

78.7

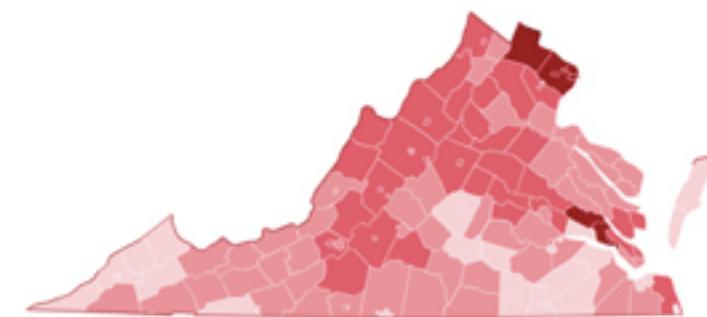
Males

75.9

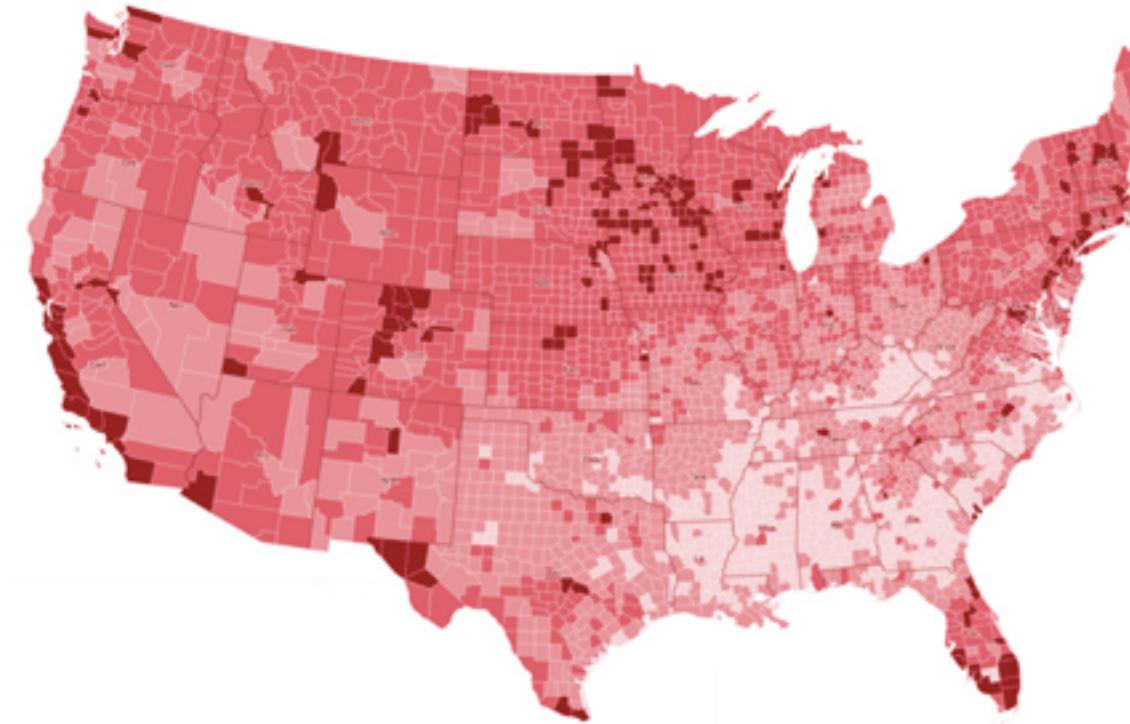
Females

81.1

Virginia Female Life Expectancy by County



US Male Life Expectancy by County



Virginia Quick Stats

US Average Life Expectancy in Years

78.6

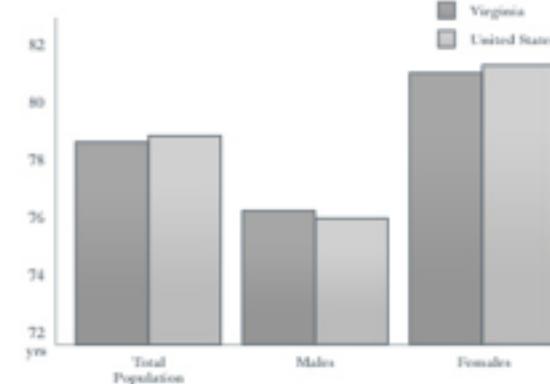
Males

76.1

Females

80.9

Estimated Life Expectancy at Birth by Gender



US Population Stats

US Total Population

308,745,538

Female persons

50.7%

White persons

72.4%

Persons under 18 years old

24.3%

Persons 65 years old and over

12.9%

Virginia Population Stats

Virginia Total Population

8,001,024

Female persons

50.8%

White persons

68.6%

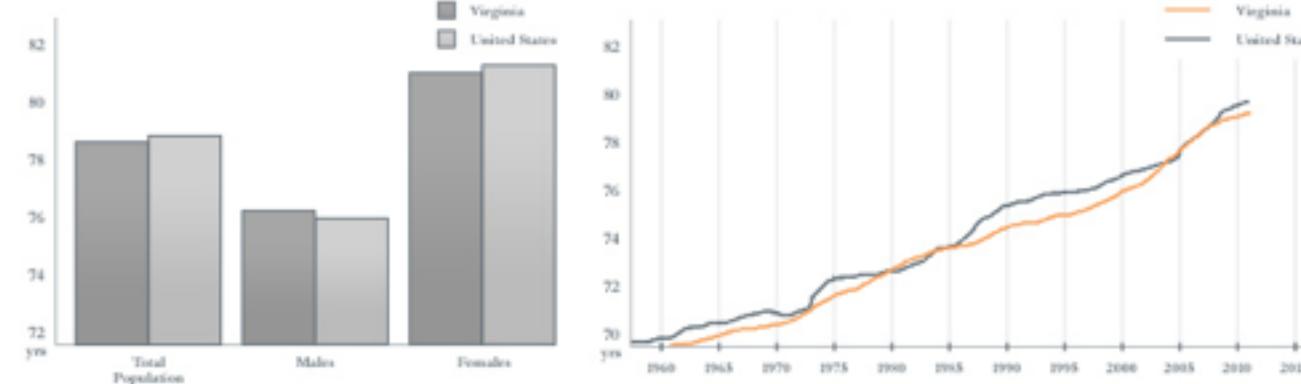
Persons under 18 years old

23.4%

Persons 65 years old and over

12.2%

Estimated Life Expectancy at Birth by Year



6. Visual Flow

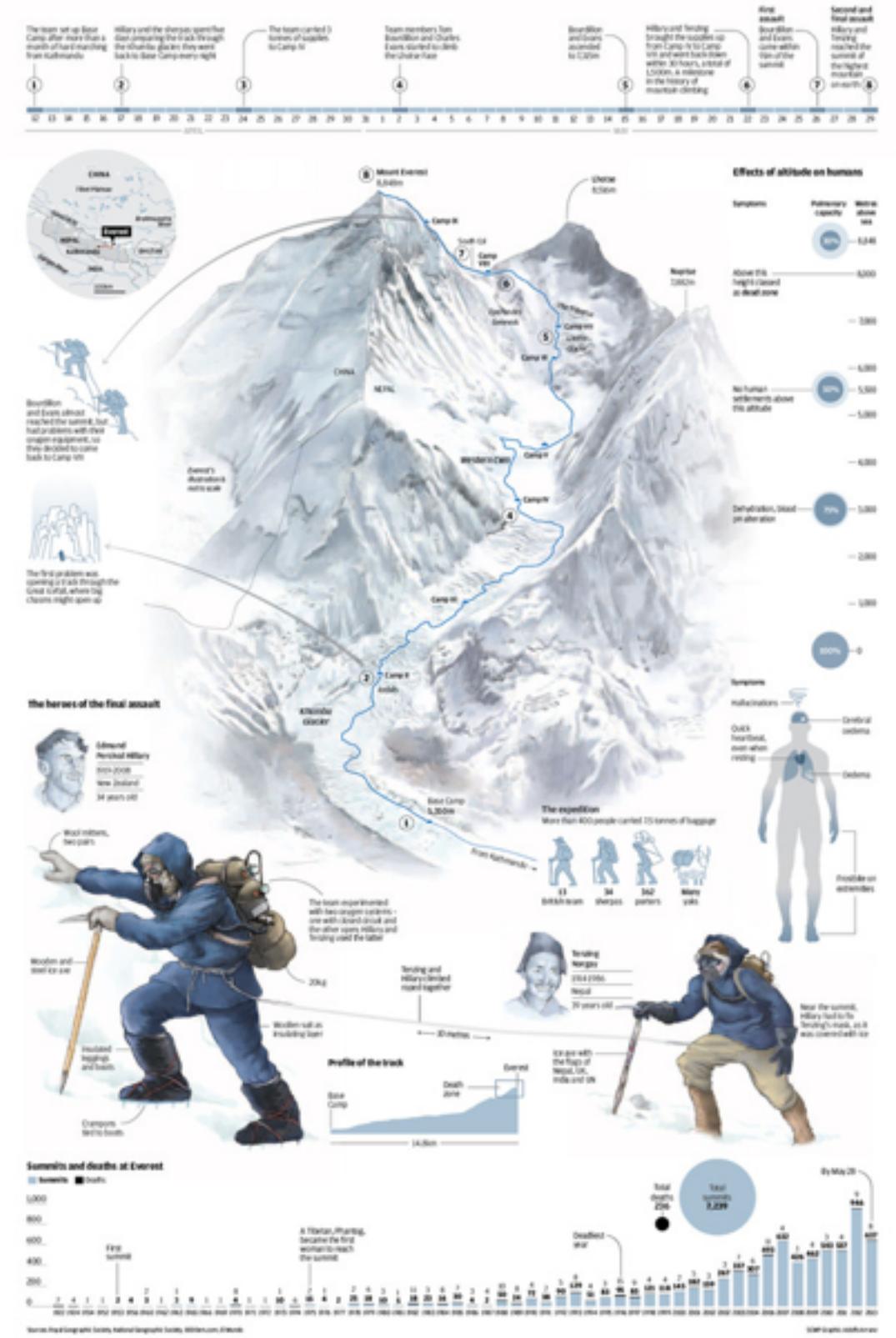
Create flow with any of the previous elements, and also with eyes, hands, lines, triangles, and subtle or explicit arrows

6. Visual Flow

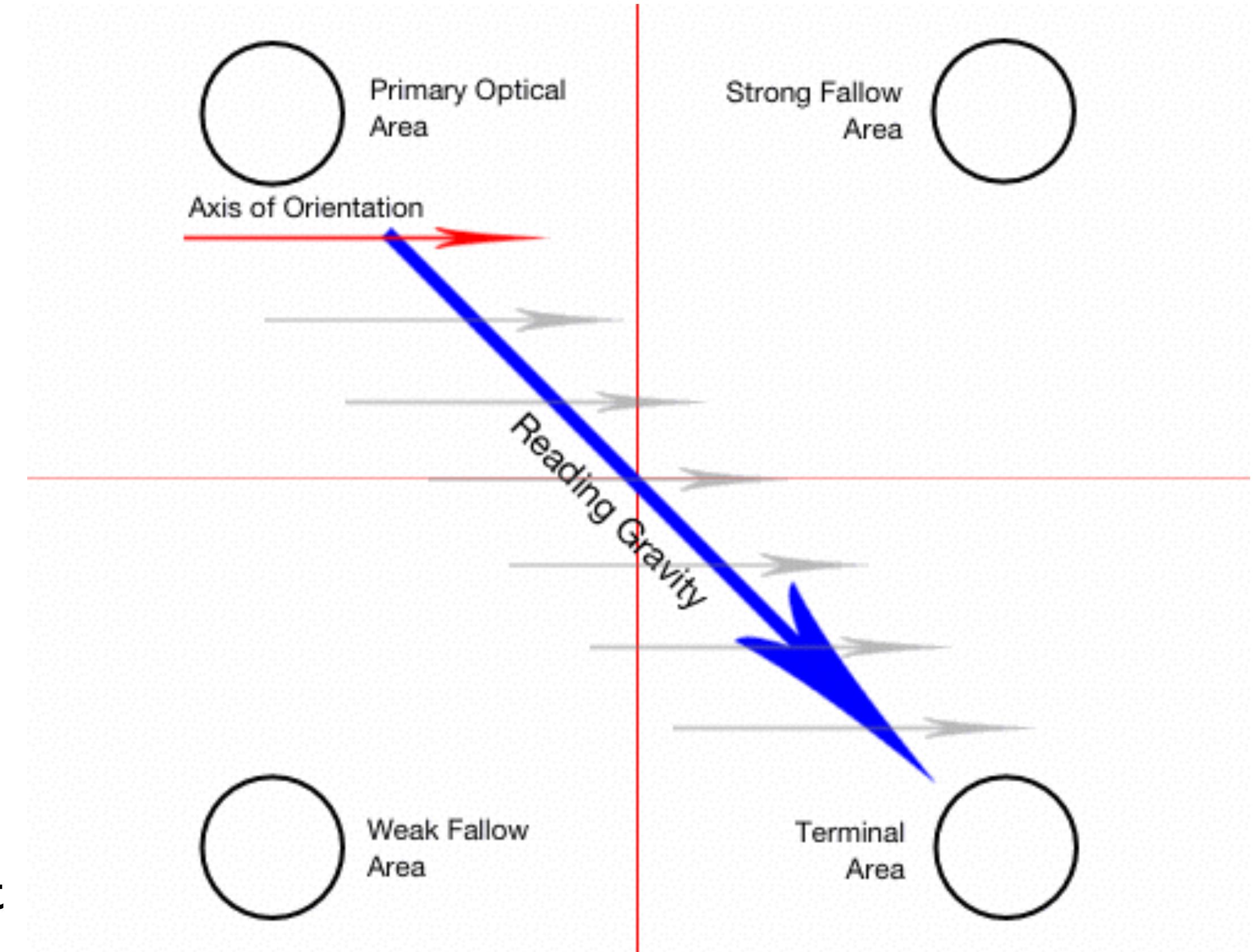
Mount Everest

Sixty years ago, Edmund Hillary and Tenzing Norgay became the first climbers to reach the summit of Mount Everest, known as Qomolangma in China and Chomolungma in Tibet. Their bravery and resilience set an example for many other adventurers in the following decades.

The challenge of scaling Everest still attracts thousands of people from all walks of life who want to push themselves to the limit.



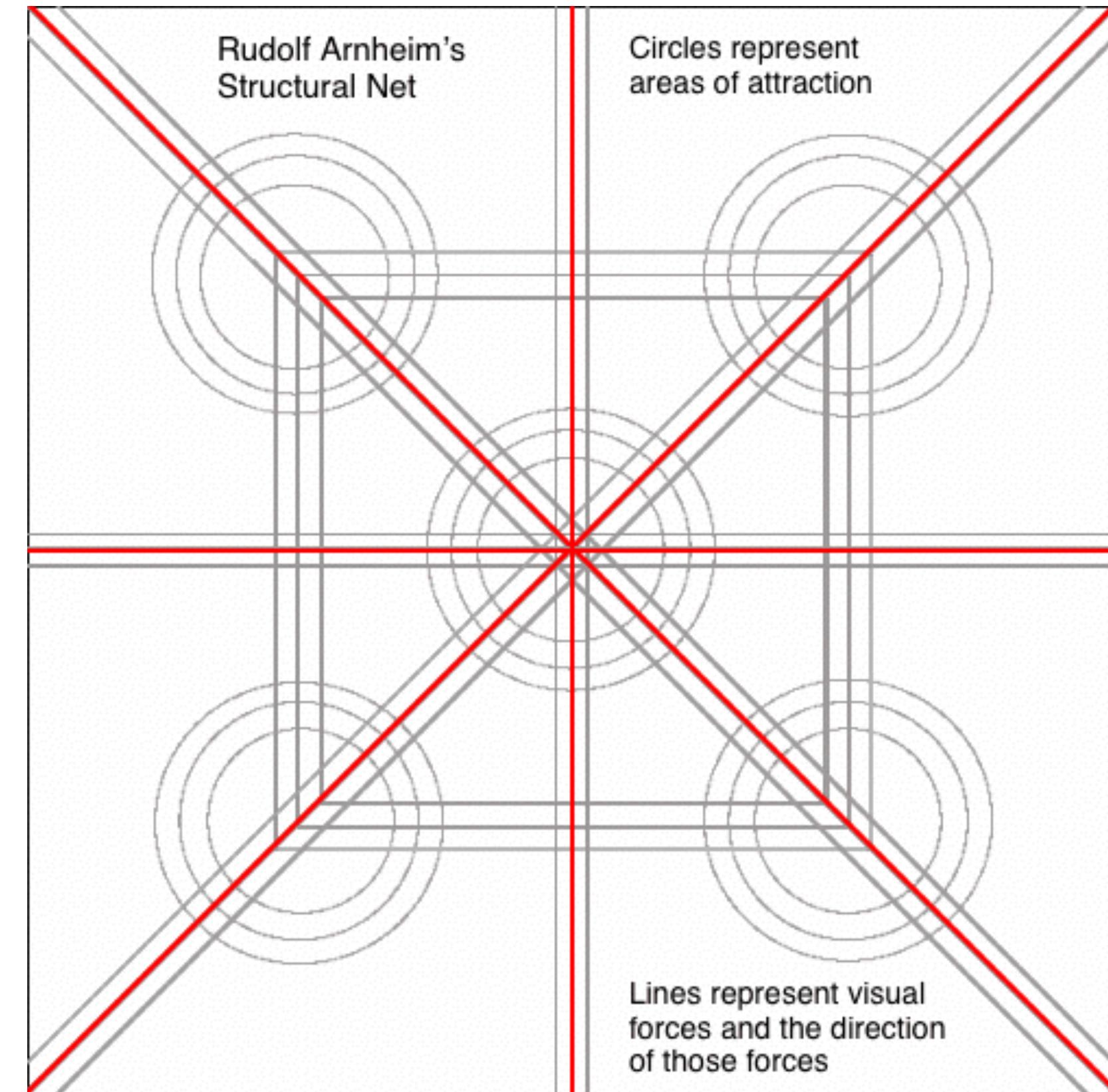
6. Visual Flow



When no design is present

6. Visual Flow

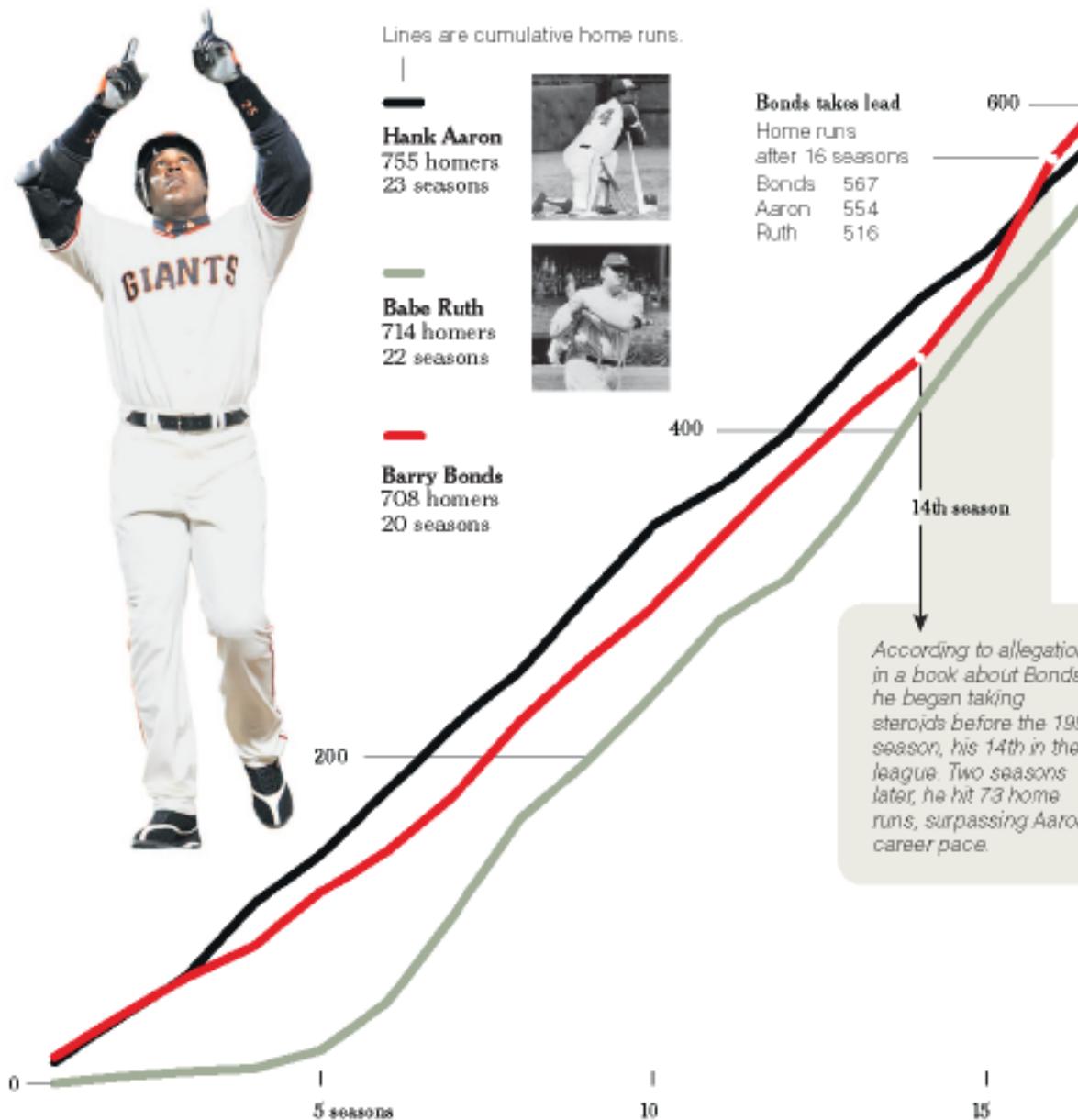
Natural points of attraction
and flow lines



755

Steroids or Not, the Pursuit Is On

Barry Bonds is taking aim at the career home run record. He needs only six more to tie Babe Ruth and 47 to equal Hank Aaron.



755
714
23 seasons
22 seasons
20 seasons

Bonds was injured last season. He played 14 games and hit 5 homers.

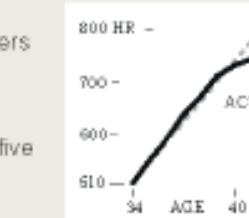
Homer Pace After Age 34

If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS

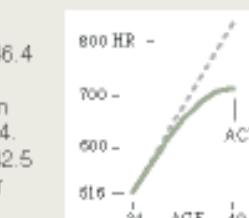
Aaron

Actual homers slightly outpace projected homers for five seasons.



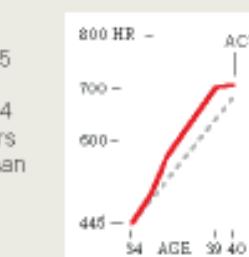
Ruth

Averaged 46.4 homers a season from age 30 to 34. Averaged 42.5 for next four seasons.



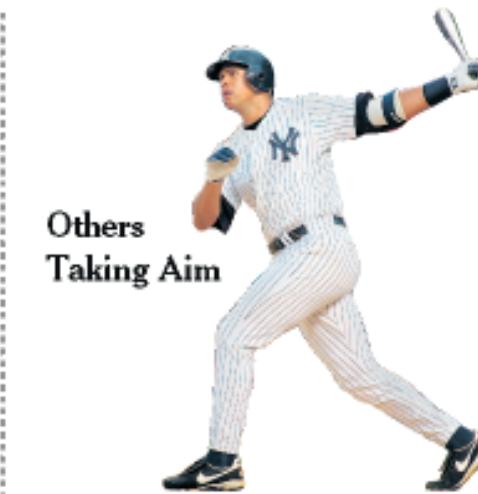
Bonds

From age 35 to 39, he averaged 14 more homers a season than projected.



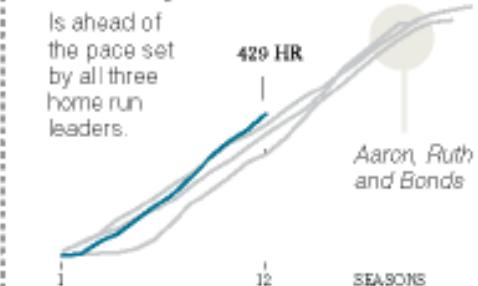
Note: Ages as of July 1 of each season.

Others Taking Aim



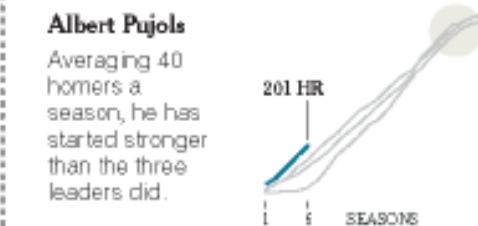
Alex Rodriguez

Is ahead of the pace set by all three home run leaders.



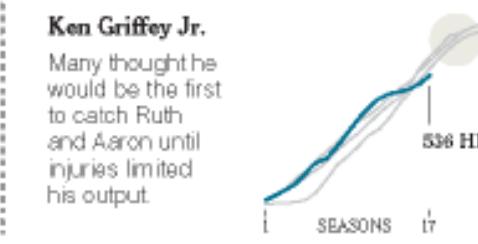
Albert Pujols

Averaging 40 homers a season, he has started stronger than the three leaders did.



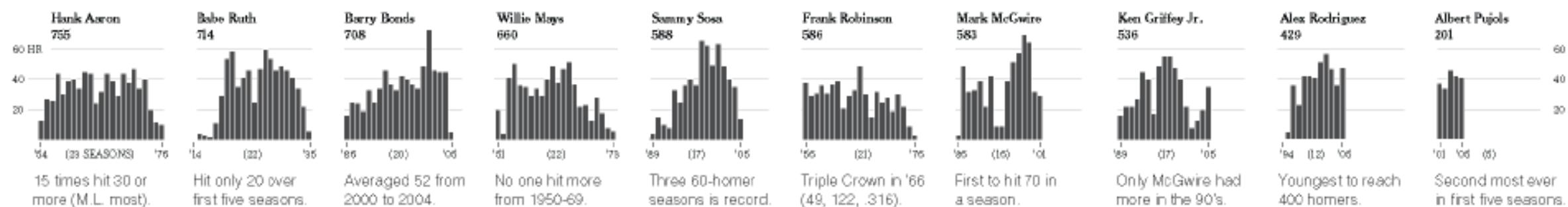
Ken Griffey Jr.

Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



Differing Paths to the Top of the Charts

The top seven players on the career home run list, along with a look at Griffey (12th), Rodriguez (37th) and Pujols (tied 257th).



Annelise Cox and Joe Ward/The New York Times

755



Steroids or Not, the Pursuit Is On

Berry Bonds is taking aim at the career home run record. He needs only six more to tie Babe Ruth and 47 to equal Hank Aaron.

Lines are cumulative home runs.



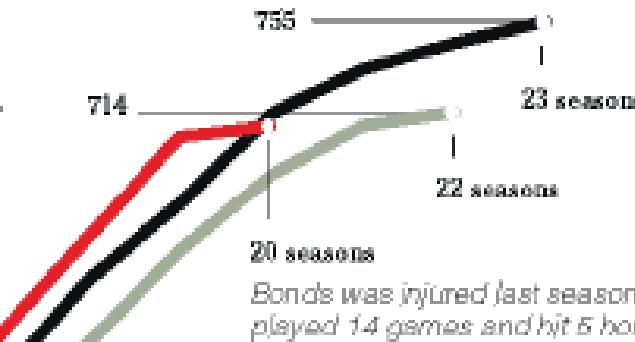
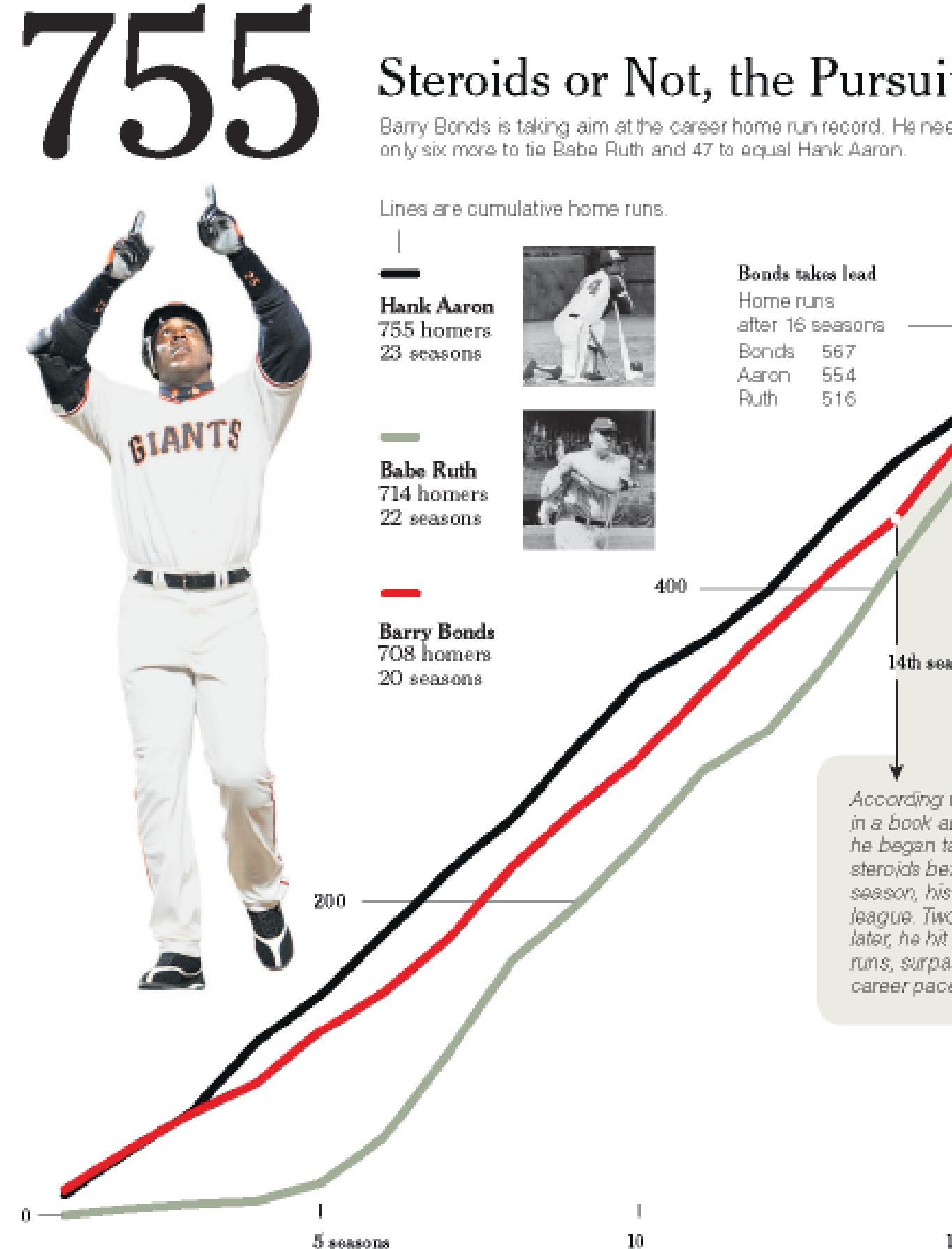
Hank Aaron
755 homers
23 seasons



Babe Ruth
714 homers
22 seasons



Barry Bonds
708 homers
20 seasons



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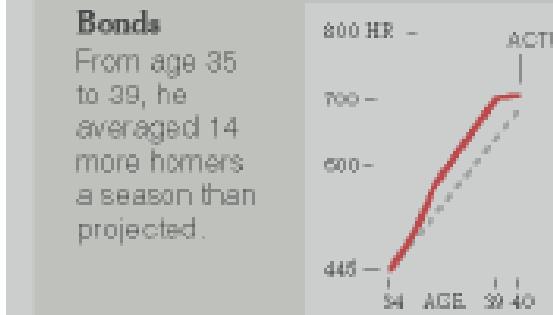
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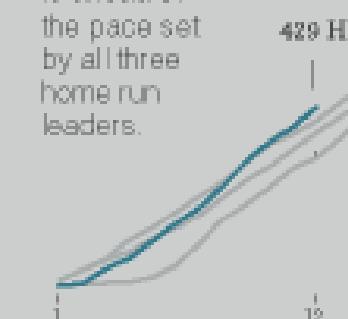


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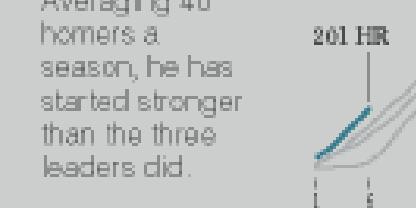
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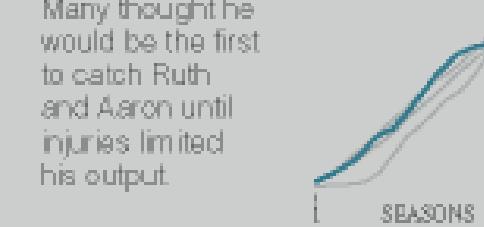
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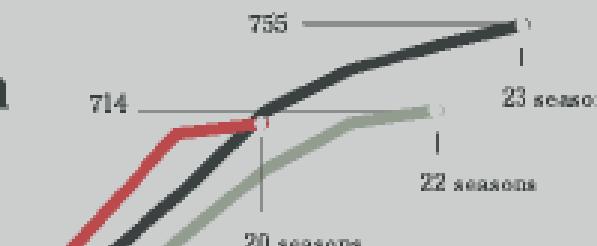
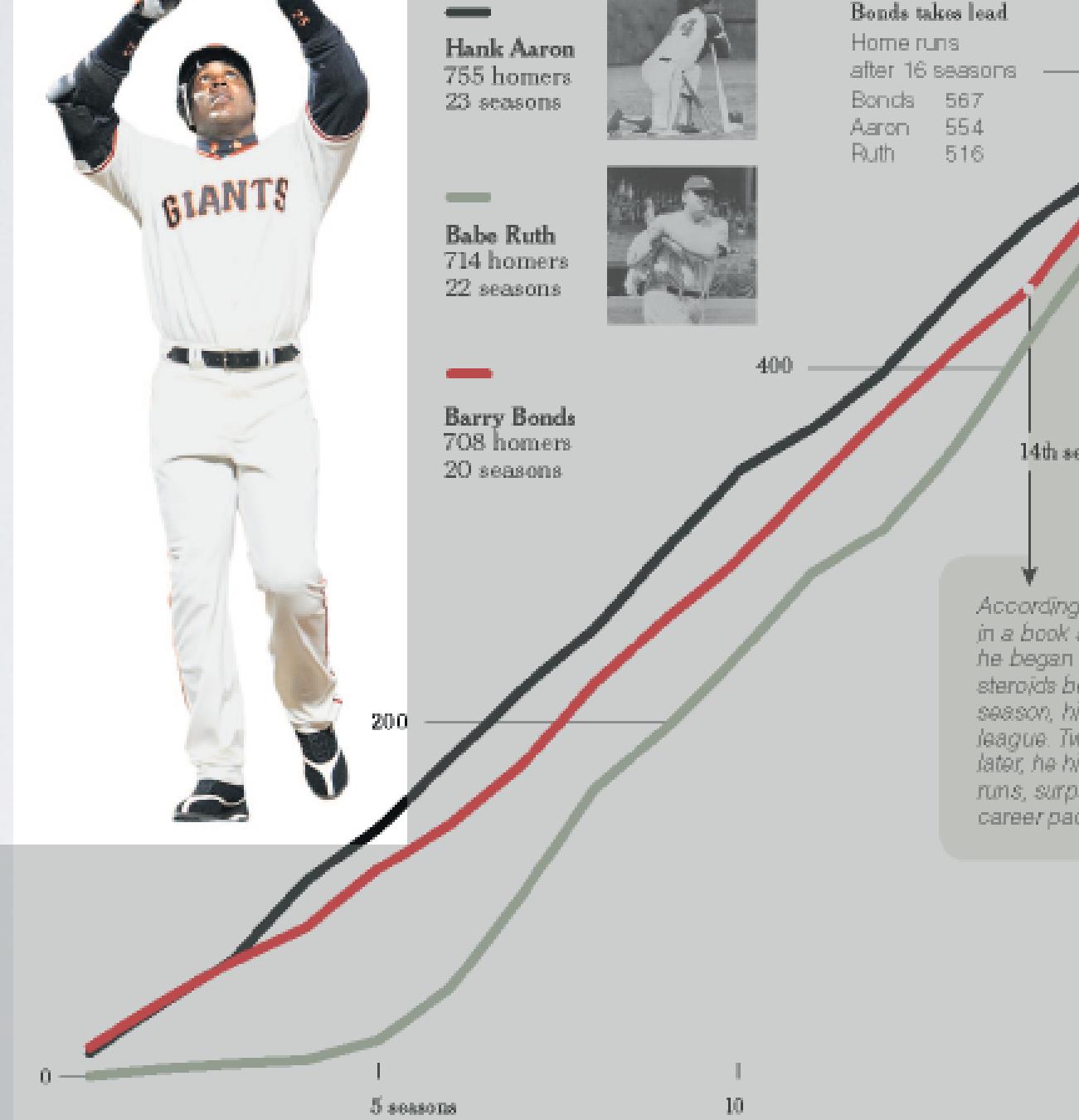


Barry Bonds
708 homers
20 seasons

Bonds takes lead
Home runs
after 16 seasons
Bonds 567
Aaron 554
Ruth 516

14th season

According to allegations in a book about Bonds, he began taking steroids before the 1999 season, his 14th in the league. Two seasons later, he hit 73 home runs, surpassing Aaron's career pace.



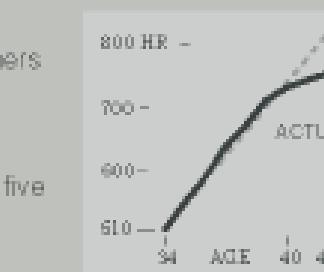
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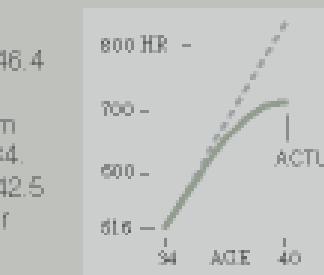
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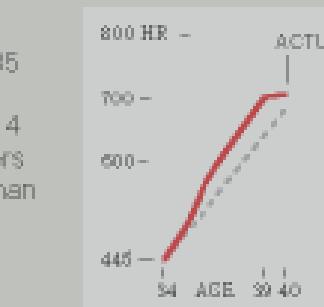
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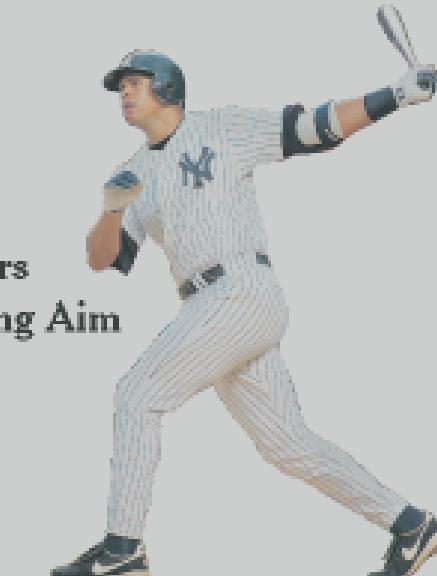
Bonds

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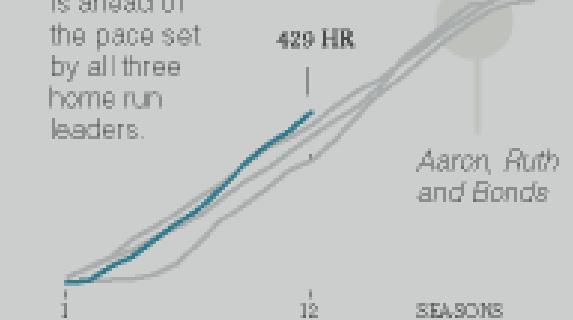
Note: Ages as of July 1 of each season.

Others Taking Aim



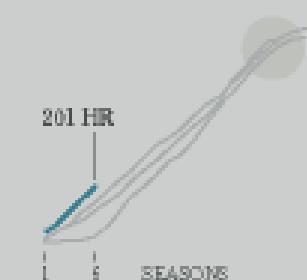
Alex Rodriguez

Is ahead of the pace set by all three home run leaders.



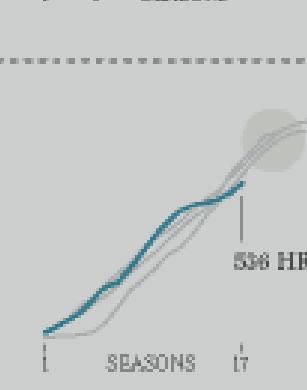
Albert Pujols

Averaging 40 homers a season, he has started stronger than the three leaders did.



Ken Griffey Jr.

Many thought he would be the first to catch Ruth and Aaron until injuries limited his output.



Differing Paths to the Top of the Charts

The top seven players on the career home run list, along with a look at Griffey (12th), Rodriguez (37th) and Pujols (tied 257th).

Hank Aaron
755

Babe Ruth
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Barry Bonds
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Willie Mays
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Sammy Sosa
588

Frank Robinson
586

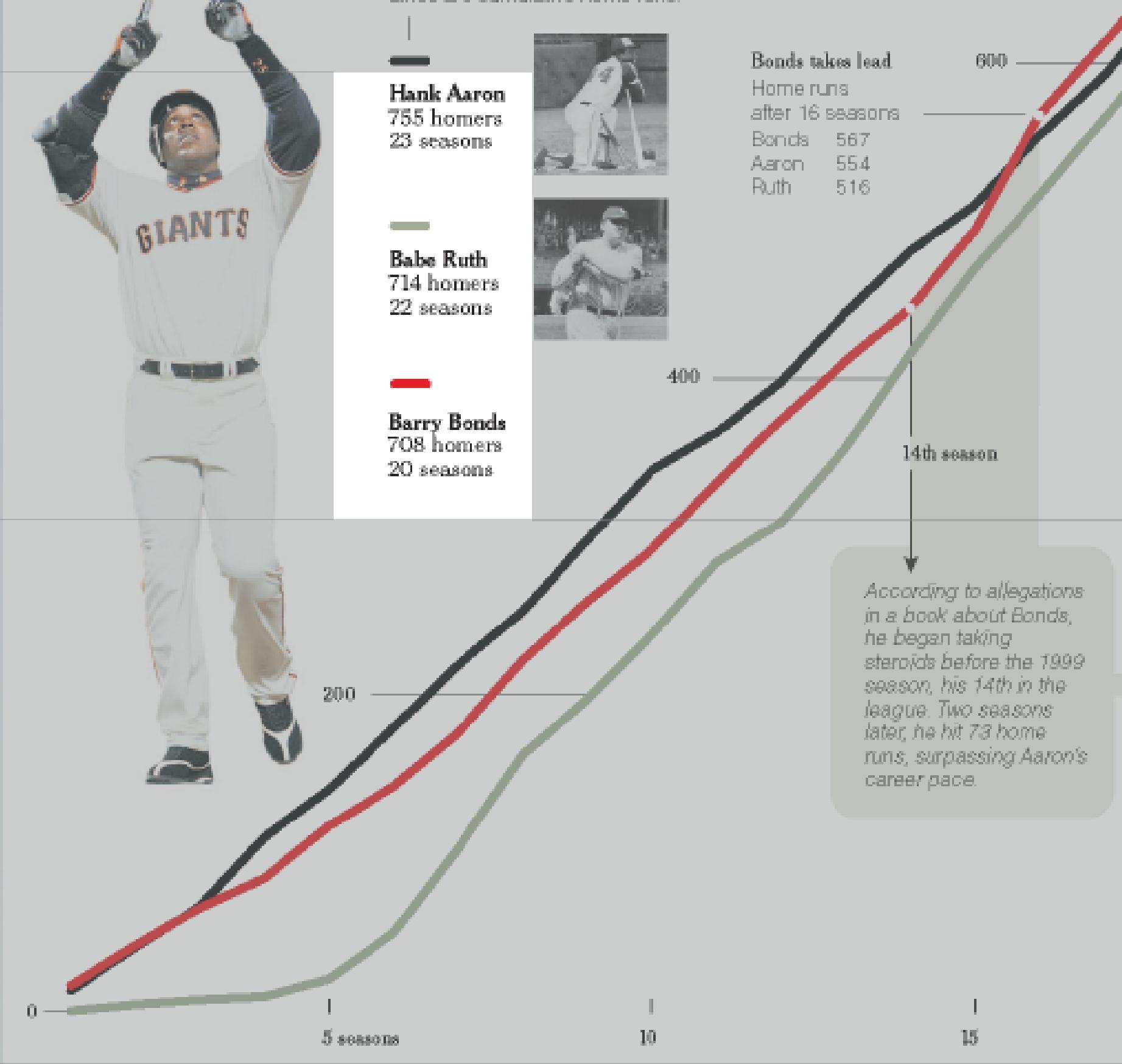
Mark McGwire
583

Ken Griffey Jr.
536

Alex Rodriguez
429

Albert Pujols
201

Taking Aim



Bonds was injured last season. He played 14 games and hit 5 homers.

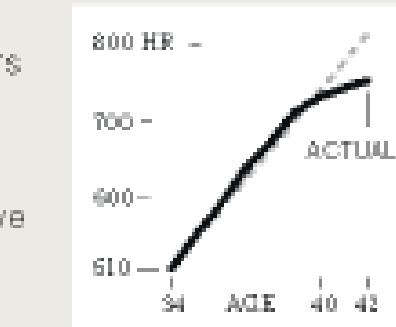
Homer Pace After Age 34

If the accusations are correct, Bonds was 34 in his first season on steroids. Here are projected home run paces for each player after age 34.

PROJECTED PACE BASED ON AVERAGE OF PREVIOUS FIVE SEASONS

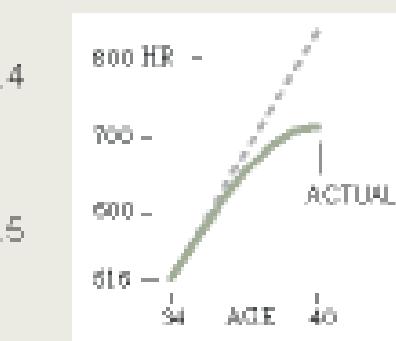
Aaron

Actual homers slightly outpace projected homers for five seasons.



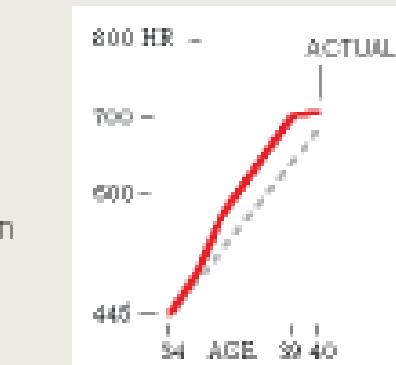
Ruth

Averaged 46.4 homers a season from age 30 to 34. Averaged 42.5 for next four seasons.



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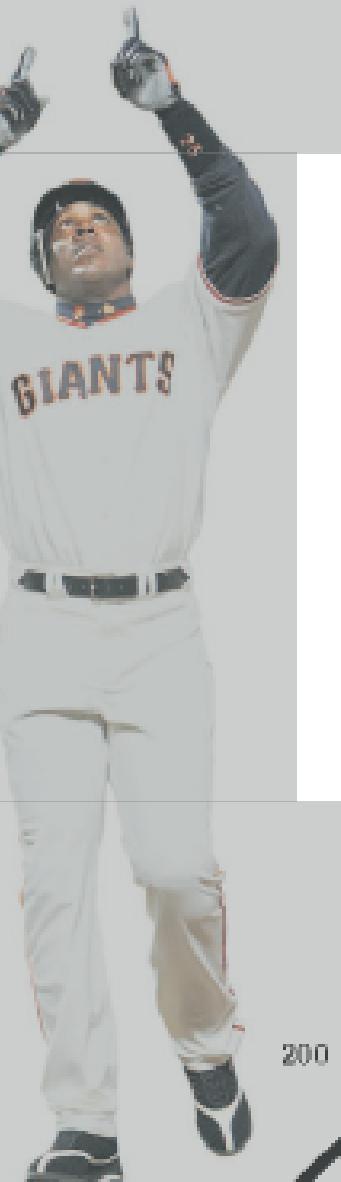


55

Steroids or Not, the Pursuit Is On

Babe Ruth is taking aim at the career home run record. He needs only six more to tie Babe Ruth and 47 to equal Hank Aaron.

Lines are cumulative home runs.



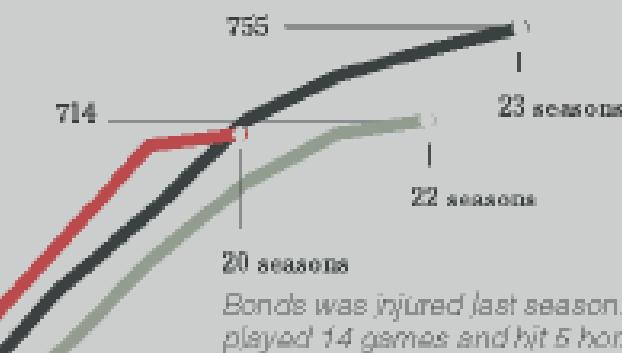
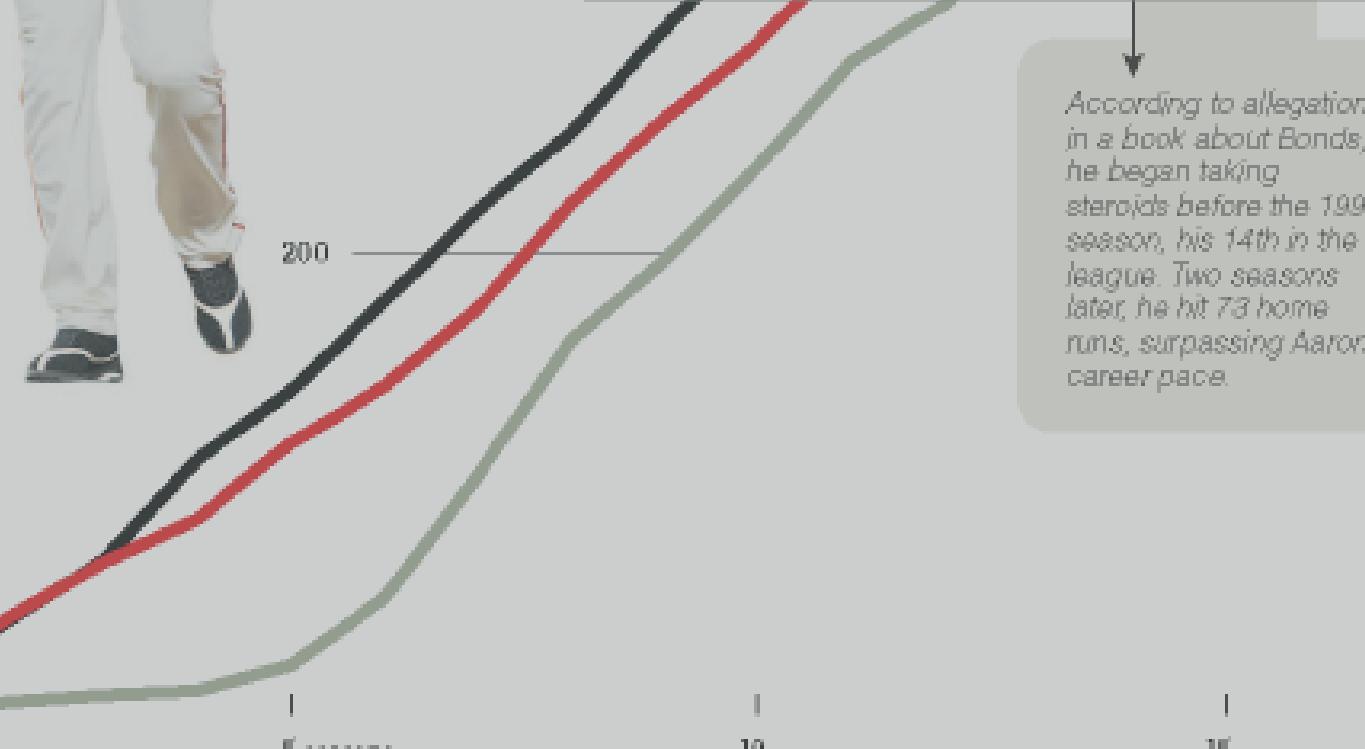
Hank Aaron
755 homers
23 seasons



Babe Ruth
714 homers
22 seasons



Barry Bonds
708 homers
20 seasons

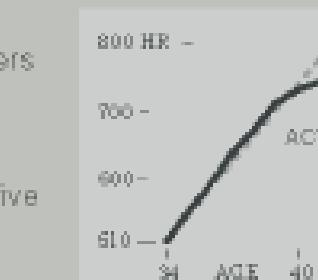


Homer Pace After Age 34

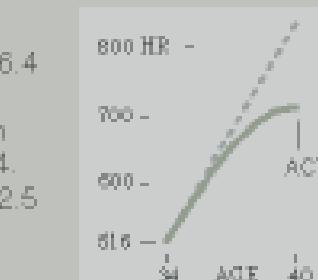
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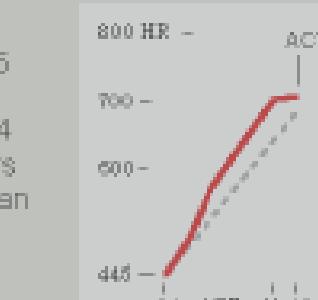
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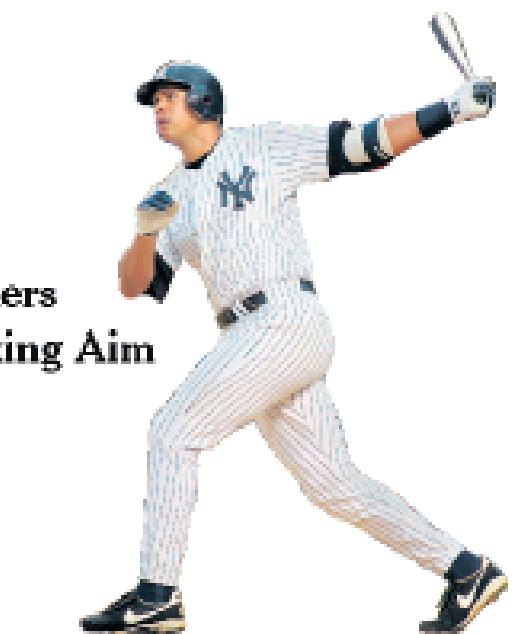


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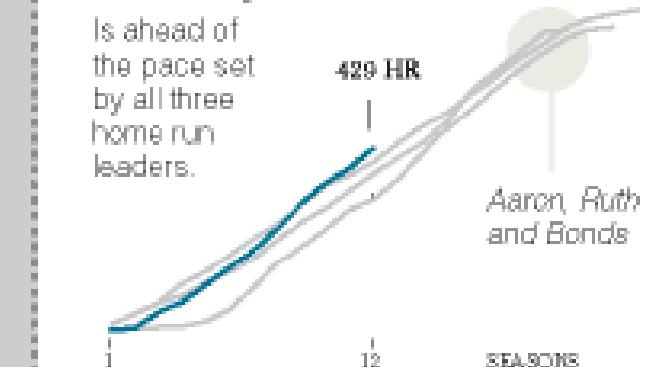
Note: Ages as of July 1 of each season.

Others Taking Aim



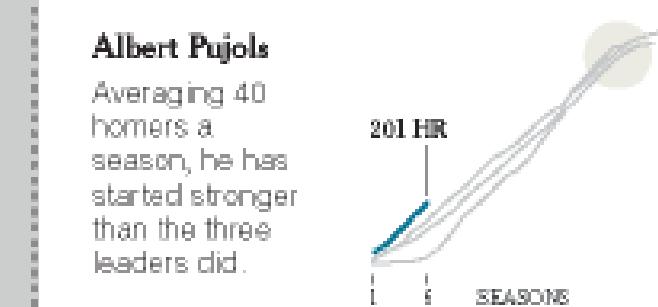
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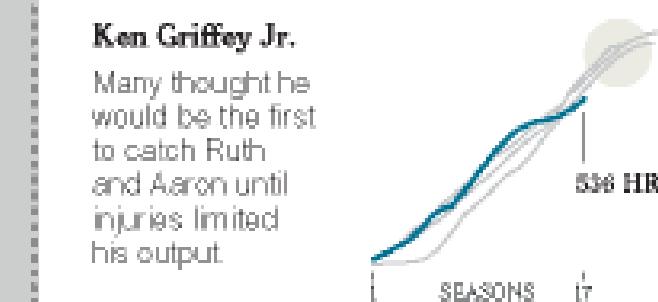
Albert Pujols

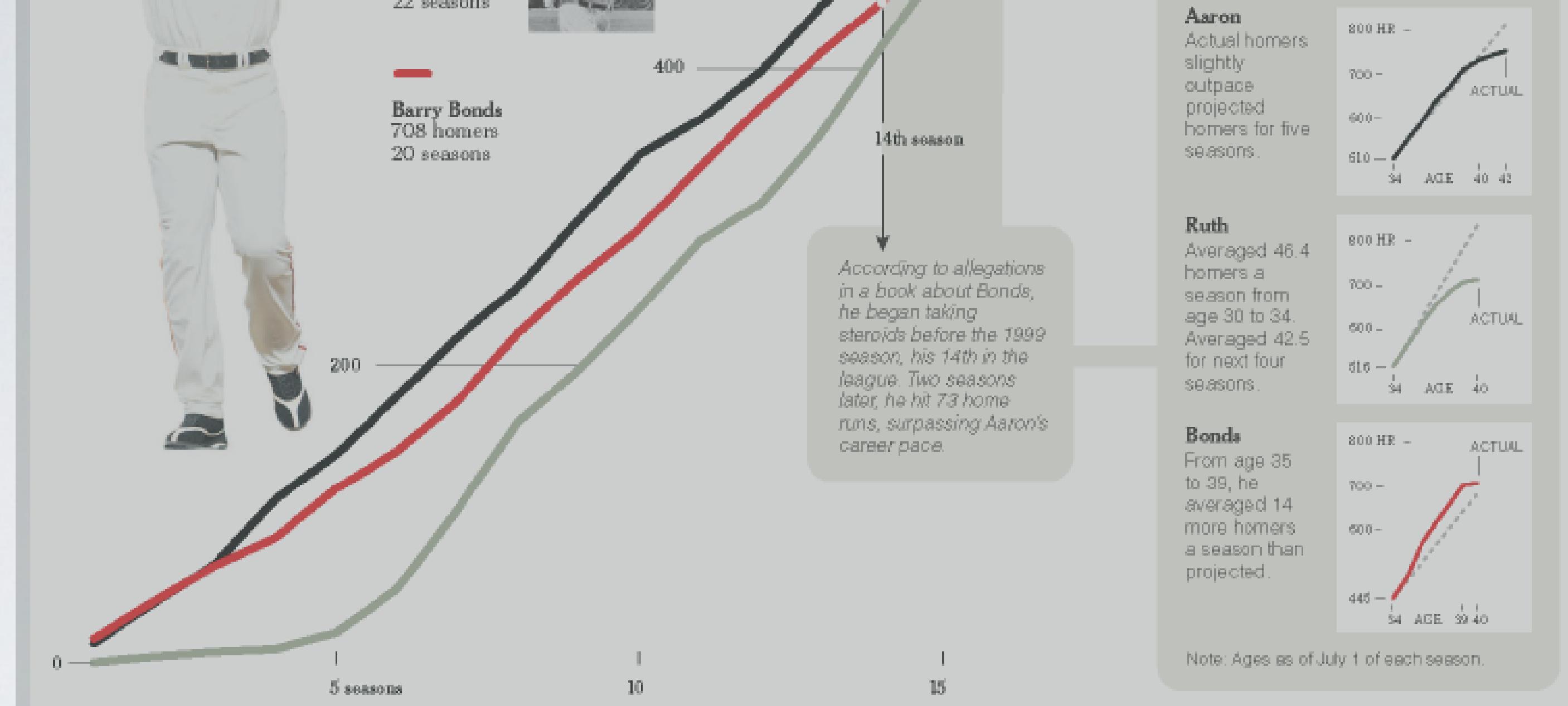
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Ken Griffey Jr.

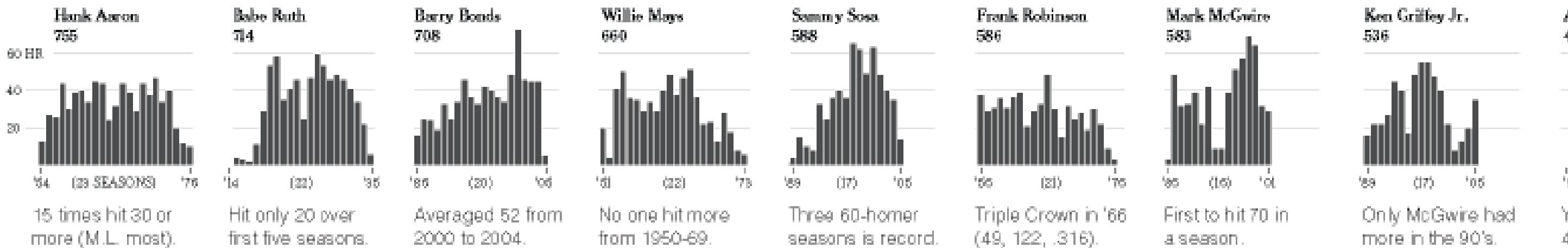
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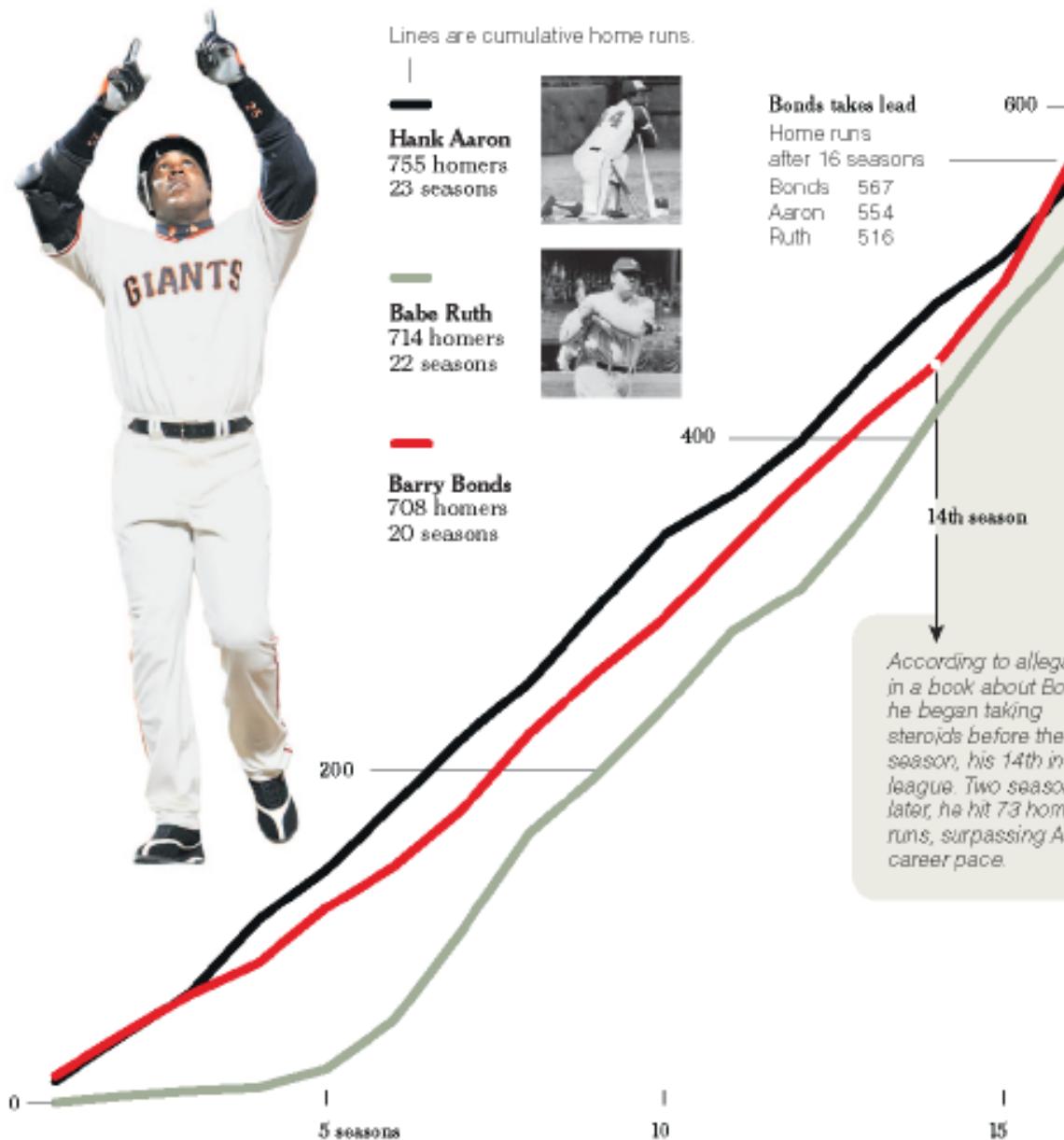


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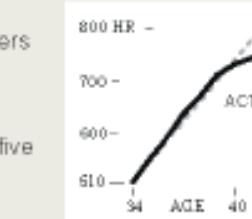
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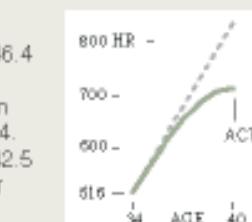
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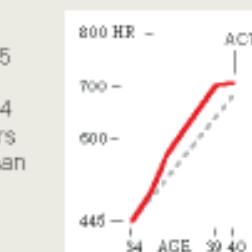
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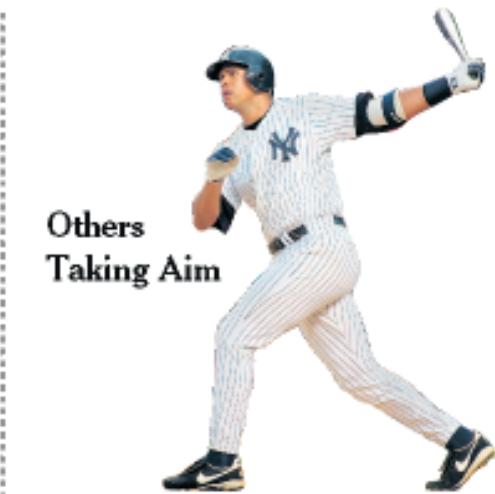
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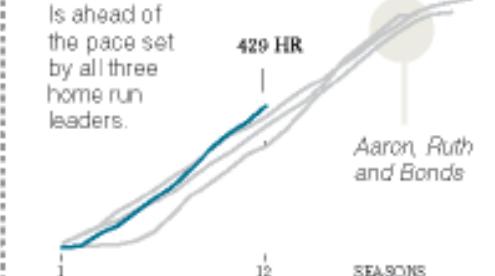
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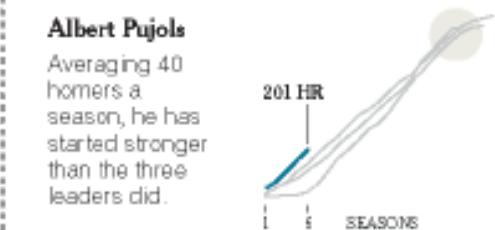
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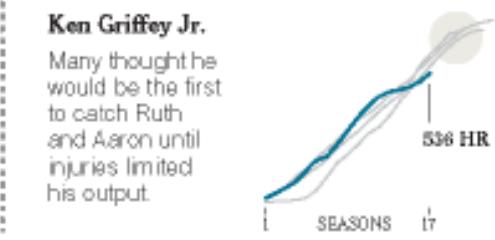
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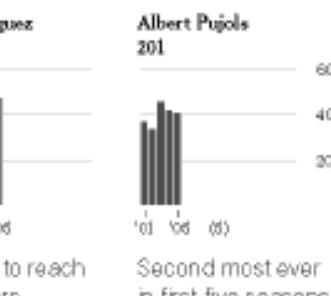
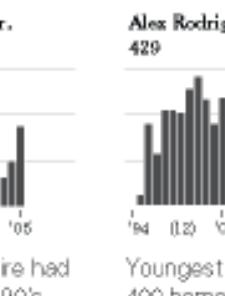
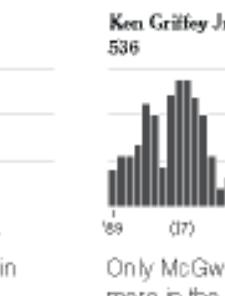
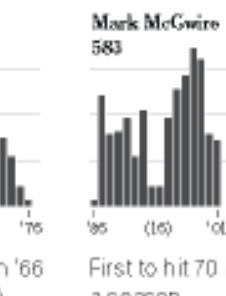
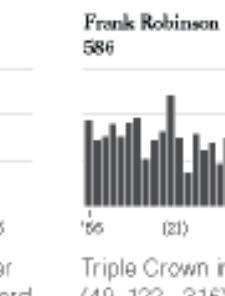
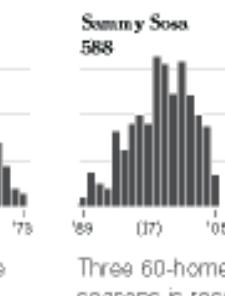
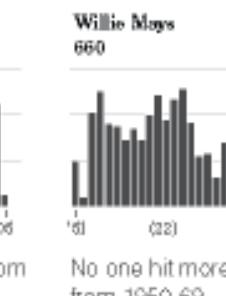
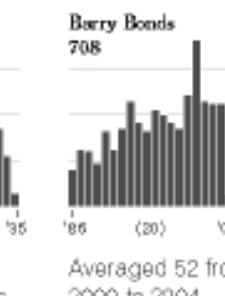
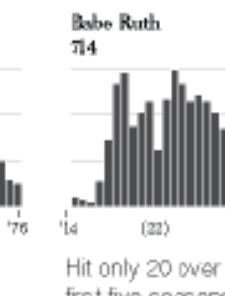
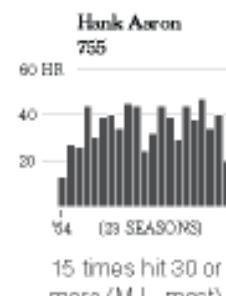
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Annelise Cox and Joe Ward/The New York Times

Interaction

Overview first, zoom and filter, details on demand

Responsiveness is required

- three major categories
 - 0.1 seconds: perceptual processing
 - 1 second: immediate response
 - 10 seconds: brief tasks
- importance of visual feedback

How?

Encode

→ Arrange

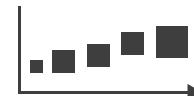
→ Express



→ Separate



→ Order



→ Use



→ Map
from categorical and ordered attributes

→ Color



→ Size, Angle, Curvature, ...

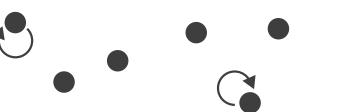


→ Shape



→ Motion

Direction, Rate, Frequency, ...



What?

Why?

How?

Manipulate

→ Change



→ Select



→ Navigate

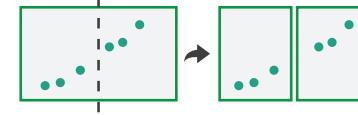


Facet

→ Juxtapose



→ Partition



→ Superimpose



Reduce

→ Filter



→ Aggregate



→ Embed



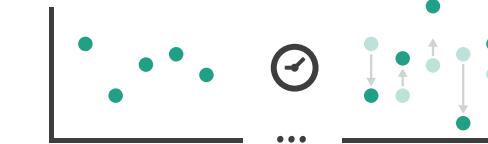
How to handle complexity: 1 previous strategy + 3 more

→ *Derive*



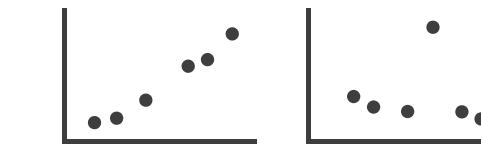
Manipulate

→ **Change**



Facet

→ **Juxtapose**



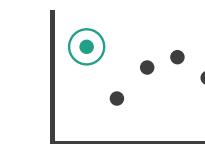
Reduce

→ **Filter**

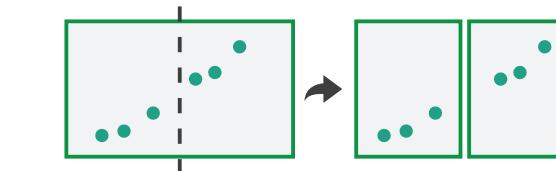


- derive new data to show within view
- change view over time
- facet across multiple views
- reduce items/attributes within single view

→ **Select**



→ **Partition**



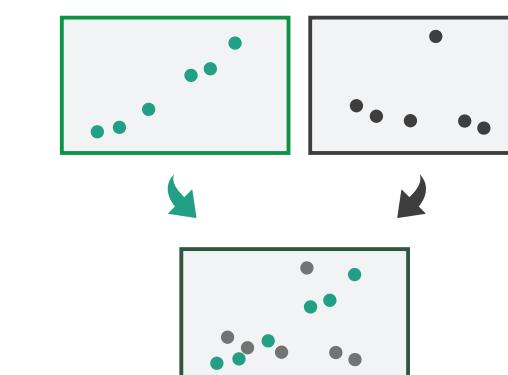
→ **Aggregate**



→ **Navigate**



→ **Superimpose**

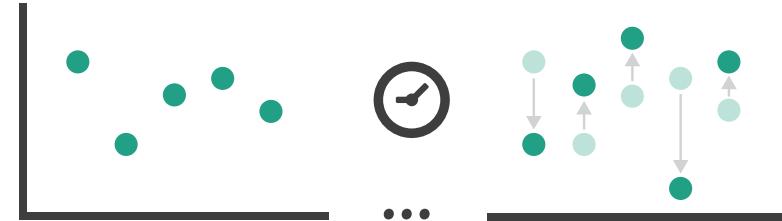


→ **Embed**

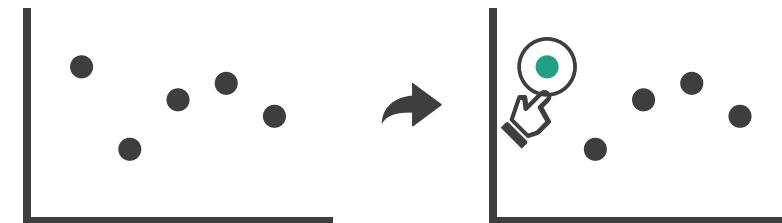


Manipulate

→ Change over Time



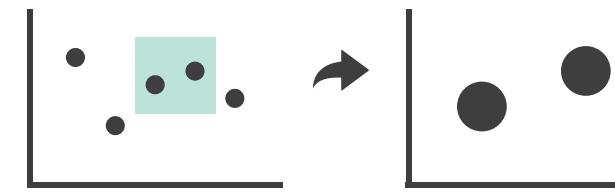
→ Select



→ Navigate

→ Item Reduction

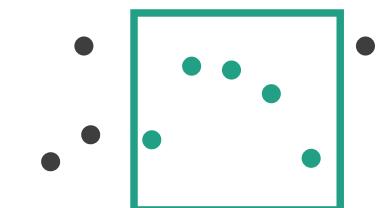
→ Zoom
Geometric or Semantic



→ Pan/Translate

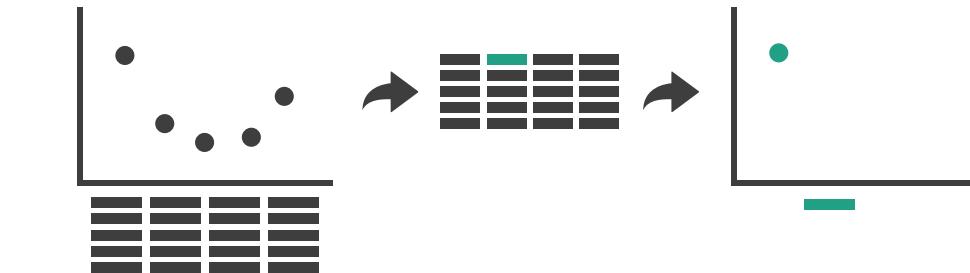


→ Constrained

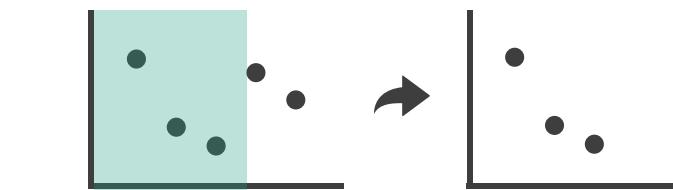


→ Attribute Reduction

→ Slice



→ Cut



→ Project

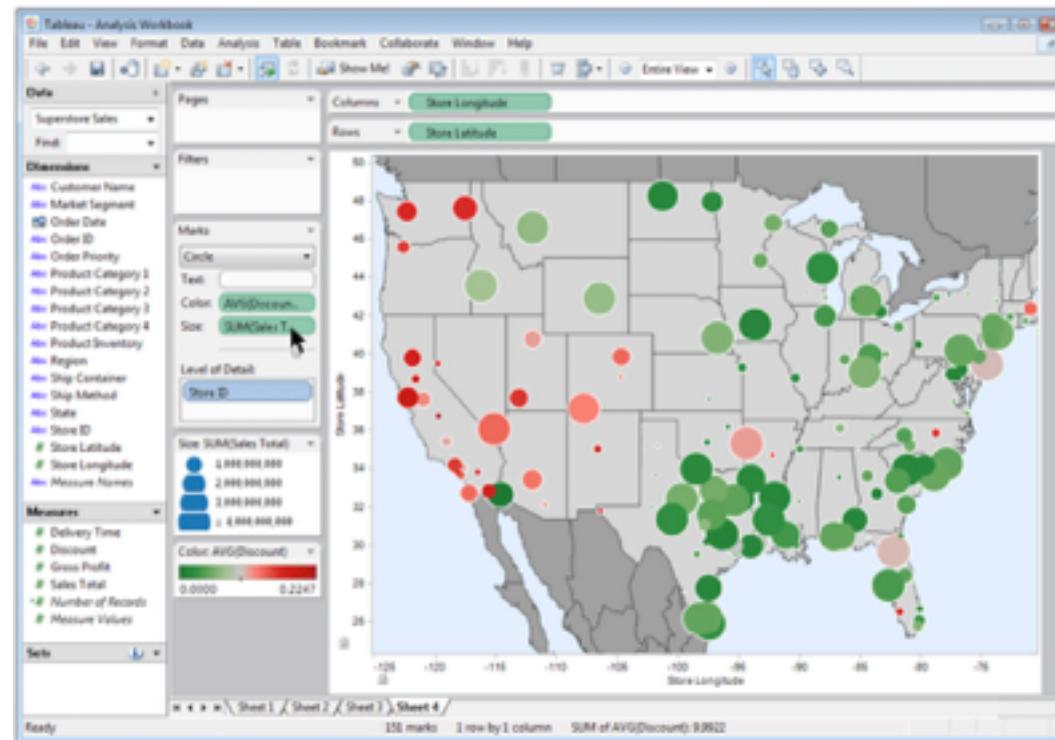
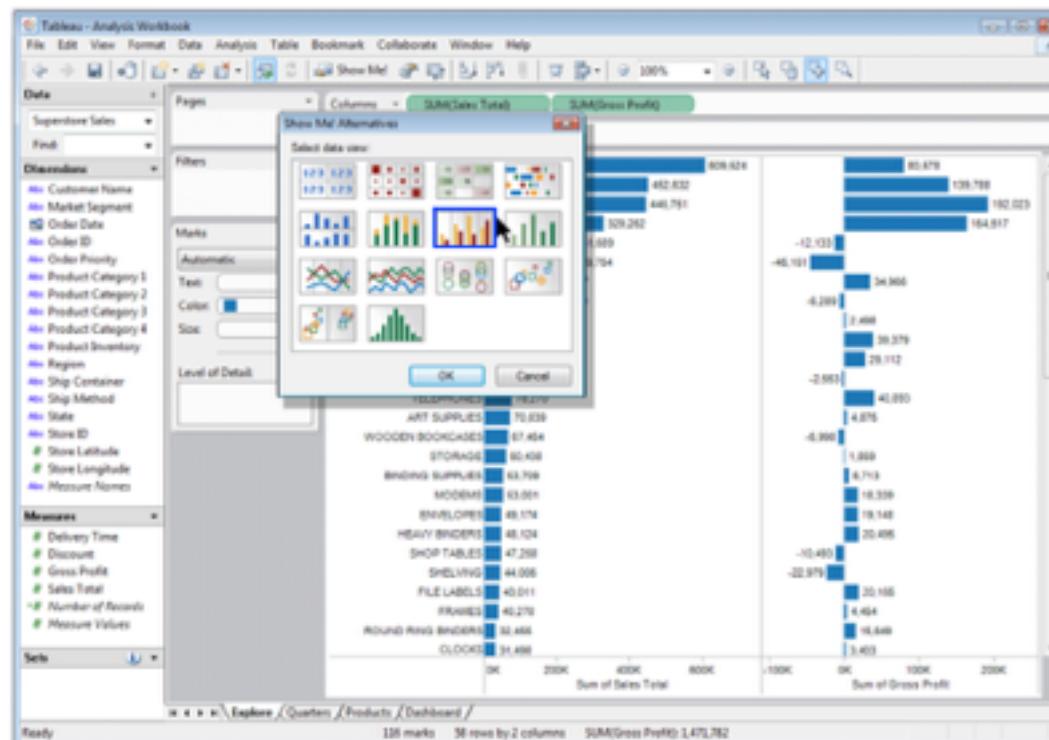
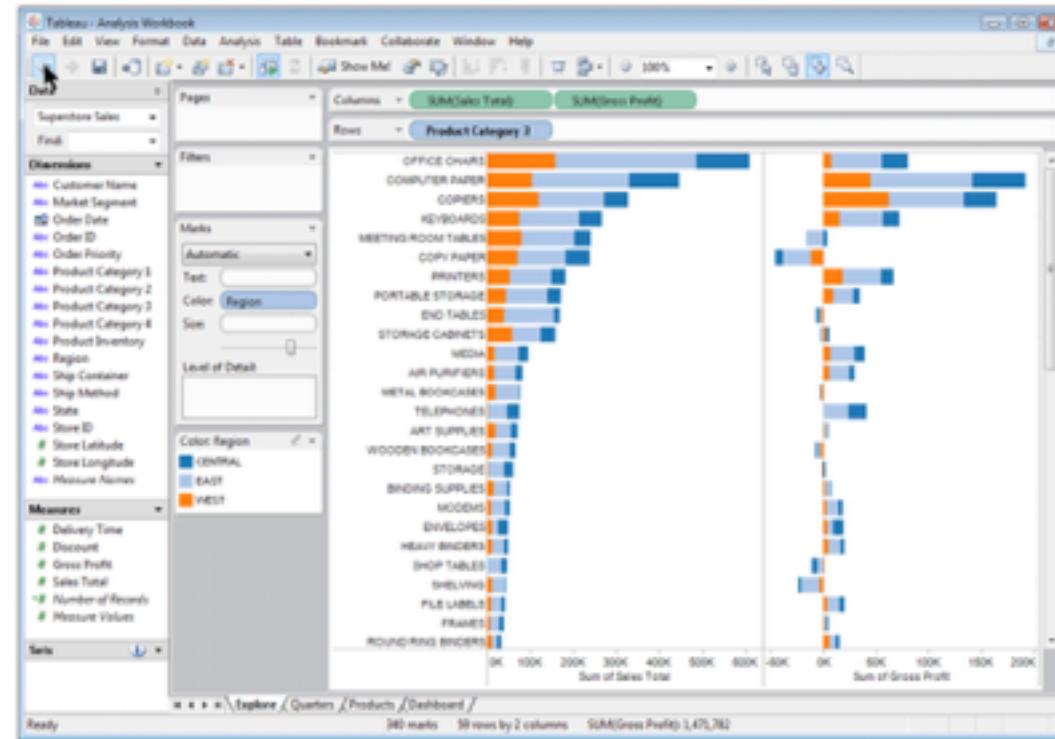
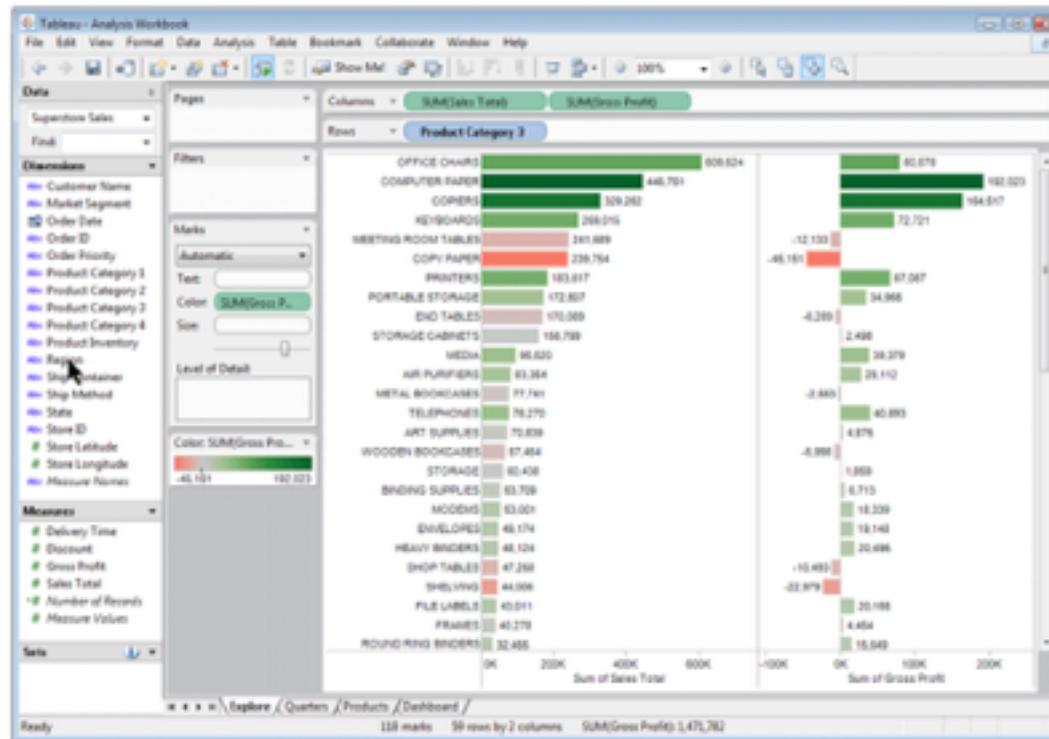


Change over time

- change any of the other choices
 - encoding itself
 - parameters
 - arrange: rearrange, reorder
 - aggregation level, what is filtered...
 - interaction entails change

Idiom: Re-encode

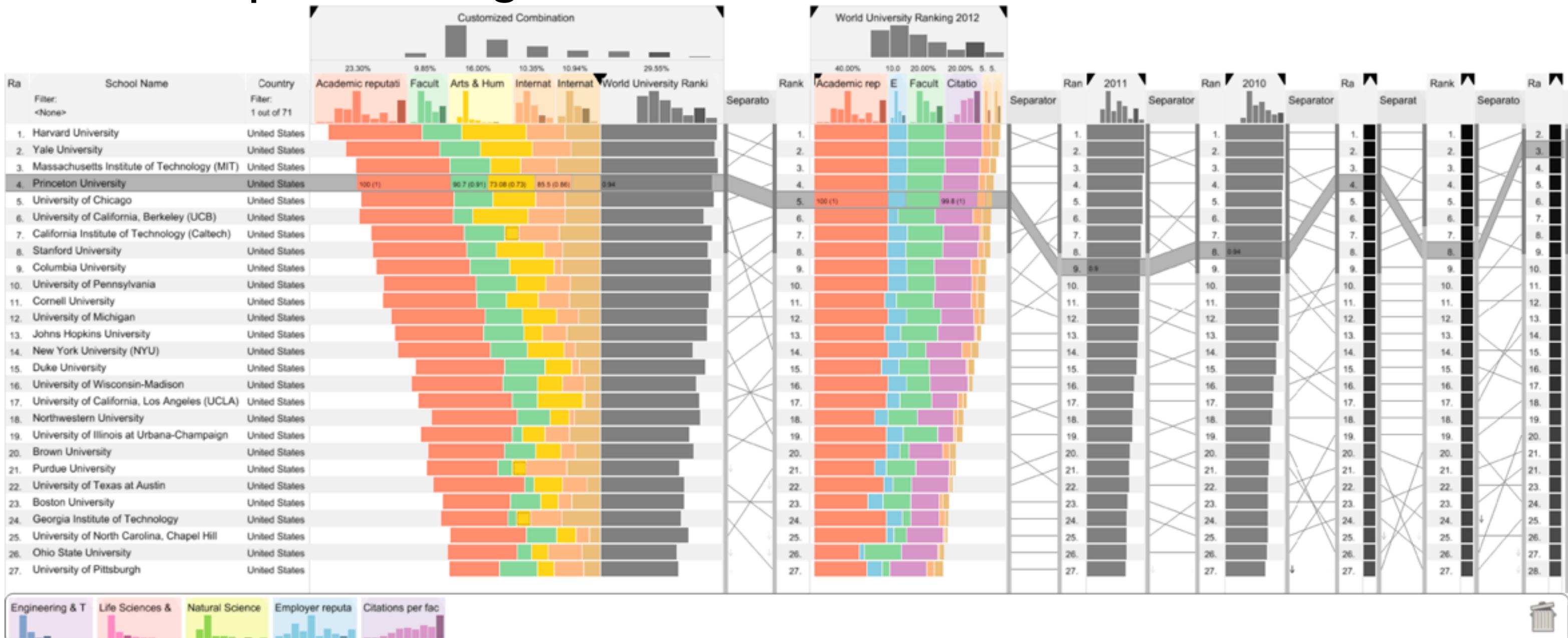
System: Tableau



Idiom: Reorder

System: LineUp

- data: tables with many attributes
 - task: compare rankings

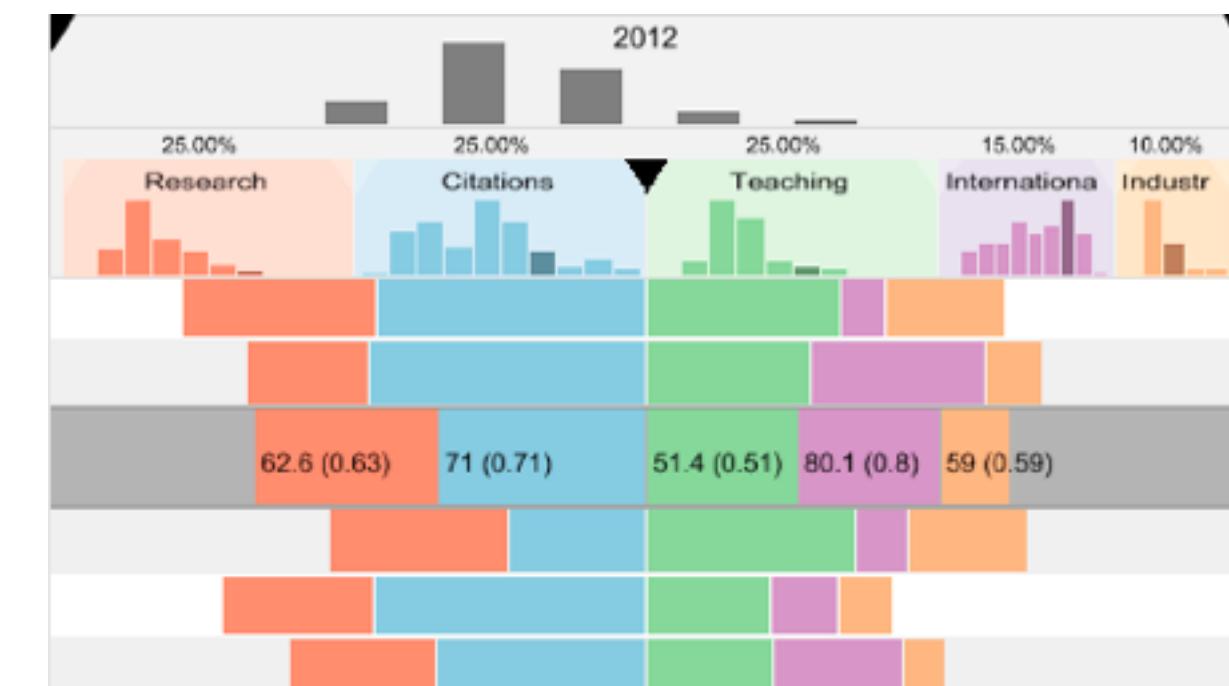
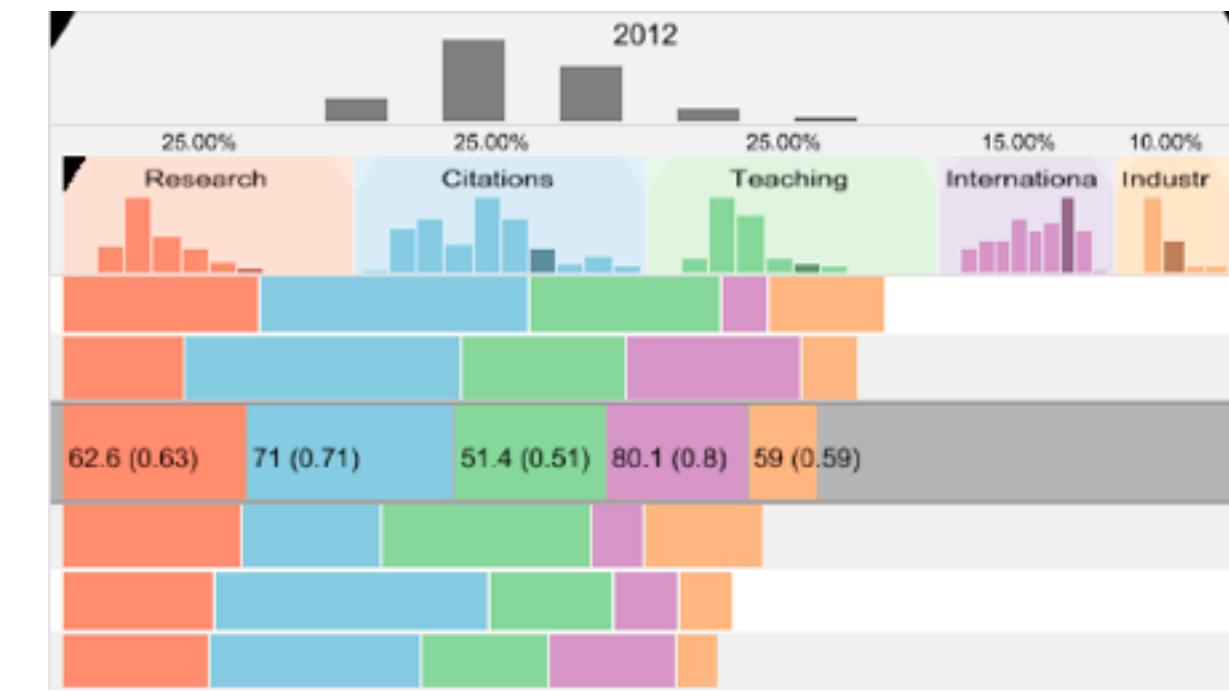


[LineUp: Visual Analysis of Multi-Attribute Rankings. Gratzl, Lex, Gehlenborg, Pfister, and Streit. *IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2013)* 19:12 (2013), 2277–2286.]

Idiom: Realign

System: LineUp

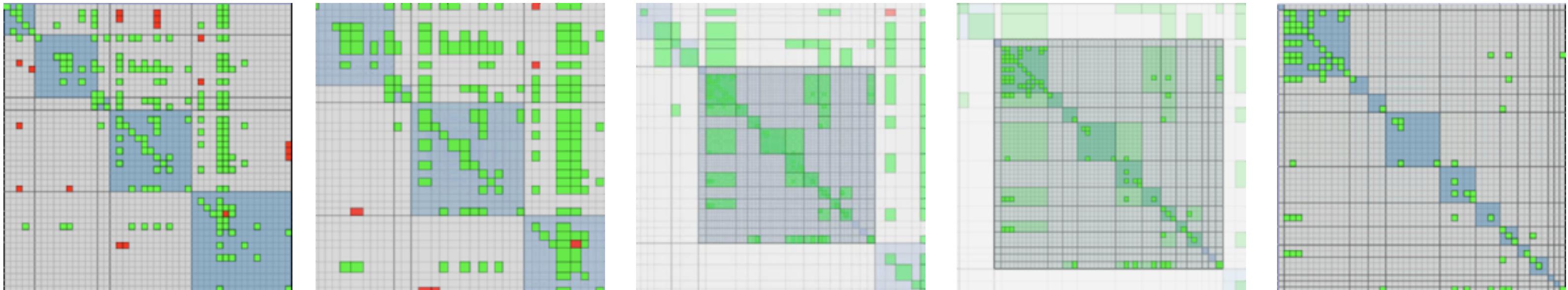
- stacked bars
 - easy to compare
 - first segment
 - total bar
- align to different segment
 - supports flexible comparison



[LineUp: Visual Analysis of Multi-Attribute Rankings. Gratzl, Lex, Gehlenborg, Pfister, and Streit. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2013) 19:12 (2013), 2277–2286.]

Idiom: Animated transitions

- smooth transition from one state to another
 - alternative to jump cuts
 - support for item tracking when amount of change is limited: “Constancy”
- example: animated transitions
 - <https://bost.ocks.org/mike/constancy/>
 - <https://bl.ocks.org/mbostock/3808234>

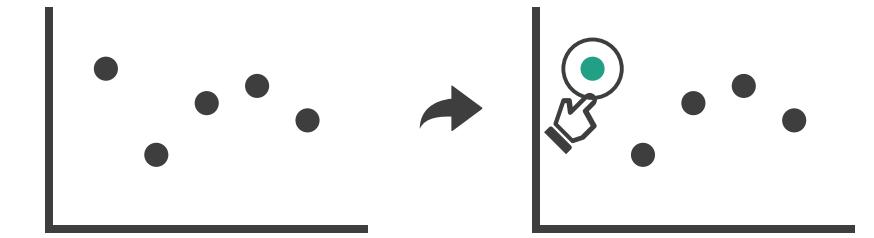


[Using Multilevel Call Matrices in Large Software Projects. van Ham. Proc. IEEE Symp. Information Visualization (InfoVis), pp. 227–232, 2003.]

Select and highlight

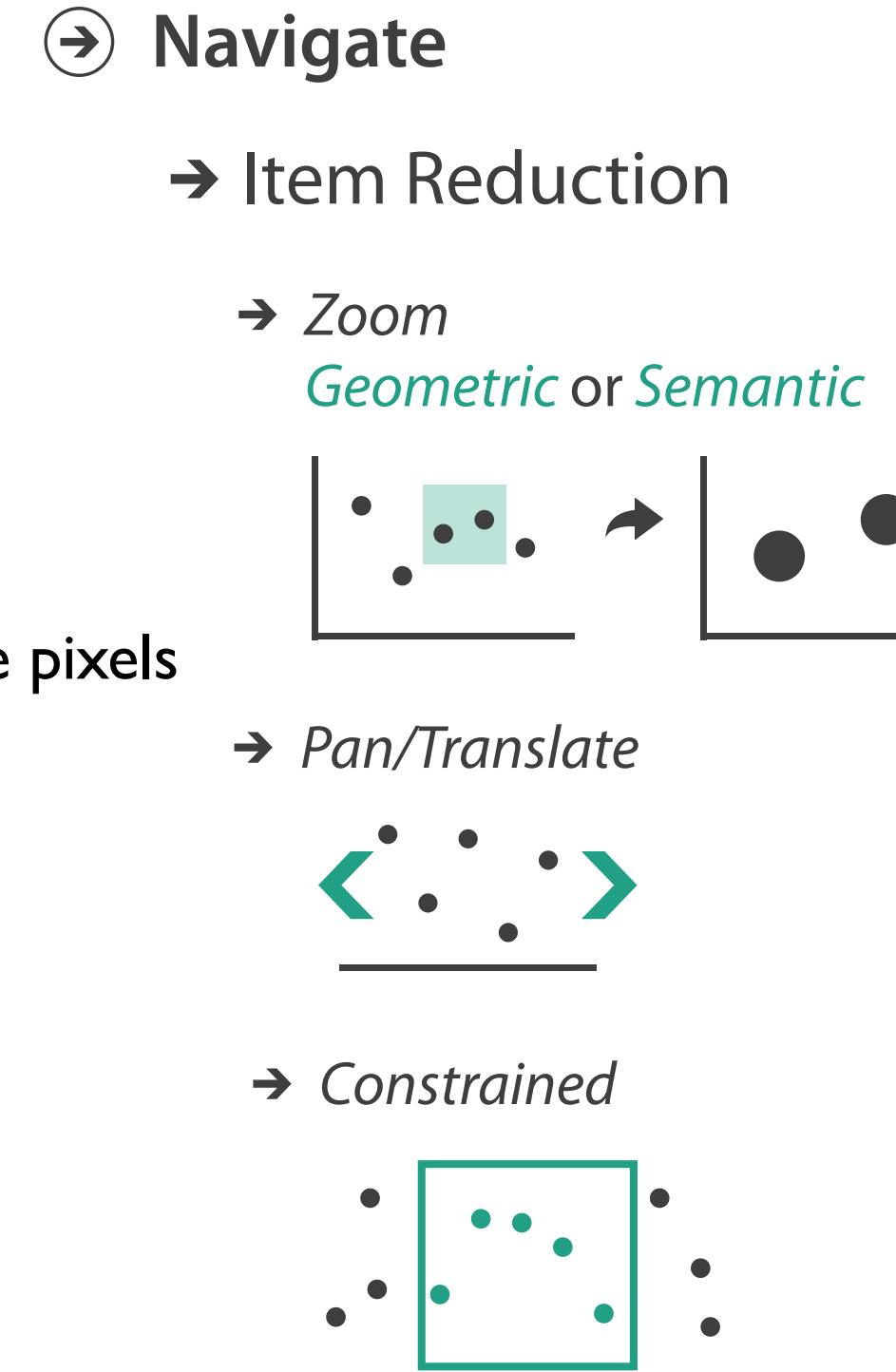
→ Select

- selection: basic operation for most interaction
- design choices
 - how many selection types?
 - click vs hover: heavyweight, lightweight
 - primary vs secondary: semantics (eg source/target)
 - highlight: change visual encoding for selection targets
 - color
 - limitation: existing color coding hidden
 - other channels (eg motion)
 - add explicit connection marks between items



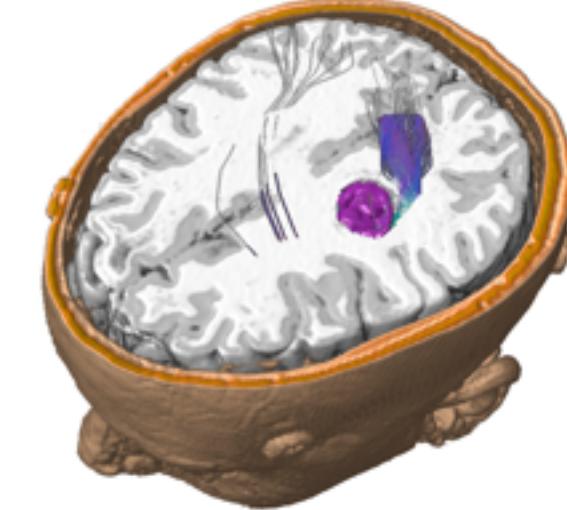
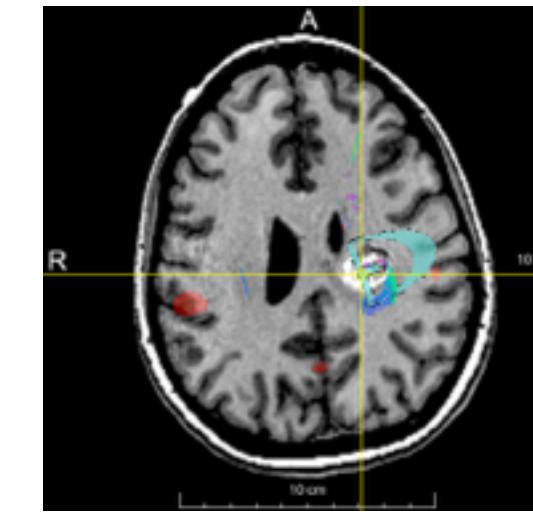
Navigate: Changing item visibility

- change viewpoint
 - changes which items are visible within view
 - camera metaphor
 - zoom
 - geometric zoom: familiar semantics
 - semantic zoom: adapt object representation based on available pixels
 - » dramatic change, or more subtle one
 - pan/translate
 - rotate
 - especially in 3D
 - constrained navigation
 - often with animated transitions
 - often based on selection set



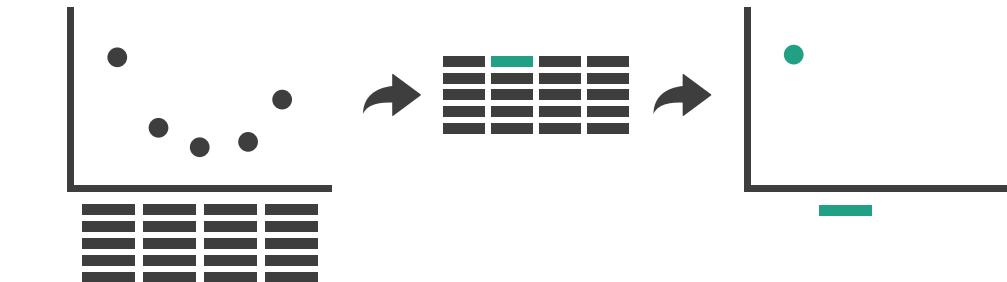
Navigate: Reducing attributes

- continuation of camera metaphor
 - slice
 - show only items matching specific value for given attribute: slicing plane
 - axis aligned, or arbitrary alignment
 - cut
 - show only items on far slide of plane from camera
 - project
 - change mathematics of image creation
 - orthographic
 - perspective
 - many others: Mercator, cabinet, ...

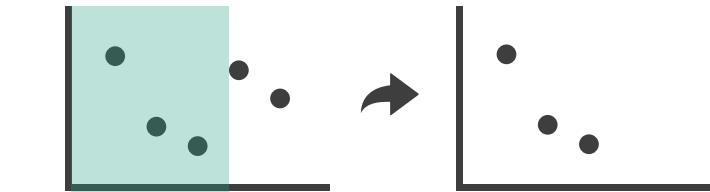


→ Attribute Reduction

→ Slice



→ Cut

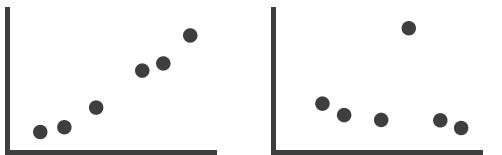


→ Project

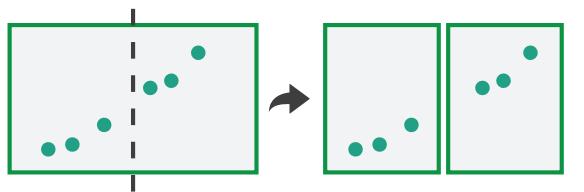


Facet

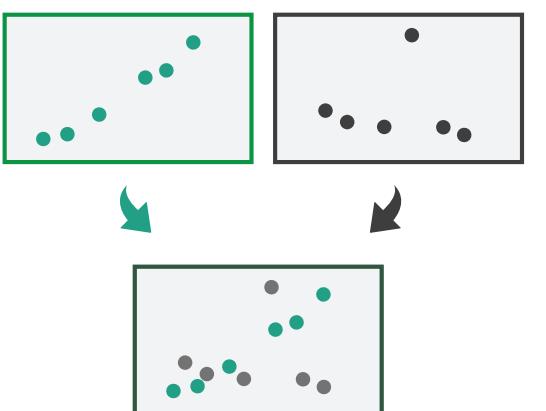
→ Juxtapose



→ Partition



→ Superimpose



Juxtapose and coordinate views

→ Share Encoding: Same/Different

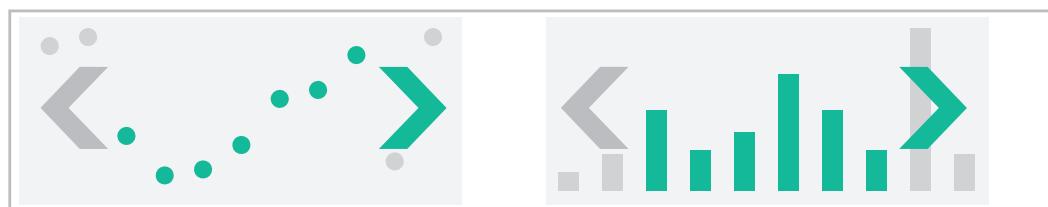
→ *Linked Highlighting*



→ Share Data: All/Subset/None



→ Share Navigation



Idiom: Linked highlighting

System: EDV

- see how regions contiguous in one view are distributed within another
 - powerful and pervasive interaction idiom
- encoding: different
 - *multiform*
- data: all shared



[*Visual Exploration of Large Structured Datasets. Wills. Proc. New Techniques and Trends in Statistics (NTTS)*, pp. 237–246. IOS Press, 1995.]

Idiom: bird's-eye maps

System: Google Maps

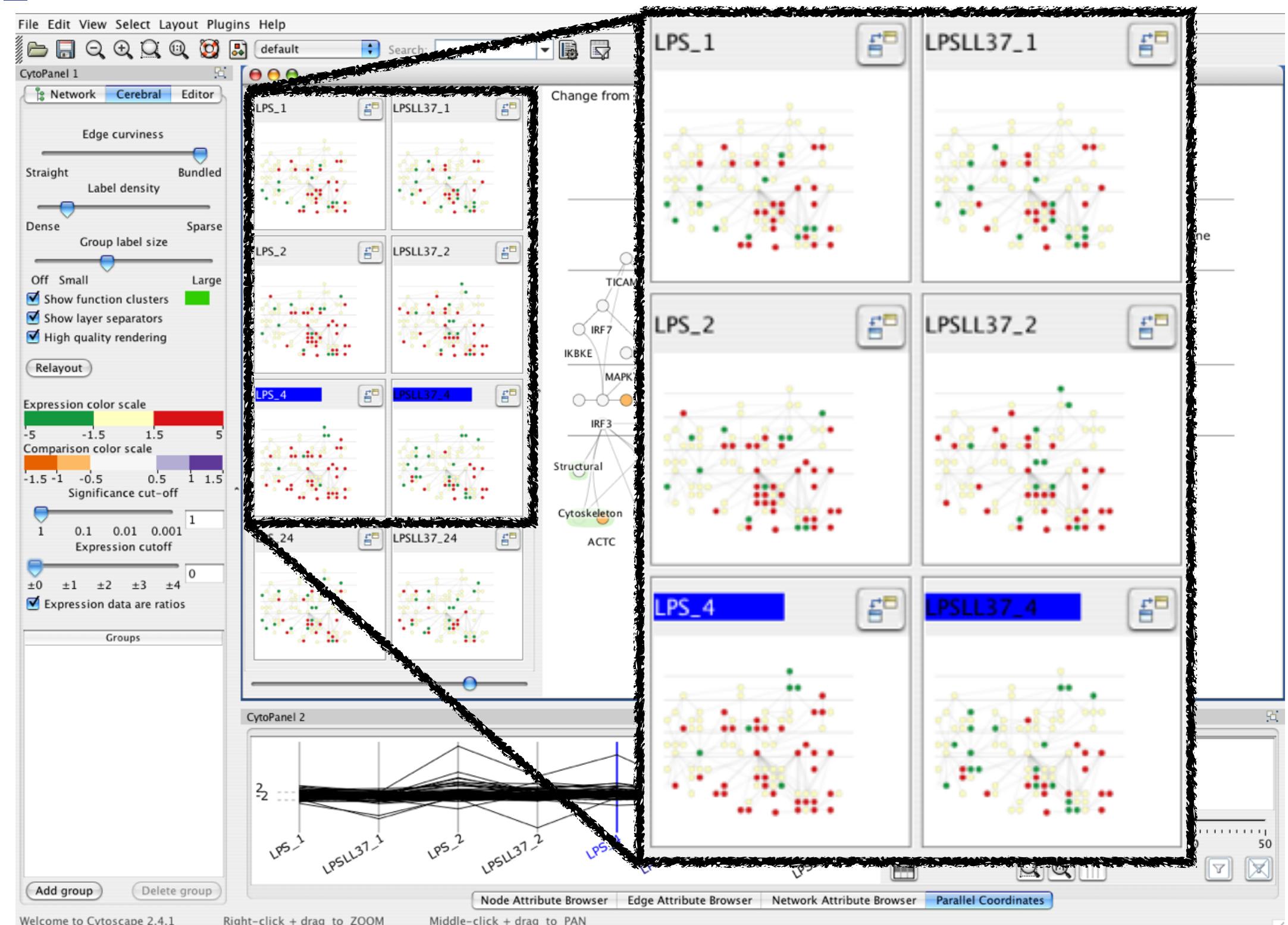
- encoding: same
- data: subset shared
- navigation: shared
 - bidirectional linking
- differences
 - viewpoint
 - (size)
- **overview-detail**



[A Review of Overview+Detail, Zooming, and Focus+Context Interfaces.
Cockburn, Karlson, and Bederson. ACM Computing Surveys 41:1 (2008),
1–31.]

Idiom: Small multiples

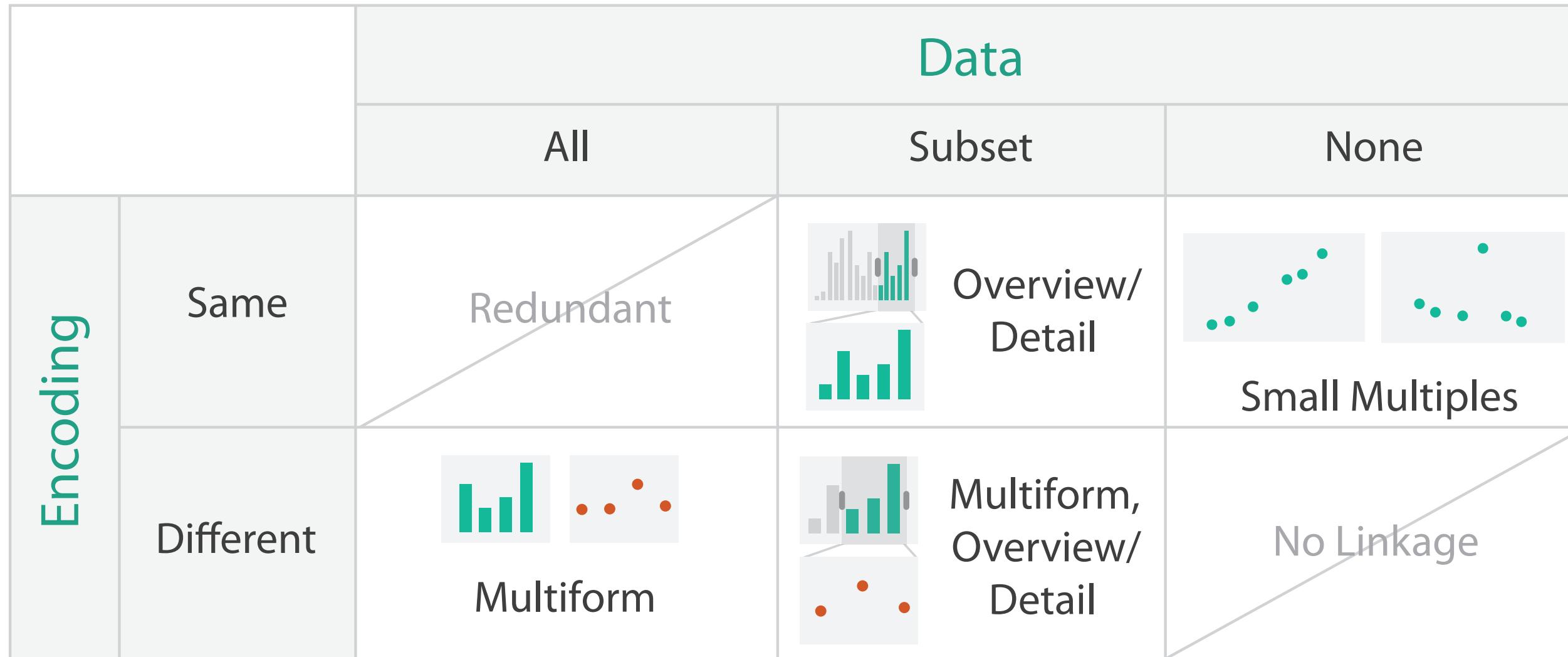
- encoding: same
- data: none shared
 - different attributes for node colors
 - (same network layout)
- navigation: shared



[Cerebral: Visualizing Multiple Experimental Conditions on a Graph with Biological Context. Barsky, Munzner, Gardy, and Kincaid. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2008) 14:6 (2008), 1253–1260.]

System: Cerebral

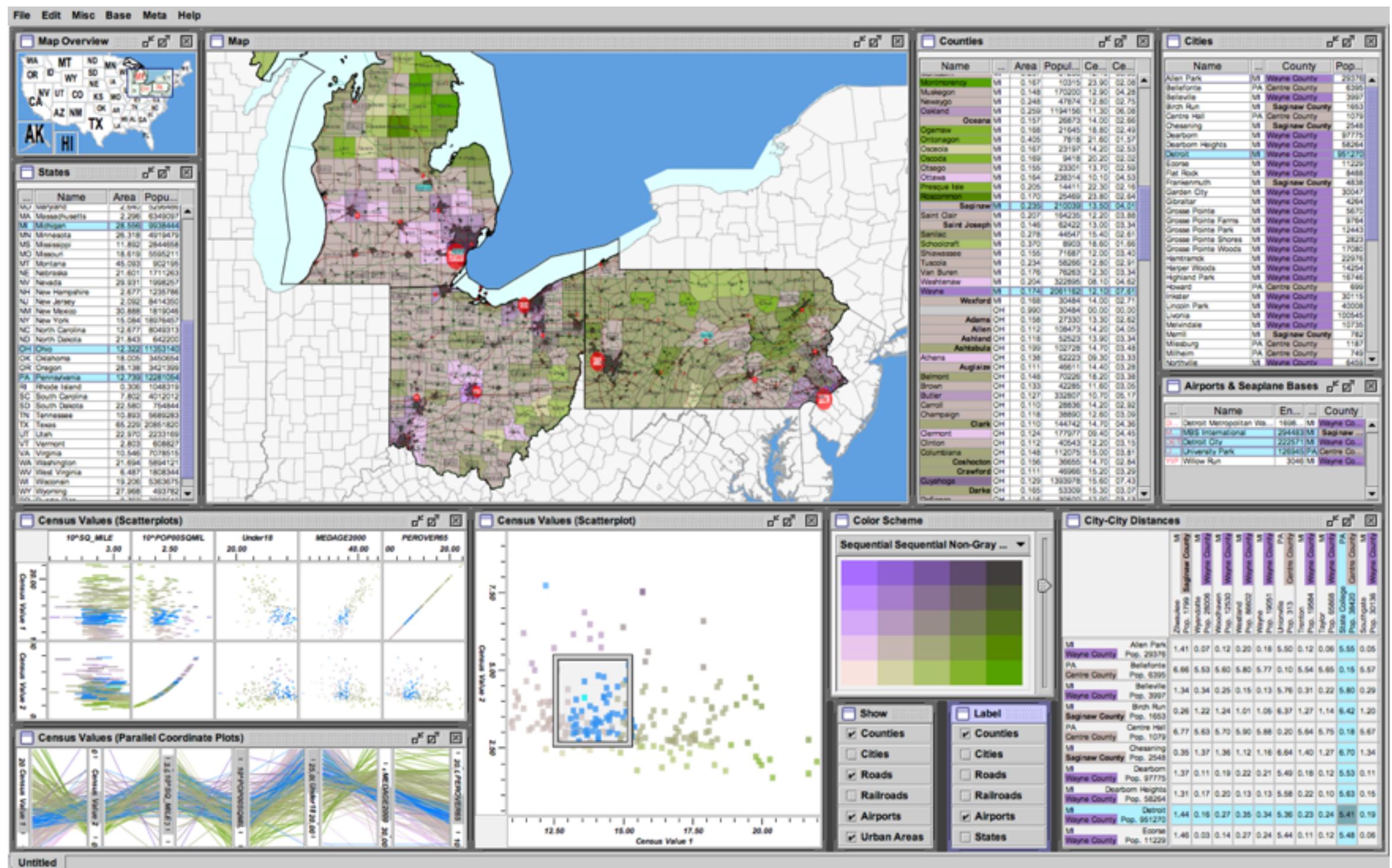
Coordinate views: Design choice interaction



- why juxtapose views?
 - benefits: eyes vs memory
 - lower cognitive load to move eyes between 2 views than remembering previous state with single changing view
 - costs: display area, 2 views side by side each have only half the area of one view

System: Improvise

- investigate power of multiple views
 - pushing limits on view count, interaction complexity
 - how many is ok?
 - open research question
 - reorderable lists
 - easy lookup
 - useful when linked to other encodings



[Building Highly-Coordinated Visualizations In Improvise. Weaver. Proc. IEEE Symp. Information Visualization (InfoVis), pp. 159–166, 2004.]

Superimpose layers

- *layer*: set of objects spread out over region

- each set is visually distinguishable group

- extent: whole view

→ Superimpose Layers

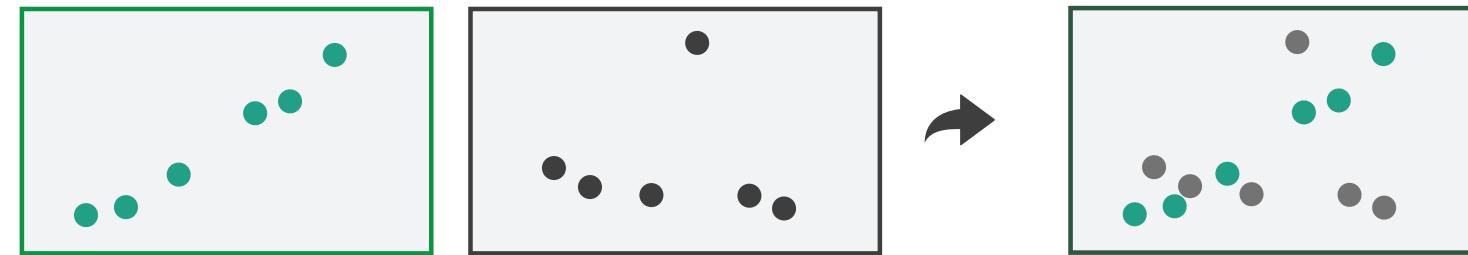
- design choices

- how many layers, how to distinguish?

- encode with different, nonoverlapping channels

- two layers achievable, three with careful design

- small static set, or dynamic from many possible?



Static visual layering

- foreground layer: roads
 - hue, size distinguishing main from minor
 - high luminance contrast from background
- background layer: regions
 - desaturated colors for water, parks, land areas
- user can selectively focus attention
- “get it right in black and white”
 - check luminance contrast with greyscale view

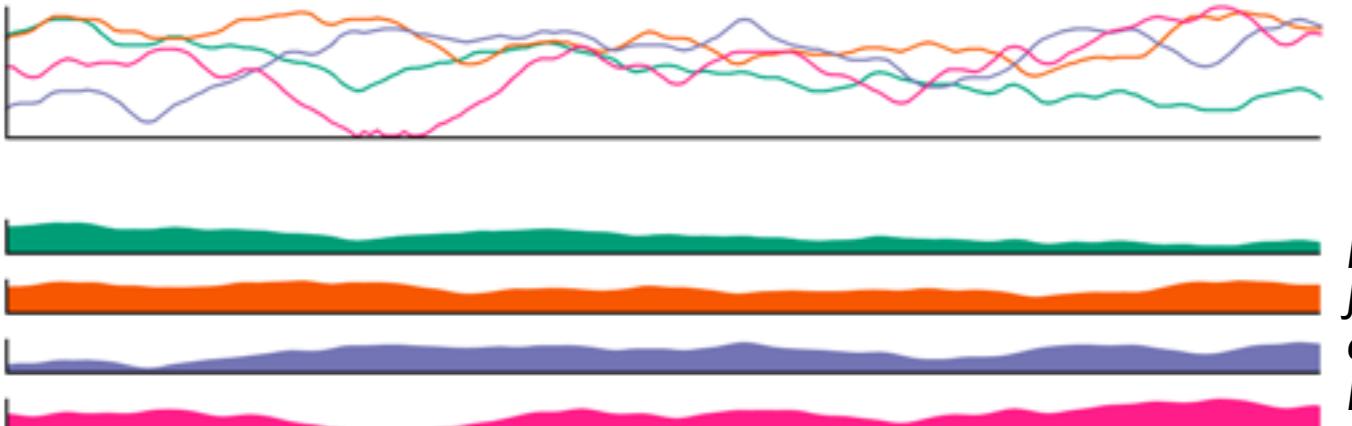


[Get it right in black and white. Stone. 2010.

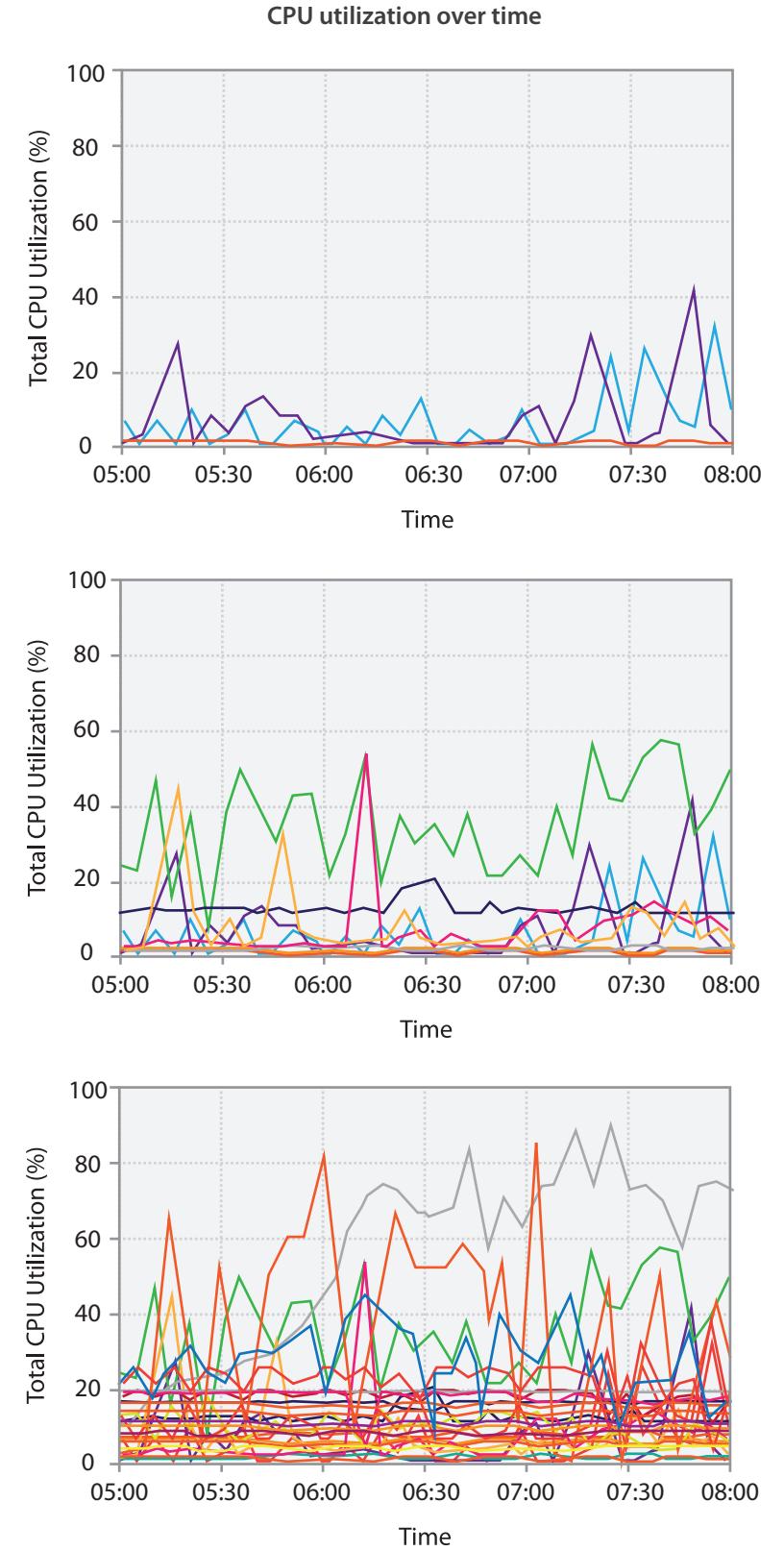
<http://www.stonesc.com/wordpress/2010/03/get-it-right-in-black-and-white>]

Superimposing limits

- few layers, but many lines
 - up to a few dozen
 - but not hundreds
- superimpose vs juxtapose: empirical study
 - superimposed for local, multiple for global
 - tasks
 - local: maximum, global: slope, discrimination
 - same screen space for all multiples vs single superimposed



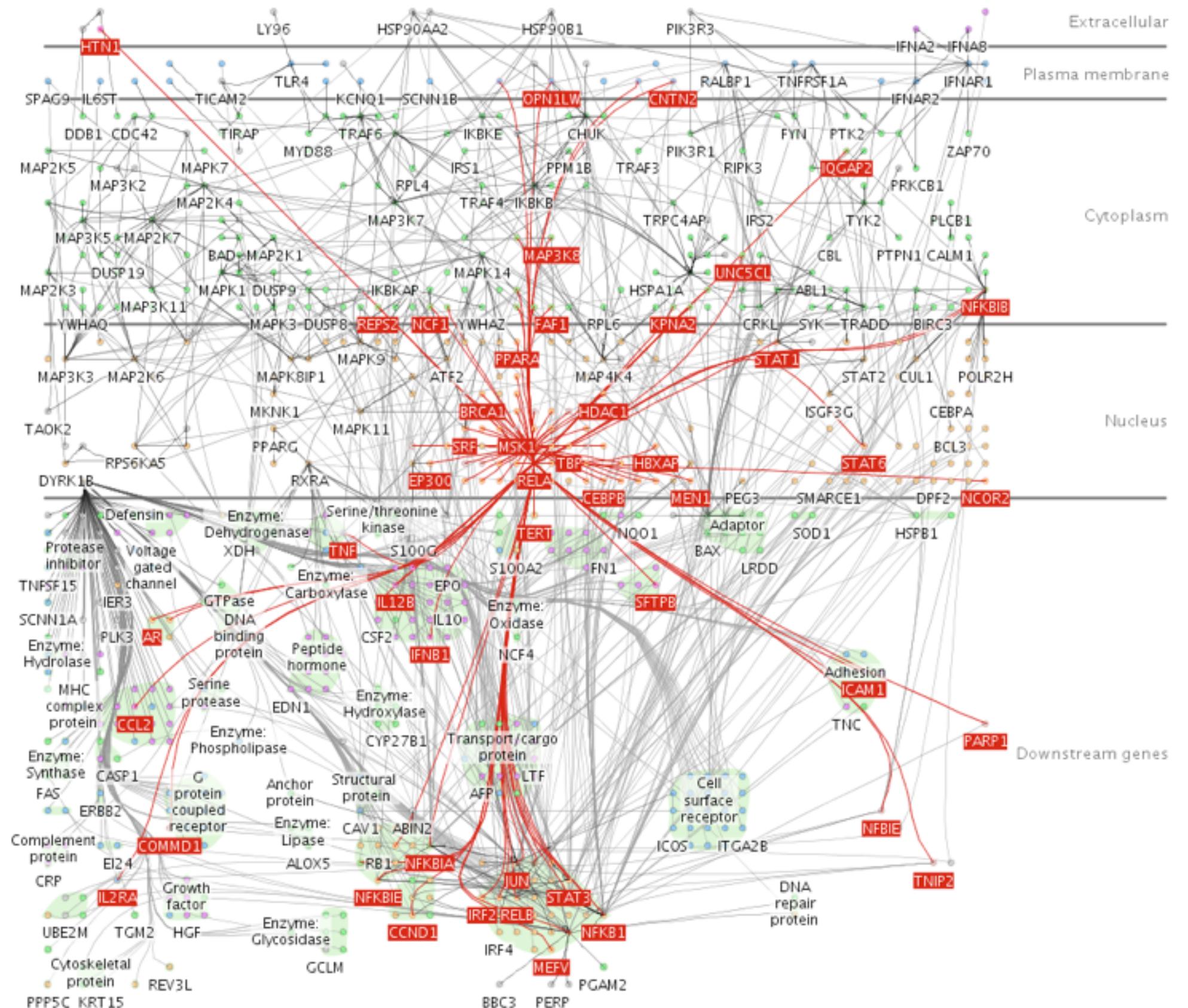
[Graphical Perception of Multiple Time Series.
Javed, McDonnel, and Elmquist. IEEE Transactions
on Visualization and Computer Graphics (Proc.
IEEE InfoVis 2010) 16:6 (2010), 927–934.]



Dynamic visual layering

System: Cerebral

- interactive, from selection
 - lightweight: click
 - very lightweight: hover
 - ex: 1-hop neighbors



[Cerebral: a Cytoscape plugin for layout of and interaction with biological networks using subcellular localization annotation. Barsky, Gardy, Hancock, and Munzner. Bioinformatics 23:8 (2007), 1040–1042.]