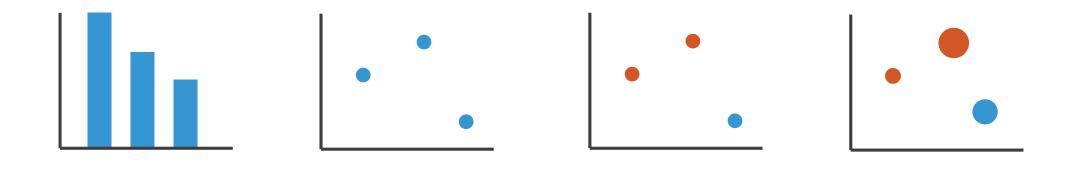
Marks and Channels

Visual Encoding

how to systematically analyze idiom structure?



- marks & channels
 - marks: represent items or links
 - channels: change appearance of marks based on attributes

Marks for Items

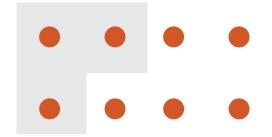
• Basic geometric elements



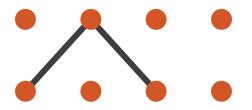
• 3D mark, volume, rarely used

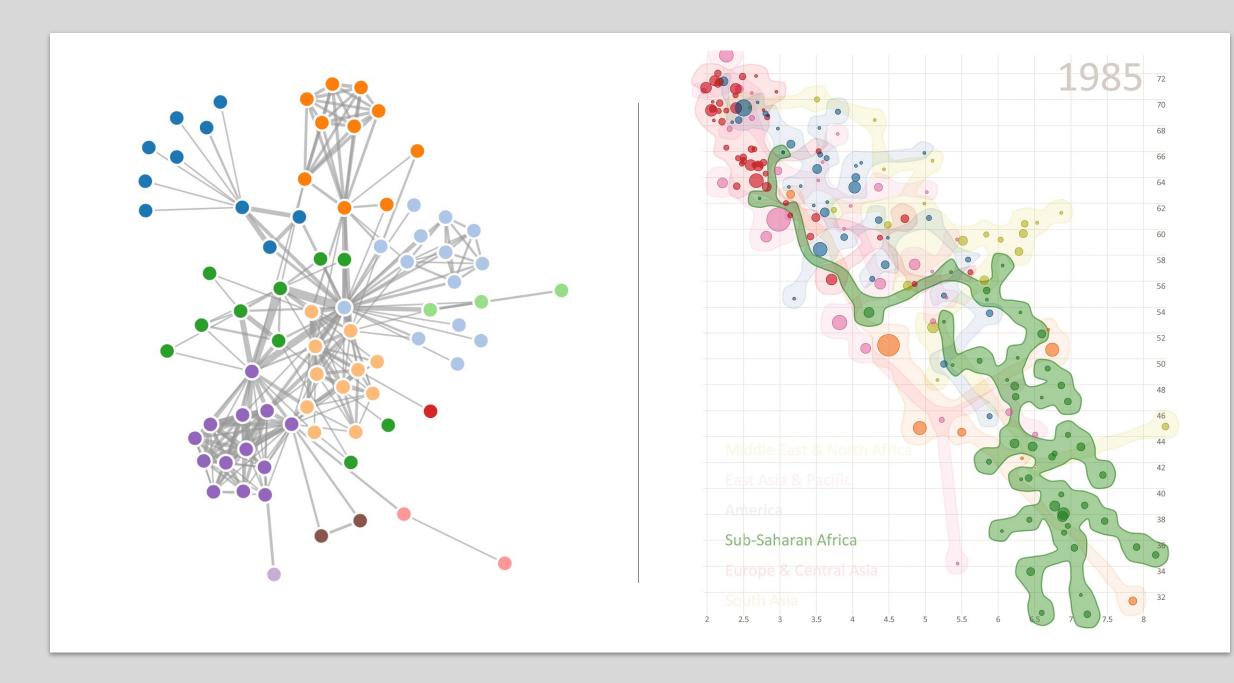
Marks for Links



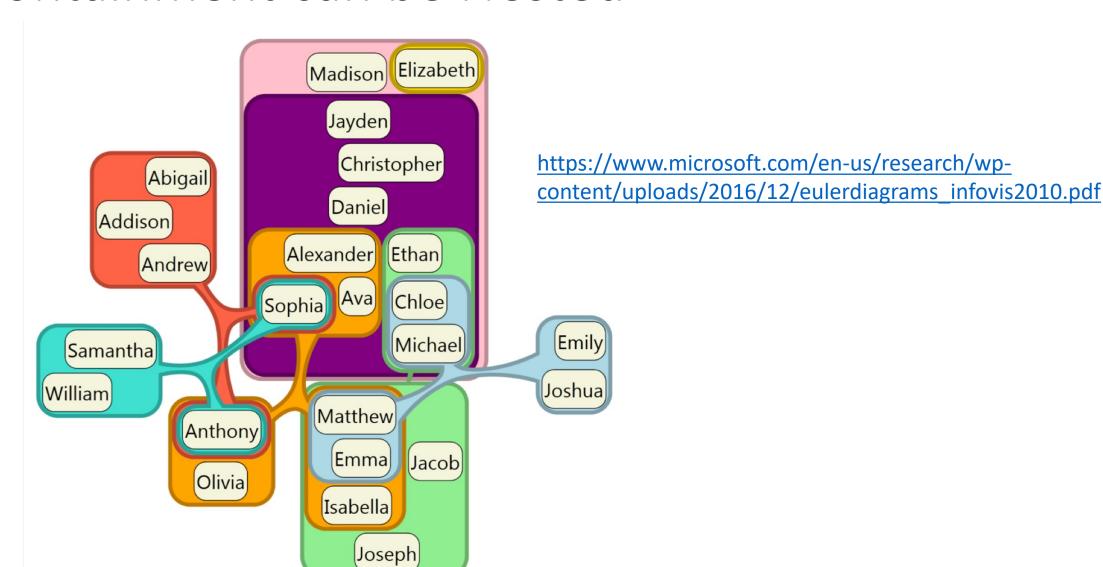


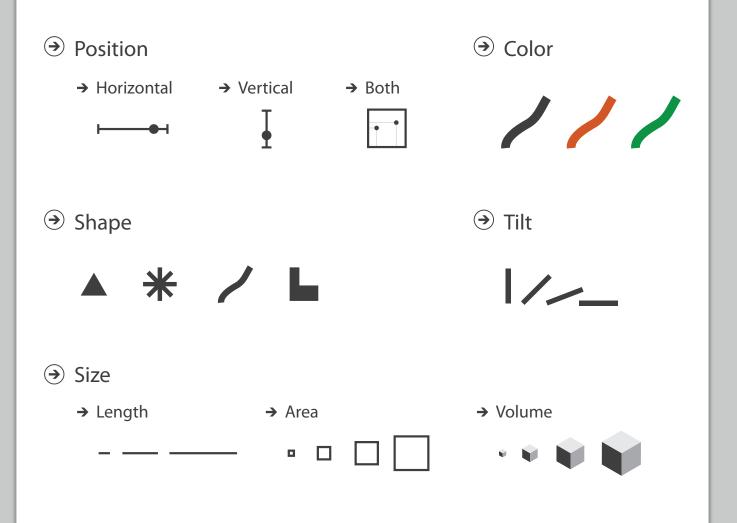






Containment can be Nested



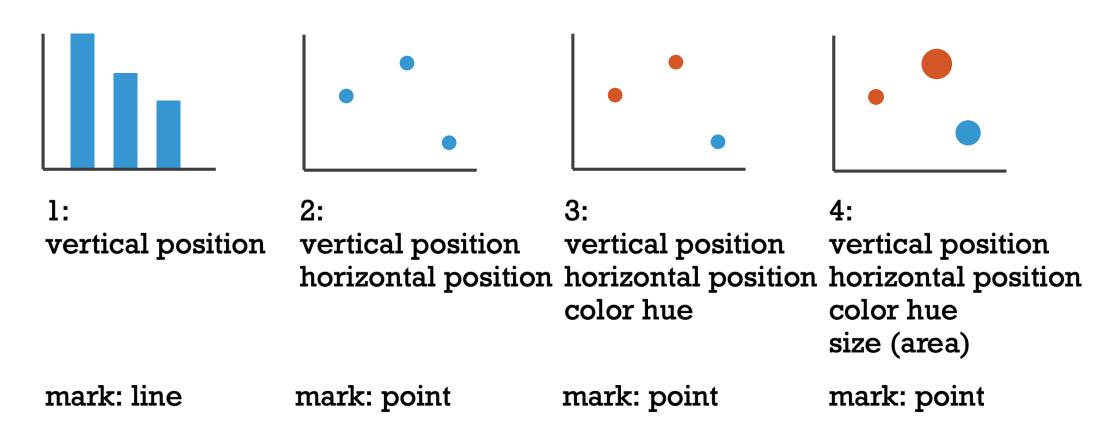


Channels

- control appearance of marks
 - proportional to or based on attributes
- many names
 - visual channels
 - visual variables
 - retinal channels
 - visual dimensions

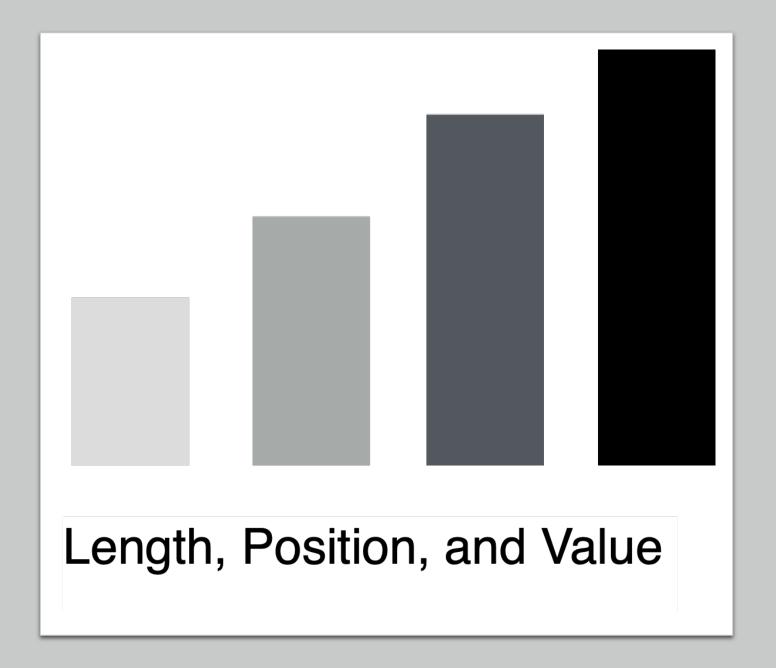
Visual Encoding

- analyze idiom structure
 - as combination of marks and channels



Redundant Encoding

- multiple channels
 - sends stronger message
 - but uses up channels



Spot the Problem



https://twitter.com/ChaseThomason/status/1118478036507164672

When to use which channel?

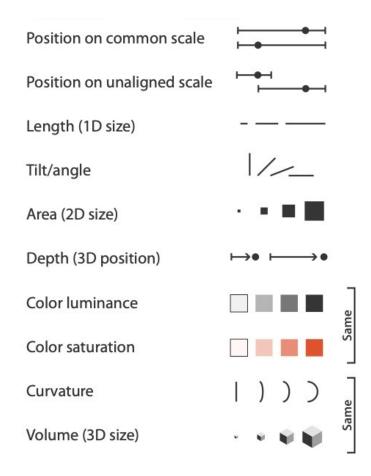
expressiveness

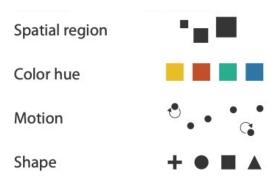
match channel type to data type

effectiveness

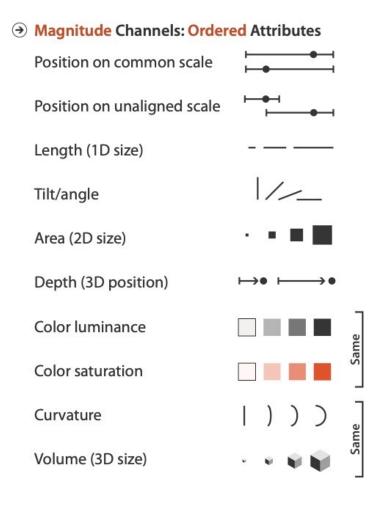
some channels are better than others

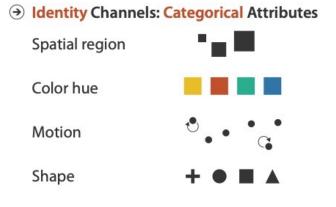
Channels





Channels: Matching Types

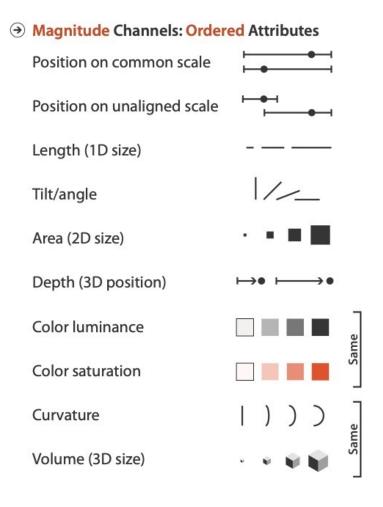


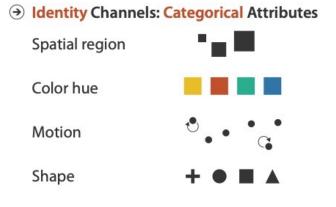


expressiveness principle

- match channel and data characteristics
 - magnitude for ordered
 - how much? which rank?
 - identity for categorical
 - what?

Channels: Matching Types

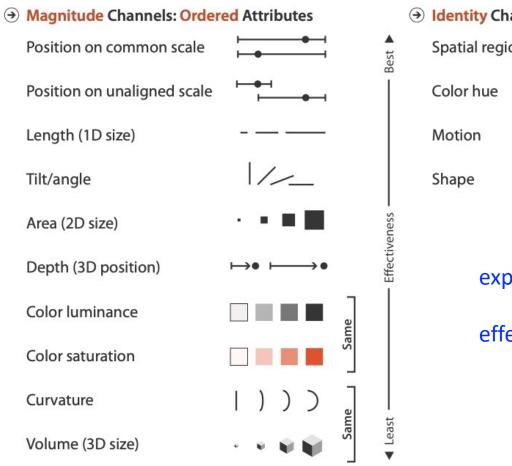




expressiveness principle

- match channel and data characteristics
 - magnitude for ordered
 - how much? which rank?
 - identity for categorical
 - what?

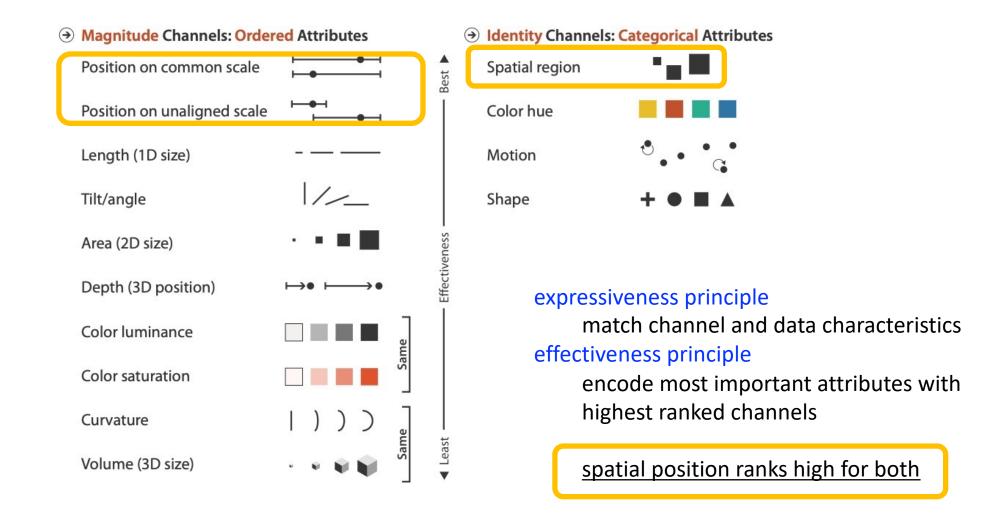
Channels: Rankings



match channel and data characteristics effectiveness principle

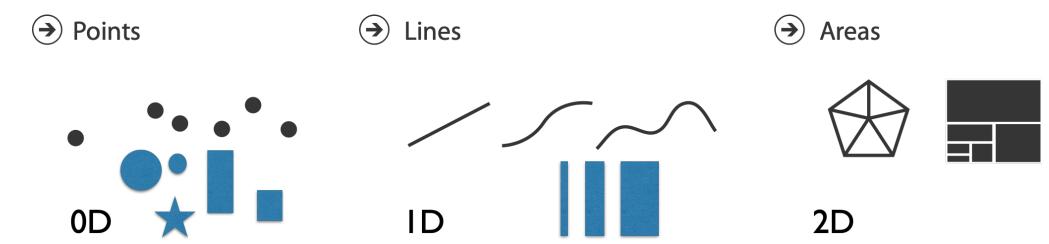
encode most important attributes with highest ranked channels

Channels: Rankings



Marks: Constrained vs Encodable

math view: geometric primitives have dimensions



- constraint view: mark type constrains what else can be encoded
 - points: 0 constraints on size, can encode more attributes w/ size & shape
 - lines: 1 constraint on size (length), can still size code other way (width)
 - areas: 2 constraints on size (length/width), cannot use size code or shape code

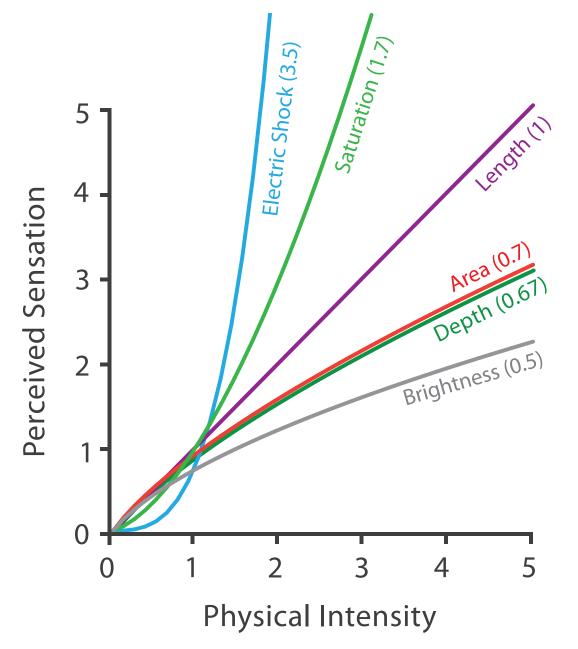
Channel Effectiveness

- Accuracy:
 - how precisely can we tell the difference between encoded items?
- Discriminability:
 - how many unique steps can we perceive?
- Separability:
 - is our ability to use this channel affected by another one?
- Popout:
 - can things jump out using this channel?

Accuracy: Fundamental Theory

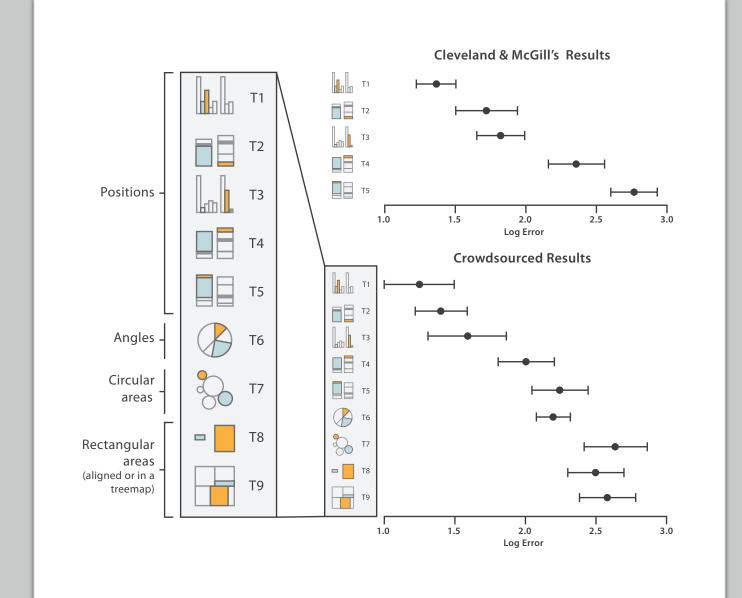
- length is accurate: linear
- others magnified or compressed
 - exponent characterizes

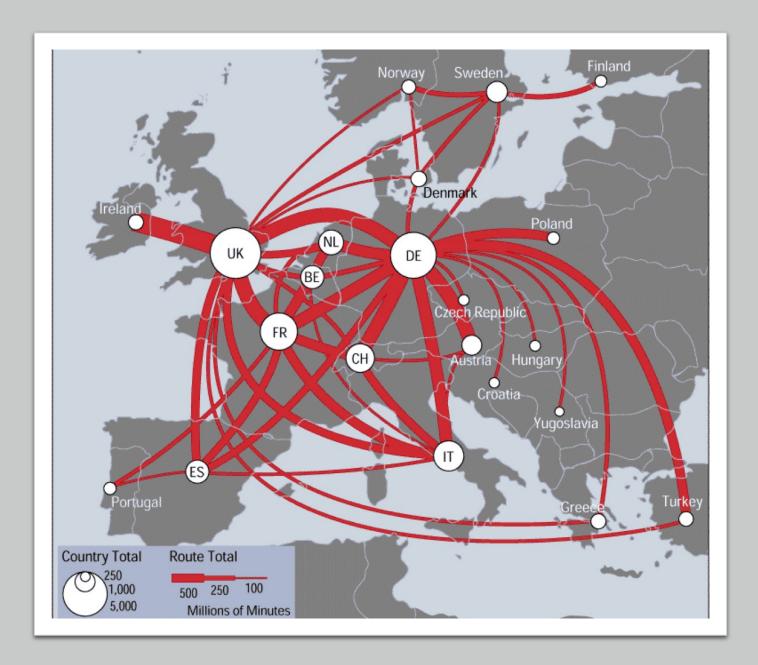
- S = sensation
- I = intensity



Accuracy: Visualization Experiments

 [Crowdsourcing Graphical Perception: Using Mechanical Turk to Assess Visualization Design. Heer and Bostock. Proc ACM Conf. Human Factors in Computing Systems (CHI) 2010, p. 203–212.]



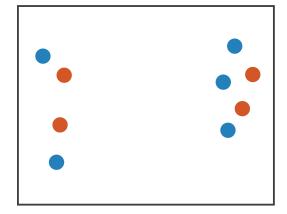


Discriminability: How many usable steps?

- must be sufficient for number of attribute levels to show
 - linewidth: few bins but salient

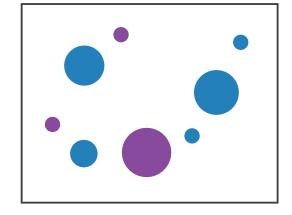
Separability vs. Integrality

Position + Hue (Color)



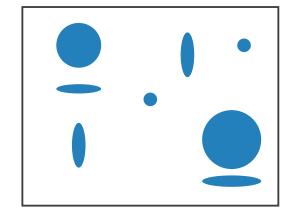
Fully separable

Size
+ Hue (Color)



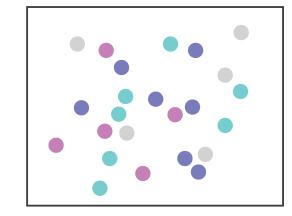
Some interference

Width + Height



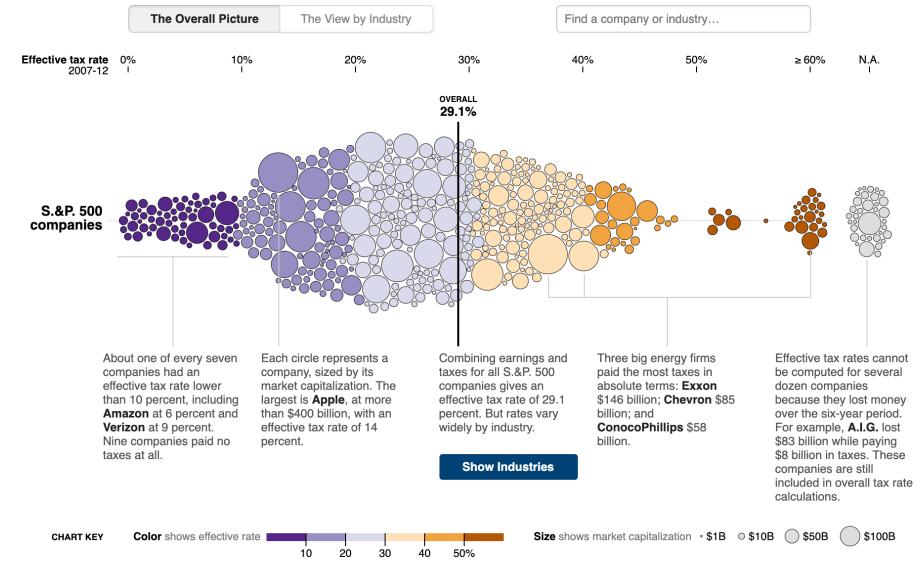
Some/significant interference

Red + Green



Major interference

Group Discussion: Marks / Channel?



https://archive.nytimes.com/www.nytimes.com/interactive/2013/05/25/sunday-review/corporate-taxes.html