



# EFFECTIVE VISUALISATION DESIGN FOR RESEARCH

max

{dr daniel ellis}

@danellisscience



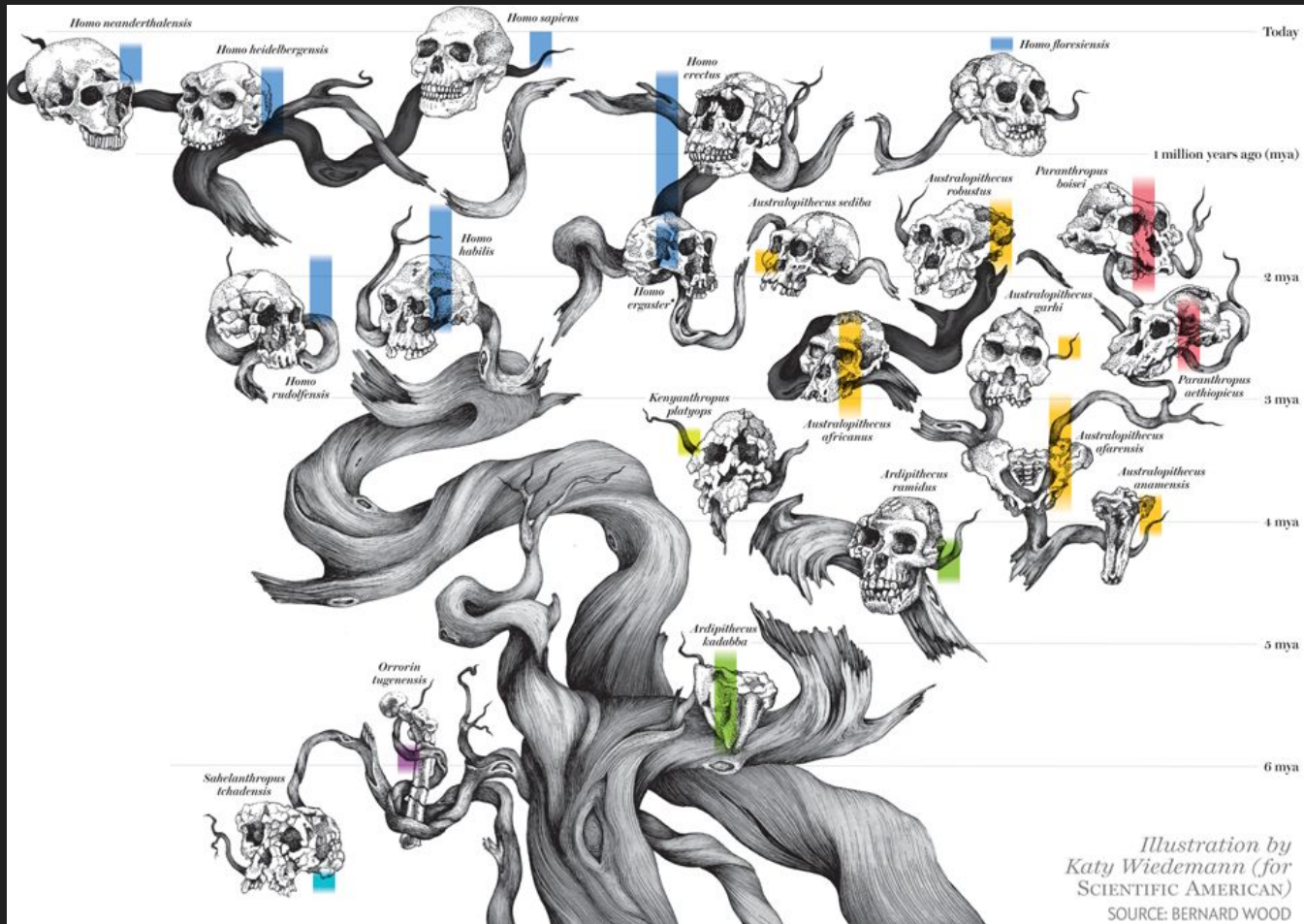


Illustration by  
 Katy Wiedemann (for  
 SCIENTIFIC AMERICAN)  
 SOURCE: BERNARD WOOD

# Stories and Storytelling

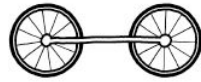
# TIMELINE OF BICYCLE DESIGN



1810



1825



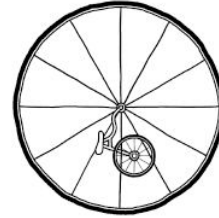
1840



1860



1875



1880



1900



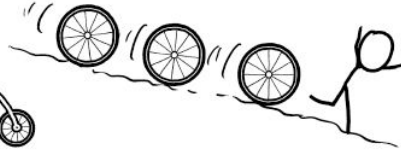
1915



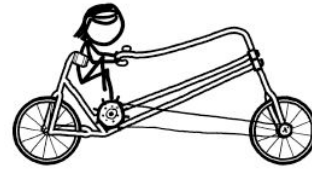
1925



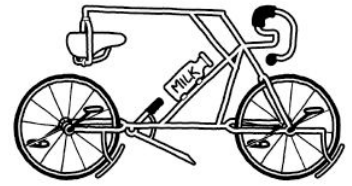
1940



1955



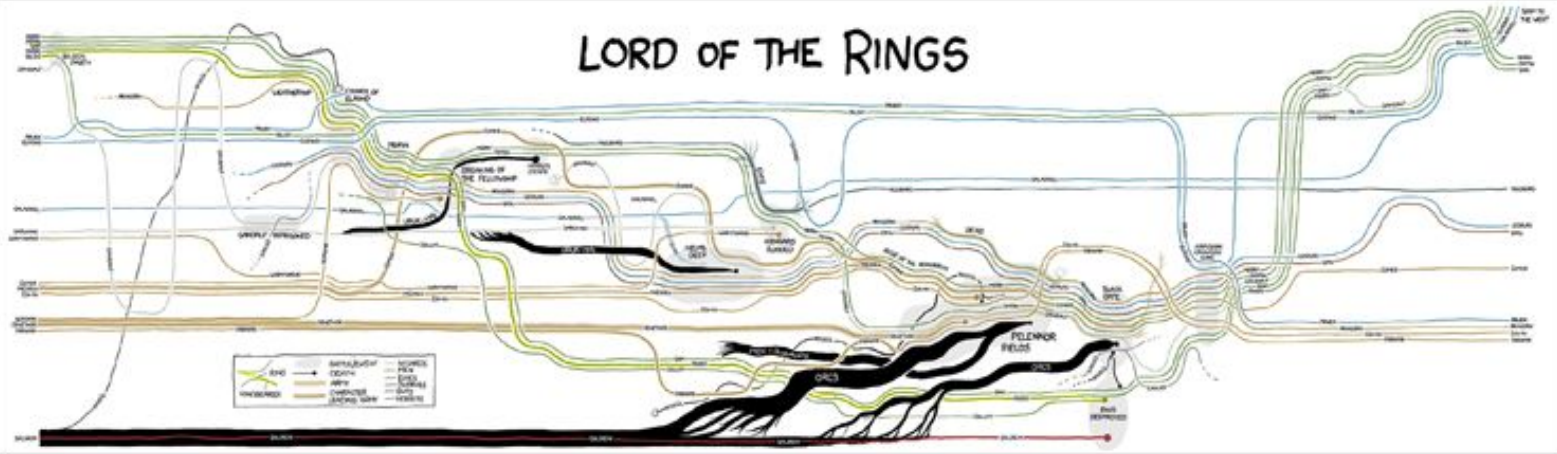
1980



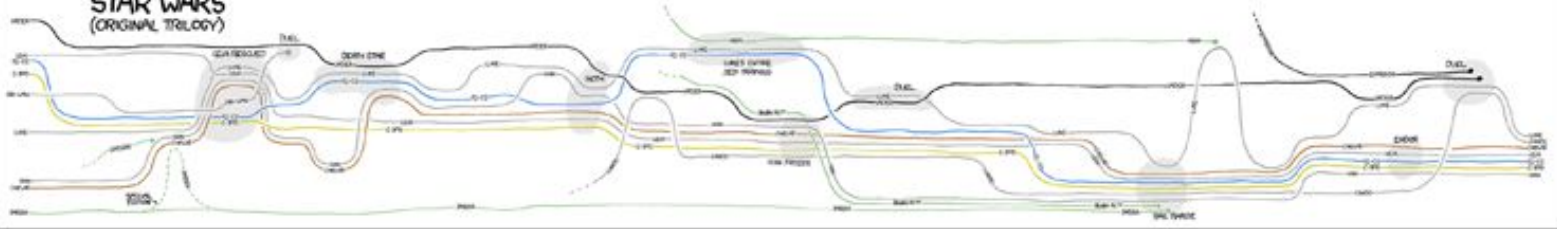
2016

THESE CHARTS SHOW MOVIE CHARACTER INTERACTIONS.  
 THE HORIZONTAL AXIS IS TIME. THE VERTICAL GROUPING OF THE  
 LINES INDICATES WHICH CHARACTERS ARE TOGETHER AT A GIVEN TIME.

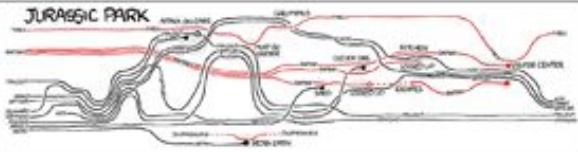
## LORD OF THE RINGS



## STAR WARS (ORIGINAL TRILOGY)



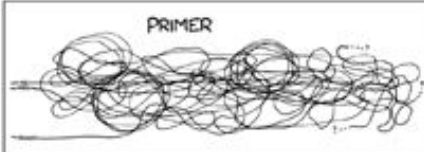
## JURASSIC PARK



## 12 ANGRY MEN



## PRIMER



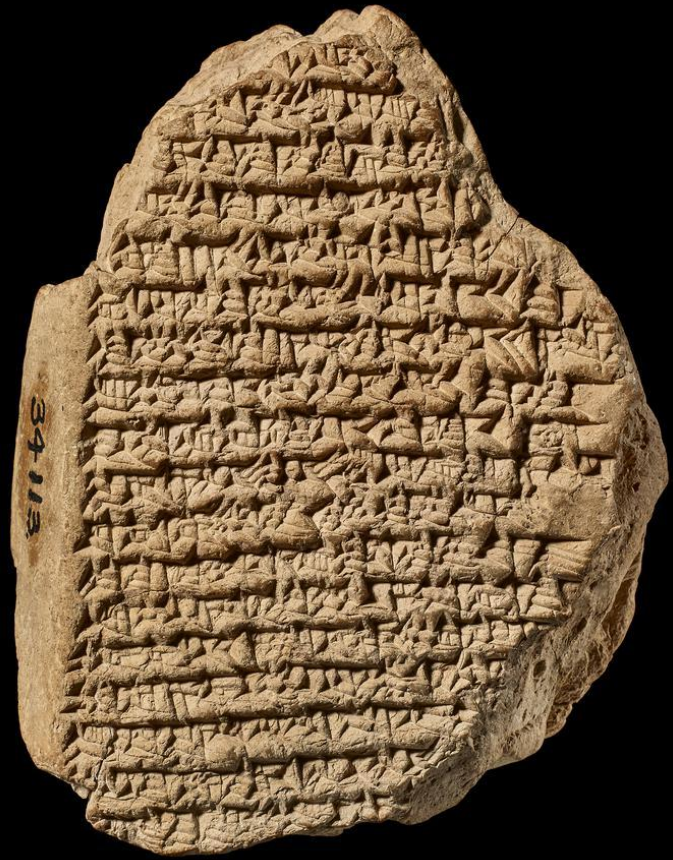


Newspaper Rock - Utah

However as tribe sizes begin to **grow**....

...so do problems with data and accounting





Cuneiform Tablet | British Museum

This consists of the first form of  
data visualisation

# Design and Selection

# Natural Metaphors



Dendrochronology: [\[source url\]](#)



## Man-Made Metaphors





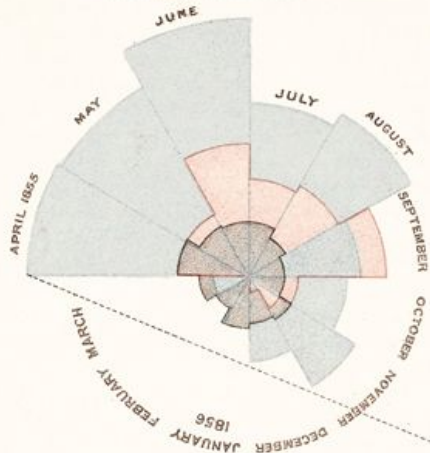


Henry Beck

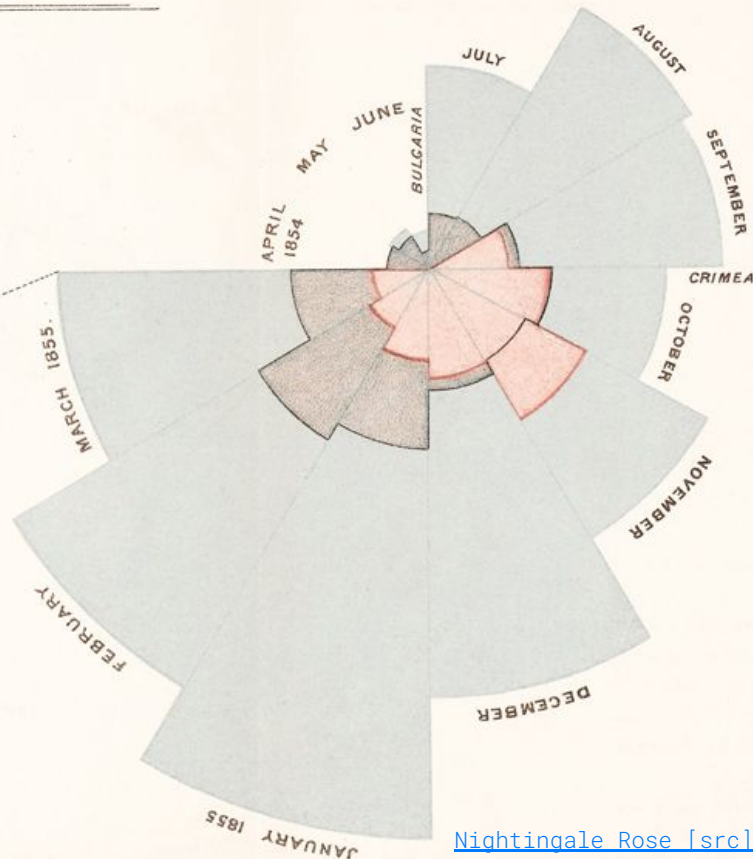
# Composite Metaphors

# DIAGRAM OF THE CAUSES OF MORTALITY IN THE ARMY IN THE EAST.

2.  
APRIL 1855 TO MARCH 1856.



1.  
APRIL 1854 TO MARCH 1855.



*e* Areas of the blue, red, & black wedges are each measured from the centre as the common vertex.

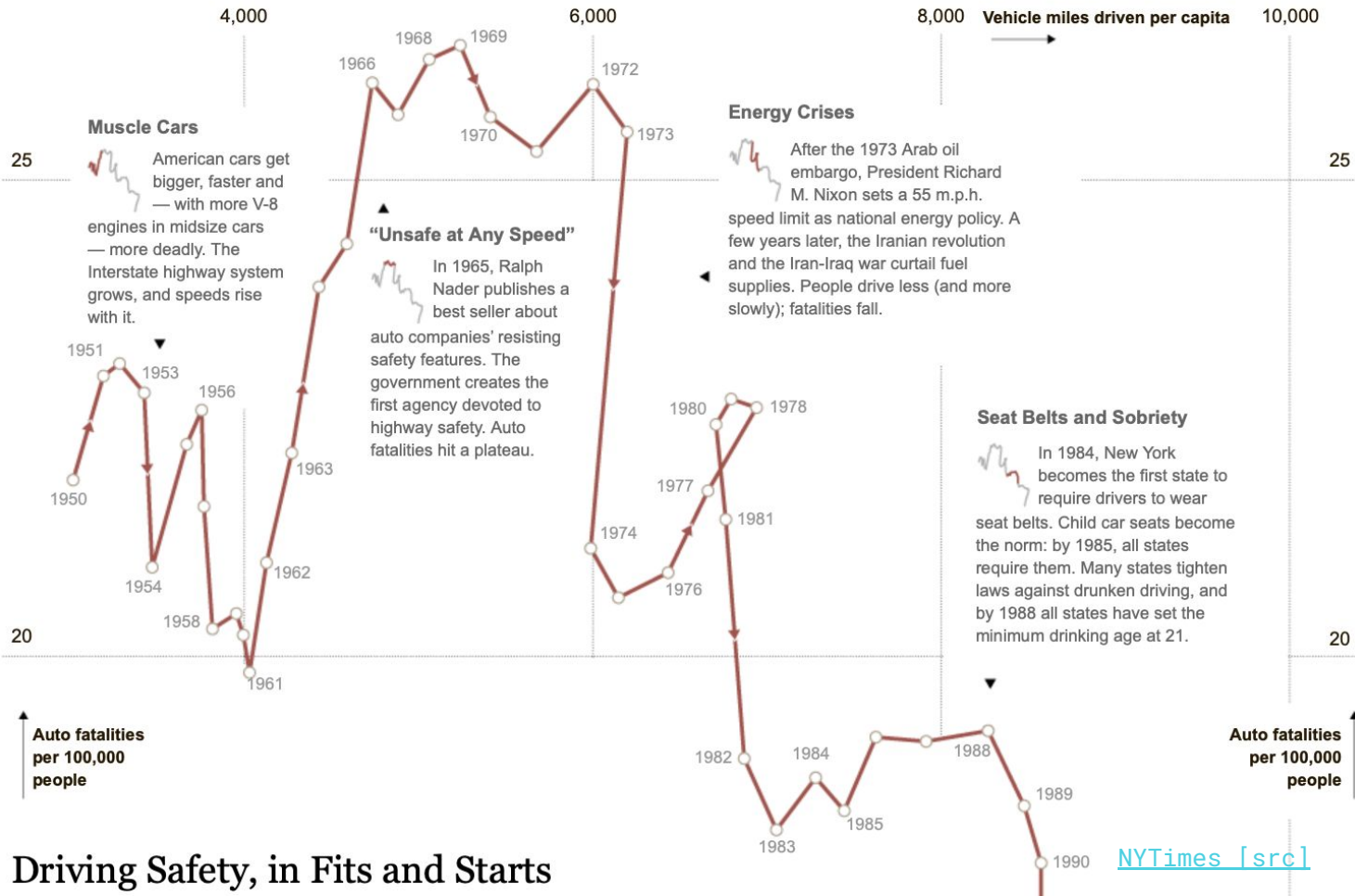
*e* blue wedges measured from the centre of the circle represent area for area the deaths from Preventable or Mitigable Zymotic diseases, the red wedges measured from the centre the deaths from wounds, & the black wedges measured from the centre the deaths from all other causes.

*e* black line across the red triangle in Nov<sup>r</sup> 1854 marks the boundary of the deaths from all other causes during the month.

*e* October 1854, & April 1855, the black area coincides with the red, in January & February 1855, the blue coincides with the black.

*e* entire areas may be compared by following the blue, the red & the

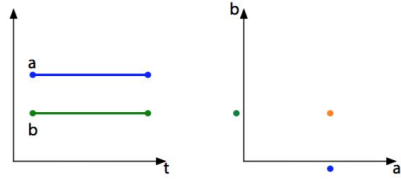
Learnt Behaviours



# Driving Safety, in Fits and Starts

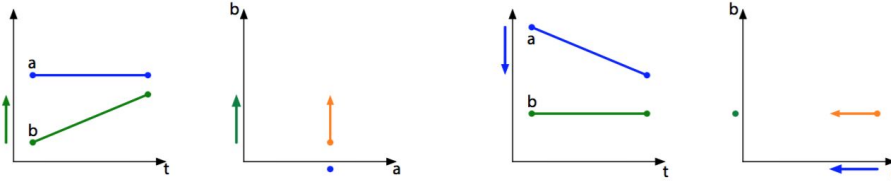
[NYTimes \[src\]](#)

A) Static

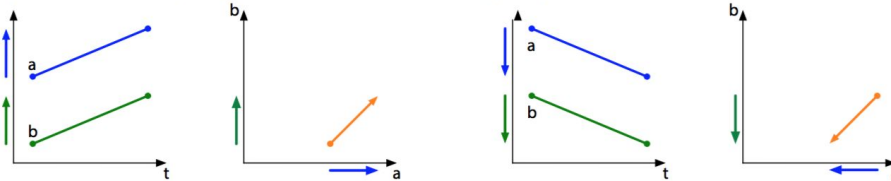


[Paper Link](#)

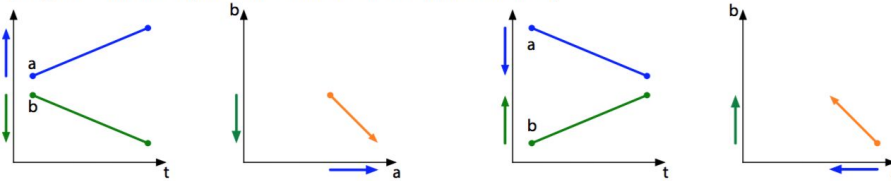
B) Only one series changes



C) Positive correlation (both series increase and decrease together)



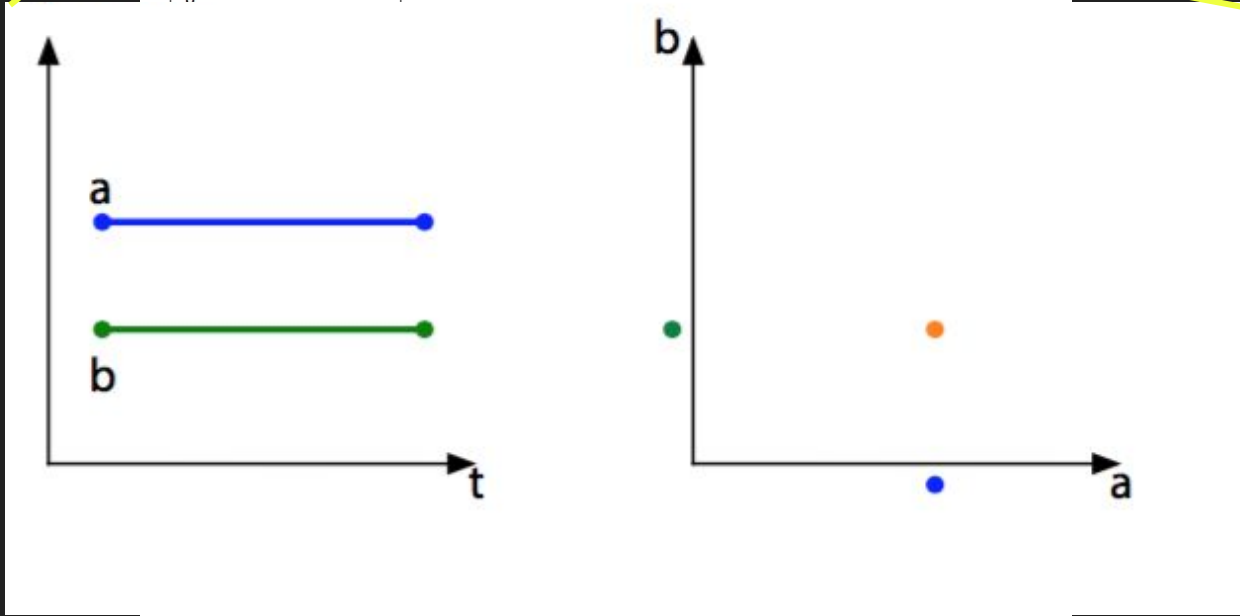
D) Negative correlation (one series increases as the other decreases)



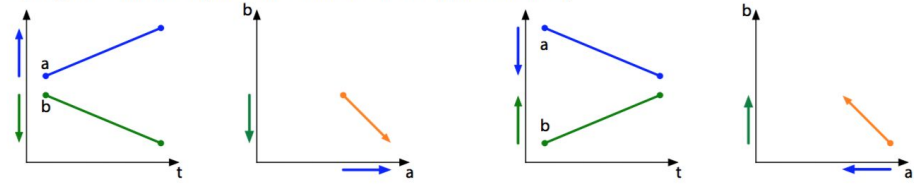
A) Static



[Paper Link](#)



D) Negative correlation (one series increases as the other decreases)



# Syntactics and Semantics



Know your **limits**



**Letter**

5' arc



**Grating**

1-2' arc



**Point**

1' arc



**Stereo**

10'' arc



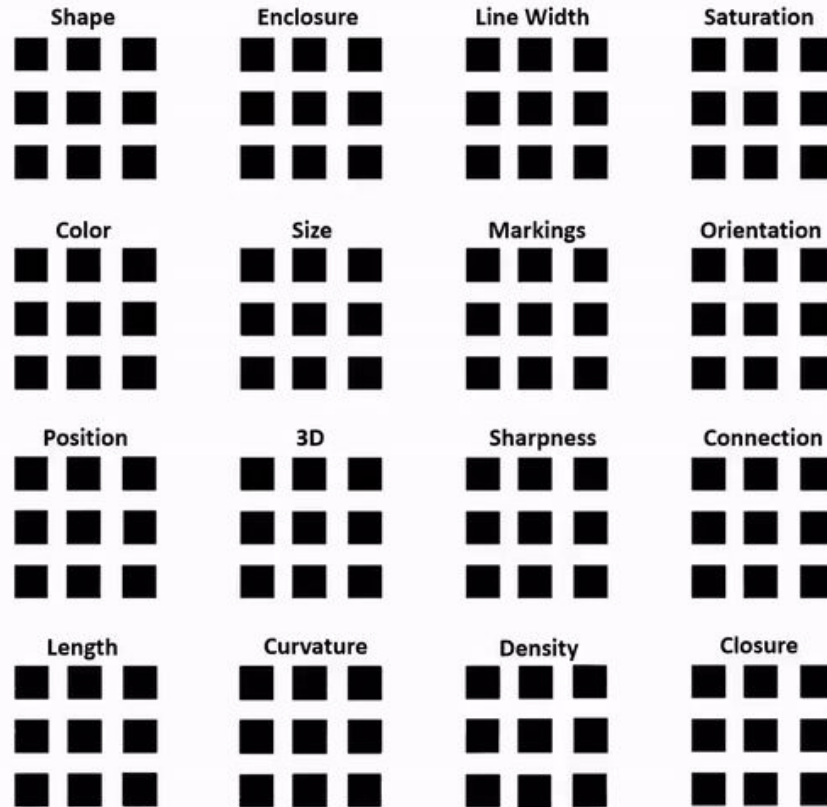
**Vernier**

10'' arc

**Fig. 10.2.** Important acuities in visualization (after Ware [76])

Direct the reader.

# How to Draw Your Audience's Focus in Visuals



w*i*th

Beware of cognitive limits.

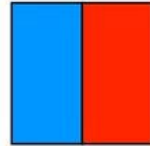
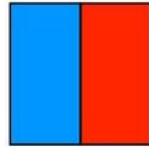
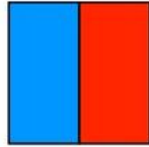
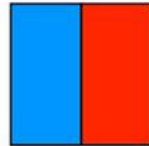
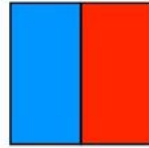
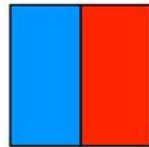
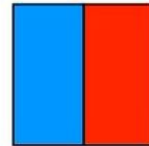
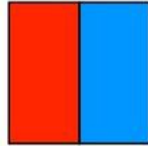
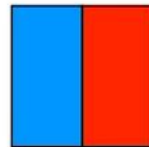
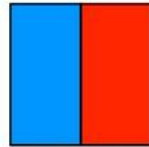
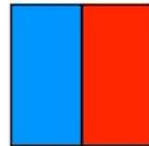
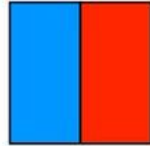
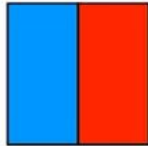
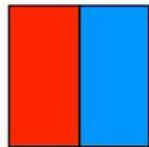
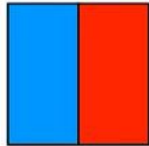
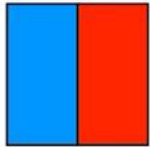
~seconds

**SLOW**



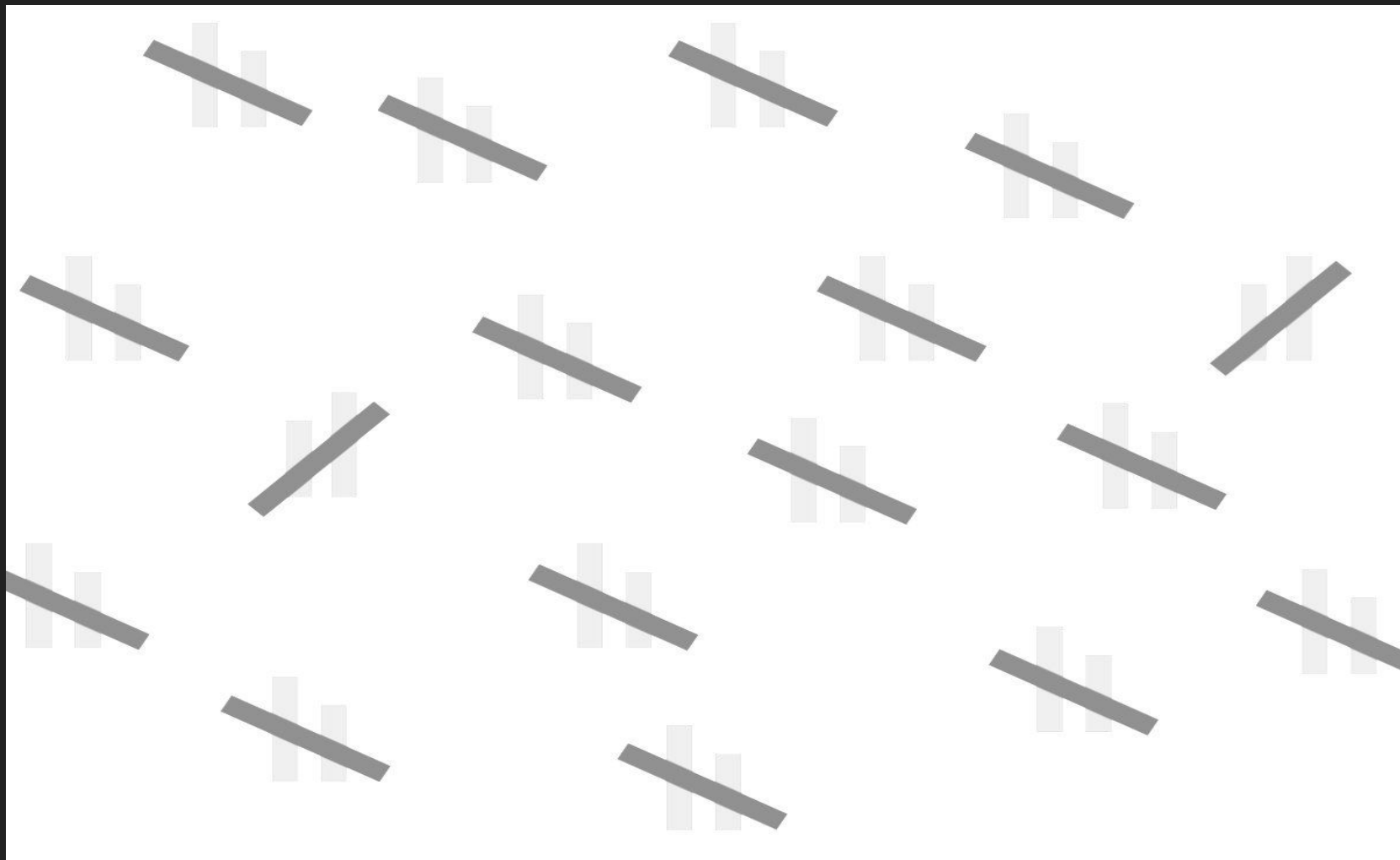
Comparisons

(Left bigger; Right lighter...)









Keep things **simple**

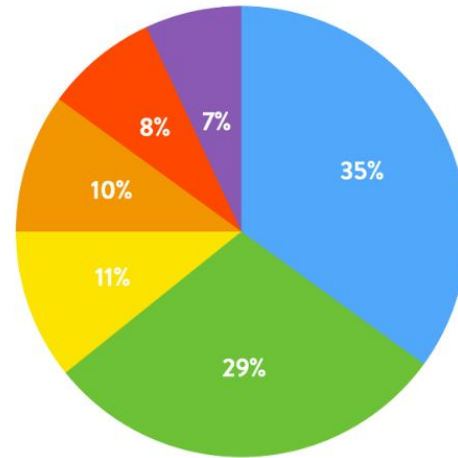


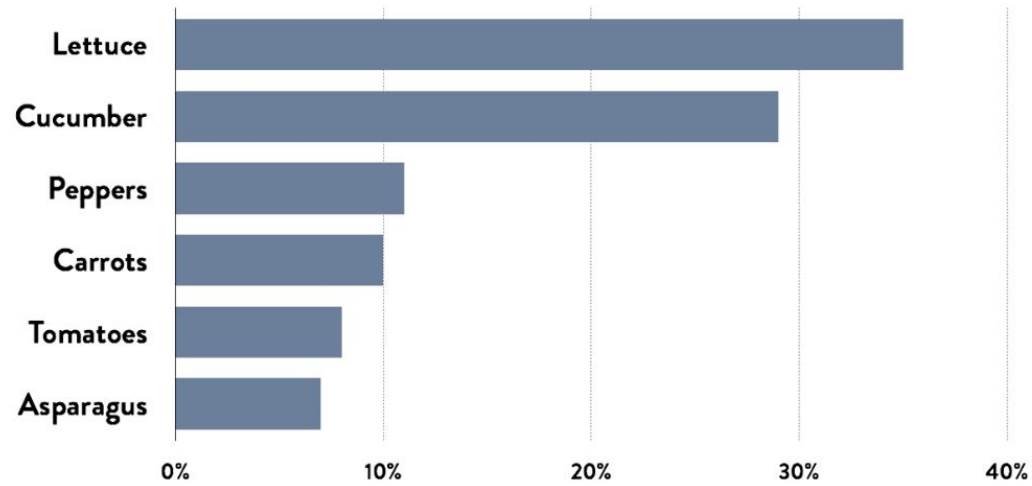
Source Unknown

Don't use `default` blindly.

VEGETABLE	AMOUNT
Lettuce	35%
Cucumber	29%
Peppers	11%
Carrots	10%
Tomatoes	8%
Asparagus	7%

- Lettuce
- Peppers
- Cucumber
- Carrots
- Tomatoes
- Asparagus







**Edward Tufte**

@EdwardTufte



There is no data that can be displayed in a pie chart, that cannot be displayed BETTER in some other type of chart. John Tukey  
[#dashboards](#)

2:33 AM · May 20, 2017 · Twitter Web Client

# User Interface, Colour and Mis-information

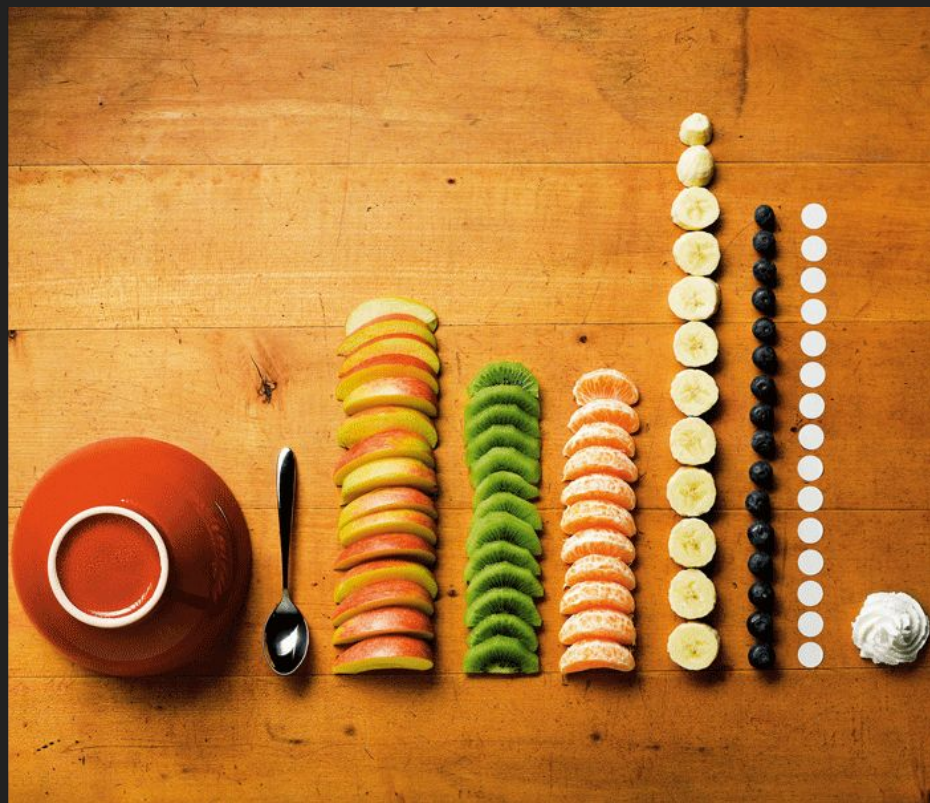


Keep things **simple**



Art of Clean Up: Life Made Neat and Tidy

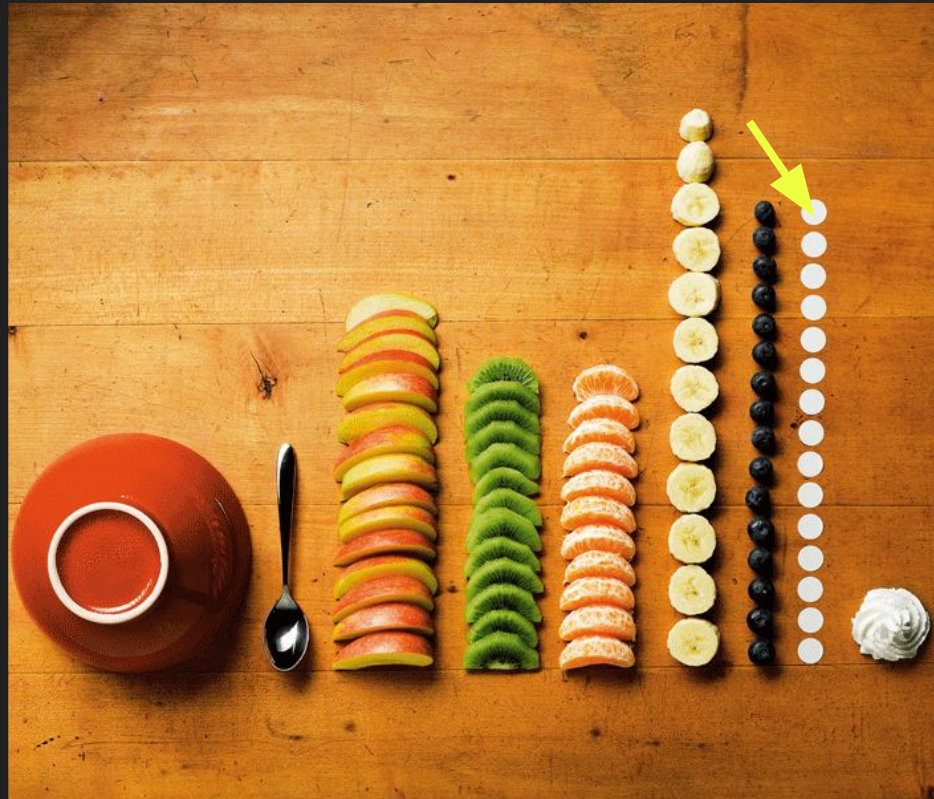
[Ursus Wehri](#)





Art of Clean Up: Life Made Neat and Tidy

Ursus Wehri



Be aware of **misinterpretation**



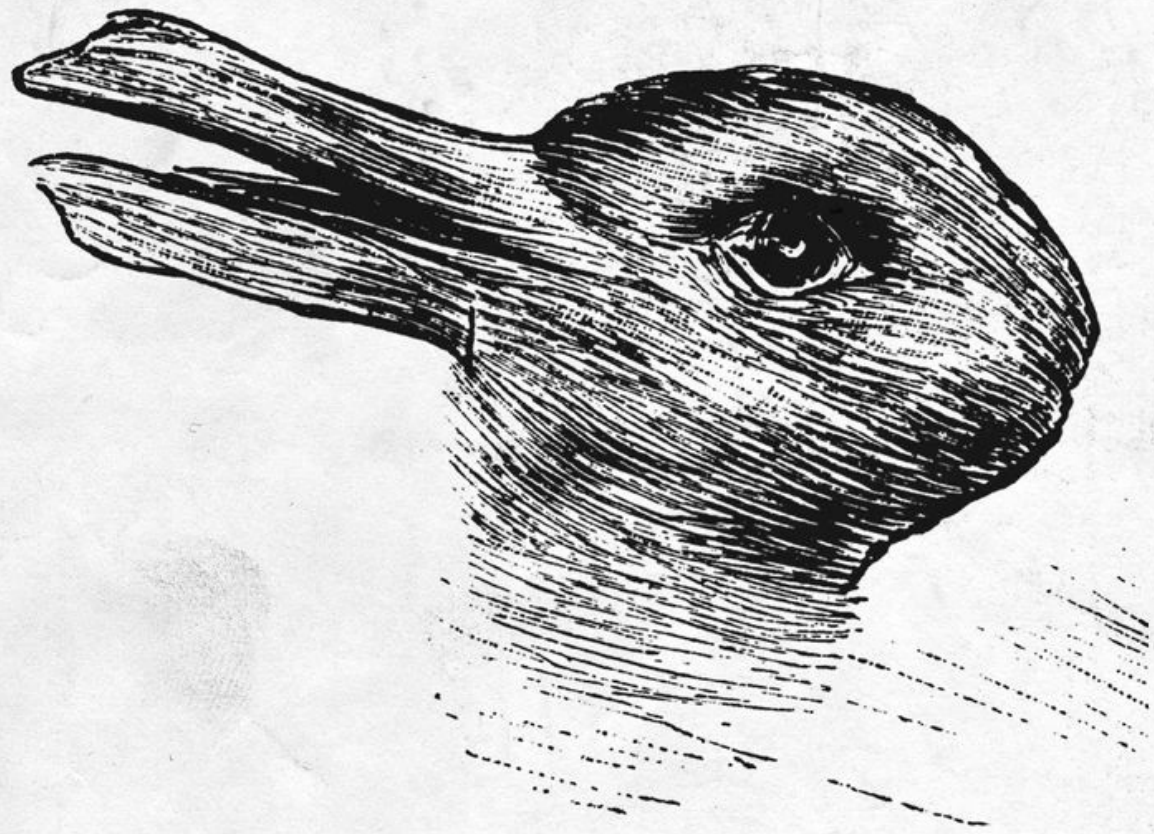


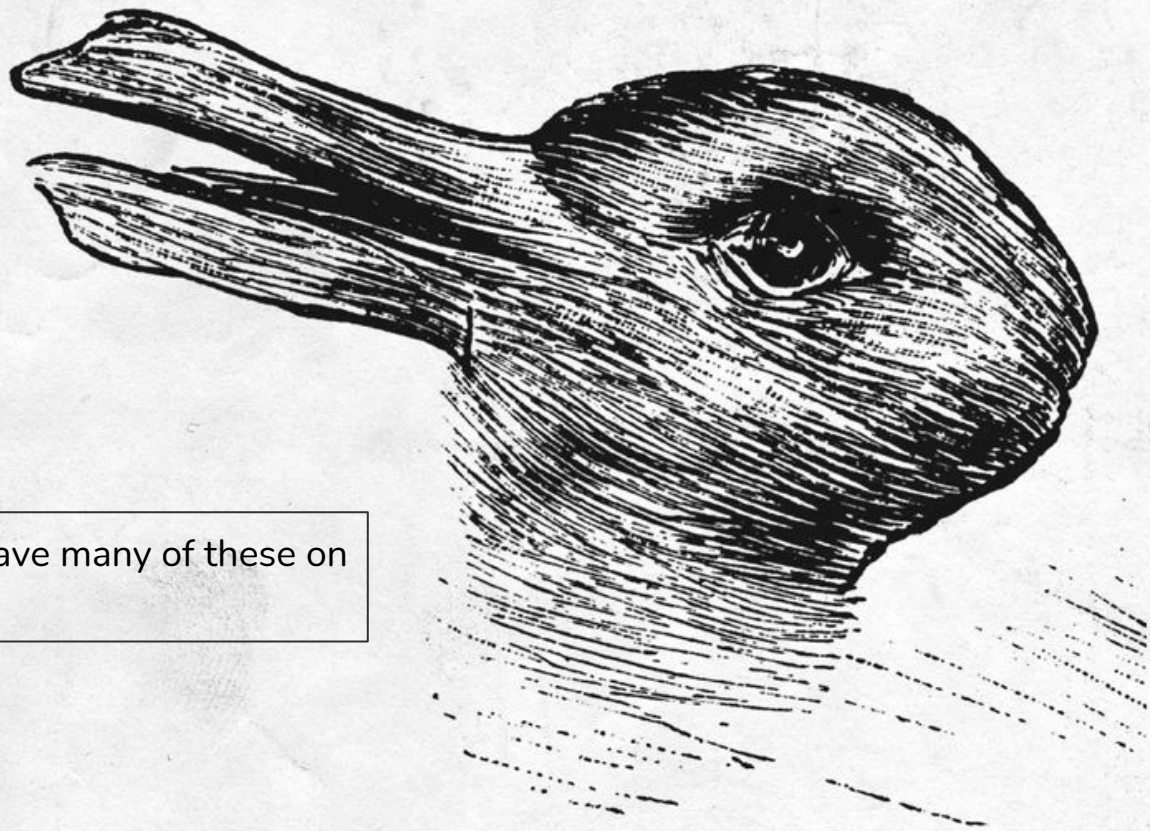
When in doubt:

When in doubt:

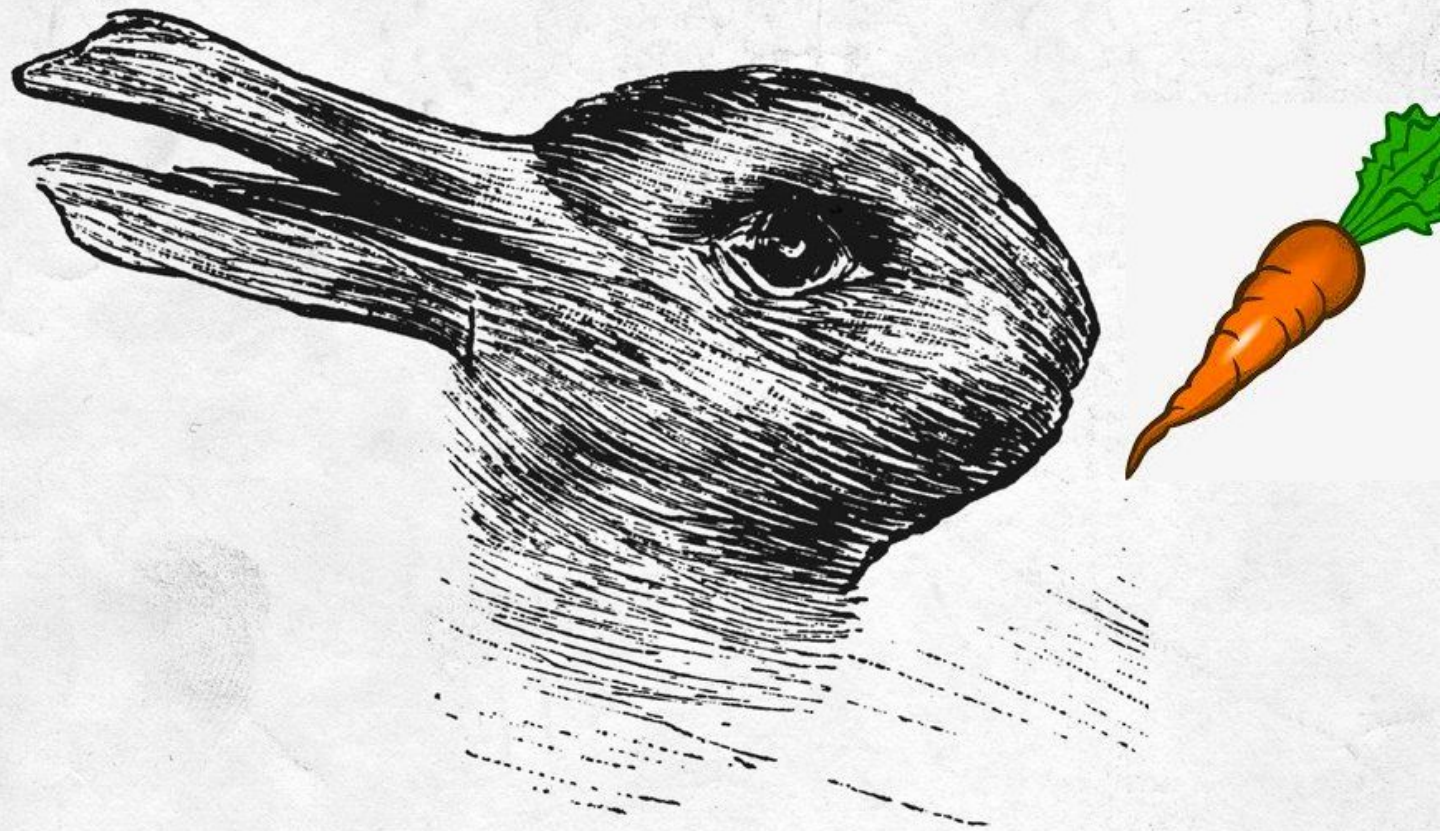
Lend a helping carrot



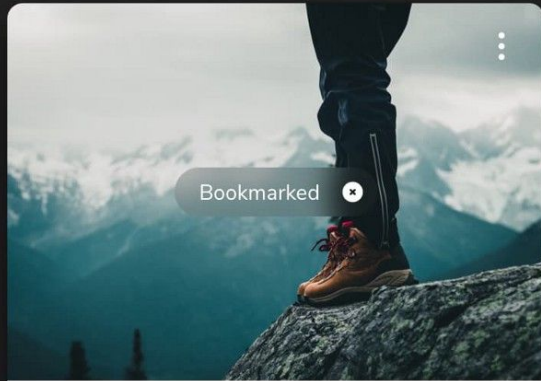




Hint: we have many of these on campus



The same applies to [interface design](#)

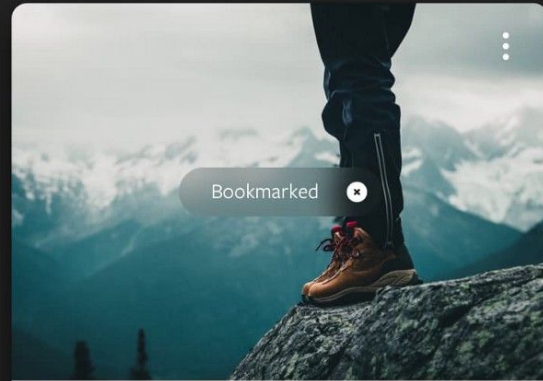


### Mountain Experience for 2



All it takes is real stamina and determination on your part to complete the task at hand and gain knowledge.

**\$360.00**



### Mountain Experience for 2

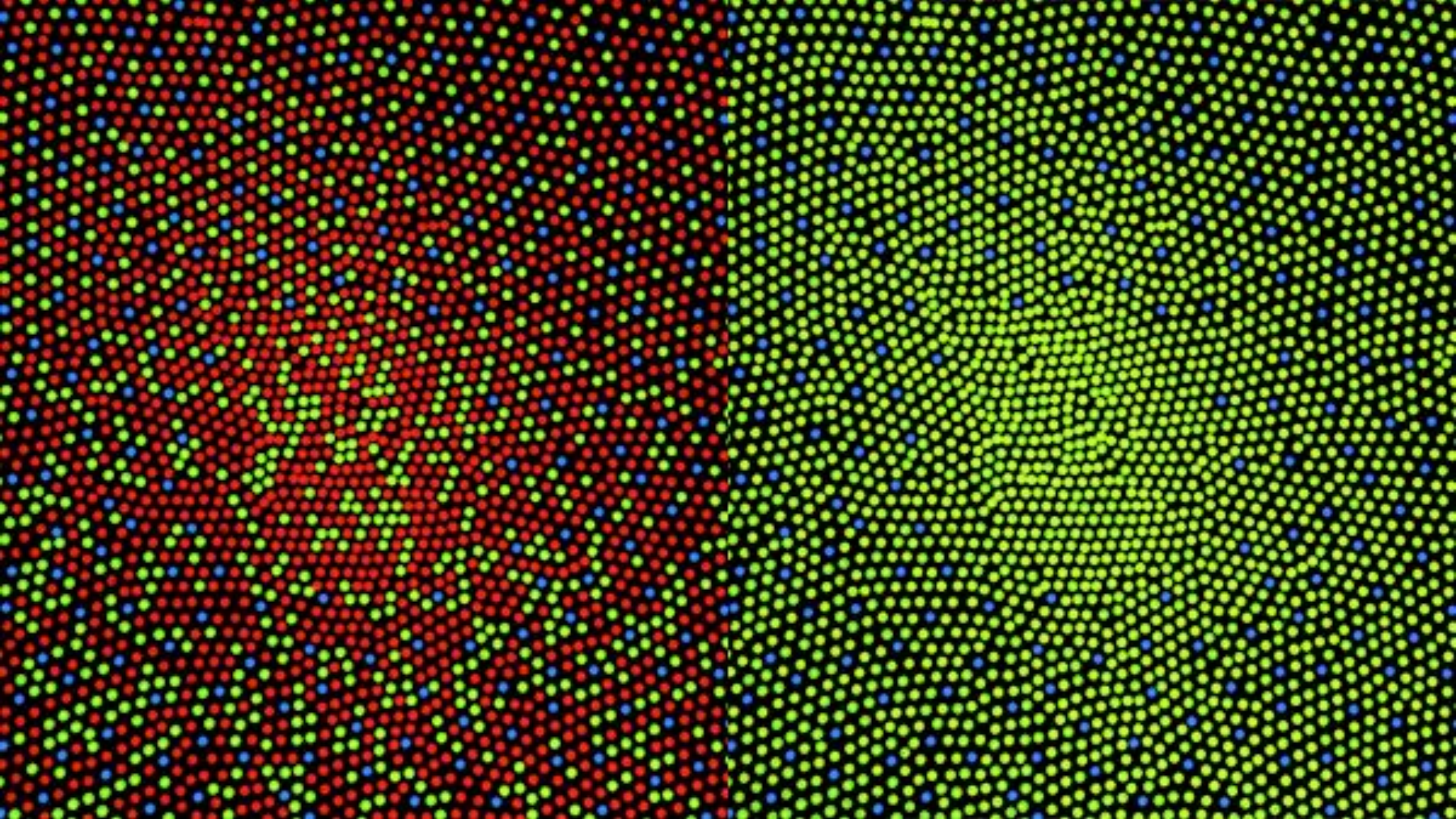


All it takes is real stamina and determination on your part to complete the task at hand and gain knowledge.

**\$360.00**



Colour matters.



# VIZ PALETTE

By: Elijah  
Meeks &  
Susie Lu

## PICK

Add

Replace

Use  
Chroma.js

Use  
Colorgical

Use  
ColorBrewer

## EDIT

7 Colors

Add

#hex

orgb ohsl

- 1 ● #ffd700 ✖
- 2 ● #ffb14e ✖
- 3 ● #fa8775 ✖
- 4 ● #ea5f94 ✖
- 5 ● #cd34b5 ✖
- 6 ● #9d02d7 ✖
- 7 ● #0000ff ✖

## GET

#hex

orgb ohsl

String quotes  
Object with  
metadata

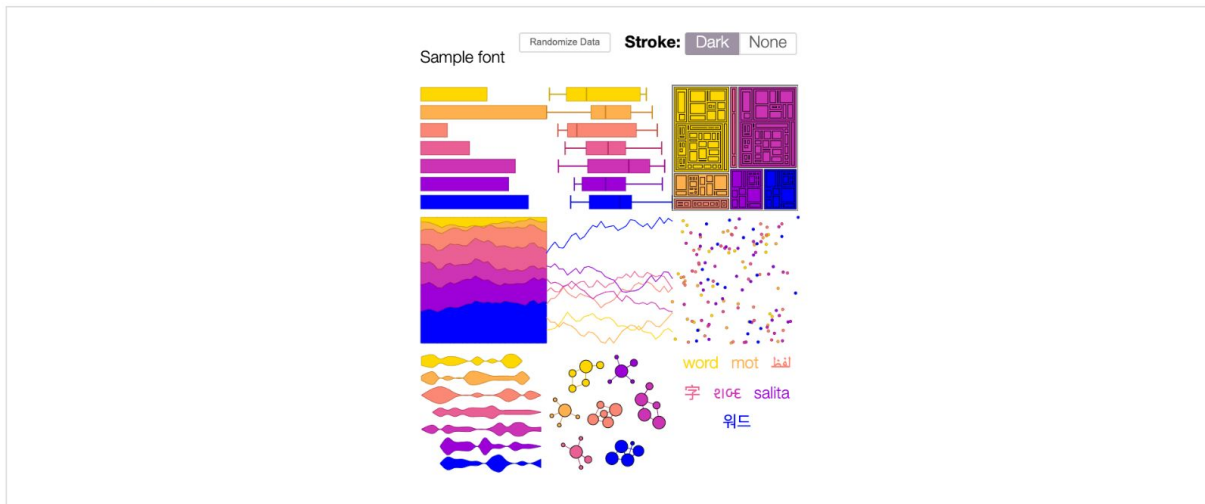
```
[ "#E4700",  
  "#E514E",  
  "#E8775",  
  "#EA594",  
  "#C34B5",  
  "#9D02D7",  
  "#0000FF",  
  1 ]
```

# COLORS IN ACTION

Font color: ● #000000 ↵

Charts made with [Semiotic](#)

Color Population: No Color Deficiency - 96% Deuteranomaly - 2.7% Protanomaly - 0.66% Protanopia - 0.59% Deuteranopia - 0.56% Greyscale



## COLOR REPORT

Area link colors difficult  
to tell apart as:  
— Lines or small points  
— Medium areas  
— Large areas

#ea5f94 pink  
#fa8775 light orange  
#fb14e orange  
#ffd700 gold  
#0000ff indigo

- Minimize name conflicts for optical palettes



# Figure formats



**VECTOR**

**VS**



**RASTER**

# Bespoke Plotting

# Bespoke Plotting

Sketch, then make



Use the correct Tool

observablehq.com/@d3/learn-d3

New

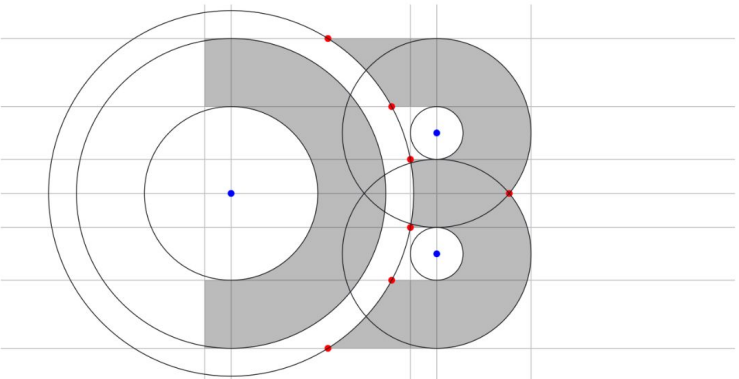
**D3** · d3js.org  
Bring your data to life.

Fork

By Mike Bostock · Published Mar 24, 2020 · ISC · 8 forks · 1 collection · 536 Likes

## Learn D3: Introduction

This series of notebooks will guide you through your first steps with [D3.js](#).



<https://observablehq.com/@d3/learn-d3>



# Resources:

[D3js Examples - list](#)

[R library for embedding ObservableHQ plots](#)

[Embedding ObservableHQ In a Webpage](#)

[Using python to send data to a website](#)

**Focus cell**

Flow-direct... Mobile parent suite Arc diagram Binary diagram Hierarchical edge b... Hierarchical edge b... Chord diagram

**Bars**

D3 multi and zero support basic charts. On latest a new form that better serves your needs.

Bar chart Horizontal bar chart Diverging bar chart Stacked bar chart Stacked horizontal b... Stacked normalized... Grouped bar chart Diverging stacked b...

Matrix chart World history timeline Calendar view The impact of vacc... Electricity usage, 20... Revenue by music fi...

**Lines**

With direct control over graphics, and support for both SVG and Canvas, the possibilities are endless.

Line chart Line with missing da... Multi-line chart Change line chart Slope chart Money's trans... Candlestick chart Variable-color line

Gradient encoding Threshold encoding Parallelogram Slope chart Inequality in Americ... New Zealand tourist... Sea ice extent, 1979...

**Areas**

Go beyond basic area charts with difference charts or choropleths. Highlight plus and bottom charts are great for comparing many simultaneous line series.

Area chart Area with missing d... Stacked area chart Normalized stacked... U.S. population by c... Streamgraph Difference chart Band chart

Hydroline (log) plot Horizon chart Realtime horizon ch...

**Dots**

Don't forget the humble scatterplot. For a single dimension, consider the [streaming](#) for tracking pairwise dimensional correlations, try [EFLUX](#).

Scatterplot Scatterplot with vba... Scatterplot matrix Dot plot Global temperature... Bubble map Spike map Bubble chart

Heatmap Voronoi tessellation Partitioning Plot...

**Radial**

Pie and donuts are good for comparing a part to the whole. And radial layouts can be appropriate for cyclical data.

Pie chart Donut chart Radial area chart Radial stacked bar c... Radial stacked bar c...

**Annotation**

Labels, legends, axes, titles, guides, and keys help a visualization communicate effectively. Here are a few strategies.

Inline labels Directly labeling lines Line chart with tooltips Voronoi labels Occlusion Grid-like labels Styled axes Color legend

**Maps**

D3 implements a diverse array of geographic projections. It works great with [GeoJSON](#), [TopoJSON](#), and [mapbox-gl.js](#).

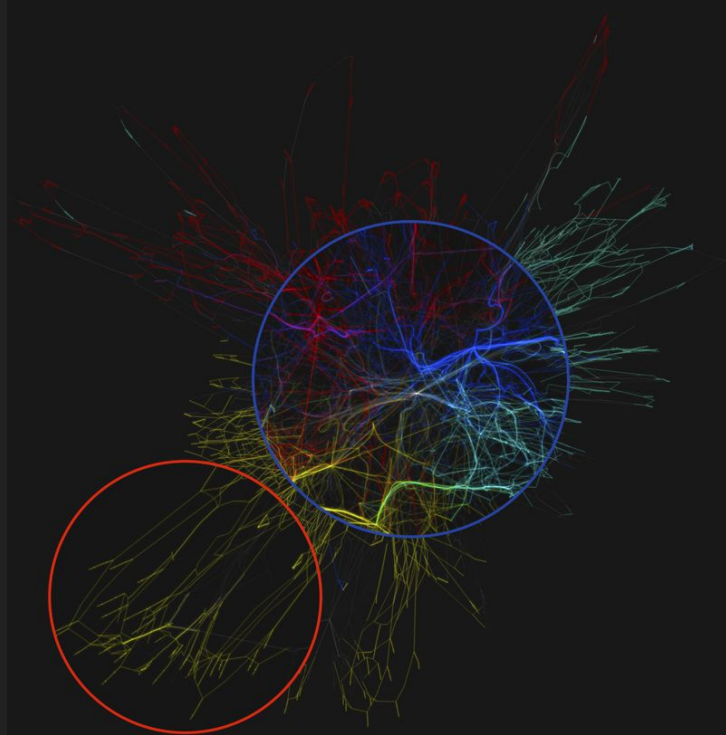
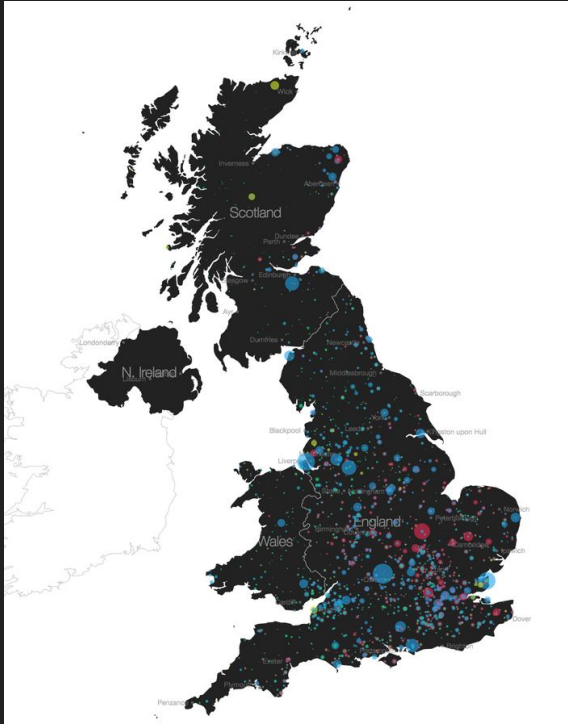
Choropleth Choropleth choropleth State choropleth World choropleth World map Projection Comparison... Taster's indicators Web Mercator tiles

Raster tiles Vector tiles Clipped map tiles Raster & vector Vector field GeoJSON contours U.S. airports voronoi World airports voronoi

Solar projection Solar path Star map Non-orthographic car...

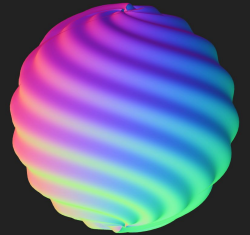
Large data

# SVG vs Canvas vs WebGL canvas



OscilliSludge

Frequency: 2894  
Detune: 36



Any Questions?

Thank you for listening.