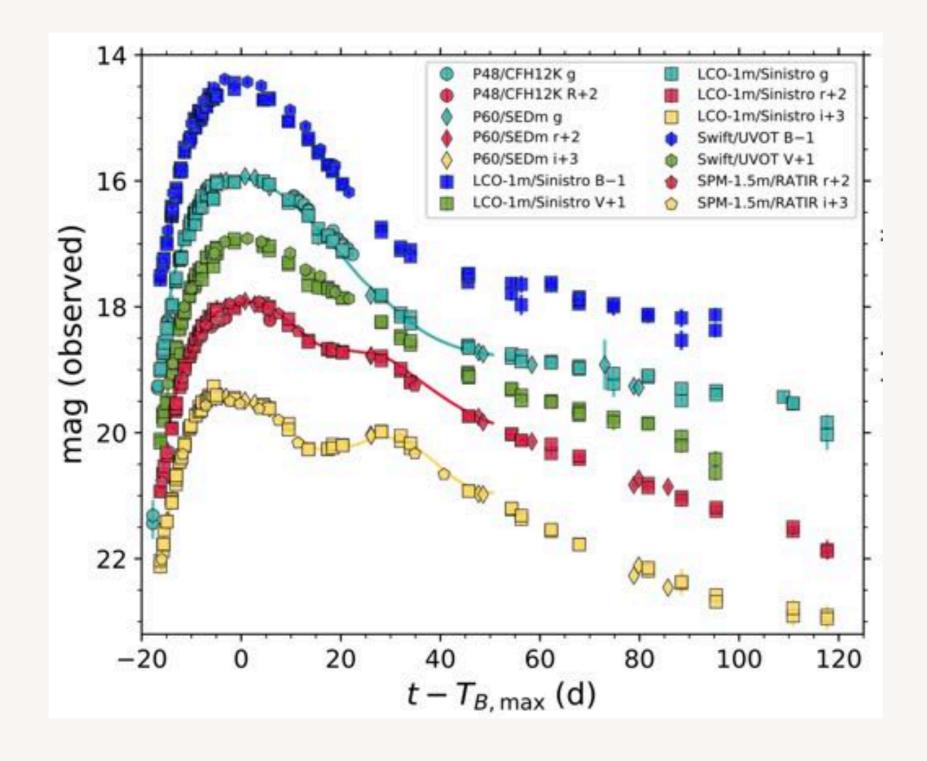


Upper limits obtained in the hours after explosion for SN 2011fe enable precise constraints on the radius of the progenitor star when compared to expectations from shock break-out models. Combined with preexplosion limits on the temperature of the progenitor, it is possible to definitively conclude that a WD must have exploded for this type Ia SN.

#### Human brain is not a multiprocessor

Information transmission needs to be efficient Impossible to simultaneously read *and* listen

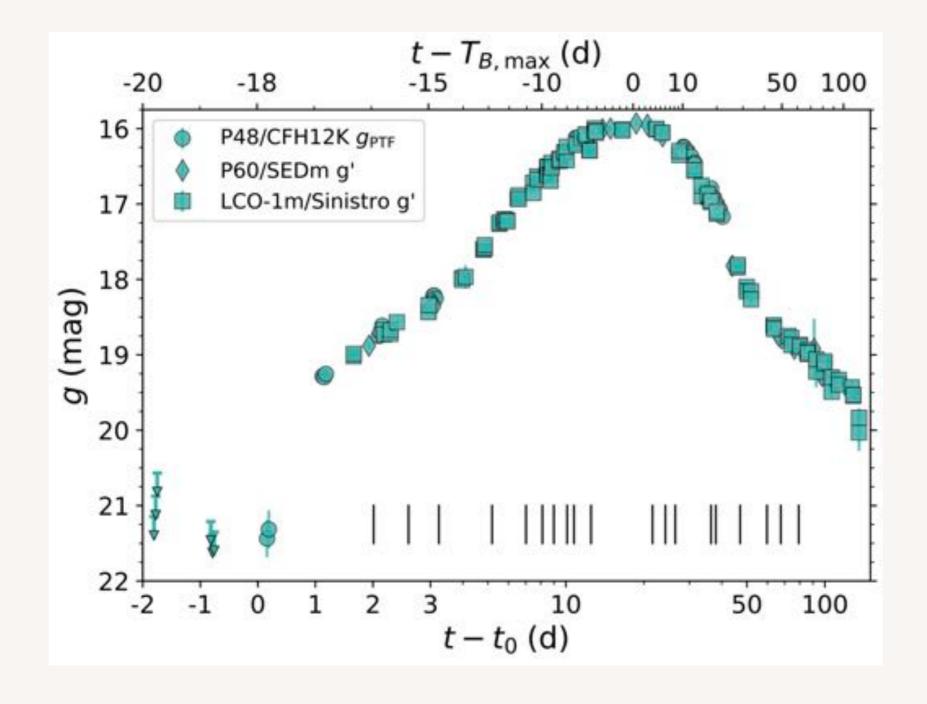
#### Context matters (an aside)



I absolutely loathe this

Info-ink ratio is tiny

#### Context matters (an aside)



Can summarize main features with less data

# Effective Communication via Principles of Design

Building better plots and slides



Adam A Miller
CIERA/Northwestern & Adler Planetarium
LSSTC DSFP Session 9
11 June 2019

#### Inspiration

Points of view — Nature Methods by Bang Wong & Collaborators

POINTS OF VIEW

Color coding

#### Communication

(noun) a process by which info is exchanged between individuals through a common system of symbols, signs, behavior

#### Communication

(noun) a process by which info is exchanged between individuals through a common system of symbols, signs, behavior

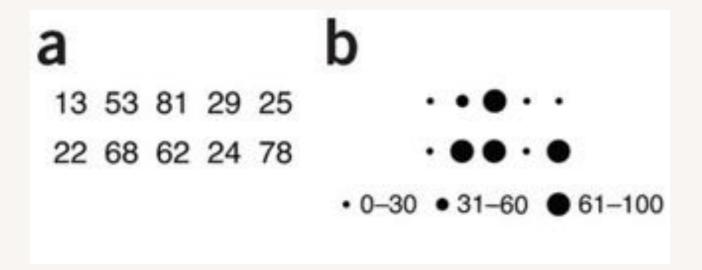
#### Humans communicate via stories

stories have a beginning, middle, and end narrative requires introduction, question, conflict, buildup, and a resolution

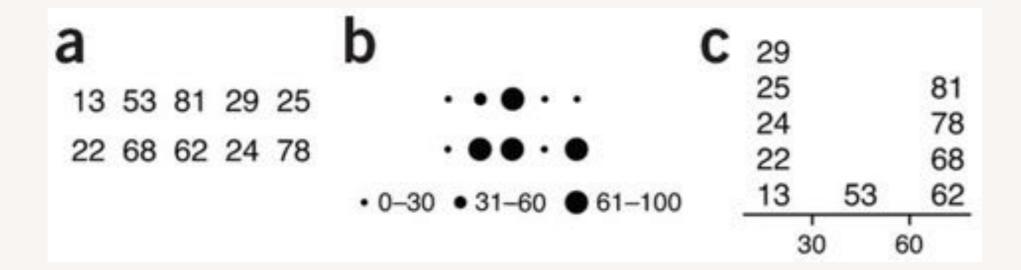
Use aggregation to emphasize the message

**a**13 53 81 29 25
22 68 62 24 78

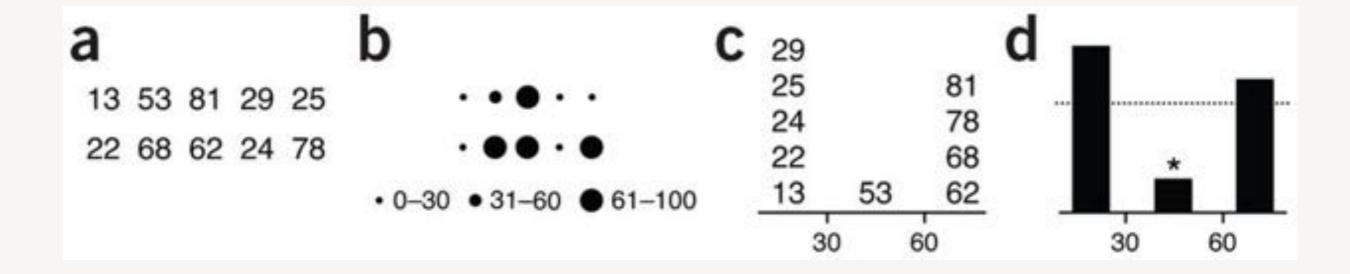
Use aggregation to emphasize the message



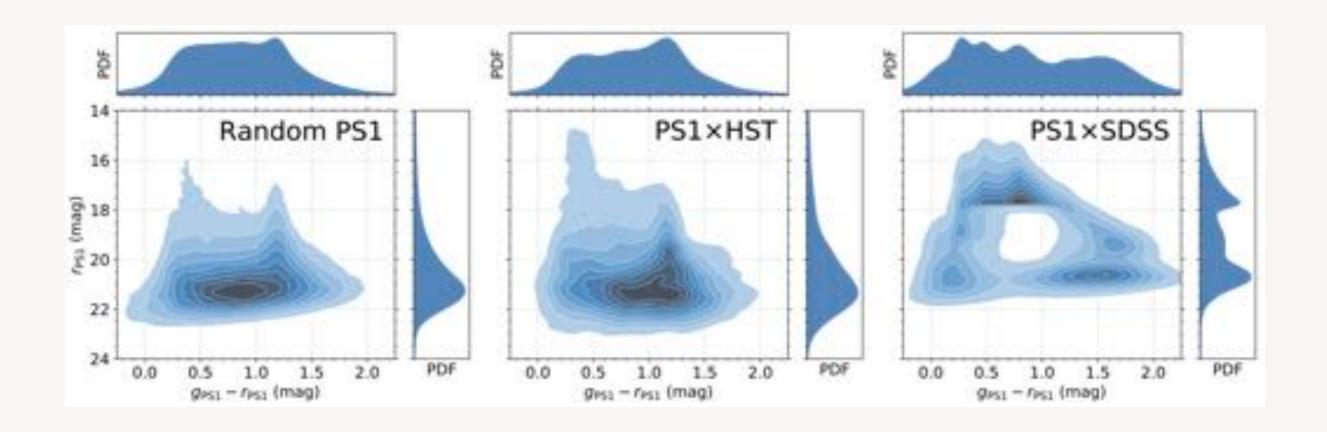
Use aggregation to emphasize the message



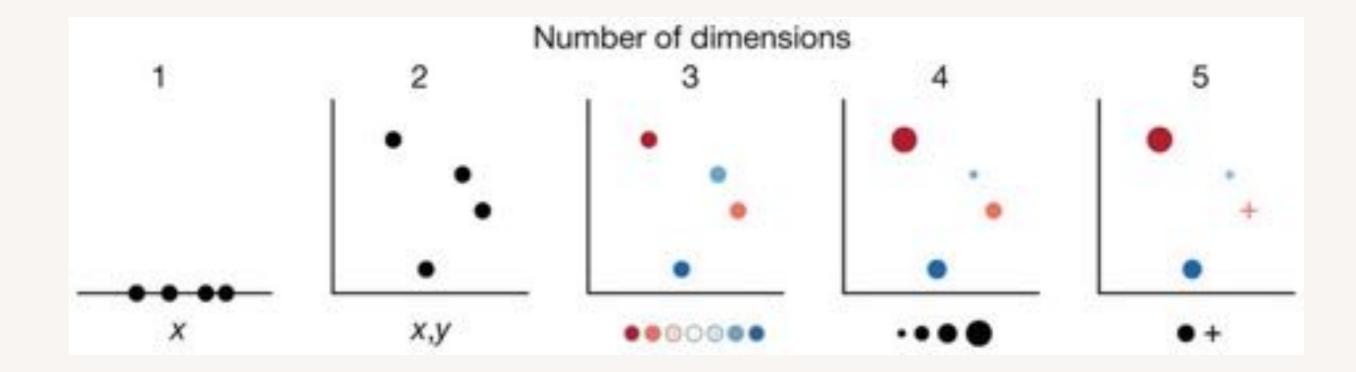
Use aggregation to emphasize the message



What is the story of this figure?



Critical given dimensionality of data and figures



#### Outline

Perception

**Plotting** 

Slides

#### Outline

Perception

**Plotting** 

Slides

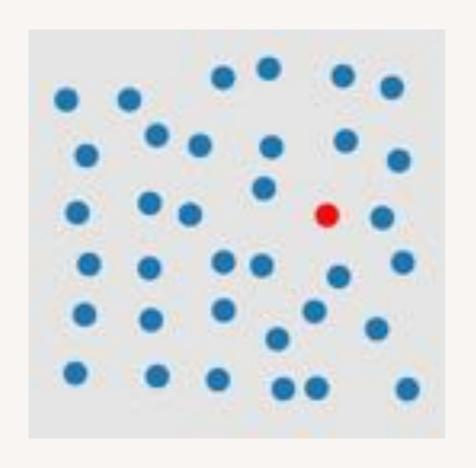
# Perception

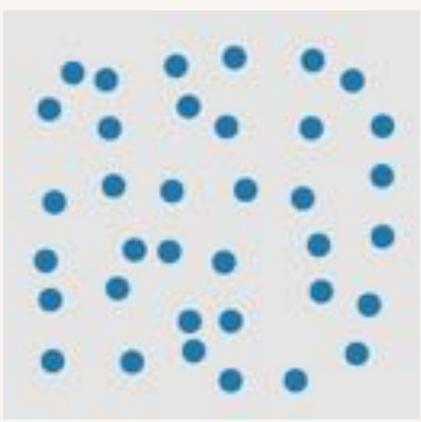
An exercise

https://www.csc2.ncsu.edu/faculty/healey/PP/#jscript\_search

### Perception

#### Pre-attentive processing



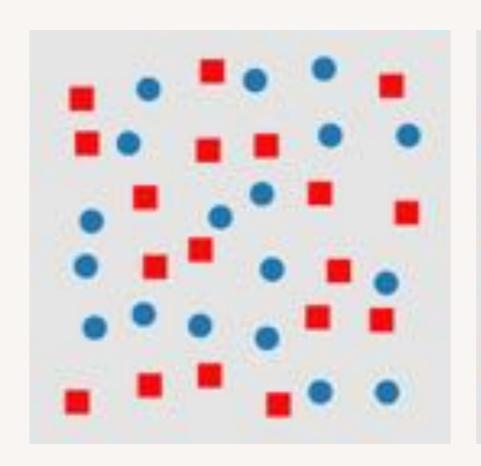


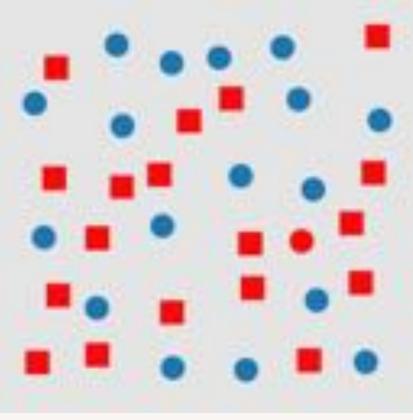
< 250 ms = pre-attentive

unique target allows: "parallel" search does not scale w/ N

### Perception

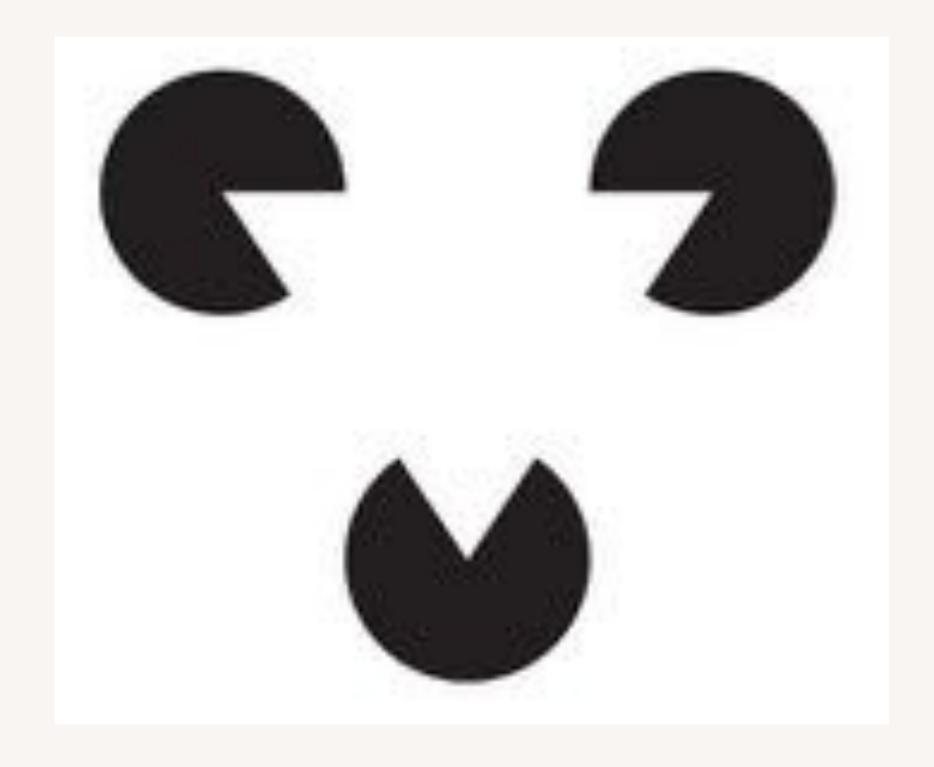
#### Pre-attentive processing





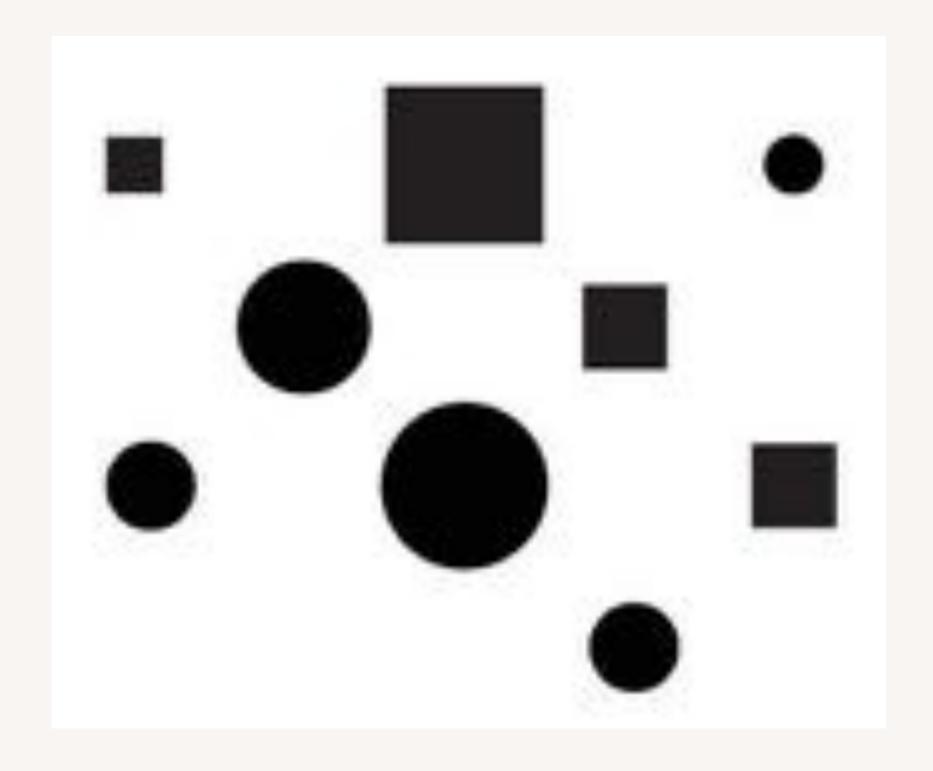
conjunction target:
"serial" search
much harder

Naturally assemble individual objects into groups



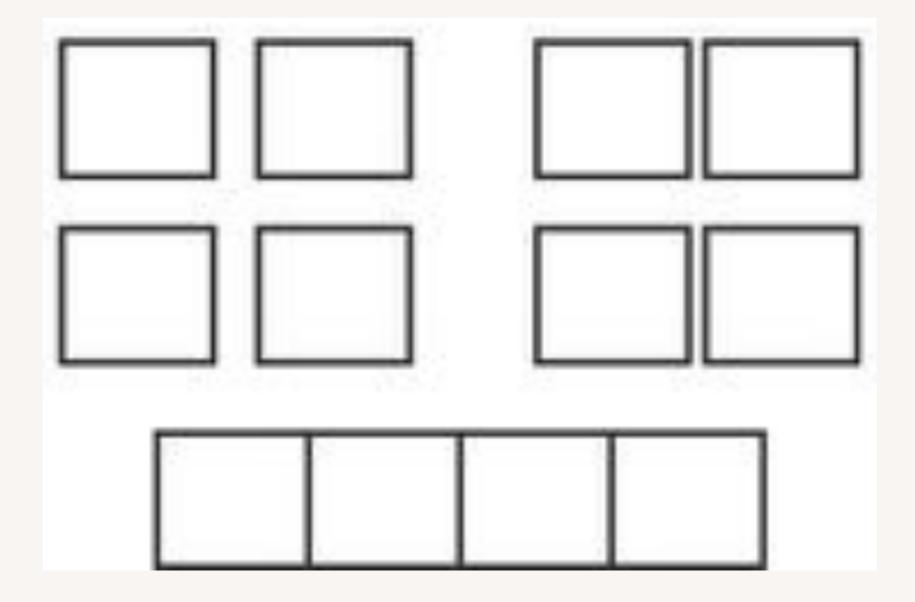
How many triangles are drawn in this figure?

#### Similarity



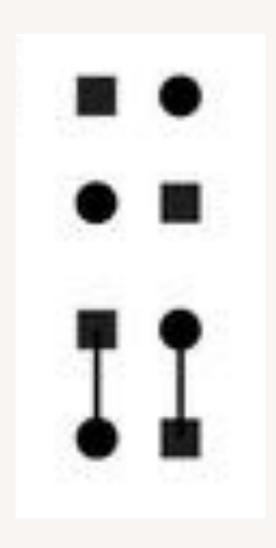
Naturally group similar size & shape

**Proximity** 



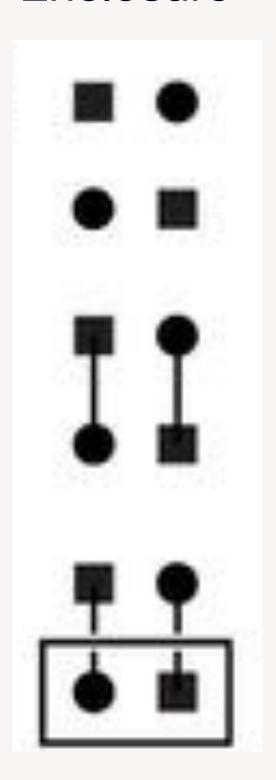
Naturally group objects that are close together

#### Connection



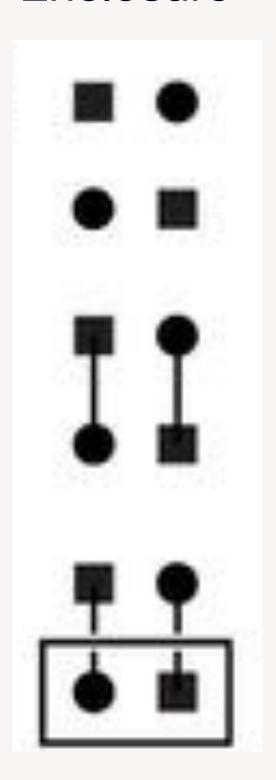
connection > similarity

#### **Enclosure**



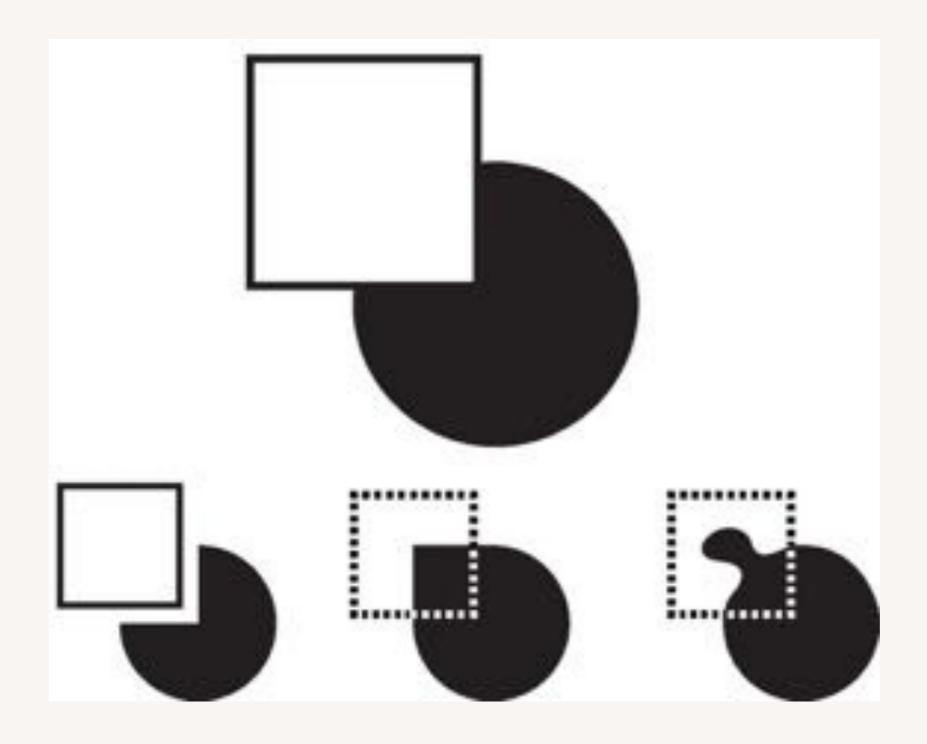
enclosure > connection

#### **Enclosure**



enclosure > connection

#### Visual completion



Naturally complete circle behind the square

#### Outline

Perception

**Plotting** 

Slides

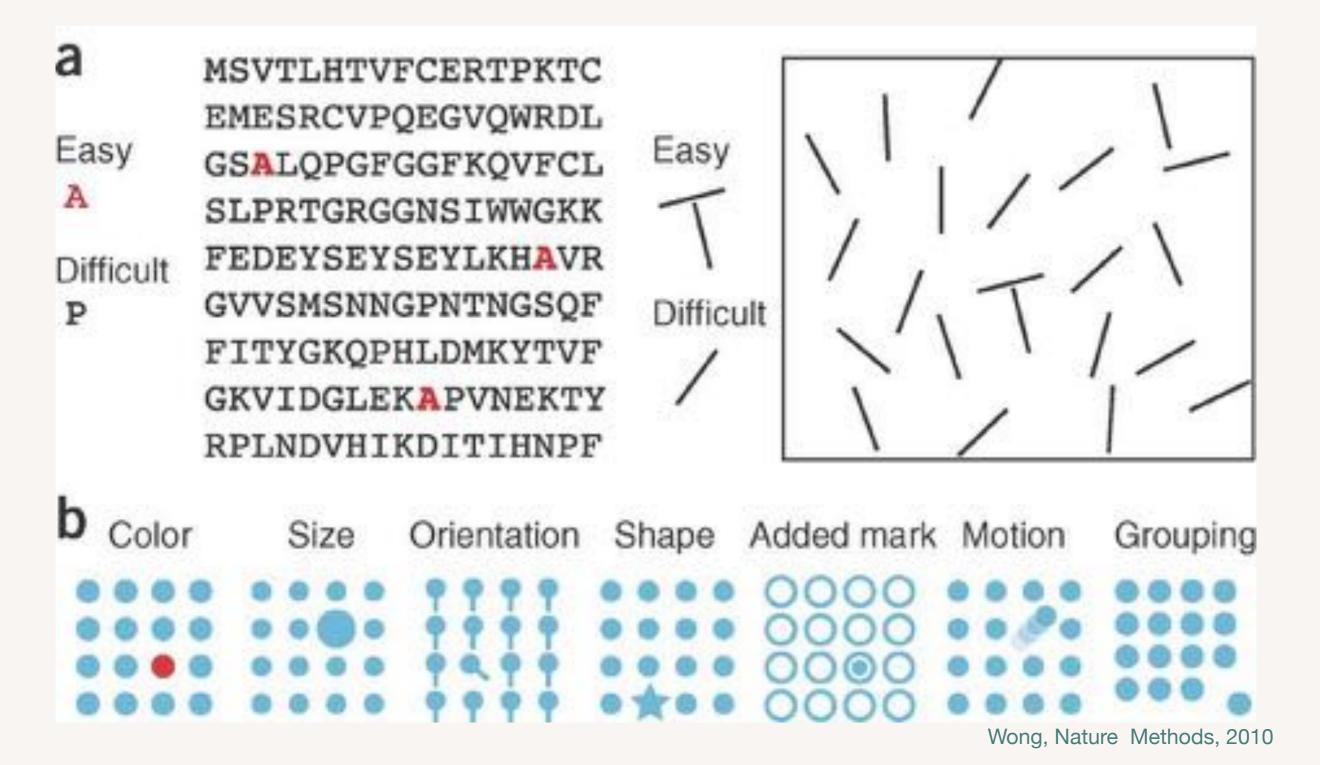
#### Salience

Gestalt principles >> identify most important features



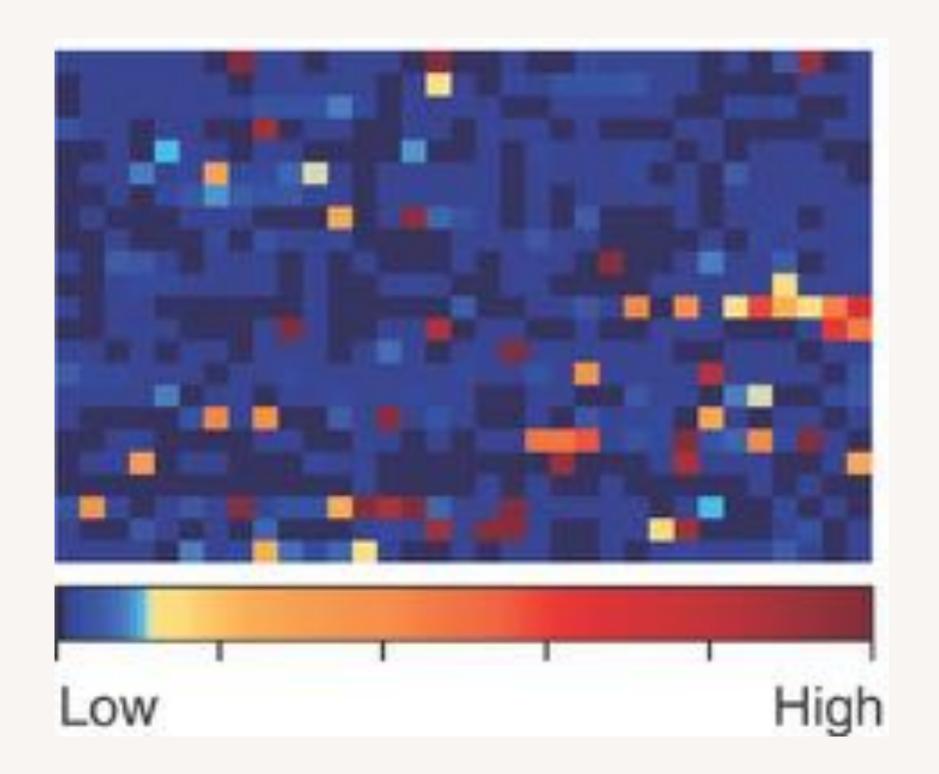
#### Salience

Things that stand out are easy to find

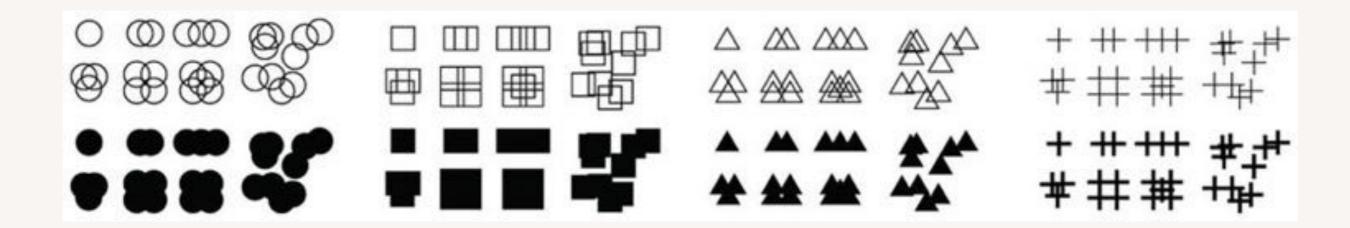


#### Salience

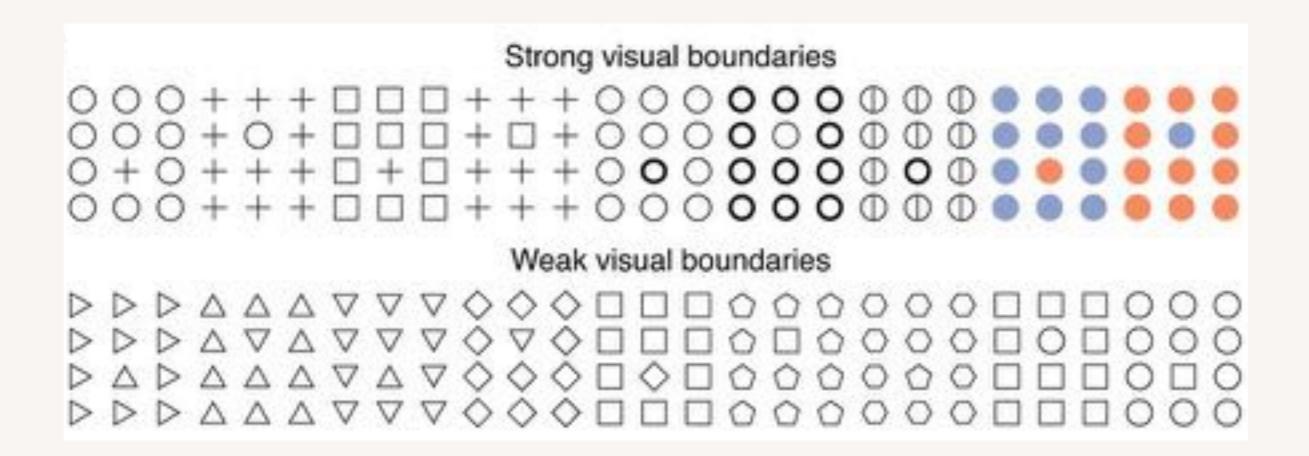
#### Salience must match relevance



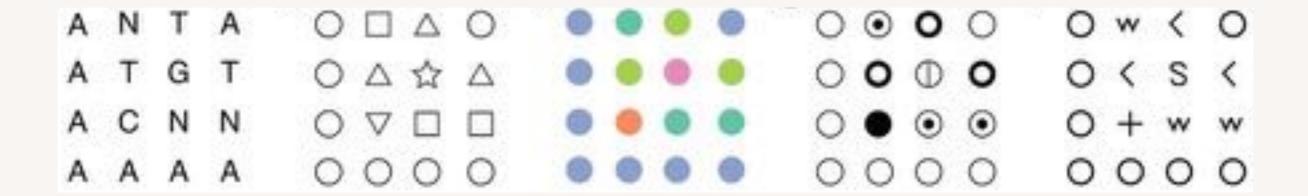
Hollow circle is the most flexible and robust



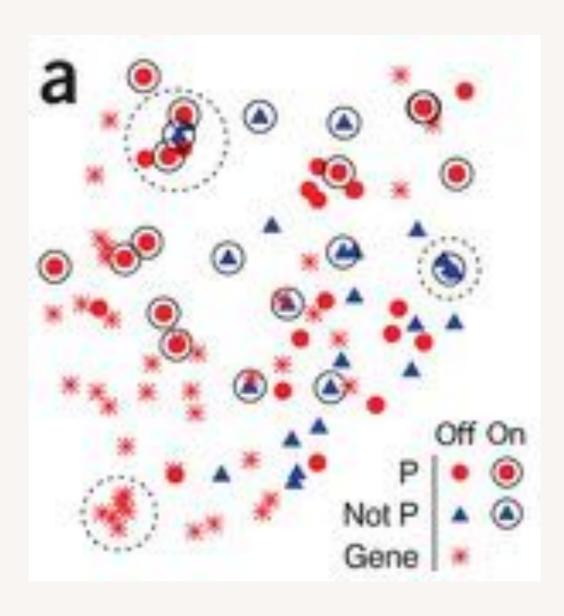
#### Form strong visual boundaries



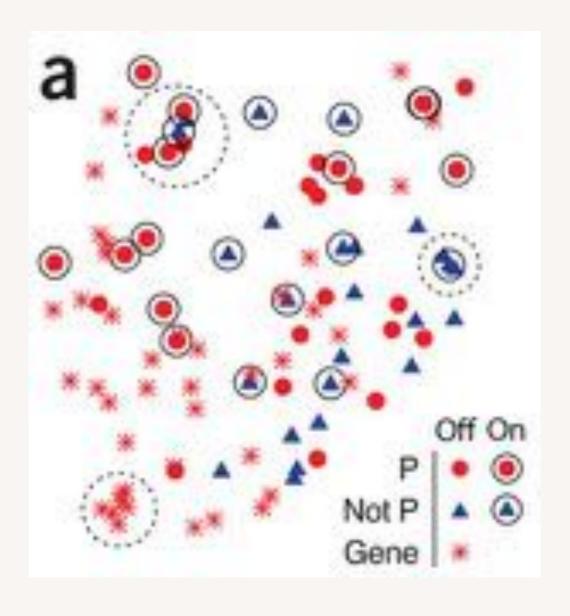
Form strong visual boundaries

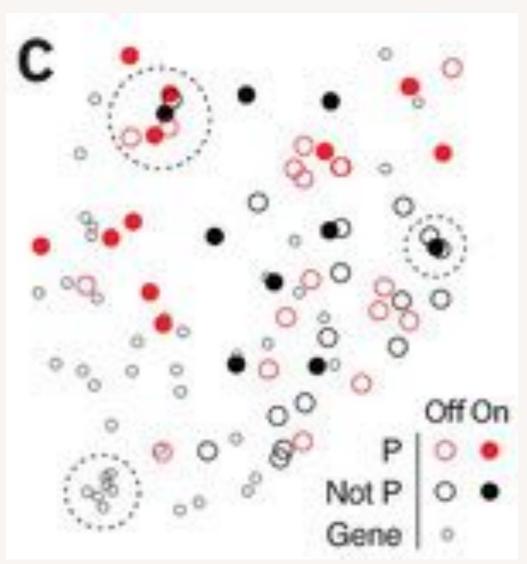


Build hierarchies into plotting choices

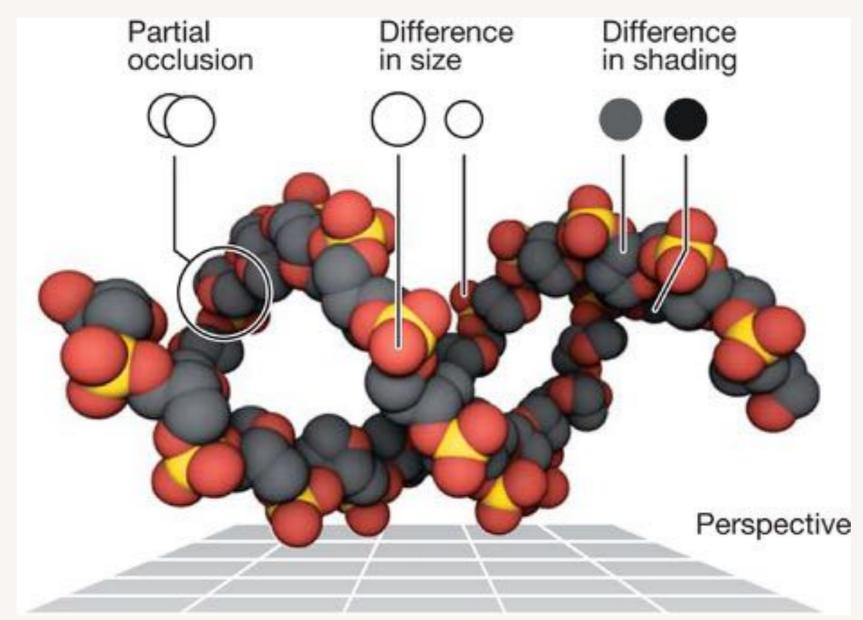


Build hierarchies into plotting choices

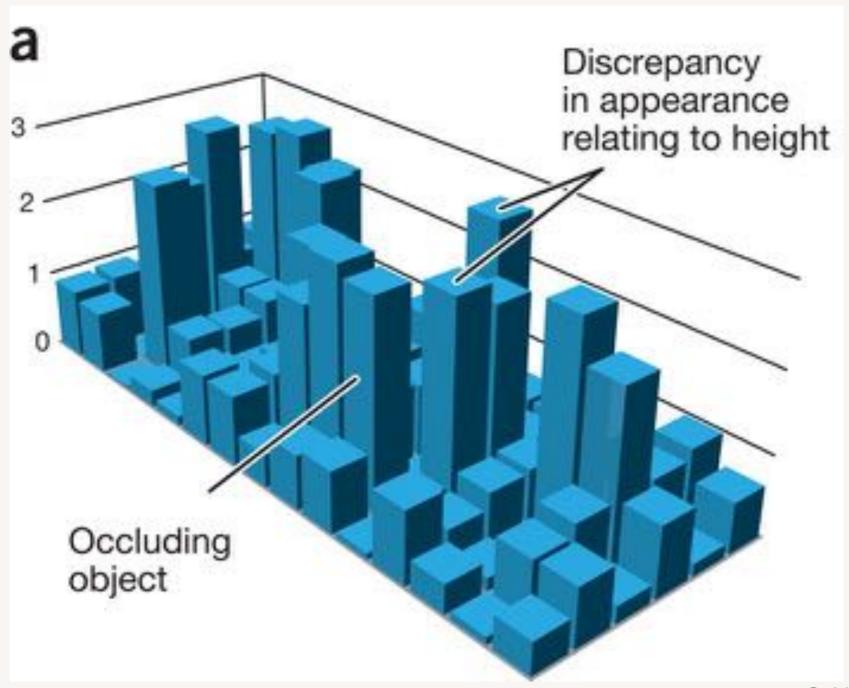




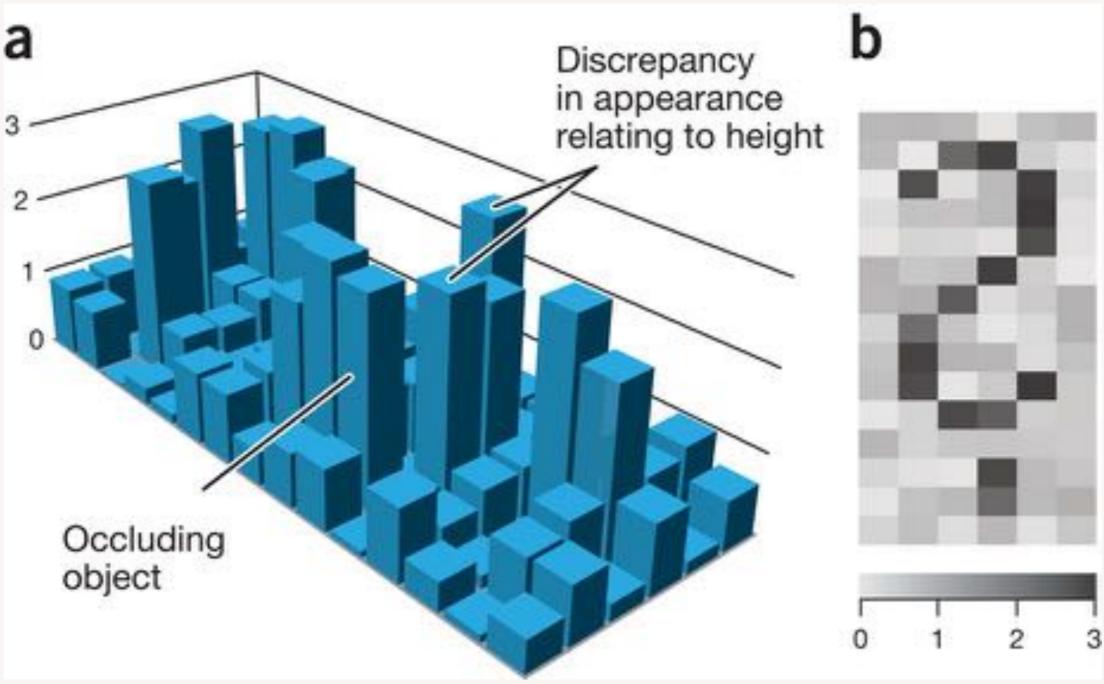
Restrict 3d plots to spatial representations



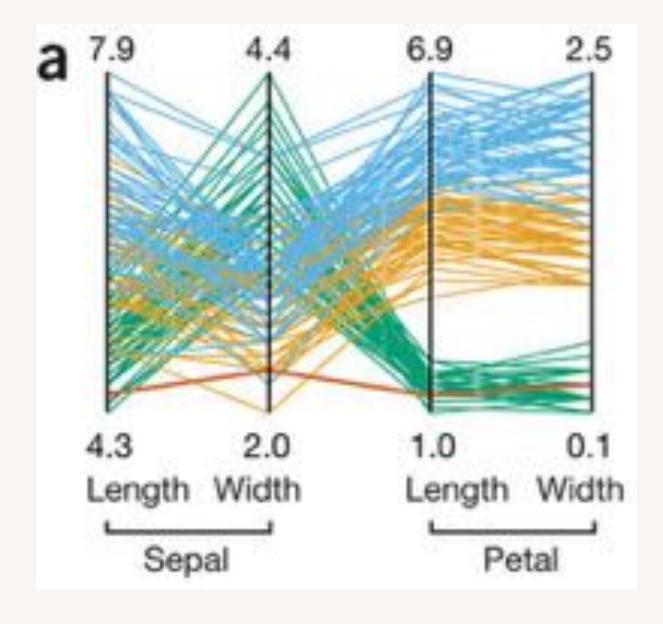
Restrict 3d plots to spatial representations



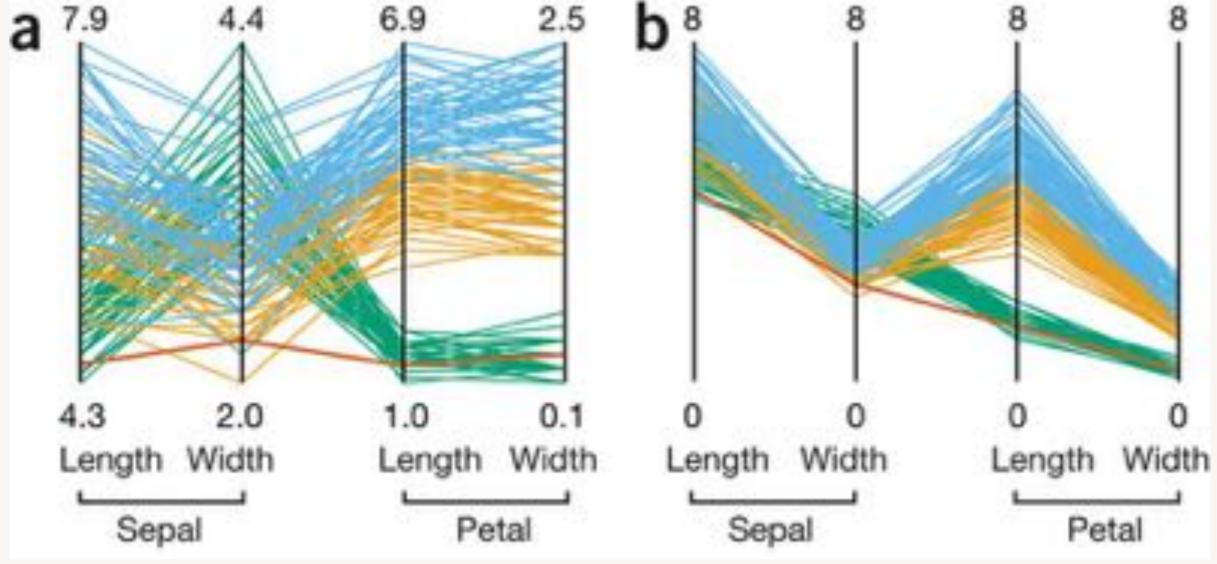
Restrict 3d plots to spatial representations



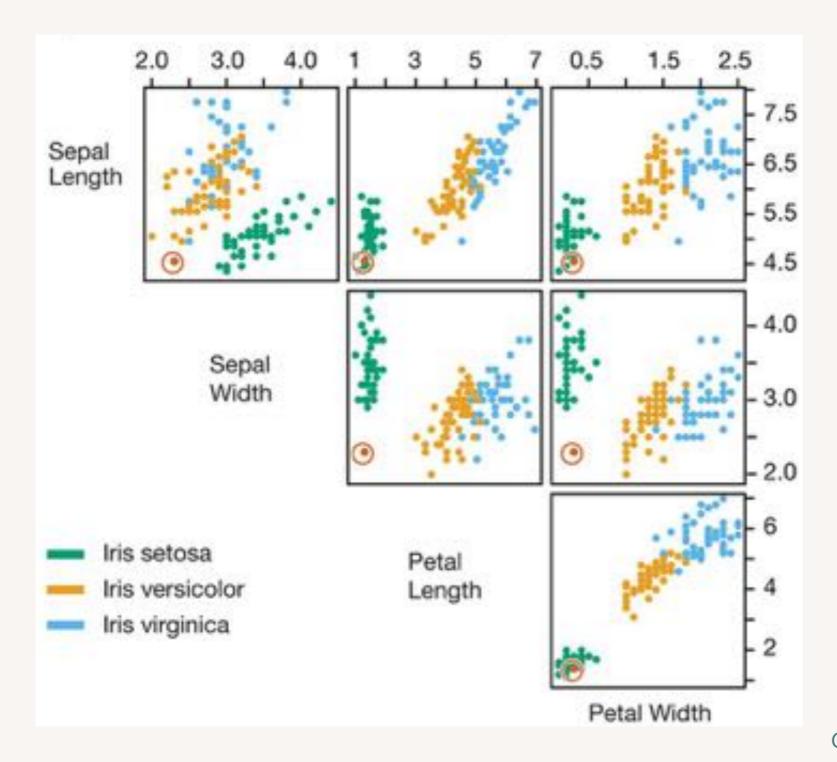
Combine multiple dimensions in 2D



Combine multiple dimensions in 2D

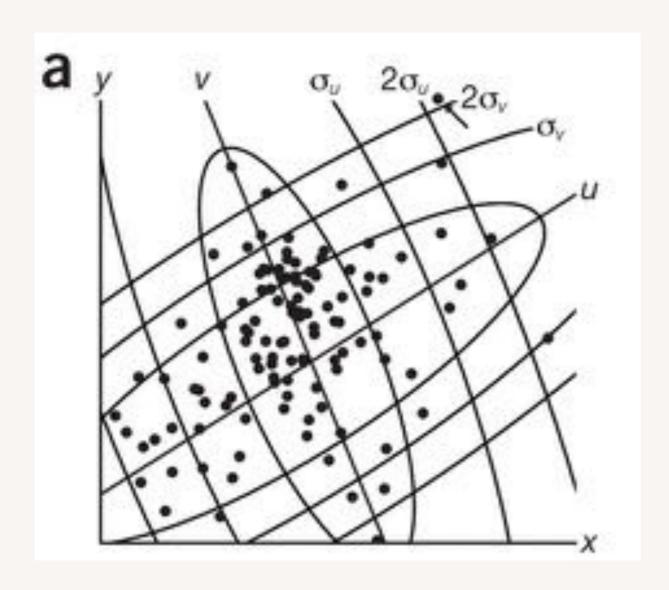


#### Combine multiple dimensions in 2D



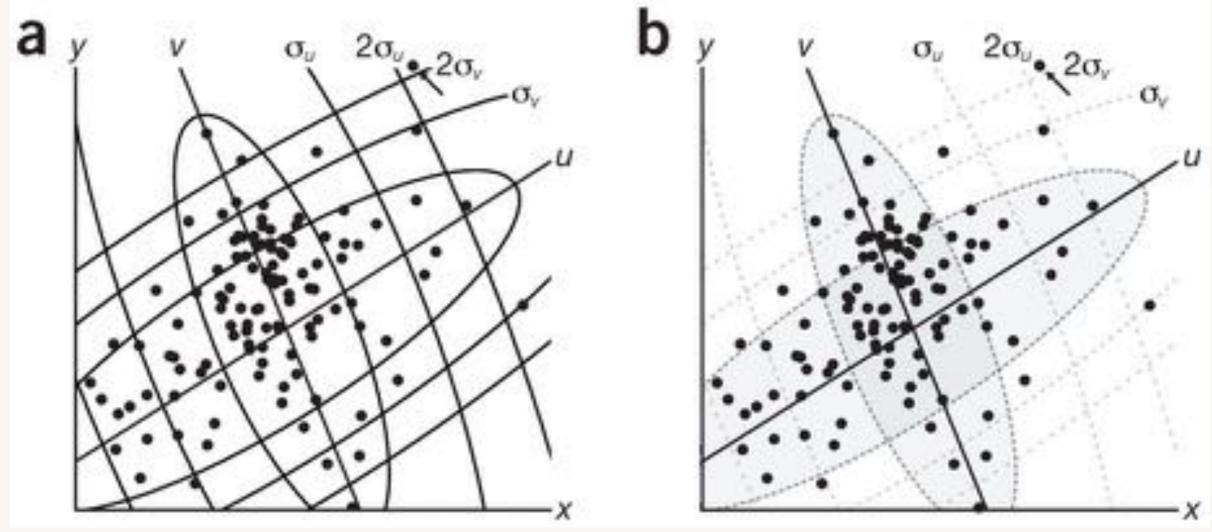
### Axes & Grids

Make navigational elements visually distinct



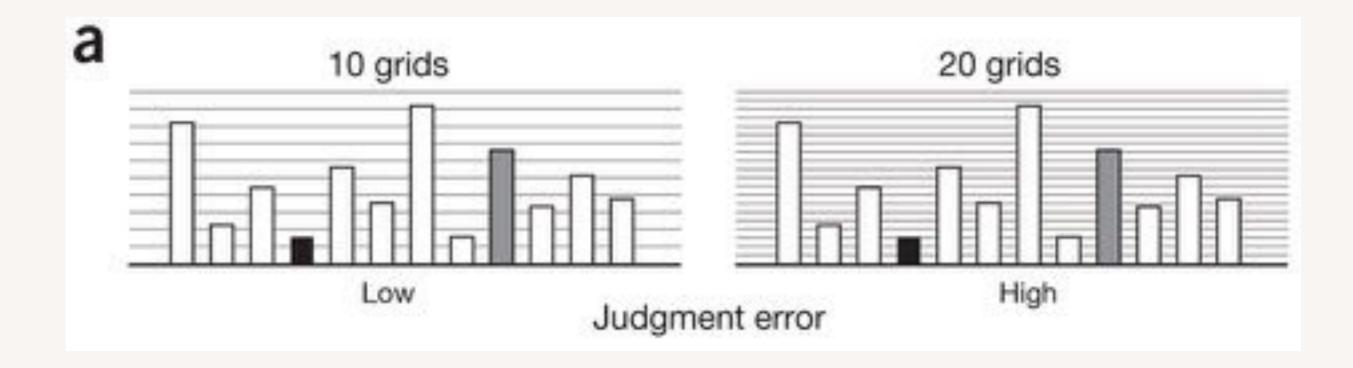
### Axes & Grids

Make navigational elements visually distinct

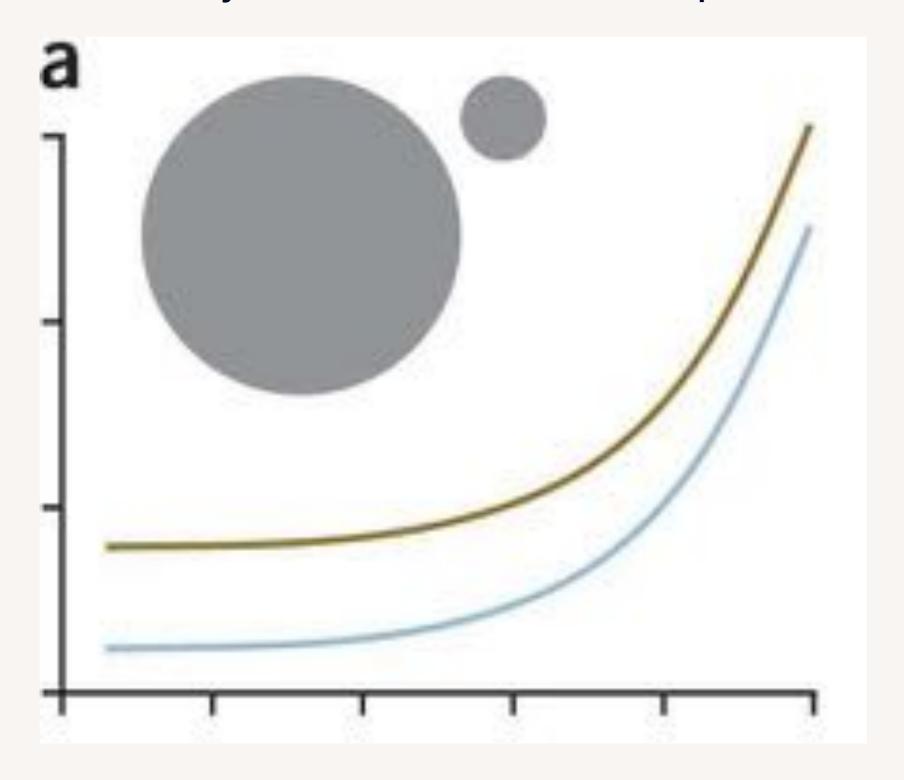


### Axes & Grids

Use grid lines judiciously

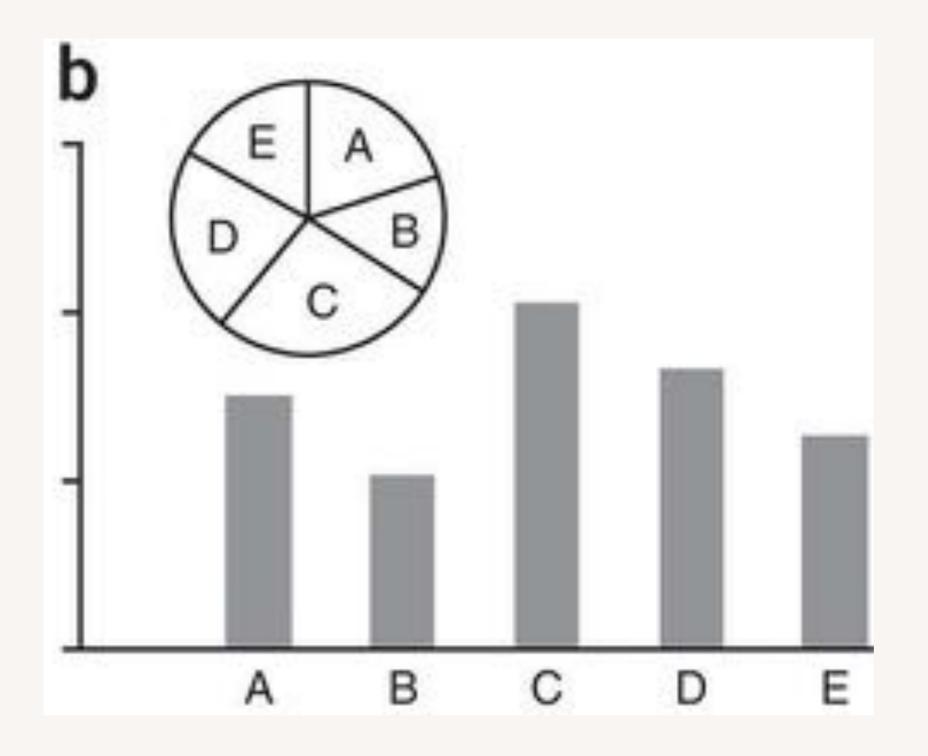


Use easy-to-estimate visual representations



relative area = easier curve separation = hard

Use easy-to-estimate visual representations



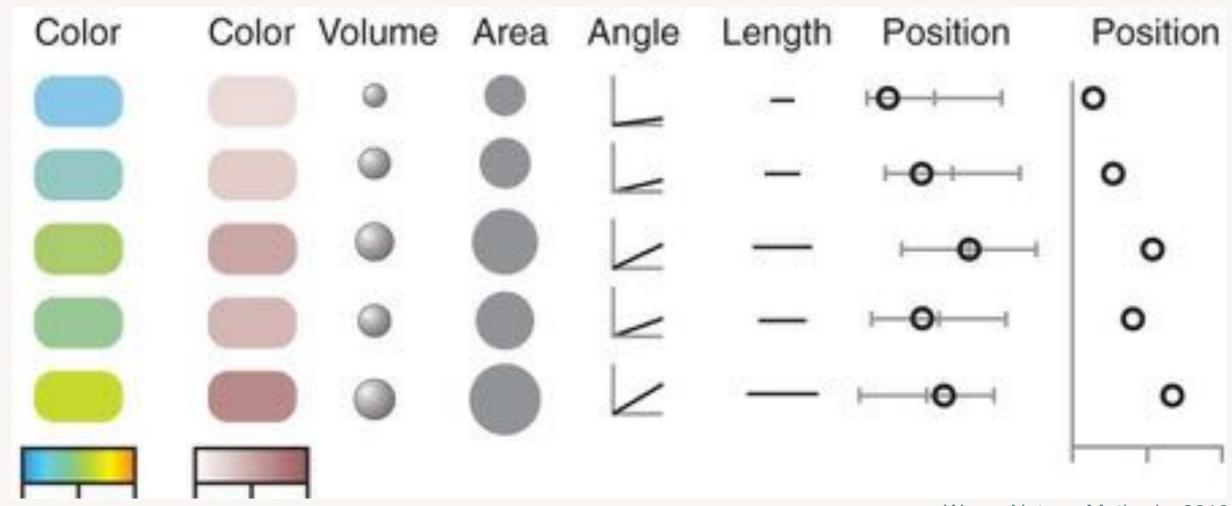
bar graphs = easy pie charts = stupid hard

#### Use easy-to-estimate visual representations

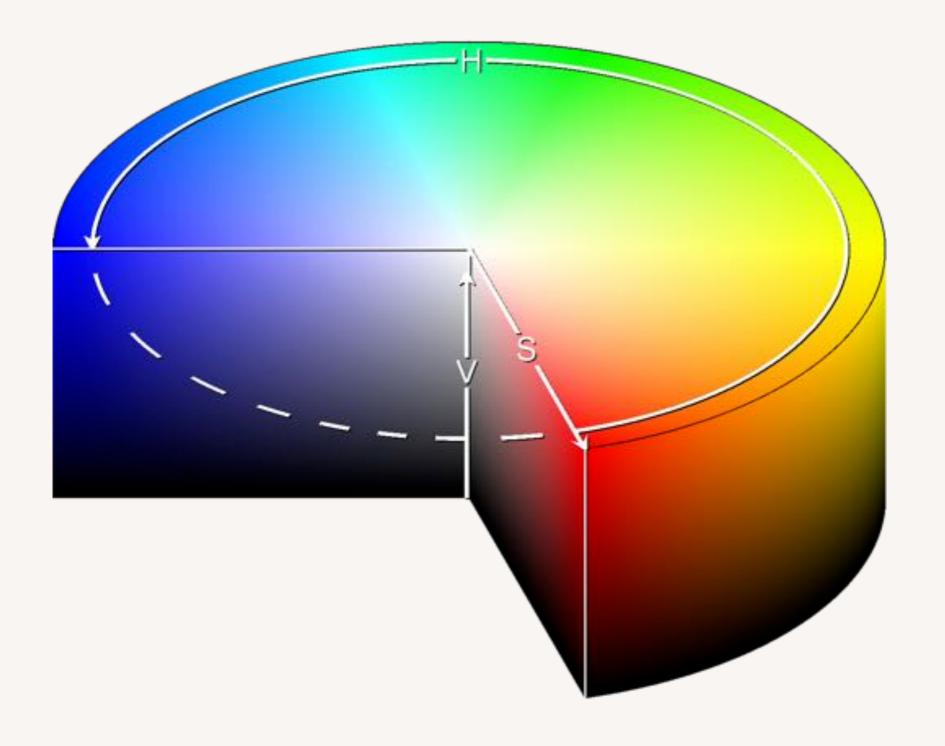
Rank	Aspect to Compare
1	Positions on a common scale
2	Positions on the same but nonaligned scales
3	Lengths
4	Angles, slopes
5	Area
6	Volume, color saturation
7	Hue

Use easy-to-estimate visual representations

positions = easy colors = hard

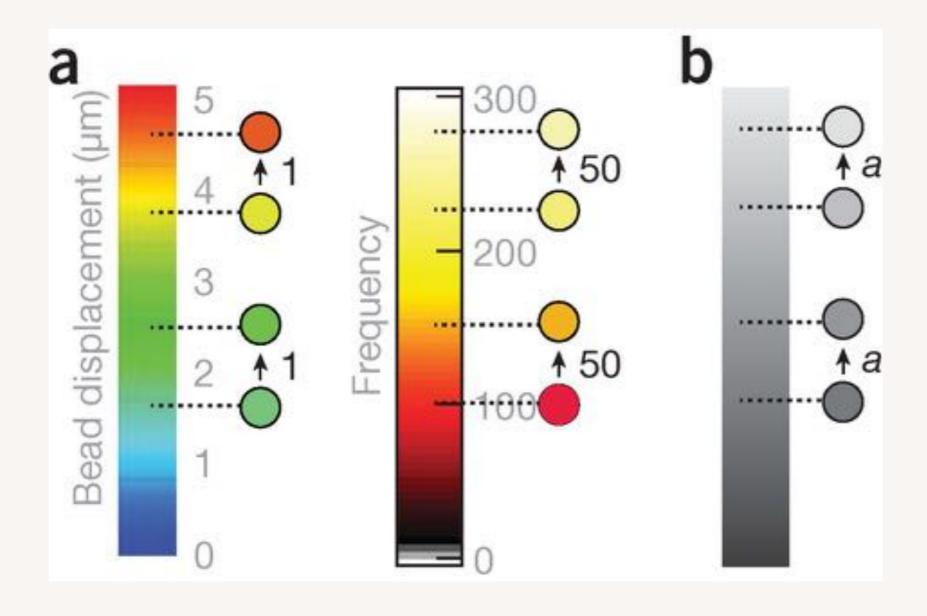


#### Color defined by hue, saturation, lightness

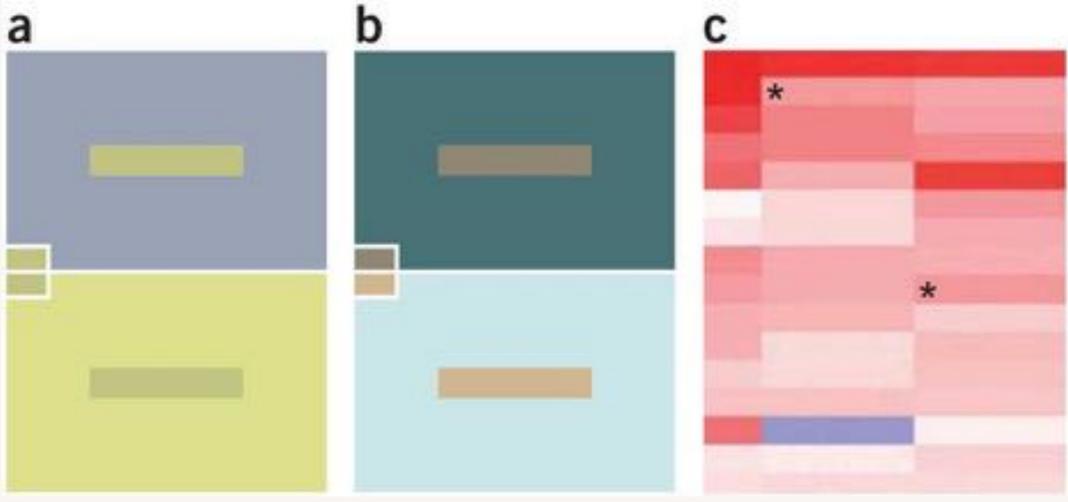


best for categorical data >6 = hard to interpret

Hue does a poor job encoding relative numerical values



Color perception depends on context



Select semantically resonant colors

banana

anger

money

sky

Select semantically resonant colors

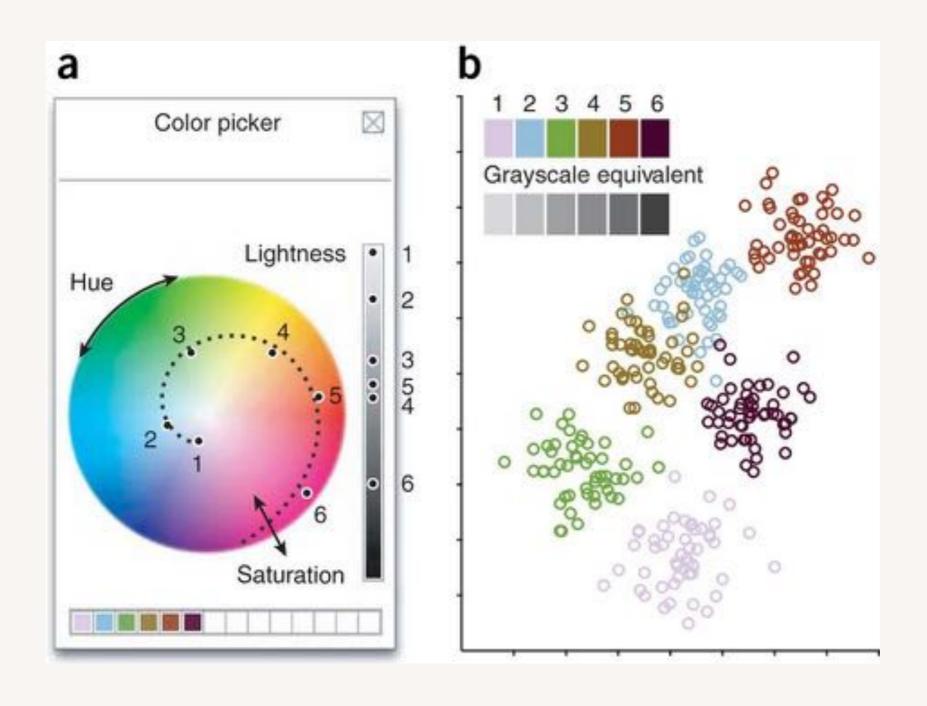
banana

anger

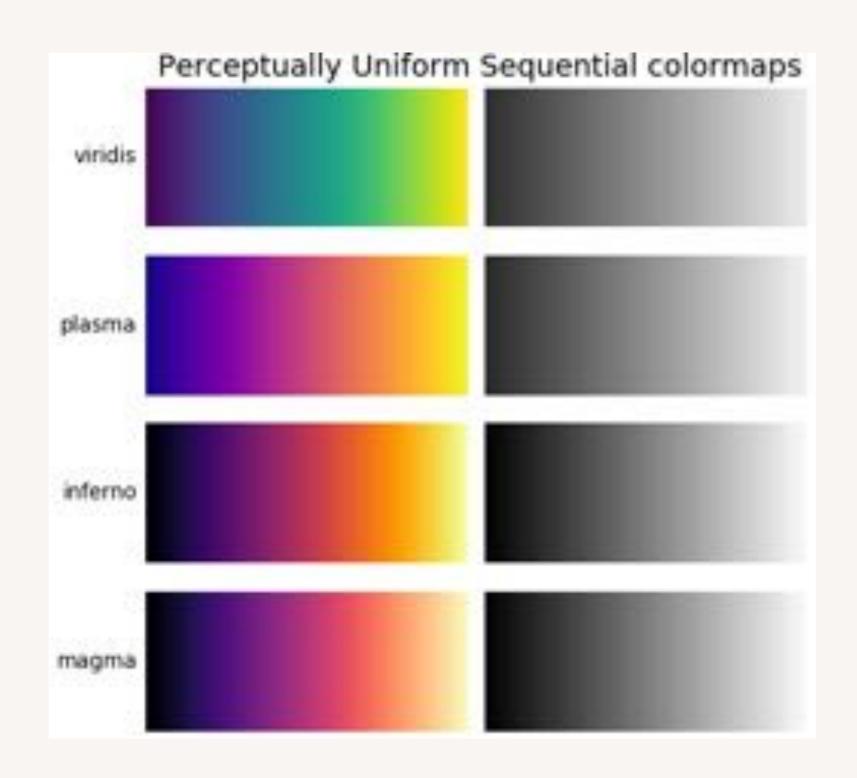
money

sky

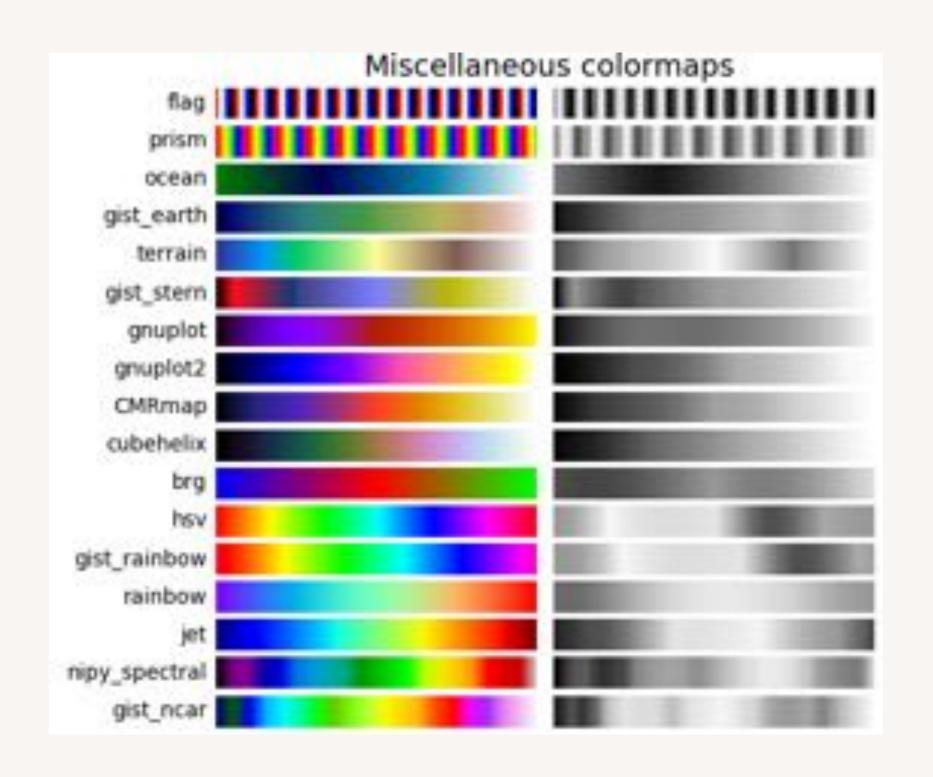
Rotate through color wheel for categorical selection



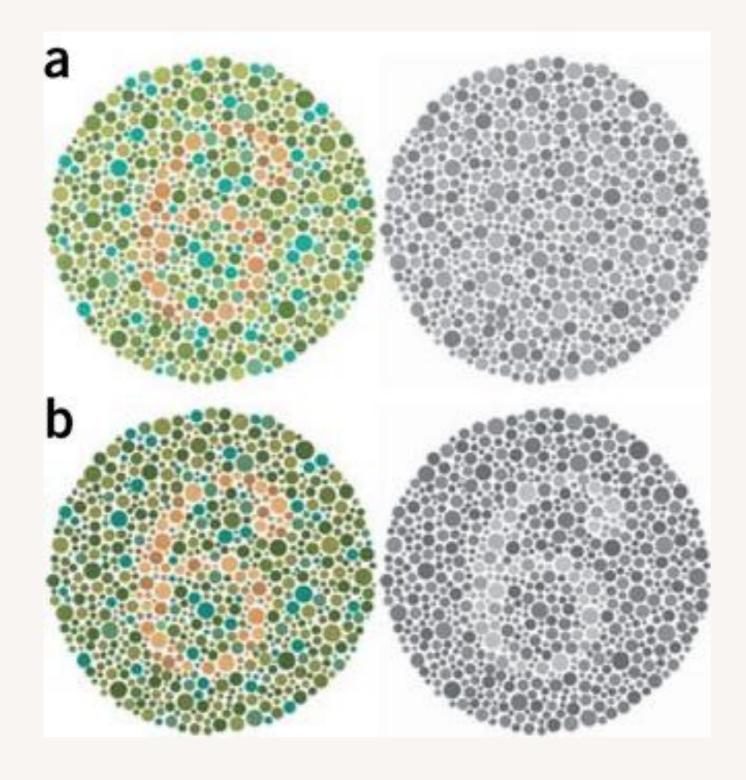
#### What does it look like in greyscale?



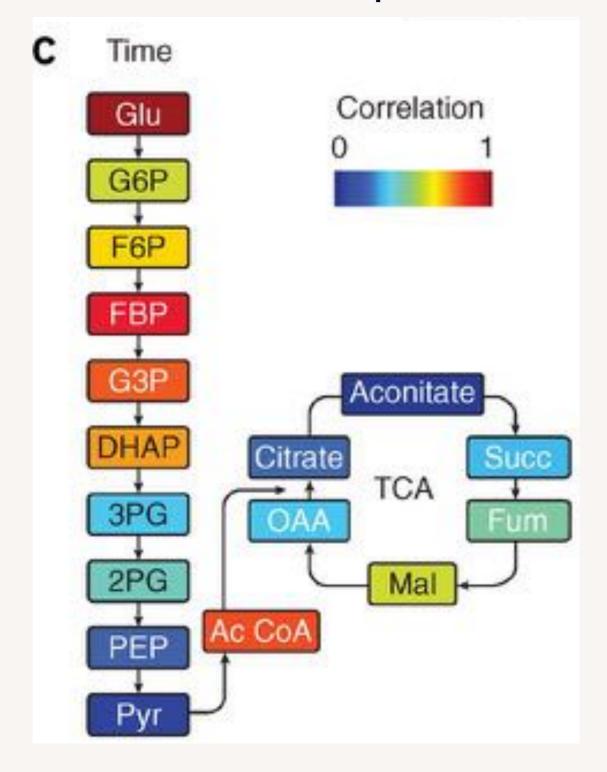
#### What does it look like in greyscale?



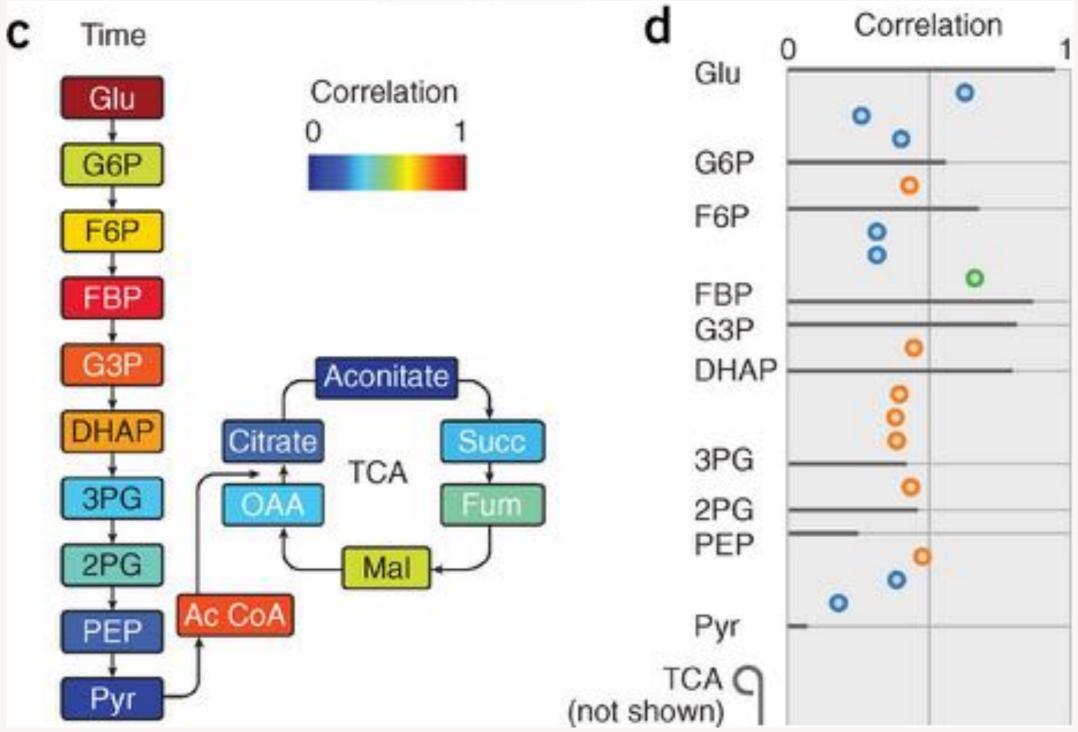
How does it look to the color blind?



#### Best avoided if possible



#### Best avoided if possible



If you must...

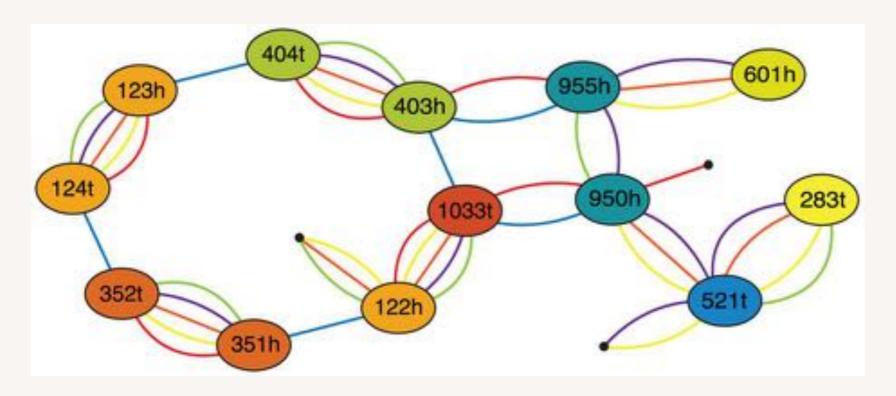
use <u>colorbrewer2.org</u> to select colorblind friendly palettes

use shapes to better highlight salience

select semantically resonant colors

consider background colors and how this affects final appearance

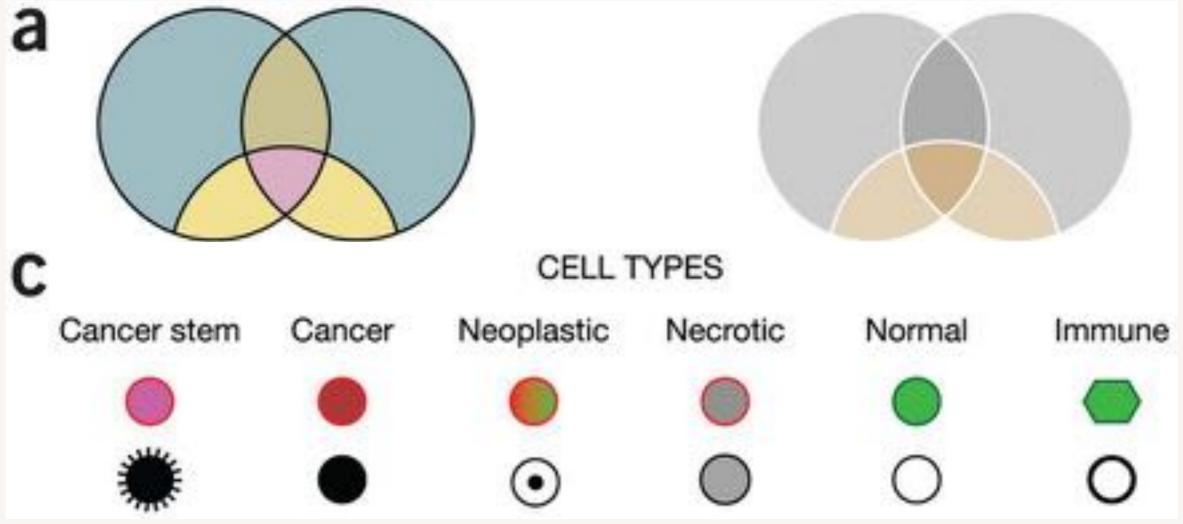
#### Avoid overstimulation



info reduction = greater emphasis on what is shown

"less is more"

Appeal to intuition

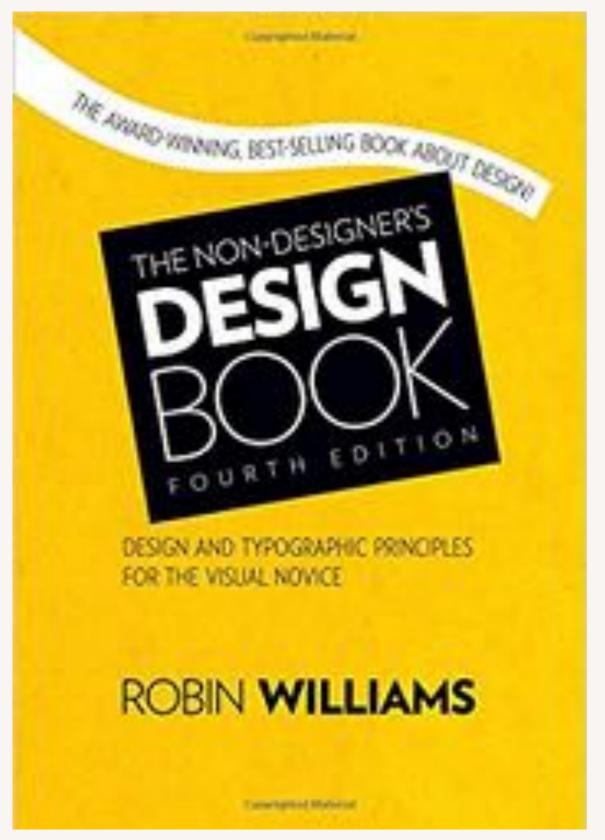


### Outline

Perception

**Plotting** 

Slides



**Proximity** 

Ralph Roister Doister

(717) 555-1212

**Mermaid Tavern** 

916 Bread Street

London, NM

**Proximity** 

### **Mermaid Tavern**

**Ralph Roister Doister** 

916 Bread Street London, NM (717) 555-1212

#### Alignment

#### **Mermaid Tavern**

Ralph Roister Doister

1027 Bread Street London, NM (717) 555-1212

#### **Mermaid Tavern**

Ralph Roister Doister

1027 Bread Street London, NM (717) 555-1212

#### Alignment

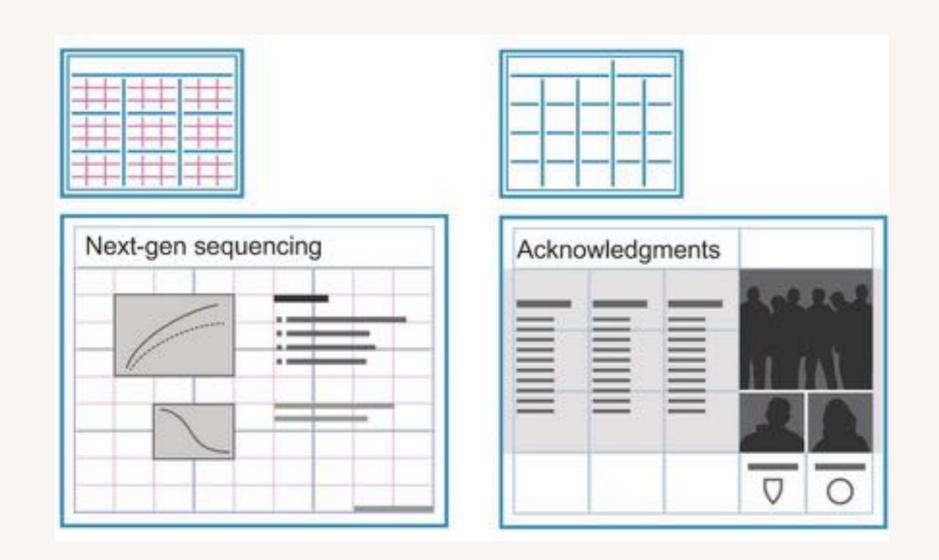
Business Plan for The Shakespeare Papers

by Patricia Williams February 25 Business Plan for

The Shakespeare Papers

by Patricia Williams February 25

Alignment



### Title text

Subtitle text

Comments on the Figs Comments on the Figs Comments on the Figs

Comments on the Figs

Comments on the Figs

Comments on the Figs

#### Repetition



mer's dodder, Violate Huskings, an wart hoppings darn honor form.

Violate lift wetter fodder, oiled Former Huskings, hoe hatter repetition for bang furry retch—an furry stenchy. Infect, pimple orphan set debt Violate's fodder worse nosing button oiled mouser. Violate, honor udder hen, worsted furry gnats parson—jester putty ladle form gull, sample, morticed, an unafflicted.

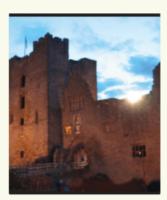
Wan moaning Former Huskings nudist haze dodder setting honor cheer, during nosing.

#### Nor symphony

VIOLATE! sorted dole former, Watcher setting darn fur? Yore canned gat retch setting darn during nosing?
Germ pup otter debt cheer!

Arm tarred, Fodder, resplendent Violate warily.

Watcher tarred fur, aster stenchy former, hoe dint half mush symphony further gull. Are badger dint doe mush woke disk moaning! Ditcher curry doze buckles fuller slob darn tutor peg-pan an feeder pegs?



 $\blacktriangleright$  Water rheumatic form!

#### **Vestibule guardings** <

Yap, Fodder. Are fetter pegs. Ditcher mail-car caws an swoop otter caw staple? Off curse, Fodder. Are mulct oiler caws an swapped otter staple, fetter checkings, an clammed upper larder inner checking-horse toe gadder oiler aches, an wen dam tutor vestibule guarding toe peck oiler bogs an warms offer vestibules, an watched an earned yore closing, an fetter hearses an..

Ditcher warder oiler hearses, toe? enter-ruptured oiled Huskings.

Nor, Fodder, are dint. Dint warder mar hearses? Wire nut?

Consistent double rule on all pages.

Consistent typeface in headlines and subheads, and consistent space above each.

This single rule repeats across the bottom of each page.

Page numbers
are in the
same place
(the bottom
outer corners)
and in the
same typeface
on each page.

#### Contrast

#### The Rules of Life

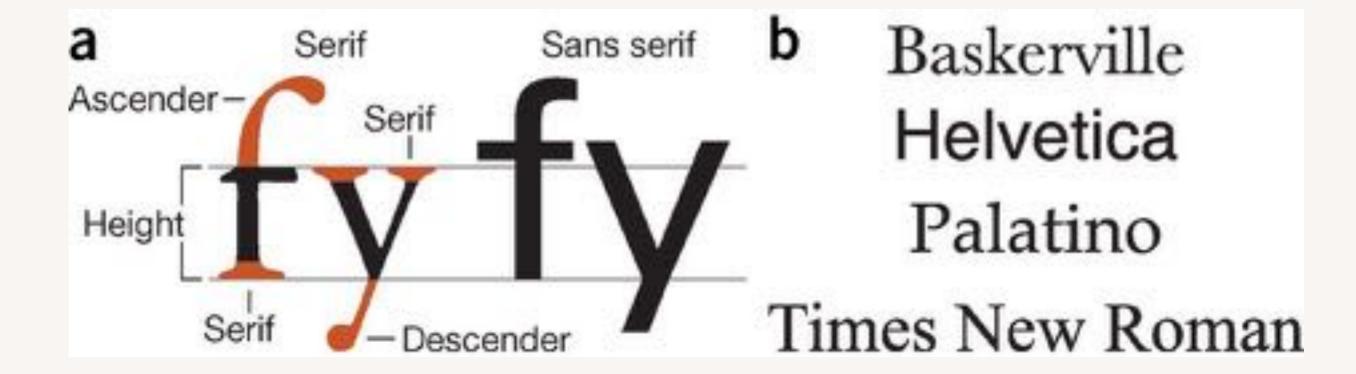
Your attitude is your life.

Maximize your options.

Don't let the seeds stop you from enjoyin' the watermelon.

Be nice.

#### Contrast



#### Contrast

### The Rules of Life

Your attitude is your life.

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