

Data Science 1

STAT/CS 287

Jim Bagrow, UVM Dept of Math and Statistics

LECTURE 20

Designing visualizations

Visualization ⊂ Communication

Visualizations are one tool to tackle the larger problem of communicating your results

Designing visualizations

Designing visualizations

Which kind of door handle is better?



Designing visualizations

Which kind of door handle is better?



Better? Easier to open!

Designing visualizations

"Design is how it works"

–Steve Jobs



Designing visualizations

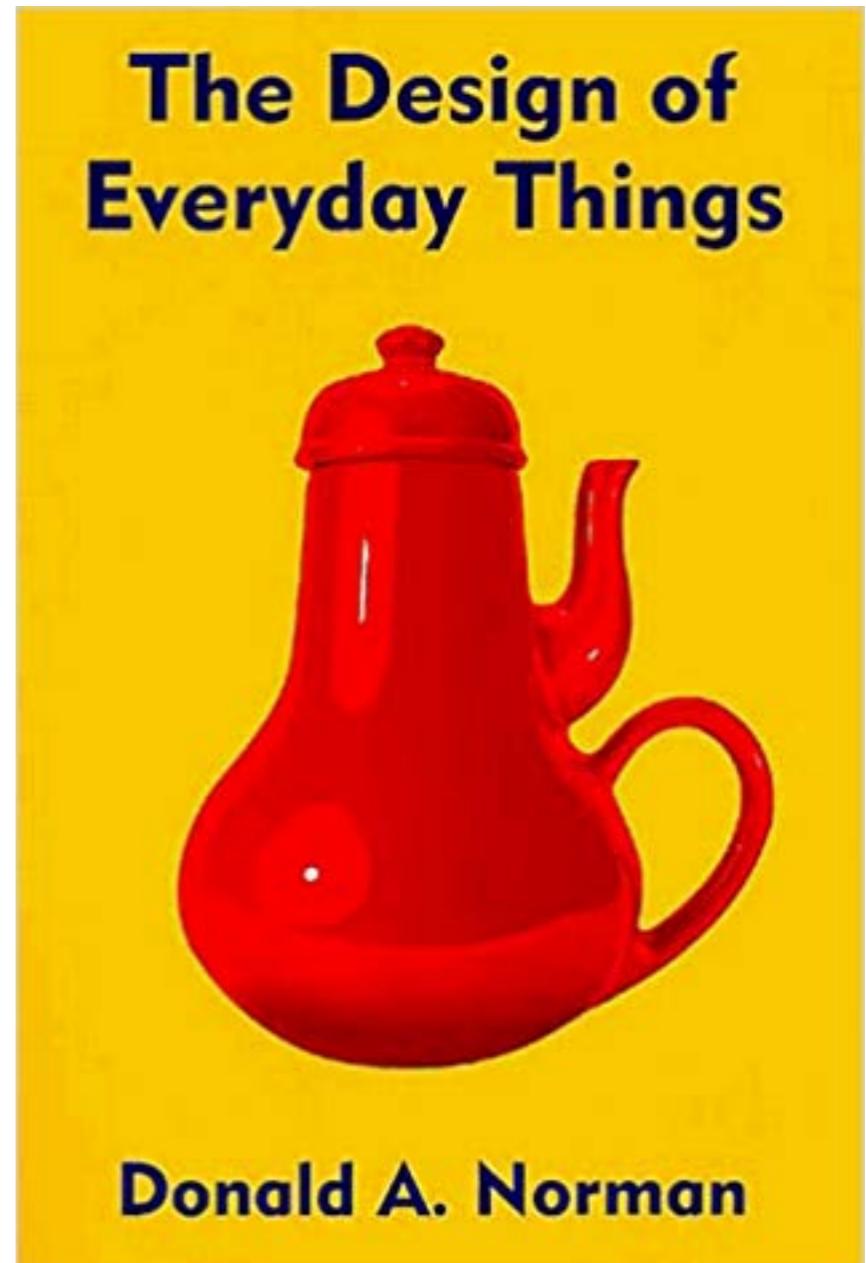
"Design is how it works"

—Steve Jobs



Designing visualizations

"Design is how it works"
–Steve Jobs



Designing visualizations

Which kind of door handle is better?



Better? Easier to open!

Visualizations: better = easier to understand

Designing visualizations

- Know your message
- Know your medium
- Know your audience
- Account for strengths and weaknesses of human perception
- Keep it simple

Many of the examples here are from a series of articles published in Nature Methods during 2010-2015 called "Points of View"

THIS MONTH

POINTS OF VIEW

Salience to relevance

In science communication, it is critical that visual information be interpreted efficiently and correctly. The discordance between components of an image that are most noticeable and those that are most relevant or important can compromise the effectiveness of a presentation. This discrepancy can cause viewers to mistakenly pay attention to regions of the image that are not relevant. Ultimately, the misdirected attention can negatively impact comprehension.

Salience is the physical property that sets an object apart from its surroundings. It is particularly important to ensure that salience aligns with relevance in visuals used for slide presentations. In these situations, information transmission needs to be efficient because the audience member is expected to simultaneously listen and read

Figure 2 consists of two panels. Panel (a) is a heatmap showing the relative visibility of different colors (blue, orange, red) on a scale from low to high. The color scale at the bottom ranges from blue (Low) to red (High). Panel (b) shows a slide layout with a title 'Slide title' and three bullet points: '• Dolor sit amet, sed eiusmod tempor', '• Ut labore et dolore veniam, quis', and '• Ullamco laboris nisi consequat'. Below the title is a small graphic of three colored circles (red, orange, and brown) arranged in a triangle, with arrows indicating they are moving. The text 'Lorem ipsum dolor' is at the bottom right.

Figure 2 | Discordances between salience and relevance can be harmful. (a) The relative visibility of hues in the color scale is asymmetric, making higher values (represented by deep red) less apparent. (b) Continuously moving images can be distracting and can compromise the viewer's ability to concentrate on other content.

In contrast, unintentional and inadvertent assignment of salience can be harmful to the communicative potential of images. In the com

The challenge

Six months of work

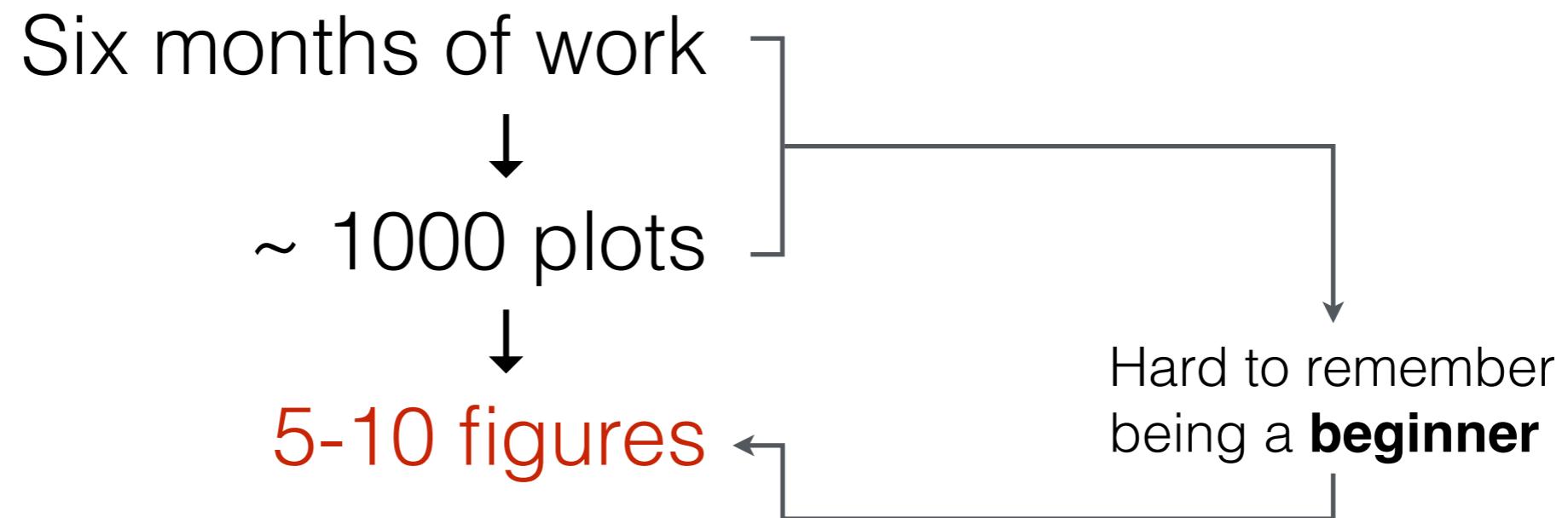


~ 1000 plots



5-10 figures

The challenge



Know your message

A figure/visualization has a **goal**: what do you want the reader to learn?

Know your message

A figure/visualization has a **goal**: what do you want the reader to learn?

Summary sentence:

“Cancer deaths are down, but mostly due to decreased smoking rates.”

“Algorithm B converges faster than A.”

“Bats spread Ebola, not rodents.”

“The rate of text messages increased after approximately day 45.”

Know your message

A figure/visualization has a **goal**: what do you want the reader to learn?

Summary sentence:

“Cancer deaths are down, but mostly due to decreased smoking rates.”

“Algorithm B converges faster than A.”

“Bats spread Ebola, not rodents.”

“The rate of text messages increased after approximately day 45.”

Build your figure(s) with this goal in mind.

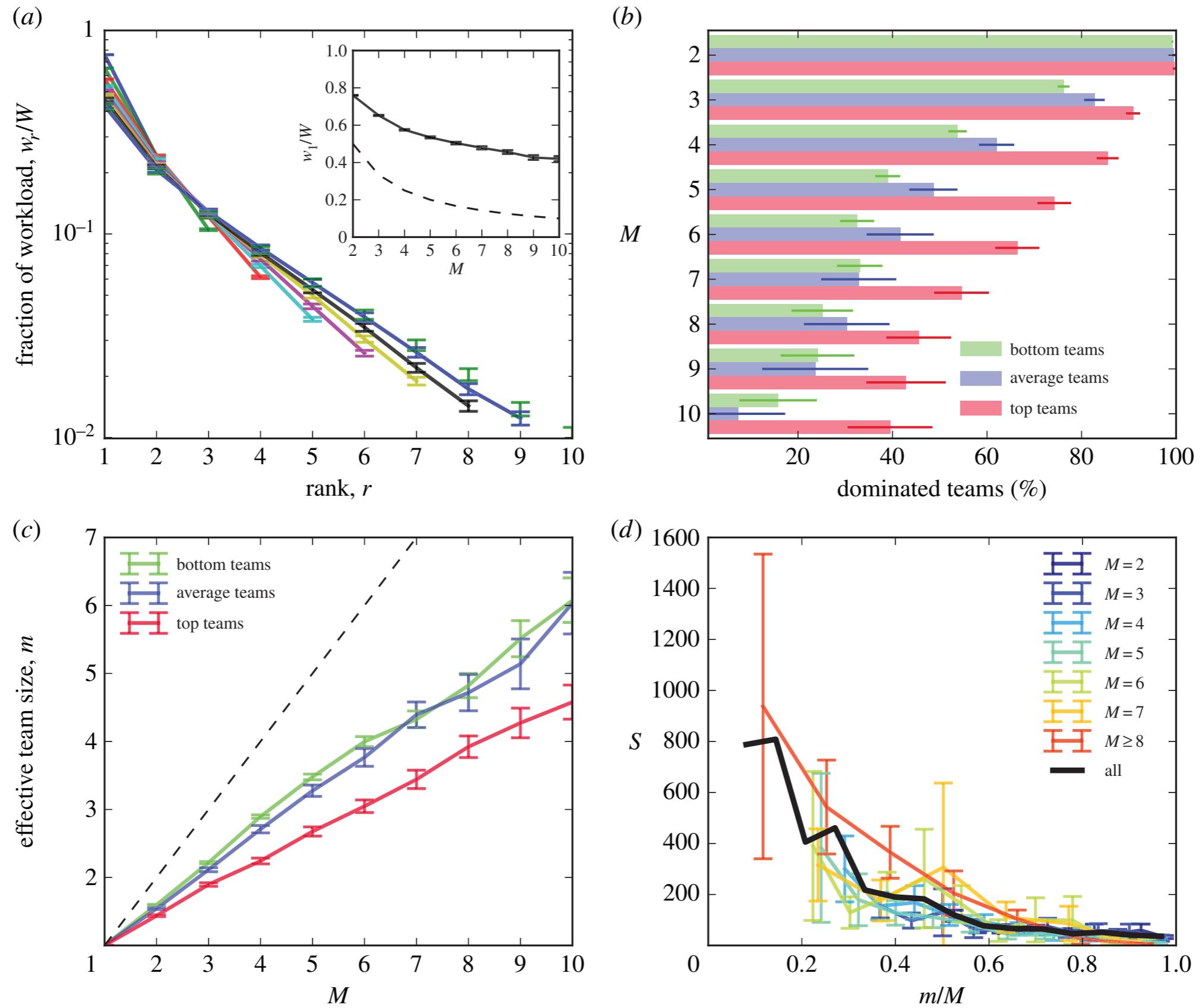
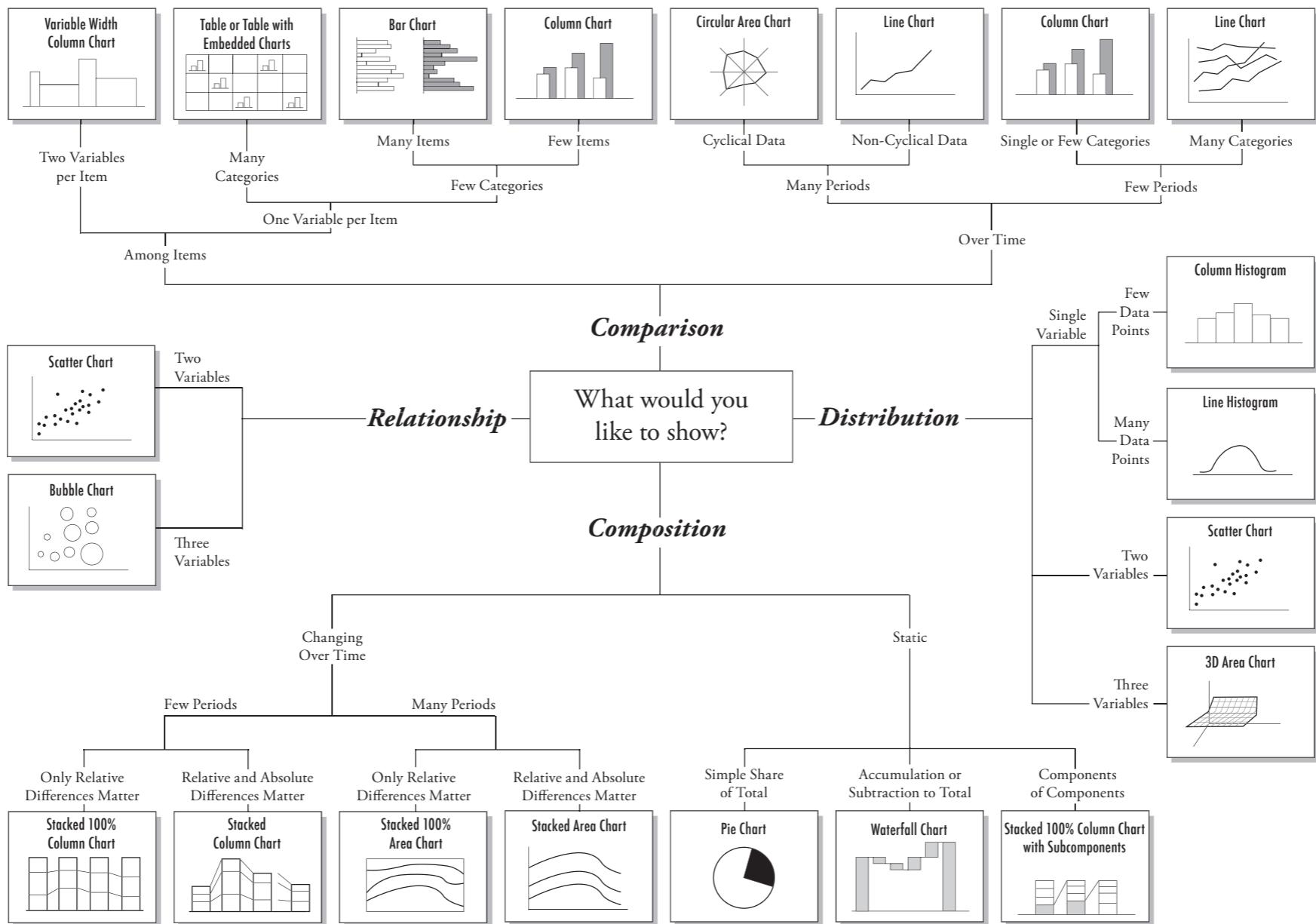


Figure 2. Teams are focused, and top teams are more focused than other teams of the same size. **(a)** The average fraction of work w_r/W performed by the r th most active member, where W is the total work of the team, for different size teams. Larger teams perform more

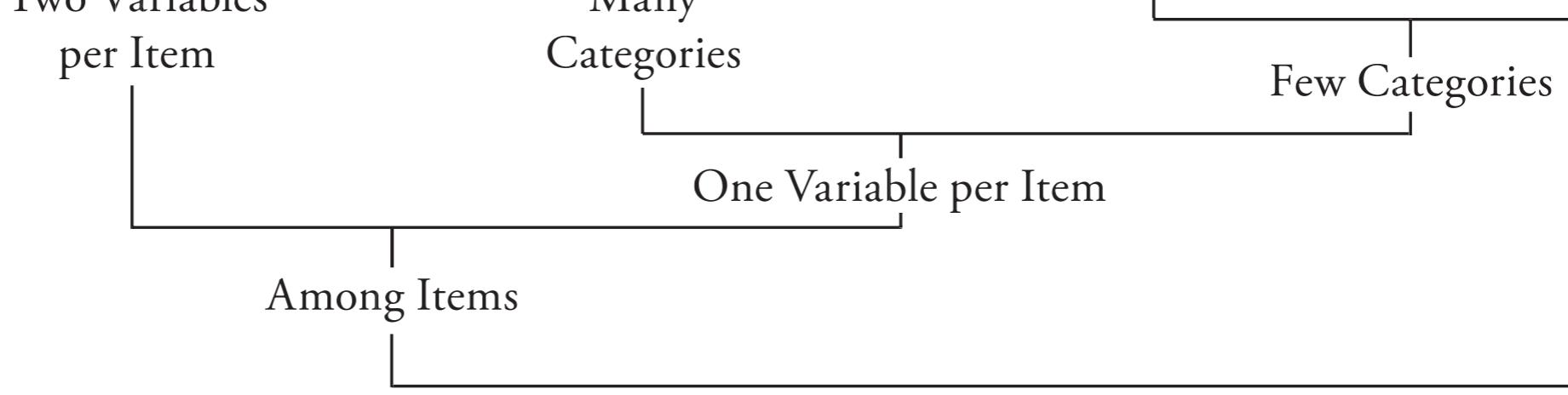
Chart Suggestions—A Thought-Starter



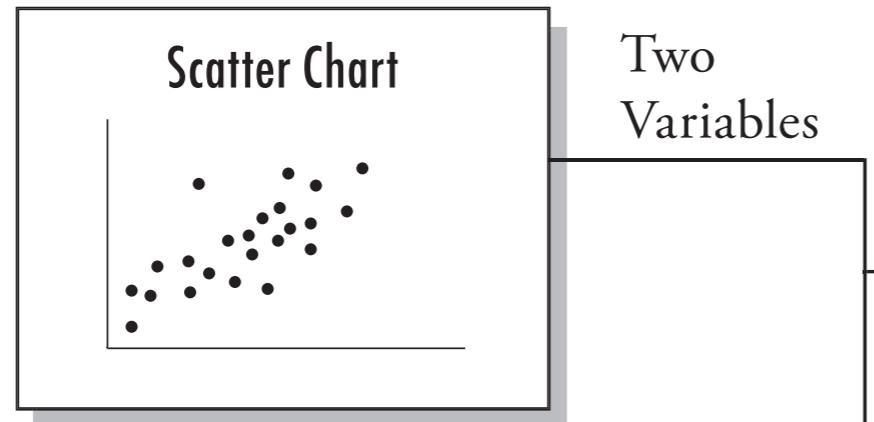
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<http://extremepresentation.com>

Zelazny, Say it with Charts, 2001

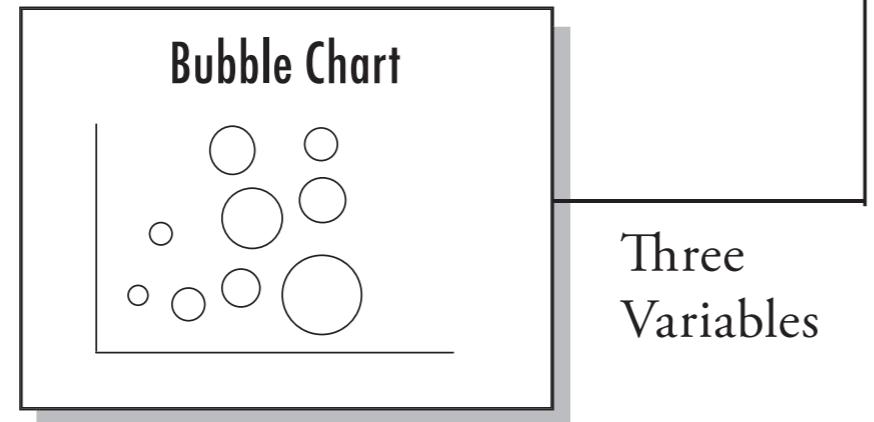


Con



Relationship

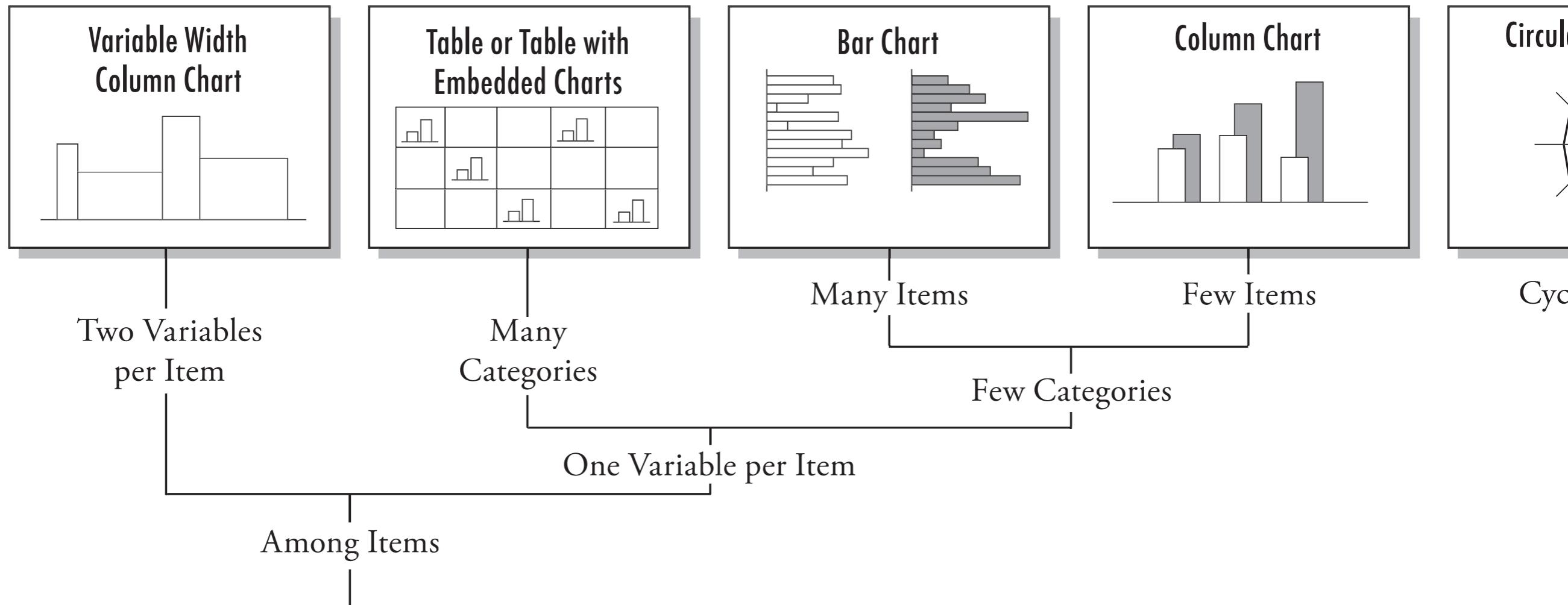
What like



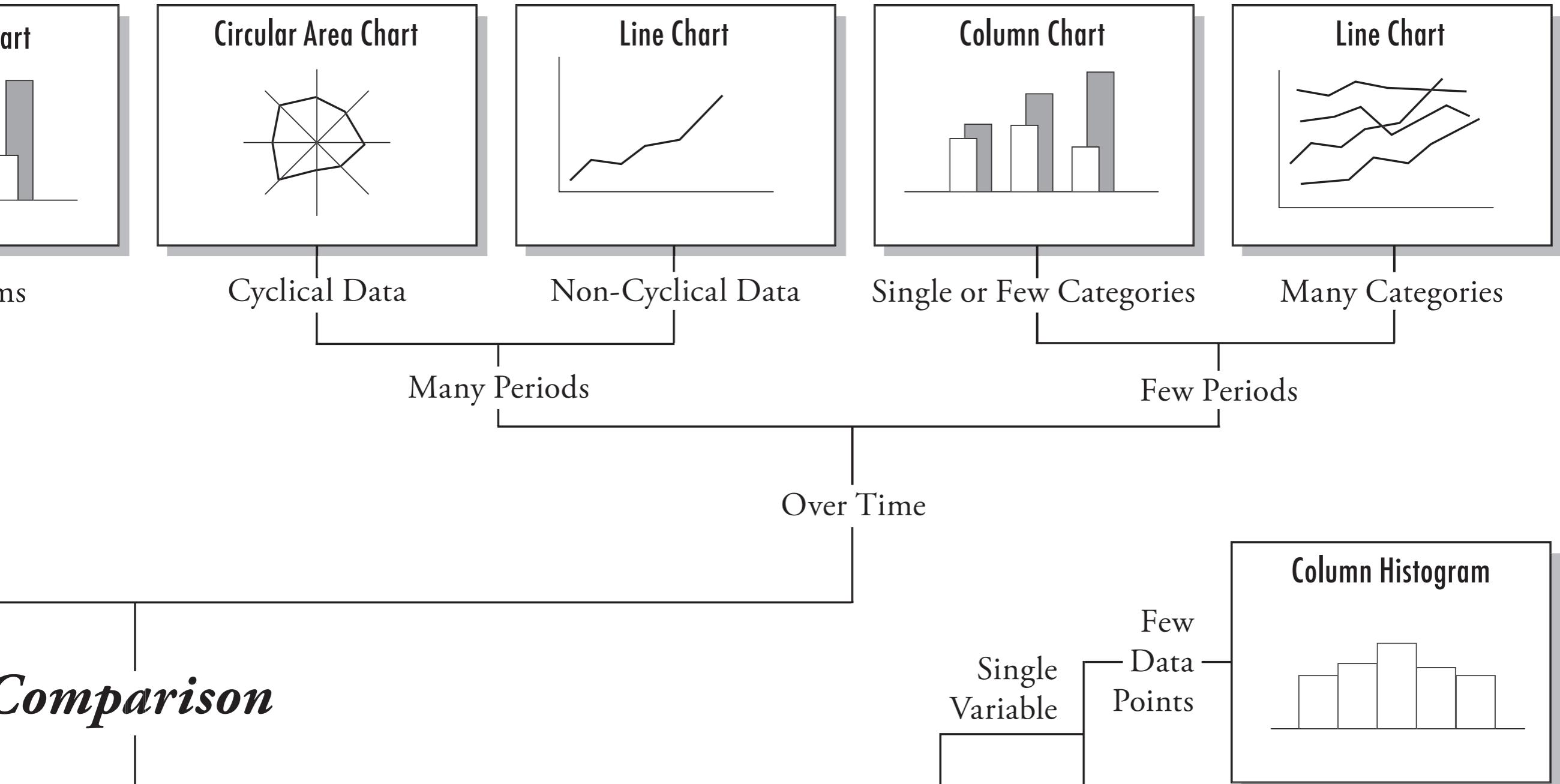
Com



Chart Suggestions—A ⁷



Options—A Thought-Starter



What would you
like to show?

Distribution

Comparison

What would you
like to show?

Distribution

Composition

Absolute
Value

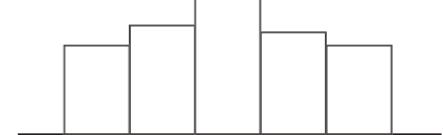
Simple Share
of Total

Accumulation or
Subtraction to Total

Components
of Components

Over Time

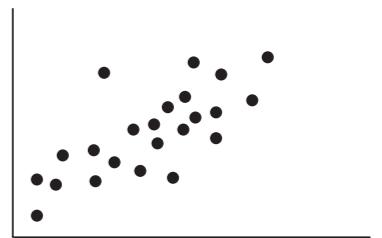
Column Histogram



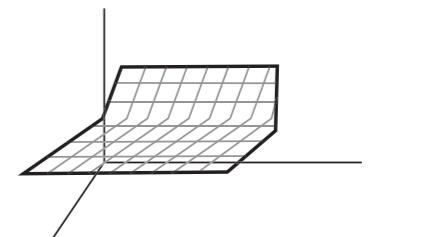
Line Histogram



Scatter Chart



3D Area Chart



Static

Two
Variables

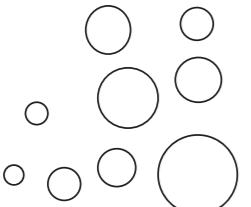
Three
Variables

Single
Variable

Few
Data
Points

Many
Data
Points

Bubble Chart



Three
Variables

Composition

Changing
Over Time

Few Periods

Many Periods

Only Relative
Differences Matter

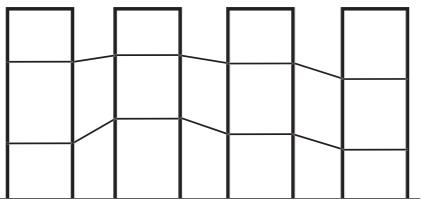
Relative and Absolute
Differences Matter

Only Relative
Differences Matter

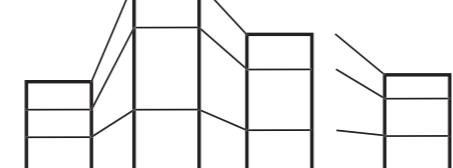
Relative and Absolute
Differences Matter

Simple
of T

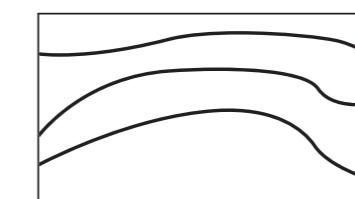
Stacked 100% Column Chart



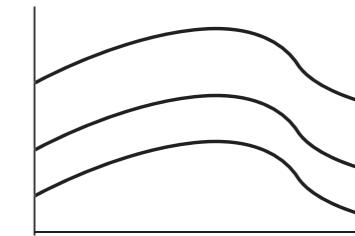
Stacked Column Chart



Stacked 100% Area Chart



Stacked Area Chart



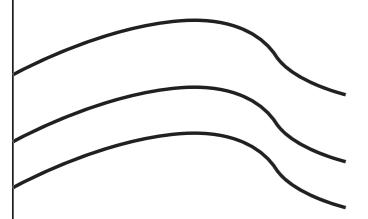
Pie C



Composition

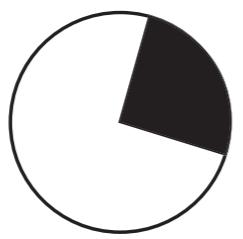
Relative and Absolute Differences Matter

Stacked Area Chart



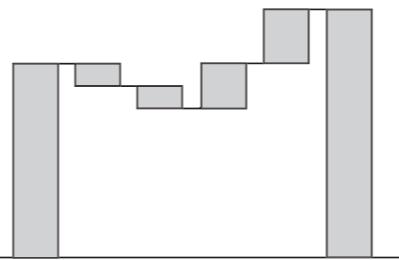
Simple Share
of Total

Pie Chart



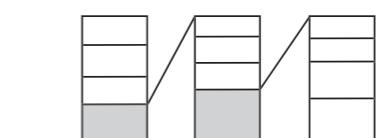
Accumulation or
Subtraction to Total

Waterfall Chart



Components
of Components

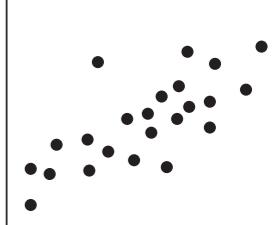
**Stacked 100% Column Chart
with Subcomponents**



Static

Two
Variables

Scatter Chart



Three
Variables

3D Area Chart

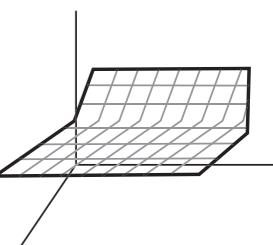
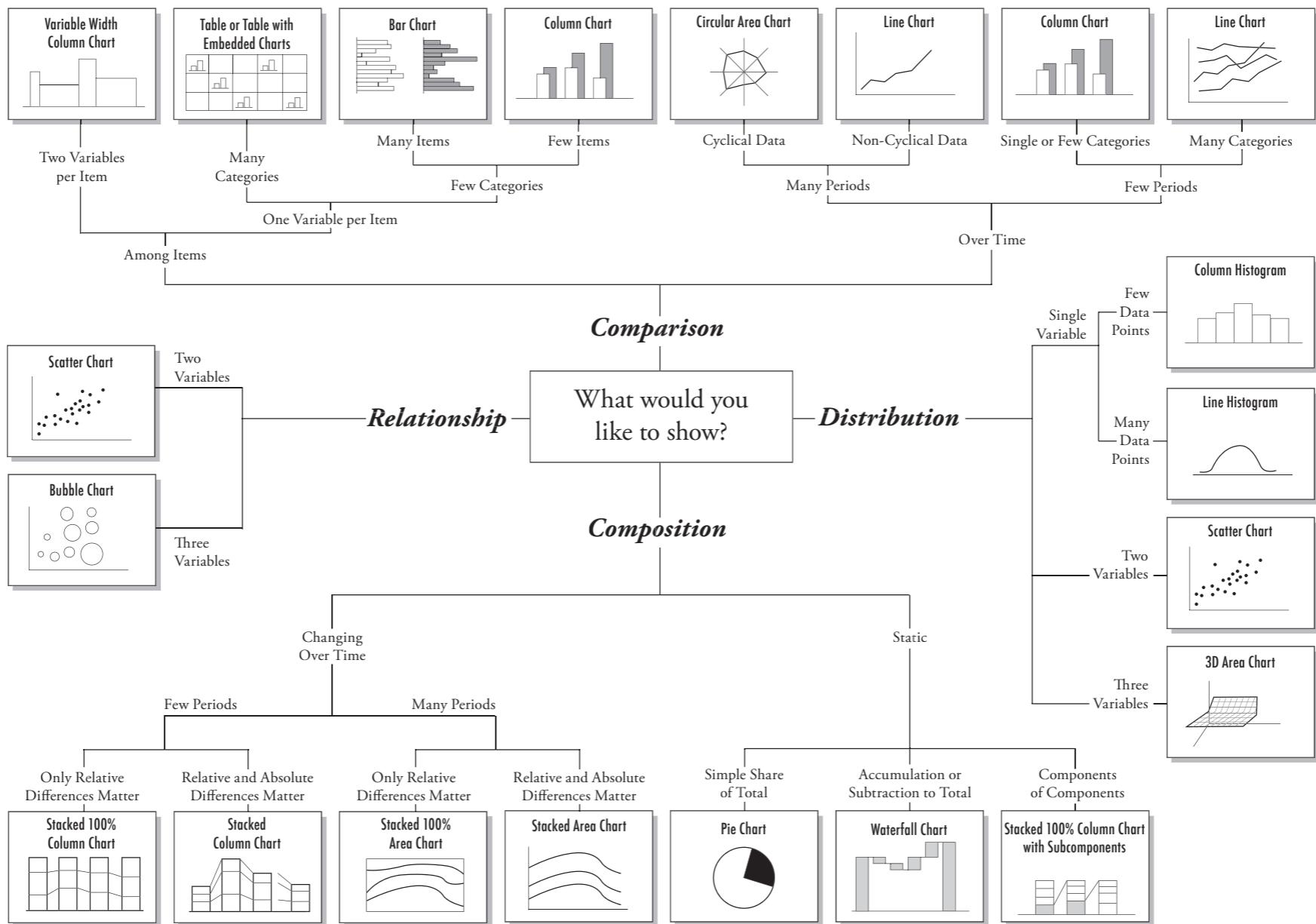


Chart Suggestions—A Thought-Starter



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<http://extremepresentation.com>

Zelazny, Say it with Charts, 2001

Know your medium

Print? Web? Slides?



Know your medium



Know your audience



Human perception

Parsing a figure or visualization requires performing **visual tasks**

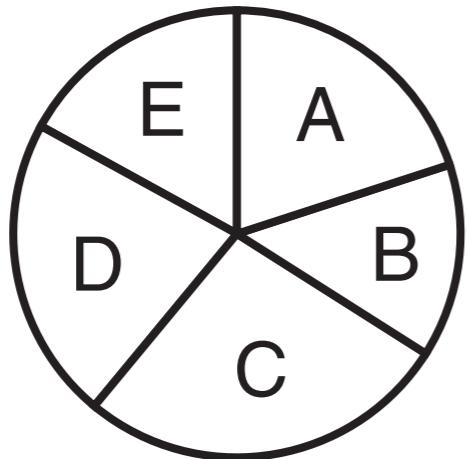
Humans are better at some tasks and worse at others

Human perception

Parsing a figure or visualization requires performing **visual tasks**

Humans are better at some tasks and worse at others

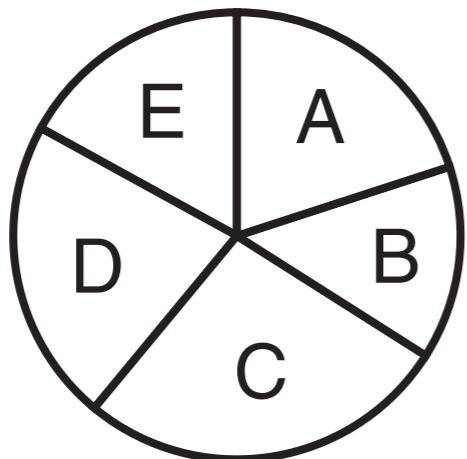
The humble pie chart



Human perception

Parsing a figure or visualization requires performing **visual tasks**

Humans are better at some tasks and worse at others

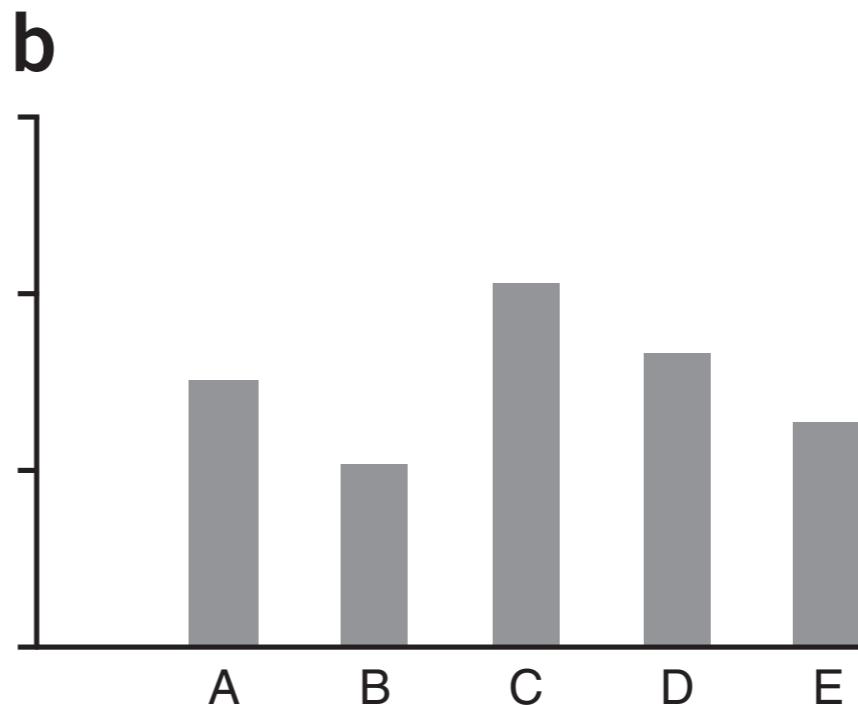
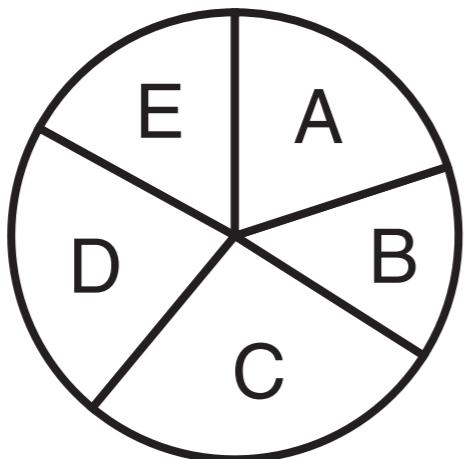


C looks bigger than D...
What about B vs. E...?

Human perception

Parsing a figure or visualization requires performing **visual tasks**

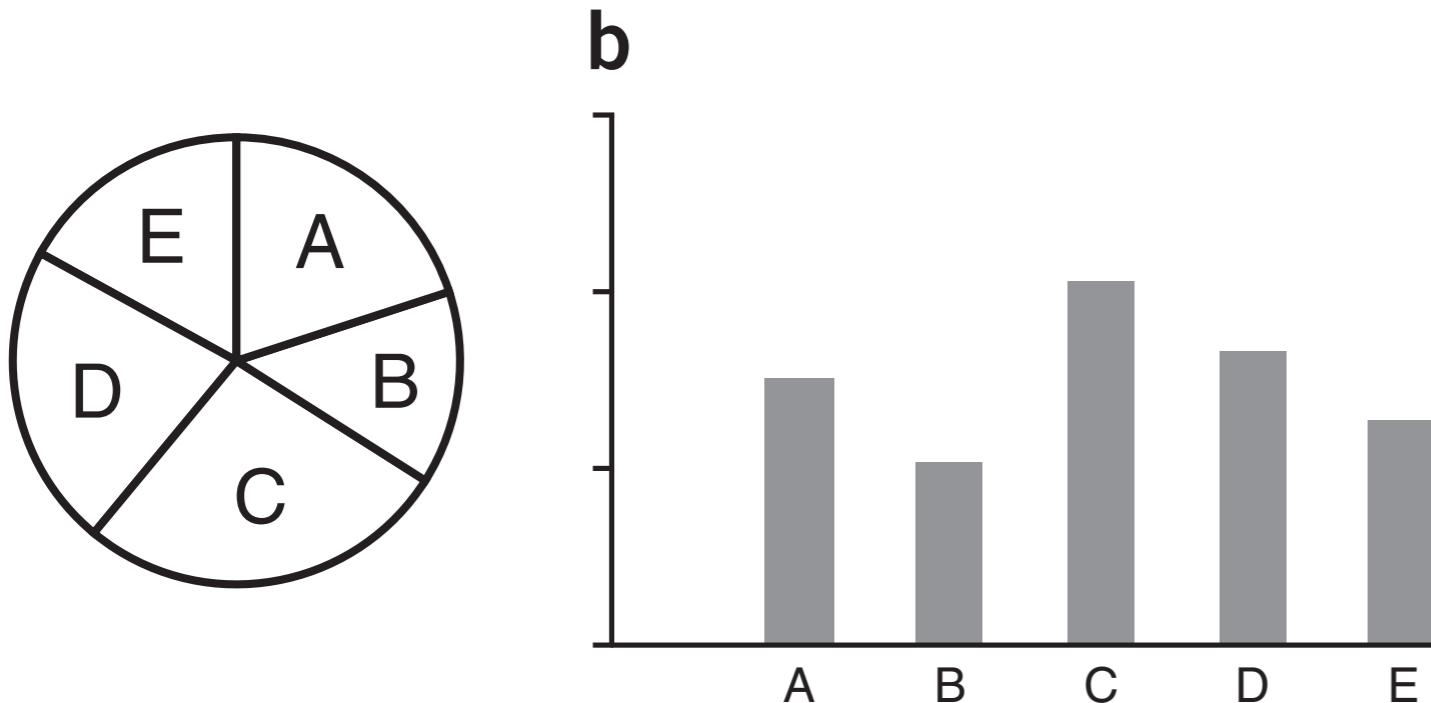
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Human perception

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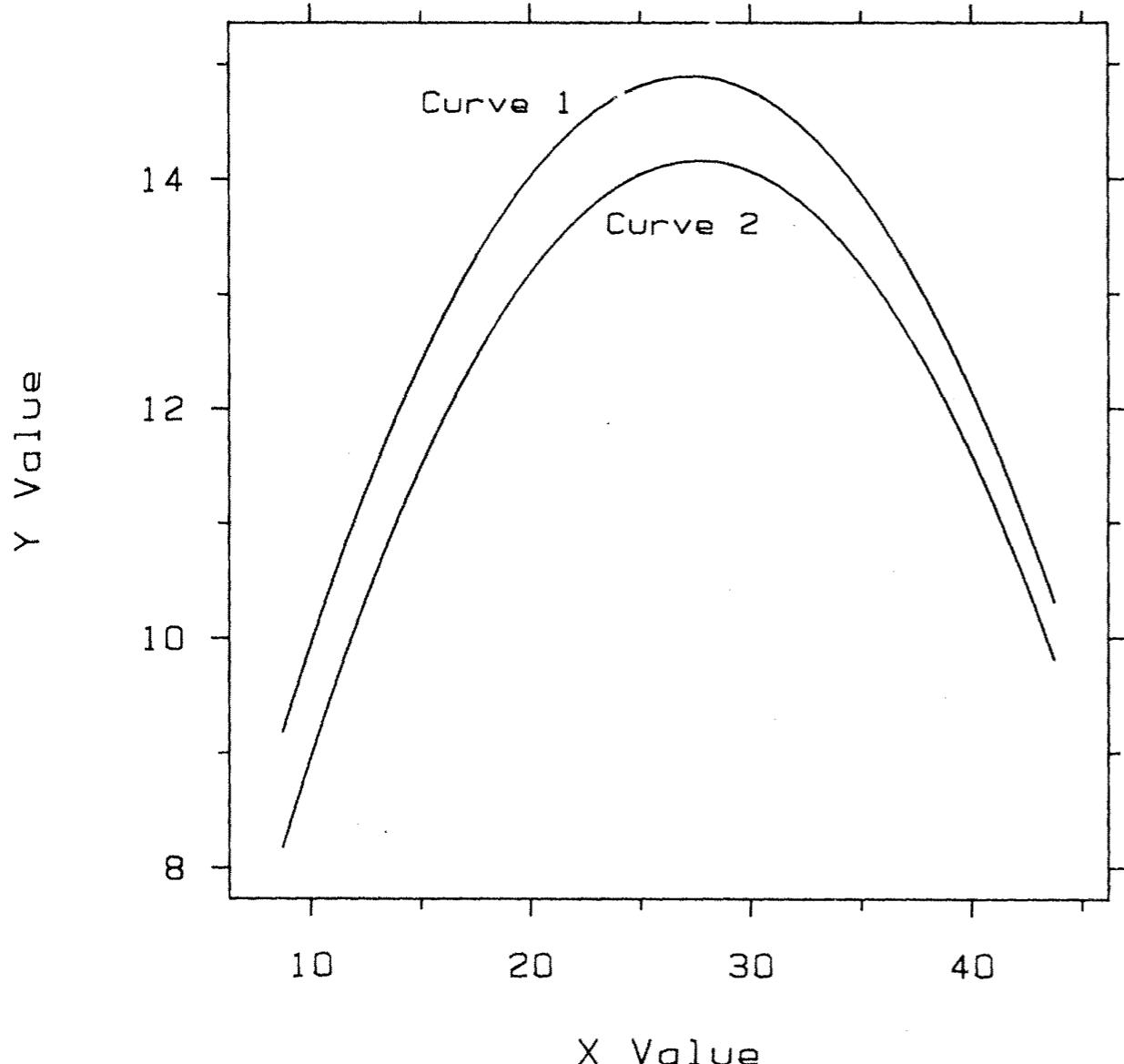
Humans are better at some tasks and worse at others



Avoid
Pie Charts

Human perception

Perceptual biases plague even basic graphics

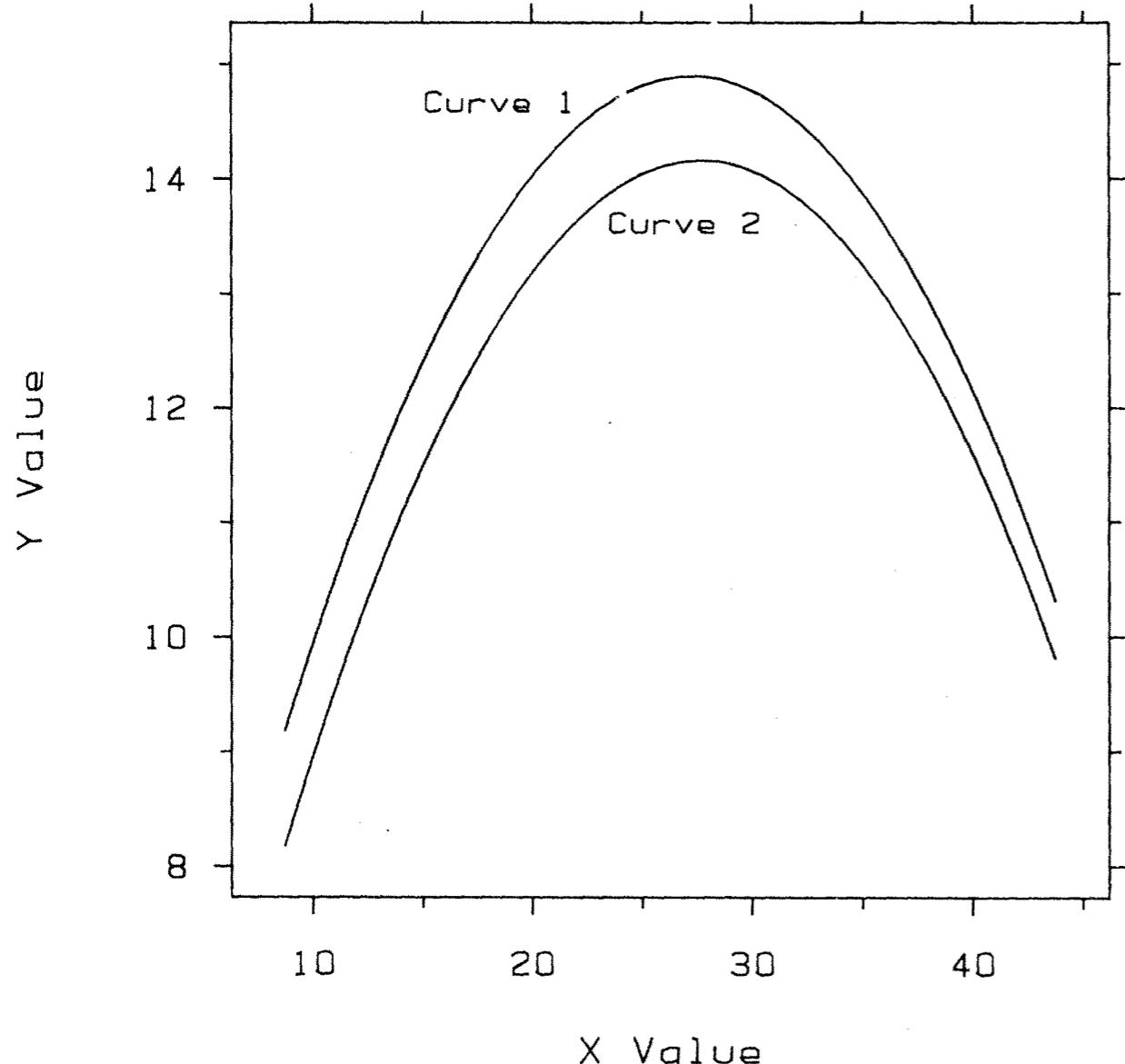


An example

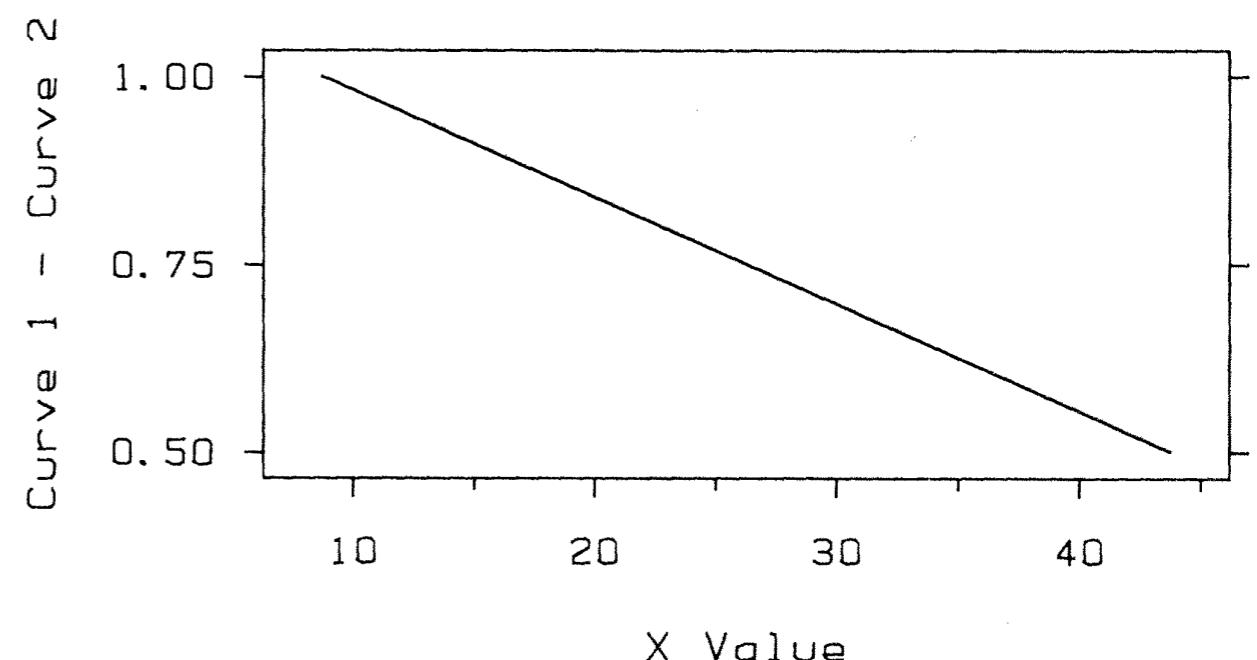
Cleveland, W.S. & McGill, R.
Science **229**, 828–833 (1985).

Human perception

Perceptual biases plague even basic graphics



An example

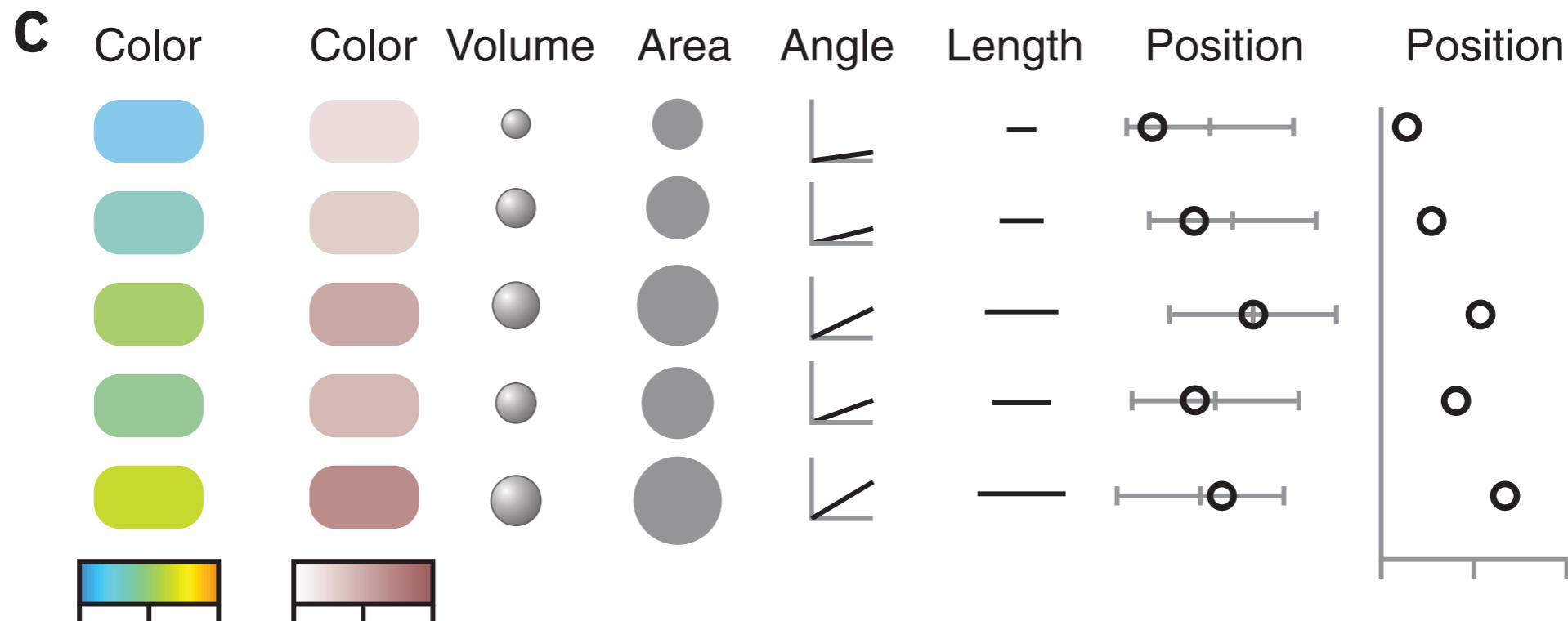


Cleveland, W.S. & McGill, R.
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Human perception

Parsing a figure or visualization requires performing **visual tasks**

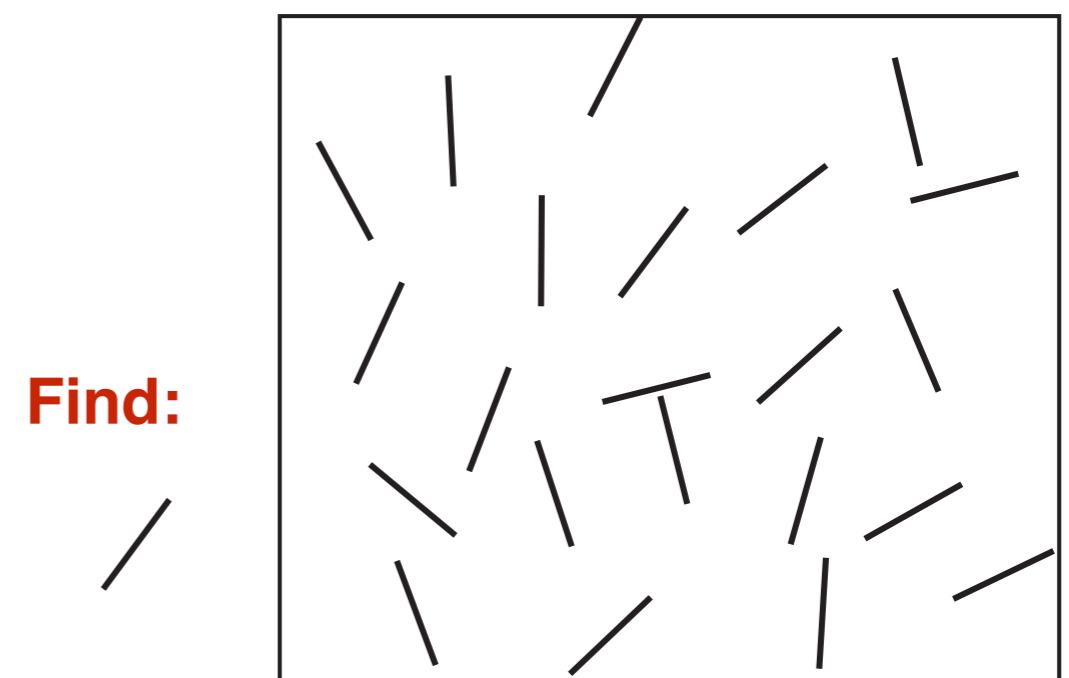
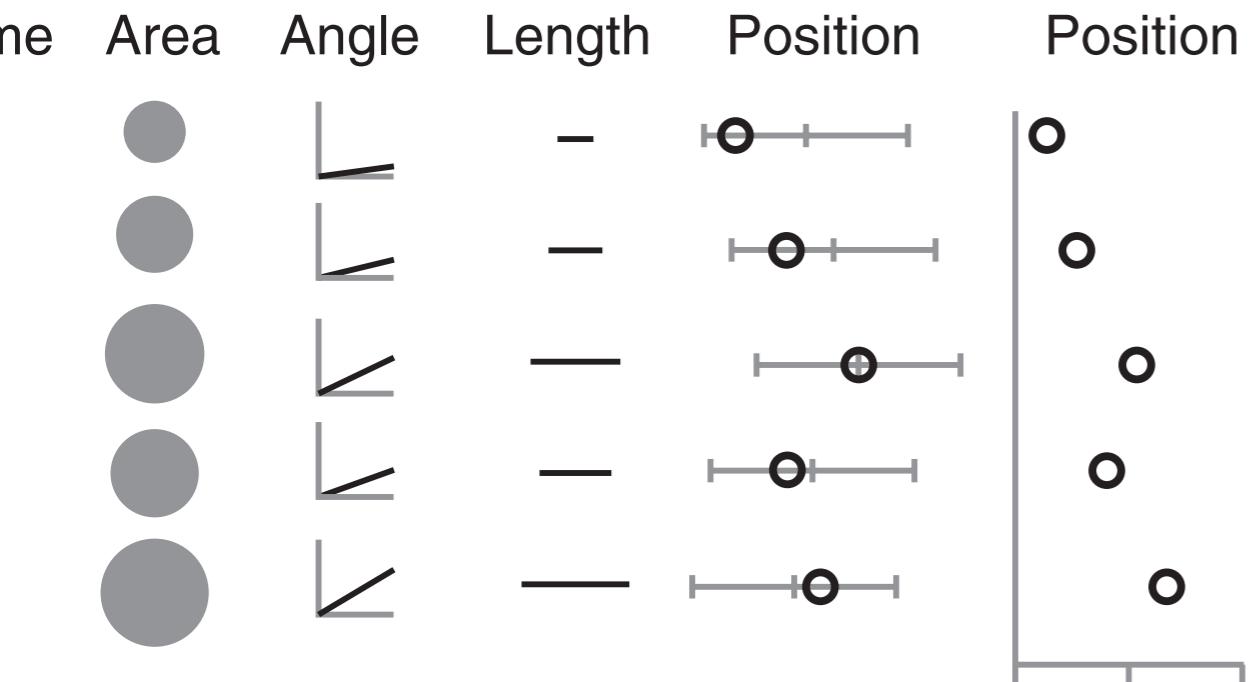
Humans are better at some tasks and worse at others



Human perception

Parsing a figure or visualization requires performing **visual tasks**

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Human perception

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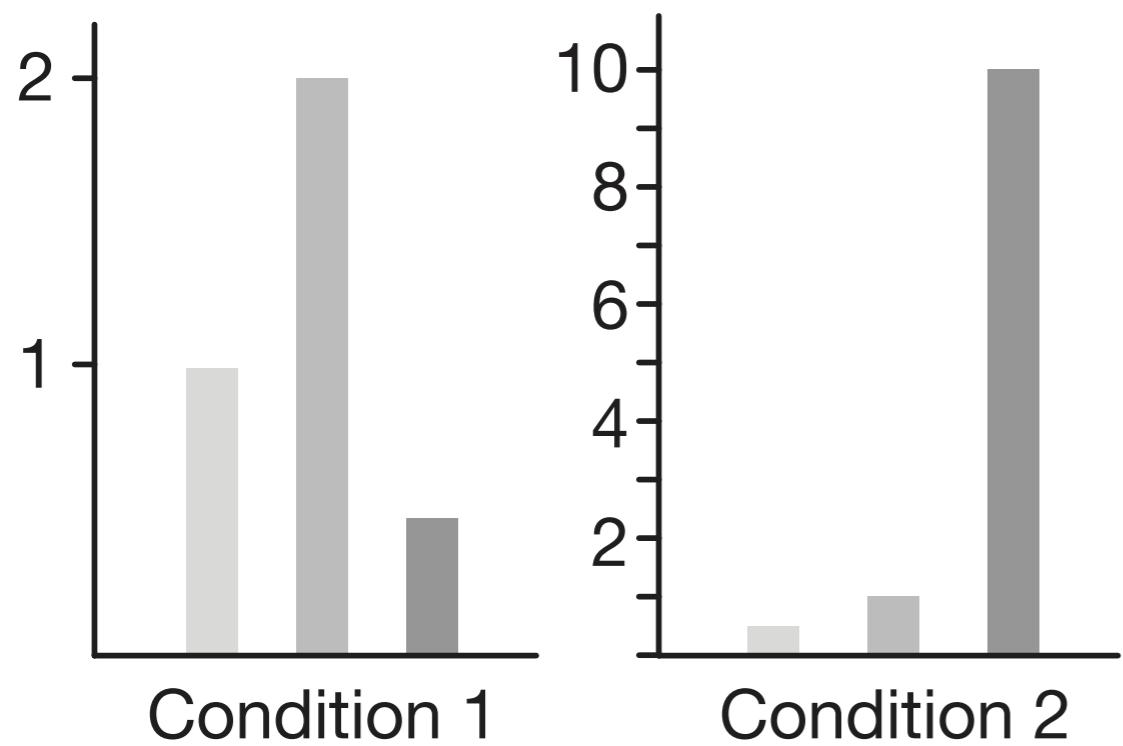
Humans are better at some tasks and worse at others

Aspect to compare	
easiest	Positions on a common scale
	Positions on the same but nonaligned scales
	Lengths
	Angles, slopes
	Area
	Volume, color saturation
hardest	Color hue

Cleveland, W.S. & McGill, R.
Science 229, 828–833 (1985).

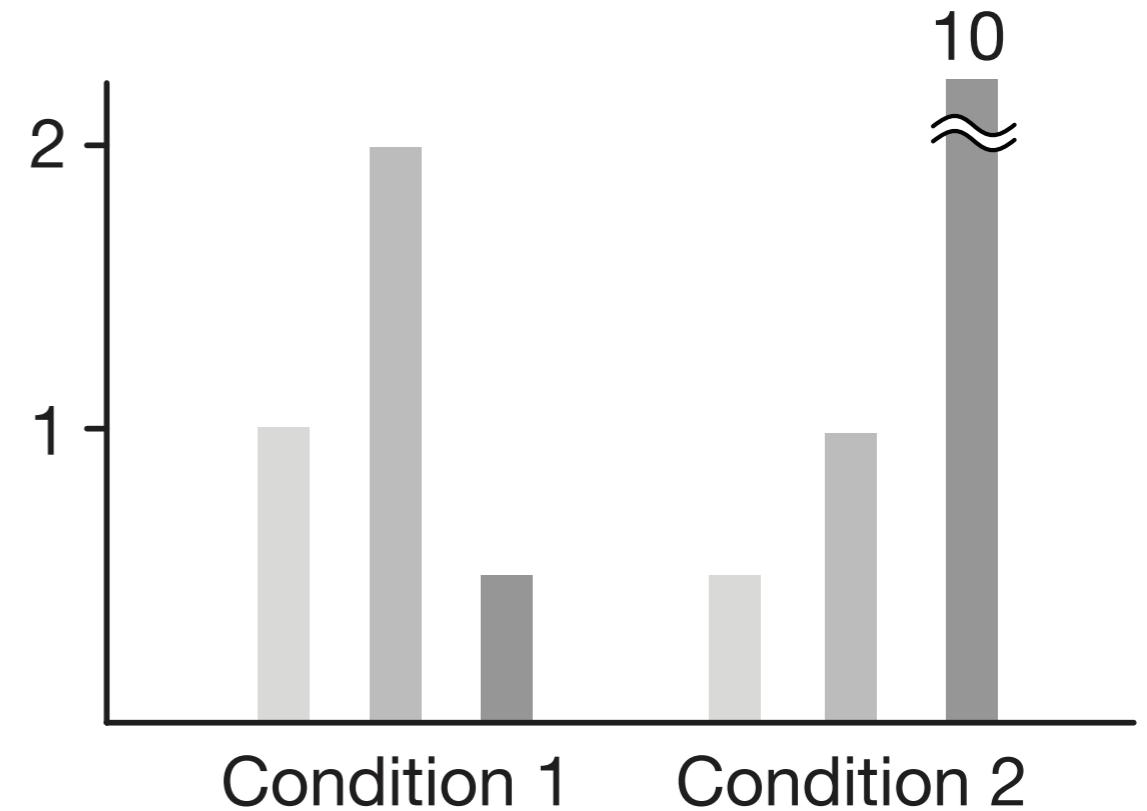
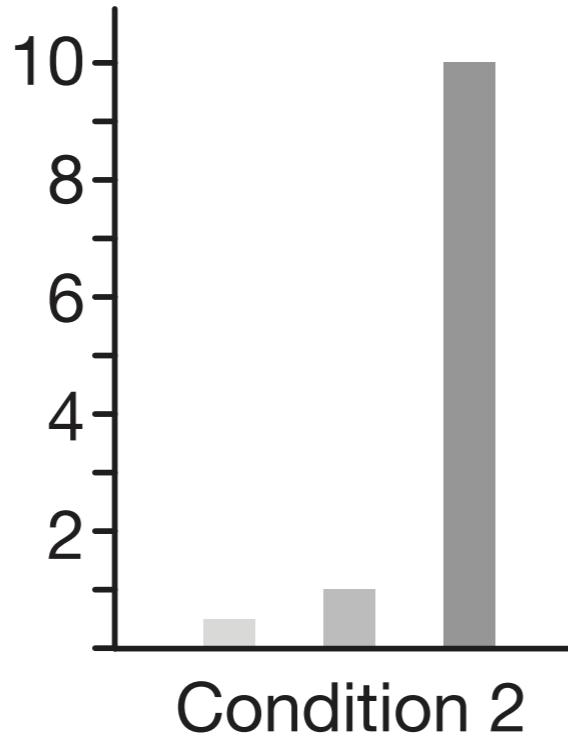
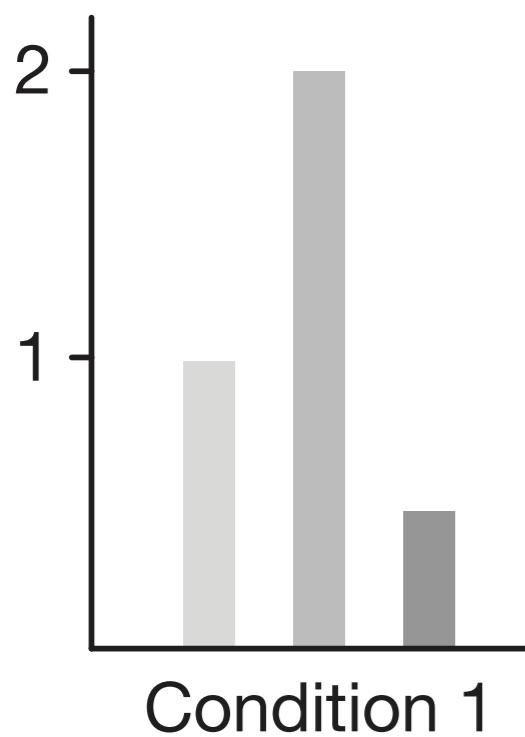
Human perception

Example

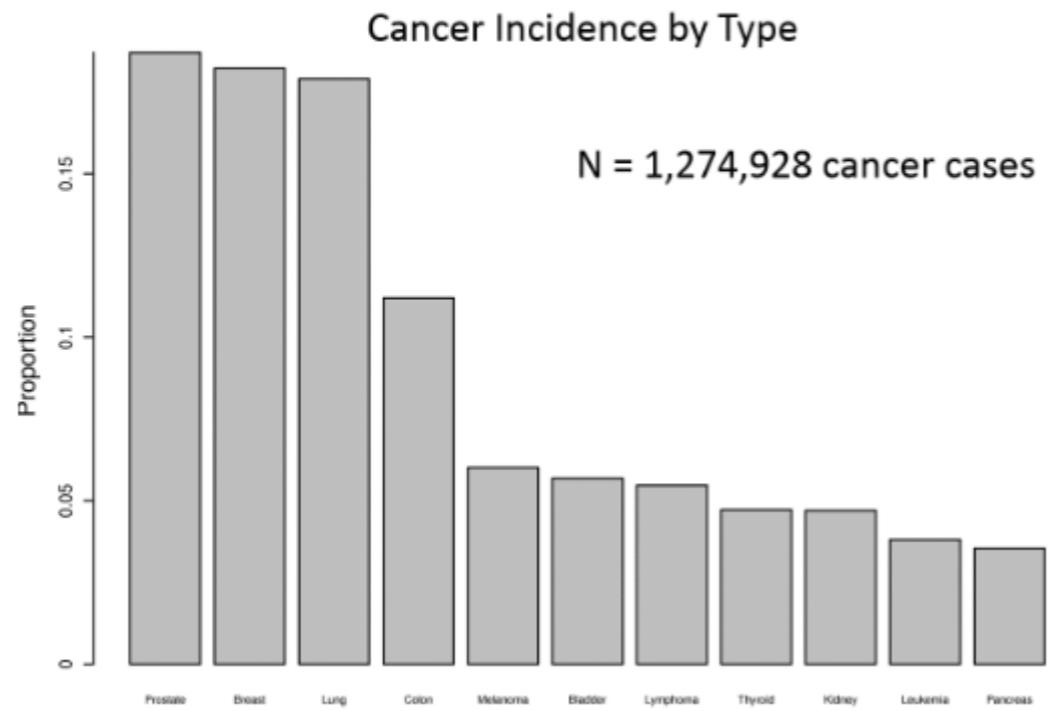


Human perception

Example

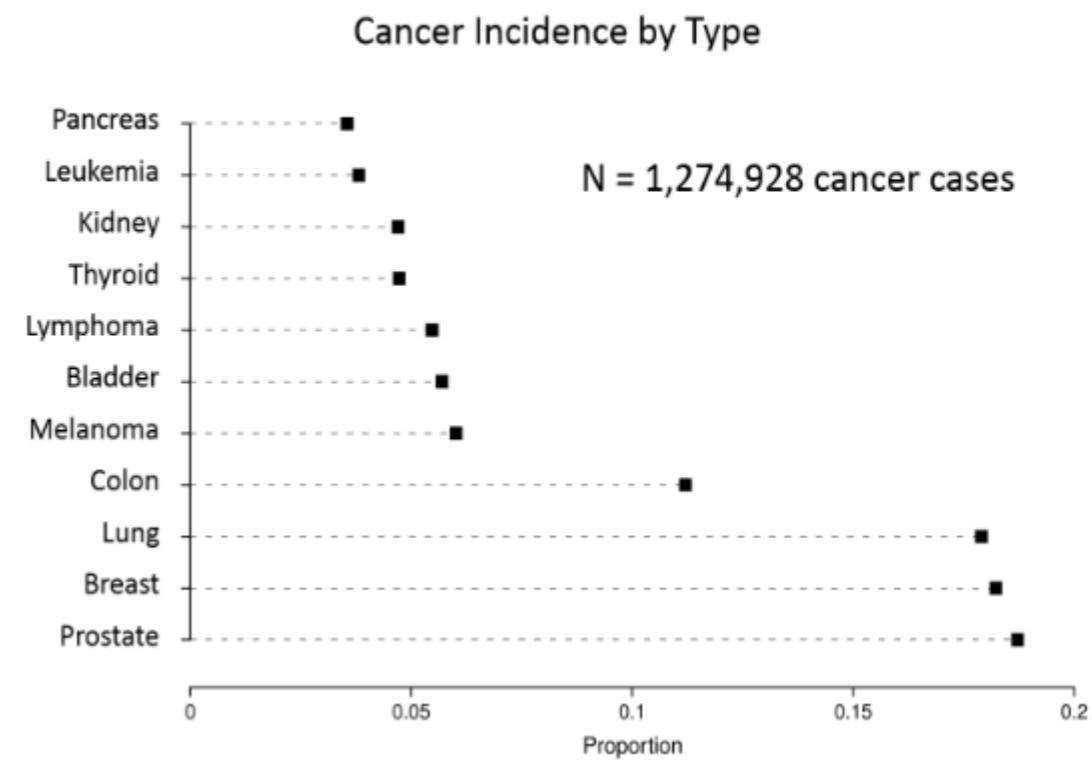
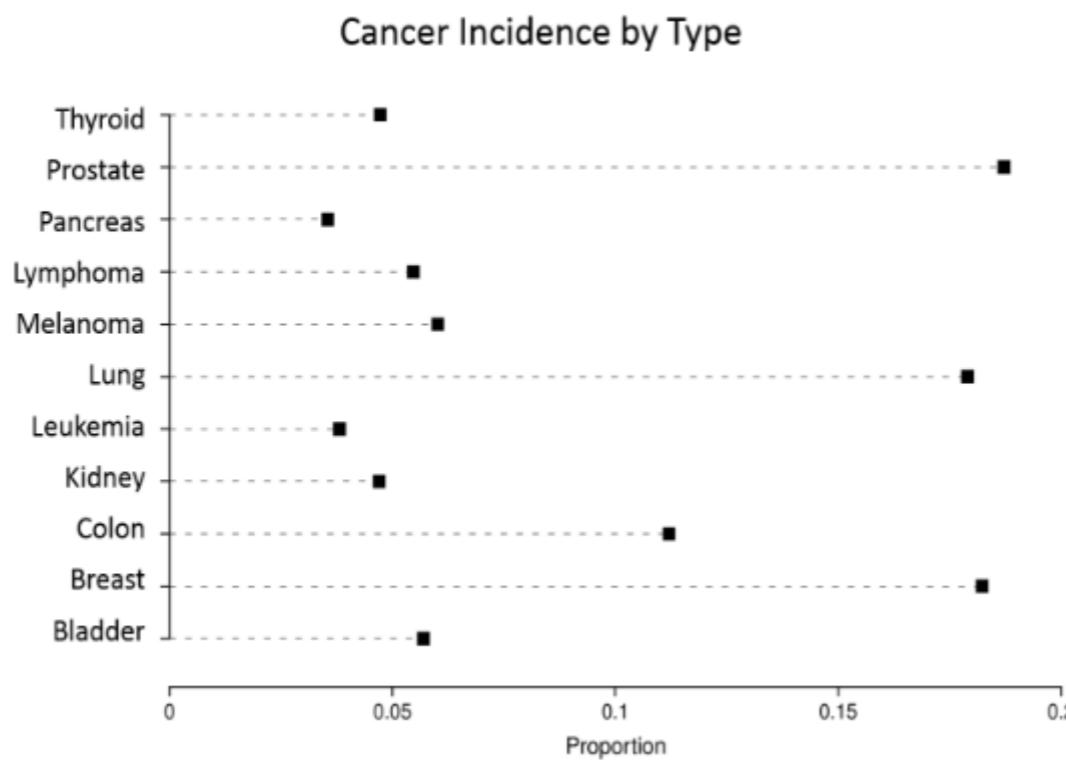
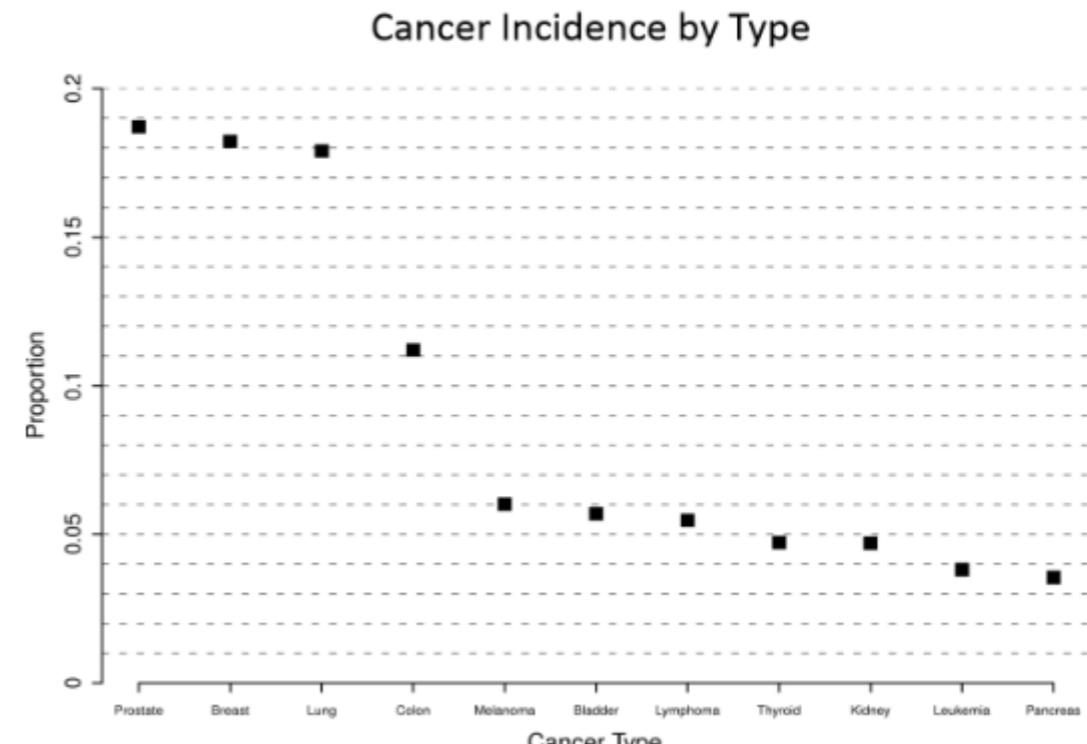
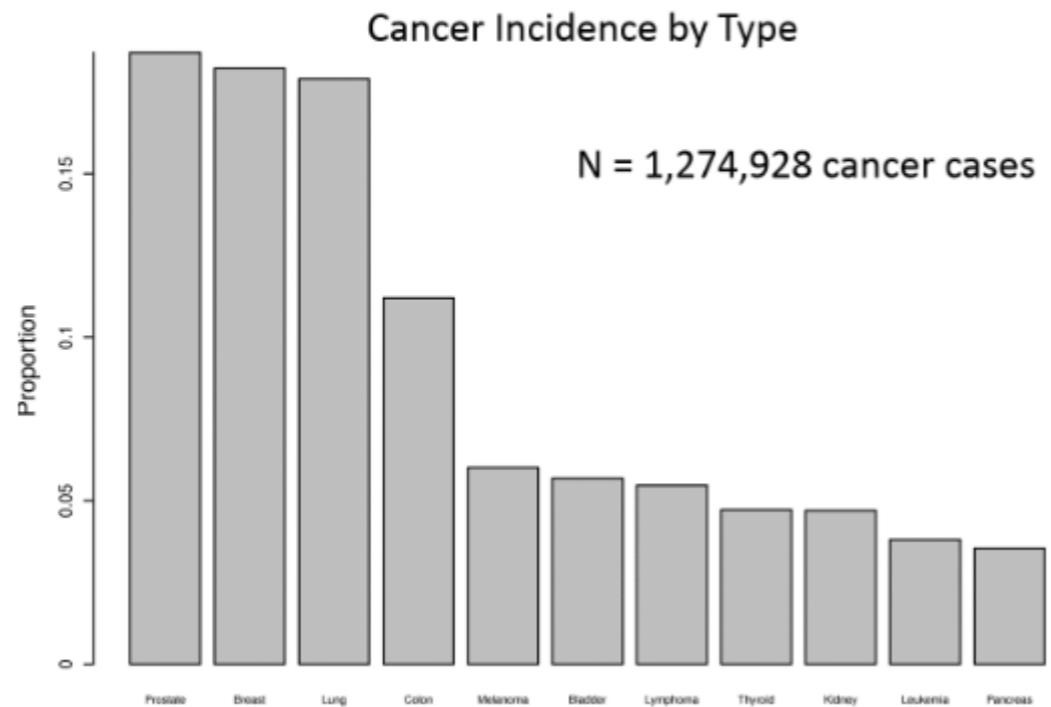


Simplification along the way



Which cancer is most common?

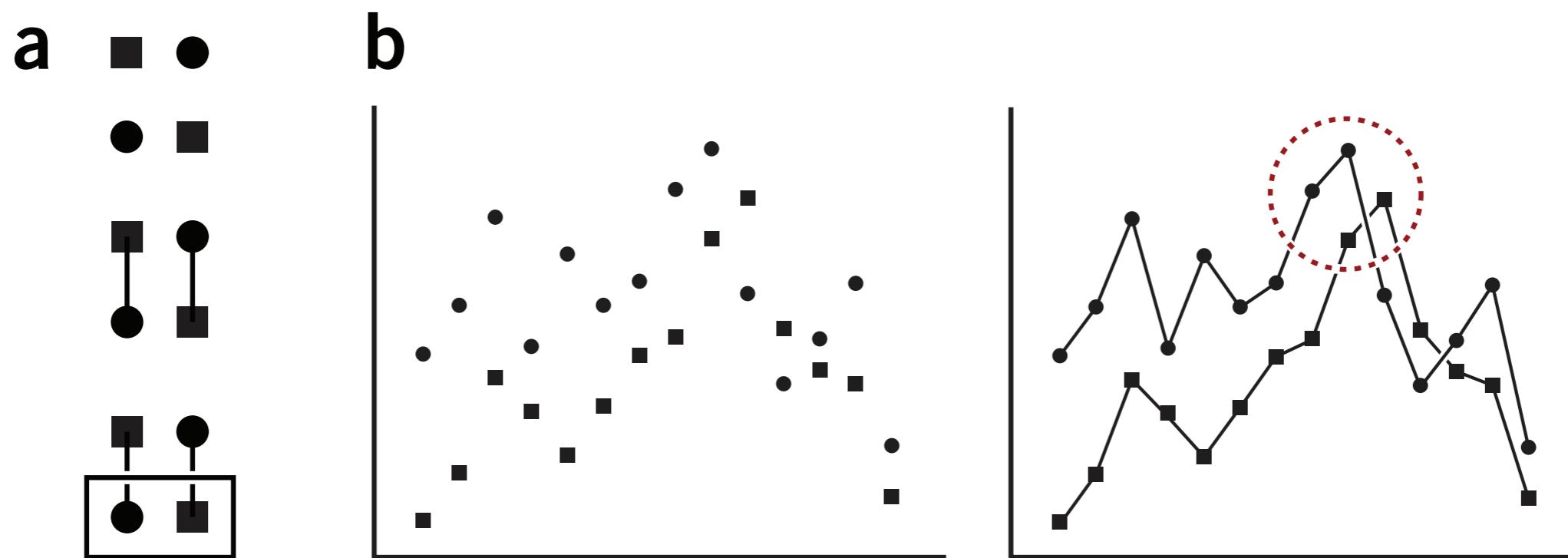
Readability is the most important goal!



Readability is the most important goal!

Exploit perception for storytelling

Highlight the **salient features** for the reader



Exploit perception for storytelling

Highlight the **salient features** for the reader

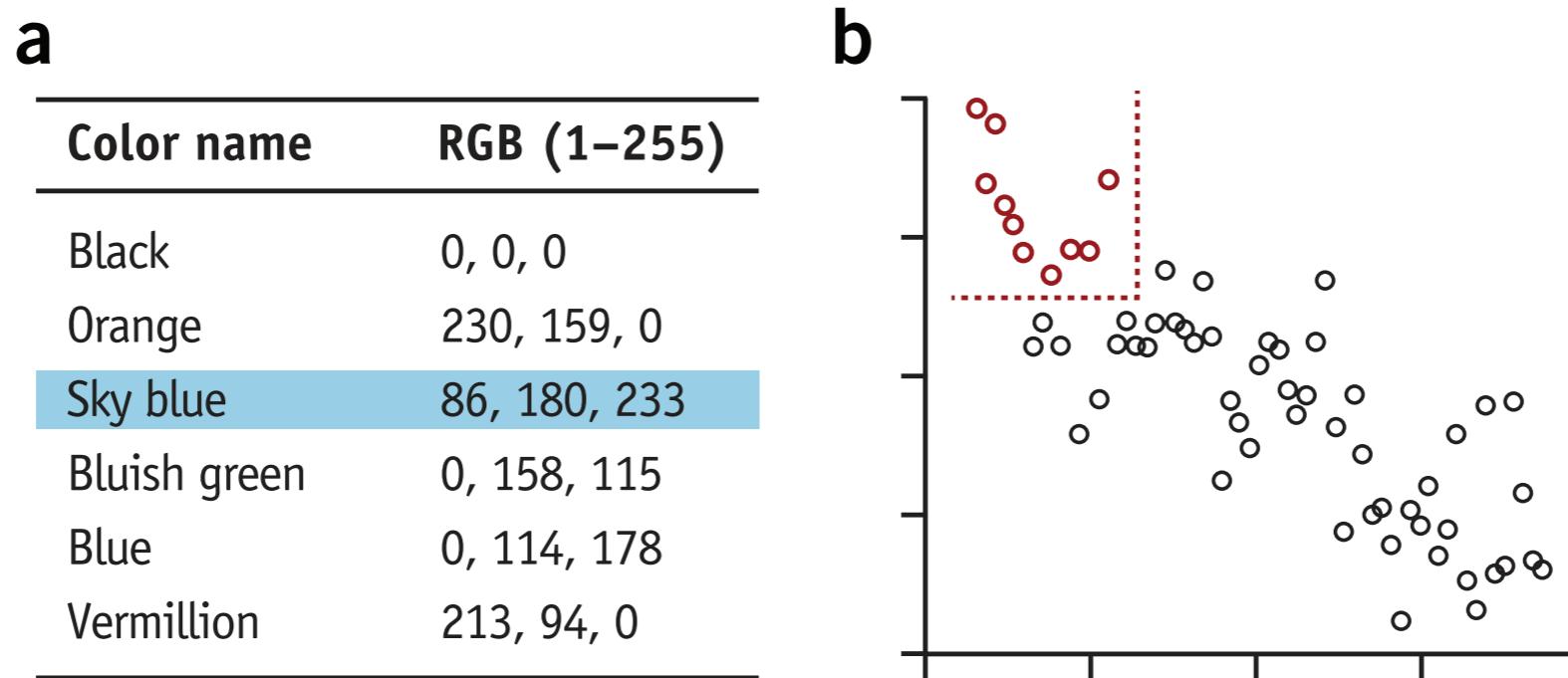
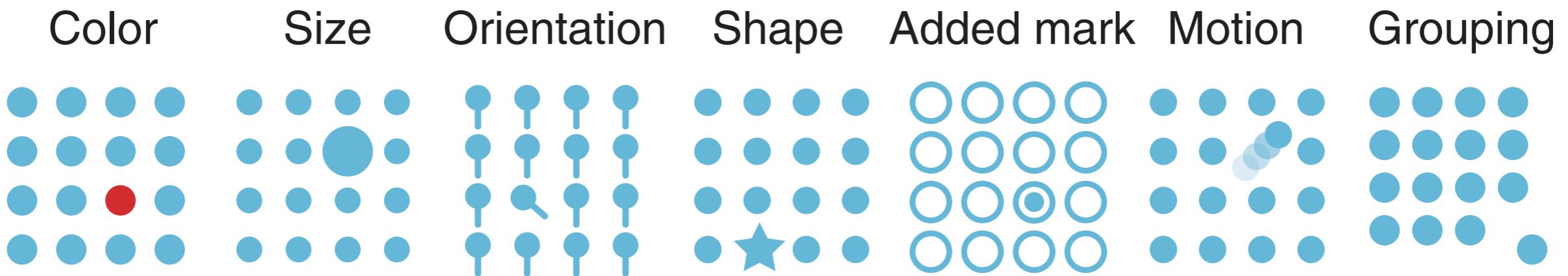


Figure 1 | Matching salience to relevance draws visual attention to important information. (a) Table with a row highlighted. (b) Segments of data in a plot emphasized with color.

Exploit perception for storytelling

Highlight the **salient features** for the reader



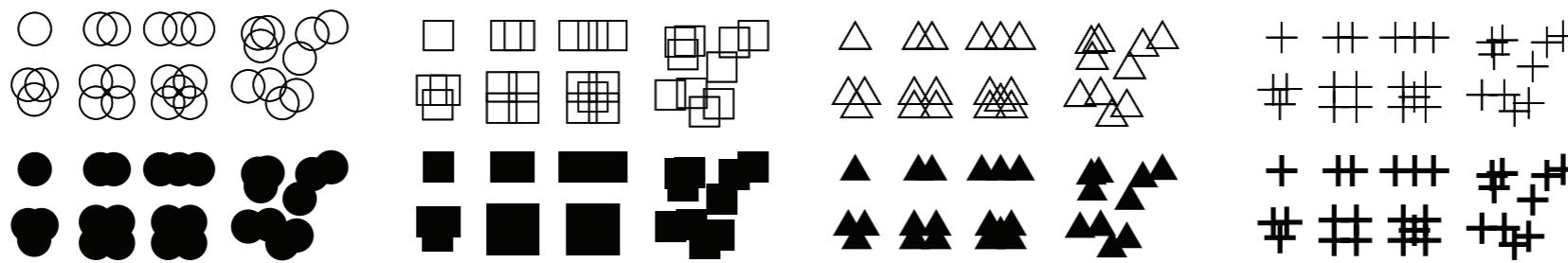


Figure 1 | The hollow circle is a flexible and robust plotting symbol.

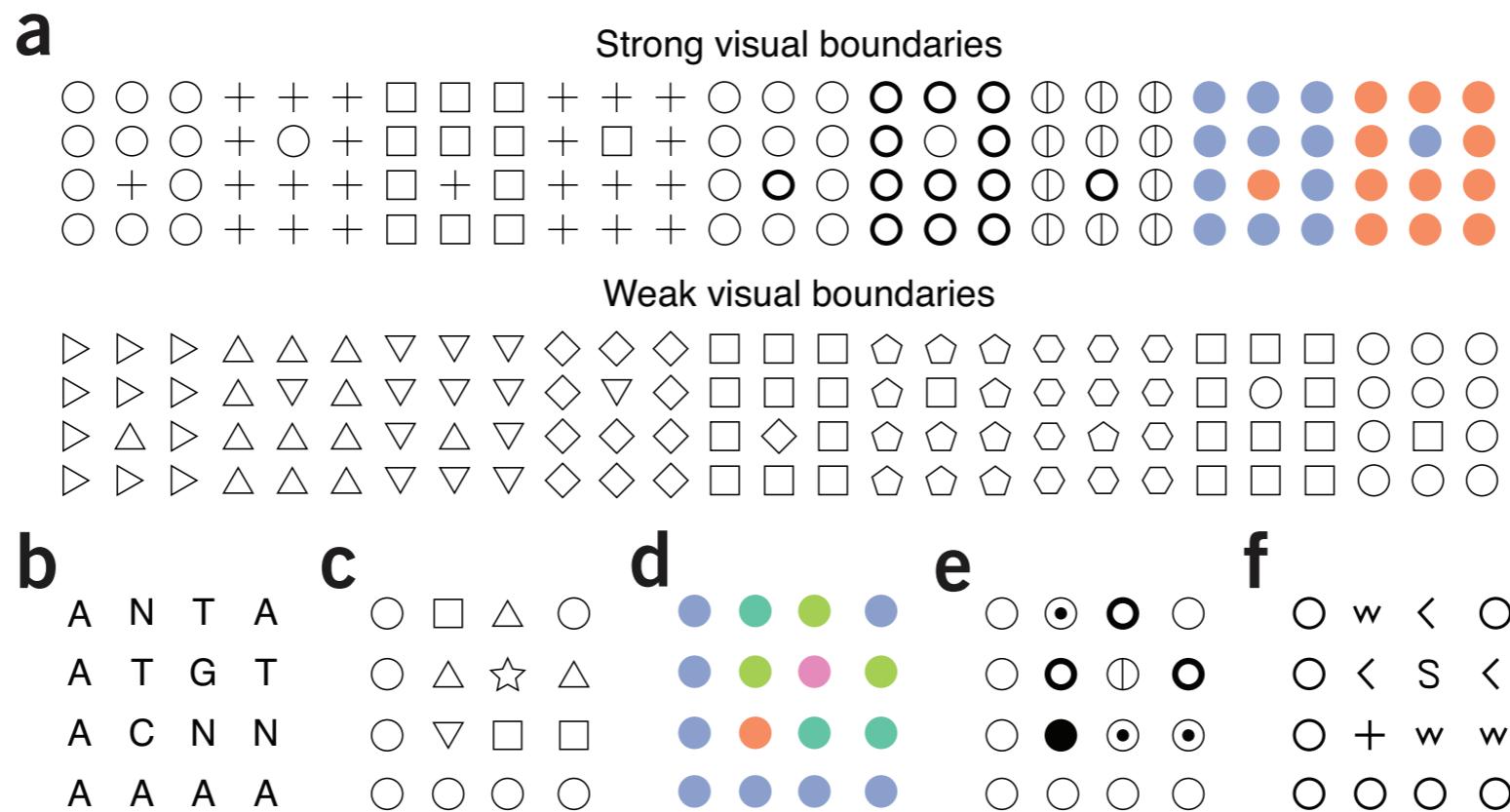
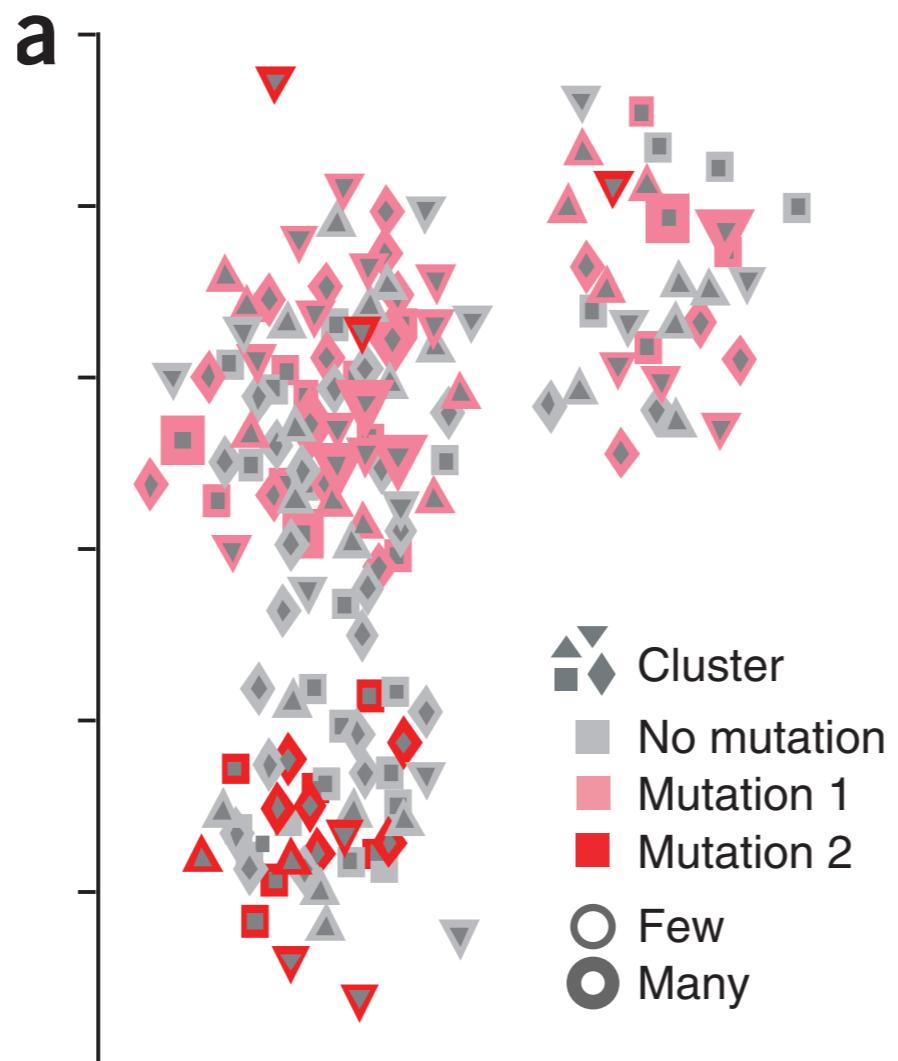


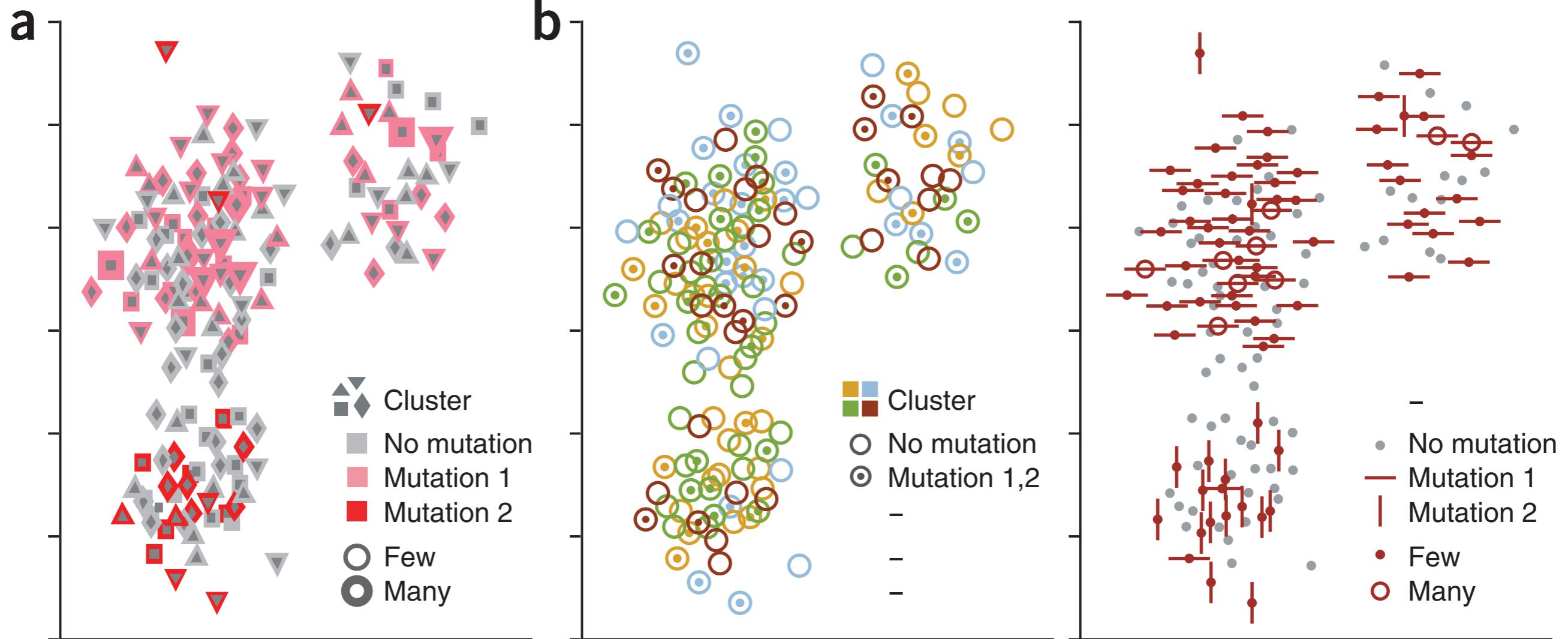
Figure 2 | Symbol diversity can be achieved by varying shape, fill or color.

(a) Symbols that contrast with one another make good combinations. (b) Letters simplify legend lookups, but many appear the same (such as C/G, B/R/P and E/F/H). (c) Shapes are powerful discriminators—but beware that, for a given width, they may appear to have different sizes owing to differences in areas. (d–f) Color is one of the differentiators (d). For black-and-white applications, vary the fills for low data densities (e) and use texture symbols when overlap is high (f).

Keep it simple though!



Keep it simple though!





color

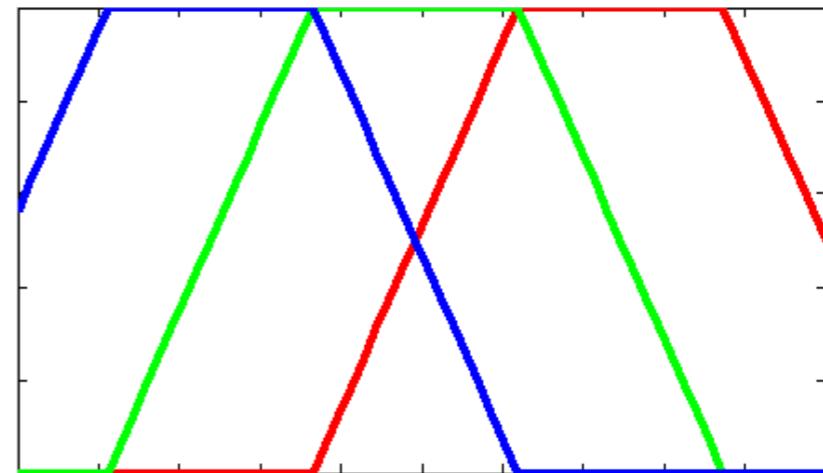
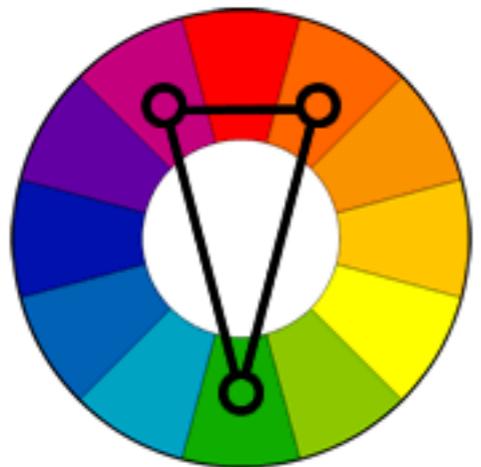
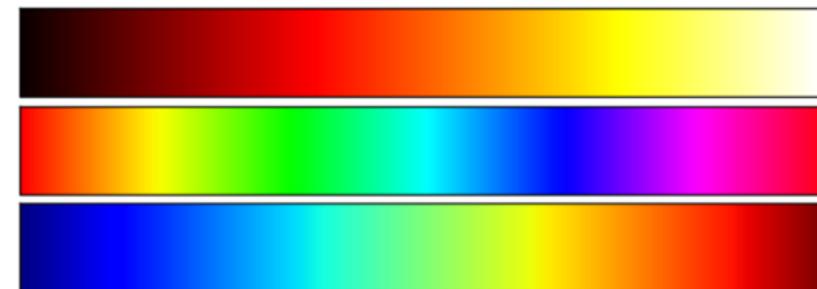
Color schemes

discrete palette

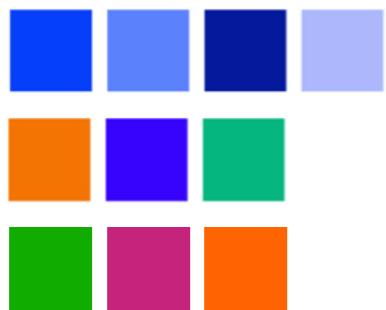


Colormaps

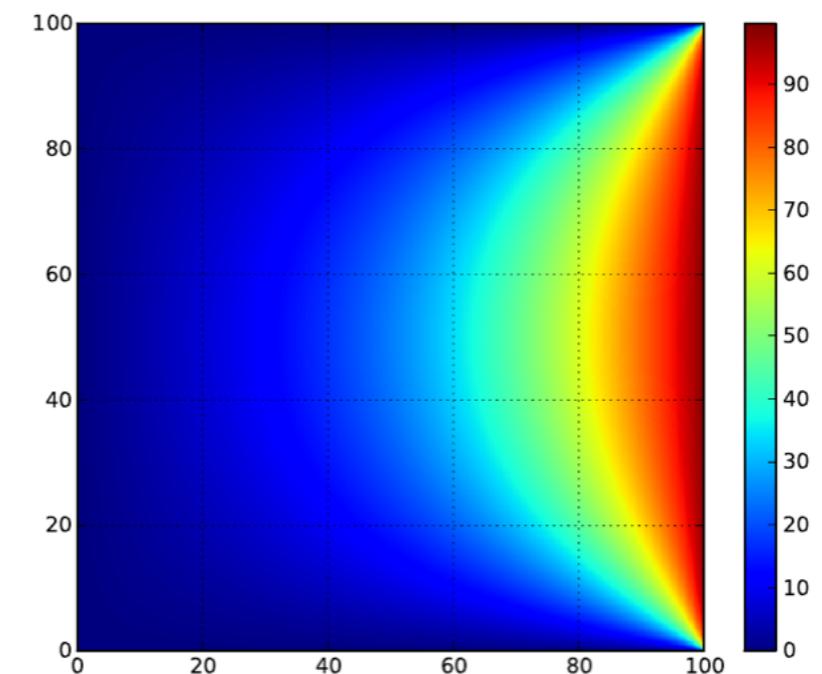
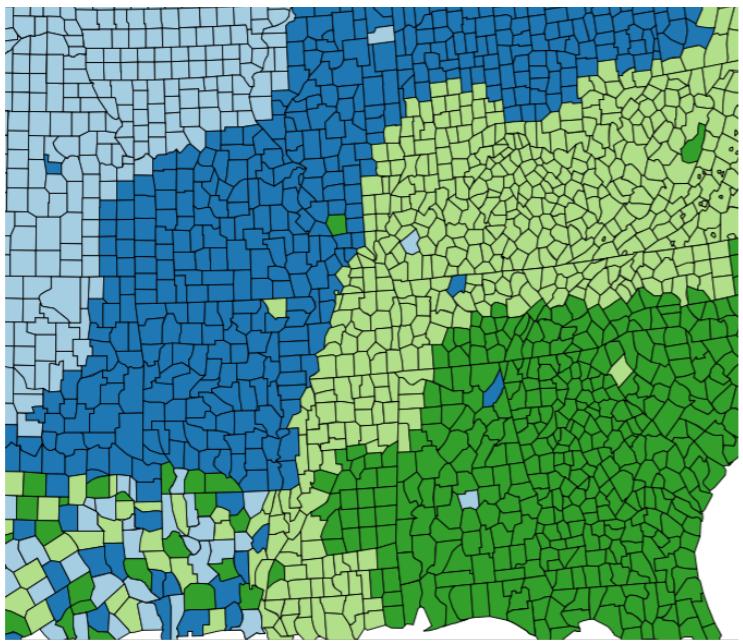
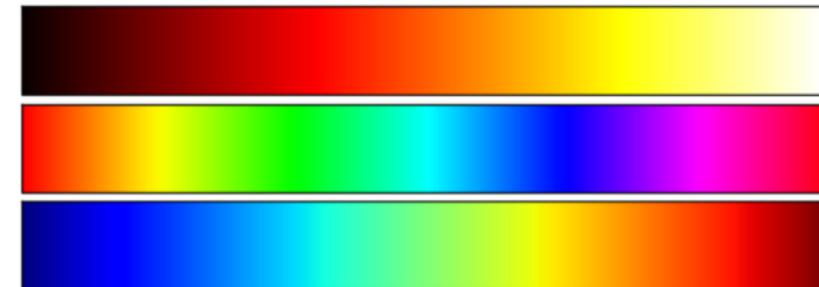
continuous (function)



Color schemes discrete palette

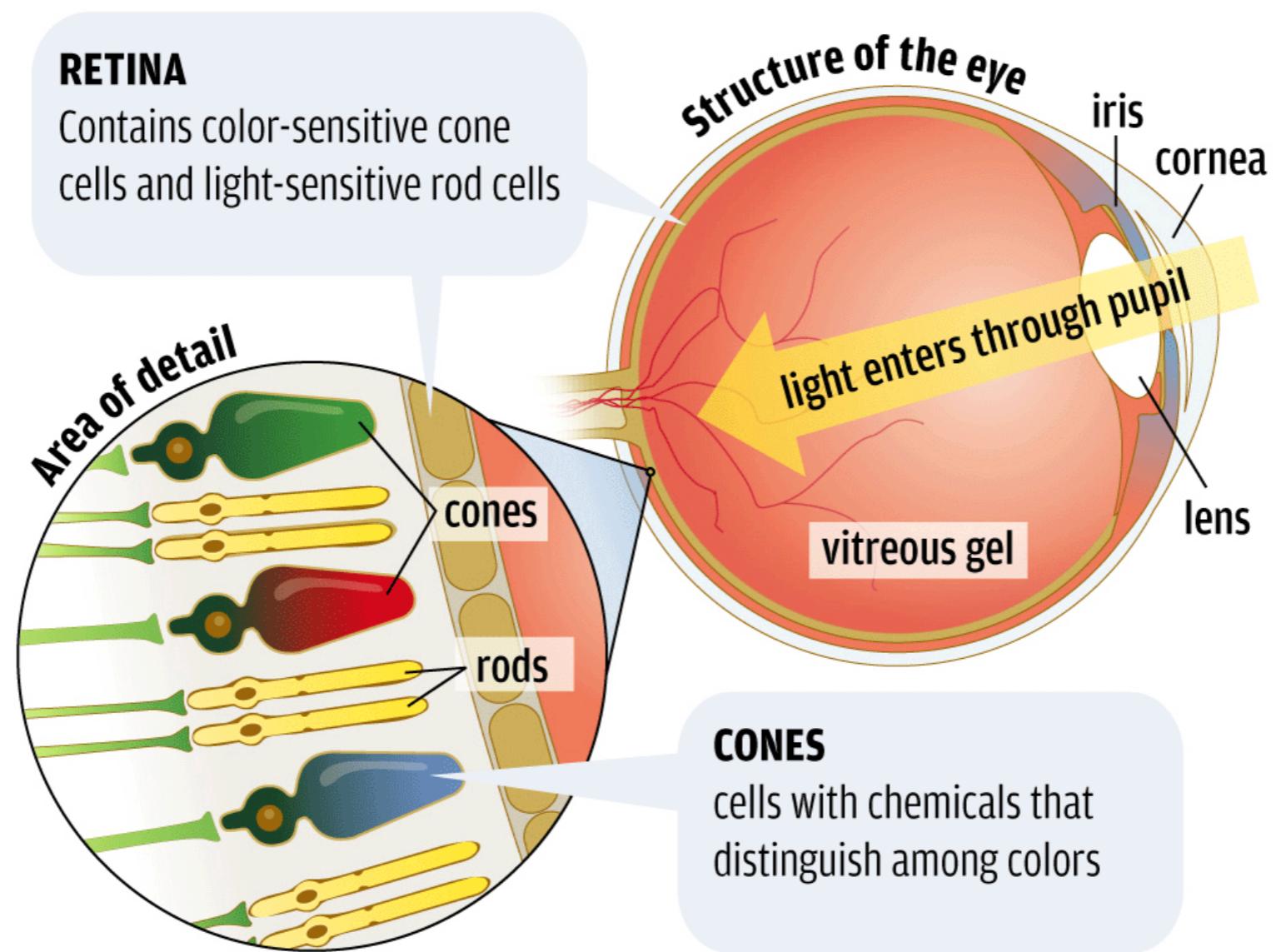


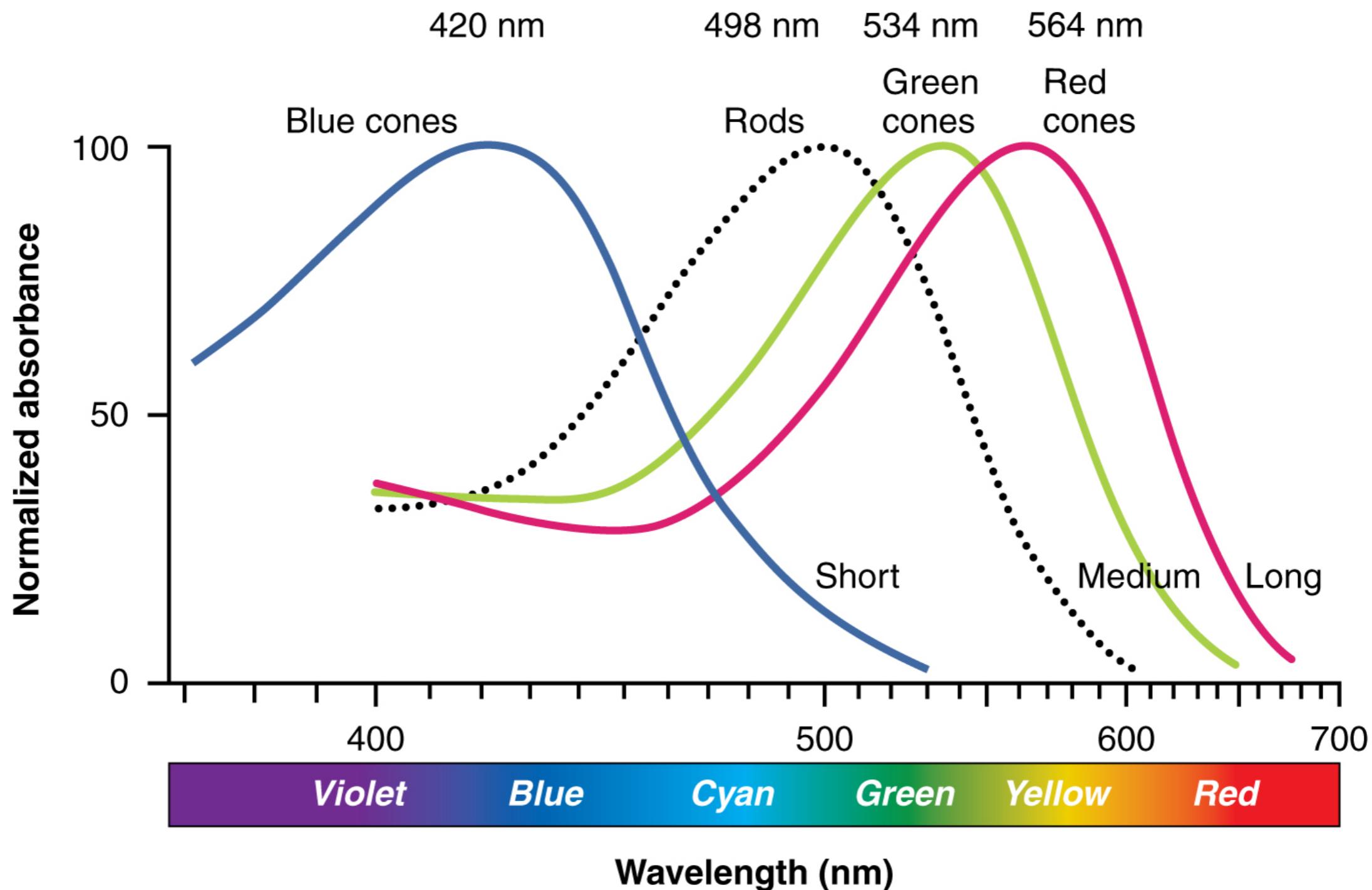
Colormaps continuous (function)



How the eye sees color

The eye sees color using cells called cones in the retina of the eye. If these cones aren't there or don't work correctly, you see color differently.





Color blindness: the **eye** is a noisy channel

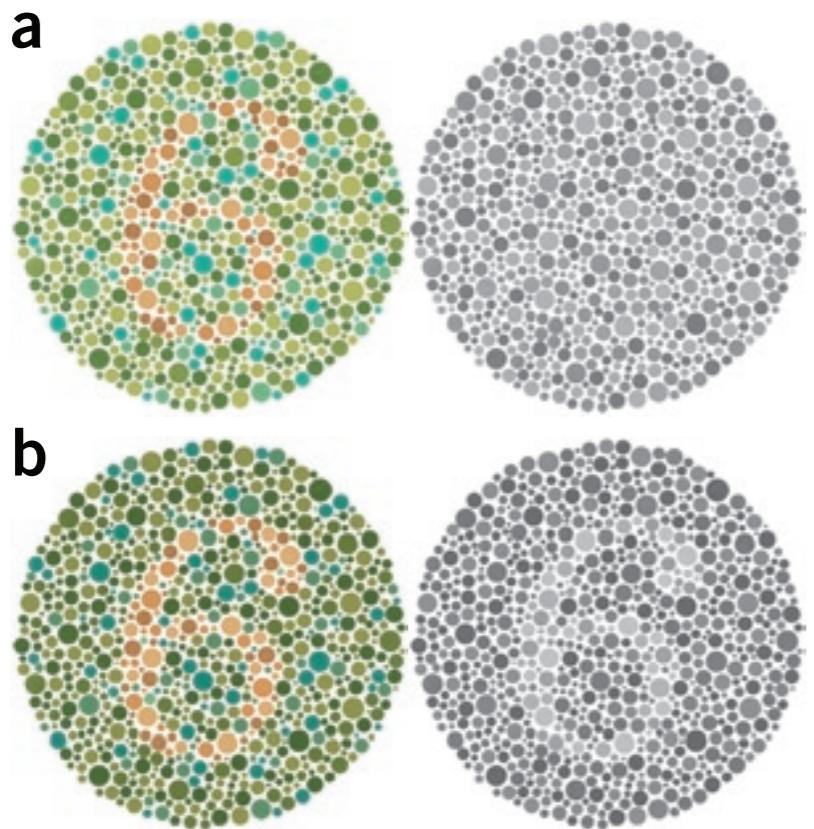
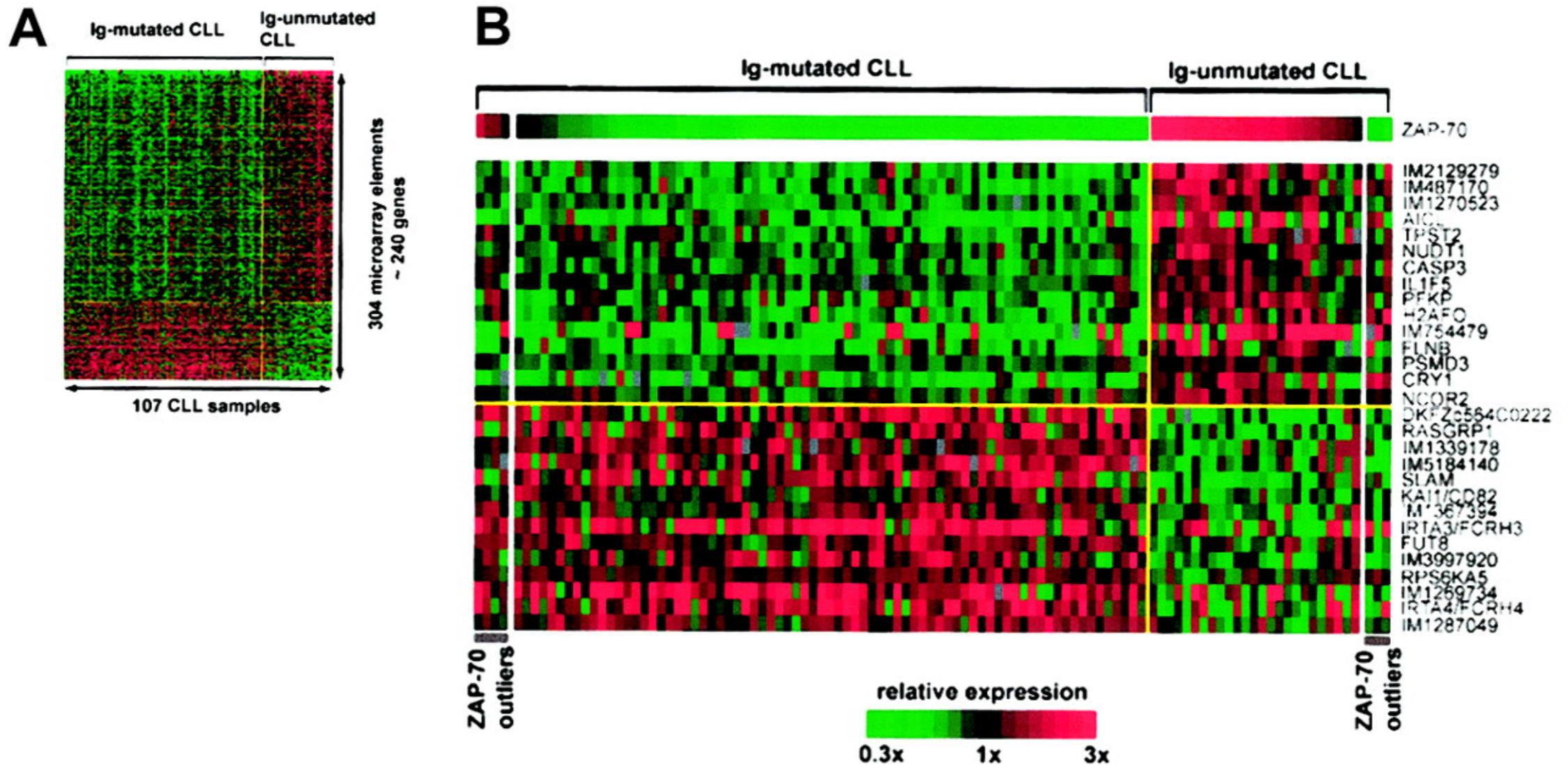
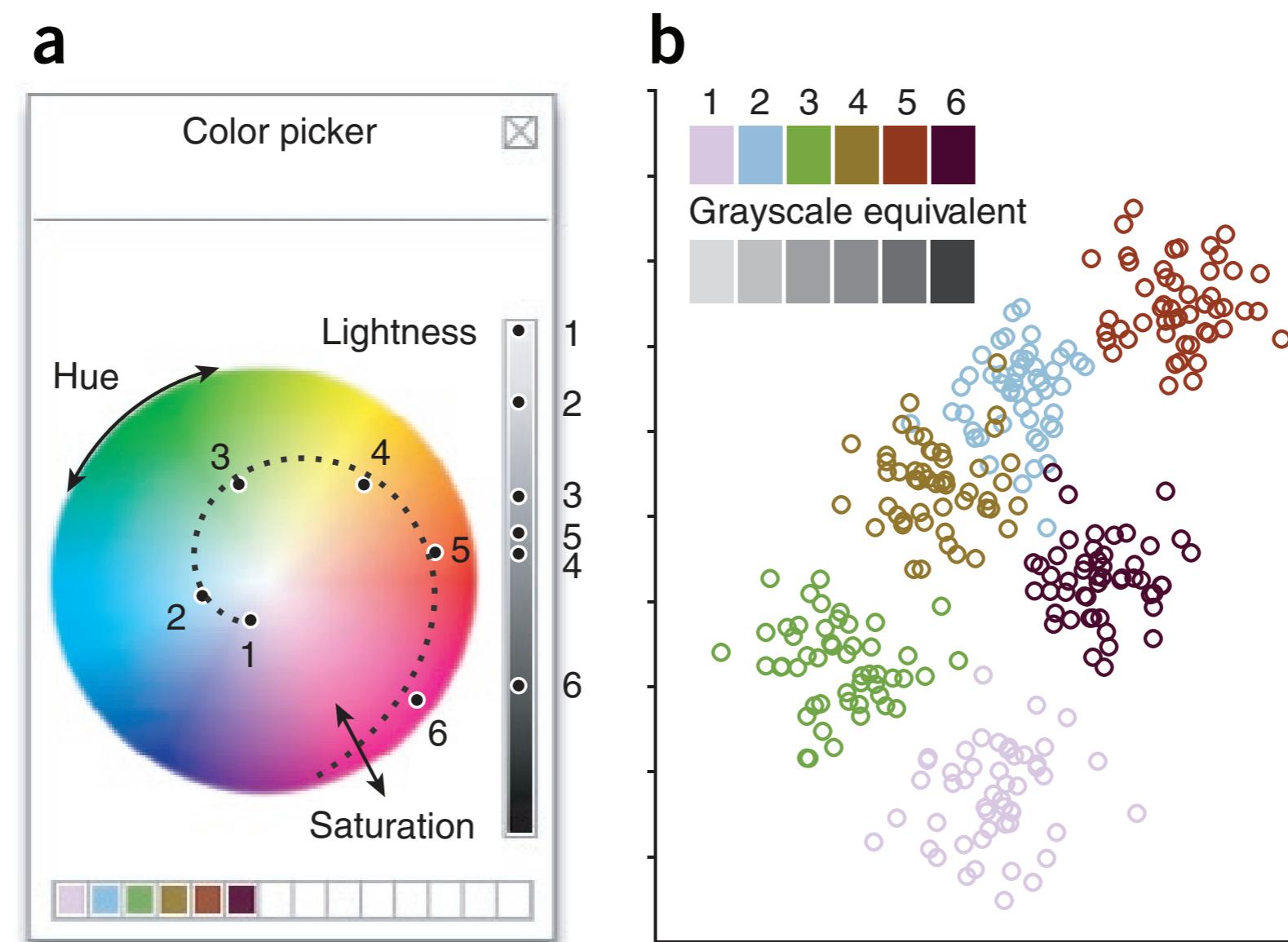


Figure 1 | Ishihara color-vision test plate.
(a) Viewers with normal color vision should see the numeral '6'. (b) Changing lightness of background improves contrast.



Red/Green blindness is most common

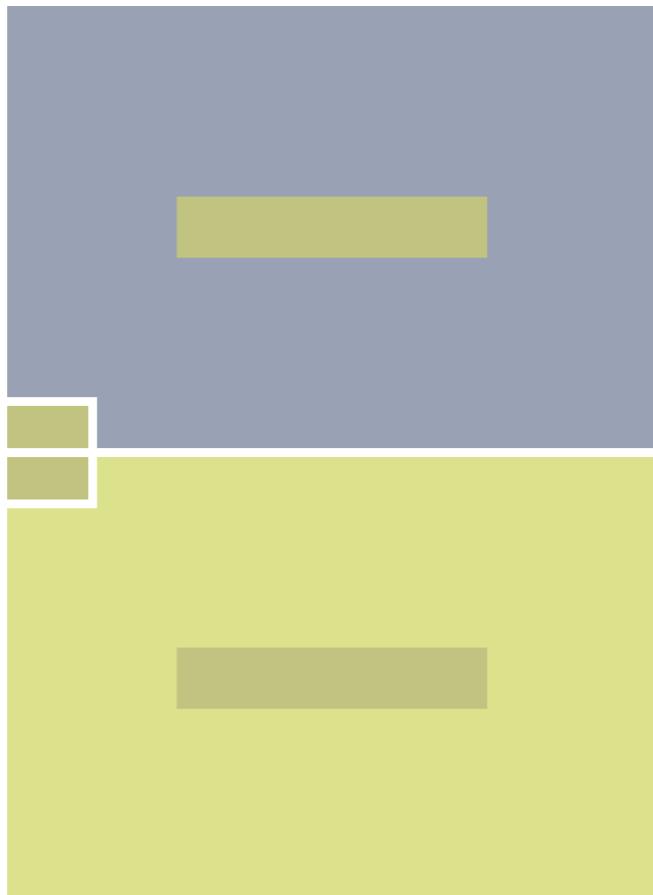
Make a color scheme that works in grayscale



Color relativity



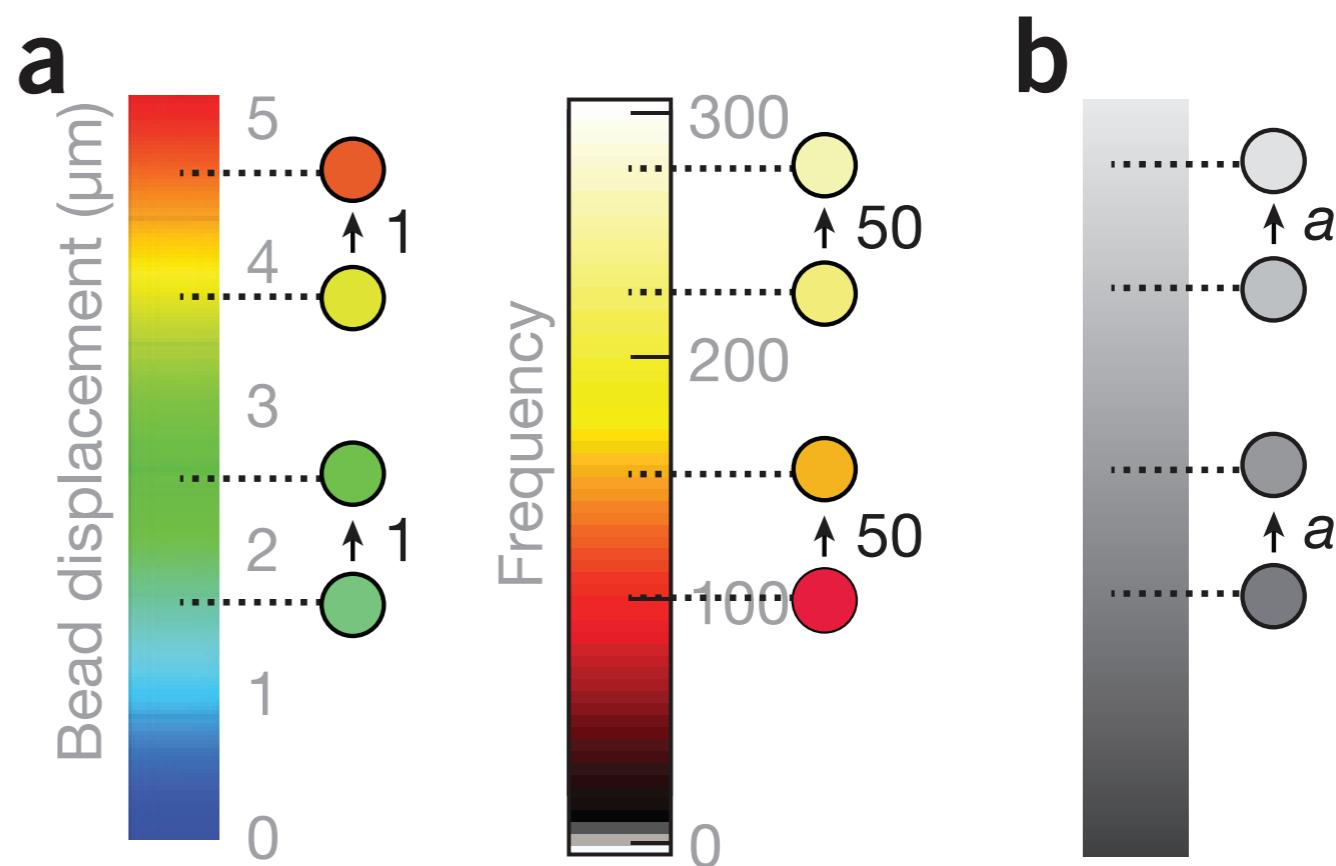
Color relativity



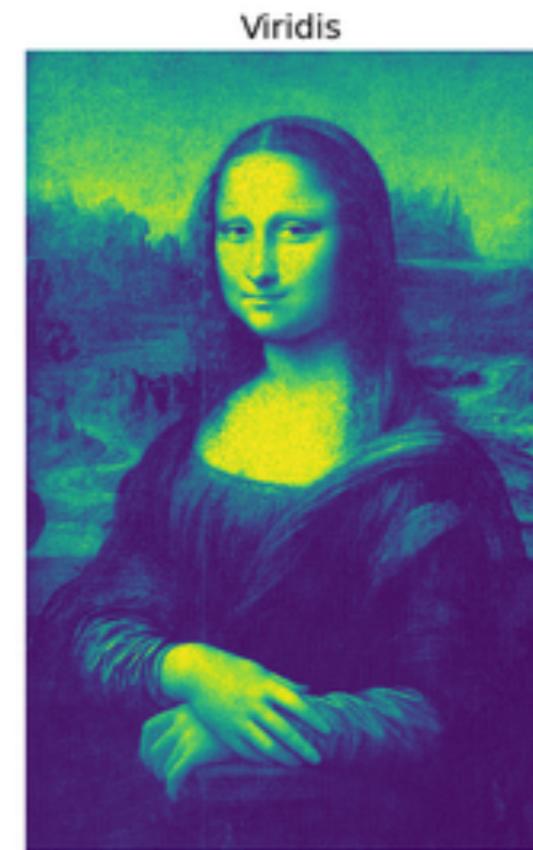
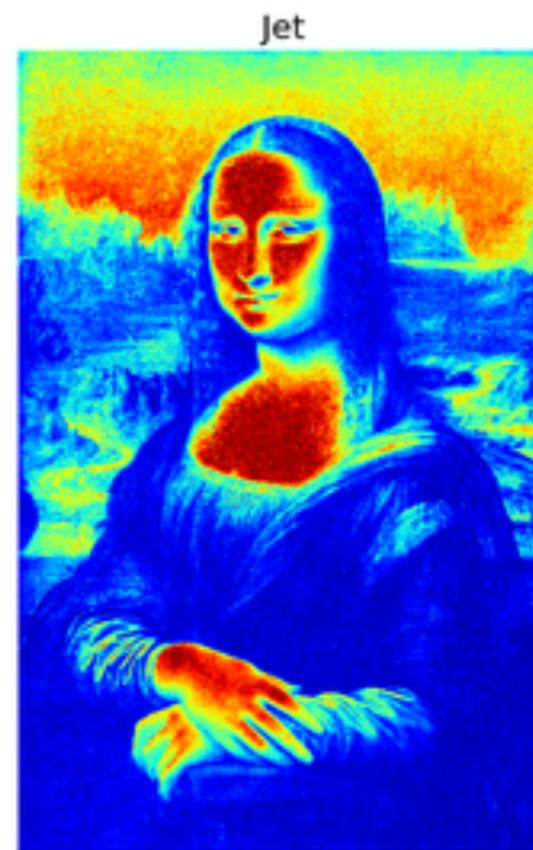
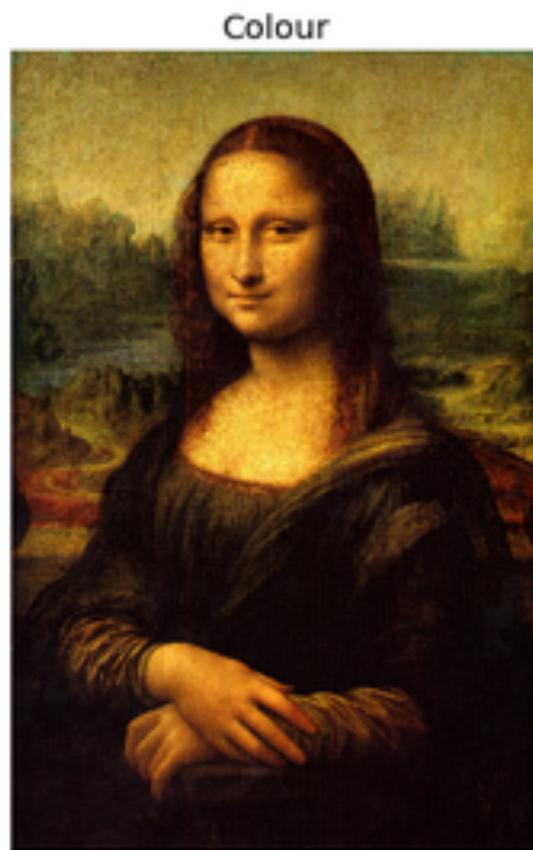
heatmap

Color maps are tricky!

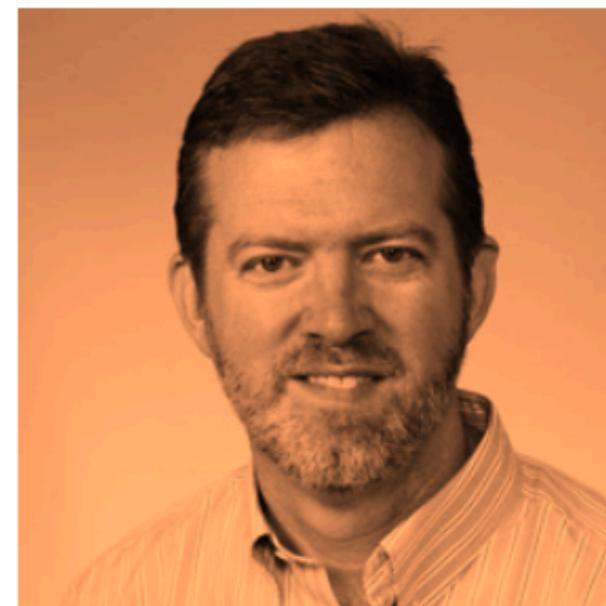
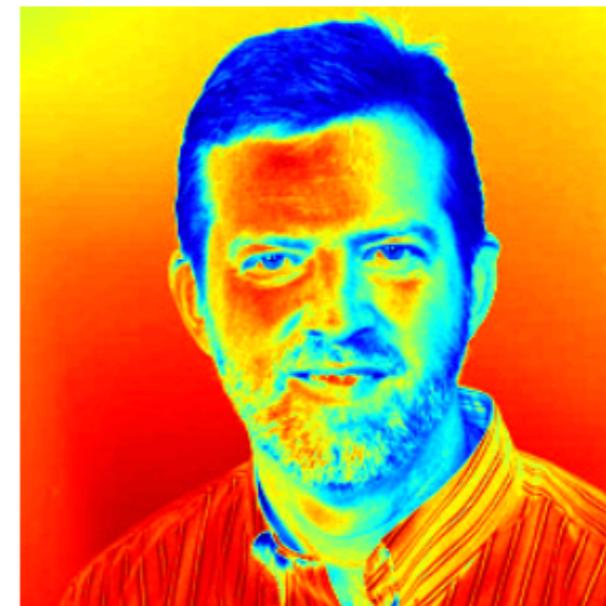
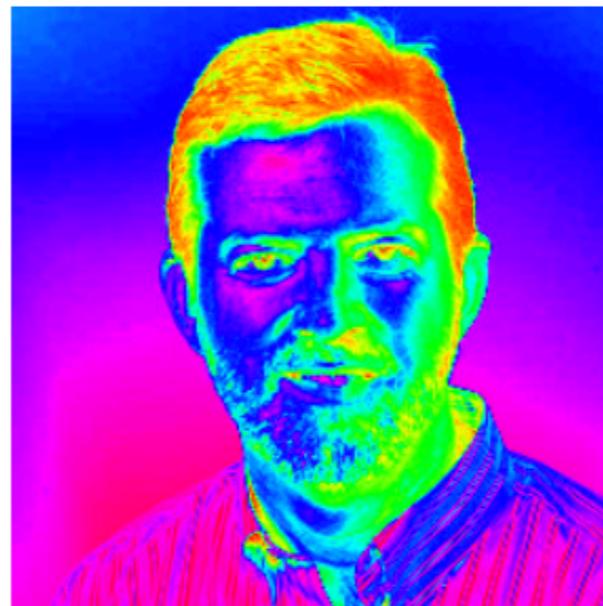
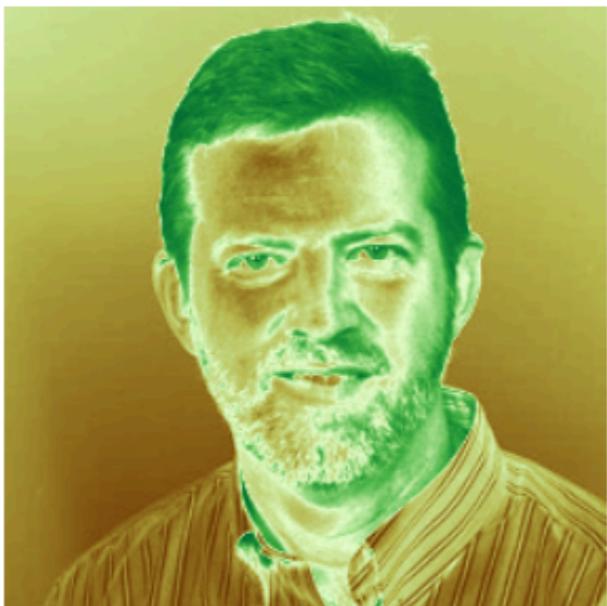
Figure 2 | Color is not ideal for presenting quantitative data. **(a)** Shifts in color scales (circles) are not visually commensurate with change in value. Reprinted from *Nature Methods*^{2,5}. **(b)** A gradation from 10–90% black produces even transitions.



Colormaps can create perceptual bias - easily seen in **photos**

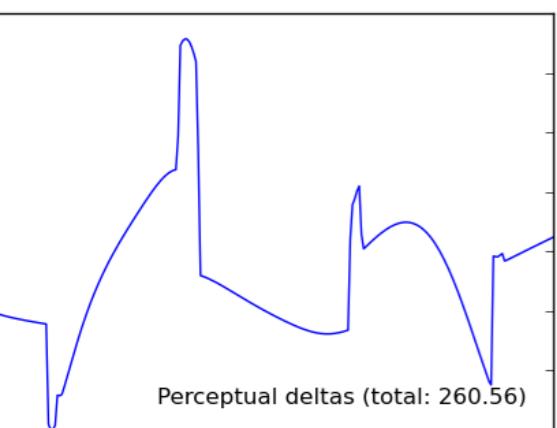


Colormaps can create perceptual bias - easily seen in **photos**

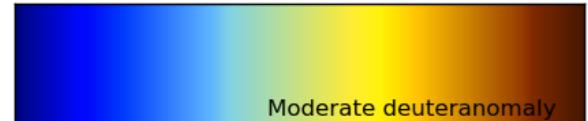


The "jet" color map (often a default)

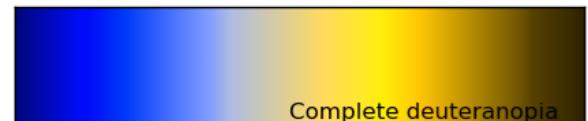
The colormap in its glory



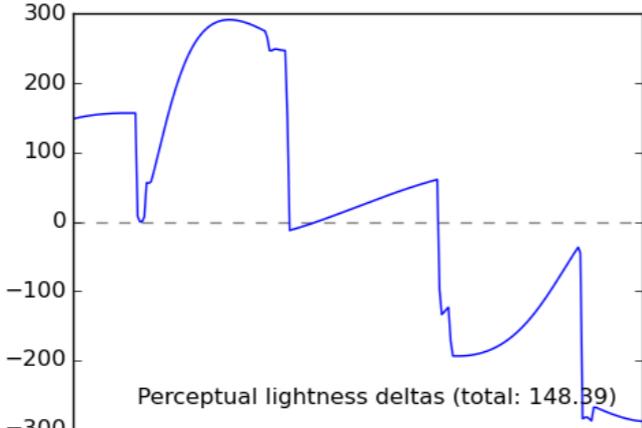
Moderate deuteranomaly



Complete deutanopia



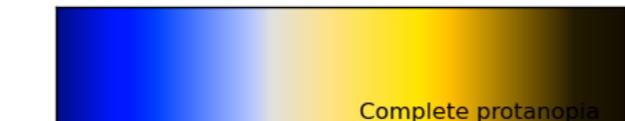
Black-and-white printed



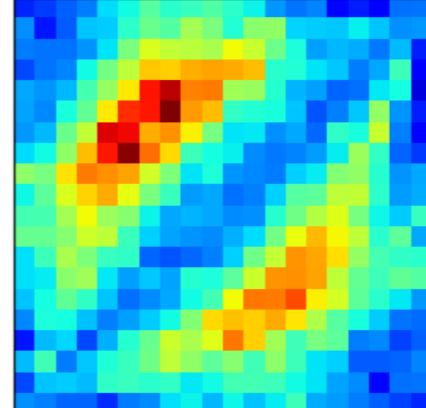
Moderate protanomaly



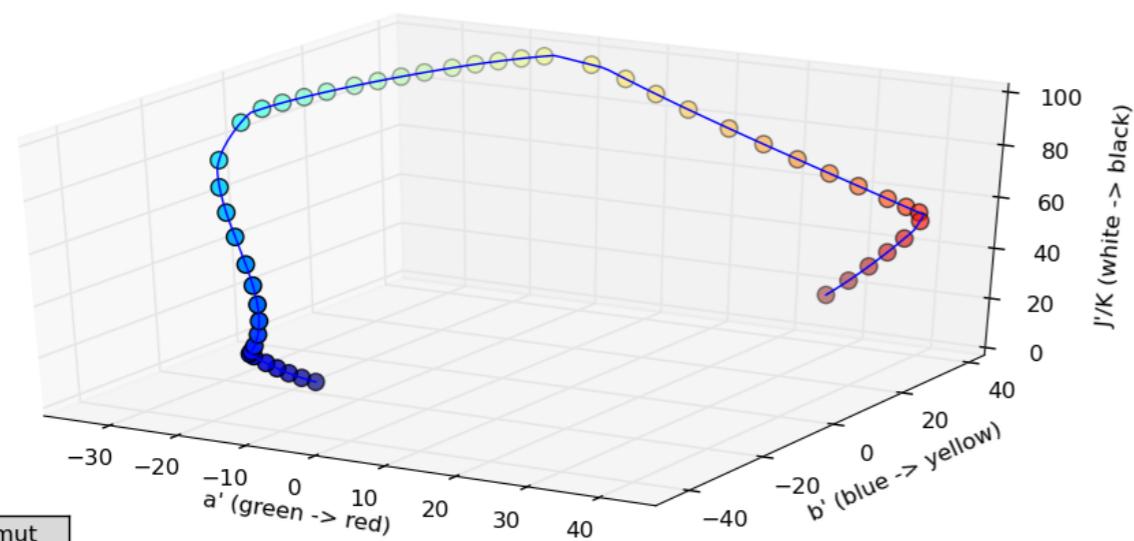
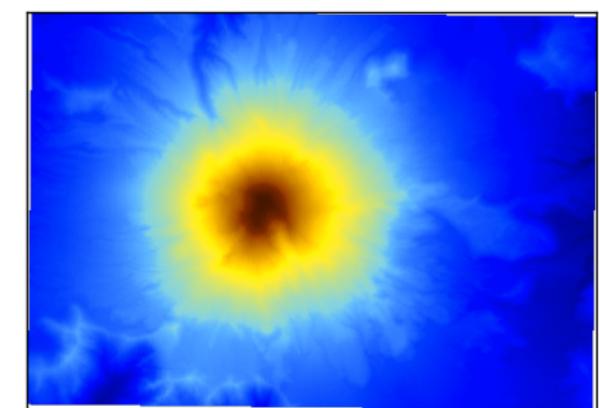
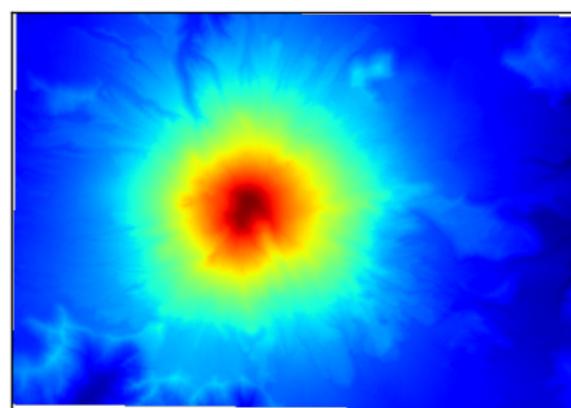
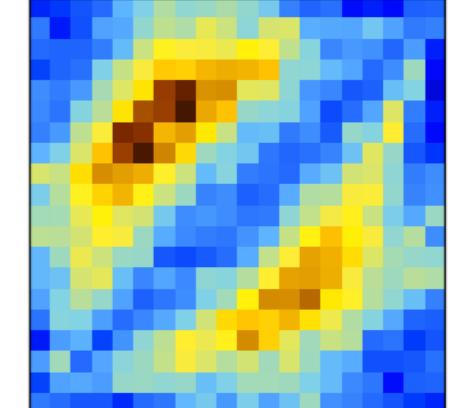
Complete protanopia



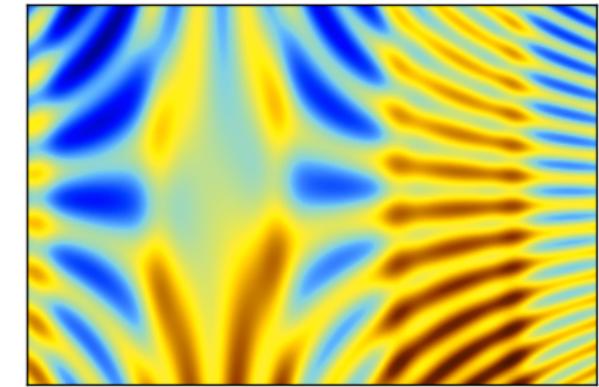
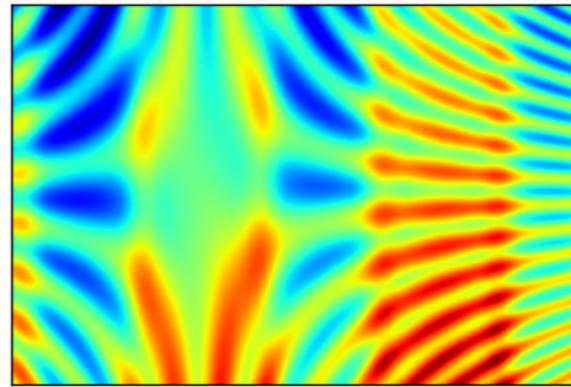
Sample images



Moderate deuter.

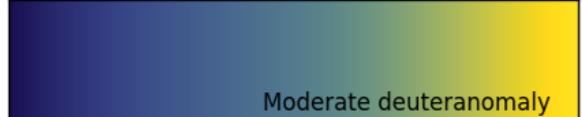
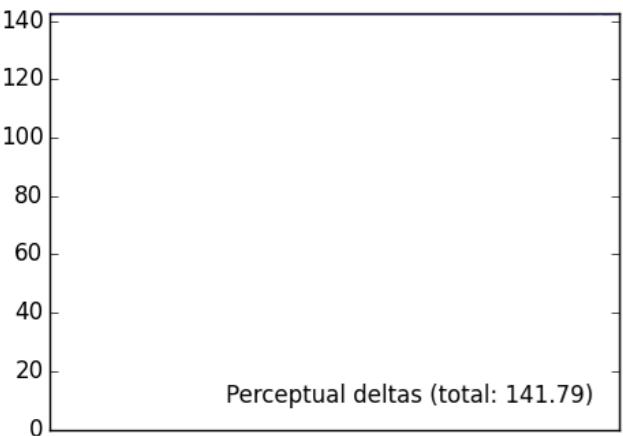


Toggle gamut

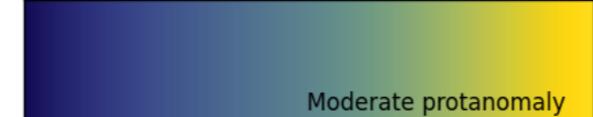
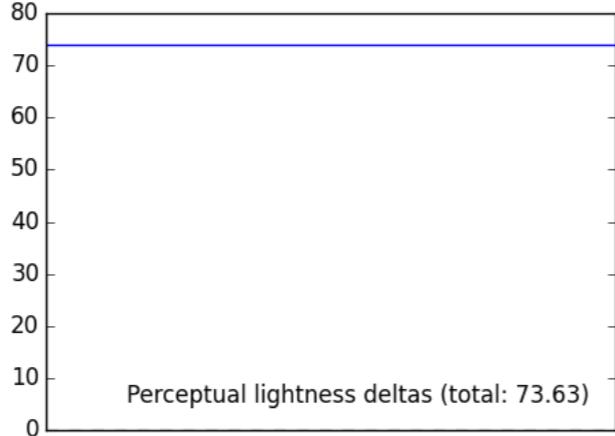


The "viridis" color map (now matplotlib's default)

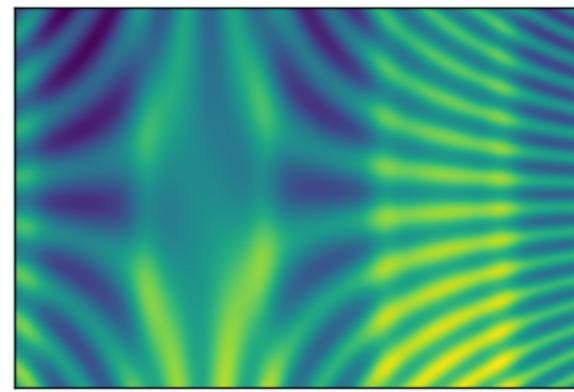
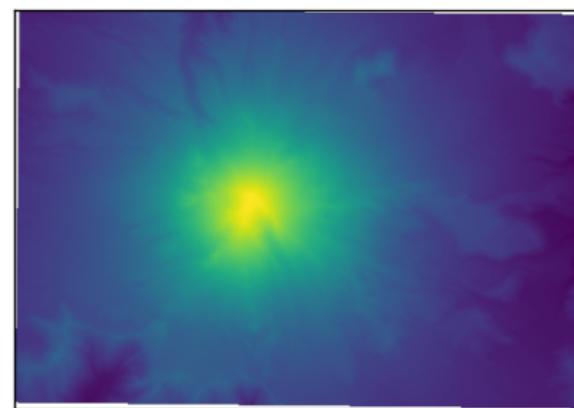
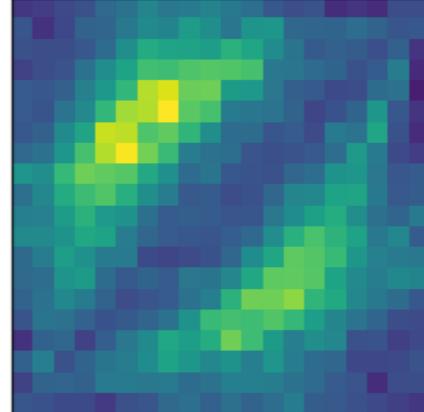
The colormap in its glory



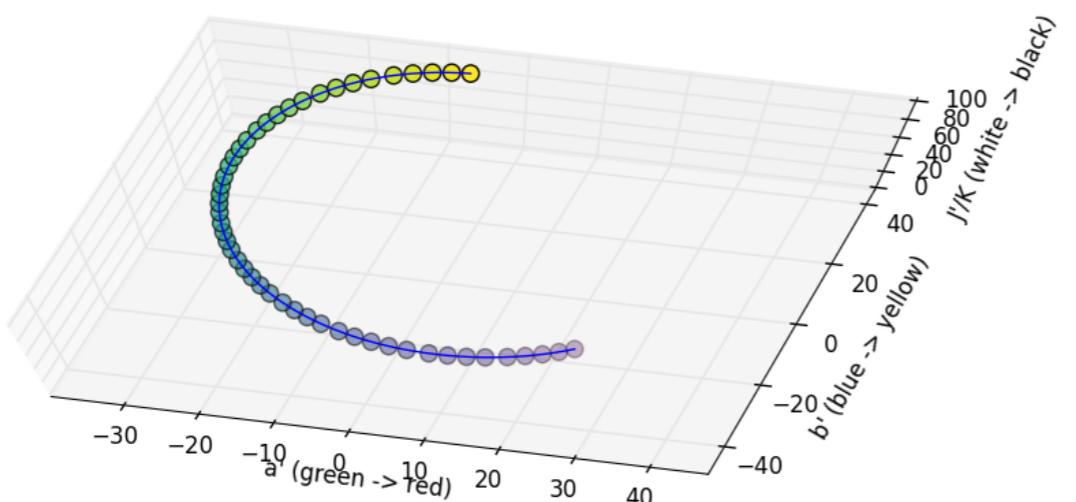
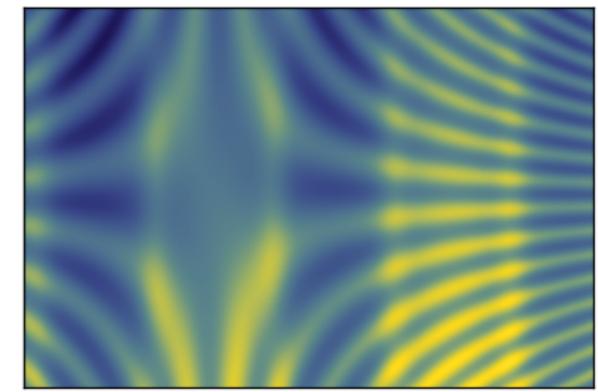
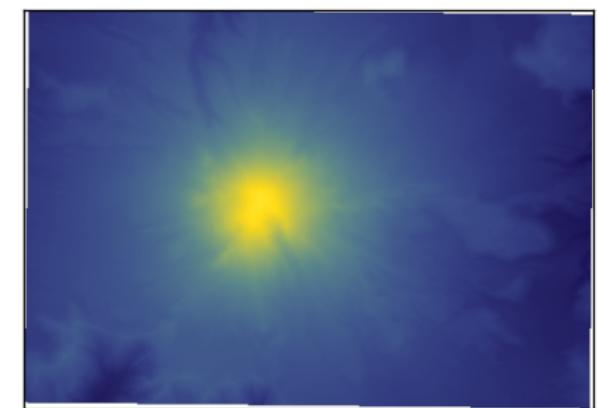
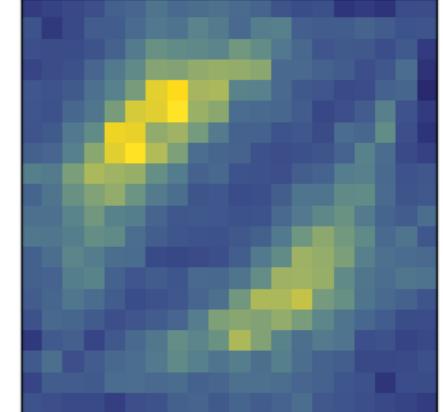
Black-and-white printed



Sample images

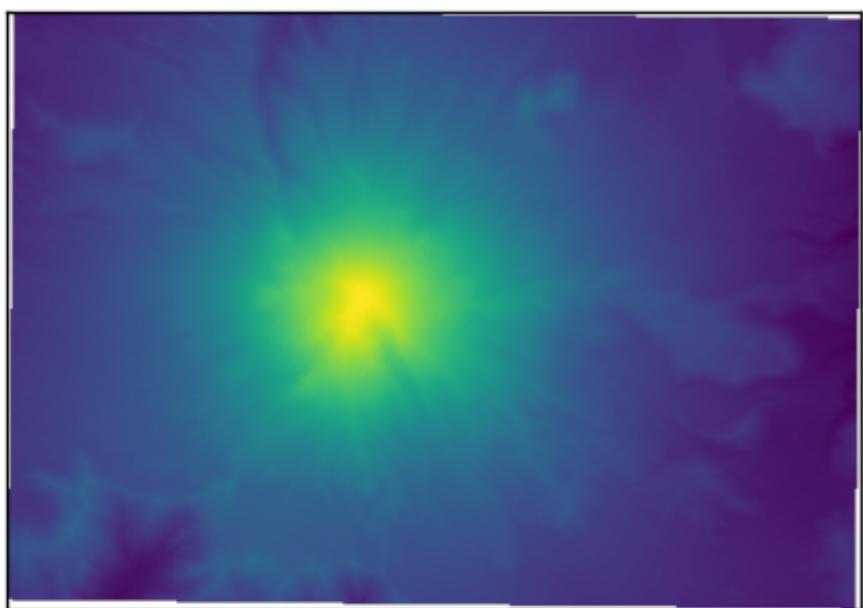


Moderate deuter.

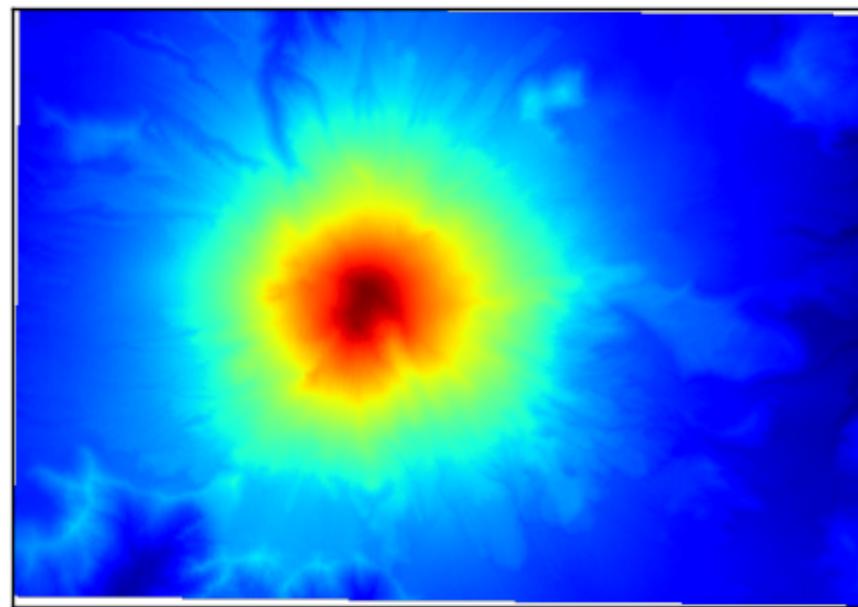


Toggle gamut

viridis



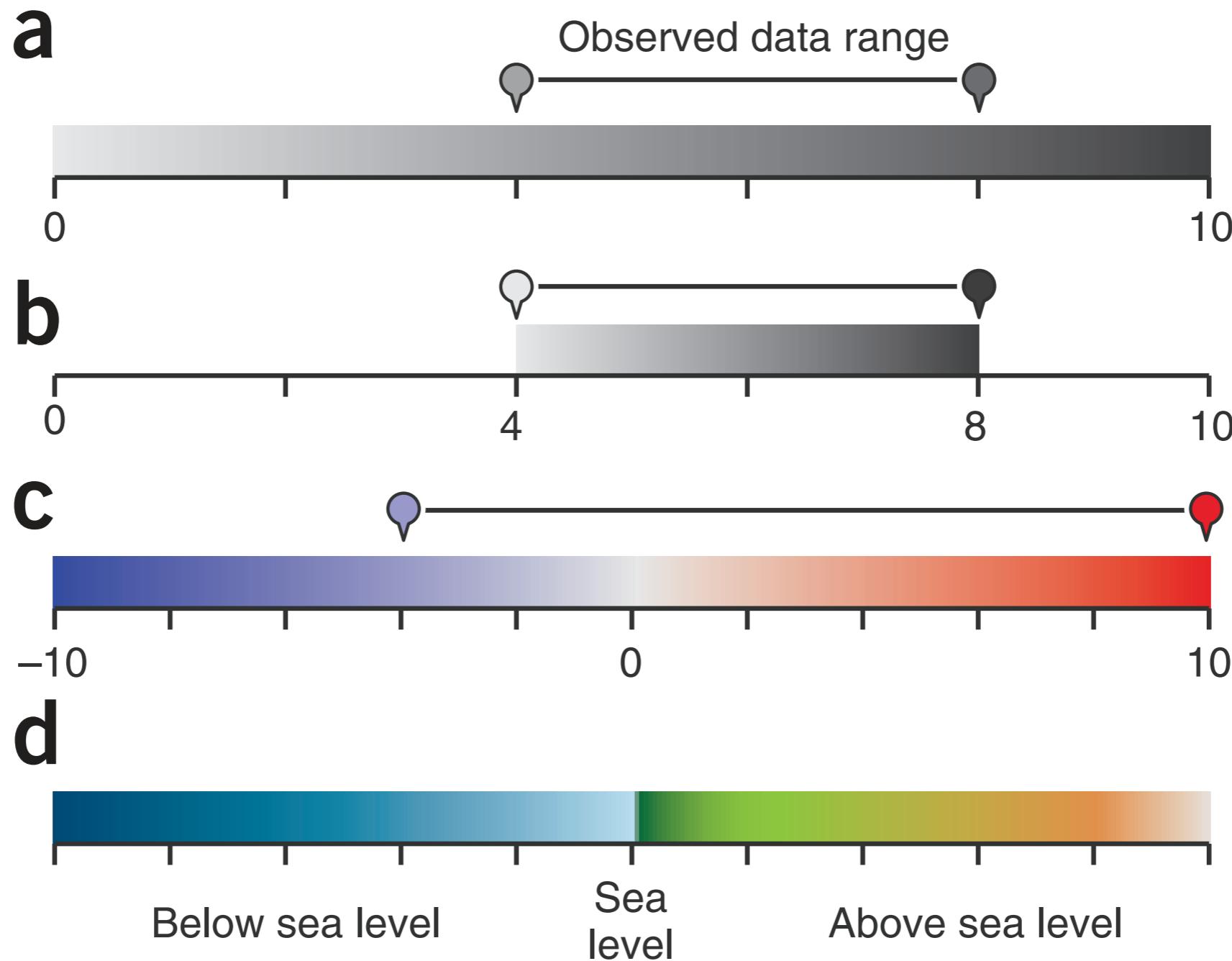
jet



Notice the hard edges in `jet` not present in `viridis`. It's just the colormap!

Color still has its place

Exploit it for storytelling!



Text and Labels

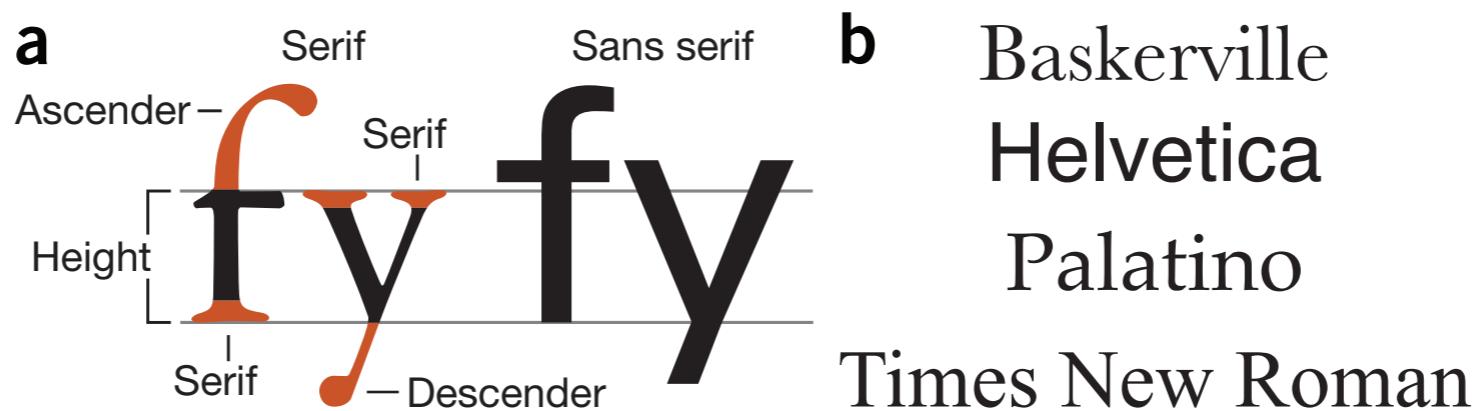
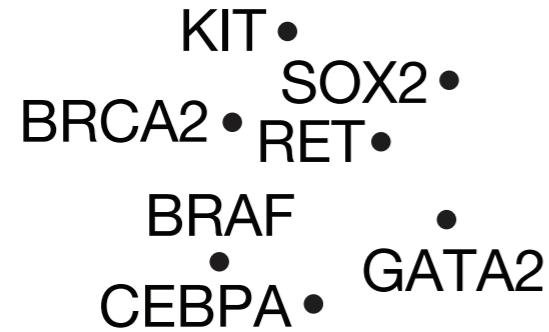


Figure 1 | Typefaces. (a) The anatomy of letterform for serif (Garamond) and sans serif (Univers) type both set at 58 point. (b) Four of the most readily available fonts.

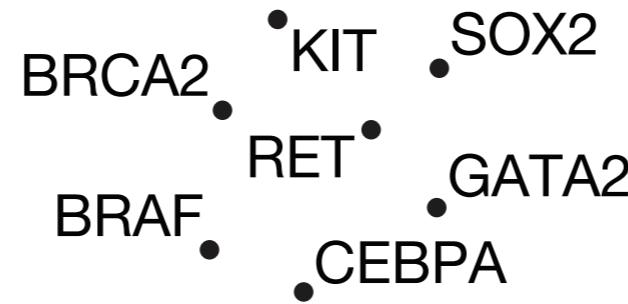
a Lorem ipsum dolor amet, adipisicing elita, sed
do eiusmod tempor et aliqua.
CR
Ut enim ad minim nostrud qui exercitation:
CR •Duis aute reprehenderit voluptate velit
CR •Esse cillum dolore fugiat nulla pariatur
CR •Sint occaecat non proidents, culpa qui
officia deserunt

b Lorem ipsum dolor amet, adipisicing elita,
sed do eiusmod tempor et aliqua.
5
Ut enim ad minim nostrud qui exercitation:
5 • Duis aute reprehenderit voluptate velit
3 • Esse cillum dolore fugiat nulla pariatur
3 • Sint occaecat non proidents, culpa qui
officia deserunt
3

Figure 2 | Spacing can reveal structure and give meaning to text. (a) Uniform carriage return (CR) spacing is incongruous with hierarchical content. (b) Relative spacing using paragraph formatting expresses relationships in the text. Numbers are 'space after' values given in point sizes.

a

Poor label placement

b

Good label placement

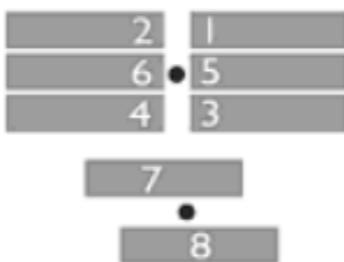
c

Label placement priority

Labels should not
overwhelm the data

Labeling Point Data

When labeling point symbols on a map, start at the center of the map and work outward. For each symbol, follow these priorities, where 1 is best, 8 is worst.



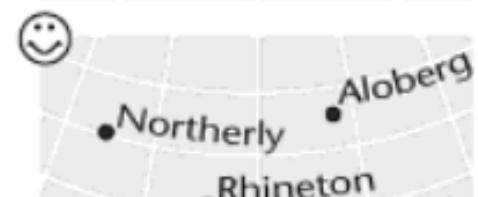
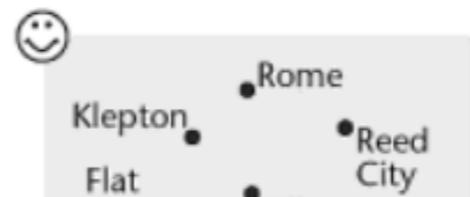
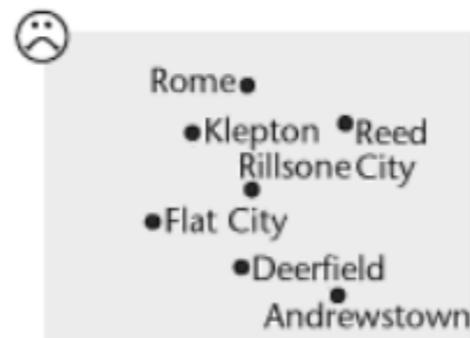
Show characteristics of the labeled location with type placement.

a
KIT • SOX2 •
BRCA2 • RET •
BRAF • GATA2
CEBPA •
Poor label placement

b
BRCA2 • KIT • SOX2
BRAF • RET • GATA2
CEBPA •
Good label placement

c
2 1 7
6 • 5 •
4 3 8
Label placement priority

Label ports and harbor towns on the sea
Label inland towns on the land
Label land features on land; water features on water
Label towns on the side of the river on which they are located
Align type to grid (latitude) if grid is included



Making Maps, Second Edition: A Visual Guide to Map Design for GIS

Organization

Organize with whitespace

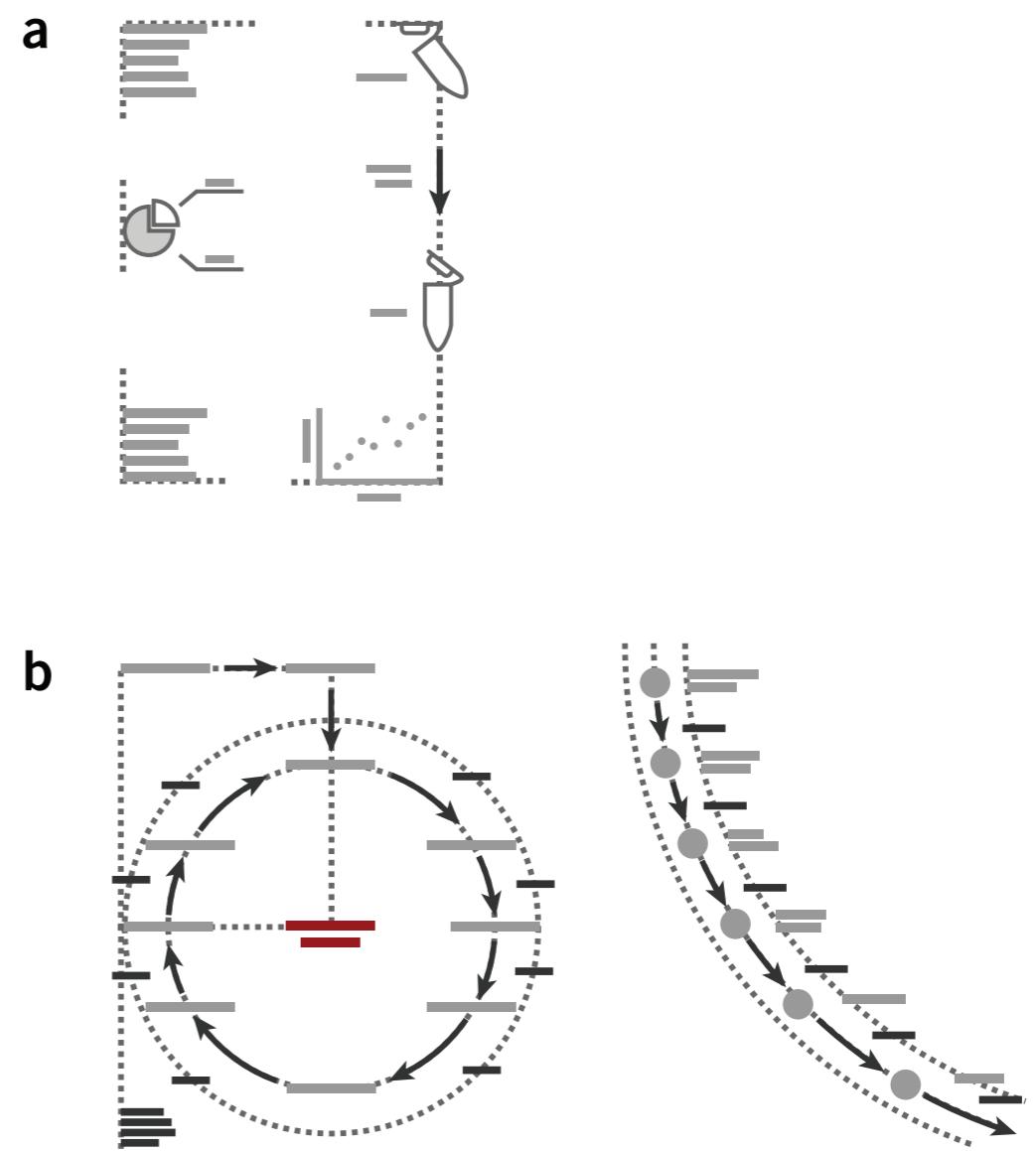
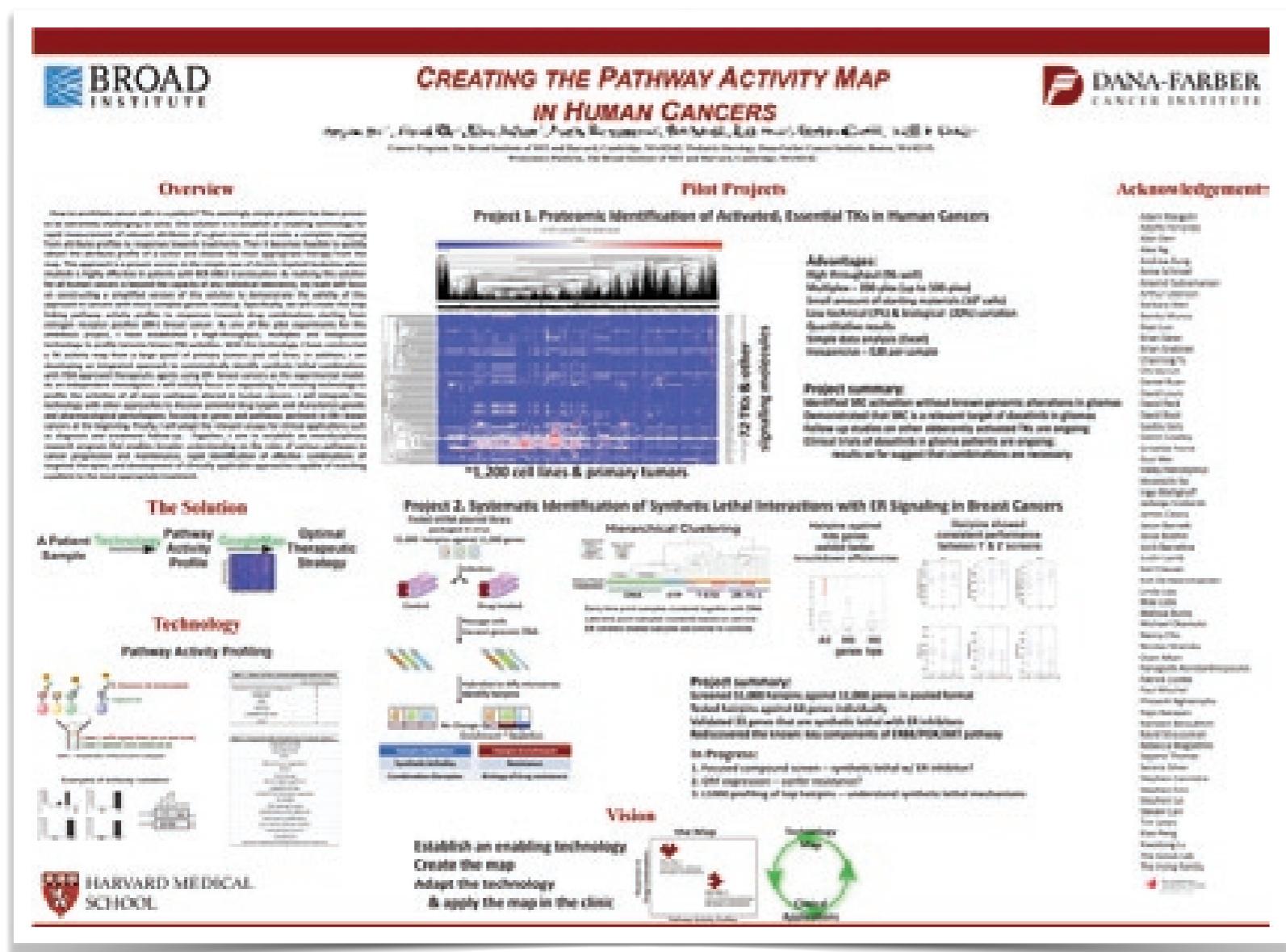
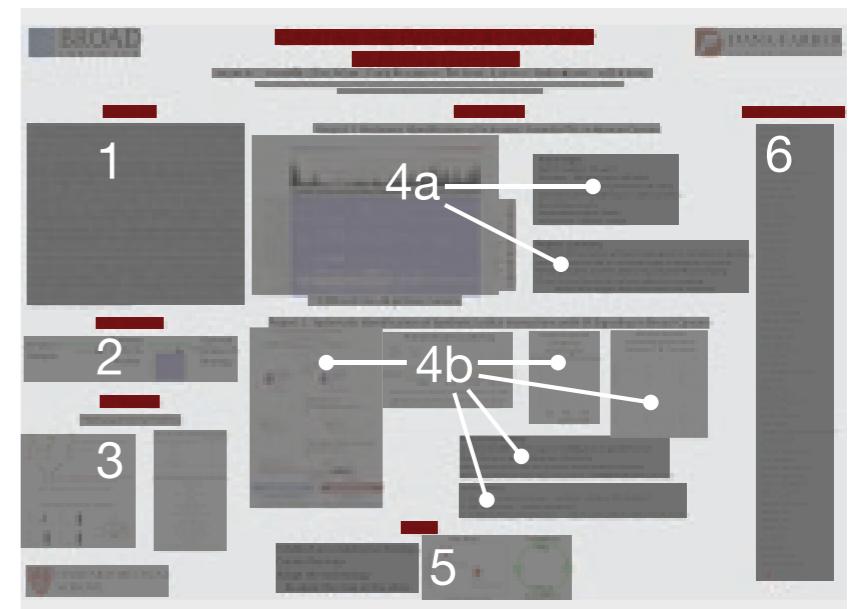


Figure 2 | Alignment. (a) Graphics and text used as vertices and edges of geometric shapes. (b) Geometric and curvilinear shapes used as flexible guides to align content.

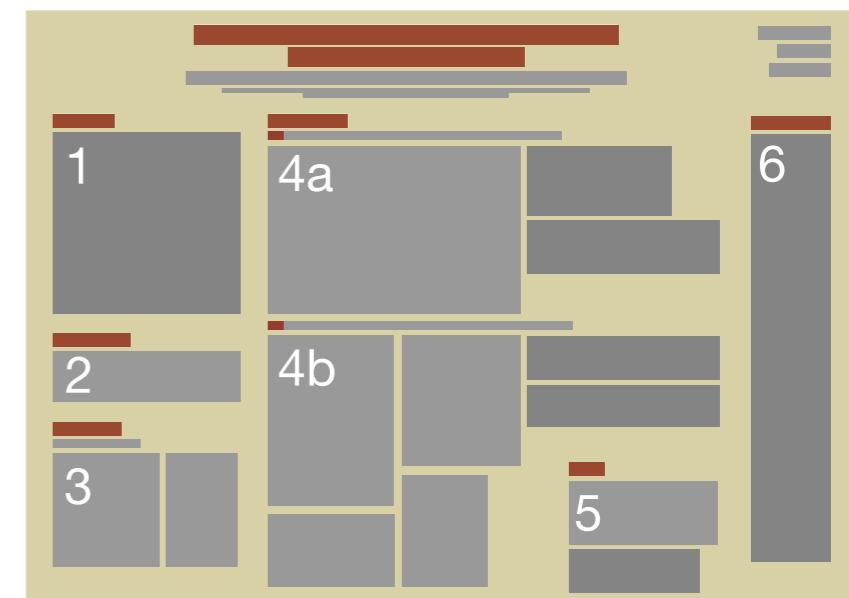
a



b



C



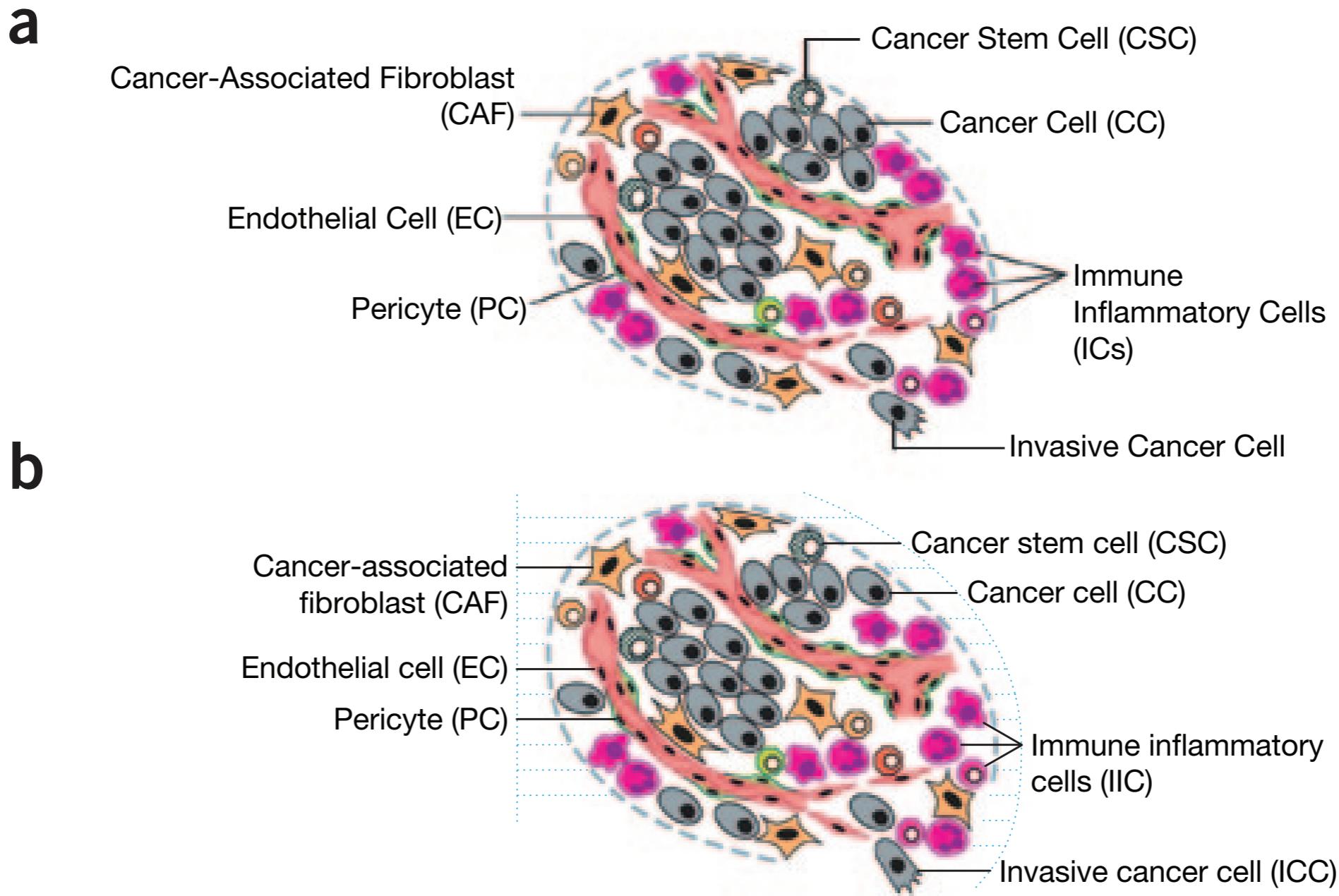


Figure 3 | Schematics with many callouts are improved by consistent line lengths and angles and uniform label spacing and alignment.

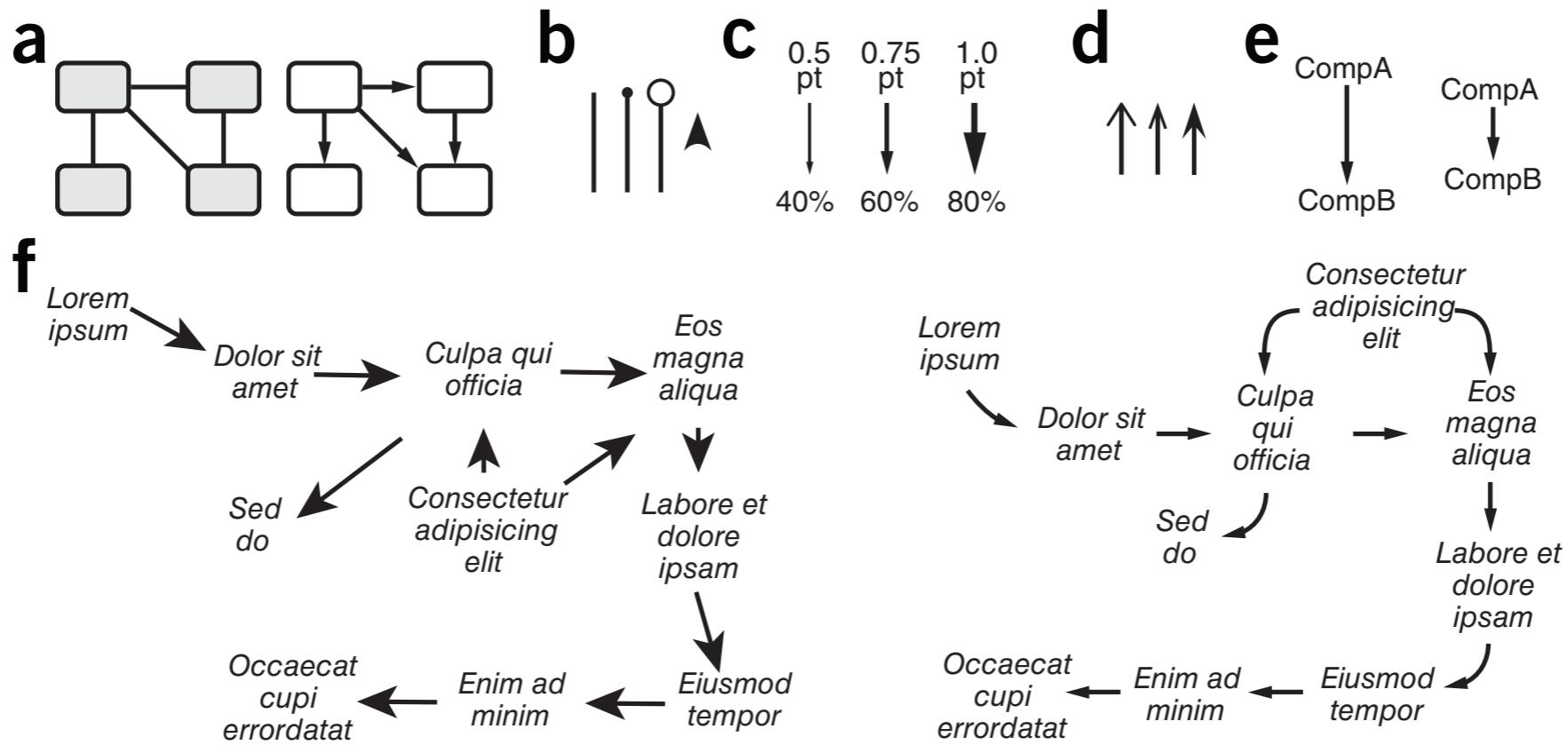


Figure 2 | Functional qualities of arrows. **(a)** The use of arrows versus lines as connectors suggests a certain functional relationship. **(b)** Alternatives to arrows as leader lines. **(c)** Reasonably sized arrows clearly indicate direction without being a distraction. **(d)** Trapped whitespace in ‘open’ arrowheads creates optical illusions that can attract unwanted attention. **(e)** Whitespace at the ends of the arrows makes them easy to discriminate from other content. **(f)** Orienting arrows in similar directions creates natural visual flow.

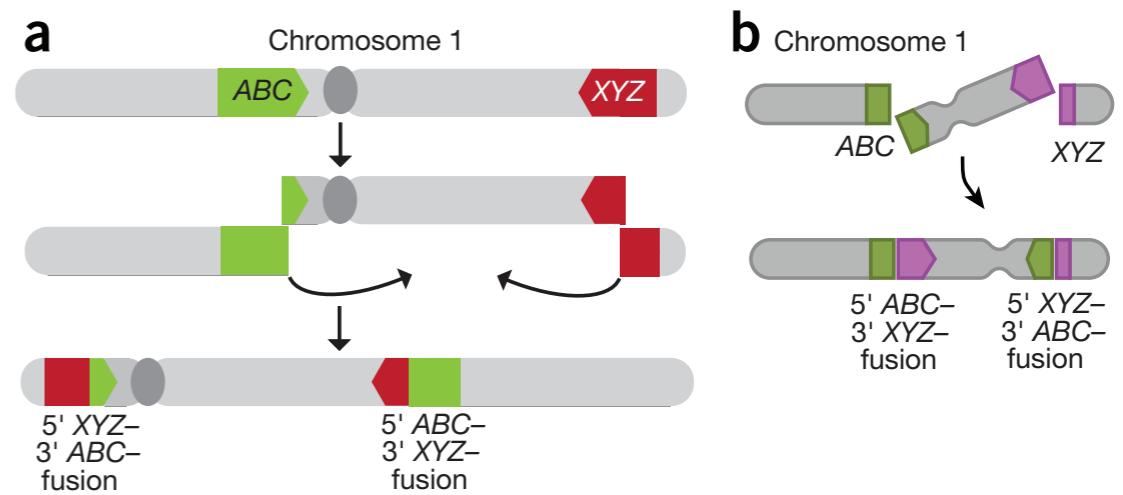
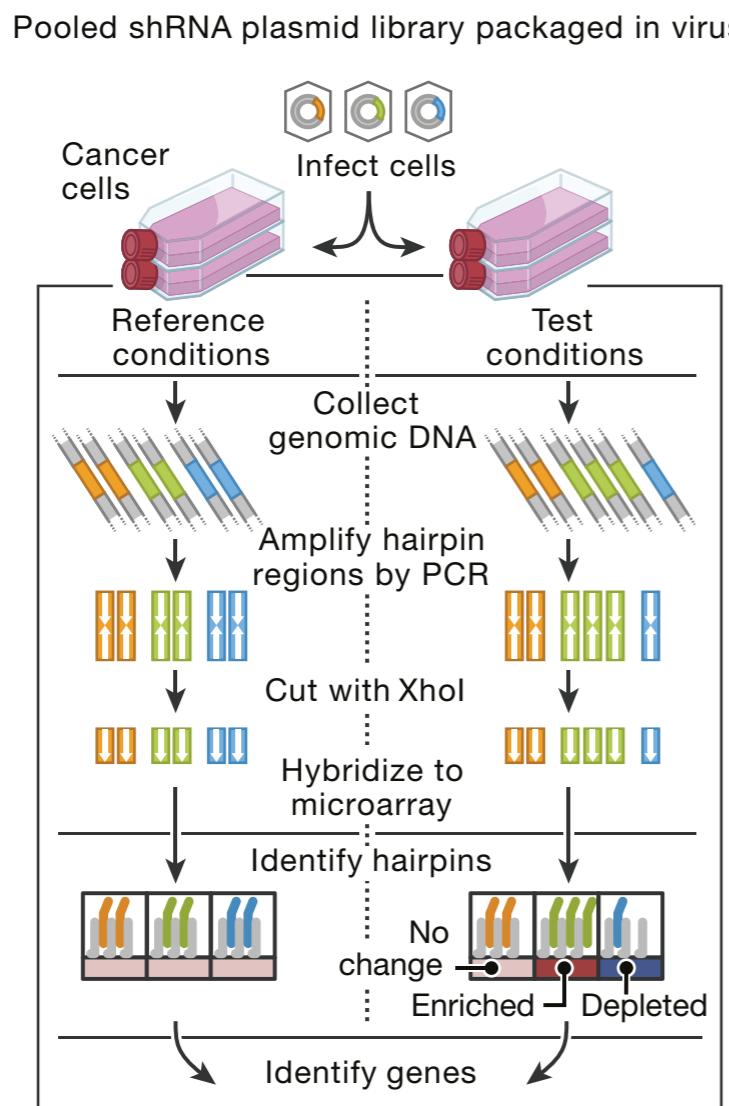


Figure 1 | Simplifying illustrations. (a) Initial diagram shows chromosomal inversion in three steps with the distal chromosomal ends exchanging places as indicated by arrows. (b) A simplified version of the diagram in a with fewer steps and a single arrow depicting the rotation of the center part of the chromosome.

Figure 2 | Well-ordered compositions and clear visual encodings make schematics easy to follow. Schematic comparing experimental conditions in a pooled RNA interference screen. Reprinted from reference 2.

3D

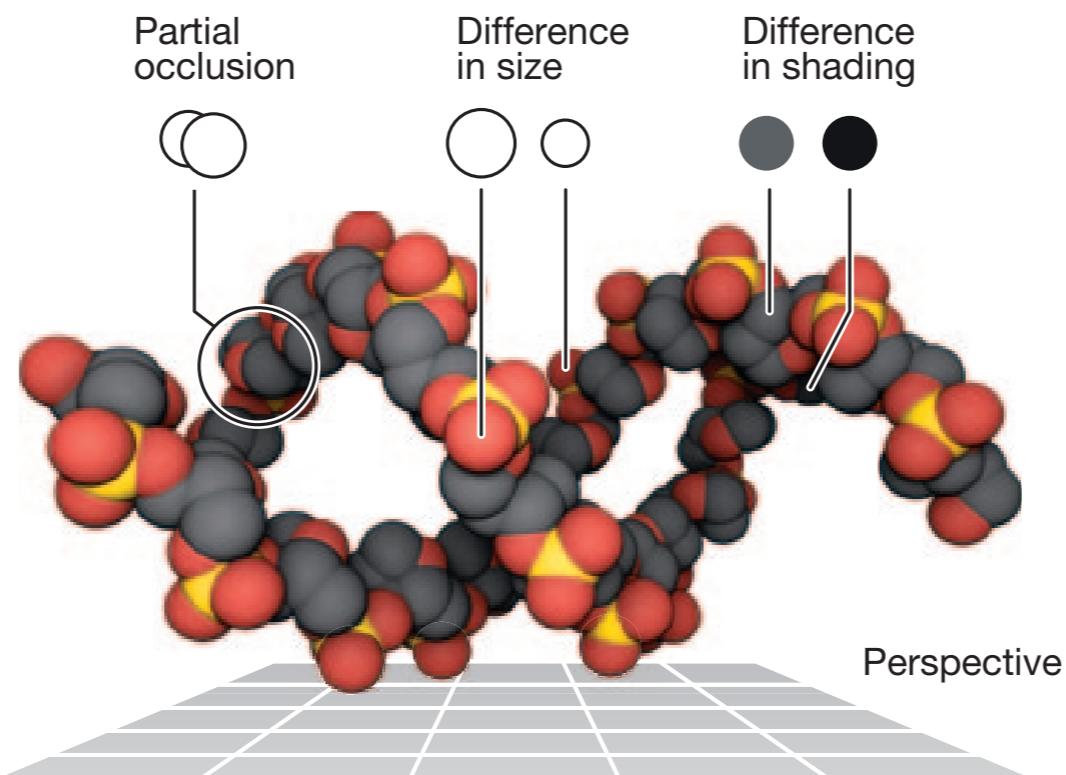


Figure 1 | Space-filling model of the DNA backbone. Depth cues enable us to perceive two-dimensional images as three-dimensional objects.

3D

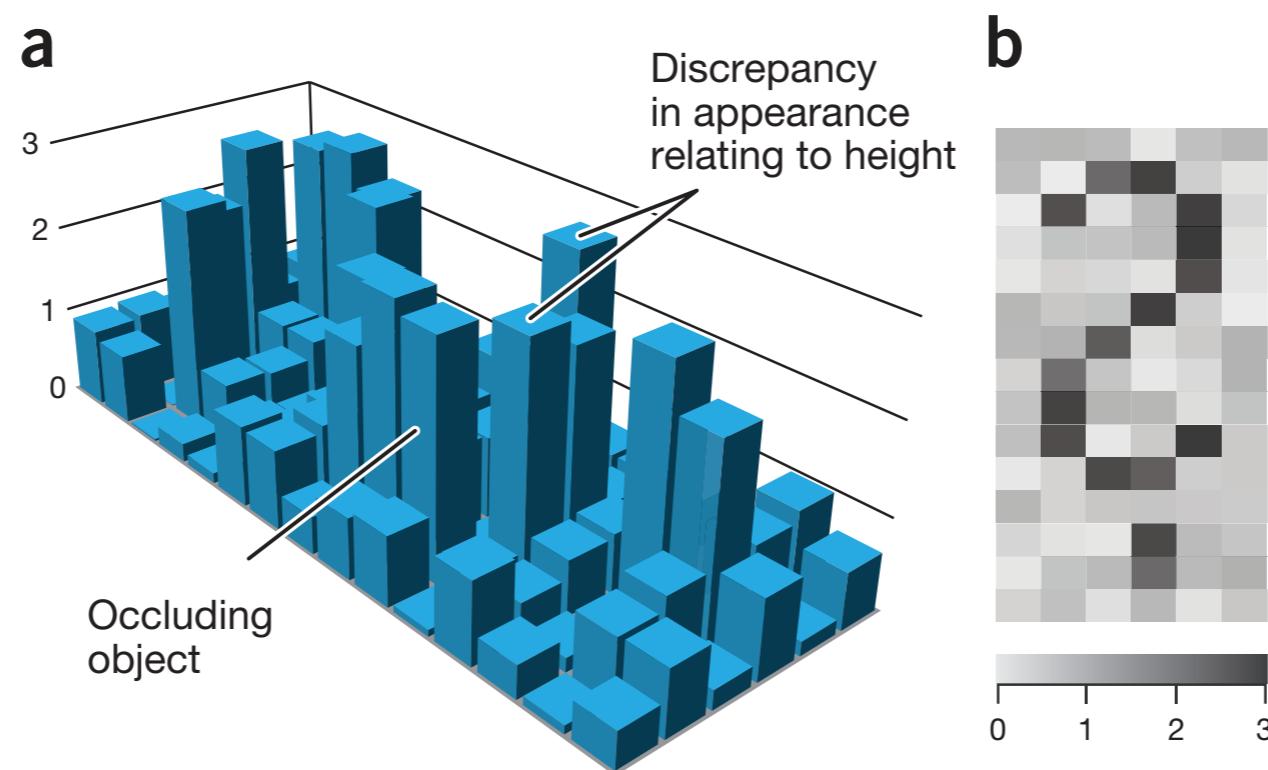


Figure 2 | Three-dimensional representation of abstract data. (a) Data occlusion and interference of visual encodings with depth cues can be problematic in three-dimensional space. (b) The same data as in a plotted as a two-dimensional heat map.

Summarization

Summarization

Recall HW05:

Problem 3: Missing data imputation

- P3.1. Perform marginal mean imputation on the missing values for each observation. Make scatterplots for each pair of variables showing their associations and use different colors/symbols to distinguish the imputed values from values that did not need imputing.

Summarization

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Implement this method of imputation. Report the Pearson correlation coefficient below.

You can't really make 28 (or 56!) nearly identical plots, then add 28 pages to a report and expect anyone to read through all that

Summarization

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Instead, put the time in to summarize →

Summarization

Recall HW05:

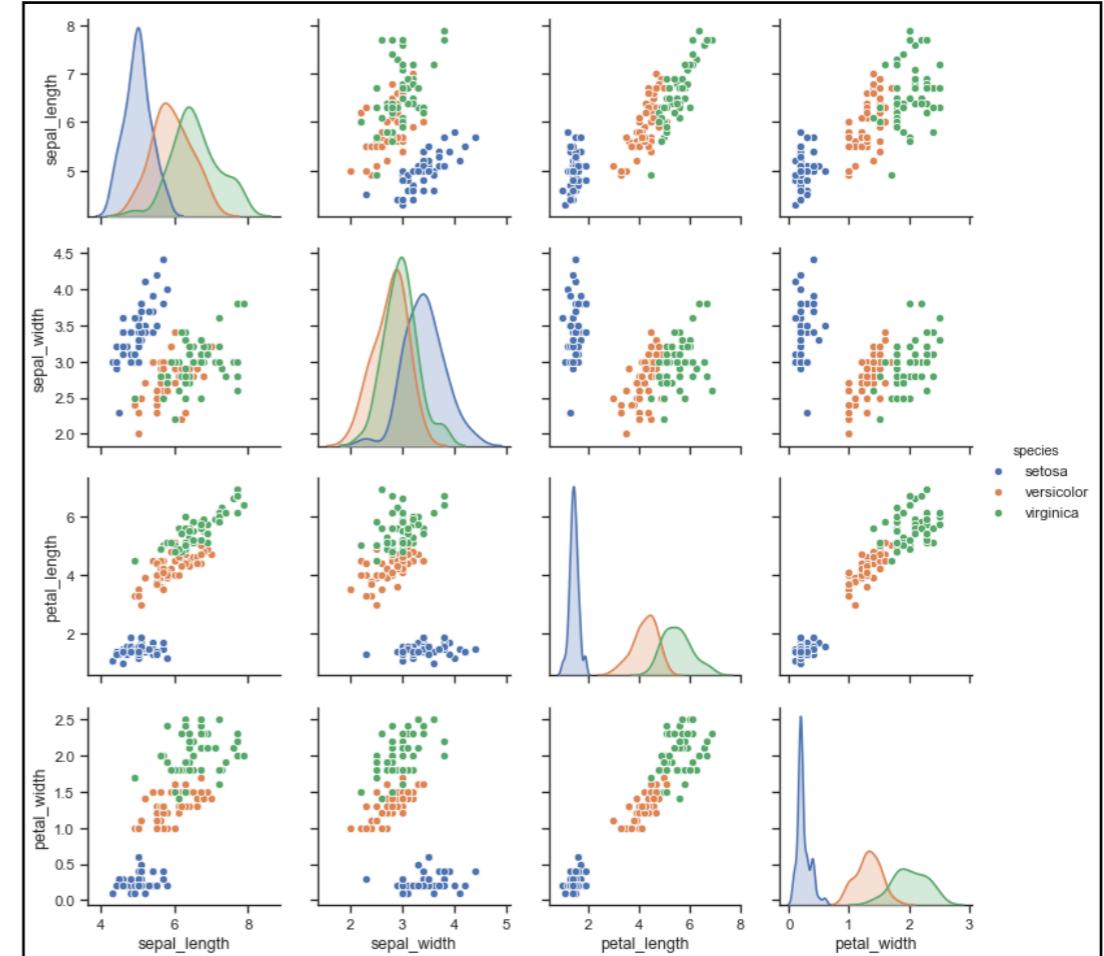
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Follow up this method of imputation. Repeat the Pearson correlation coefficient below.

You can't really make 28 (or 56!) nearly identical plots, then add 28 pages to a report and expect anyone to read through all that

Instead, put the time in to summarize



See matplotlib's **subplots** function

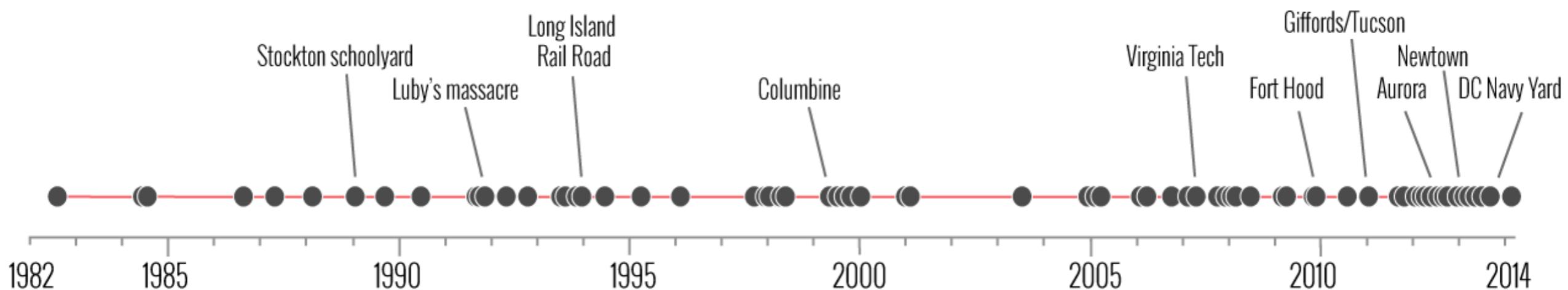
Communicating takeaways

Put it all together

Keep it simple

Know your audience

Time Between Mass Shootings, 1982-2014

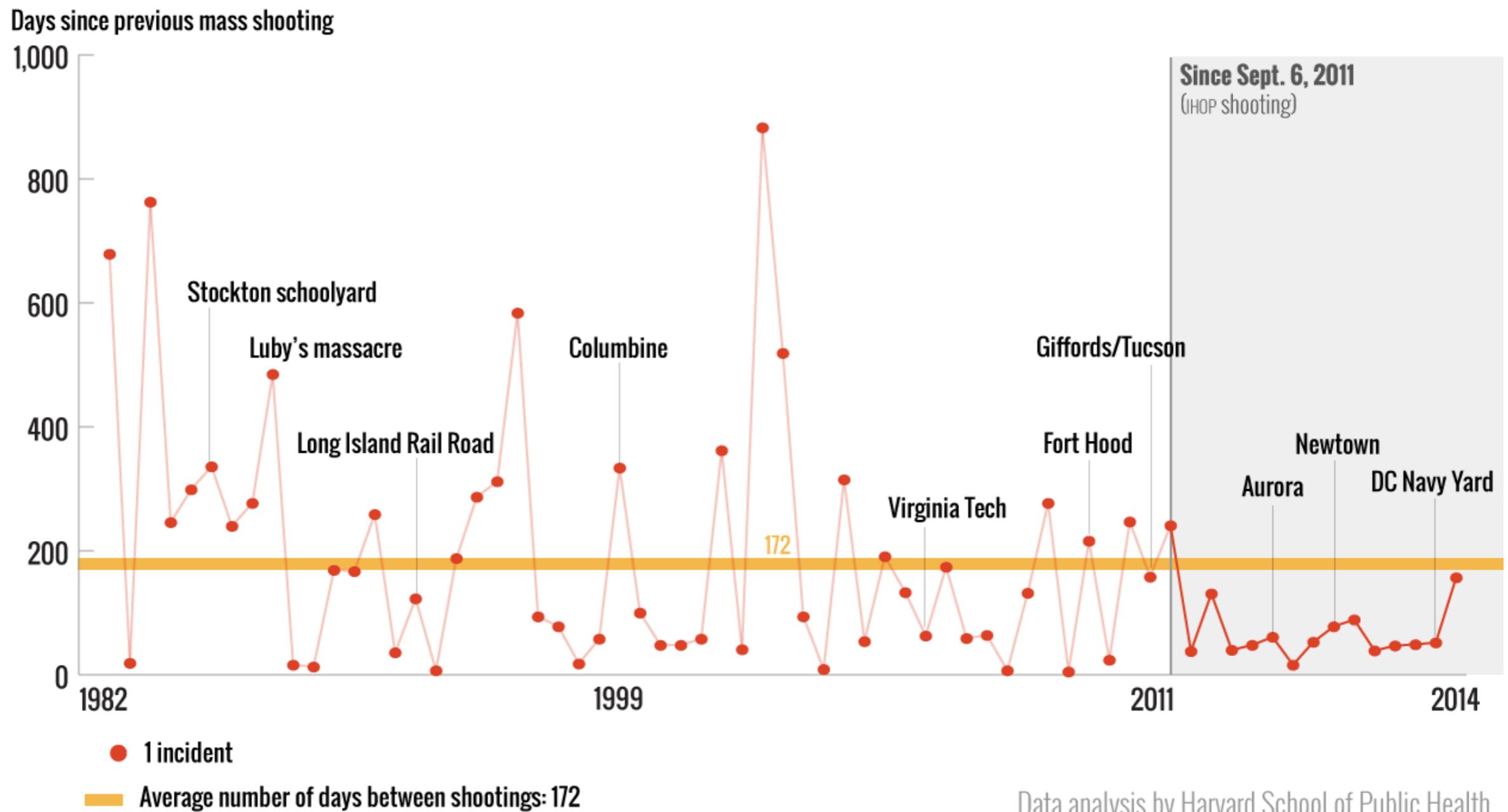


Data analysis by Harvard School of Public Health

Mother Jones

Put it all together Keep it simple Know your audience

More Frequent Mass Shootings Since 2011



Put it all together

WHERE THERE'S SMOKE—THERE'S CANCER

Cancer rates are up, but mortality is down. New diagnostics and treatments are responsible for part of this trend. But the greatest single contributing factor is the decline in smoking—rates are at their lowest level in 50 years.

Men Women

1 Increased incidence

An aging population contributes to rising incidence of cancer.

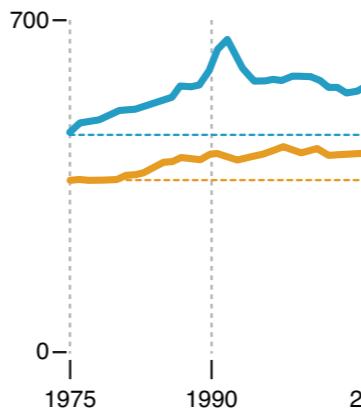
2 Fewer deaths

Cancer deaths have been dropping since 1991, especially in males.

3 Decline of lung cancer

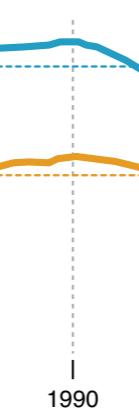
Drop in lung cancer deaths in males is the primary reason why death rates are down.

Cancer incidence rates (per 100,000)

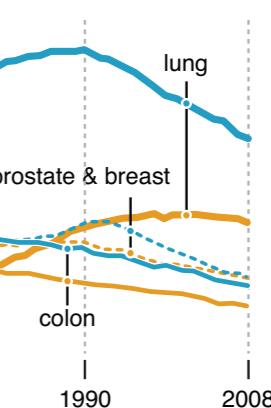


Cancer death rates (per 100,000)

OVERALL



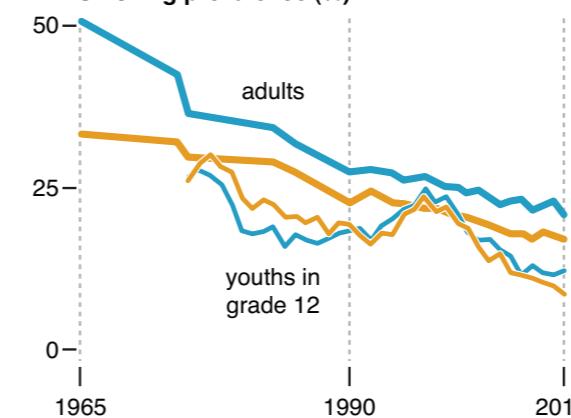
BY CANCER



4 Decline in smoking

Since the 1964 first Surgeon General's report, smoking rates have been dropping. By 2010, the rate among males was down to 20%, from 50% at its peak. Among youths, rates have been on an even steeper decline since 1997.

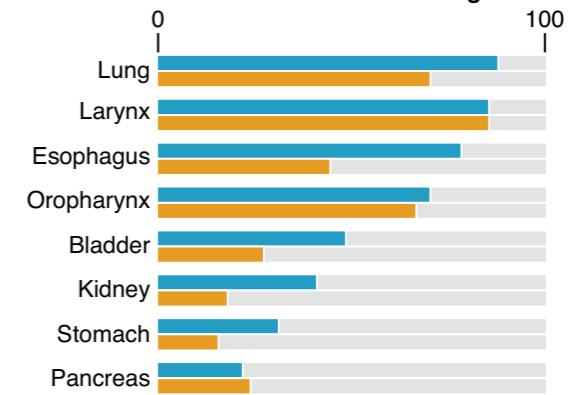
Smoking prevalence (%)



5 Impact of smoking on cancer deaths

Smoking is a major risk factor for many types of cancer and significant contributor to cancer-related deaths. It remains the single largest preventable cause of disease and premature death in the US.

Percentage of cancer deaths attributable to smoking



source: American Cancer Society Cancer Statistics 2012; Monitoring the Future (University of Michigan).

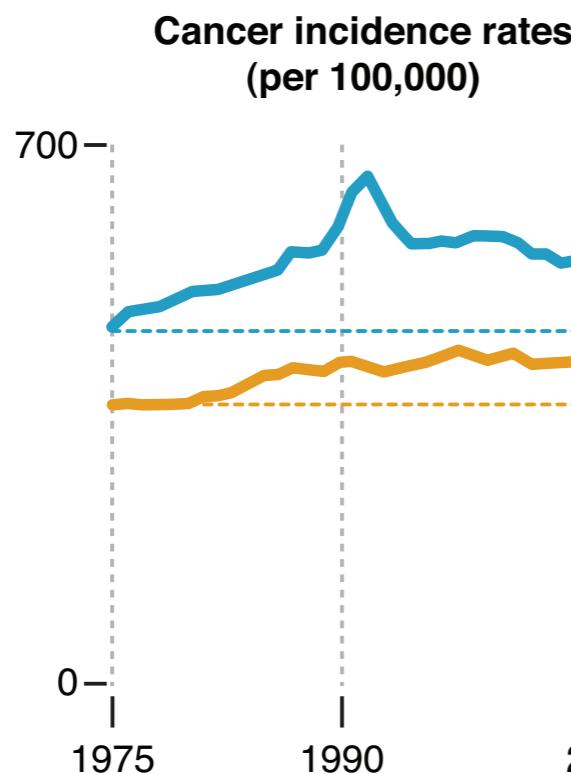
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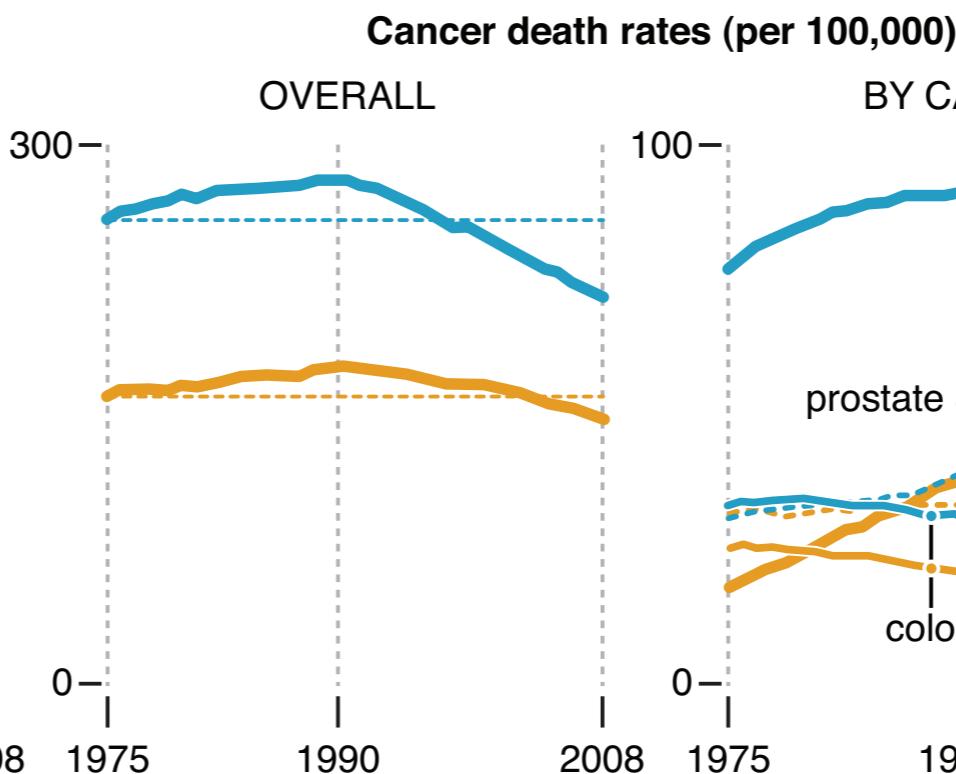
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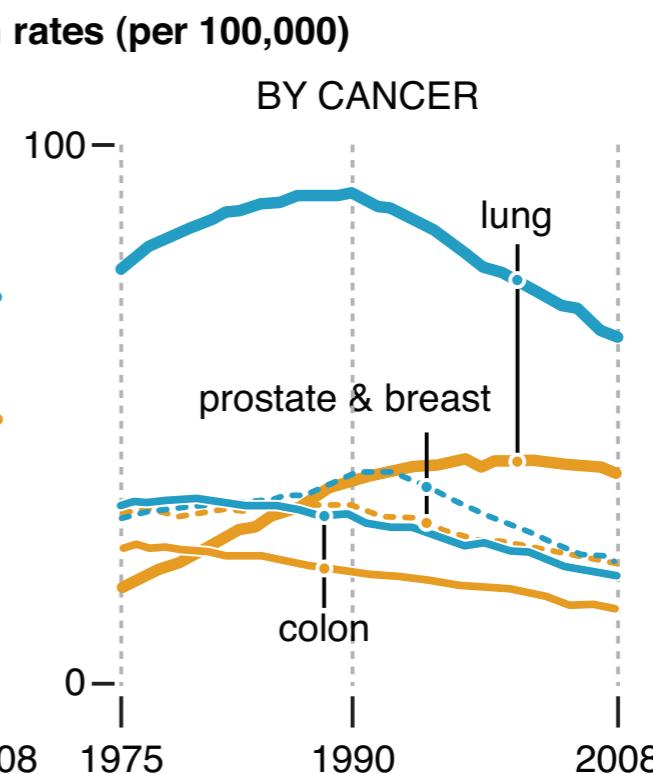
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5 Impact of smoking on cancer deaths

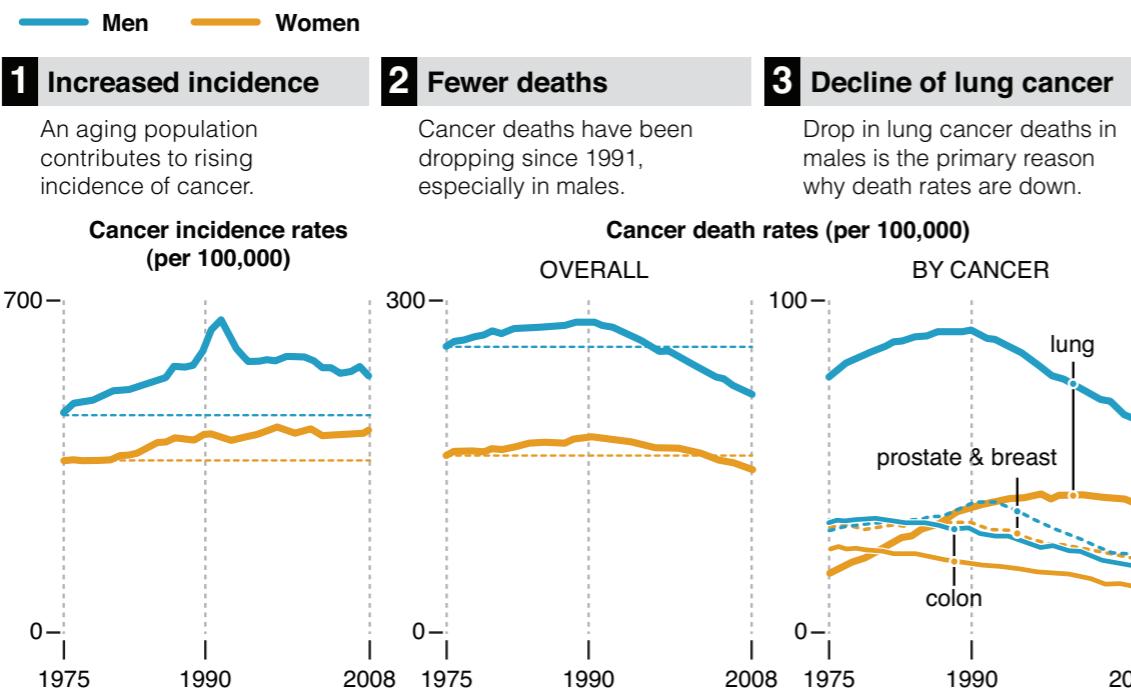
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(Know your medium)

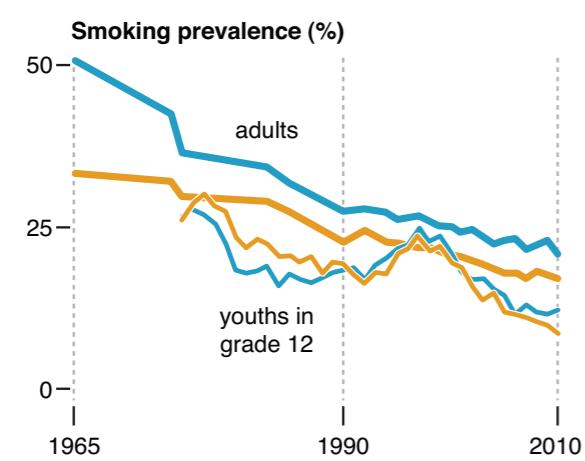
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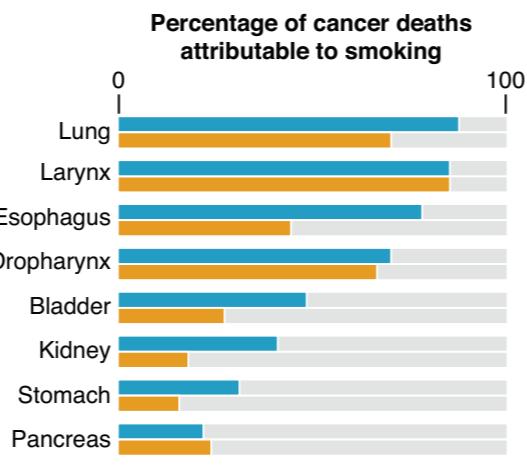
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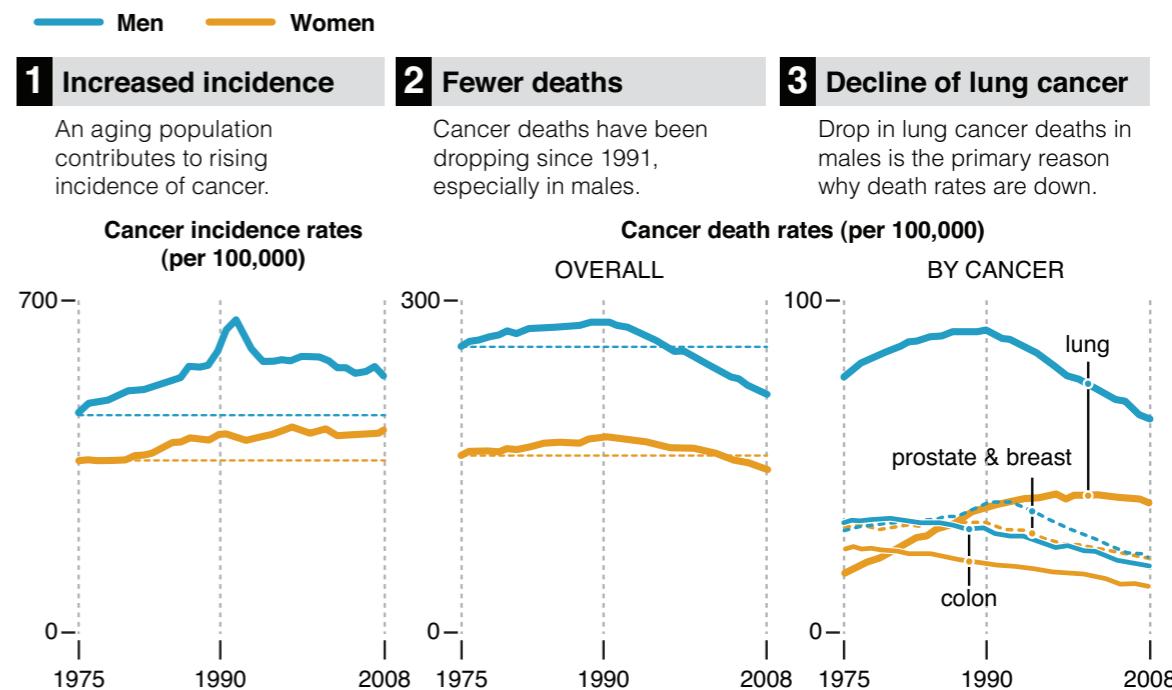
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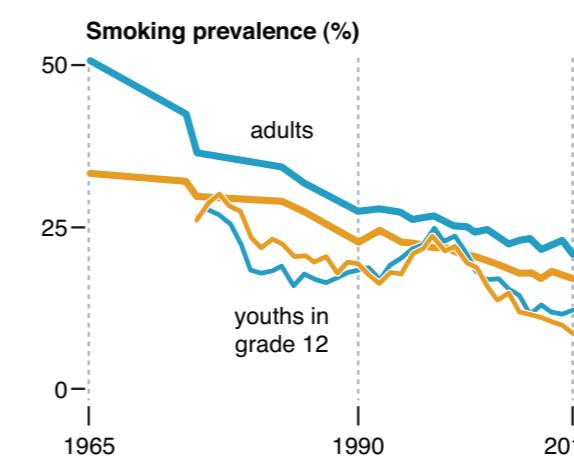
WHERE THERE'S SMOKE—THERE'S CANCER

Cancer rates are up, but mortality is down. New diagnostics and treatments are responsible for part of this trend. But the greatest single contributing factor is the decline in smoking—rates are at their lowest level in 50 years.



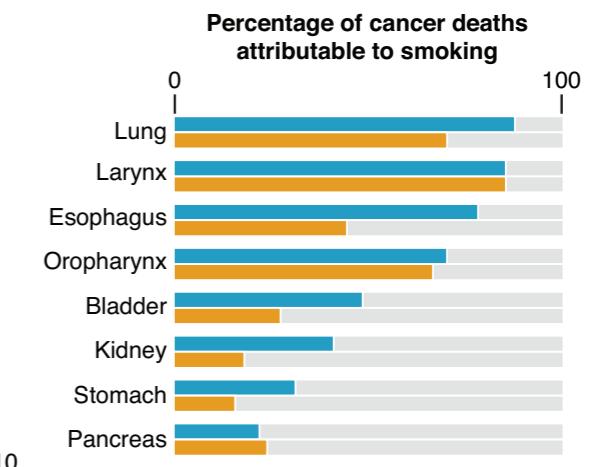
4 Decline in smoking

Since the 1964 first Surgeon General's report, smoking rates have been dropping. By 2010, the rate among males was down to 20%, from 50% at its peak. Among youths, rates have been on an even steeper decline since 1997.



5 Impact of smoking on cancer deaths

Smoking is a major risk factor for many types of cancer and significant contributor to cancer-related deaths. It remains the single largest preventable cause of disease and premature death in the US.



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(Know your medium)

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Men Women

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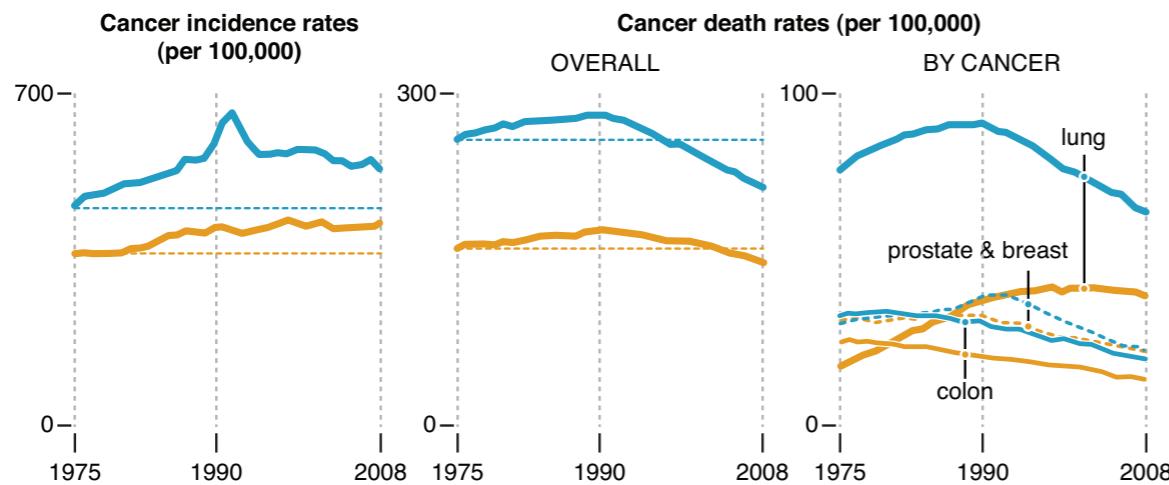
An aging population contributes to rising incidence of cancer.

2 Fewer deaths

Cancer deaths have been dropping since 1991, especially in males.

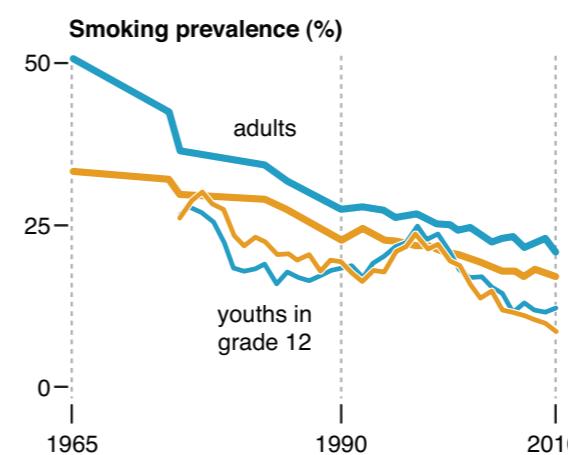
3 Decline of lung cancer

Drop in lung cancer deaths in males is the primary reason why death rates are down.



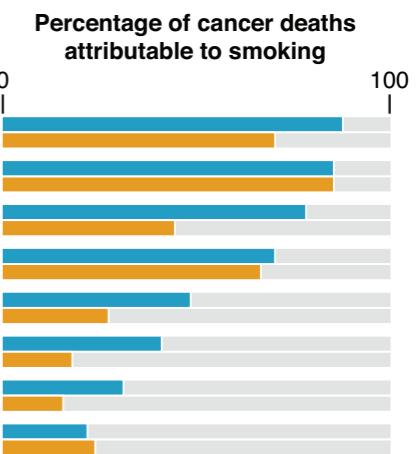
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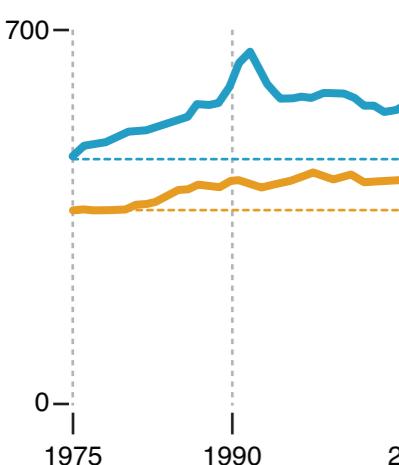
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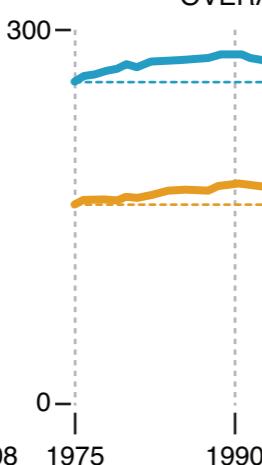
Cancer incidence rates (per 100,000)



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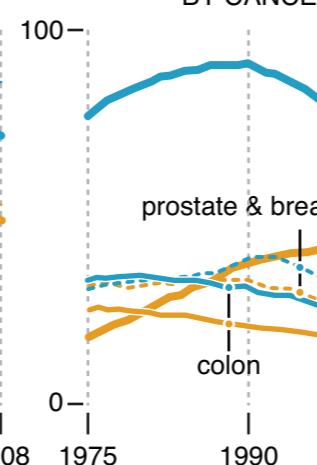
Cancer death rates (per 100,000)



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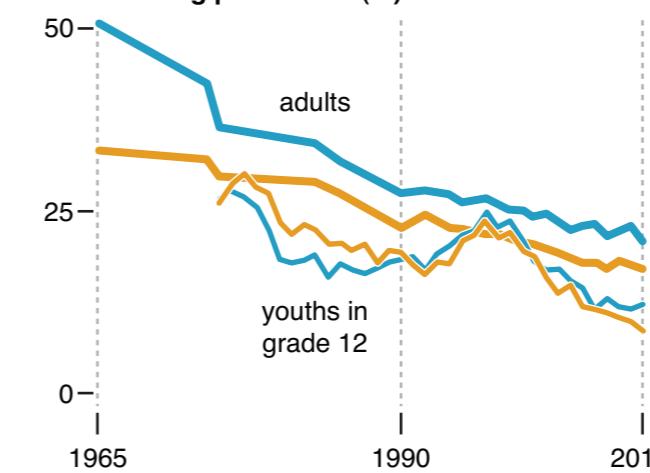
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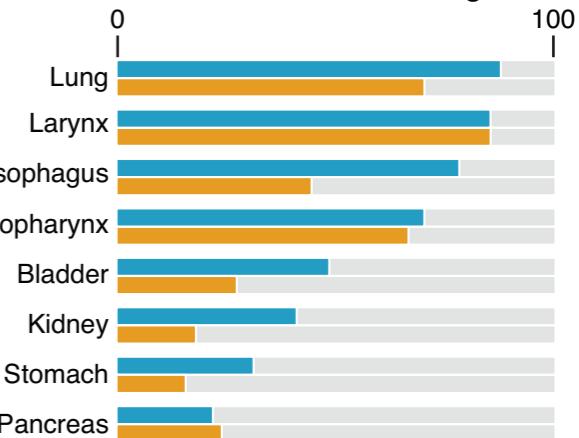
Smoking prevalence (%)



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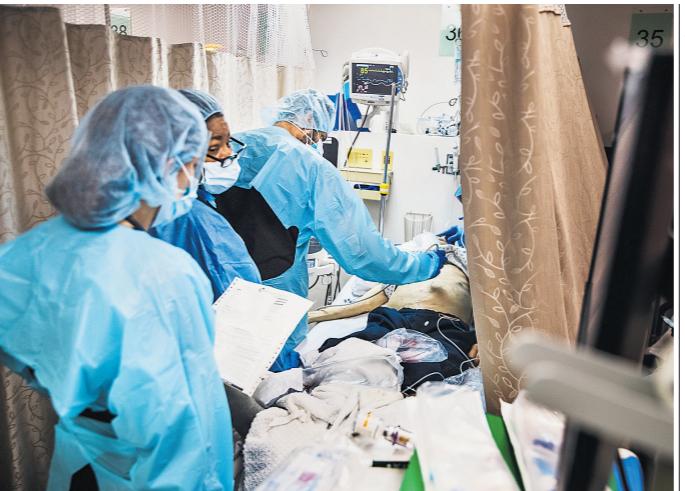
Percentage of cancer deaths attributable to smoking



source: American Cancer Society Cancer Statistics 2012; Monitoring the Future (University of Michigan).

- Know your message
- Know your medium
- Know your audience
- Account for strengths/weaknesses of human perception
- Keep it simple

JOB LOSSES SOAR; U.S. VIRUS CASES TOP WORLD



Since the coronavirus descended on Brooklyn Hospital Center three weeks ago, the staff has handled over 800 potential cases.

Under Trump, Unfilled Posts Hinder Action

By JENNIFER STEINHAUER and ZOLAN KANNO-YOUNG
WASHINGTON — Of the 75 senior positions at the Department of Homeland Security, 20 are either vacant or filled by acting officials, including Chad F. Wolf, the acting secretary who recently was unable to tell a Senate committee how many respirators and protective face masks were available in the United States.

The National Park Service, which like many federal agencies is full of vacancies in key posts, tried this week to fill the job of a director for the national capital region after hordes of visitors flocked to see the cherry blossoms near the National Mall, creating a potential public health hazard as the coronavirus continues to spread.

At the Department of Veterans Affairs, workers are scrambling to order medical supplies on Amazon and elsewhere, lacking experience in disaster responses, failed to prepare for the onslaught of patients at its medical centers.

Ever since President Trump came into office, a record high turnover and unfilled jobs have emptied offices across wide sections of the federal bureaucracy.

Now, current and former administration officials and disaster experts say the coronavirus has exposed those failings as never before.

Continued on Page A11

By NIKITA STEWART

Allia Phillips was excited about picking up an iPad from her school in Harlem last week. She did not want to miss any classes and hoped to land on the fourth-grade honor roll.

On Monday, the first day that New York City public schools began remote learning, the 10-year-old placed her iPad on a tray she set up over her pillow on a twin bed. She was alone, as that is what she shares with her mother and grandmother inside a homeless shelter on the Upper West Side.

"And then, Allia saw nothing."

"I went downstairs to find out they didn't have internet," said her mother, Leah, 42. Allia's mother, "You're screwing up my daughter's education. You want to screw me up?" Fine. But not my daughter's education."

The Department of Education, which oversees the nation's school system in the country with more than 11 million students, began attempting to teach all students through remote learning this week because schools were closed to slow the spread of the coronavirus.

Ensuring the vast system, which includes 1,800 schools, was a serious challenge for the city, and the large-scale, indefinite school closures are uncharted territory, altering the lives and routines of millions of children.

Continued on Page A16

By SHERI FINK

It was not even 9 in the morning and Dr. Sylvie de Souza's green N95 mask, which was supposed to form a seal against her face, was already askew.

In front of a main Monday, she trudged in clogs between the emergency department she chairs at the Brooklyn Hospital Center and a tent outside, keeping a sharp eye on the trainee doctors, nurses and other staff members who would screen nearly 100 walking patients for the coronavirus that day.

Inside her E.R., more than a dozen people showing signs of infection waited for evaluation in a area used just a few weeks ago for stitches and casts. Another dozen lay on gurneys arranged one in front of the next, like a New York City car park. One man on a ventilator was waiting for space in the intensive care unit.

Minutes before paramedics wheeled in a heart attack patient, Dr. de Souza pointed to her colleagues: "We would screen them separately in a newly constructed wall from the suspected virus cases." This is our safe area," she told a reporter. Then she corrected herself: "This is thought to be safe." There was really no way

Continued on Page A17

By DAN BARRY

Professional baseball greeted a new season this afternoon with an Opening Day game for the ages, an extra-inning masterpiece that vividly unfolded on the sun-dappled field of Citi Field. The grand finale of the bat could almost be heard, the blur of white almost seen, the communal joy almost felt.

From the moment the first batter thumbed his helmet — and both flew out — to the walk-off home run by a faltering pinch-hitter, this 11-inning affair redefined what constitutes a perfect game. No one cared about the outcome; the distraction was reward enough.

Don't misunderstand: This

Continued on Page A13

A Fan Writes a Fantasy for Opening Day

game between the New York Gothams and the Cincinnati Reds marred in inopportune ways by avoid the colors of wins and losses. It mattered so much that complaints about baseball's slow pace yielded to the universal wish that this game would last forever.

It could've played into the night," said the red-clad Gothams left fielder Sammy Sosa, who missed part of last season after sneezing so hard he strained a ligament in his back. "I didn't

Continued on Page A13

By JEFFREY BROWN

Weekly unemployment claims

Note: Official figures are seasonally adjusted. Source: Department of Labor

WEEKLY AVERAGE: 345,000

0

100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120

THE NEW YORK TIMES

BUSINESS B1-9

Armed With Sewing Machines

With hospitals desperate for masks, people are pulling out their sewing machines to fill the void.

PAGE B4

A Gusher Can't Be Contained

A chaotic mismatch between supply and demand for oil means the world is running out of places to store it.

PAGE B9

Netanyahu Rival Relents

A lawsuit led New Mexico to remake its failing system into one advocates hope will serve as a national model.

PAGE A22

Starting Over on Foster Care

The pandemic gives added urgency to a central issue that was already a talking point for Joseph R. Biden Jr. and other Democrats.

PAGE A22

Brushing Aside a Slaughter

Russia and China, which often revel in grudges against other countries, are employing selective memory to address a massacre that occurred on their border in 1900.

PAGE A18

SPORTSFRIDAY B11-15

Slow to Embrace a Delay

Athletes question why U.S. Olympic leaders took so long to join calls to postpone the Tokyo Games.

PAGE B11

OBITUARIES A24-25

Chronicler of U.S. History

Richard Reeves's books on Nixon, Clinton and others could be as unsparing as his column. He was 83.

PAGE A24

Globetrotters' Dean of Dribble

Fred "Curly" Neal dazzled fans with his ball-handling wizardry in more than 6,000 games. He was 77.

PAGE A25

EDITORIAL, OP-ED A26-27

Paul Krugman

PAGE A27

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New Data Shows Staggering Toll of Outbreak

This article is by Ben Casselman, Patricia Cohen and Tiffany Hsu.

More than three million people filed for unemployment benefits last week, sending a collective shudder throughout the economy that is unlike anything Americans have experienced.

The alarming numbers, in a report released by the Labor Department on Thursday, provide some of the first hard data on the economic toll of the coronavirus pandemic, which has shut down whole swaths of American life faster than government statistics can keep track.

Just three weeks ago, barely 200,000 people applied for jobless benefits, a historically low number. In the half-century that the government has tracked applications, the weekly total ever with 895,000, so-called initial claims, had been in 1982.

Thursday's figure of nearly 3.3 million set a grim record. "A large part of the economy just collapsed," said Ben Herzog, executive director of IHS Markit, a business statistician and financial firm.

The numbers provided only the first hint of the economic cataclysm in progress. Even comparatively optimistic forecasters expect millions more lost jobs, and with them foreclosures, evictions and bankruptcies. Thousands of businesses have closed in response to the pandemic, and many will never reopen. Some economists say the decline in gross domestic product this year could rival the worst years of the Great Depression.

And there was fresh evidence on Thursday of the relentless course of the virus itself. Cases in the United States now exceed 80,000, the most of any nation, even China and Italy, according to a New York Times tally. More than 1,000 deaths across the country have been linked to the virus.

At least 160 million people nationwide are in quarantine. Continued on Page A17

By BEN CASSELMAN, PATRICIA COHEN and TIFFANY HSU

Courage at a Brooklyn Hospital, At the Front of an Invisible War

With Supplies Waning, Workers Soldier On

By SHERI FINK

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Continued on Page A11

Online Class With No Way To Get There

By NIKITA STEWART

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On Monday, the first day that New York City public schools began remote learning, the 10-year-old placed her iPad on a tray she set up over her pillow on a twin bed in a studio that she shares with her mother and grandmother inside a homeless shelter on the Upper West Side.

And then, Allia saw nothing.

"I went downstairs to find out that they don't have any internet," said Kasha Phillips-Lewis, Allia's mother. "You're screwing up my daughter's education. You want to screw me up? Fine. But not my daughter's education."

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Continued on Page A16

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By SHERI FINK

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With Supplies Waning, Workers Soldier On

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Continued on Page A17

Labeling Regions by Risk

President Trump told governors he planned to classify counties according to the danger of coronavirus infection. Page A11.

2,000,000

1,500,000

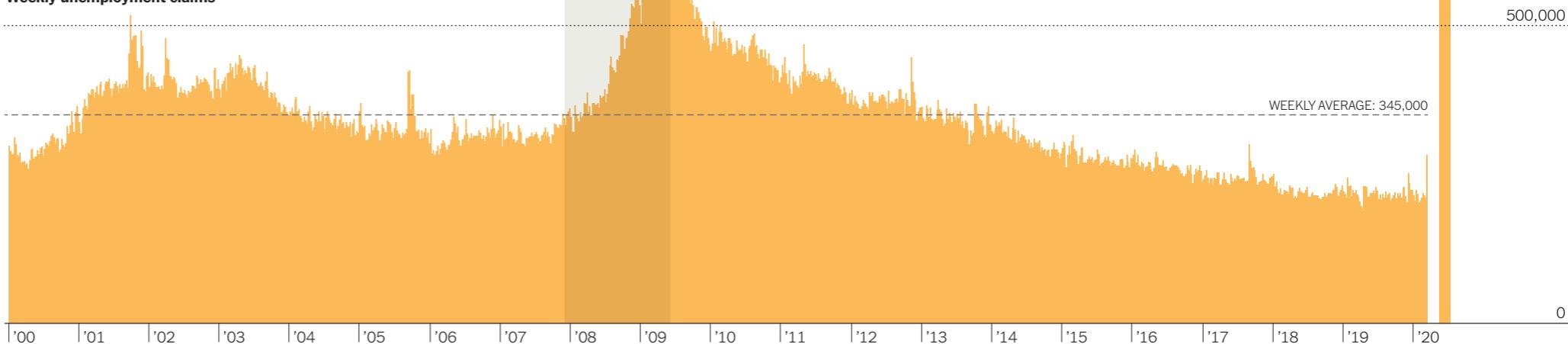
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THE NEW YORK TIMES

BUSINESS B1-9

Armed With Sewing Machines

With hospitals desperate for masks, people are pulling out their sewing machines.

INTERNATIONAL A18-20

Maduro Is Indicted in U.S.

Federal prosecutors accused the Venezuelan president, whom the U.S. no

NATIONAL A21-23

New Focus on Health System

The pandemic gives added urgency to a central issue that was already a main

WEEKEND ARTS C1-16

For Pint-Size Paleontologists

Like dinosaurs? Have crayons? Take a peek at two pages reprinted from The New York Times, which could be as unsparing as

OBITUARIES A24-25

Chronicler of U.S. History

Richard Reeves's books on Nixon, Clinton and others could be as unsparing as

Summary

Know your message

Summary sentence, what do we learn

Know your medium

print, web, slideshow

Know your audience

Technical background, interests

Account for strengths/weaknesses of human perception

Good design makes perceptual tasks easier

Reduce load and guide the eye

Color is tricky → rods and cones

Keep it simple

Avoid distractions (“chartjunk”), information overload

Prototype appropriately, work at true size

Refer to these materials as you
prepare your projects