ELEMENTS OF DATA VISUALIZATION & DESIGN

Welcome!

12 Months to Better Data Series
RIPL, Fall 2024

Hello! My name is:

AMANDA

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AGENDA

Choosing the right visualization

Practice: Graph Critique

Design Principles

Practice: Design a one-page

LEARNING OUTCOMES

- Identify the key steps in creating a data-informed visualization

- Increased confidence in choosing the right visualization to effectively display data

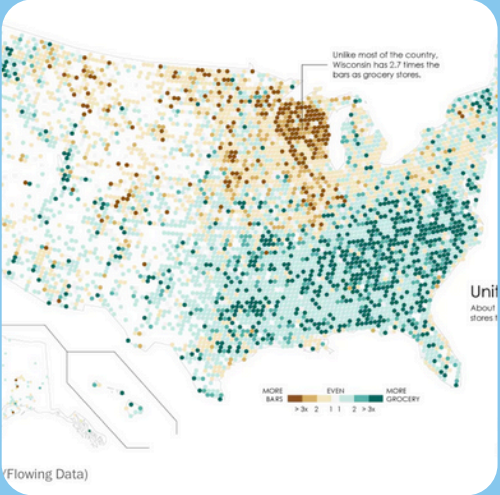- Be familiar with basic design principles that enhance comprehension and accommodate accessibility needs

What is data visualization?

EXAMPLES OF VISUALIZATIONS

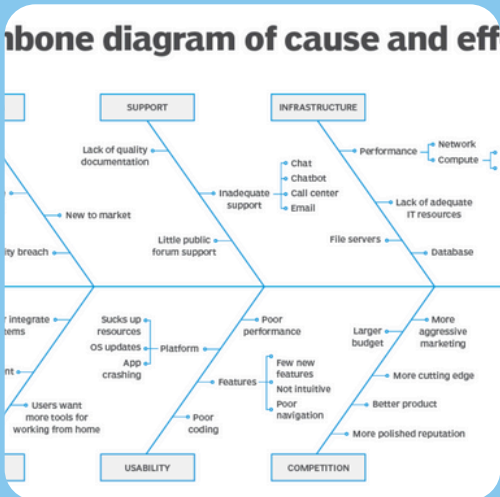**Poll question:** What kinds of visualizations do you typically create?

Charts & Graphs

Maps

Tables

Diagrams

Infographics

Why visualize data?

The more visual the input becomes, the more likely it is to be recognized and recalled.

John Medina, Brain Rules

REASONS TO VISUALIZE

To see patterns

	1		2		3		4	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

Almost identical summary statistics:

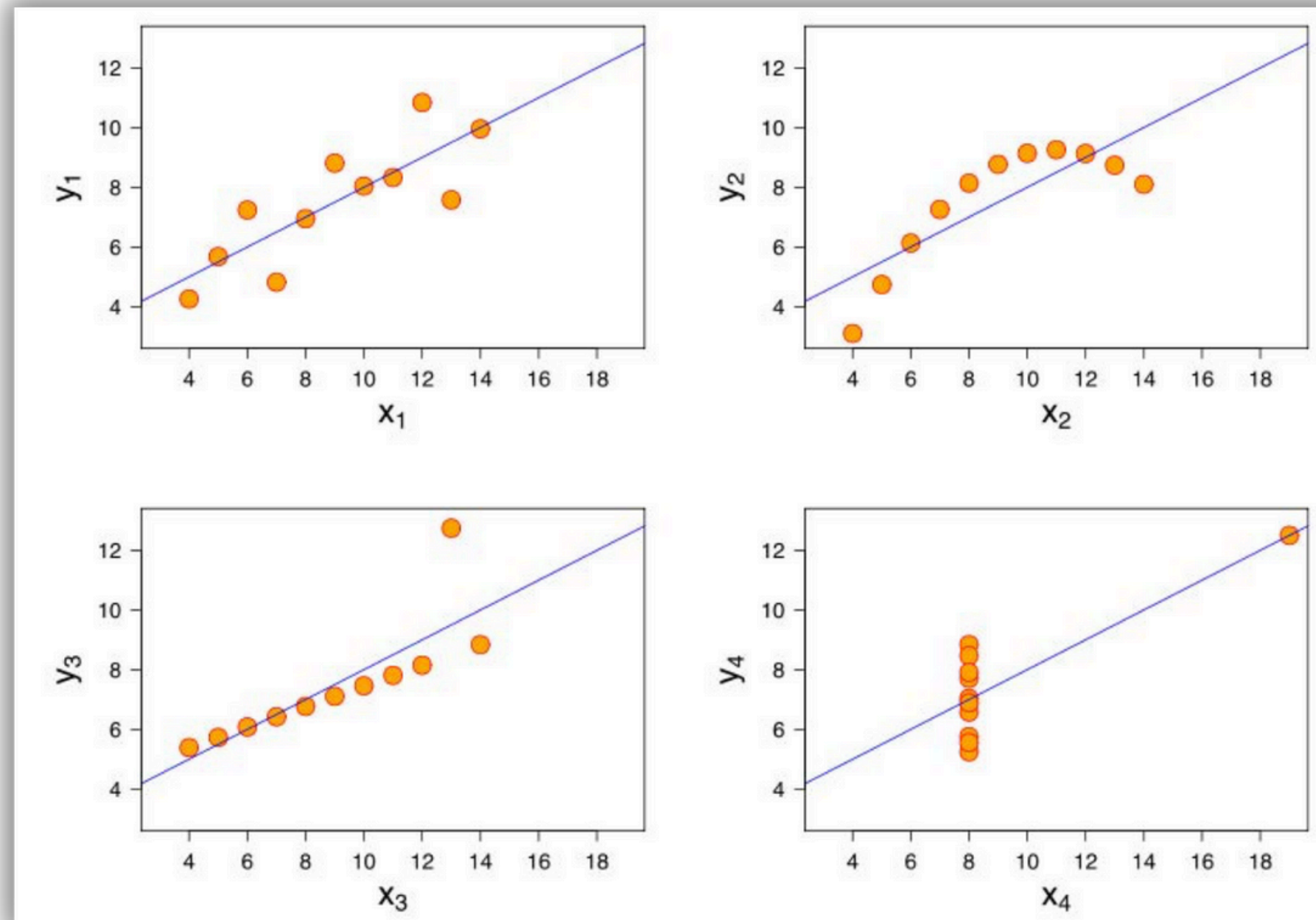x & y mean
x & y variance
x-y correlation
x-y linear regression

Anscombe's Quartet

REASONS TO VISUALIZE

To see patterns

Anscombe's Quartet

REASONS TO VISUALIZE

To grab attention

DEIA Considerations

Understand your bias. We all have bias!

Use empathy and people-centered language.

Put accessibility at the forefront when making design choices.

PART 1:
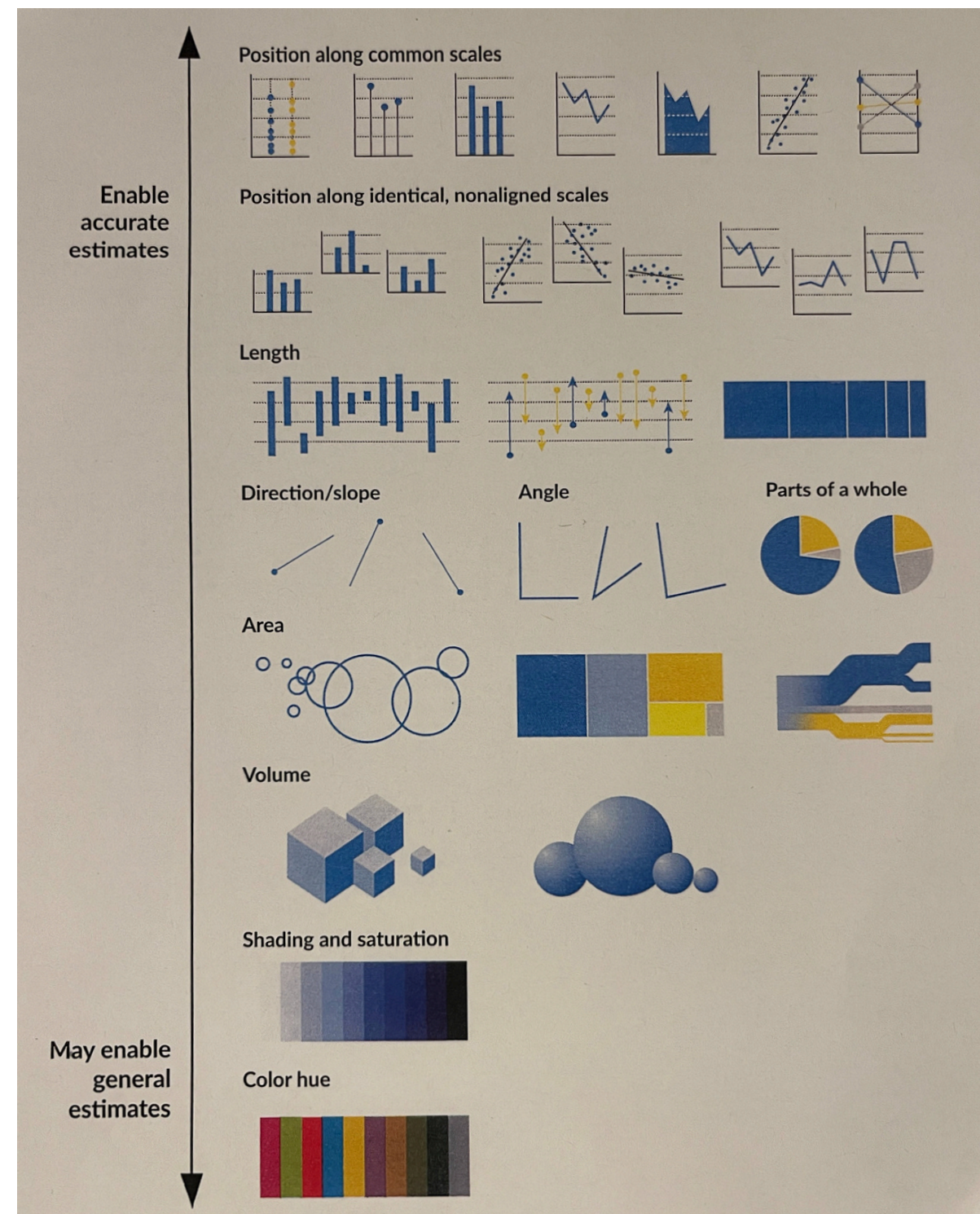# CHOOSING THE RIGHT VISUALIZATION

VISUALIZATION BEST PRACTICES

1. Use the right visualization format

2. Give context to numbers & show the data

3. Tell a story

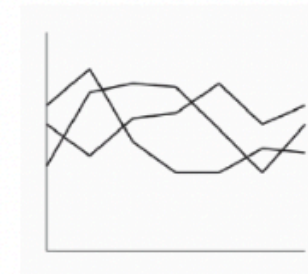4. Keep it simple

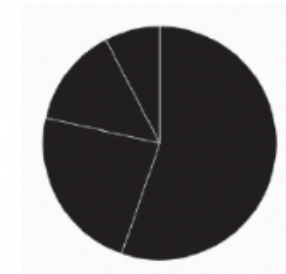# USE THE RIGHT VISUALIZATION
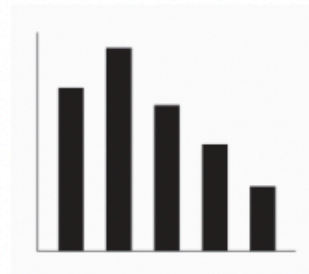

Questions to consider:
- What needs to be communicated?
- What level of precision is needed?

USE THE RIGHT VISUALIZATION
CHARTS

**Good charts for broad audiences**

- Bar chart
- Pie chart
- Line chart
- Scatterplot
- Highlight table/ heatmap
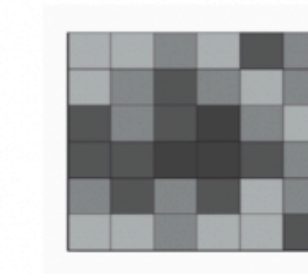
Zoss, Angela M. "Designing Public Visualizations of Library Data." In *Data Visualization: A Guide to Visual Storytelling for Librarians*, edited by Lauren Magnuson. Lanham, MD: Rowman & Littlefield Publishers, Inc., 2016. Preprint: https://dx.doi.org/10.6084/m9.figshare.3811713.v1
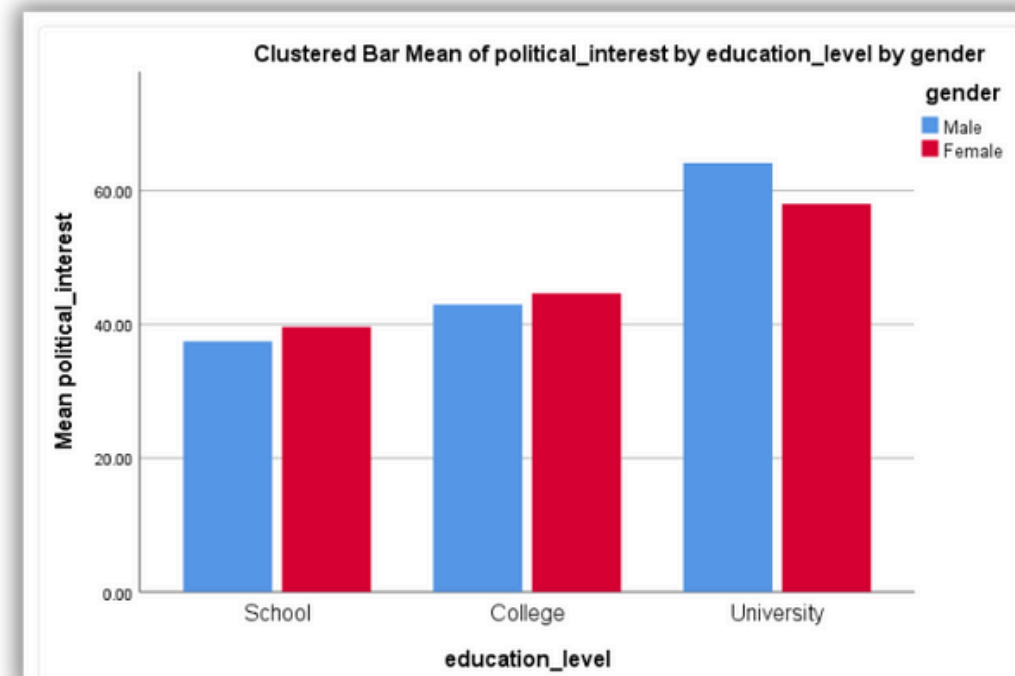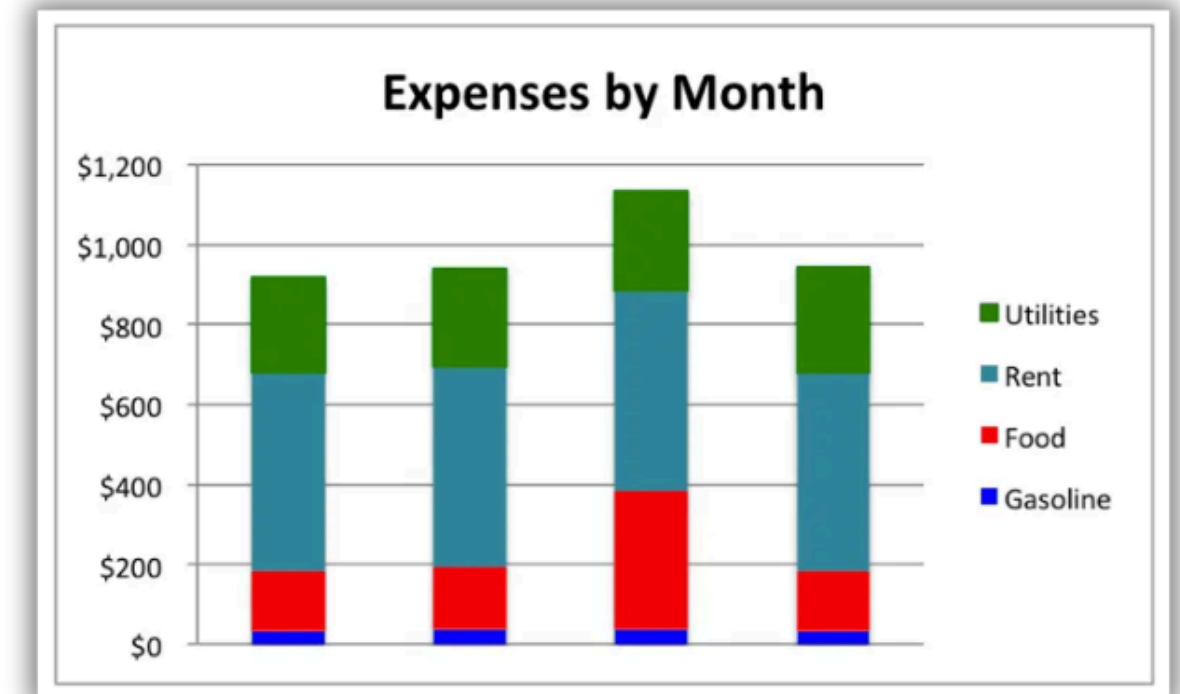
USE THE RIGHT VISUALIZATION
BAR CHARTS
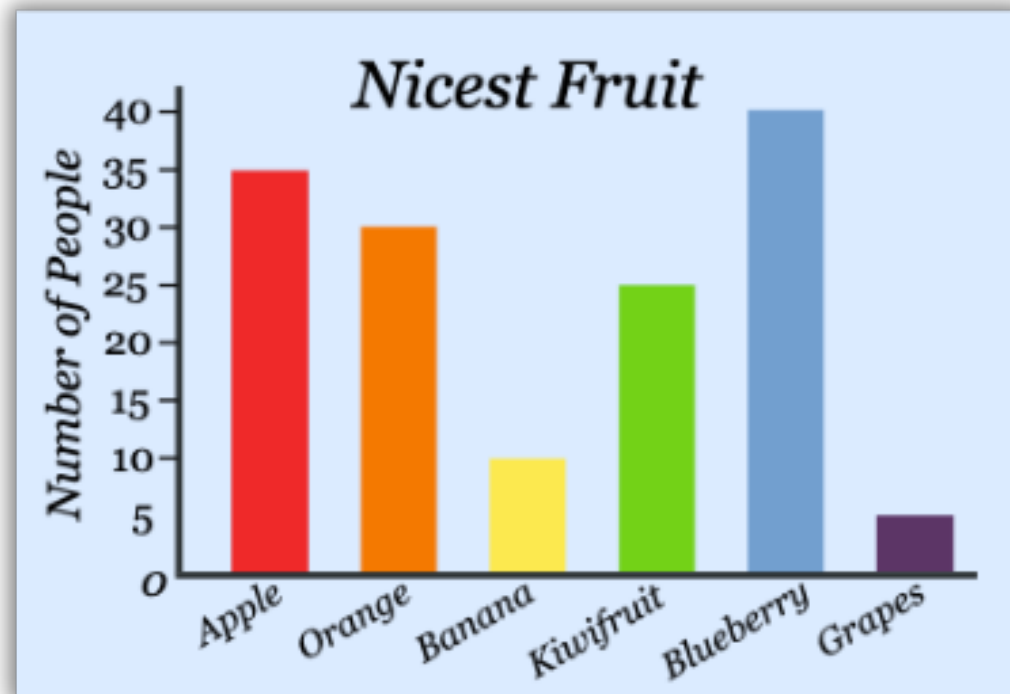
Standard bar chart
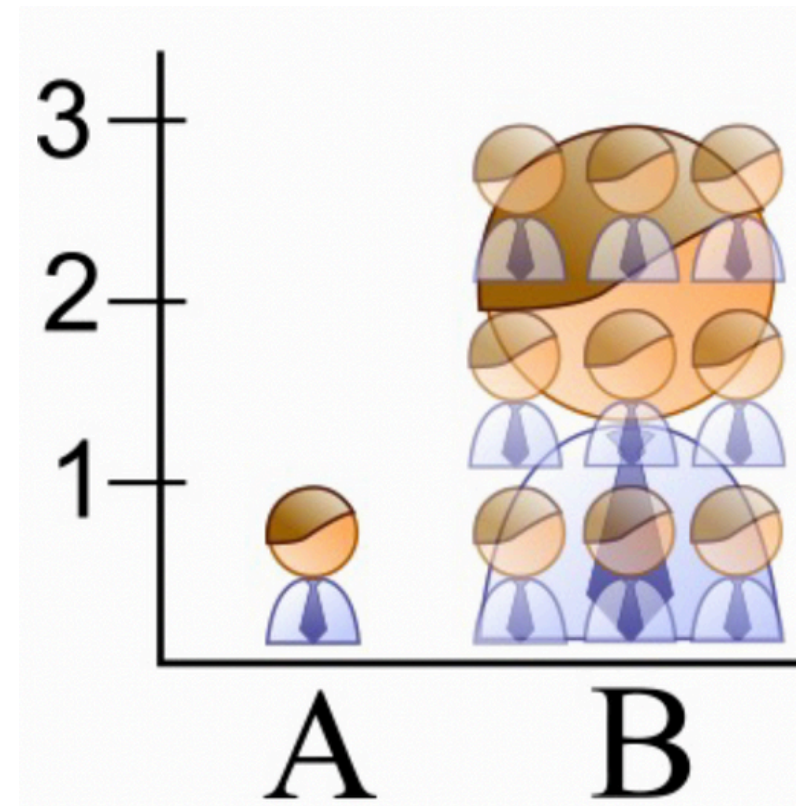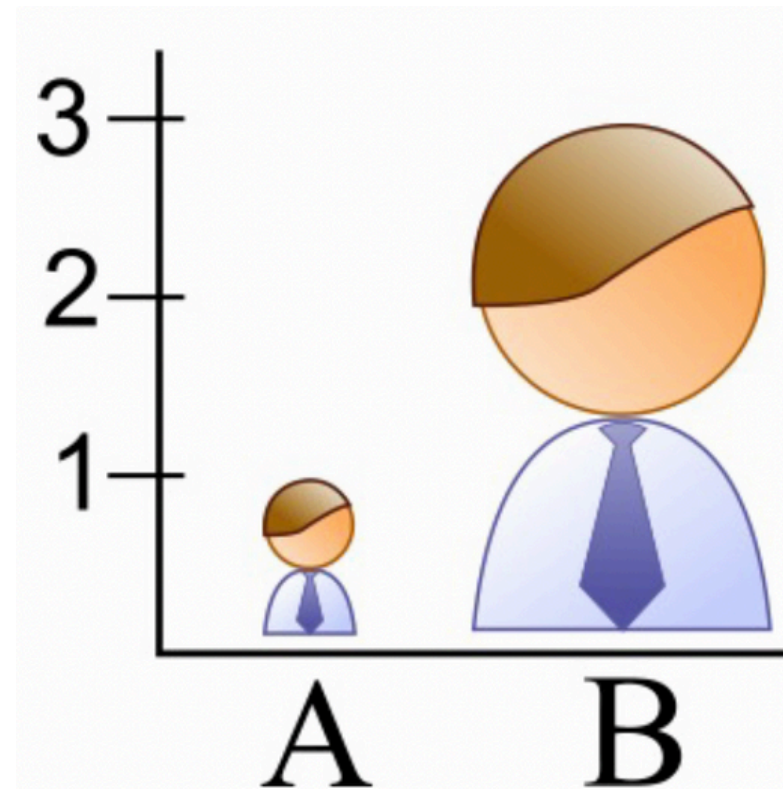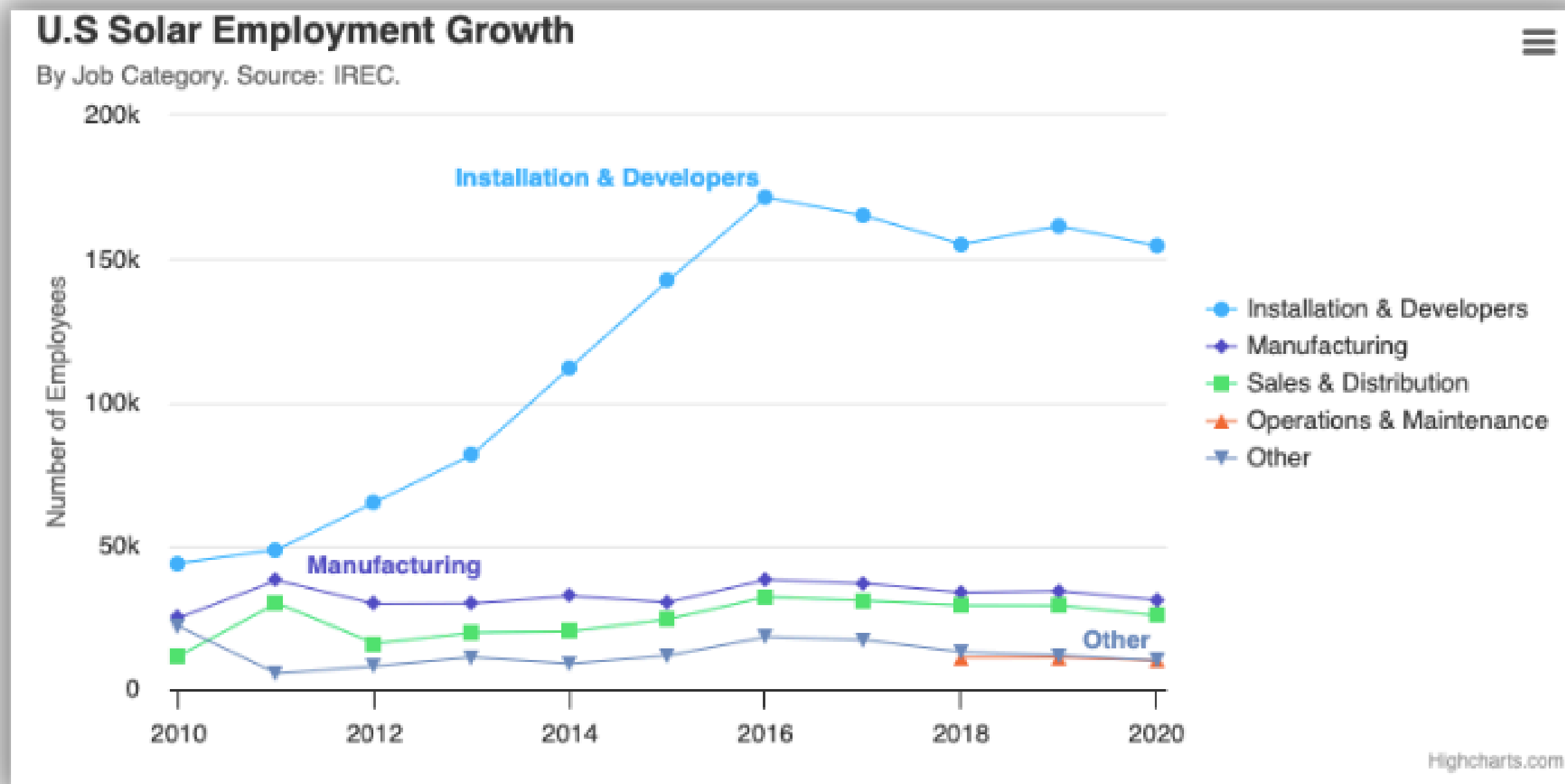
source

Grouped bar chart

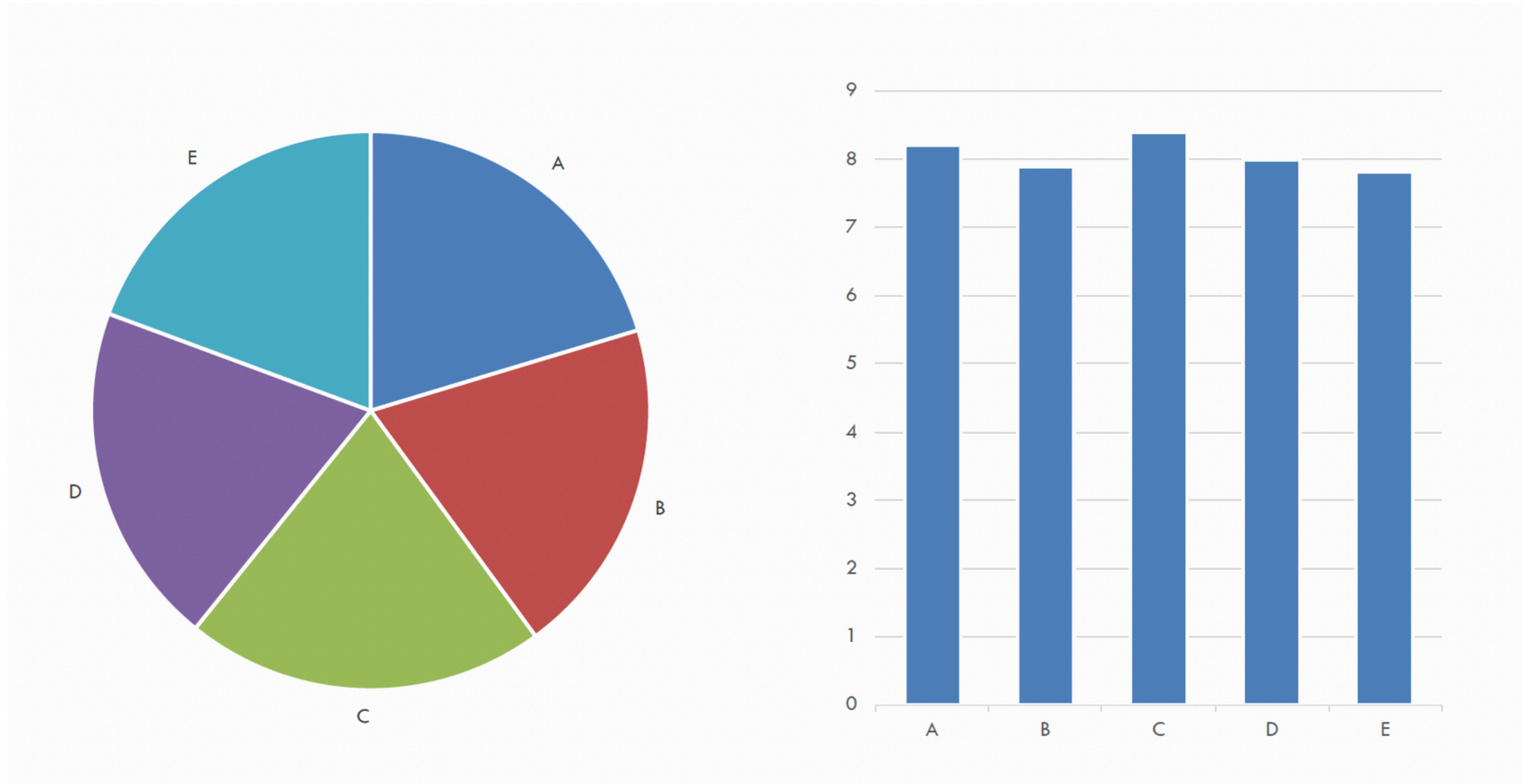Stacked bar chart

Source

DISTORTION
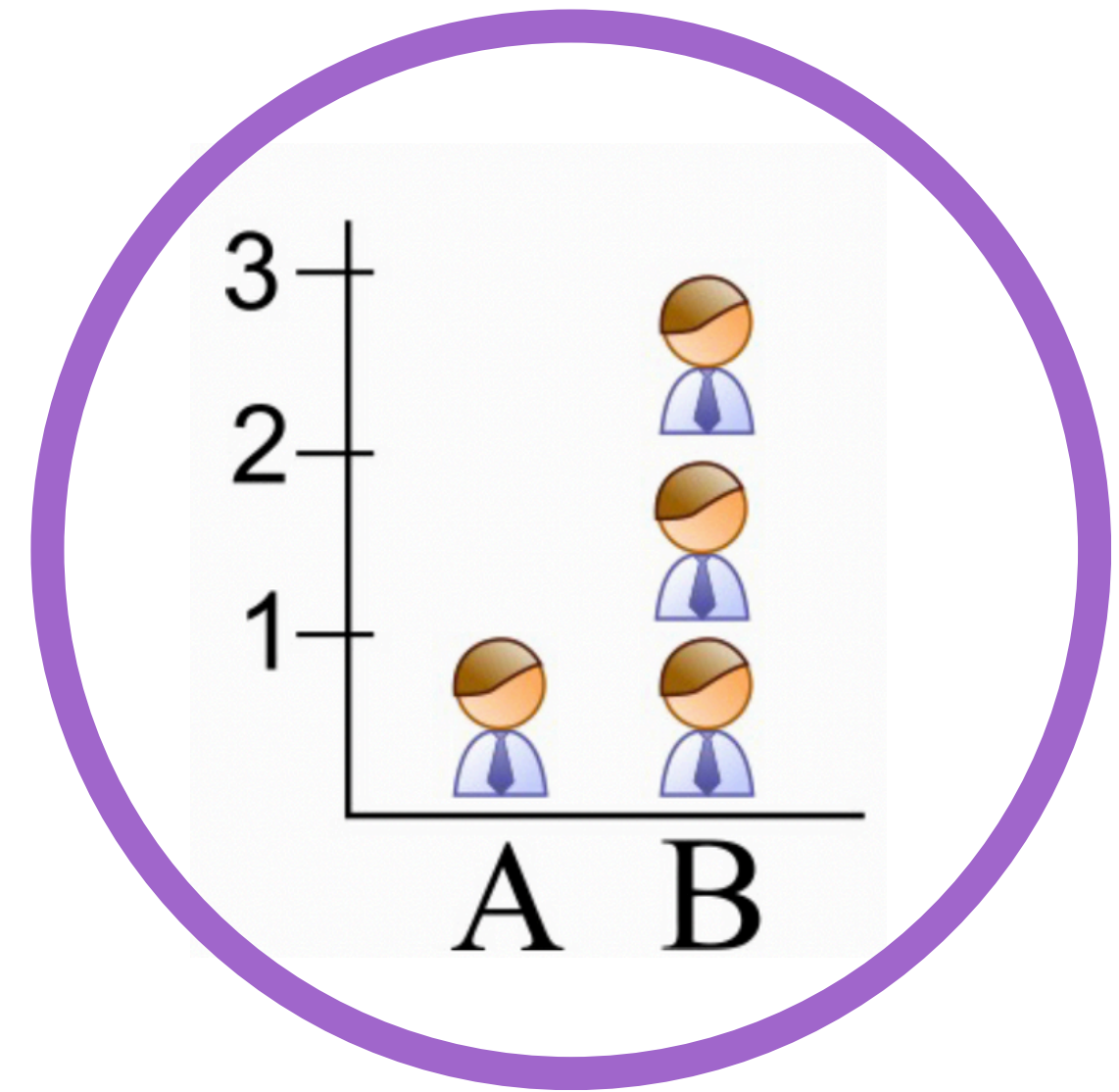
USE THE RIGHT VISUALIZATION
LINE CHARTS

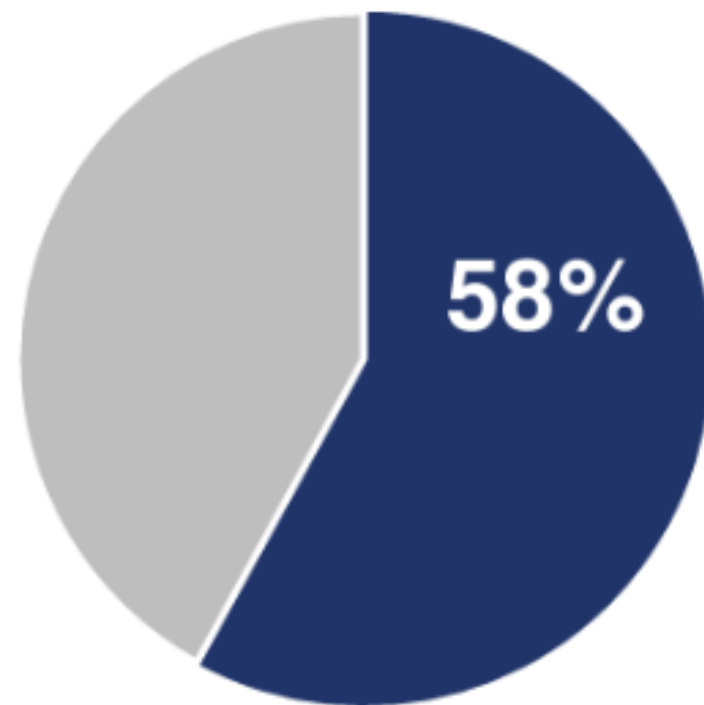# USE THE RIGHT VISUALIZATION

PIE CHARTS

USE THE RIGHT VISUALIZATION
PIE CHARTS

Federal law requires schools to have a transition plan for every special education student exiting high school.
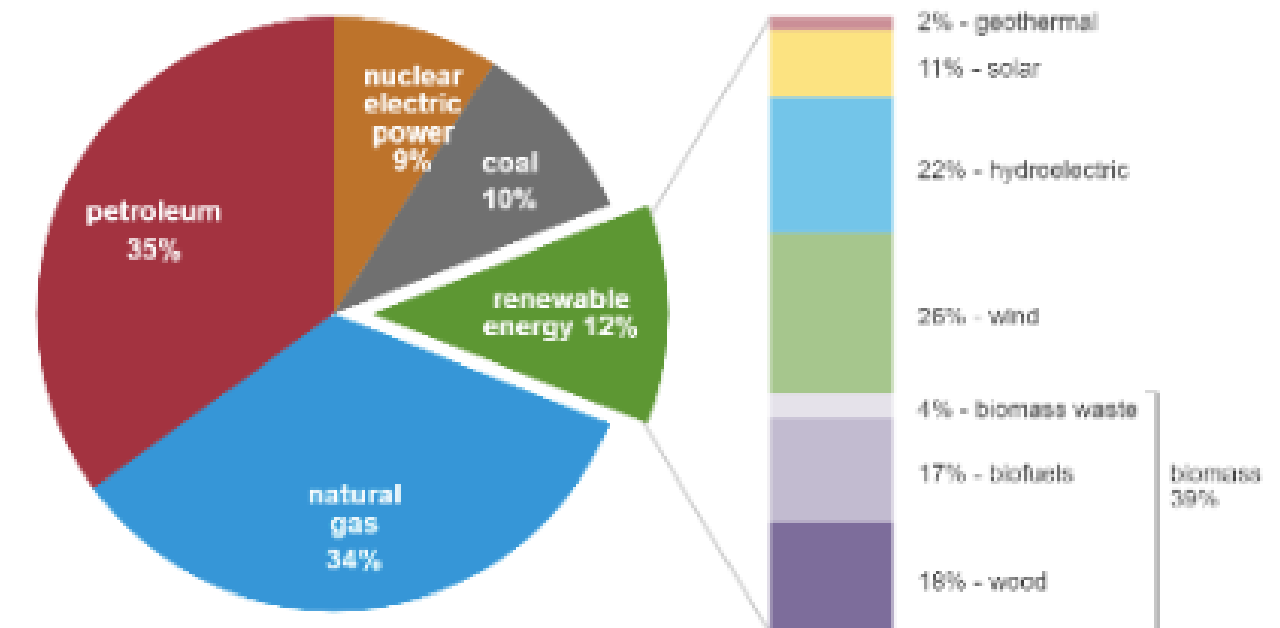
58% of youth with autism had a transition plan by the required age according to their teachers.

U.S. primary energy consumption by energy source, 2020

total = 92.94 quadrillion British thermal units (Btu)

total = 11.59 quadrillion Btu

petroleum 35%

nuclear electric power 9%

coal 10%

natural gas 34%

renewable energy 12%

2% - geothermal
11% - solar
22% - hydroelectric
26% - wind
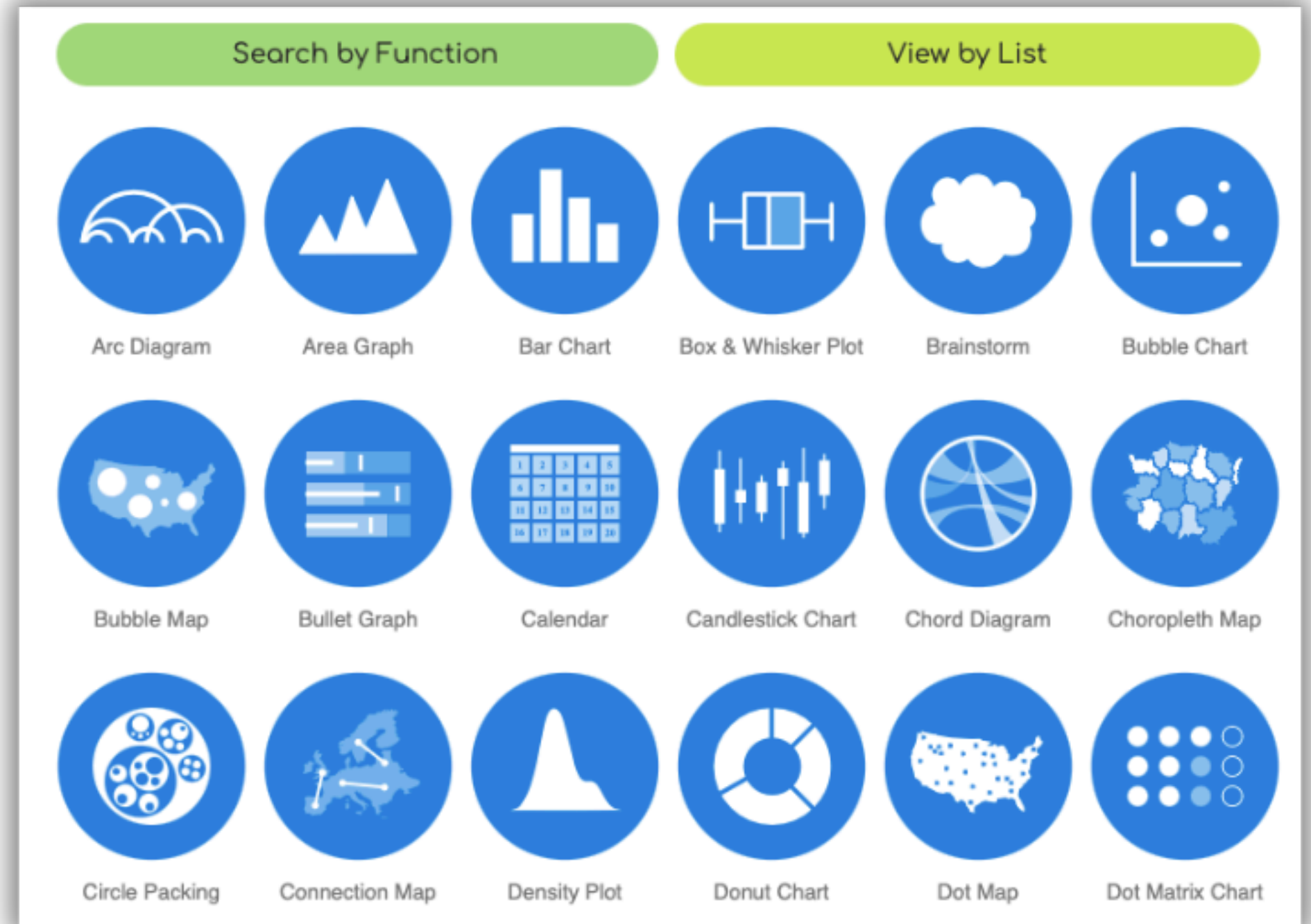4% - biomass waste
17% - biofuels
18% - wood
biomass 39%

Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2021, preliminary data
Note: Sum of components may not equal 100% because of independent rounding.

cia

Source

Source

USE THE RIGHT VISUALIZATION
OTHER CHARTS
Data Viz Catalogue

USE THE RIGHT VISUALIZATION

TABLES

1. Offset the header from the body
2. Use subtle dividers
3. Right-align numbers and column headers
4. Left align text values
5. Choose the appropriate level of precision
6. Guide the reader with spacing
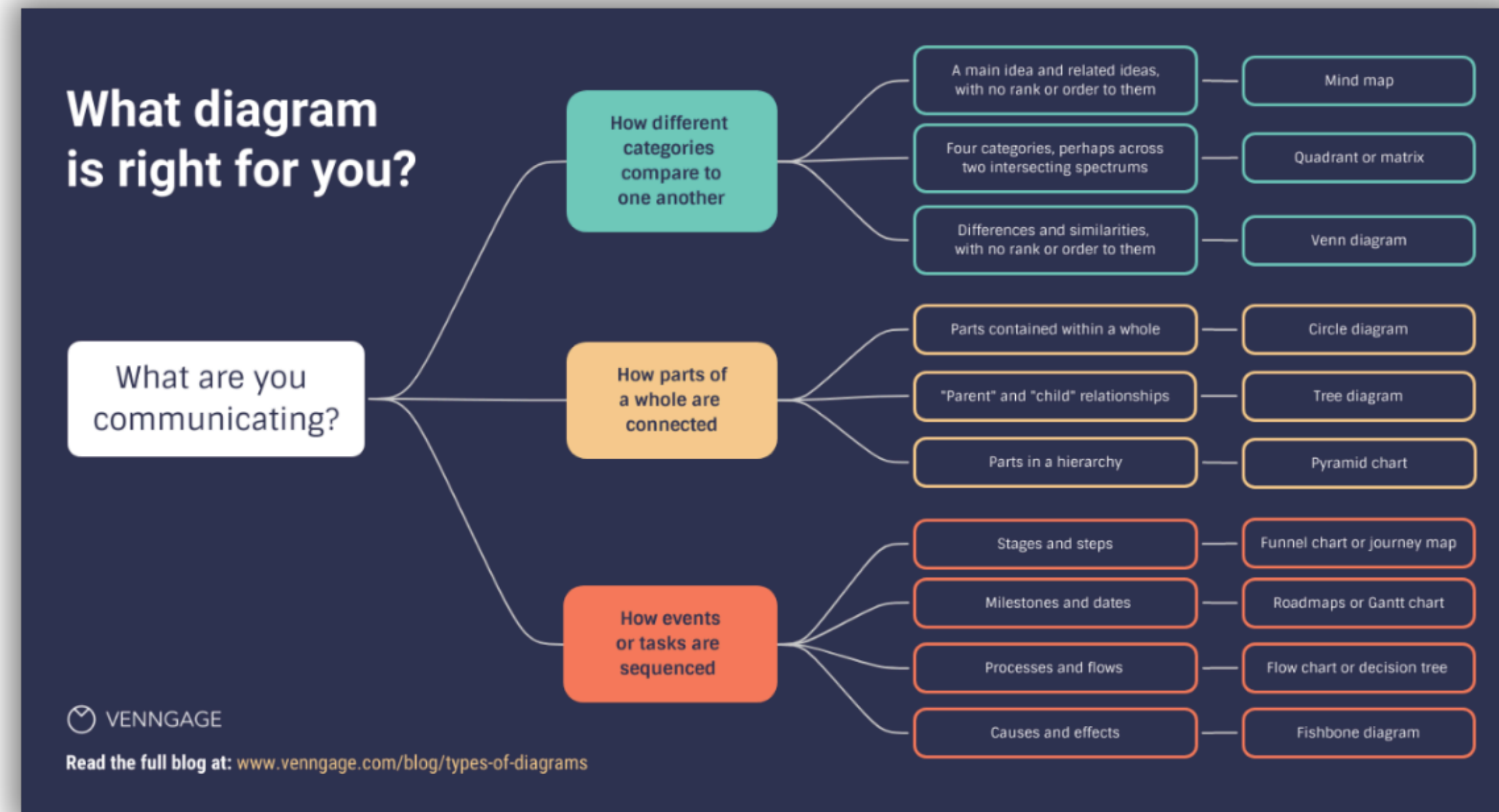7. Highlight outliers or important data
8. Introduce visualization

Number of People Participating in Food Distribution Programs on Indian Reservations
(Data as of March 9, 2018)

State	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Percent Change FY 2013-FY 2017
Alaska	204	347	479	650	724	254.9 ▲
Arizona	10,835	11,556	11,880	11,887	11,235	3.7 ▲
California	5,593	5,495	5,159	4,795	4,463	-20.2 ▼
Colorado	419	454	402	442	353	-15.8 ▼
Idaho	1,440	1,566	1,688	1,706	1,530	6.3 ▲
Kansas	416	551	569	592	613	47.4 ▲
Michigan	1,299	1,846	1,971	2,061	1,960	50.9 ▲
Minnesota	2,297	2,756	2,645	2,600	2,487	8.3 ▲
Mississippi	701	863	958	1,056	1,169	66.8 ▲
Montana	2,375	3,144	3,149	3,313	3,271	37.7 ▲
Nebraska	1,010	1,229	1,339	1,396	1,267	25.4 ▲
Nevada	1,373	1,611	1,508	1,468	1,328	-3.3 ▼
New Mexico	2,533	2,853	2,966	2,890	2,809	10.9 ▲
New York	380	384	369	452	350	-7.9 ▼
North Carolina	584	736	743	700	671	14.9 ▲
North Dakota	3,840	4,800	4,976	5,661	5,569	45.0 ▲
Oklahoma	25,678	29,012	31,042	33,588	32,795	27.7 ▲
Oregon	678	871	800	785	687	1.3 ▲
South Dakota	7,457	8,123	8,208	8,505	8,525	14.3 ▲
Texas	117	131	142	124	114	-2.6 ▼
Utah	117	167	217	421	384	228.2 ▲
Washington	3,164	3,185	3,284	3,410	3,221	1.8 ▲
Wisconsin	2,441	2,978	3,240	3,442	3,367	37.9 ▲
Wyoming	657	742	881	1,096	1,190	81.1 ▲
Total	75,608	85,397	88,615	93,038	90,083	19.1

Note: FDPIR is an alternative to the Supplemental Nutrition Assistance Program for Indian tribal organizations which prefer food distribution. Participation numbers are 12-month average. Data are subject to revision.

r icons denoting change—are other ways to add

USE THE RIGHT VISUALIZATION
DIAGRAMS
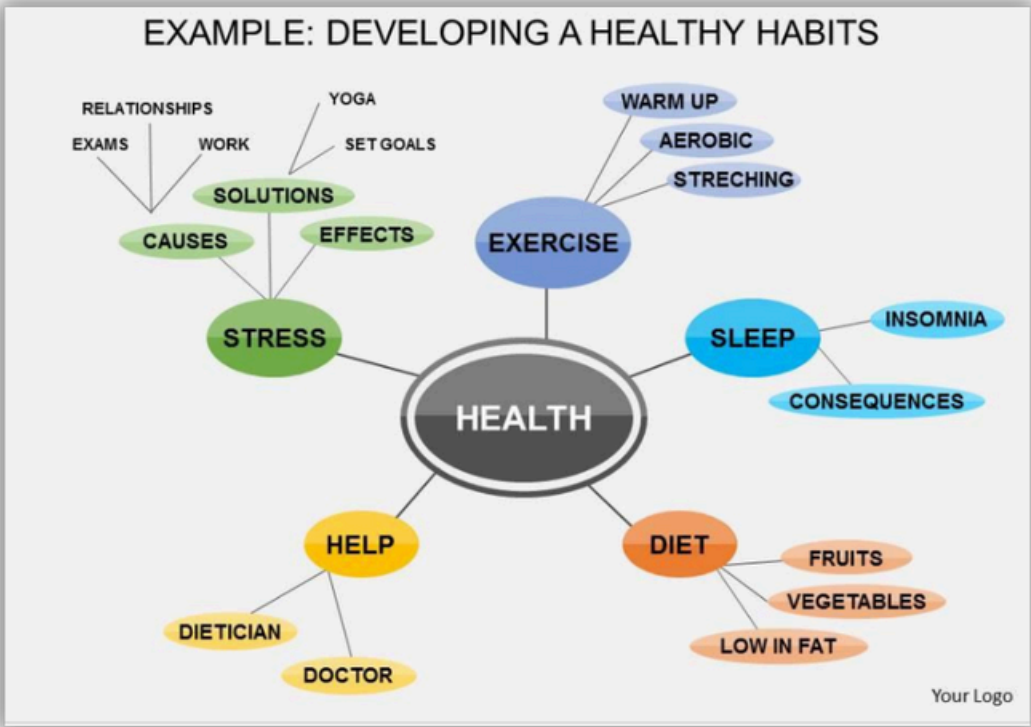### Venngage

What diagram is right for you?

What are you communicating?

How different categories compare to one another
- A main idea and related ideas, with no rank or order to them → Mind map
- Four categories, perhaps across two intersecting spectrums → Quadrant or matrix
- Differences and similarities, with no rank or order to them → Venn diagram

How parts of a whole are connected
- Parts contained within a whole → Circle diagram
- "Parent" and "child" relationships → Tree diagram
- Parts in a hierarchy → Pyramid chart

How events or tasks are sequenced
- Stages and steps → Funnel chart or journey map
- Milestones and dates → Roadmaps or Gantt chart
- Processes and flows → Flow chart or decision tree
- Causes and effects → Fishbone diagram

VENNGAGE

Read the full blog at: www.venngage.com/blog/types-of-diagrams

USE THE RIGHT VISUALIZATION
DIAGRAMS

How different categories compare to one another

Mind Map

Venn diagram

Matrix

USE THE RIGHT VISUALIZATION
DIAGRAMS
How different parts of a whole are connected

Circle Diagram
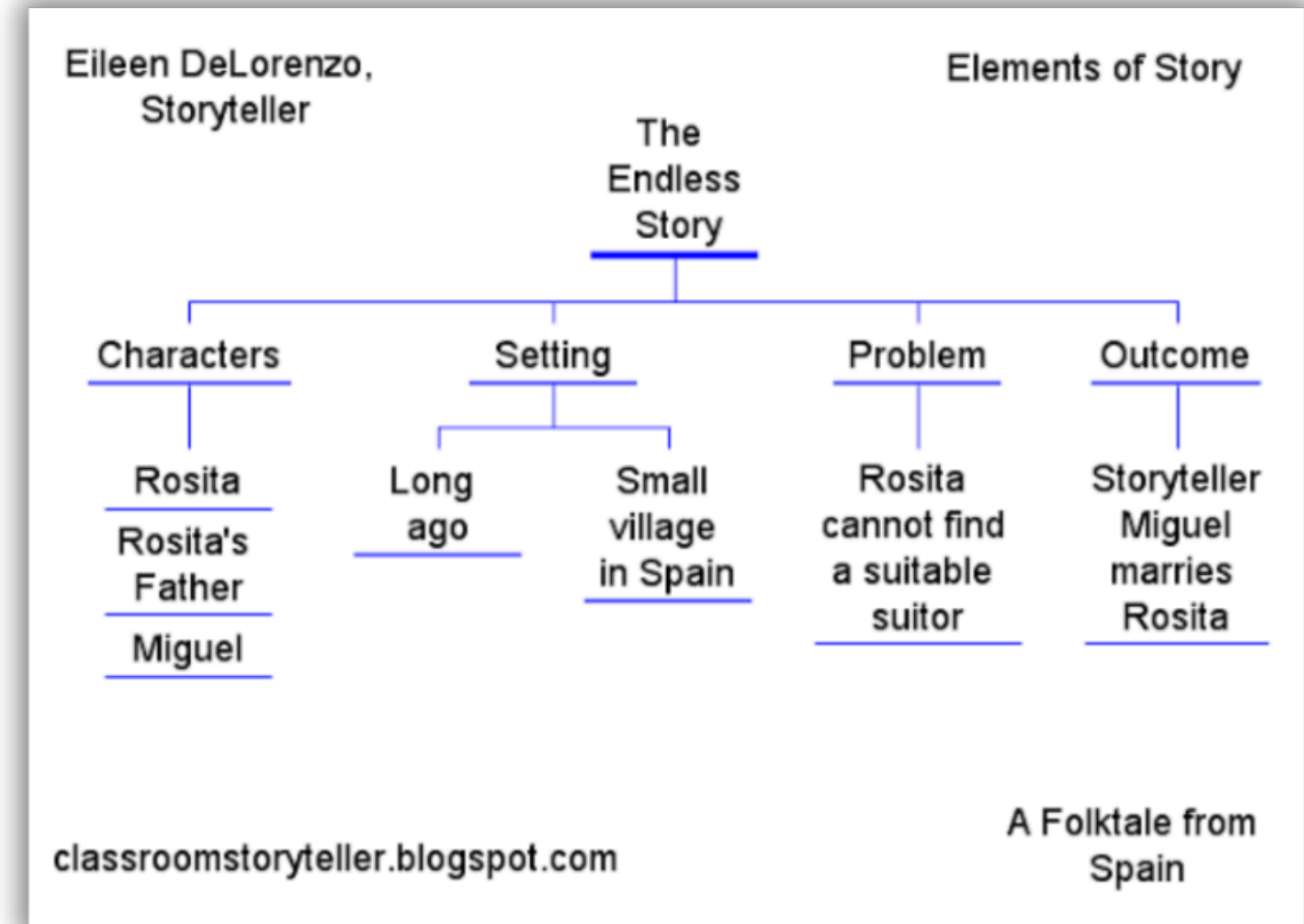
Tree Map

USE THE RIGHT VISUALIZATION
DIAGRAMS

How events or tasks are sequenced in a process
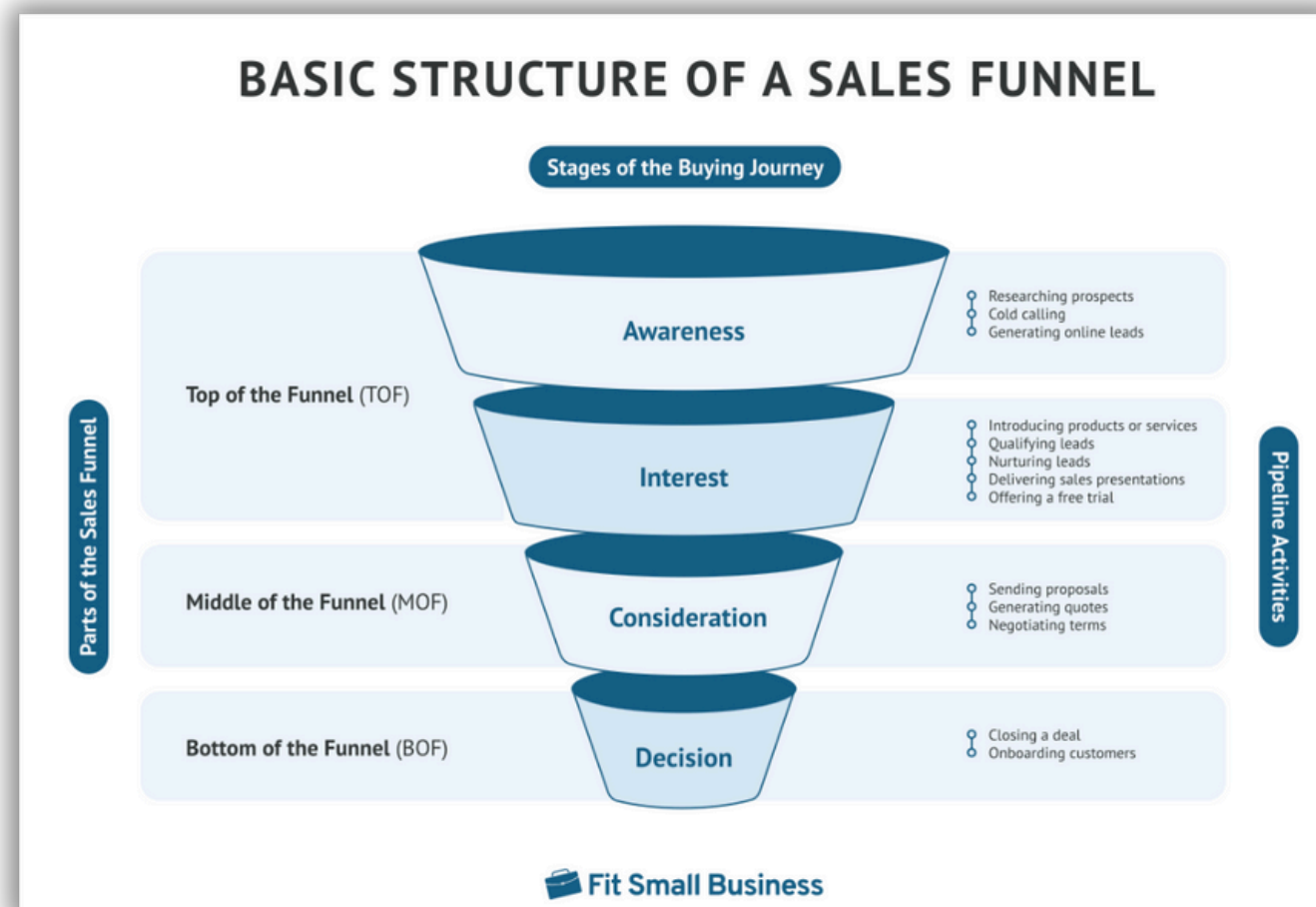
Funnel chart
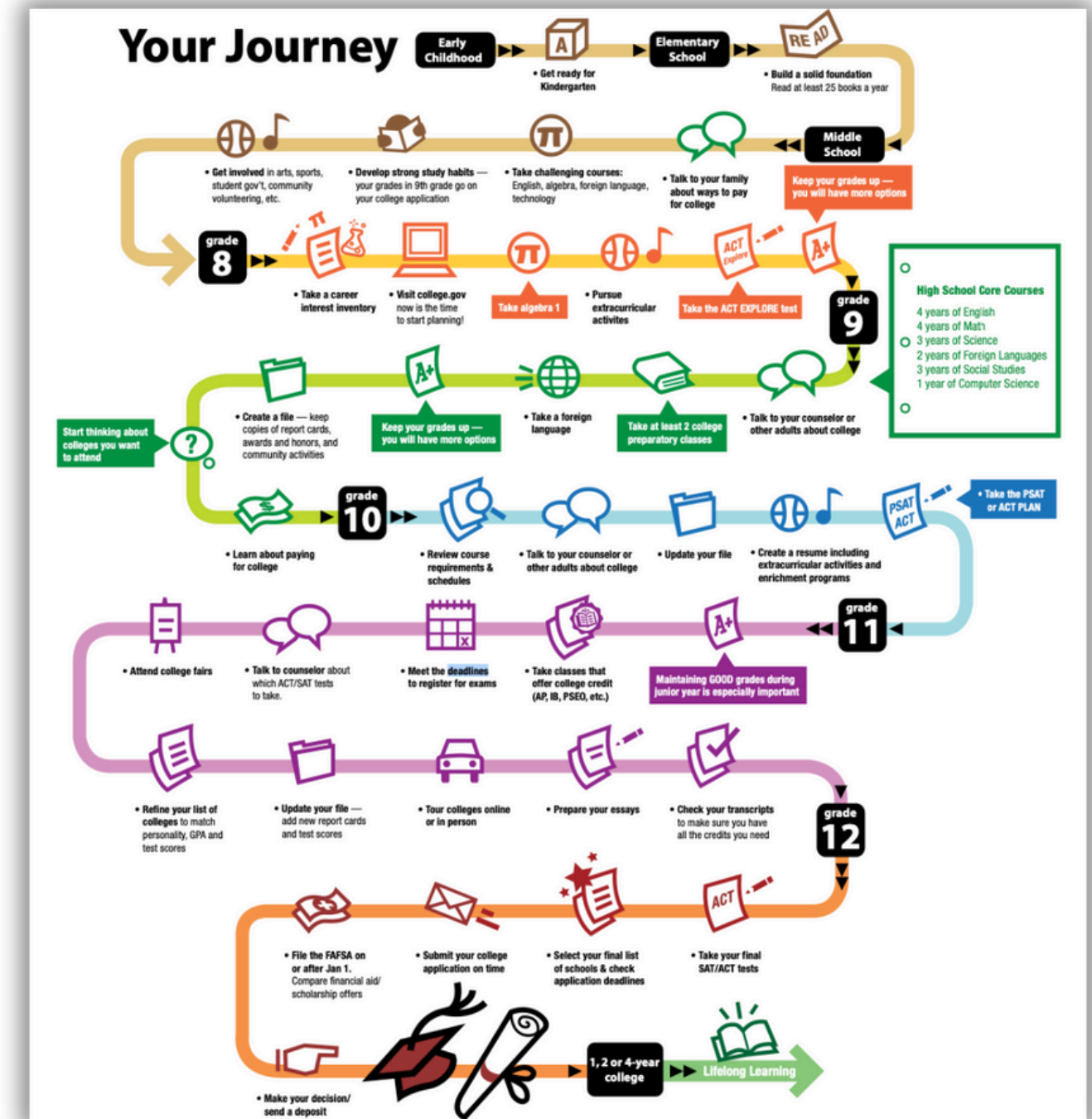
Journey Map

USE THE RIGHT VISUALIZATION
MAPS
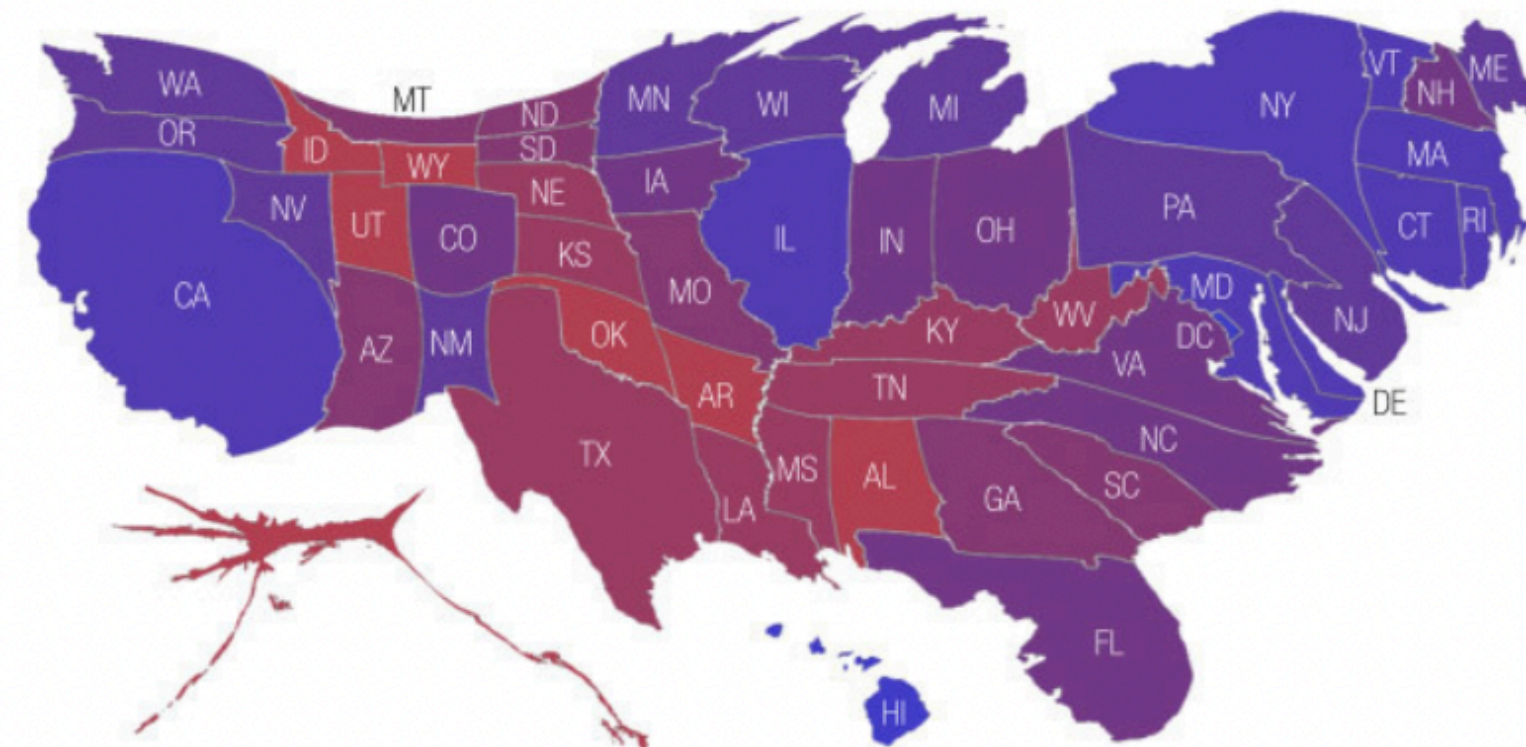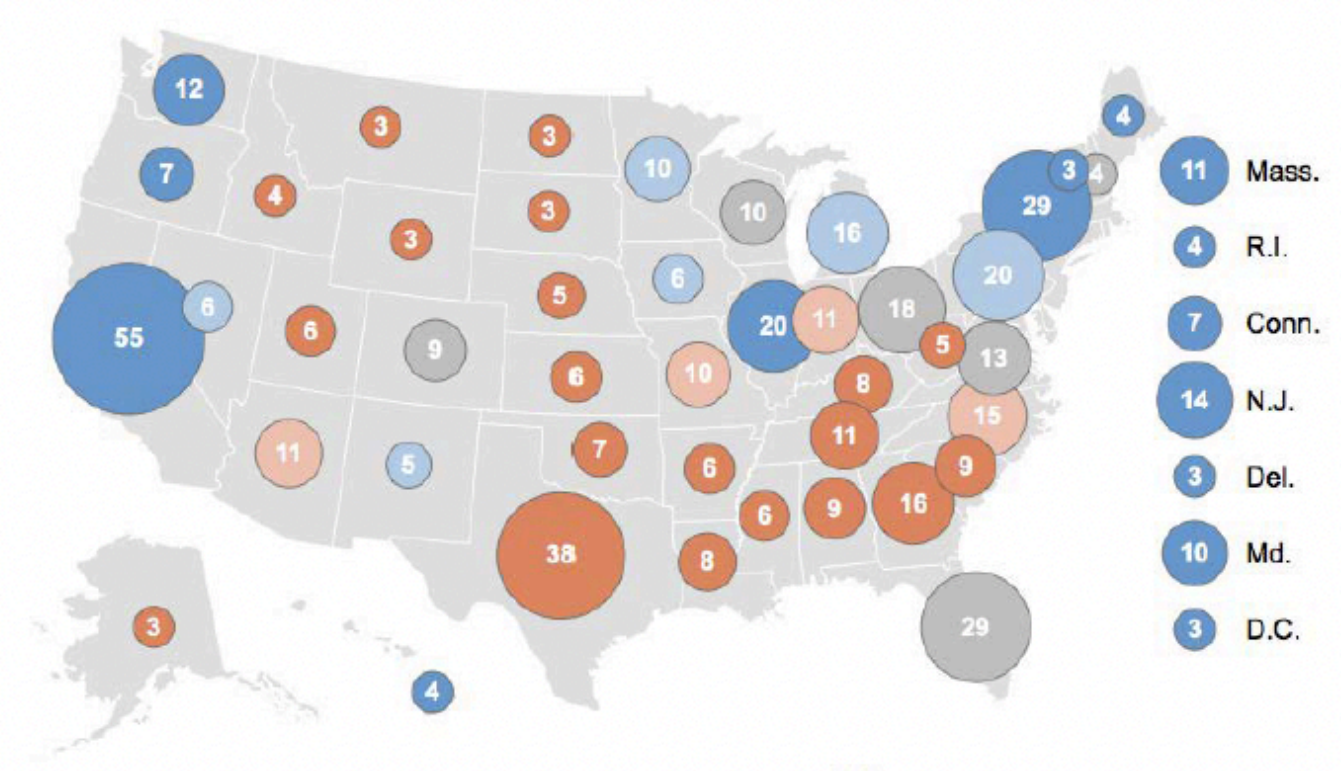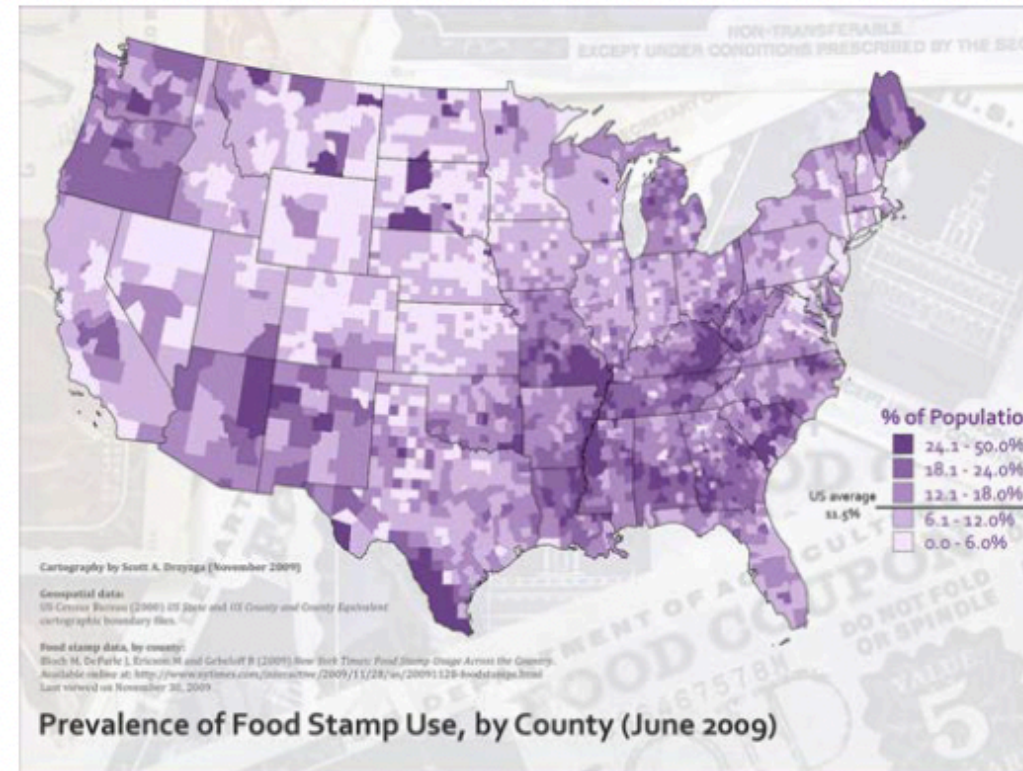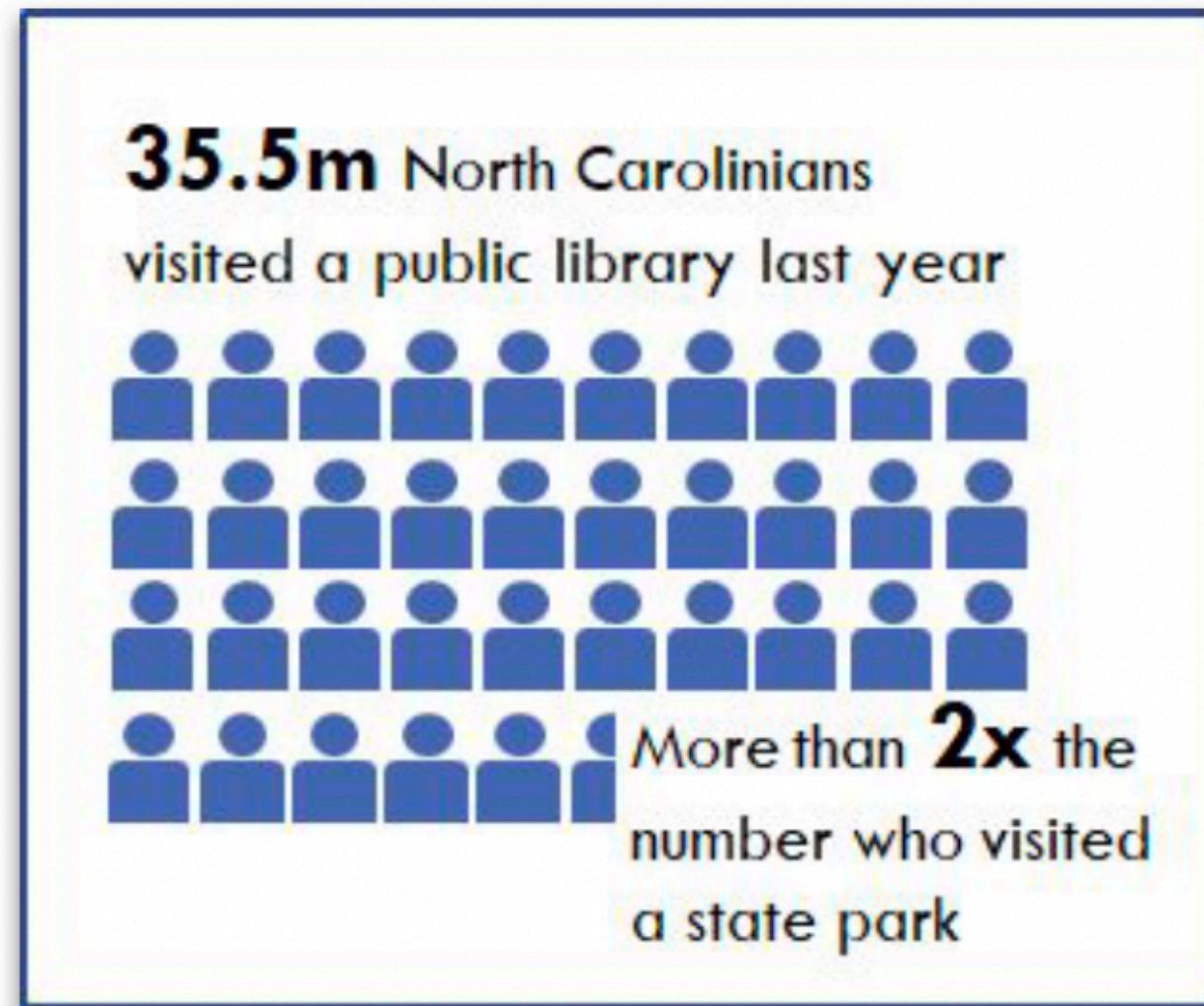
Prevalence of Food Stamp Use, by County (June 2009)

2. GIVE CONTEXT TO NUMBERS & SHOW THE DATA

35.5m North Carolinians visited a public library last year

More than **2x** the number who visited a state park

123M items circulated annually

or more than **22** Items for each person In the state

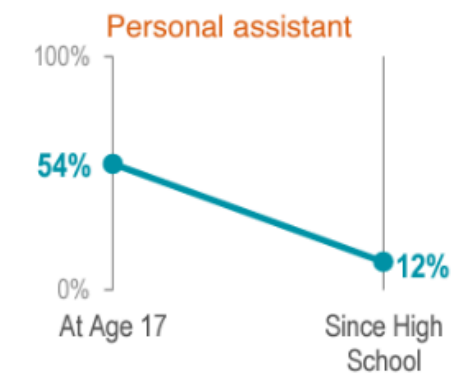# 2. GIVE CONTEXT TO NUMBERS & SHOW THE DATA
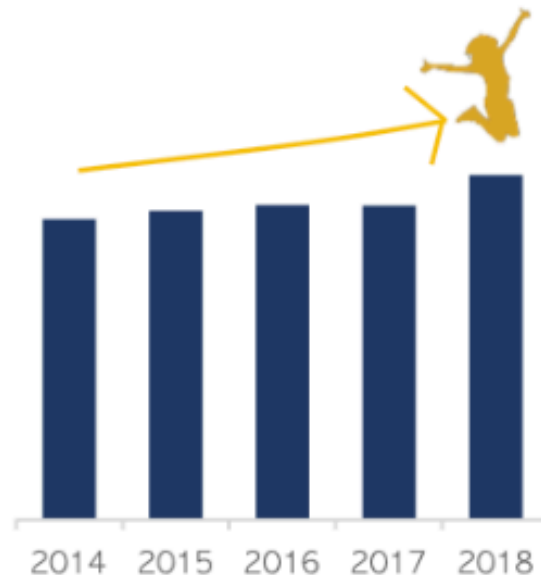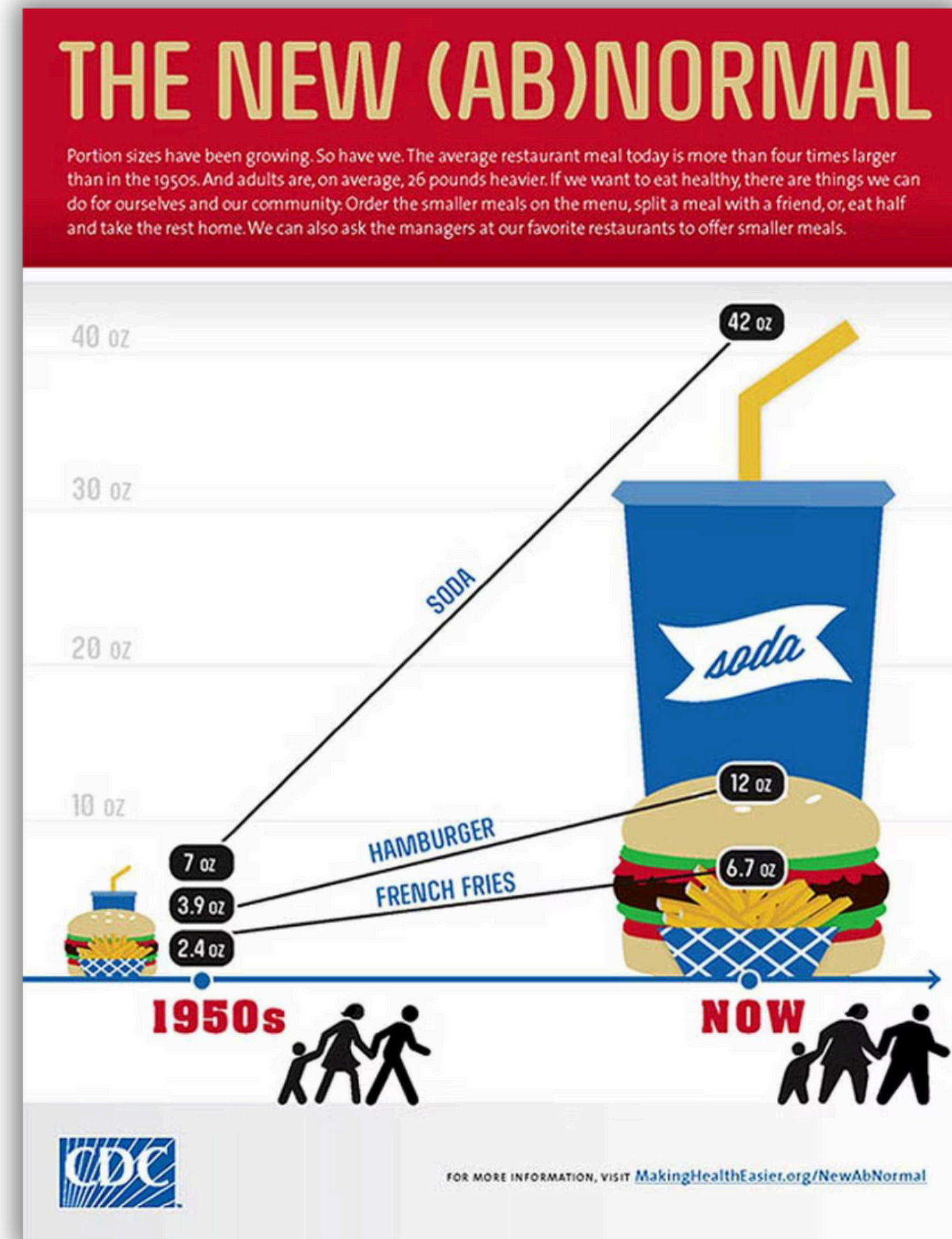
3. TELL A STORY
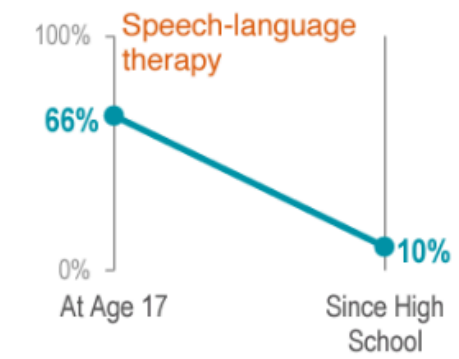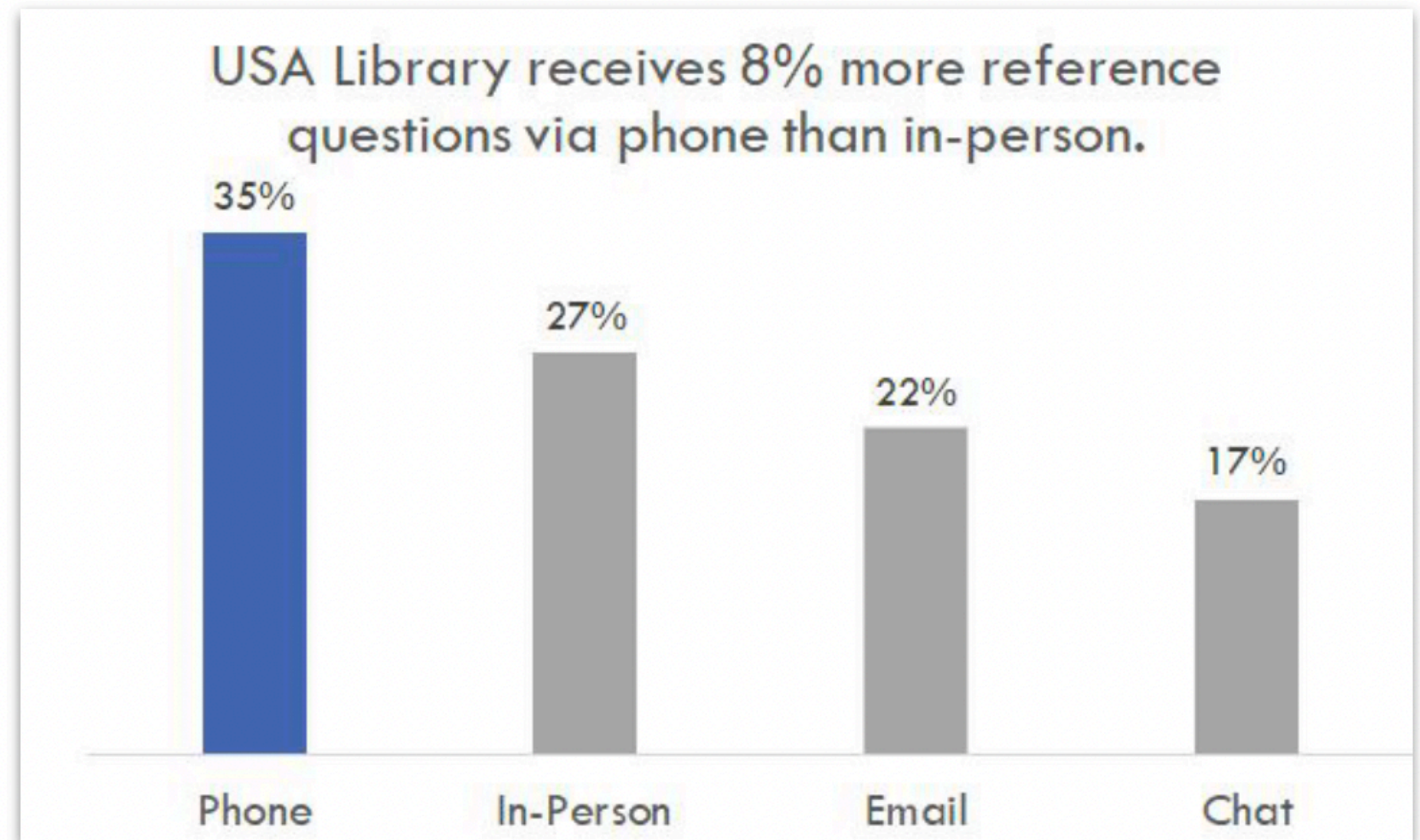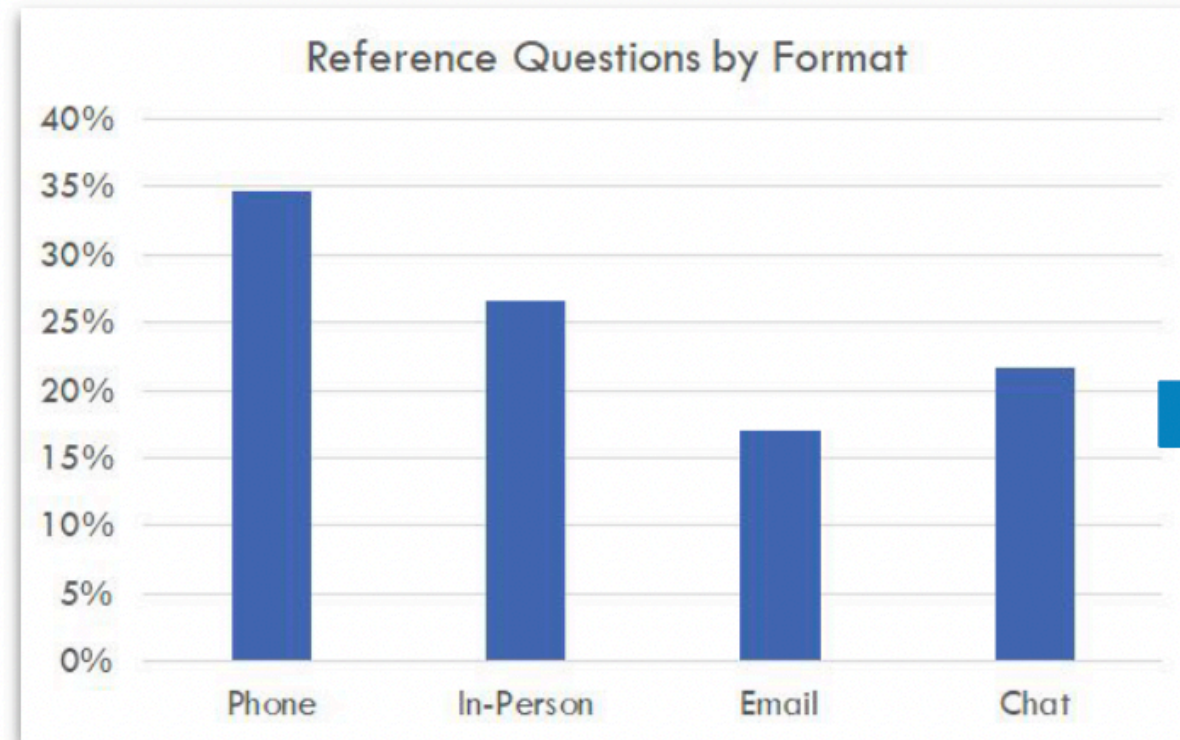
DISTORTION
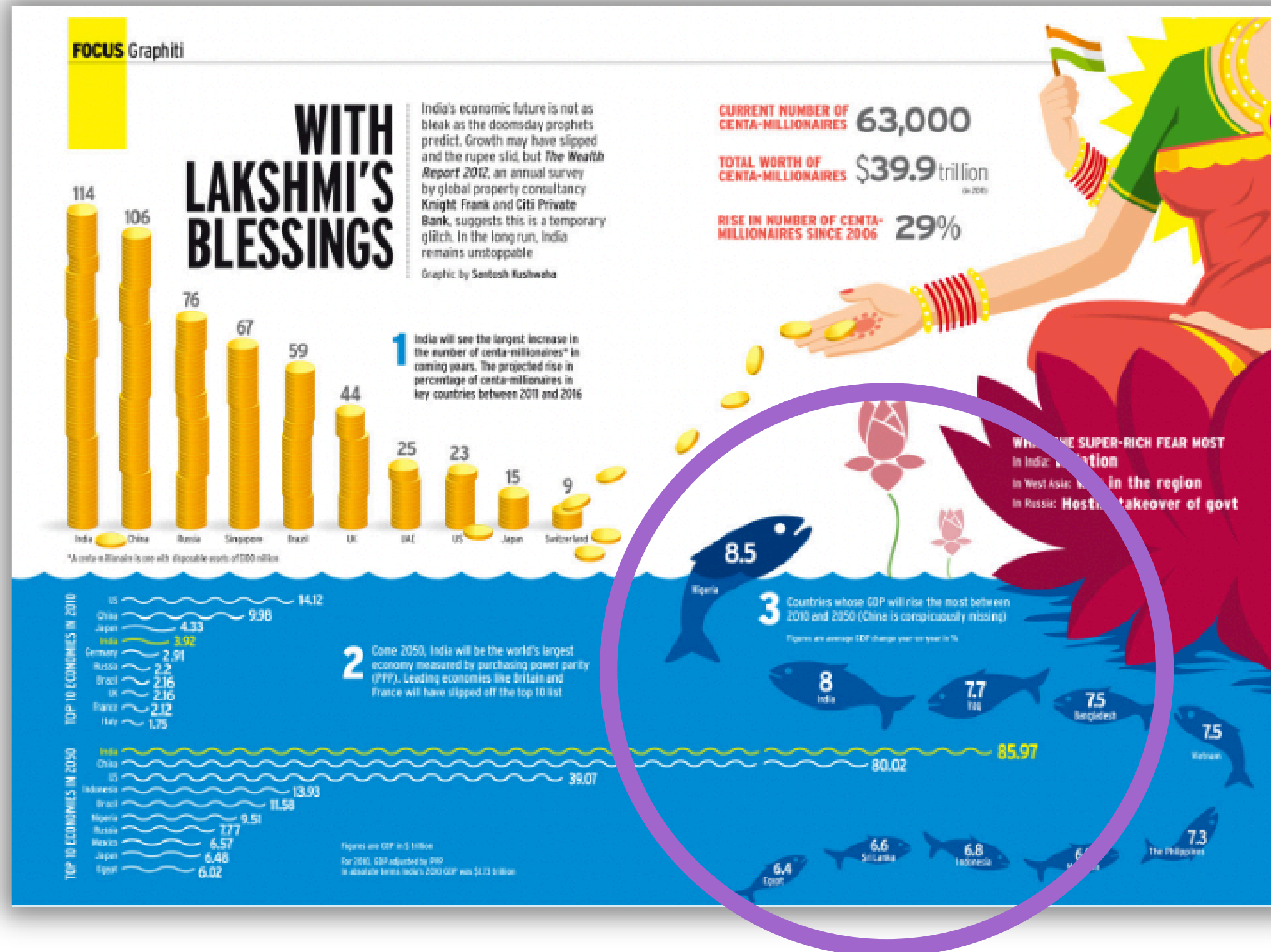
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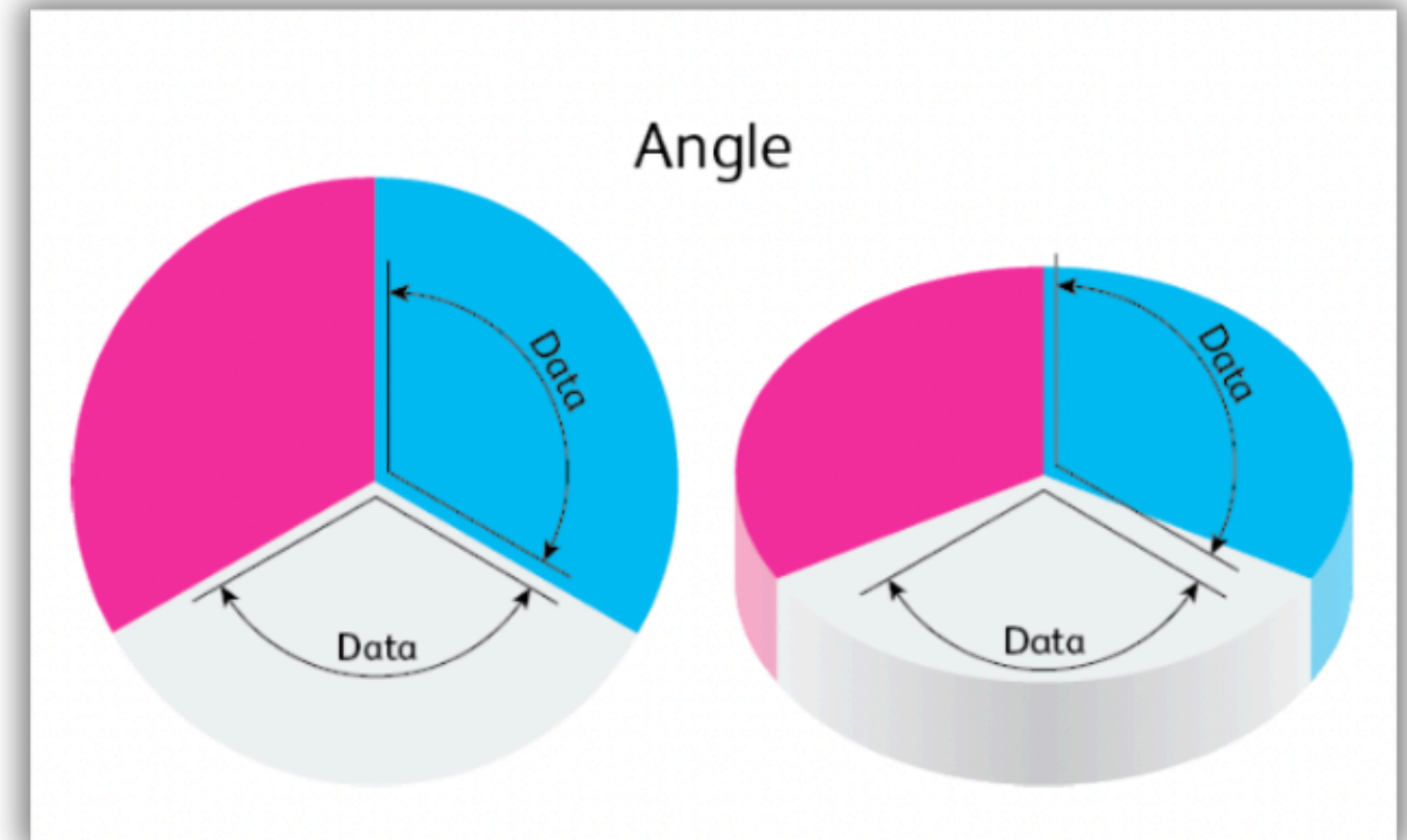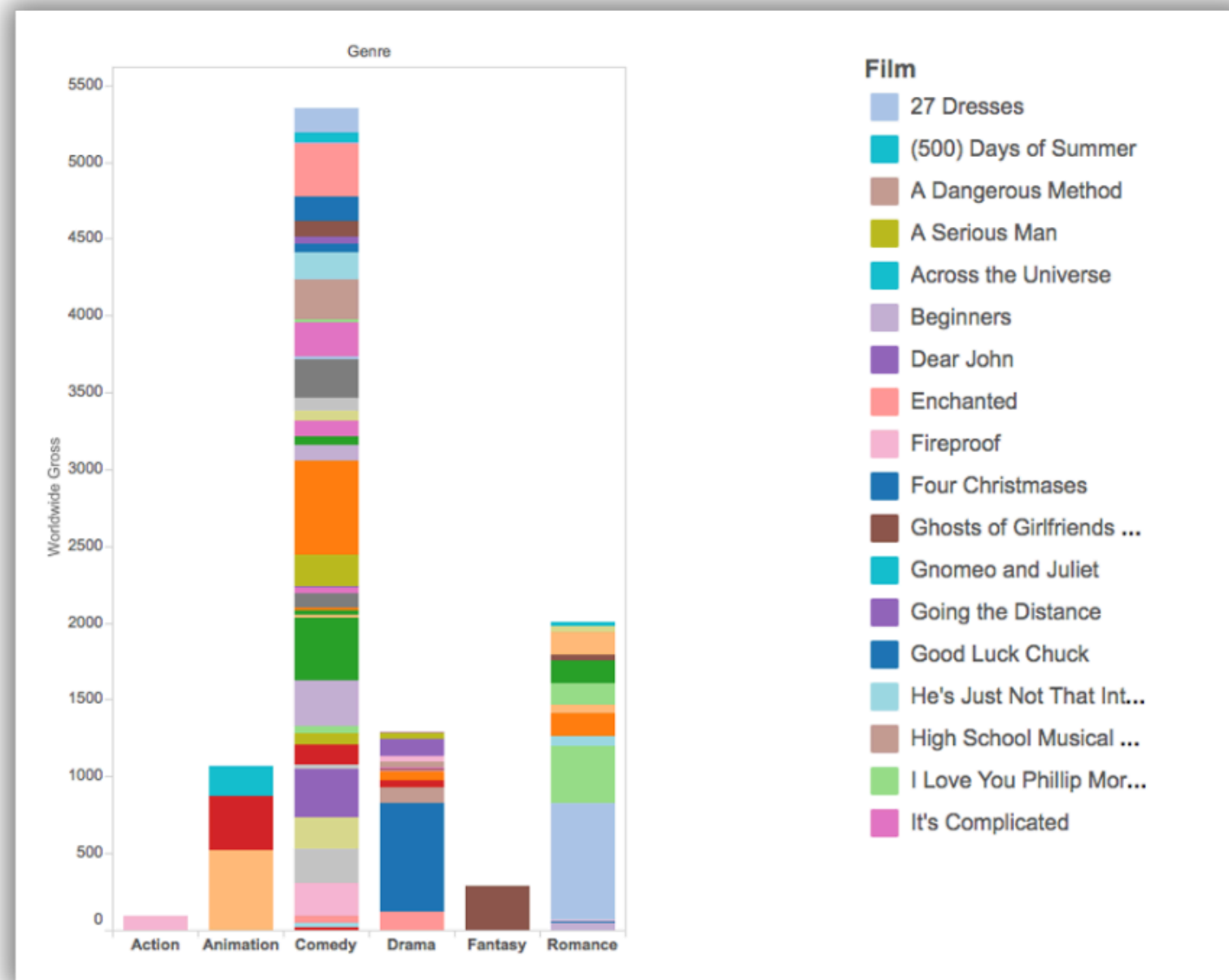

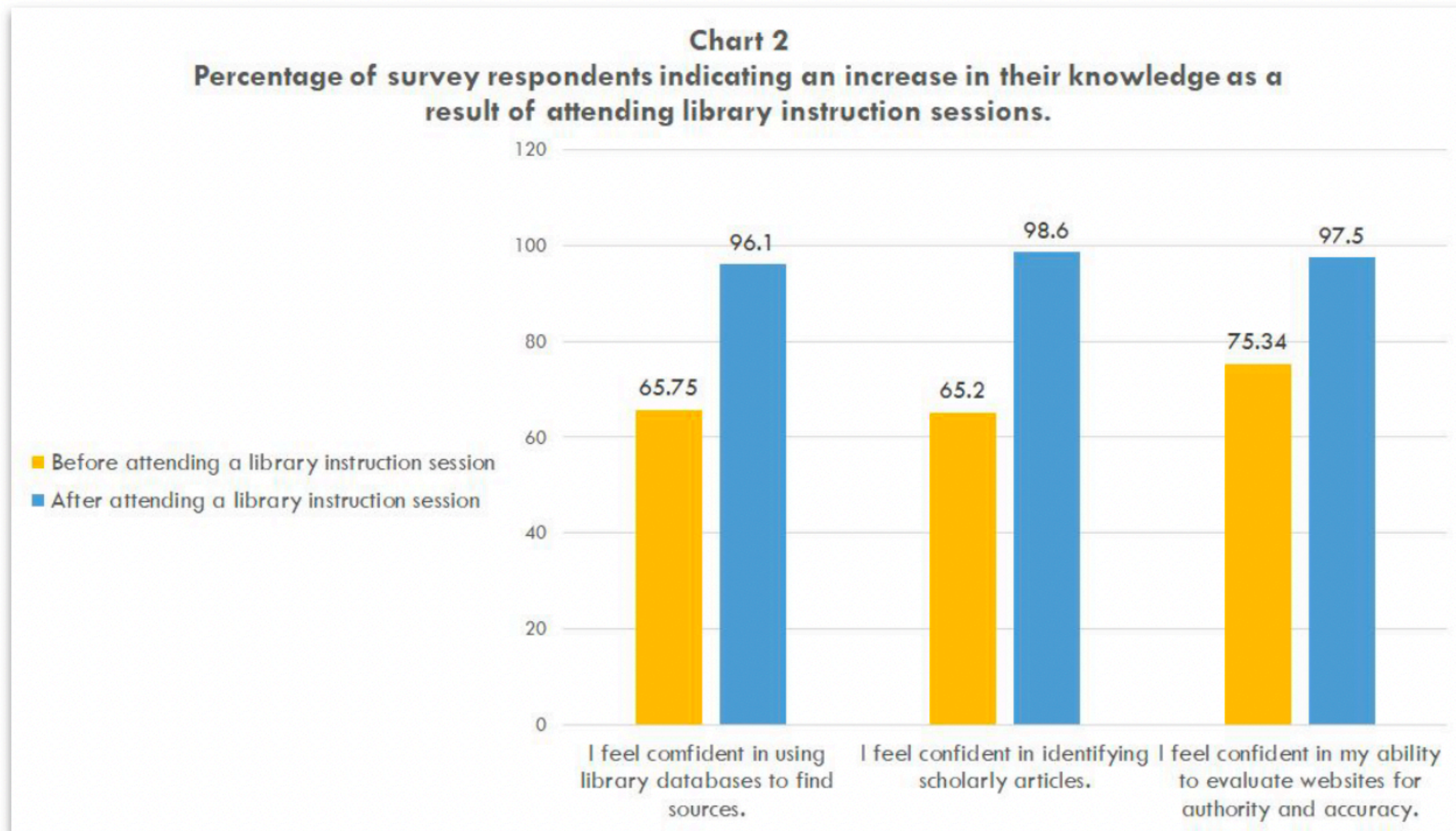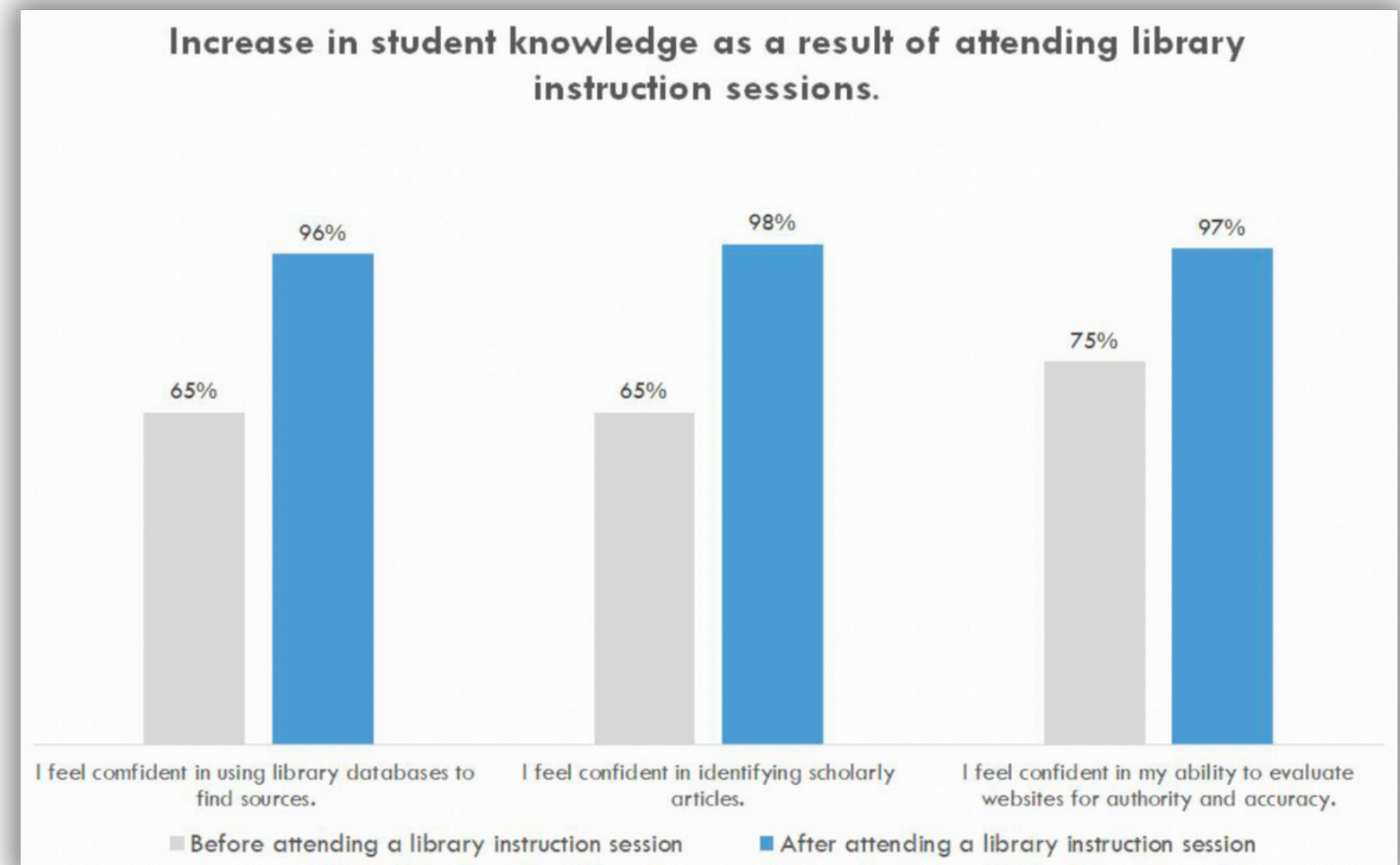Services consistently decreased following high school.

Speech-language therapy: At Age 17 66% → Since High School 10%

Personal assistant: At Age 17 54% → Since High School 12%

Social work: At Age 17 58% → Since High School 22%

Case management: At Age 17 67% → Since High School 42%

Transportation: At Age 17 50% → Since High School 30%

Occupational or life skills therapy: At Age 17 51% → Since High School 32%

Psychological or mental health: At Age 17 41% → Since High School 30%

Respite care: At Age 17 23% → Since High School 13%

Diagnostic medical services: At Age 17 37% → Since High School 28%

Assistive technology: At Age 17 15% → Since High School 6%

Physical therapy: At Age 17 14% → Since High School 7%

Source

3. TELL A STORY

4. KEEP IT SIMPLE FOR THE VIEWER

4. KEEP IT SIMPLE FOR THE VIEWER

Chart 2
Percentage of survey respondents indicating an increase in their knowledge as a result of attending library instruction sessions.

- Before attending a library instruction session
- After attending a library instruction session

	I feel comfident in using library databases to find sources.	I feel confident in identifying scholarly articles.	I feel confident in my ability to evaluate websites for authority and accuracy.
Before	65.75	65.2	75.34
After	96.1	98.6	97.5

4. KEEP IT SIMPLE FOR THE VIEWER

Practice 1
Chart Critique

- Work in teams
- Review each chart, what is it communicating?
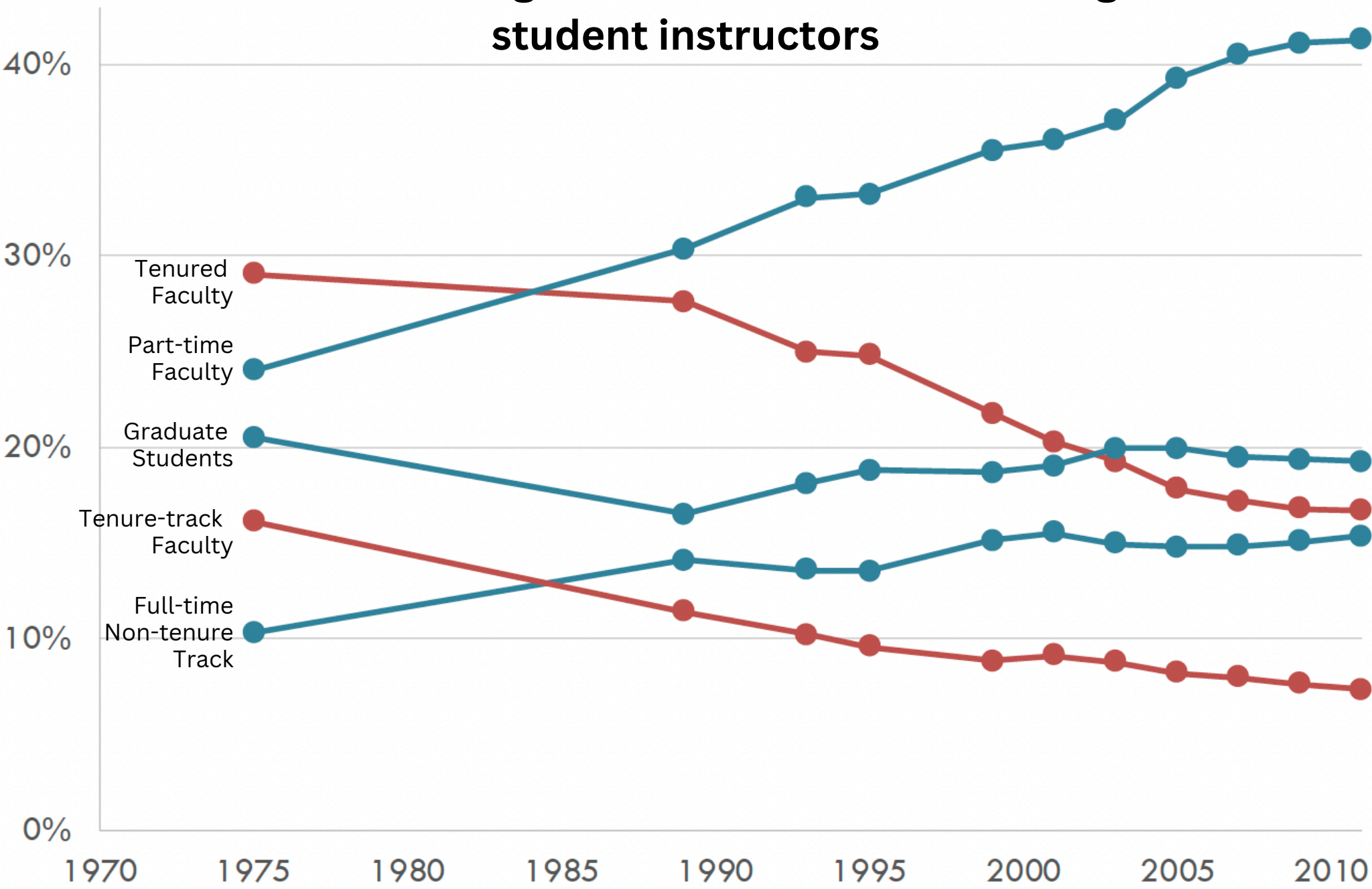- Discuss three changes that would improve the chart.
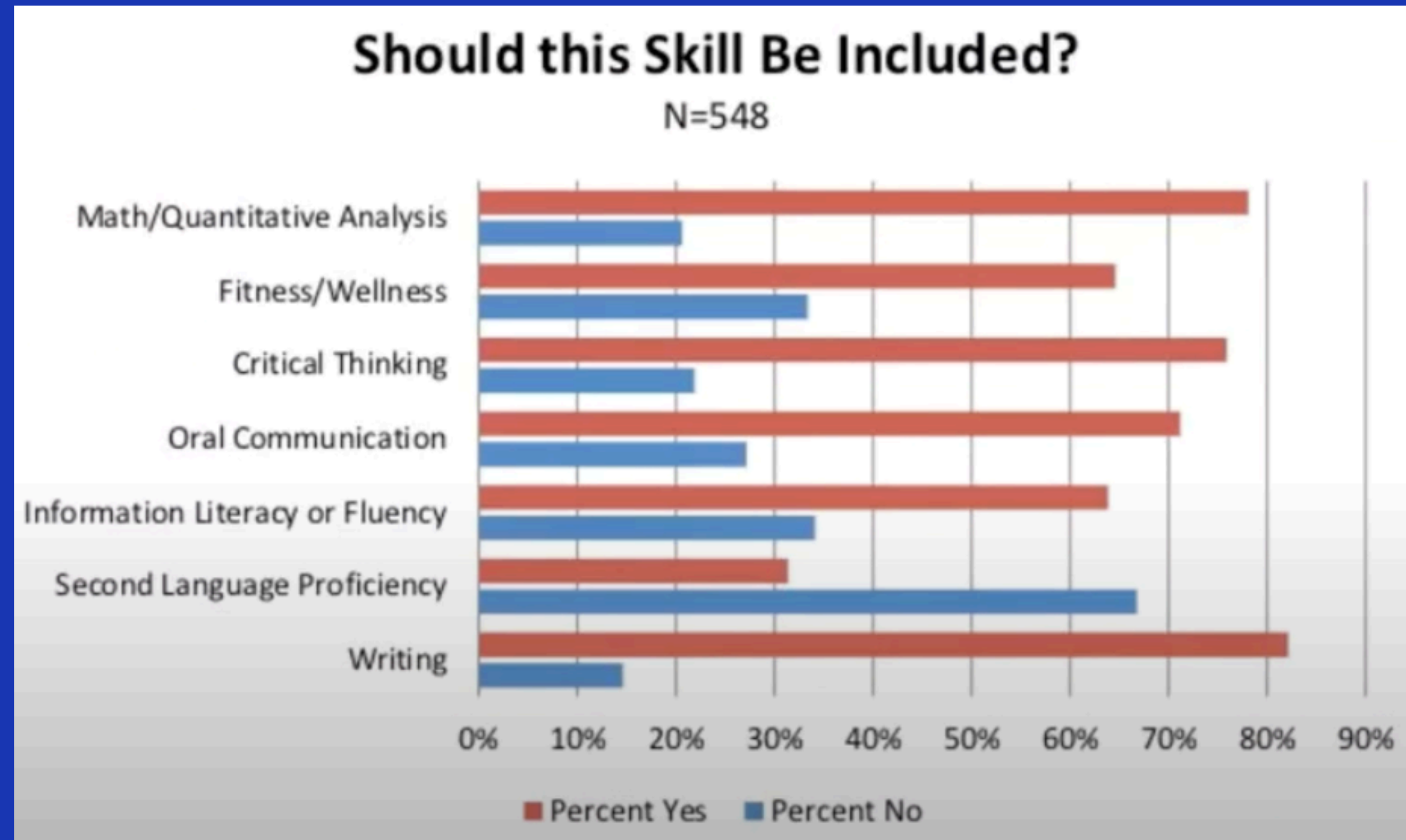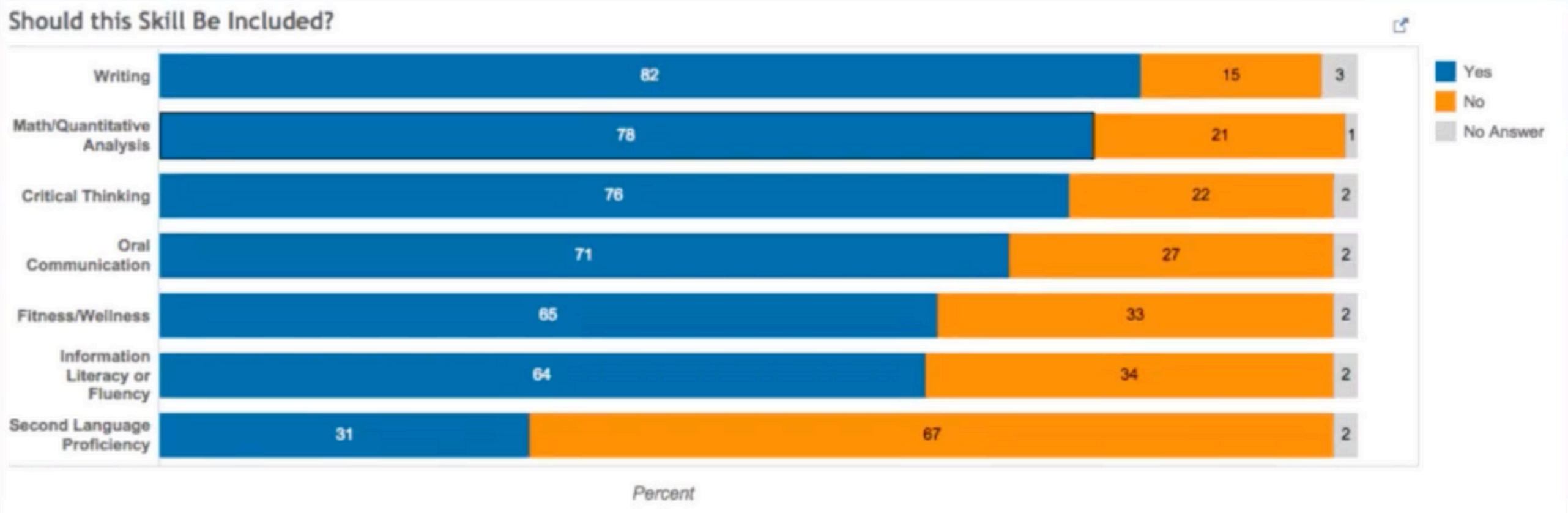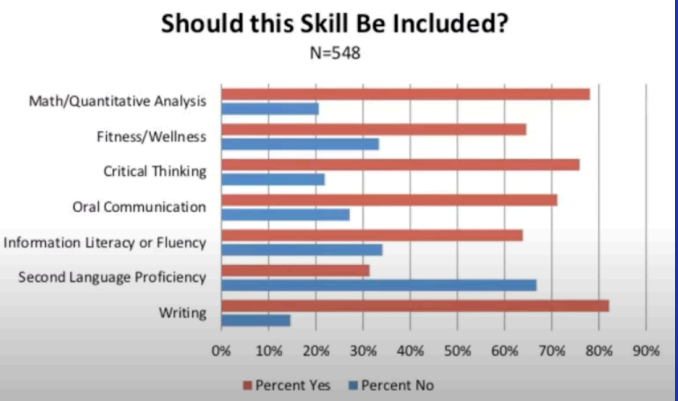
VISUALIZATION 1

Trends in Instructional Staff Employment Status, 1975-2011
All Institutions, National Totals
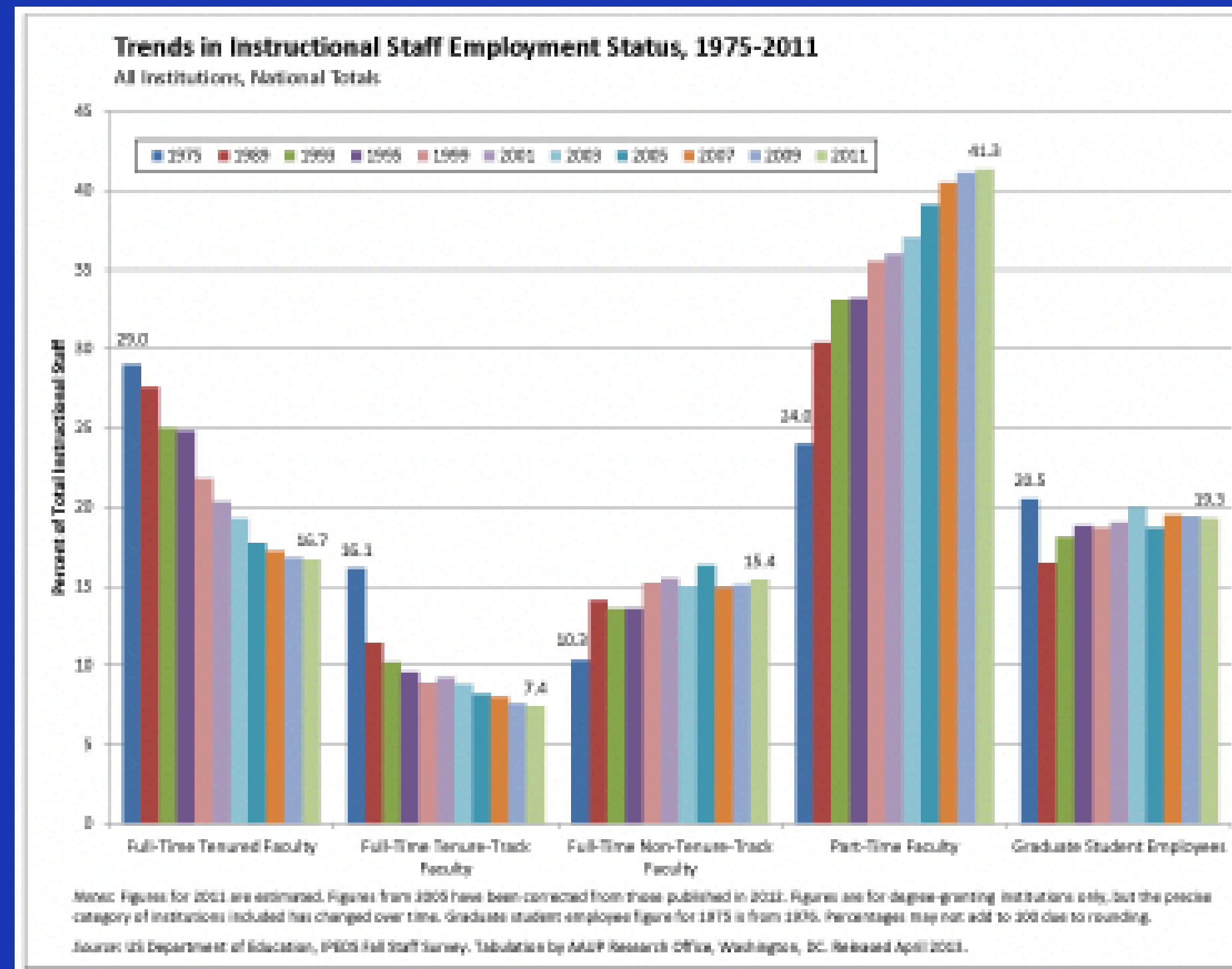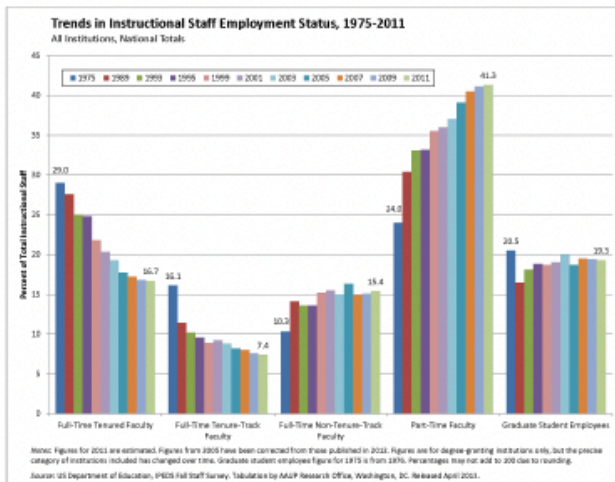
VISUALIZATION 1

Universities are hiring more non-tenure track and graduate student instructors

VISUALIZATION 2

Should this Skill Be Included?
N=548

Math/Quantitative Analysis
Fitness/Wellness
Critical Thinking
Oral Communication
Information Literacy or Fluency
Second Language Proficiency
Writing

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

■ Percent Yes ■ Percent No

VISUALIZATION 2

Should this Skill Be Included?
N=548

Skill	
Math/Quantitative Analysis	
Fitness/Wellness	
Critical Thinking	
Oral Communication	
Information Literacy or Fluency	
Second Language Proficiency	
Writing	

Percent Yes · Percent No

Should this Skill Be Included?

Skill	Yes	No	No Answer
Writing	82	15	3
Math/Quantitative Analysis	78	21	1
Critical Thinking	76	22	2
Oral Communication	71	27	2
Fitness/Wellness	65	33	2
Information Literacy or Fluency	64	34	2
Second Language Proficiency	31	67	2

Percent

VISUALIZATION 3

Trust rank	Index rank	Borough	Amount approved (£)	Number of grants
1	3	Tower Hamlets	£9,692,642	269
2	2	Hackney	£7,809,608	225
3	12	Southwark	£7,266,118	232
4	14	Camden	£6,140,419	136
5	4	Islington	£5,424,137	156
6	8	Lambeth	£5,257,941	156
7	2	Newham	£5,217,075	154
8	13	Hammersmith and Fulham	£4,085,708	109
9	29	Merton	£3,656,112	113
10	20	Croydon	£3,629,066	127
11	9	Lewisham	£3,537,049	144
12	17	Westminster	£3,357,911	100
13	15	Ealing	£3,057,709	84
14	30	Bromley	£3,038,621	131
15	19	Kensington and Chelsea	£2,979,468	74
16	11	Brent	£2,898,224	85
17	10	Greenwich	£2,837,658	87
18	24	Barnet	£2,796,587	99
19	21	Wandsworth	£2,592,453	89
20	5	Waltham Forest	£2,505,730	131
21	28	Sutton	£2,468,511	87
22	18	Hounslow	£2,383,393	75
23	7	Haringey	£2,360,290	101
24	22	Redbridge	£2,285,173	75
25	33	Rechmond upon Thames	£2,249,983	133

VISUALIZATION 3

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Islington	5	4	156	£5,424,137
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Newham	7	2	154	£5,217,075
Hammersmith and Fulham	8	13	109	£4,085,708
Merton	9	29	113	£3,656,112
Croydon	10	20	127	£3,629,066
Lewisham	11	9	144	£3,537,049
Westminster	12	17	100	£3,357,911
Ealing	13	15	84	£3,057,709
Bromley	14	30	131	£3,038,621
Kensington and Chelsea	15	19	74	£2,979,468
Brent	16	11	85	£2,898,224
Greenwich	17	10	87	£2,837,658
Barnet	18	24	99	£2,796,587
Wandsworth	19	21	89	£2,592,453
Waltham Forest	20	5	131	£2,505,730
Sutton	21	28	87	£2,468,511
Hounslow	22	18	75	£2,383,393
Haringey	23	7	101	£2,360,290
Redbridge	24	22	75	£2,285,173
Rechmond upon Thames	25	33	133	£2,249,983
Hullingdon	26	23	103	£2,181,566
Enfield	27	16	86	£2,145,800
Barking and Dagenham	28	6	68	£1,943,59
Havering	29	25	95	£1,934,42
Bexley	30	26	103	£1,631,4
Harrow	31	27	62	£1,516,
Kingston upon Thames	32	31	55	£1,353
City of London	33	32	11	£4

PART 2:
ENHANCING UNDERSTANDING WITH DESIGN PRINCIPLES

3 KEY PRINCIPLES

Color

Font

Space

COLOR THEORY

Hue

Value
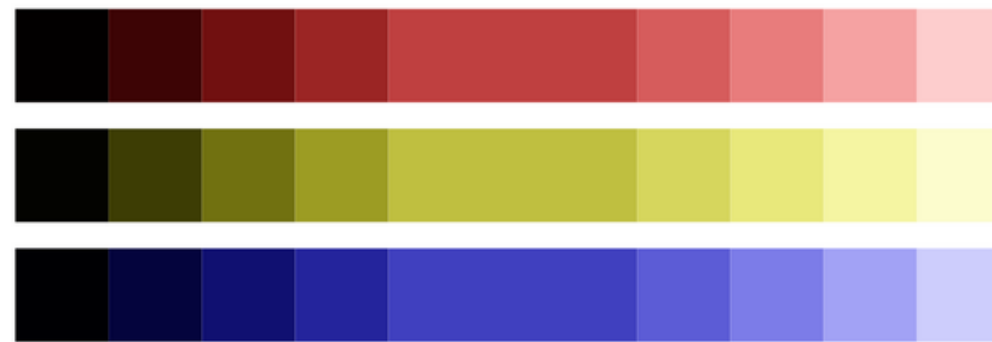
Chroma
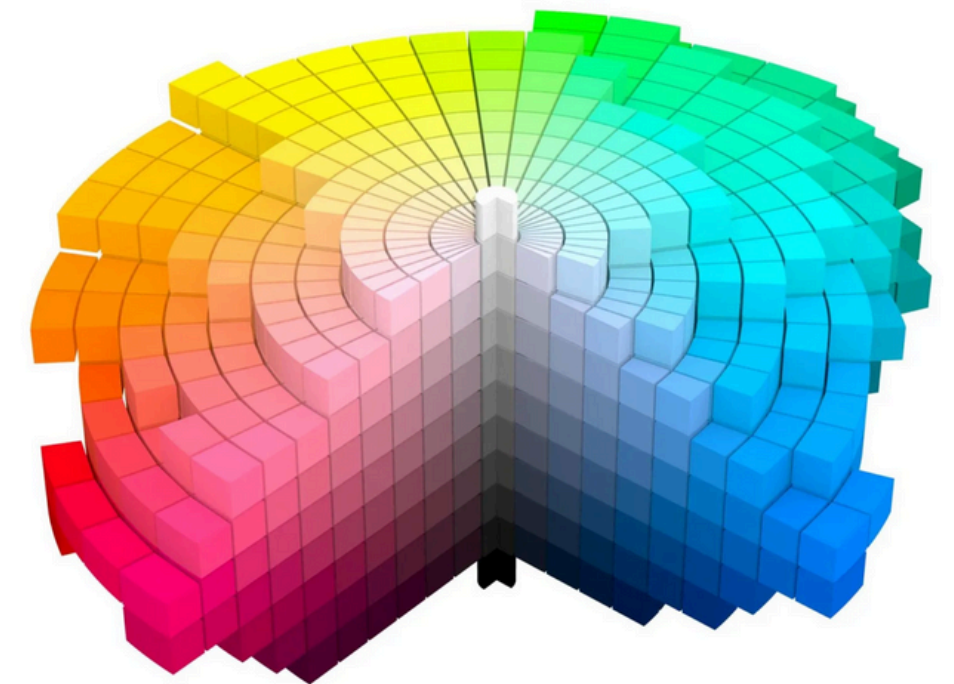
WAYS TO UTILIZE COLOR

Sequential
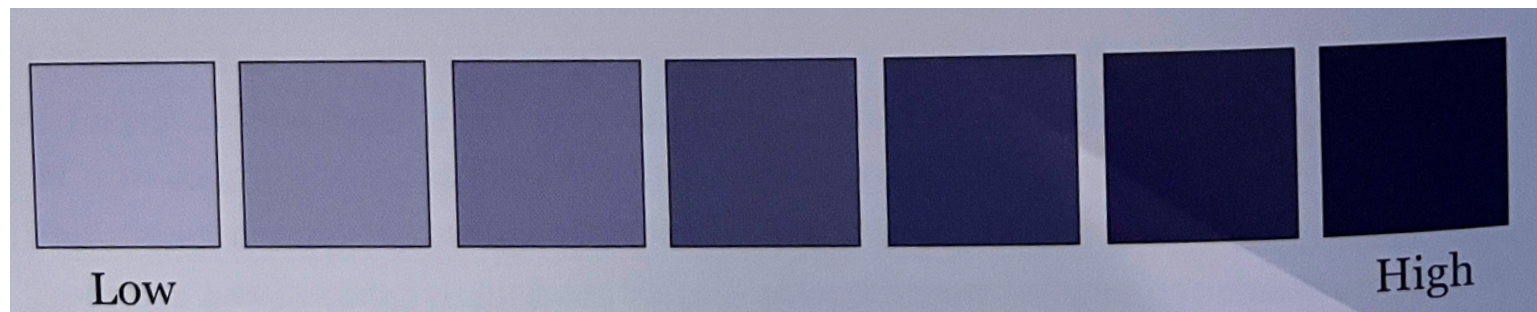
Divergence
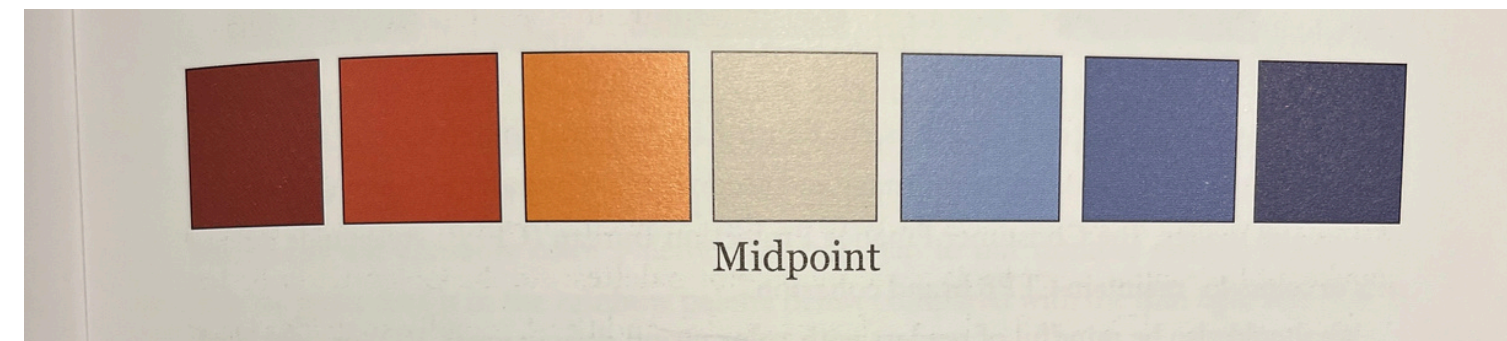
Categorical
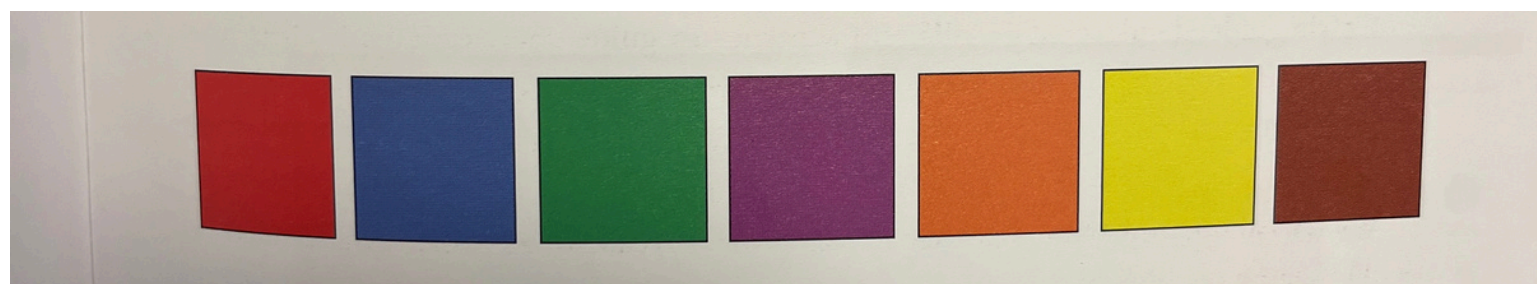
Highlighting
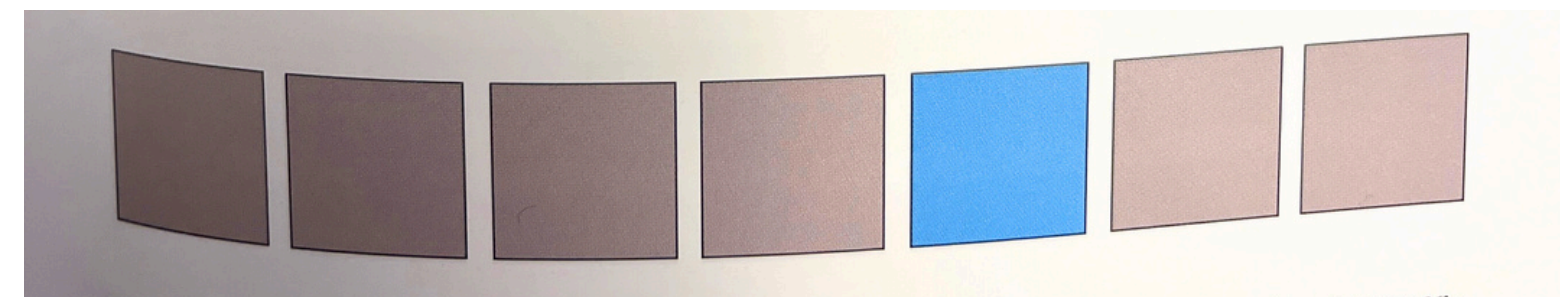
WAYS TO UTILIZE COLOR

Use hue to differentiate categories
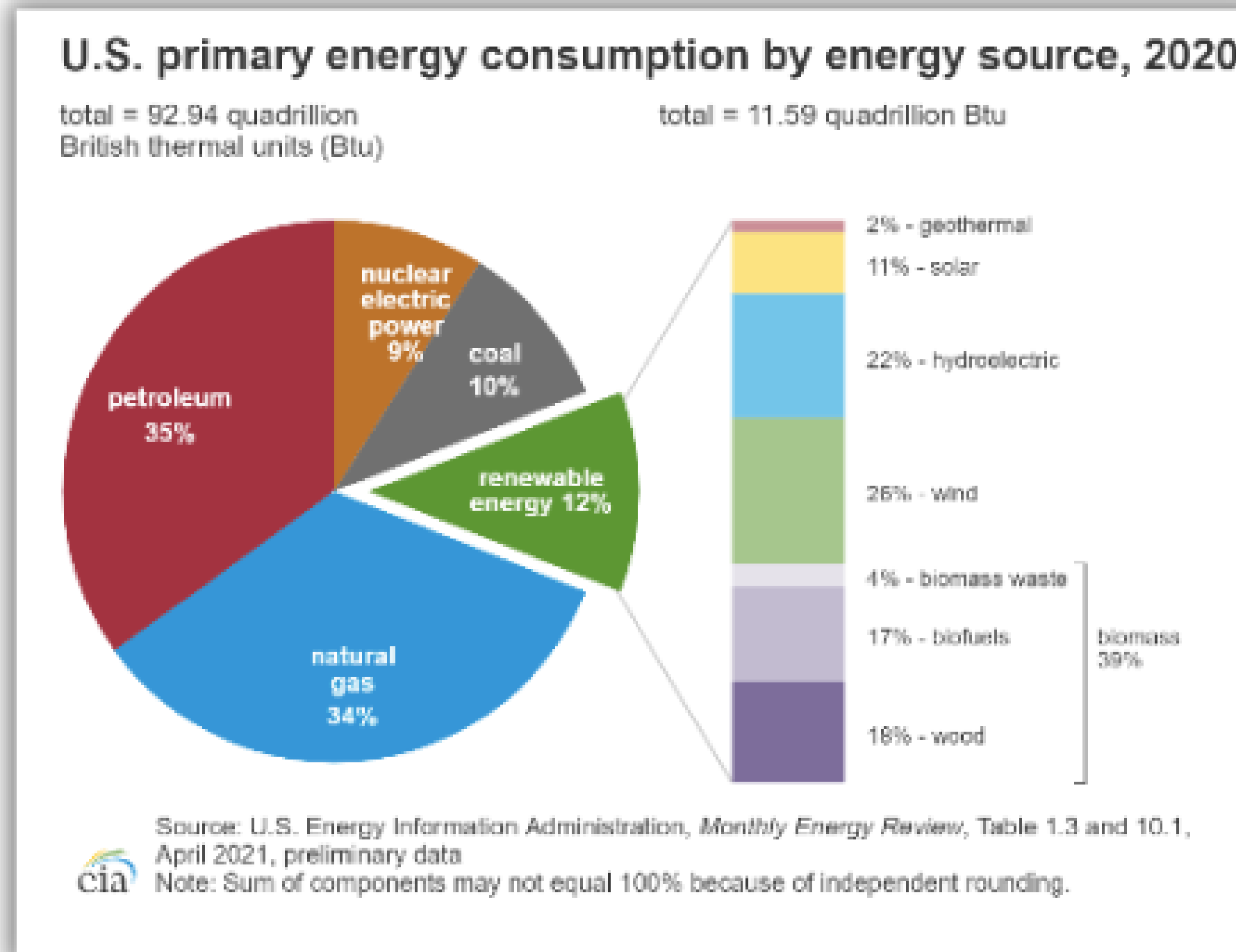
WAYS TO UTILIZE COLOR

Vary chroma or value for change in time or ordered relationship

New Marriage Rate by Education
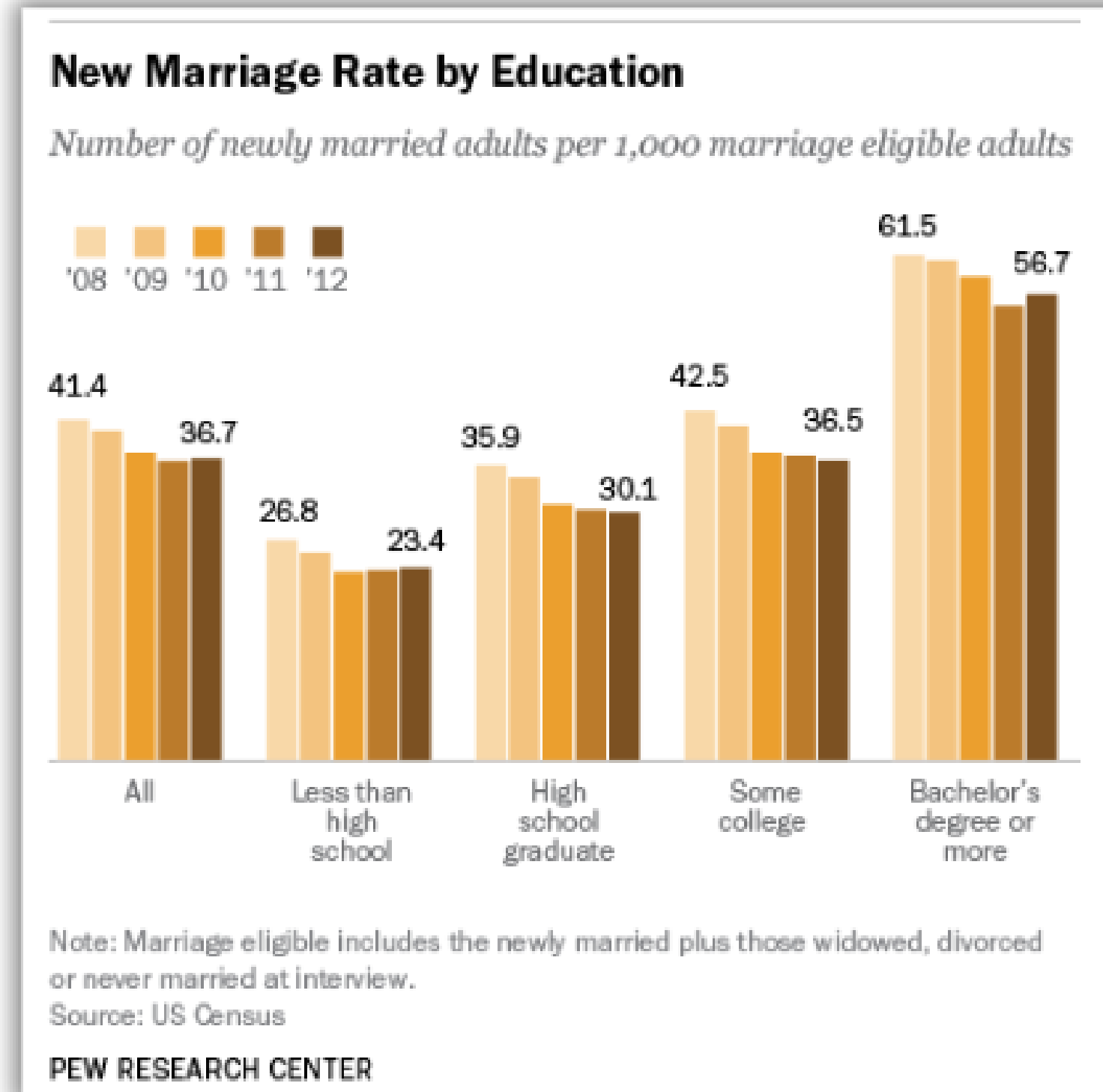
WAYS TO UTILIZE COLOR

Highlight important data
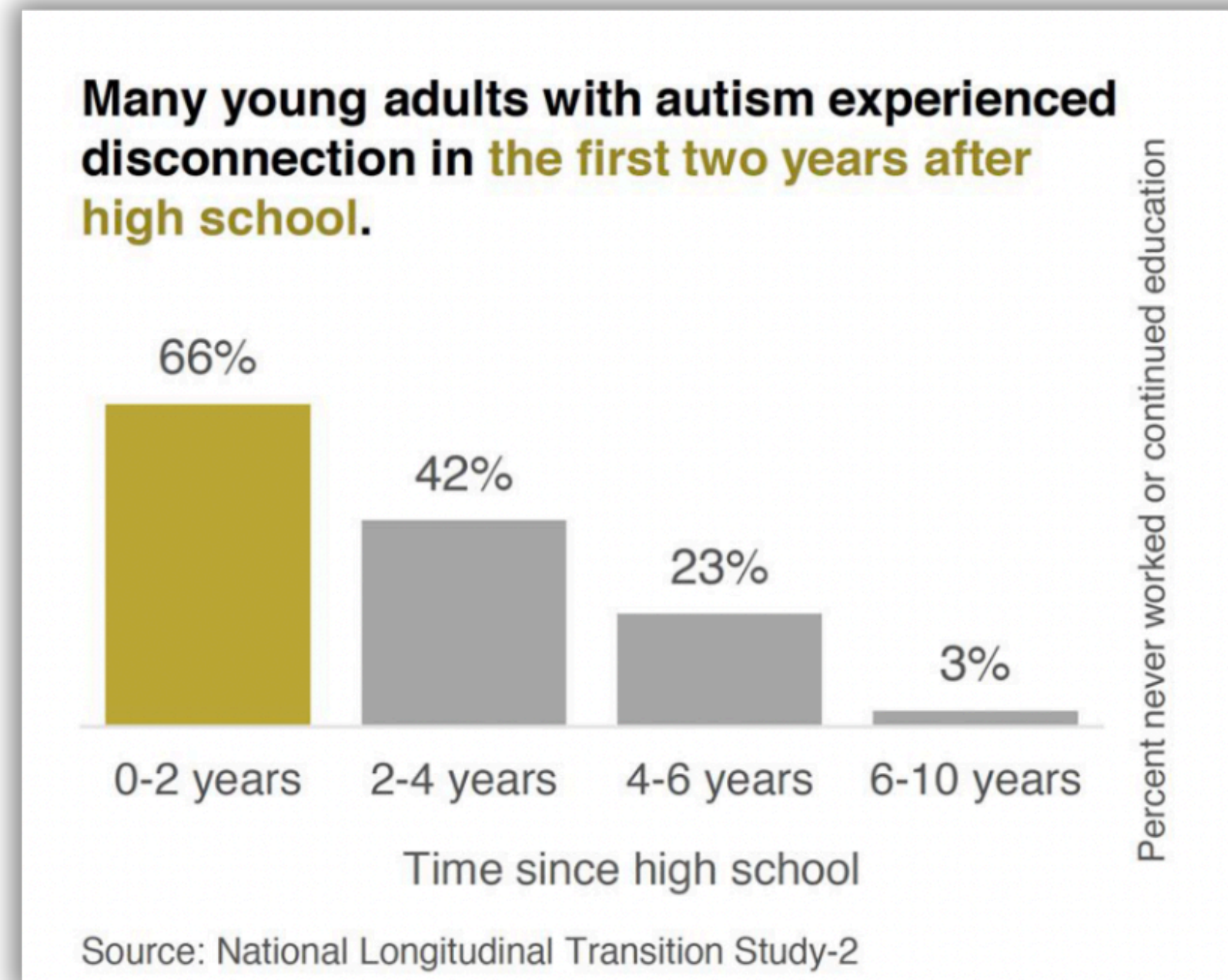
COLOR & ACCESSIBILITY
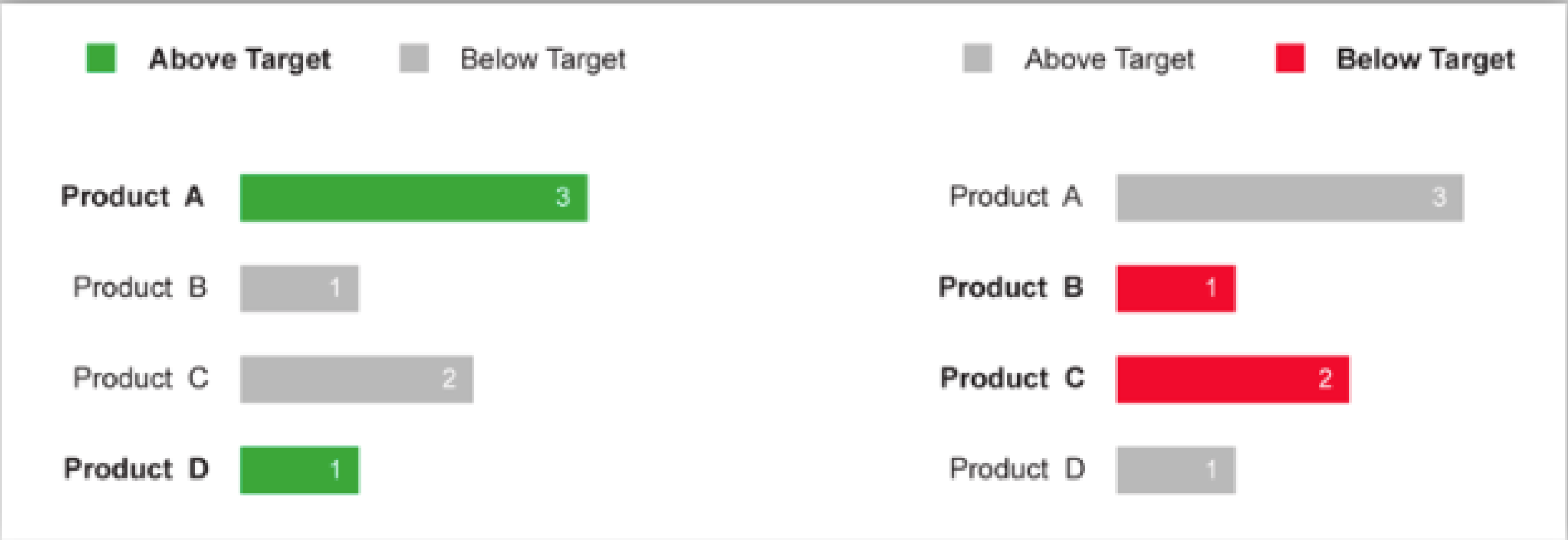
COLOR & ACCESSIBILITY
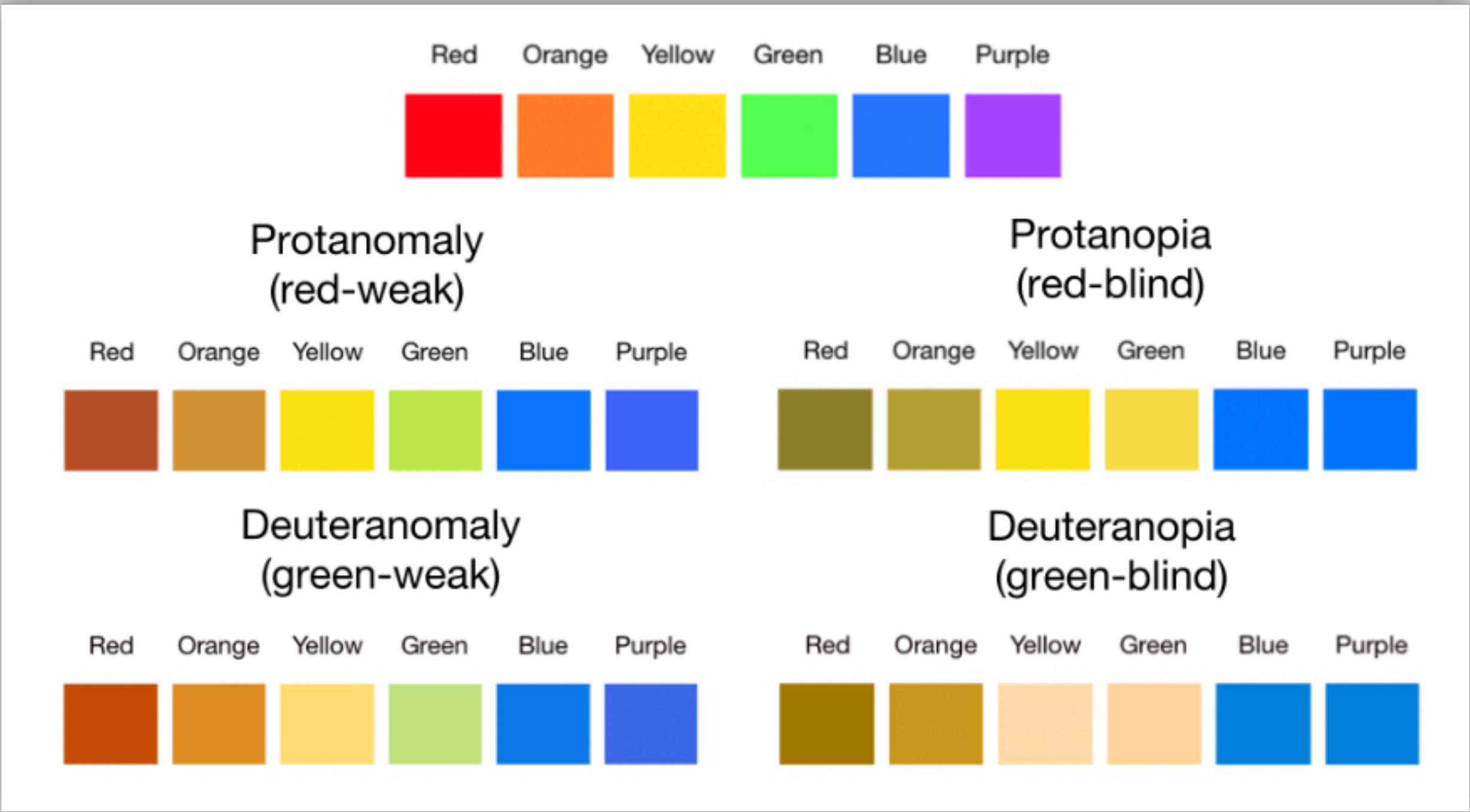
COLOR & ACCESSIBILITY

Utilize more than color to denote difference

' / '   ' \ '   ' | '   ' - '   ' + '
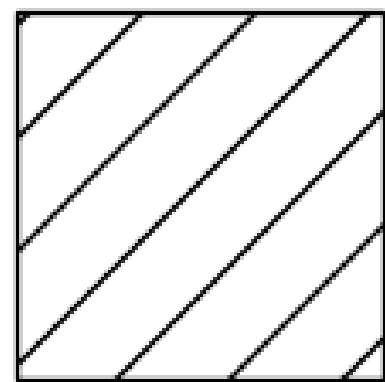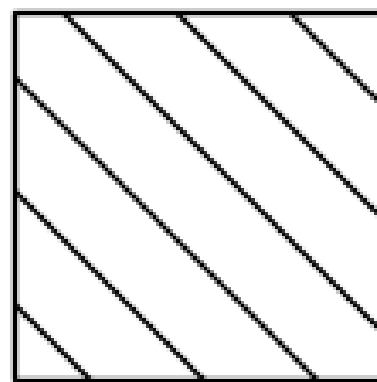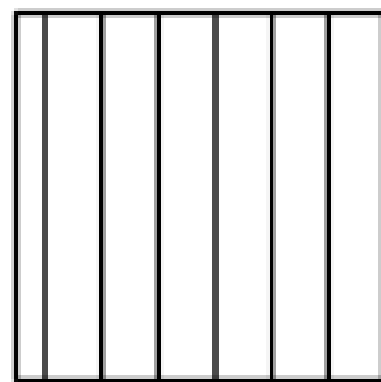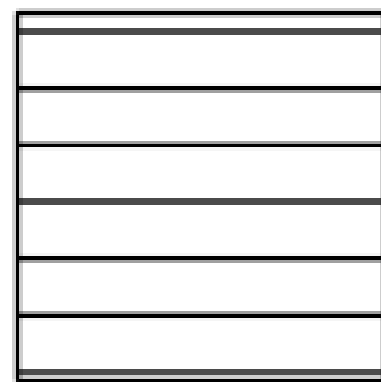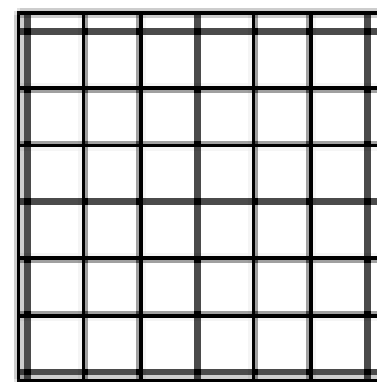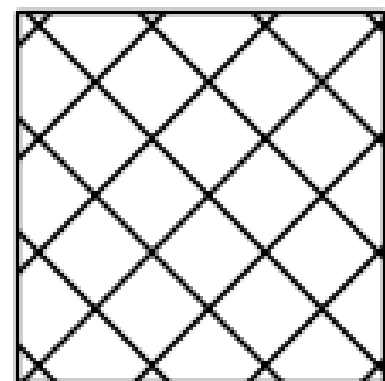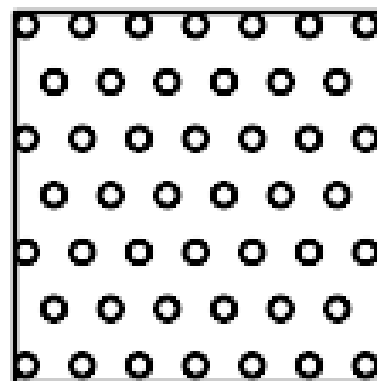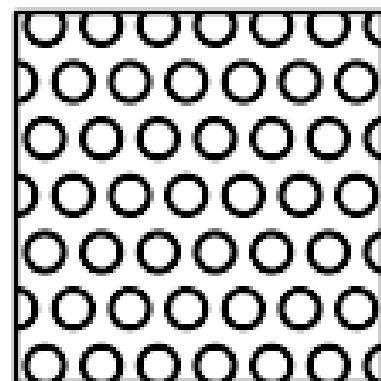
' x '   ' o '   ' O '   ' . '   ' * '
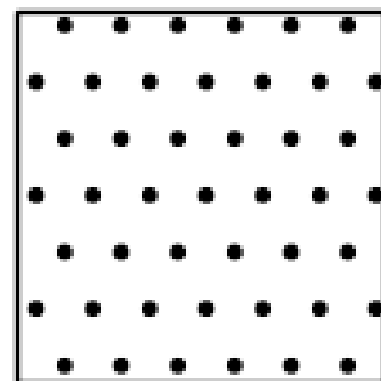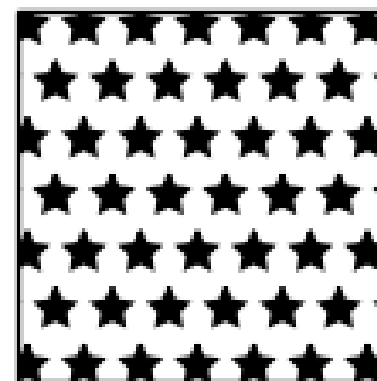
Accessibility tools:

[Inclusive Design Guide](#)

[W3C Accessibility Guidelines](#)

Check built-in tools

COLOR EXAMPLE 1:

HOW MILITARY MEMBERS CAST BALLOTS IN 2020

Legend: Definitely Voted | Definitely Voted Absentee

- In-Person: 25%
- Mail: 65% / 87%
- Email: 6% / 8%
- Online: 3% / 4%
- Fax: .9% / 1%
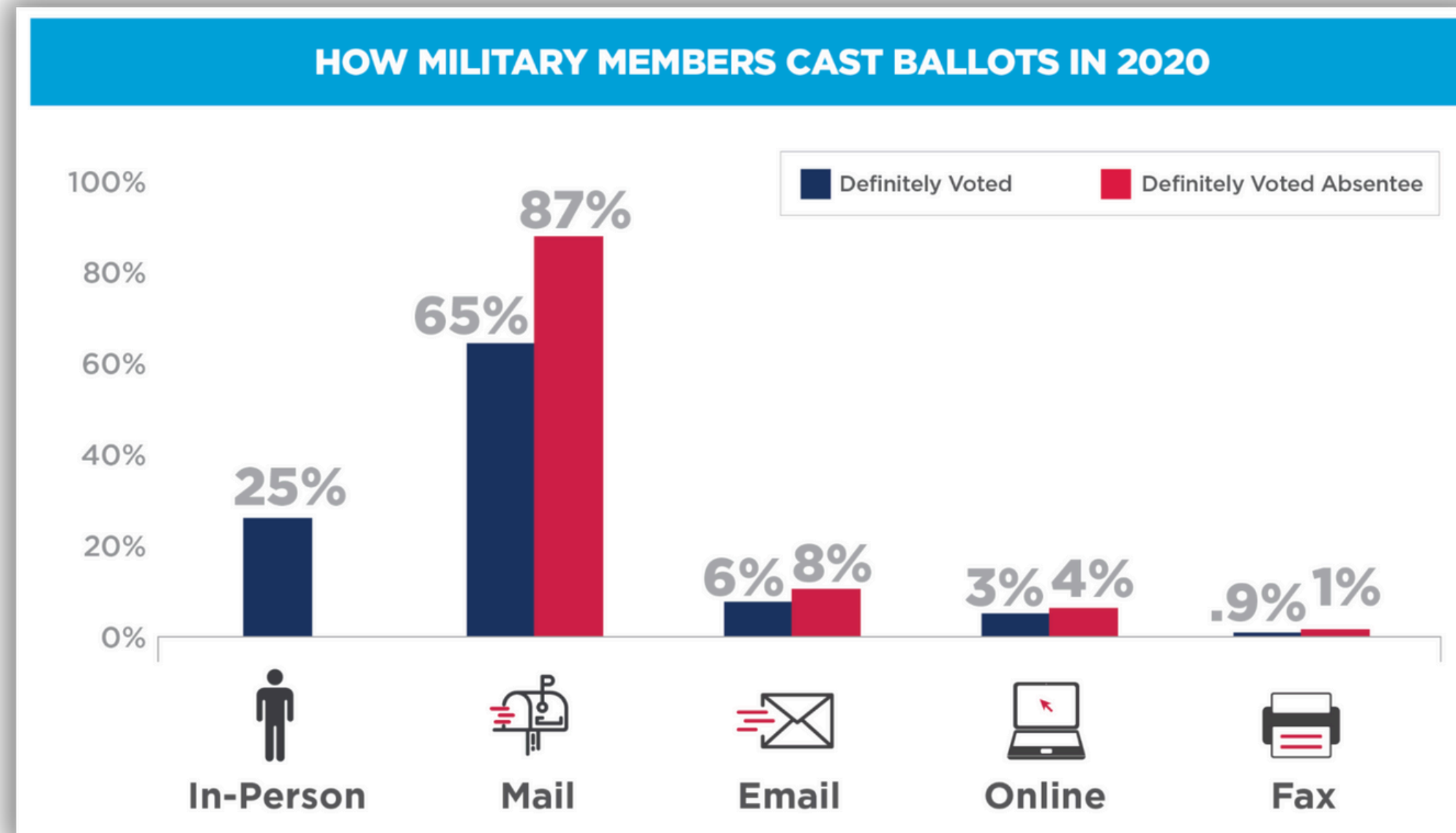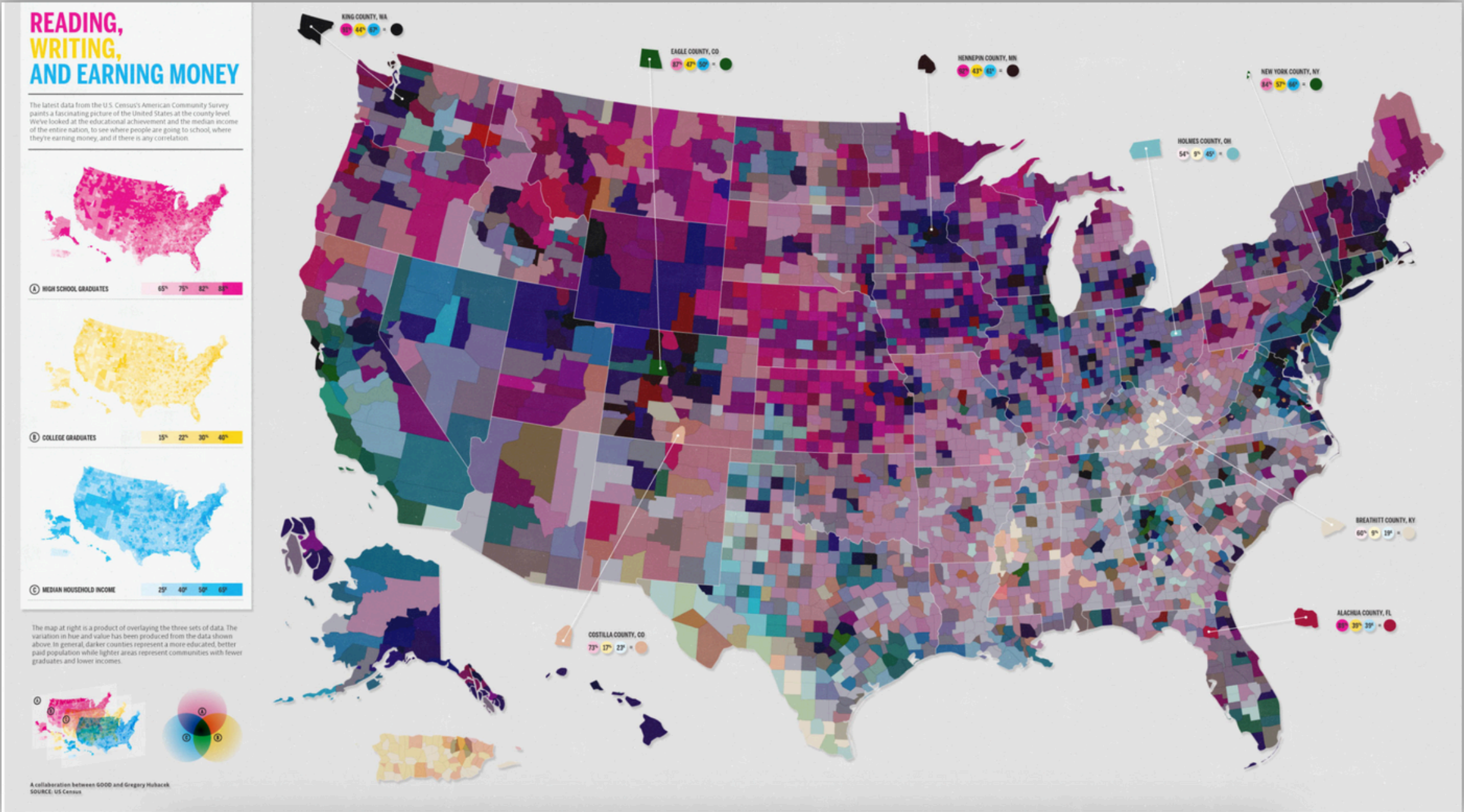
COLOR EXAMPLE 2:

COLOR EXAMPLE 3:
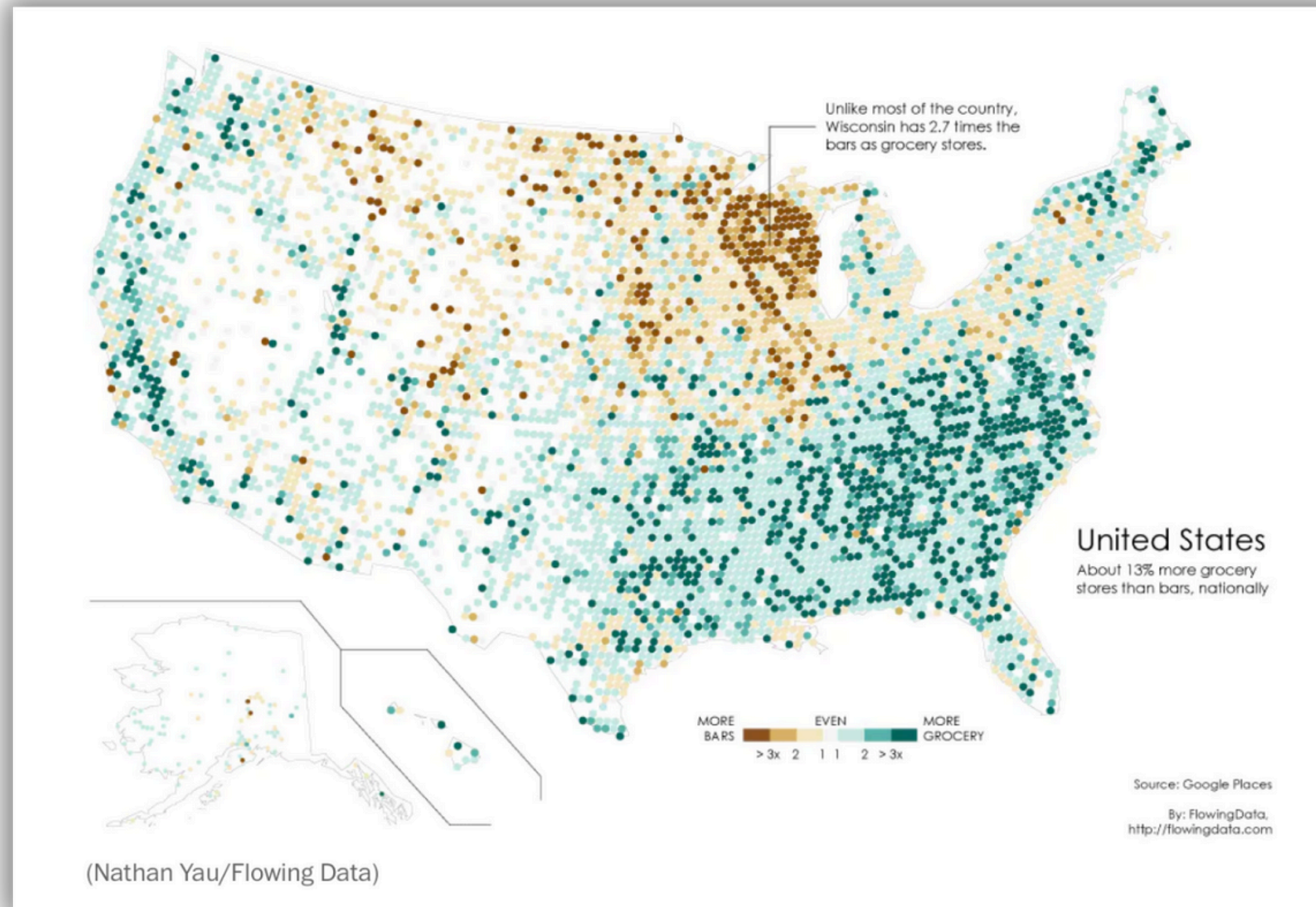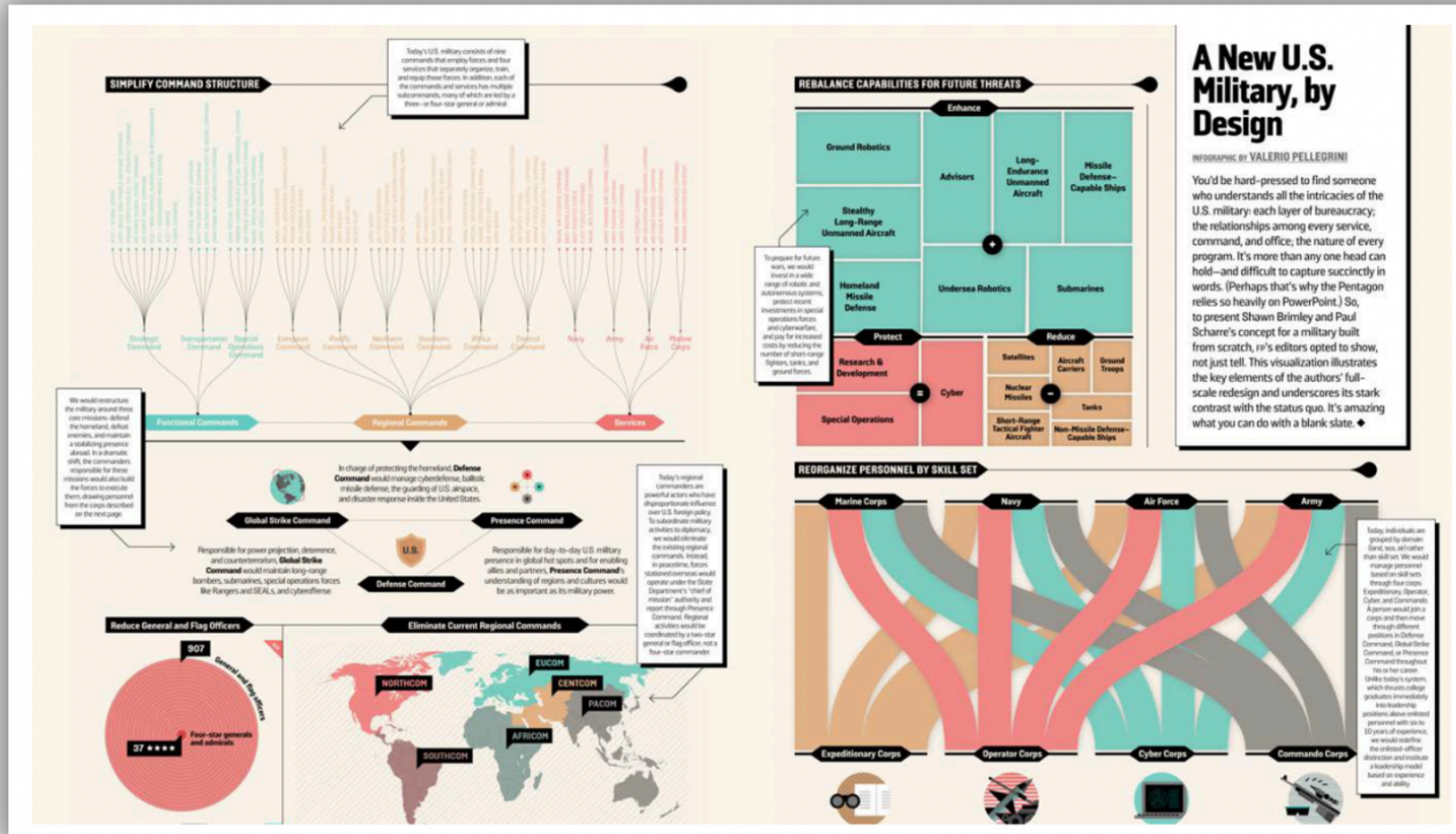
COLOR EXAMPLE 4:

COLOR EXAMPLE 4:
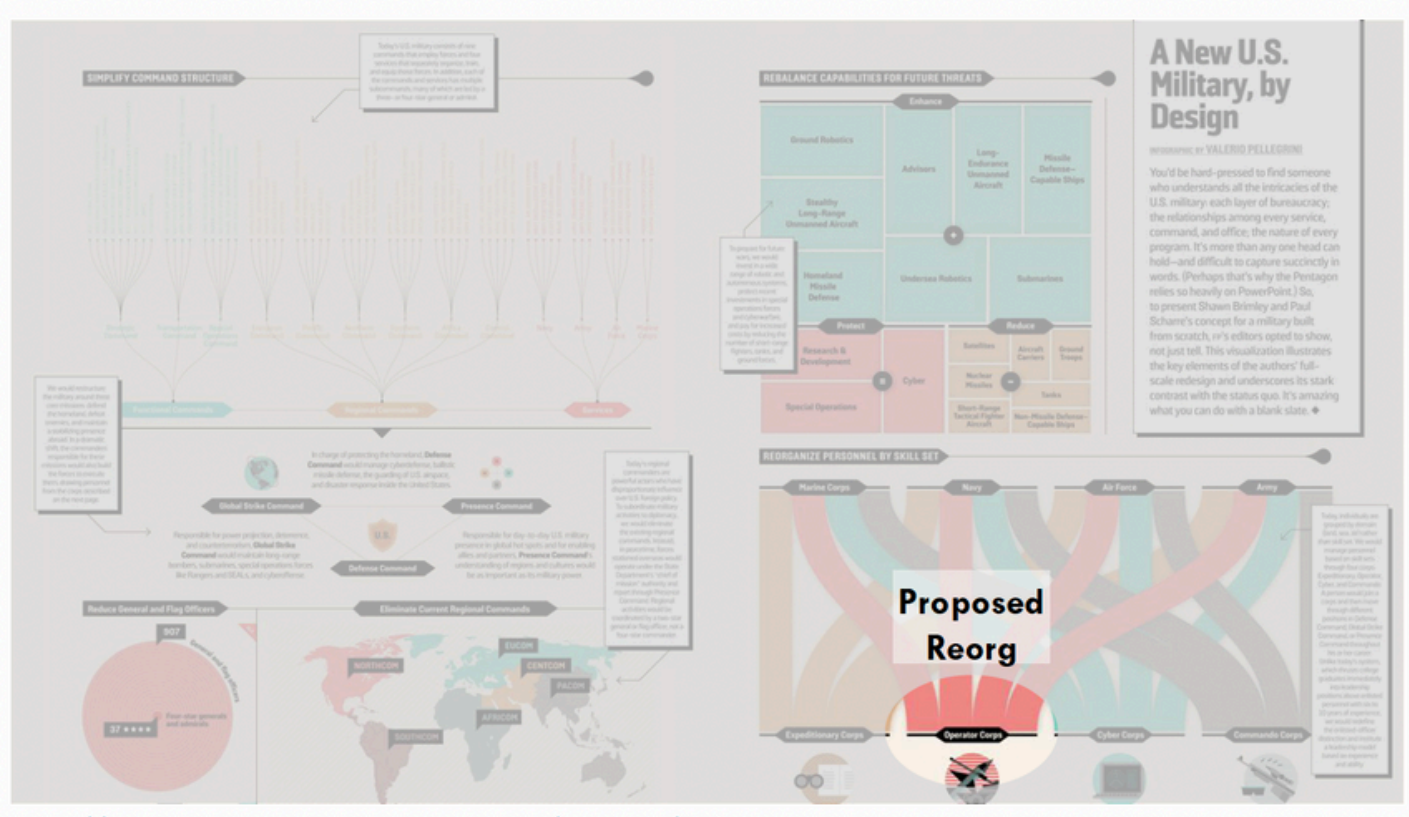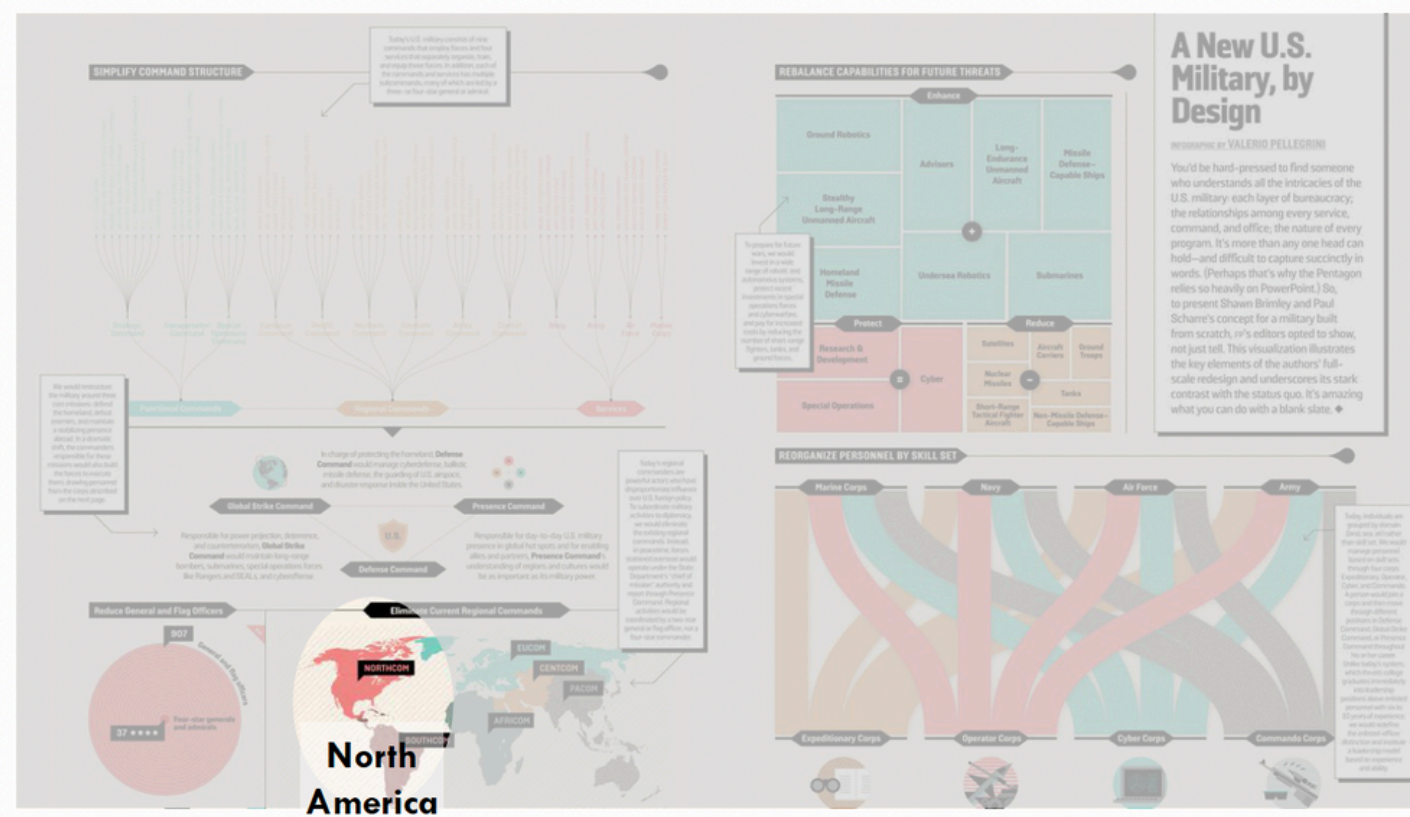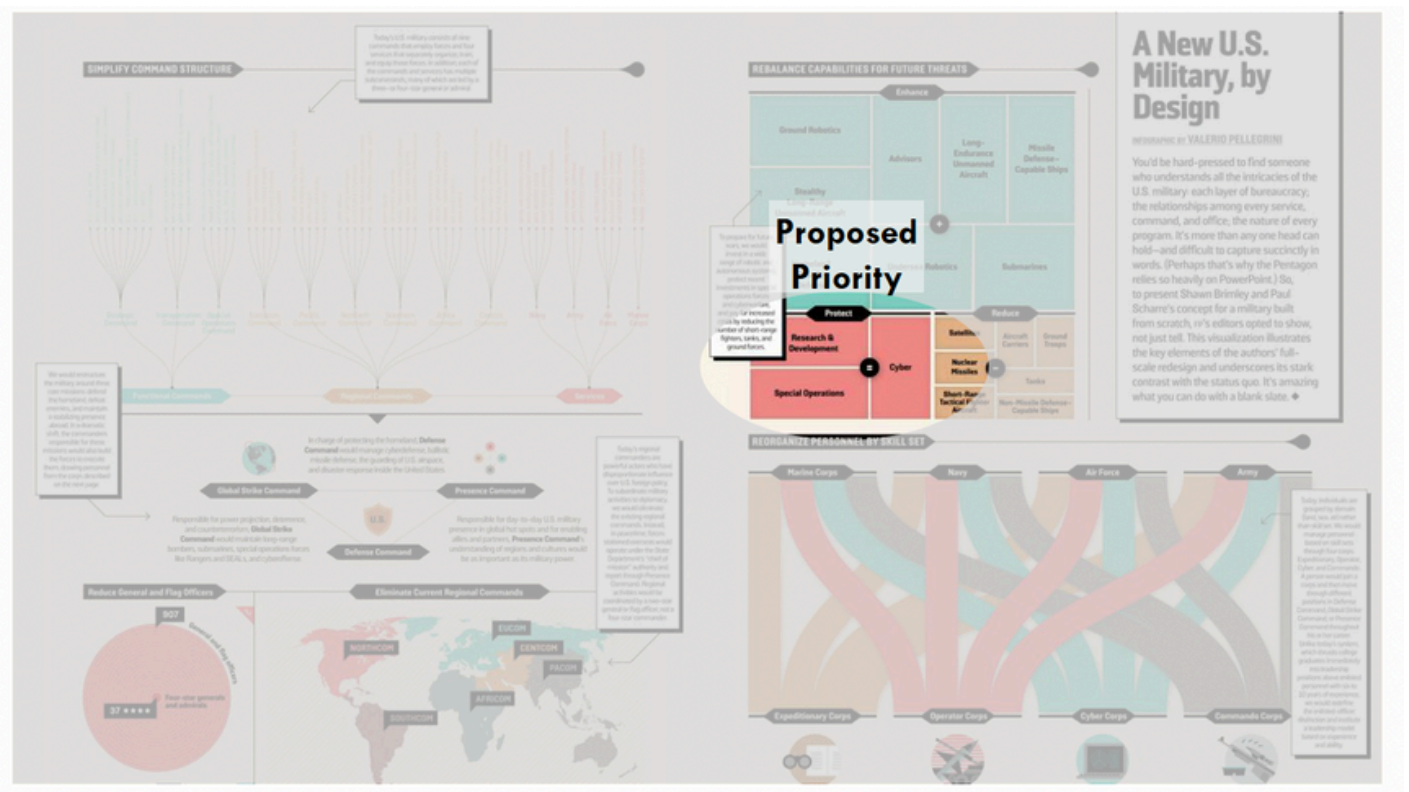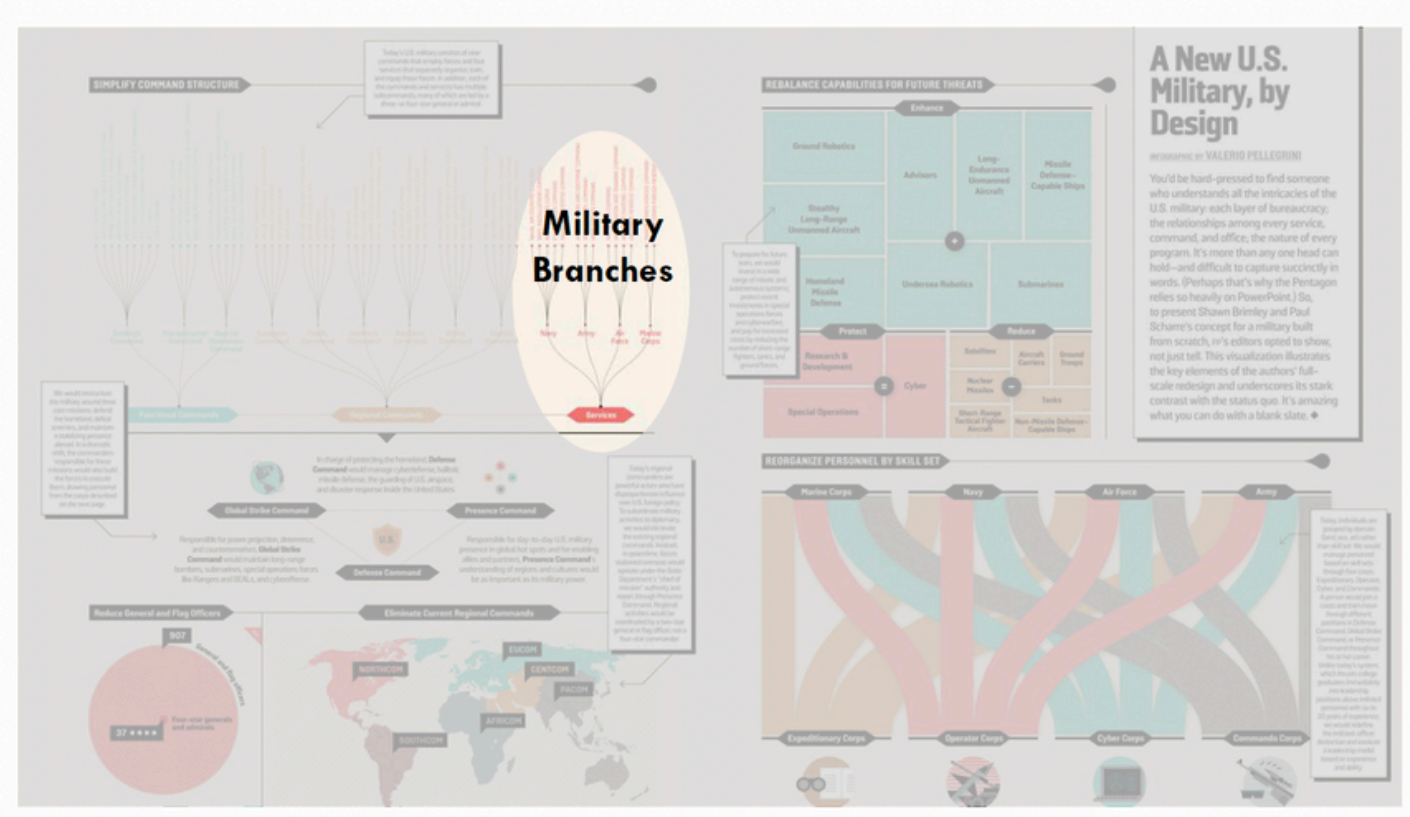
FONT

WHEN USED DAILY FOR 8 WEEKS...

👉 100% OF USERS 👈

OF SENEPLEX COMPLEX

51.9% INCREASED FIRMNESS

23.3% INCREASE IN **CELL RENEWAL!**

SEE

168% INCREASED COLLAGEN SYNTHESIS

25% DECREASED SAGGING

48.7% INCREASED LUMINOSITY

54.2% INCREASED MOISTURE & HYDRATION

👉 😱 55.7% REDUCTION OF FINE LINES & WRINKLES

FONT

Consider the look and feel of your visualization

Tip: Use no more than three fonts

FONT

Oldword vs. Lining Fonts
Proportional vs. Tabular

Use a font with lining and tabular numbers.

124.17
680.90
FP DANCER

124.17
680.90
GEORGIA

124.17
680.90
WORK SANS

124.17
680.90
GARAMOND

NOT IDEAL: OLDSTYLE

BETTER: LINING

124.17
680.90
WORK SANS

124.17
680.90
INTER

124.17
680.90
ROBOTO

124.17
680.90
SOURCE SANS PRO

NOT IDEAL: PROPORTIONAL

BETTER: TABULAR

Source

FONT

Create a visual hierarchy

FONT
Accessibility

SPACE
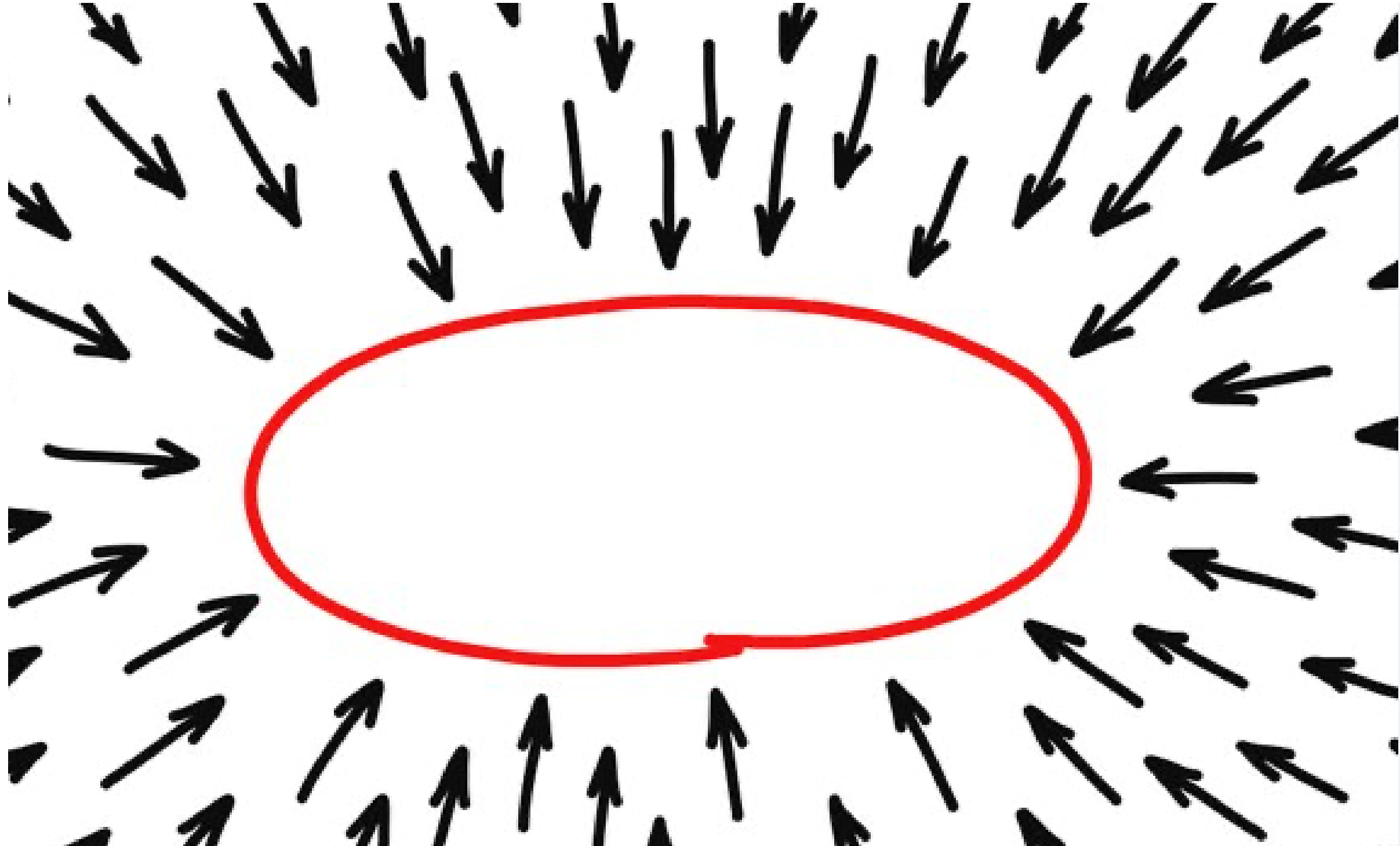
SPACE
GESTALT PRINCIPLES
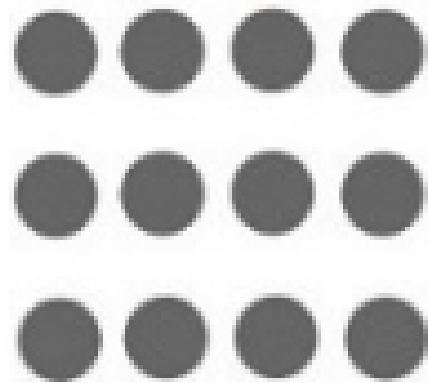
SPACE
PROXIMITY
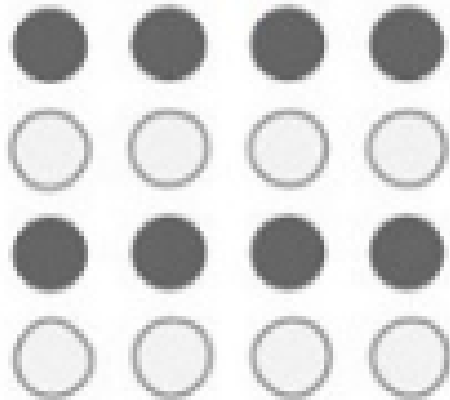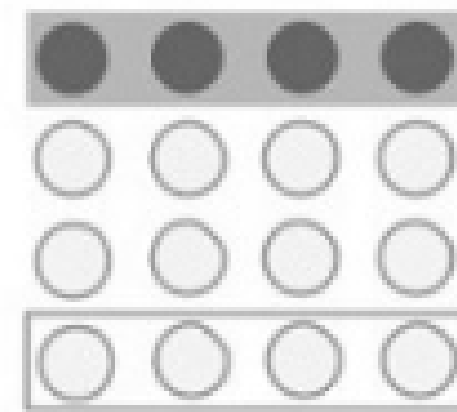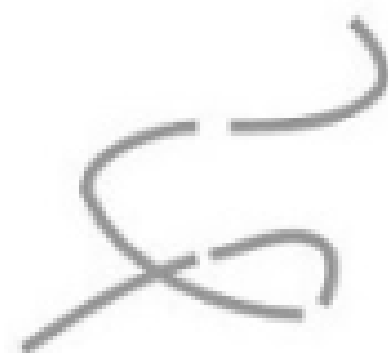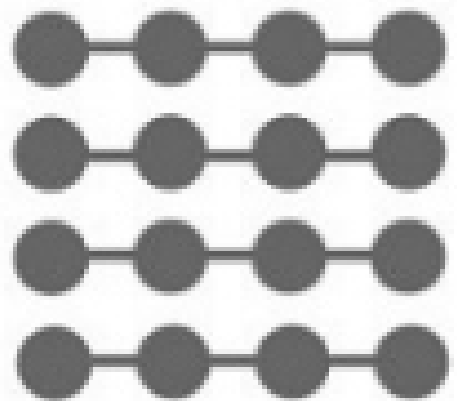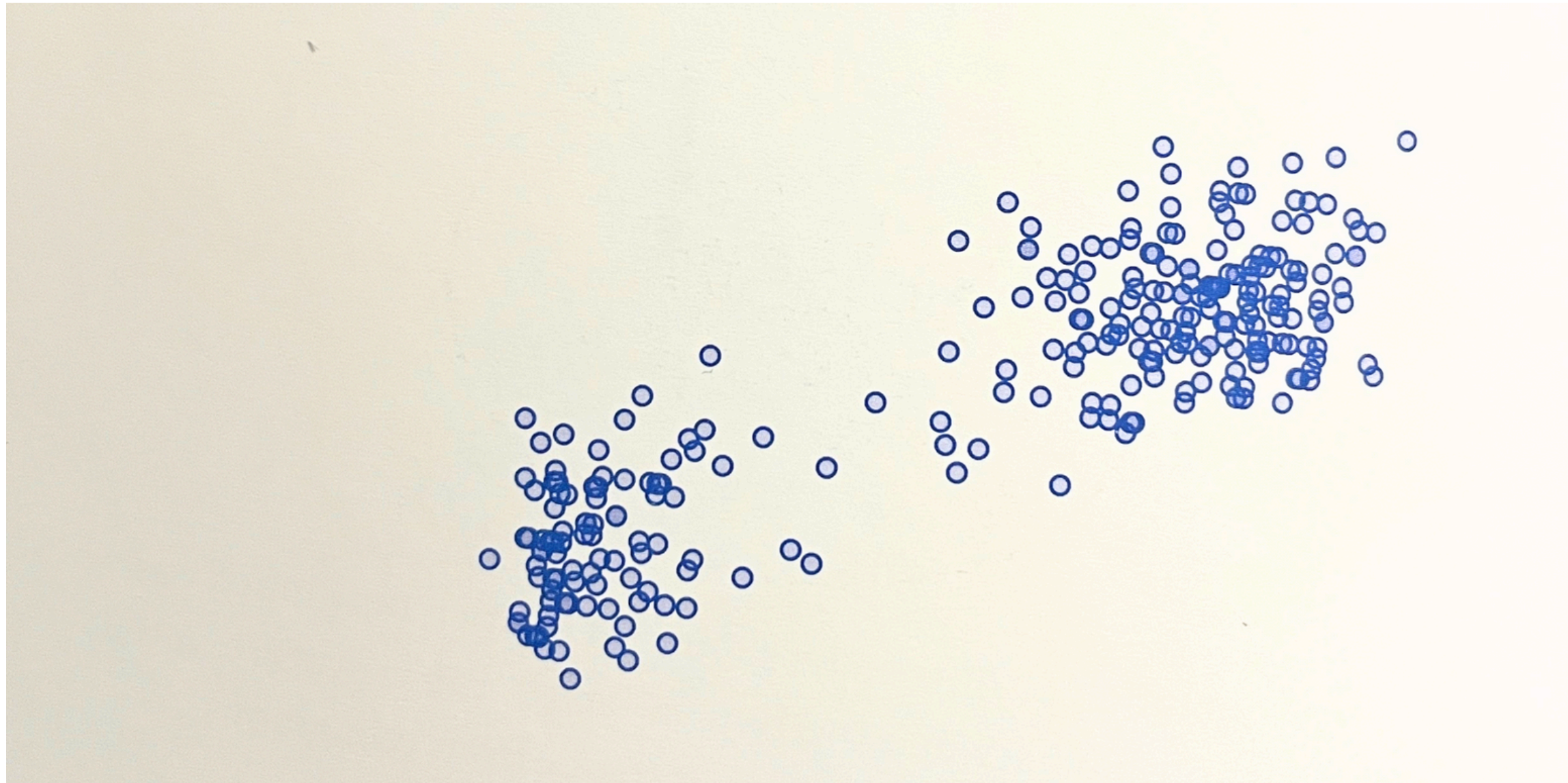
SIMILARITY

SPACE
ENCLOSURE

Better Data Visualizations
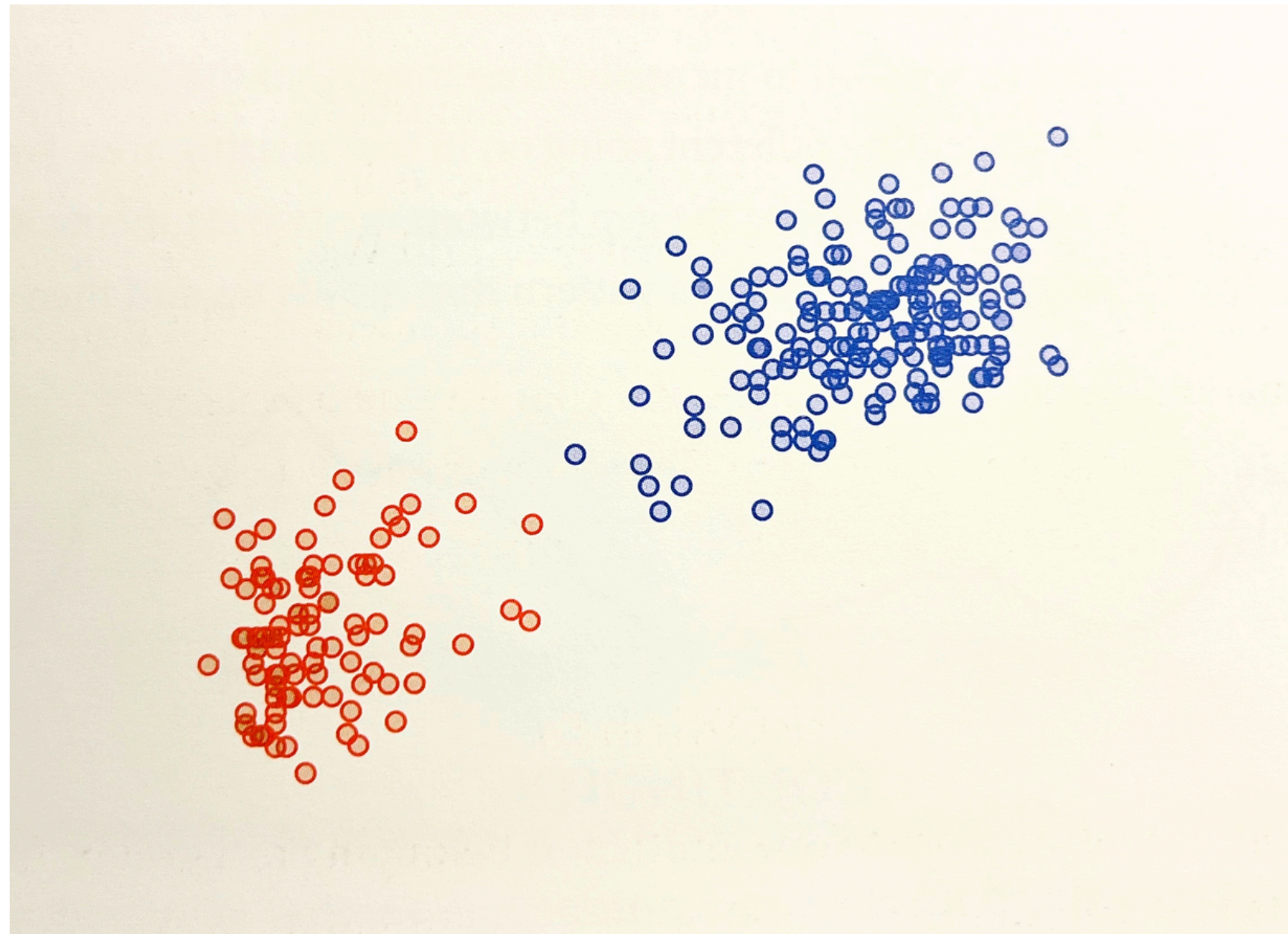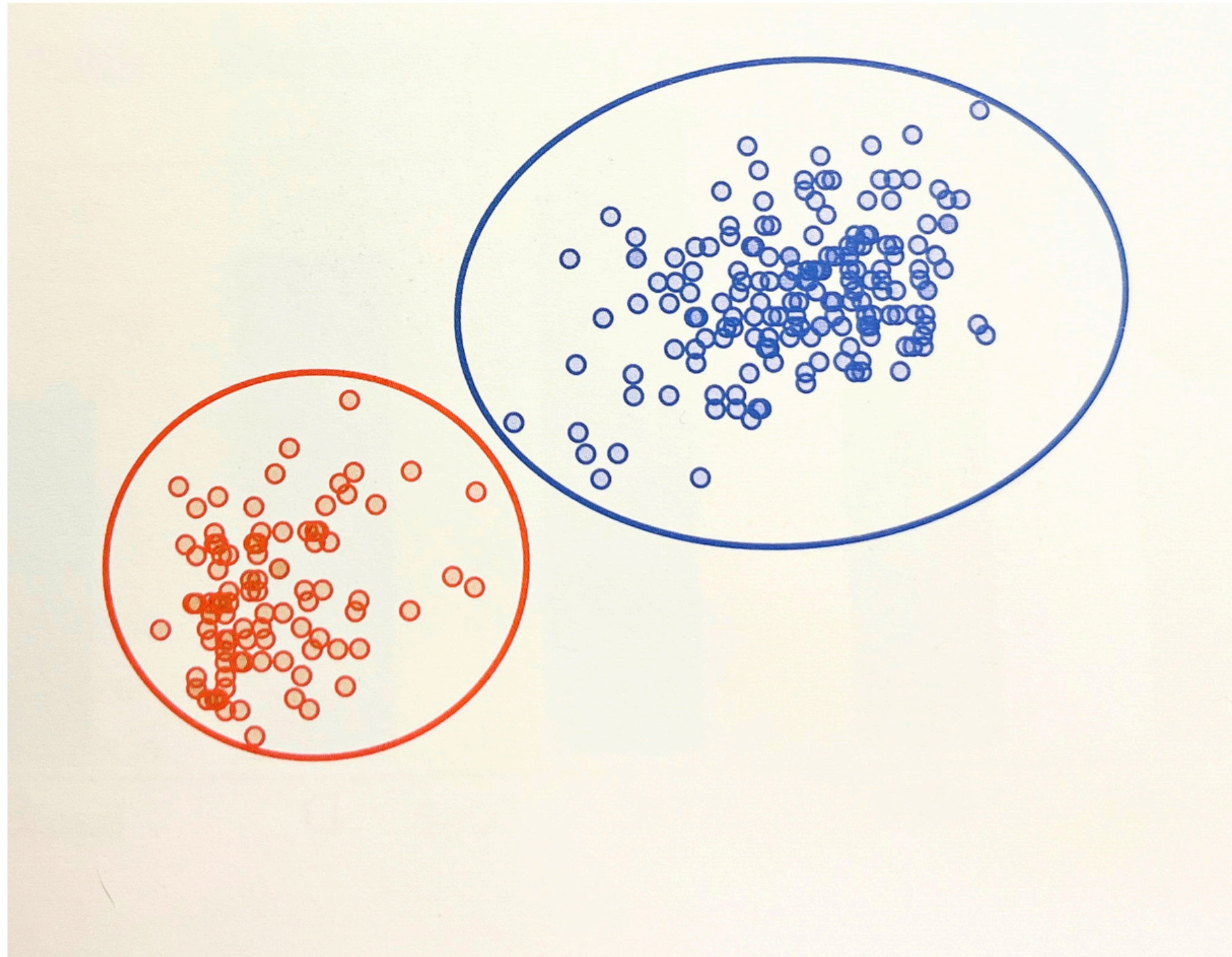
SPACE
CONNECTION

SPACE
CONTINUITY

USA Library receives 8% more reference questions via phone than in-person.

35% — Phone
27% — In-Person
22% — Email
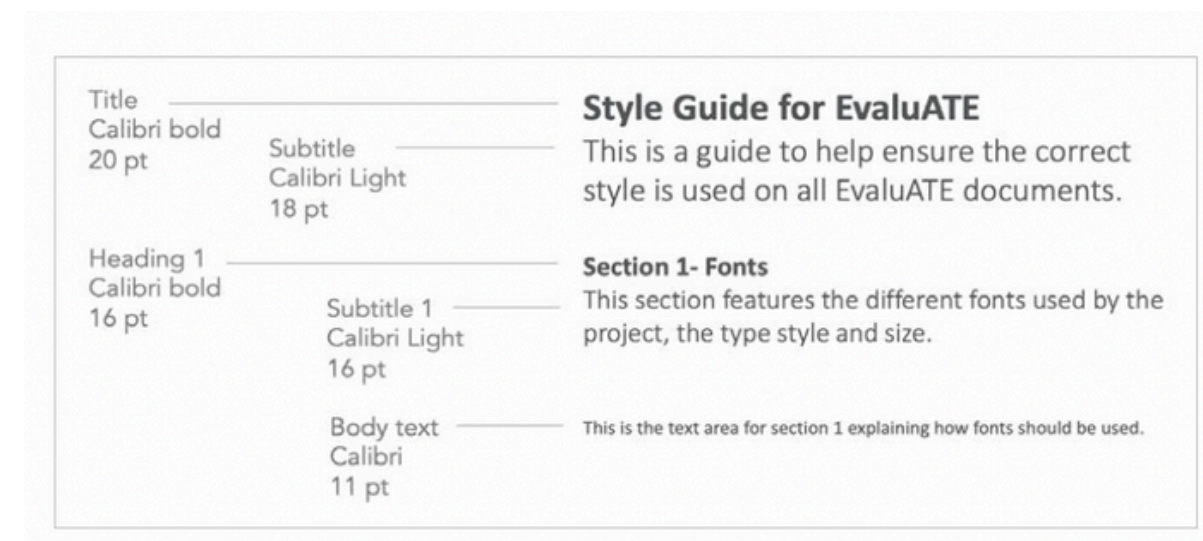17% — Chat
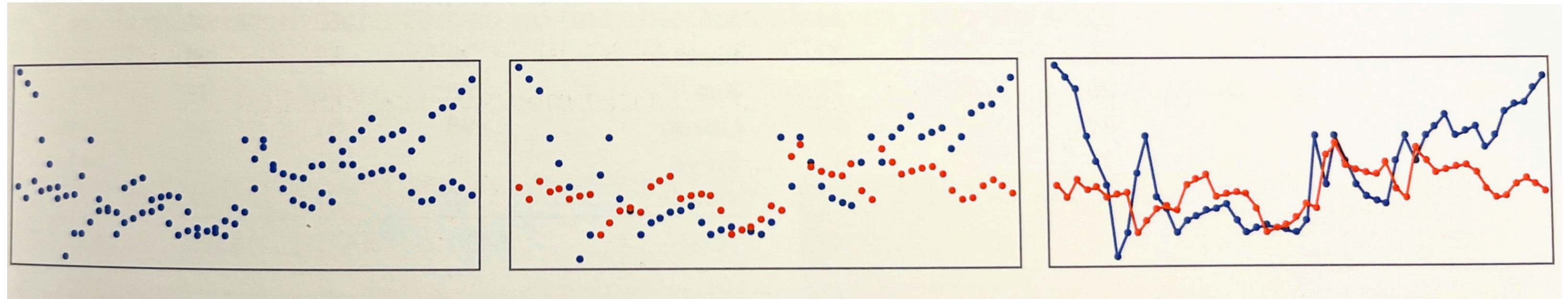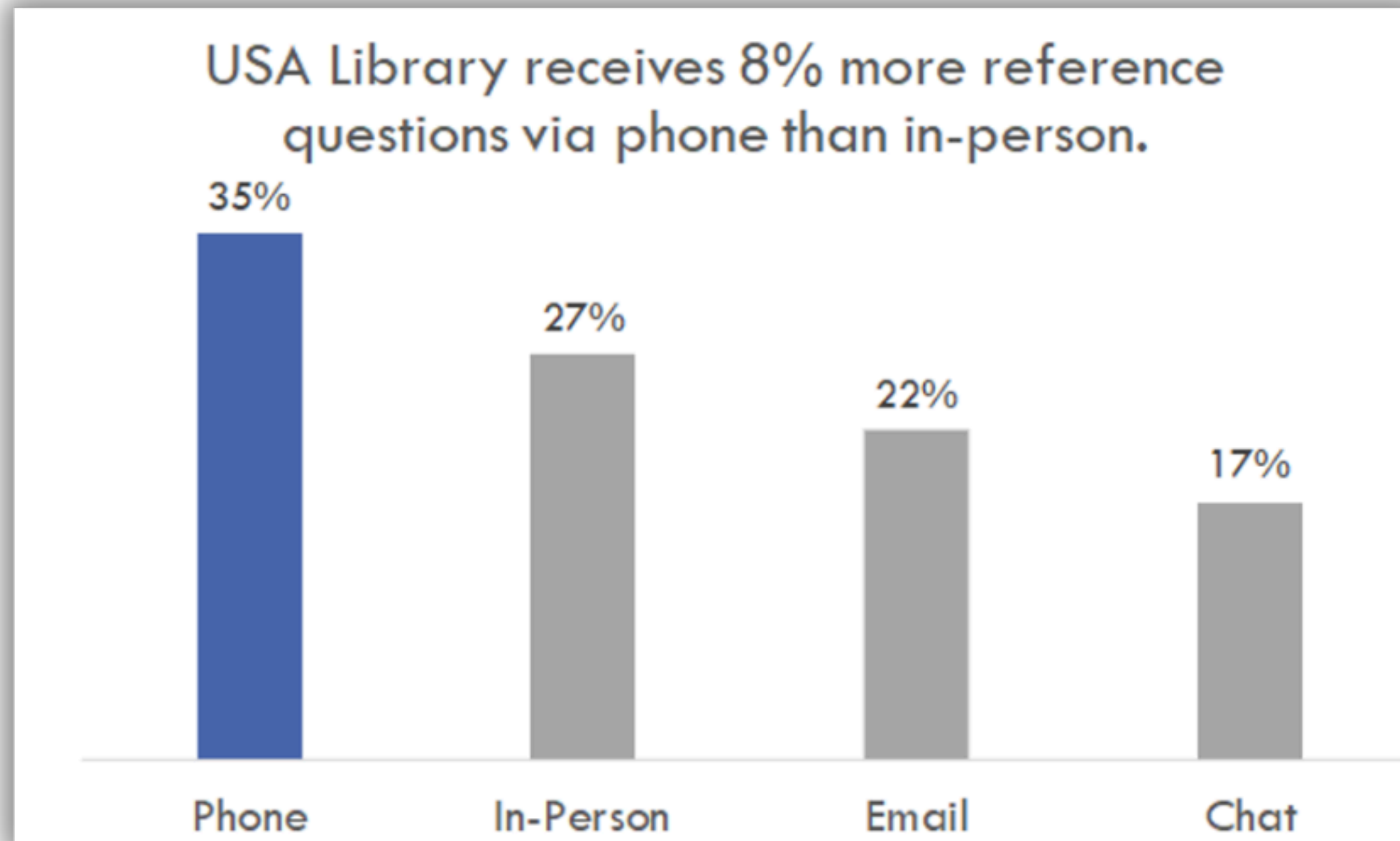
SPACE
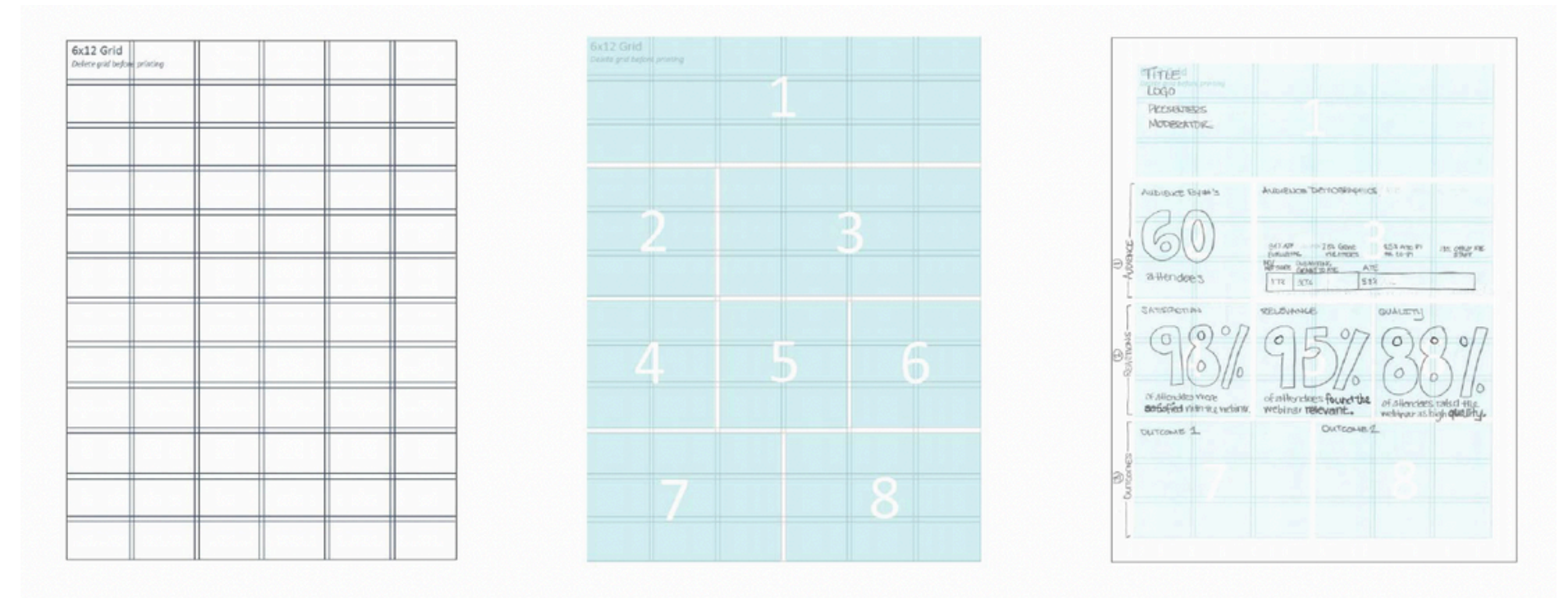# KEEP IT SIMPLE AND PREDICTABLE

Designing a One Page Report

10 STEPS

1. Identify your audience
2. Identify the purpose
3. Prioritize the information
4. Choose a grid
5. Draft the layout
6. Create an intentional visual path
7. Create a purposeful hierarchy
8. Use white space
9. Get feedback
10. Triple check for consistency

10 steps Handout

Source

USE A GRID TO PLOT YOUR INFORMATION

Tip 1: sketch it out!

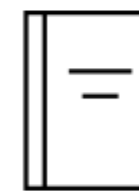**Tip 2:** Check out PowerPoint. Use the QR code to find tips on PowerPoint visualizations.
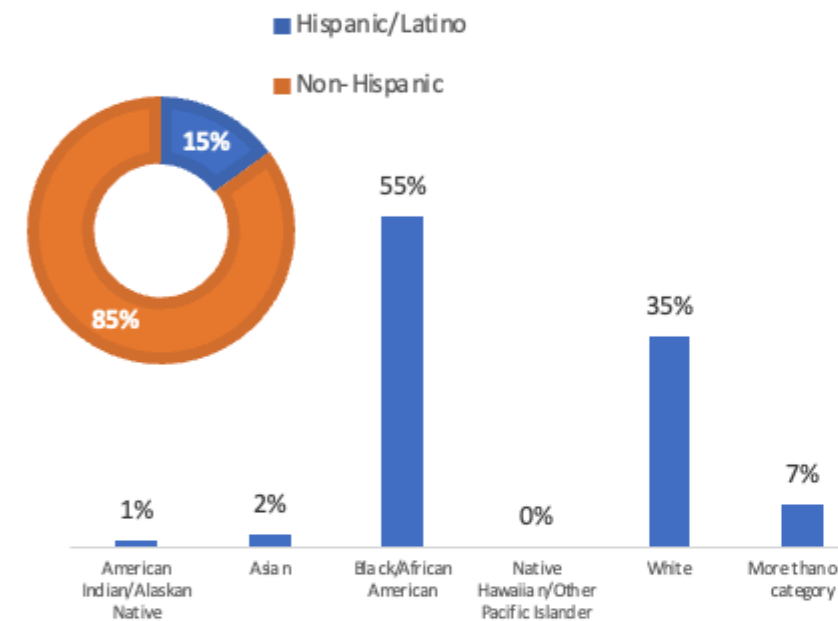
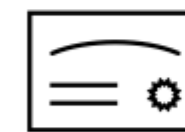# Practice 2:
Putting it all together

- Design a report for either:
  - the director who interested in if this program is encouraging ongoing library use
  - the town council who making funding decisions and is concerned with expanding equity
  - the local healthcare system (partner) who is interest in if the series is leading to better health/wellness outcomes
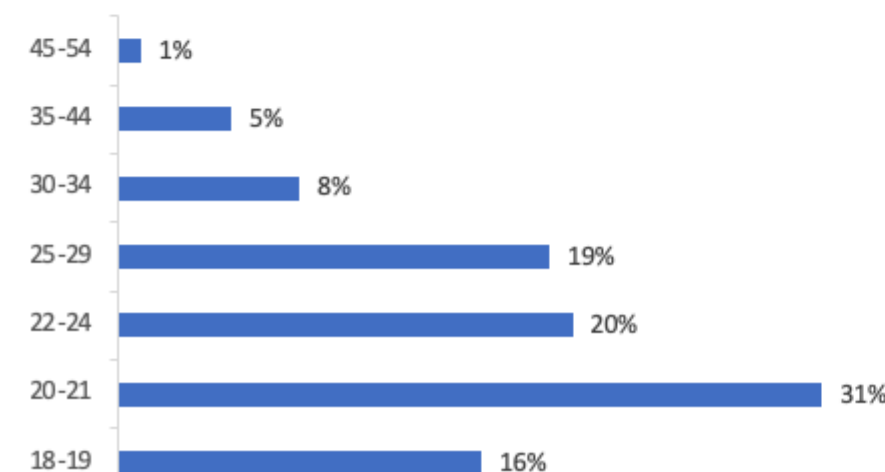
Families served in FY 2021

Caregivers

1,975 Caregivers

- Hispanic/Latino
- Non-Hispanic

15%

85%

55%

35%

1% American Indian/Alaskan Native
2% Asian
Black/African American
0% Native Hawaiian/Other Pacific Islander
White
7% More than one category

49 % have a high school diploma or less

28% attended some college

23% college graduates

45-54 1%
35-44 5%
30-34 8%
25-29 19%
22-24 20%
20-21 31%
18-19 16%

Children

763 children
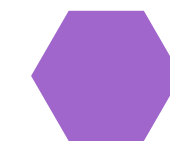
1-2yrs 30%

under 1 58%

3-5yrs 12%
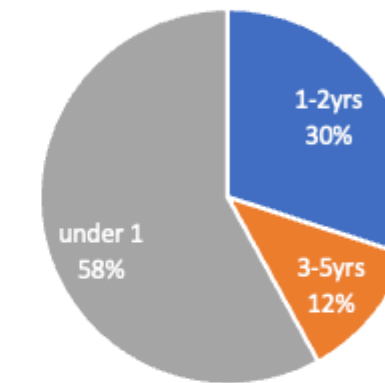
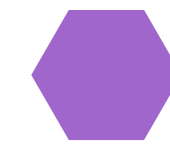82% of participants completed the 4 week series.

90% of survey respondents reported feeling more confident as caregivers.

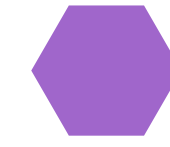44% of respondents reported having attended other early literacy events at the library.
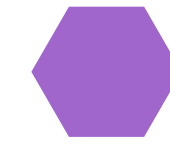
Final Takeaways

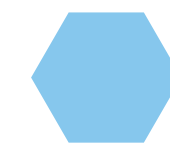- Choose the right visualization for the type of information you have
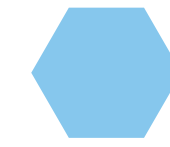- Give context to numbers and show the data
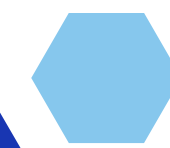- Tell a story
- Keep it simple for the viewer
- Use color wisely - remember accessibility!
- No more than 2-3 fonts
- Pay attention to whitespace and Gestalt Principles

TOOLS

Data Visualization Programs/Software
Static and Interactive
Microsoft PowerPoint
Adobe Illustrator
Tableau
Piktochart
Canva
Venngage
Visme
Infogram
Miro

Animated
Powtoon
Animaker

Typography
Font squirrel
MyFont
FontPair

Iconography
Noun Project

Color
Adobe Color CC
Picular
Colorbrewer2
(mapping)

THANK YOU!

Contact: Amanda@allianceresearchco.com