

[http://huppenkothen.org/  
data-visualization-tutorial/](http://huppenkothen.org/data-visualization-tutorial/)

# Data Visualization

Daniela Huppenkothen

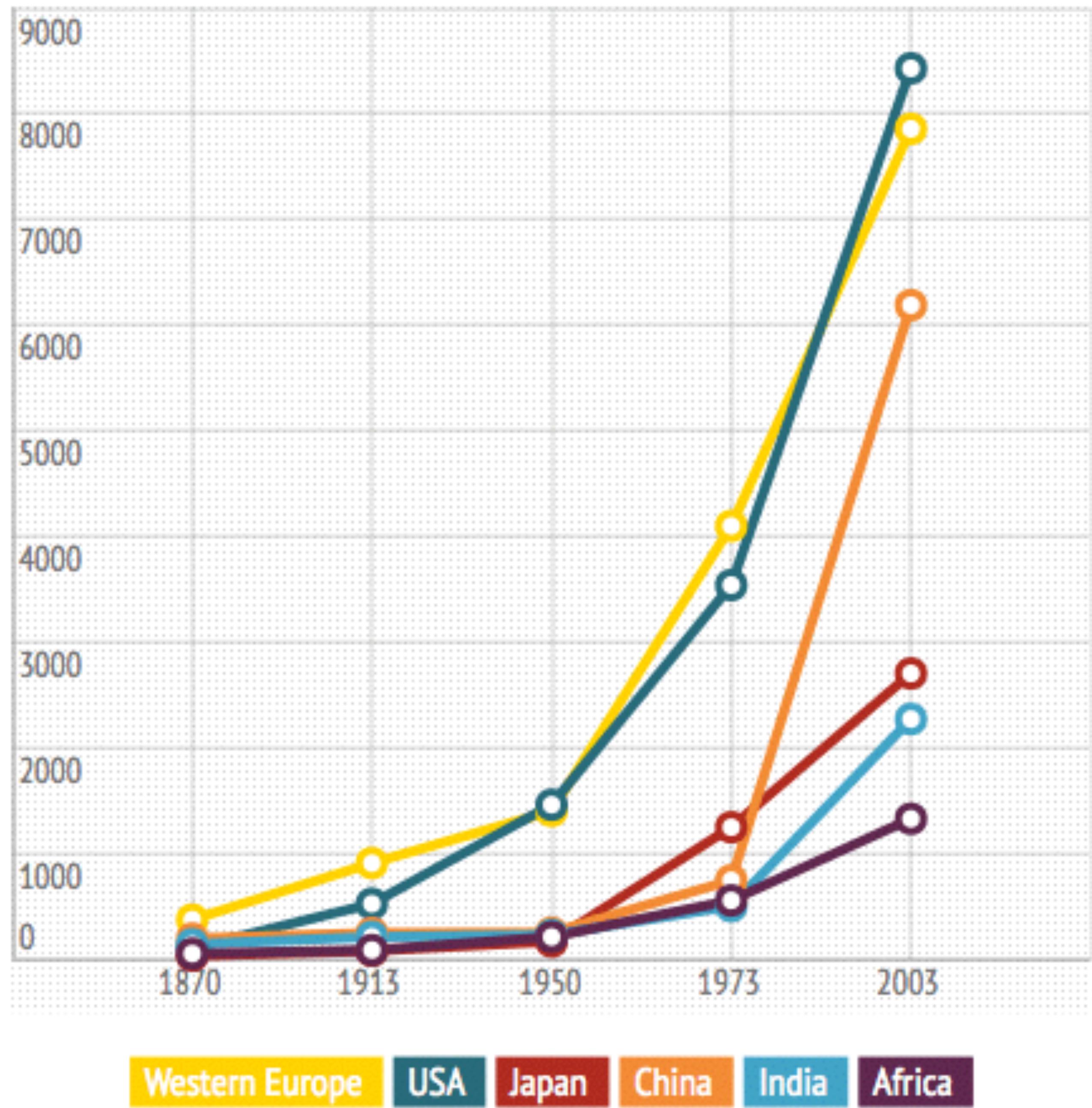
DIRAC, University of Washington

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1. Introduction
2. Exercise: Co-creating best practices
3. Accessibility in Data Visualization
4. Pre-Attentive Processing
5. Gestalt Principles
6. Space
7. Choosing a Visualization
8. Data Visualization + Society
9. Exercise: Wireframing

Data visualization lets you see  
things that would otherwise go  
unnoticed.

	A	B	C	D	E	F
1	Past GDP	1870	1913	1950	1973	2003
2	Western Europe	367	902	1396	4096	7857
3	USA	98	517	1455	3536	8430
4	Japan	25	71	160	1242	2699
5	China	189	241	244	739	6187
6	India	134	204	222	494	2267
7	Africa	45	79	203	549	1322



“By visualizing information, we turn it into a landscape that you can explore with your eyes. A sort of information map. And when you’re lost in information, an information map is kind of useful.”

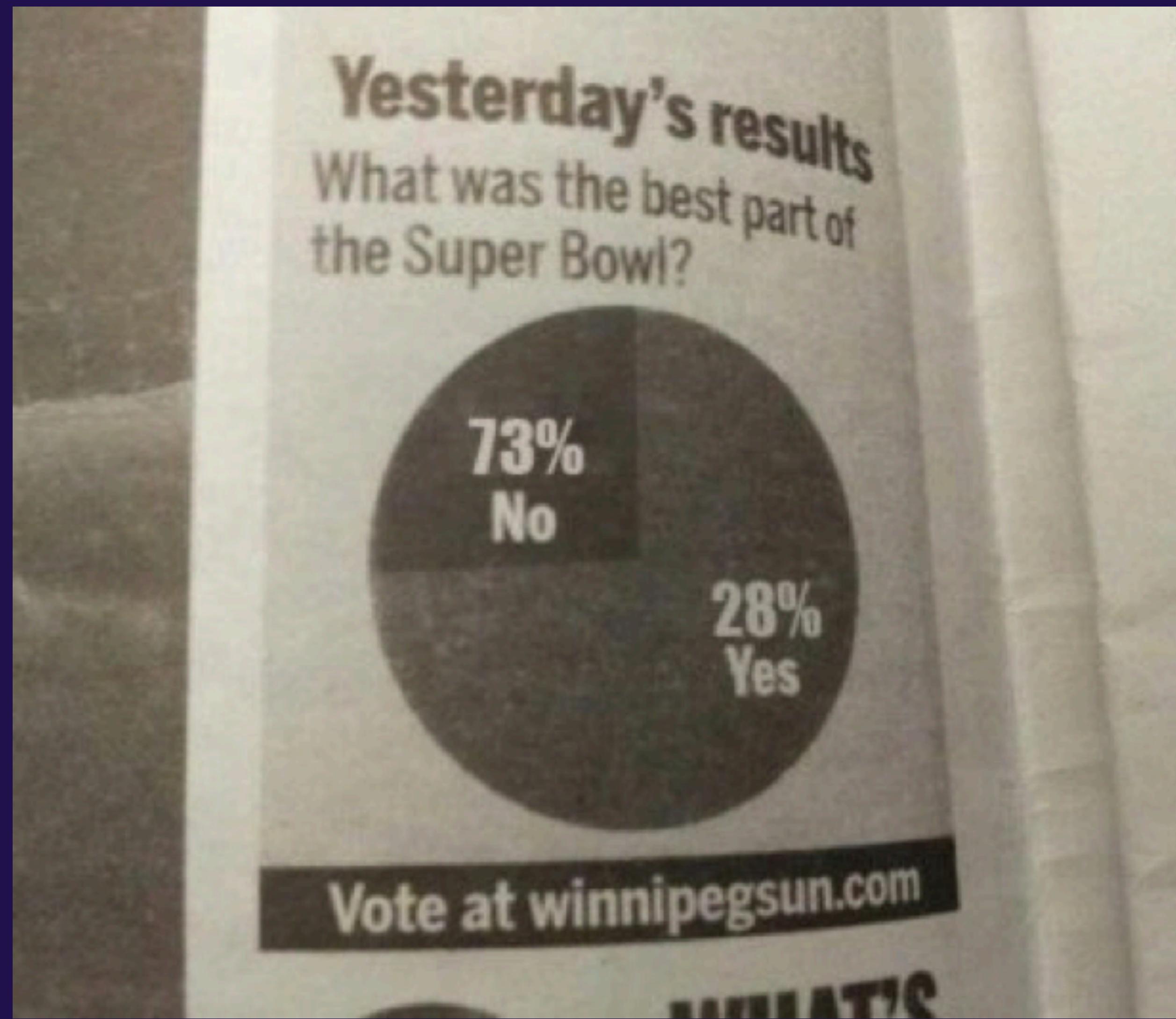
– David McCandless

# Open Street Maps



Think of visualization as a new  
set of **languages** you can use to  
communicate

# How **not** to do visualization ...



What makes a data visualization  
**effective** at communicating  
information?

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# Exercise:

1. What do you think is the **main point** or piece of information this visualization is trying to convey?
2. What **elements** of the visualization help you understand the information that is being conveyed?
3. What **elements** would you **change** or **improve** in order to make the meaning clearer?
4. What **general principles** about visualization design can you derive from your observations?

<https://etherpad.wikimedia.org/p/ata-dataviz-exercise1>

# Structure

1. 5 minutes: by yourself
2. 10 minutes: find a partner + discuss your answers
3. 10 minutes: find another team of 2 and collect best practices:  
<https://etherpad.wikimedia.org/p/ata-dataviz-exercise1>
4. 10 minutes: share with the group

<https://etherpad.wikimedia.org/p/ata-dataviz-exercise1>

# Reminders

1. Share space and time!
2. Listen to one another!
3. Encourage one another!
4. Use positive and inclusive language!

<https://etherpad.wikimedia.org/p/ata-dataviz-exercise1>

# Exercise:

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**Accessibility (n):**  
the quality of being  
easily understood  
or appreciated

# Individuals

- with low vision
  - with colour blindness
  - with screen readers
  - on the autistic spectrum
  - with anxiety
  - with dyslexia
  - ...
- 

**Accessibility (n):**  
the quality of being  
easily understood  
or appreciated

# Captions and Alt-Text

## Markdown

```
![Bar graph of quantity Y for each of the categories A, B and C.](./fig/mybarchart.png)
```

# Captions and Alt-Text

## Markdown

```
![Bar graph of quantity Y for each of the categories A, B and C.](./fig/mybarchart.png)
```

## HTML

```

```

# Captions and Alt-Text

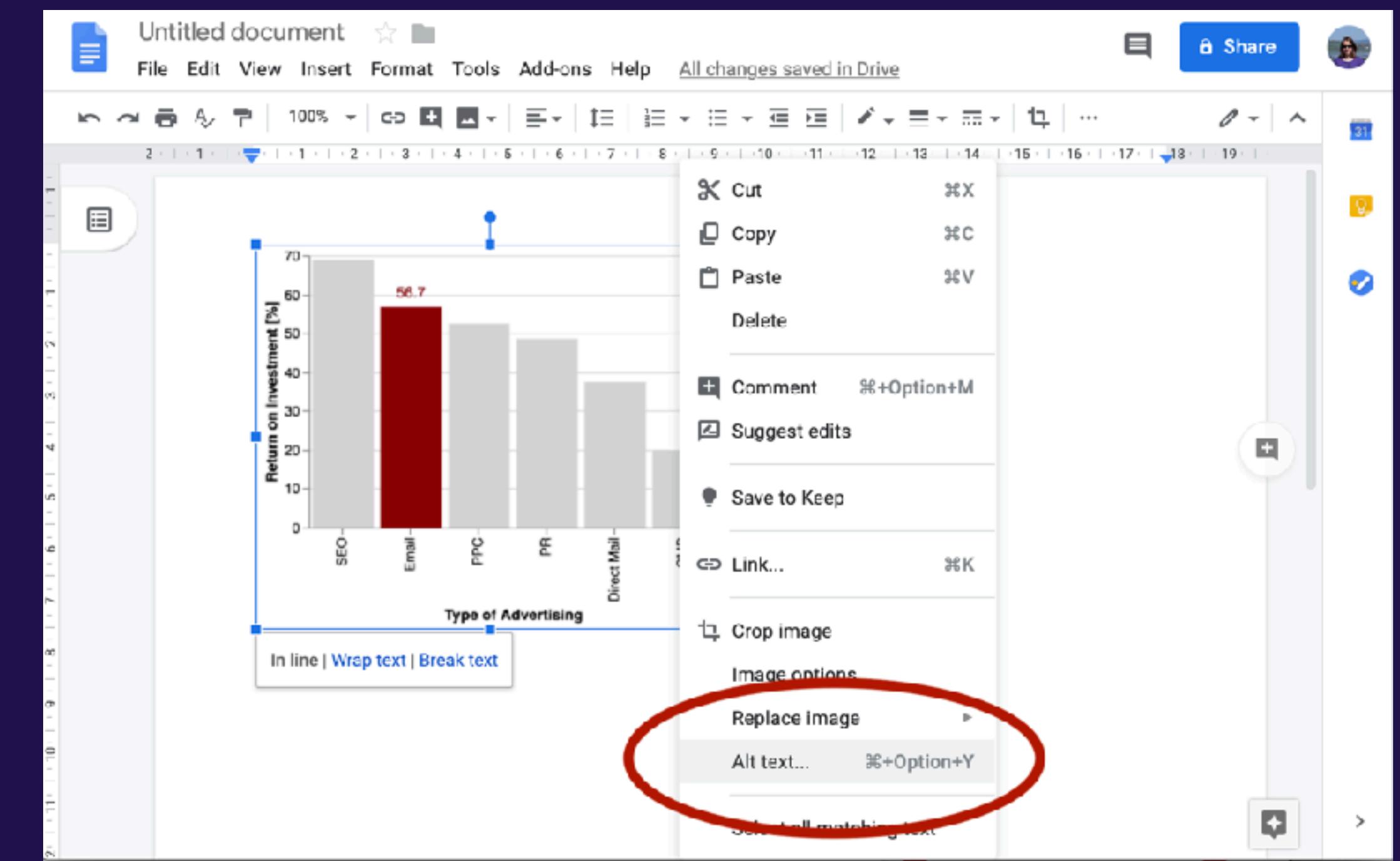
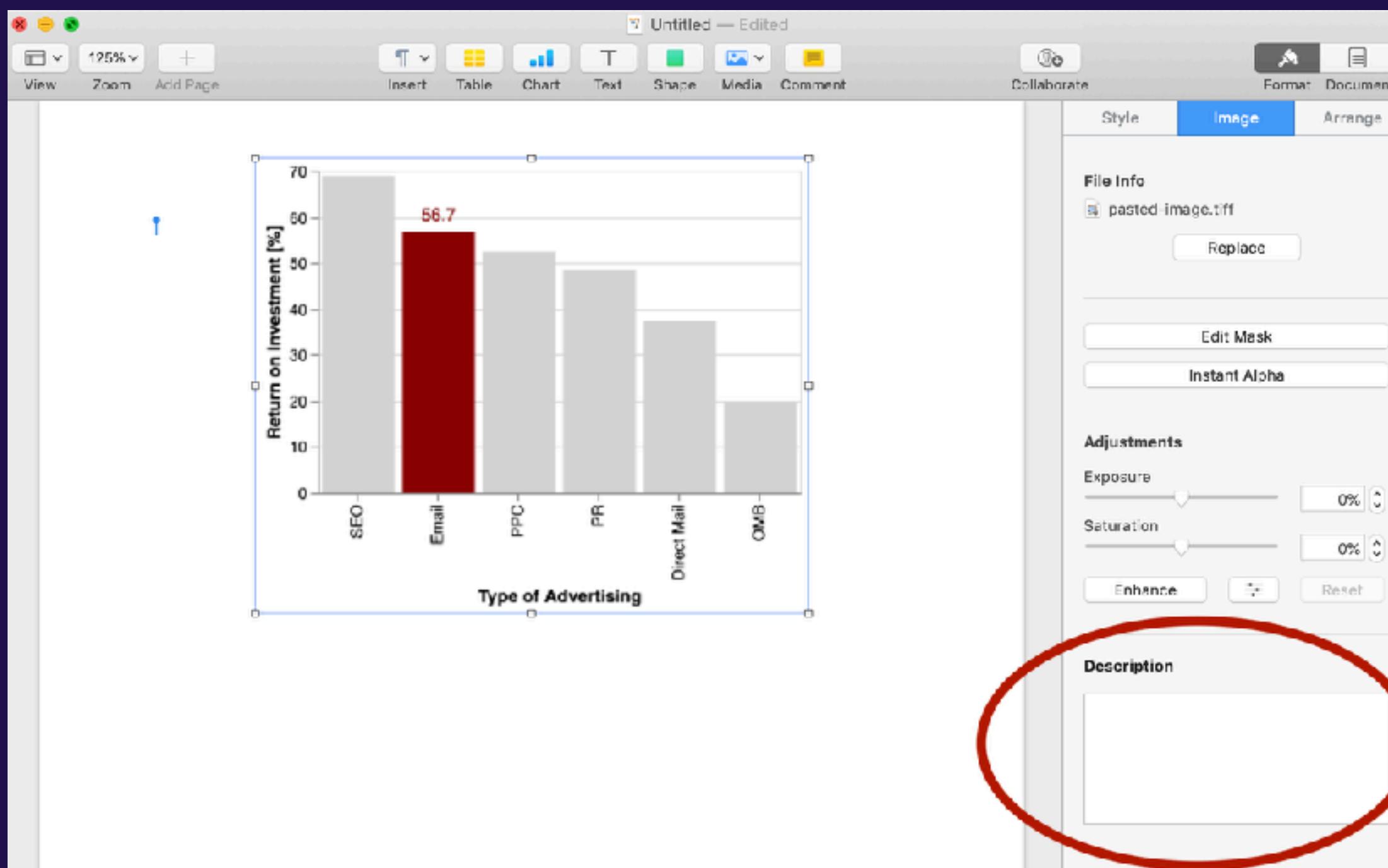
## Markdown

```
![Bar graph of quantity Y for each of the categories A, B and C.](./fig/mybarchart.png)
```

## HTML

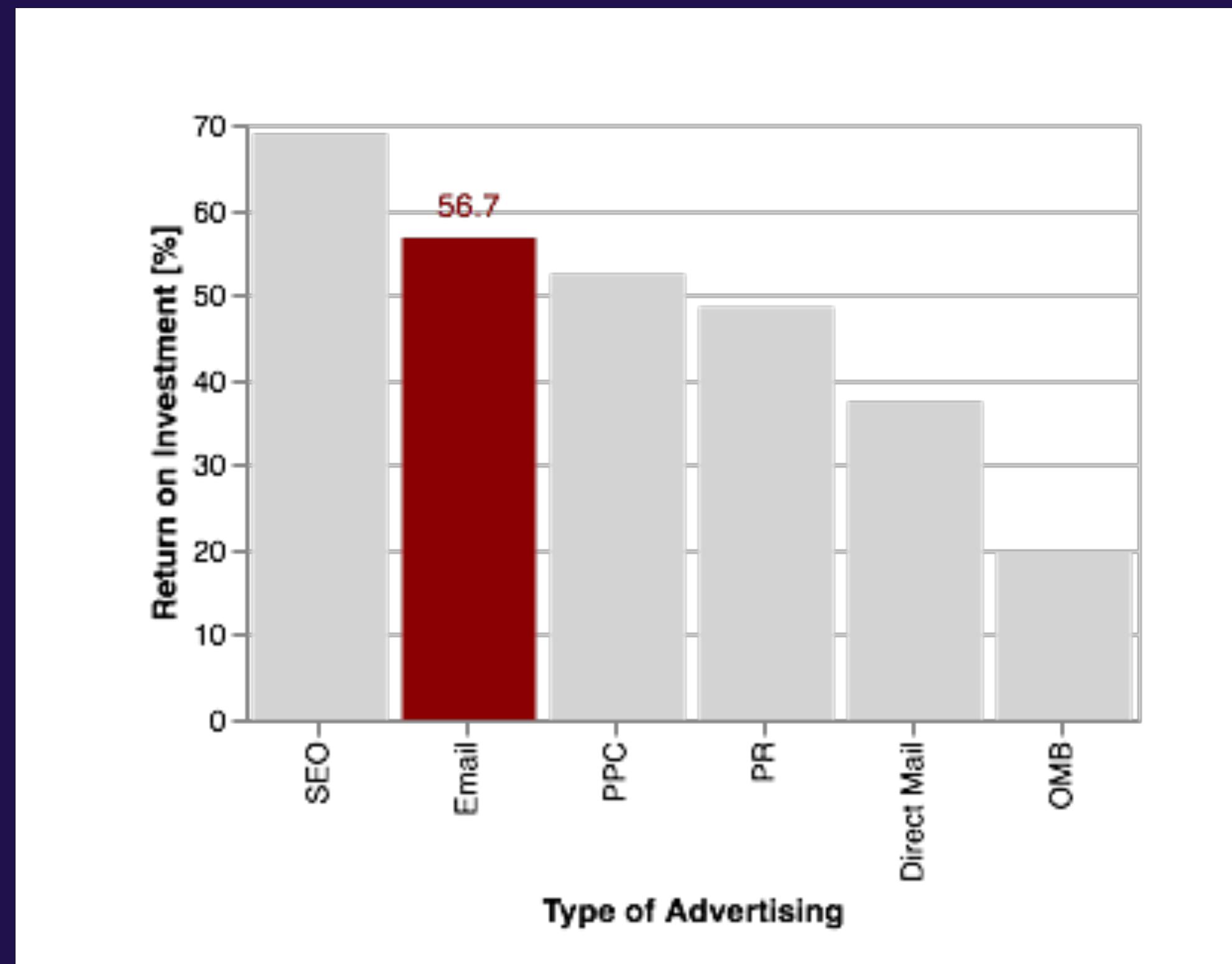
```

```



# Write Descriptive Figure Caption

- describe what's **shown** in the figure
- describe the **main point** to take away from it



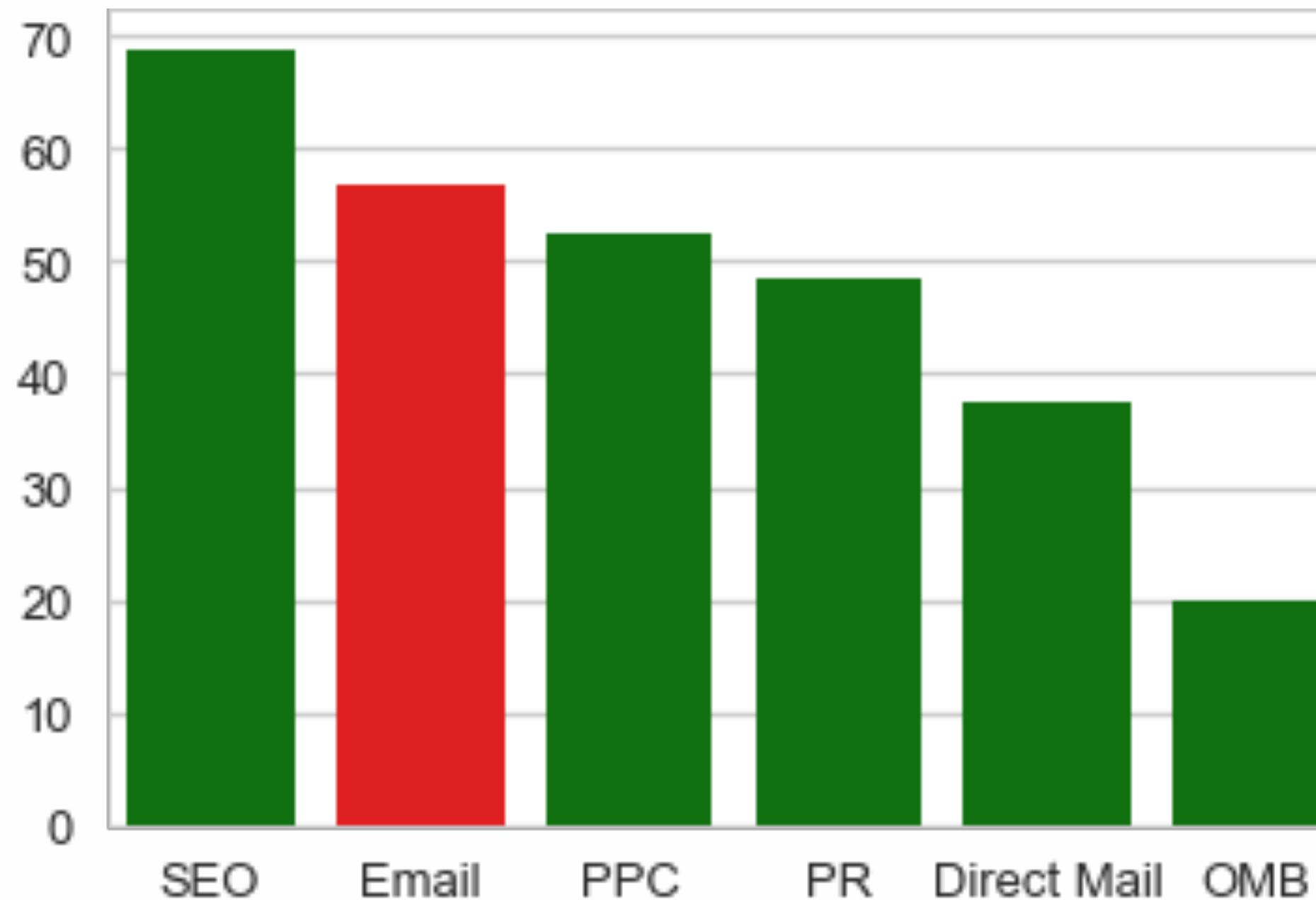
"In this figure, we show the Return of Investment in percent as a function of the type of advertisement for SEO, E-mail, PPC, PR, Direct Mail and OMB. Our results show that E-mail is the second-most effective advertising tool behind SEO, with a 56.7% ROI."

# Contrast

<https://webaim.org/resources/contrastchecker/>

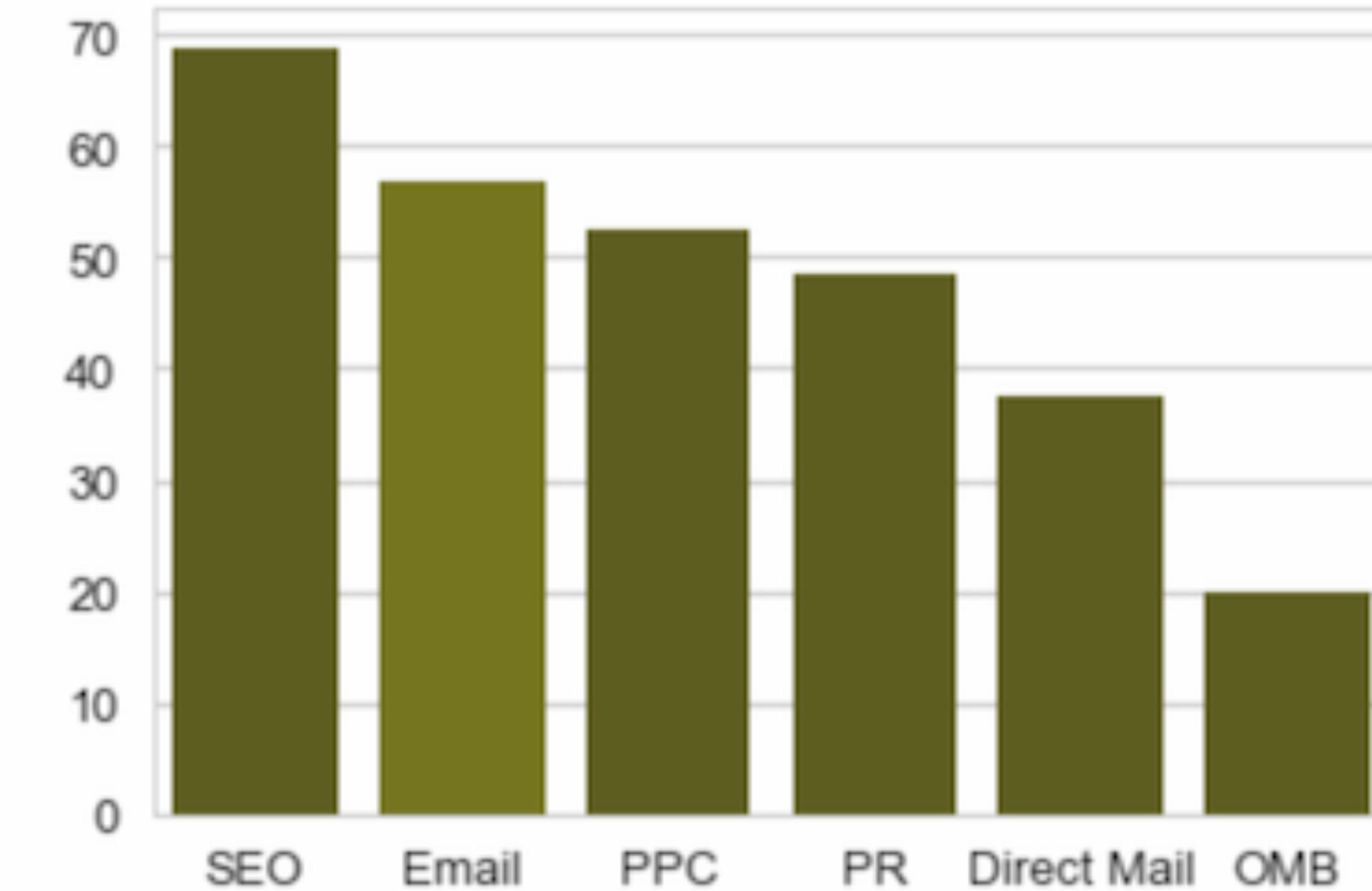
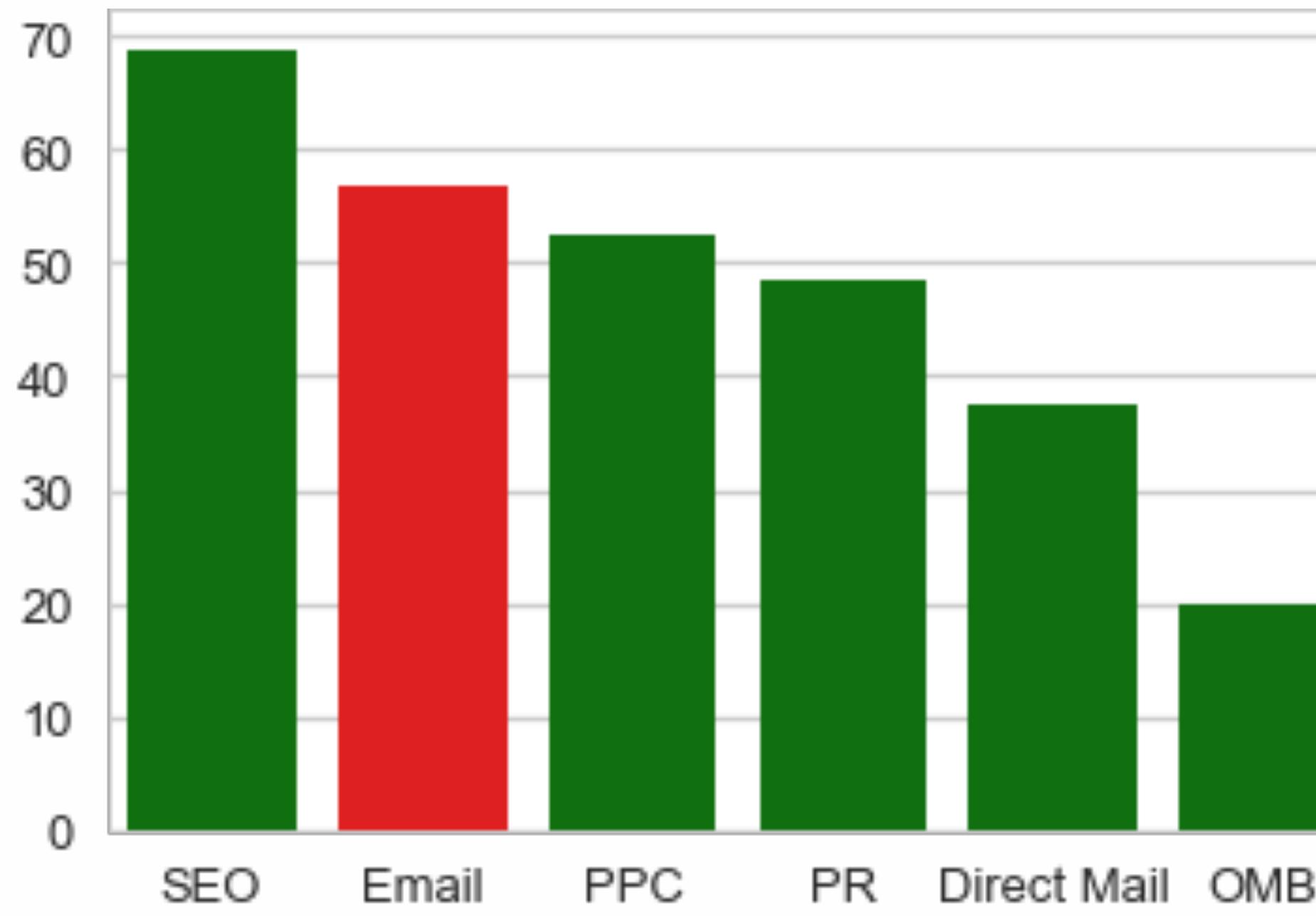
# Colour Blindness

Can you spot the bar that has a different colour?



# Colour Blindness

Can you spot the bar that has a different colour?



<https://ukhomeoffice.github.io/accessibility-posters/>

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Visualization is about managing  
the viewer's attention\*.

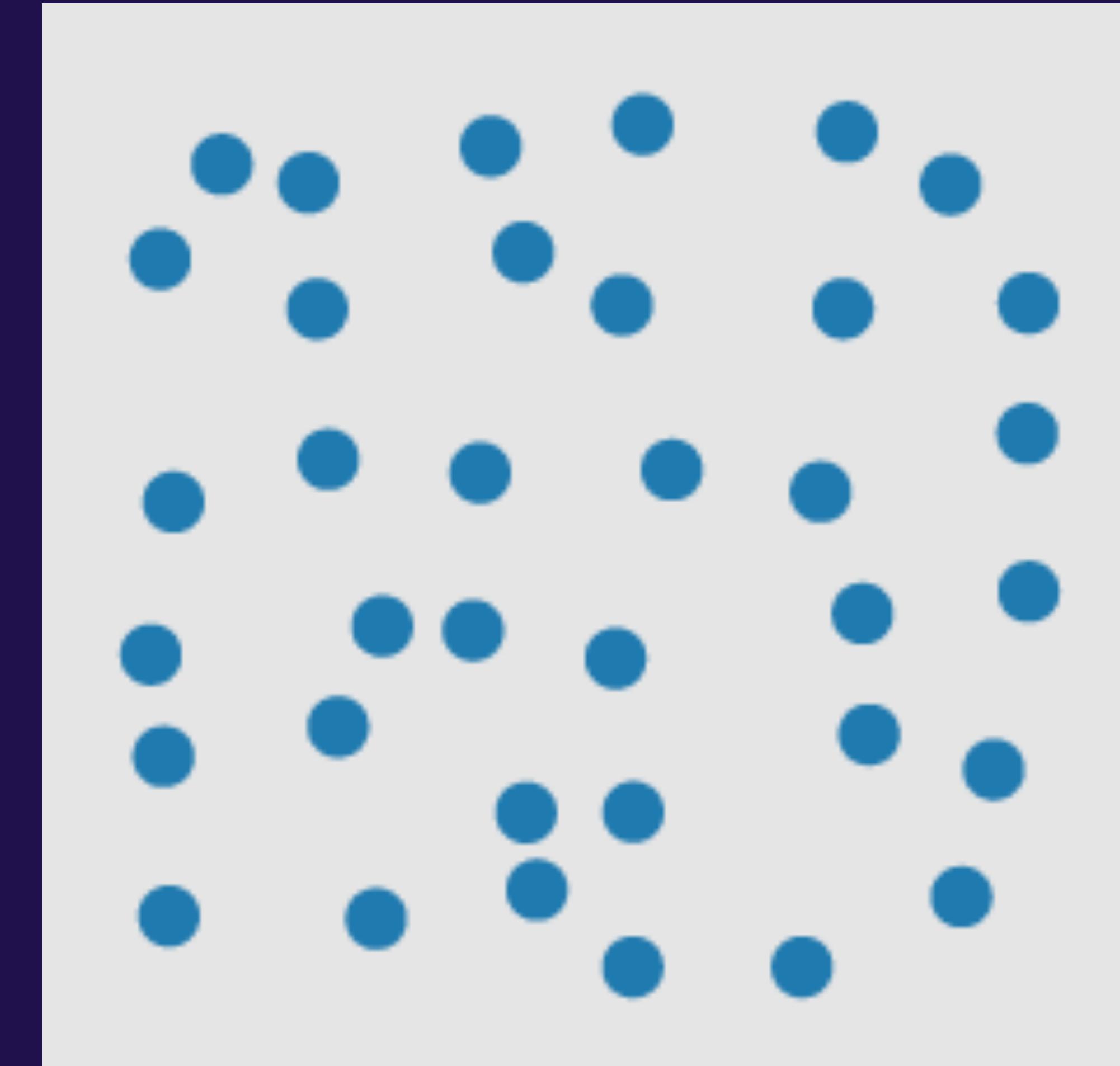
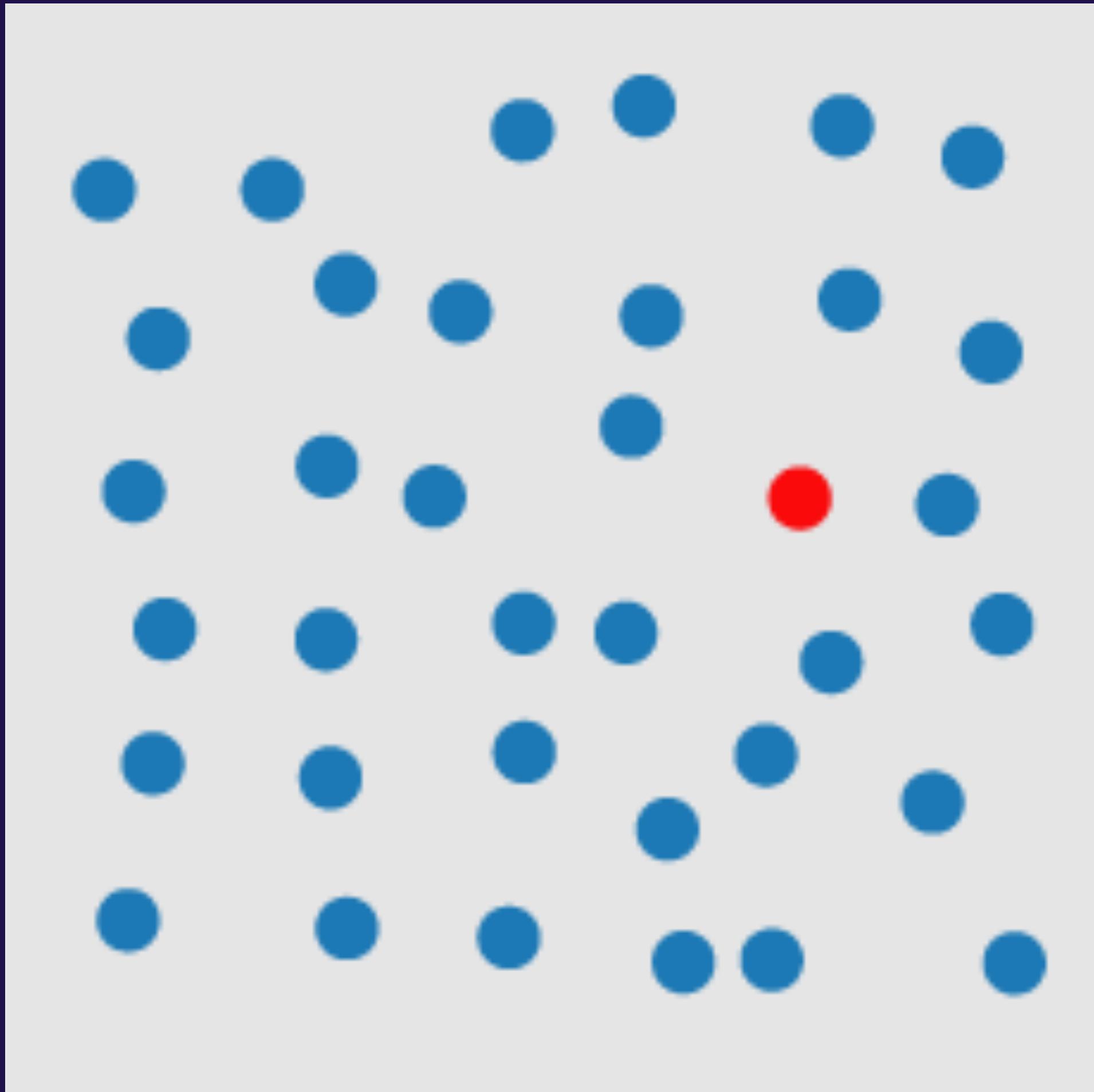
\*Side note: research tells us that there is no vision without attention

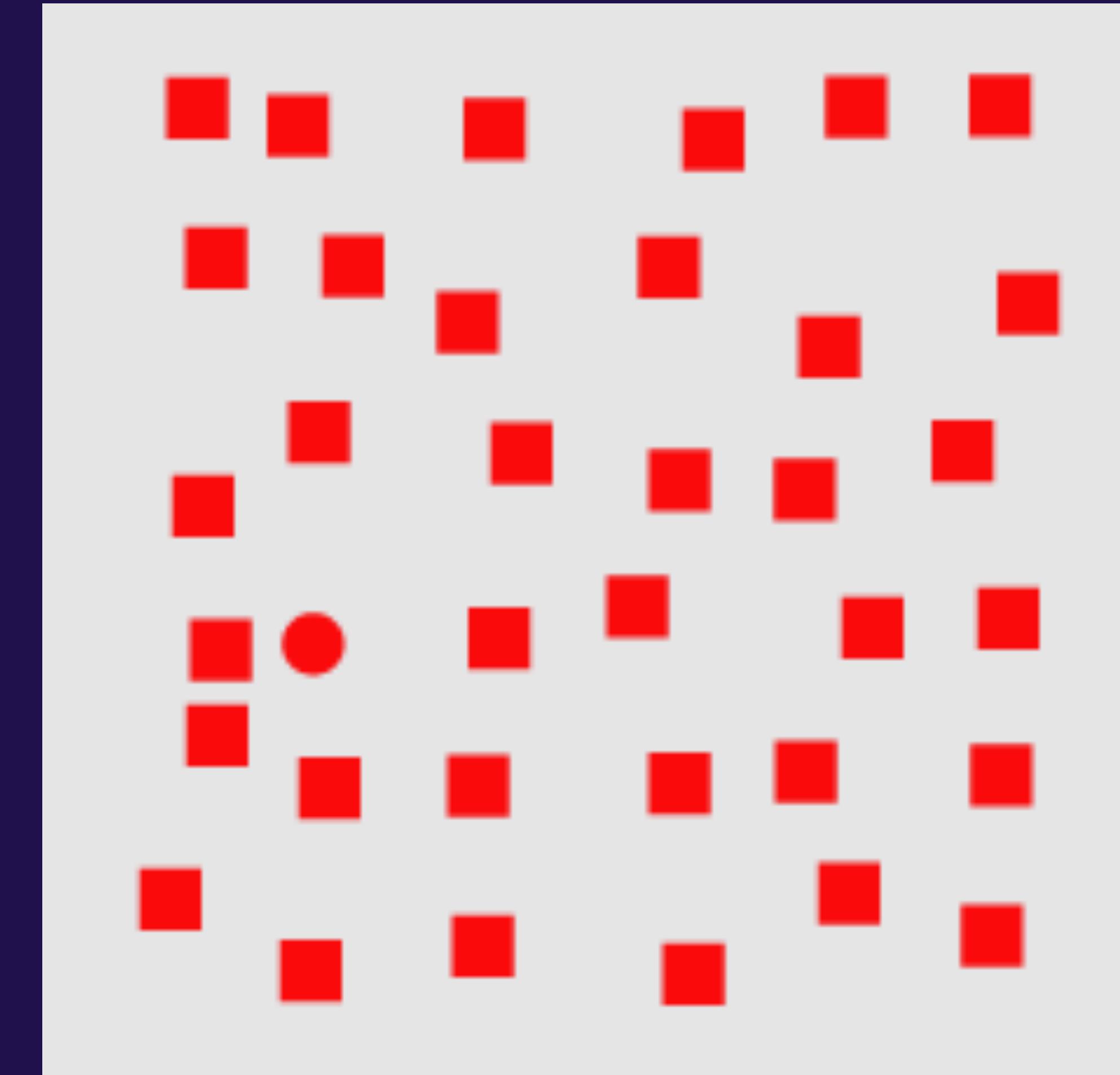
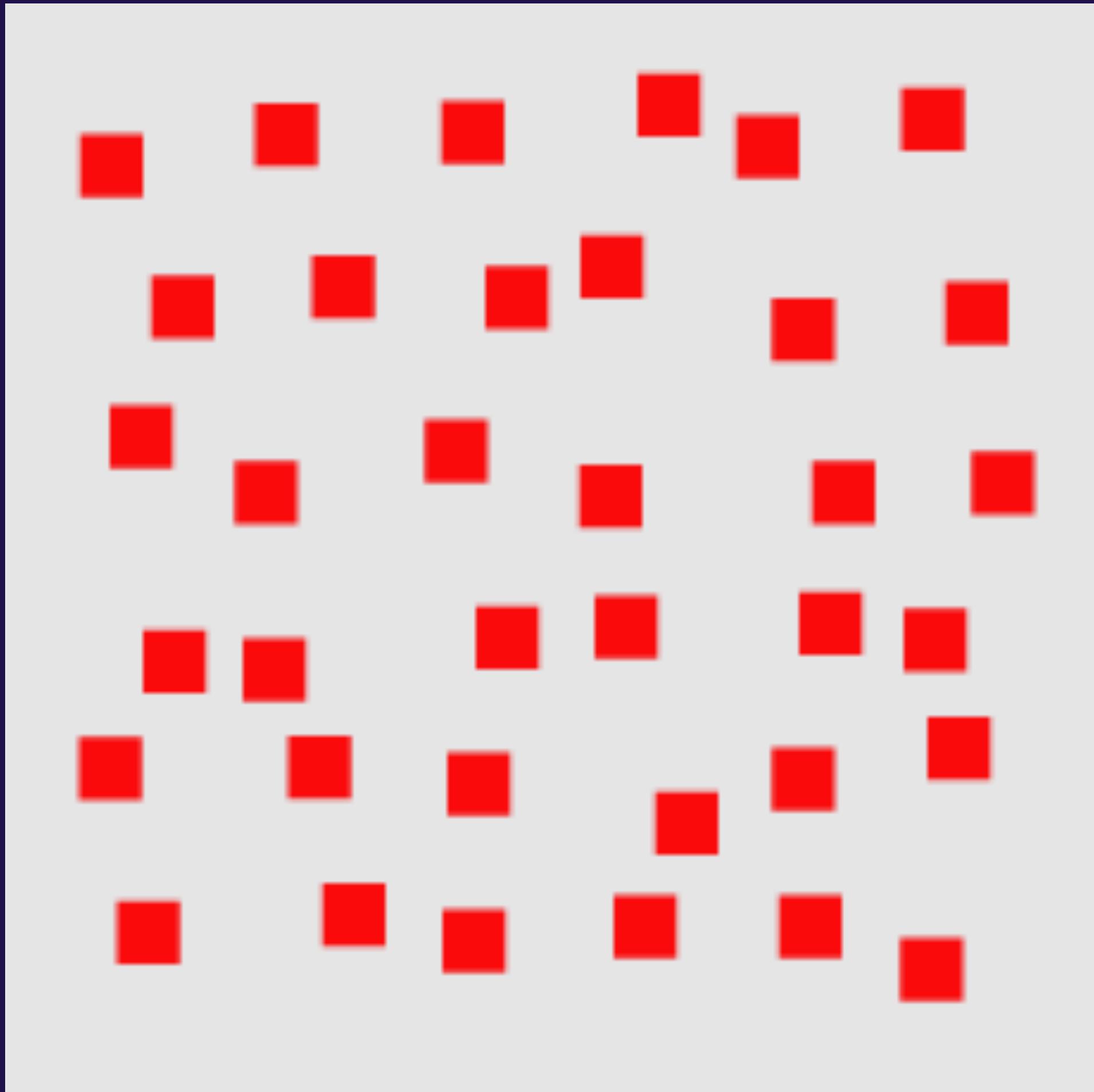


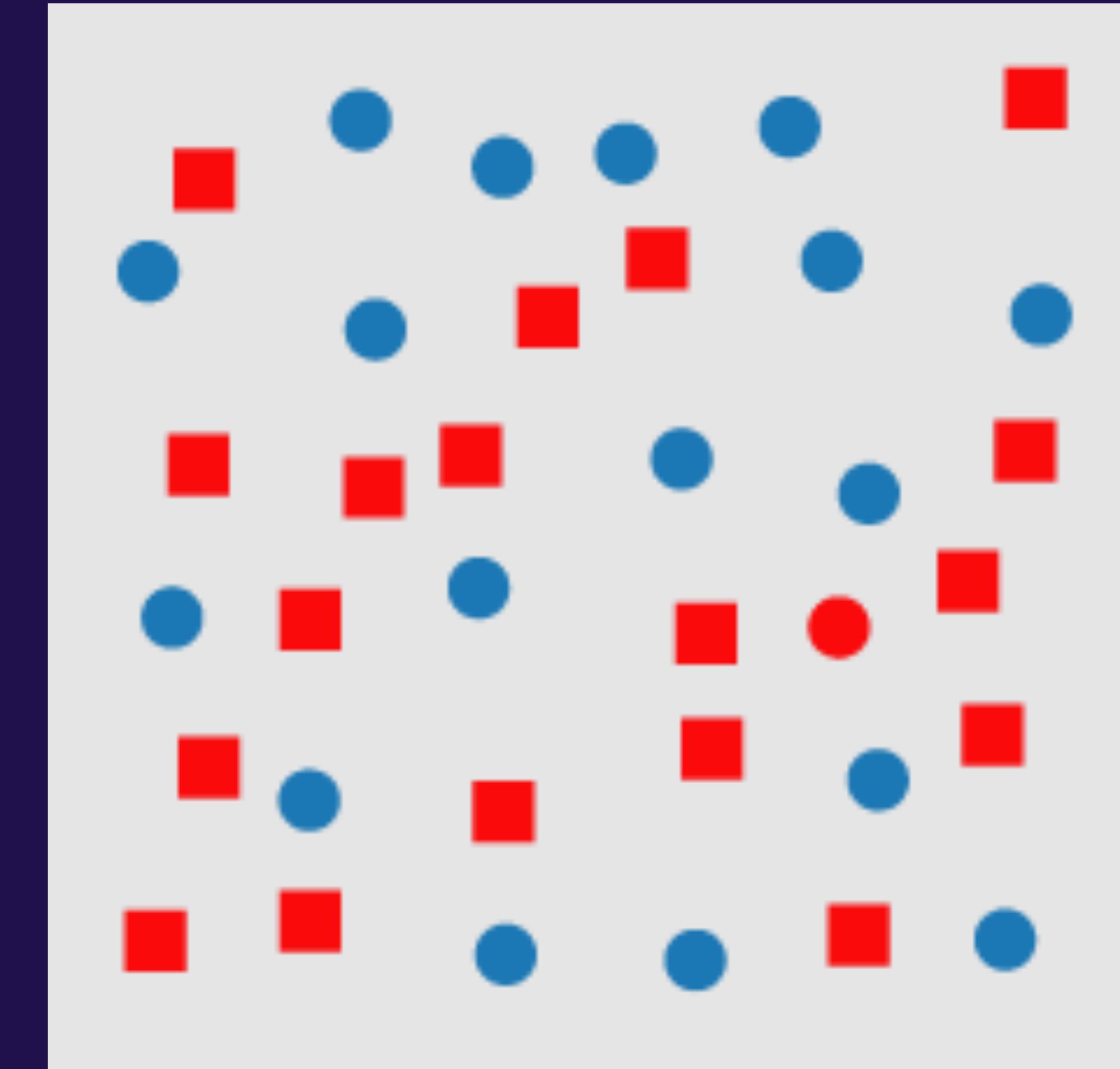
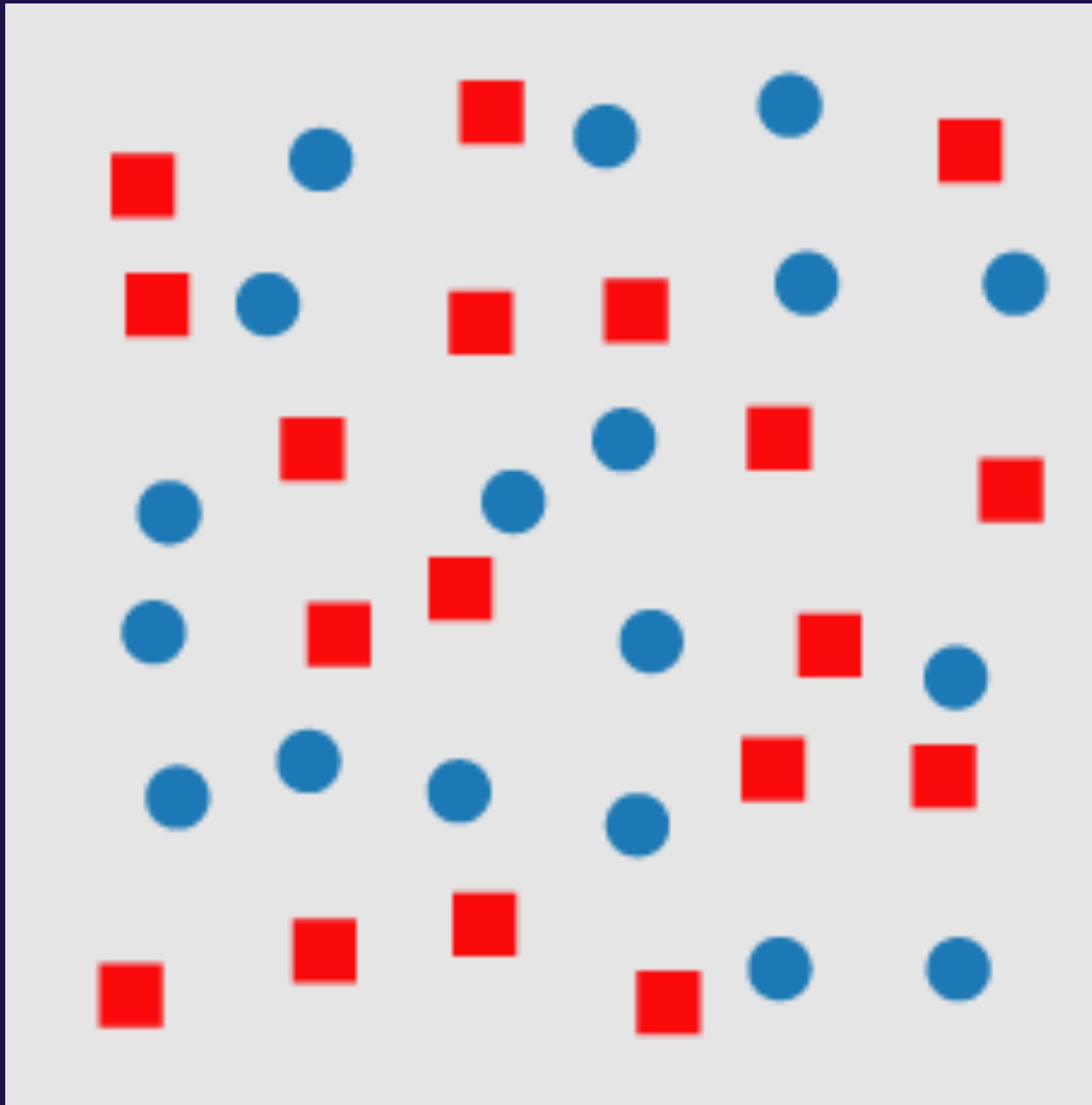
**pre-attentive processing**

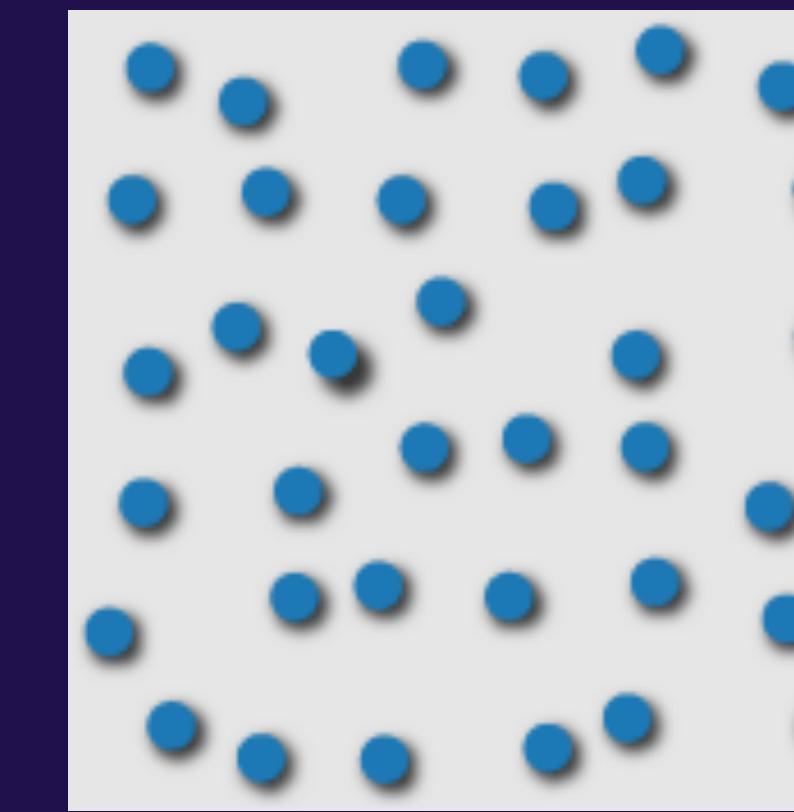
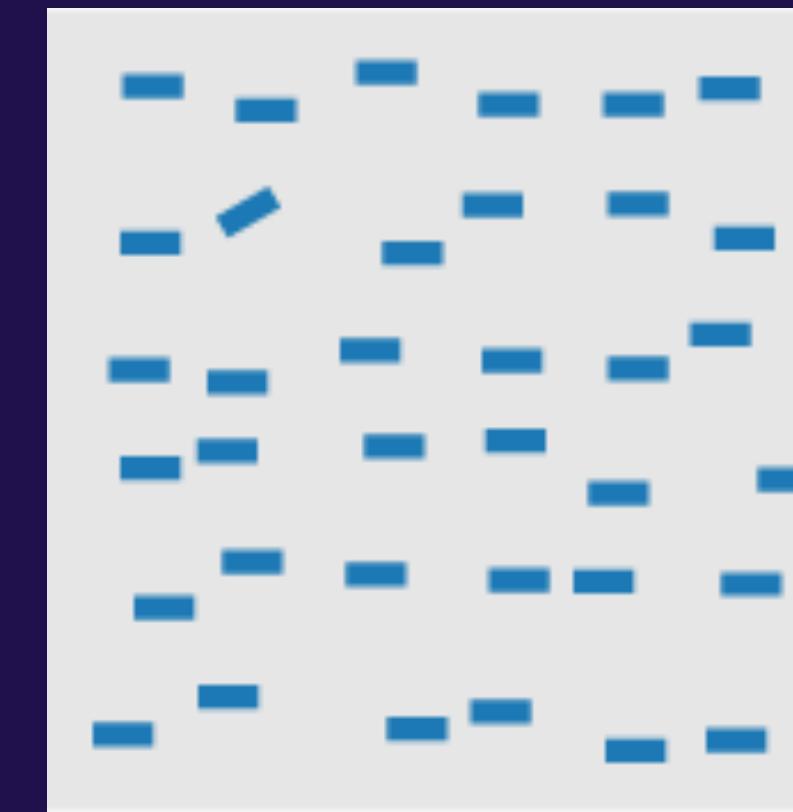
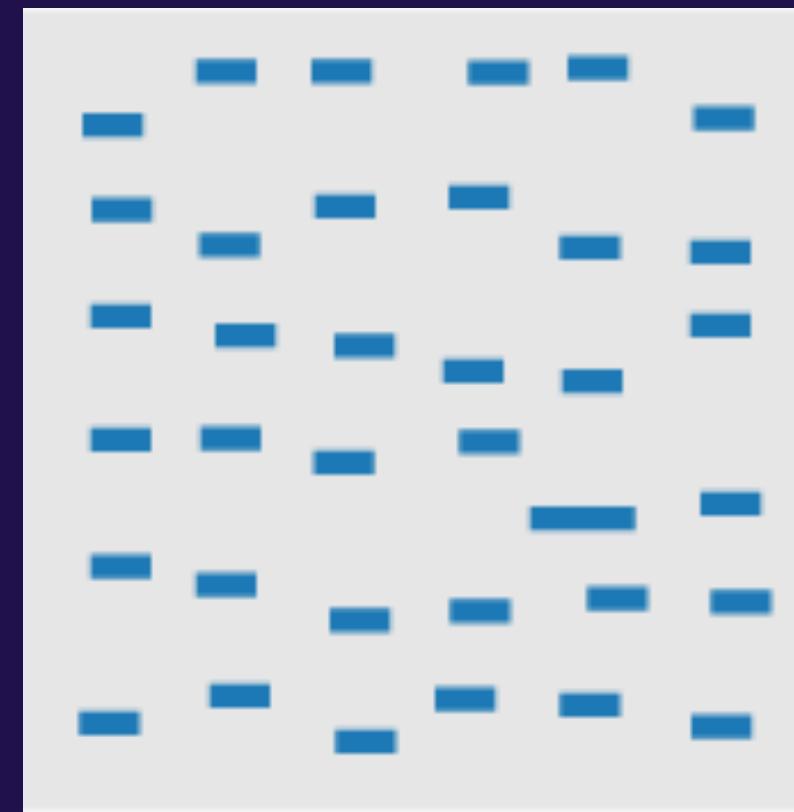
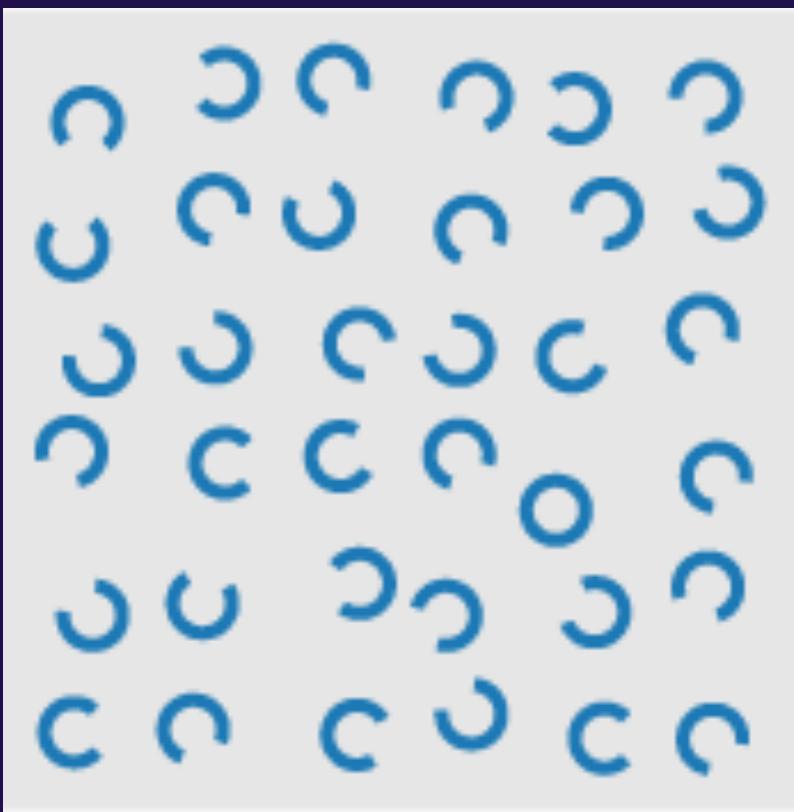
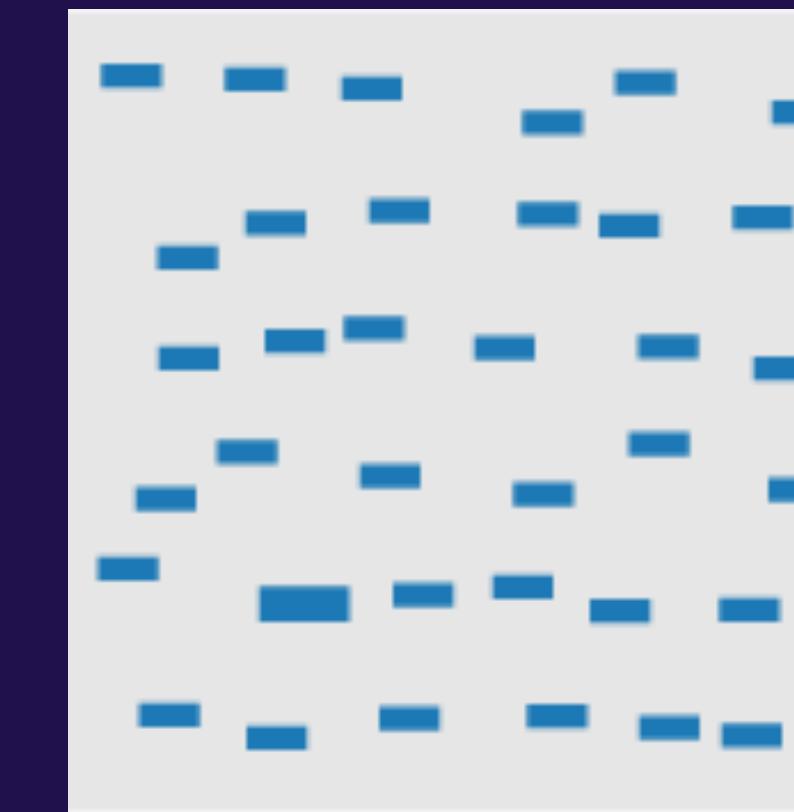
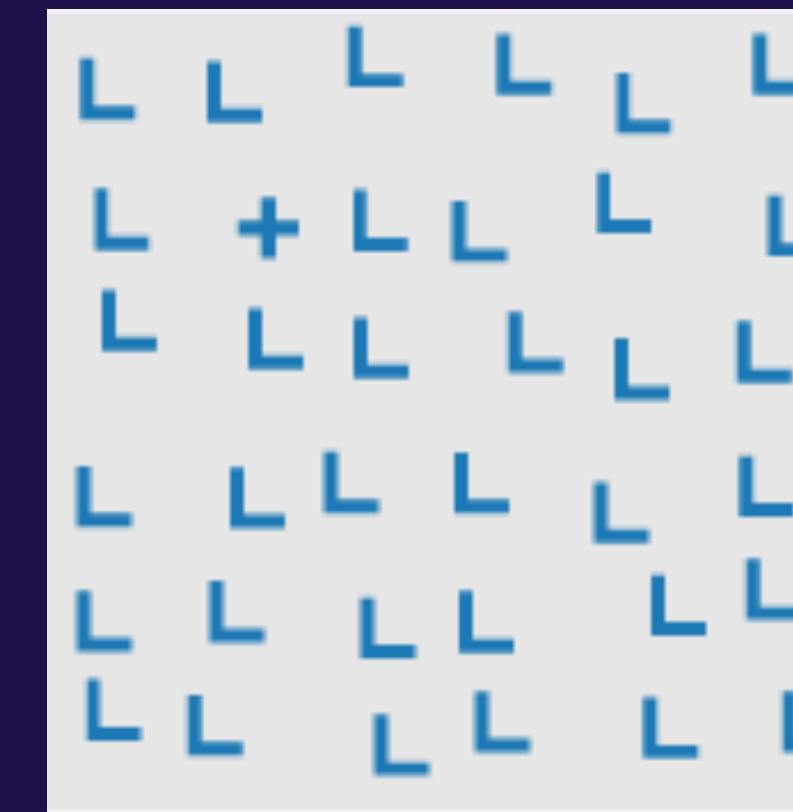
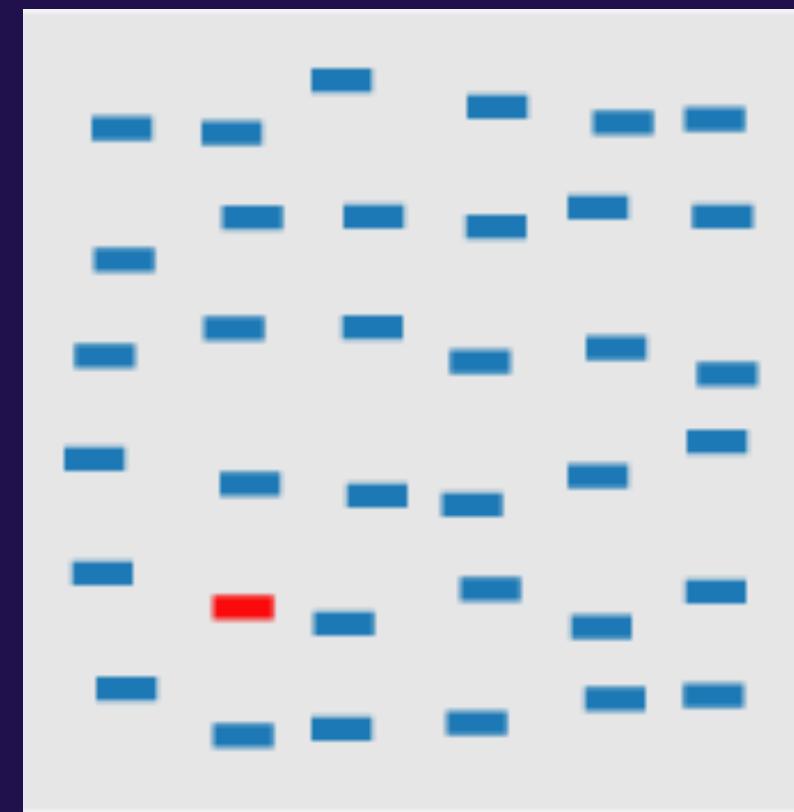
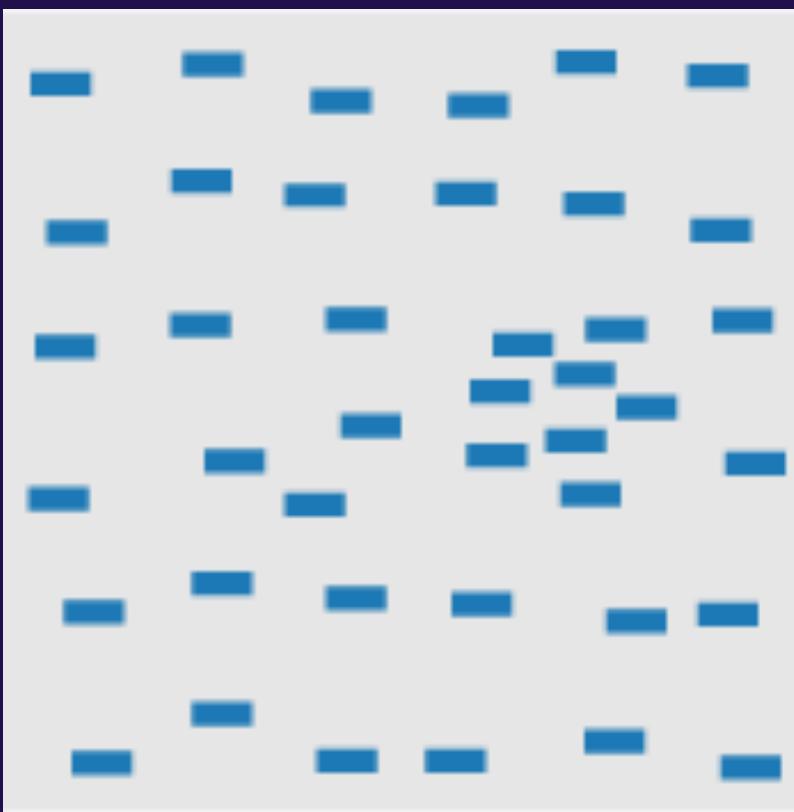
# Let's do an experiment ...

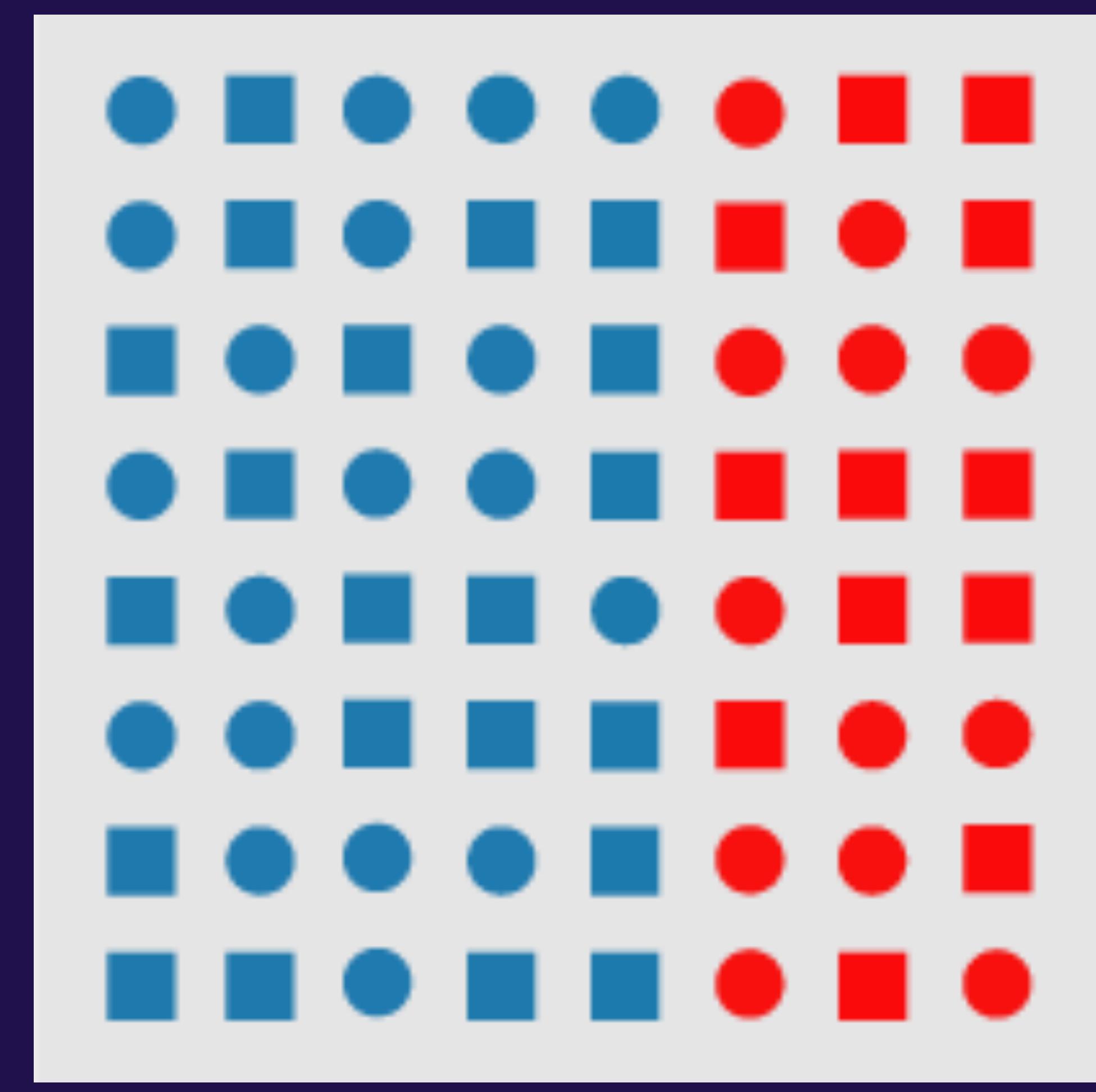
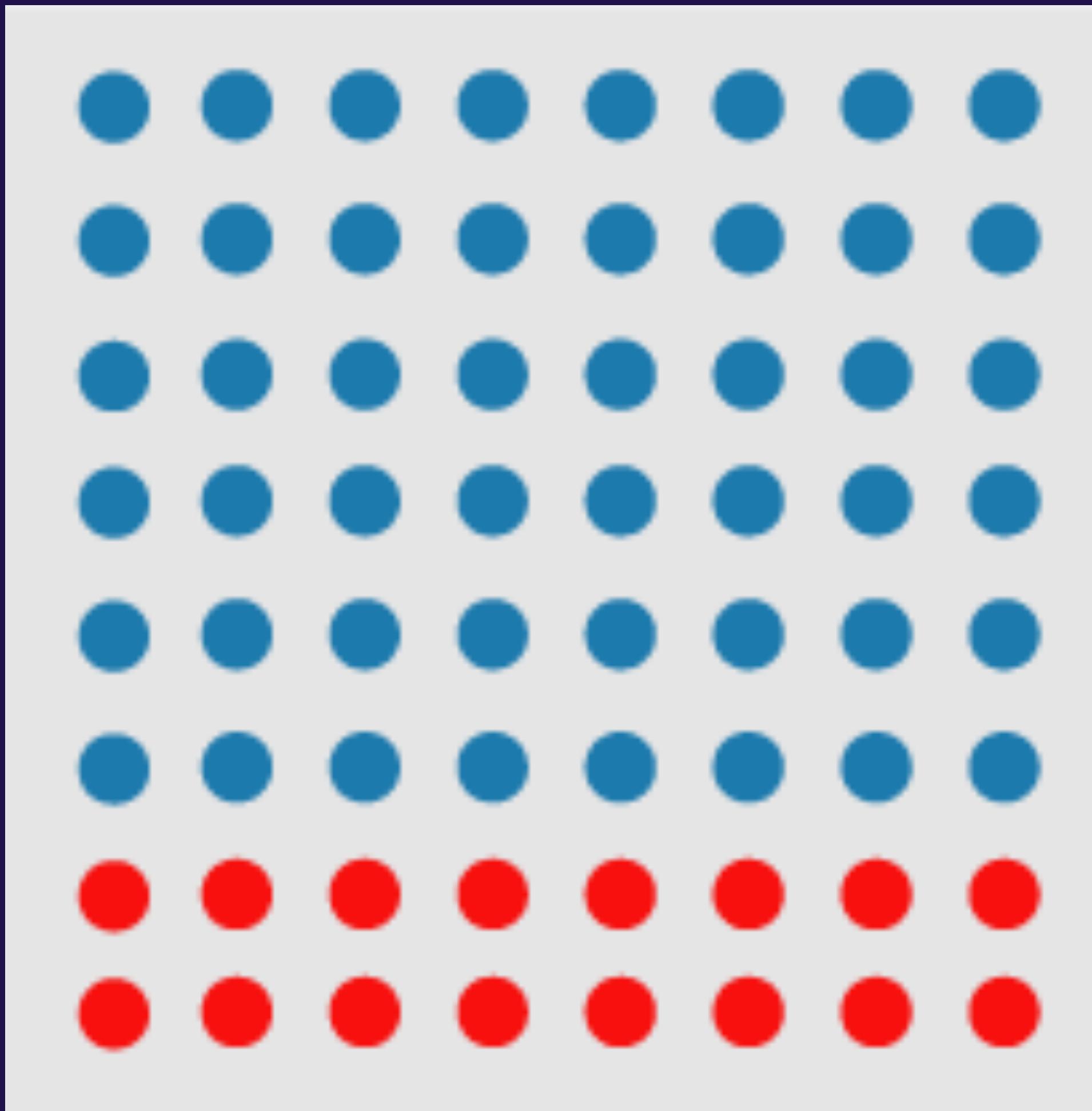
<https://www.csc2.ncsu.edu/faculty/healey/PP/>

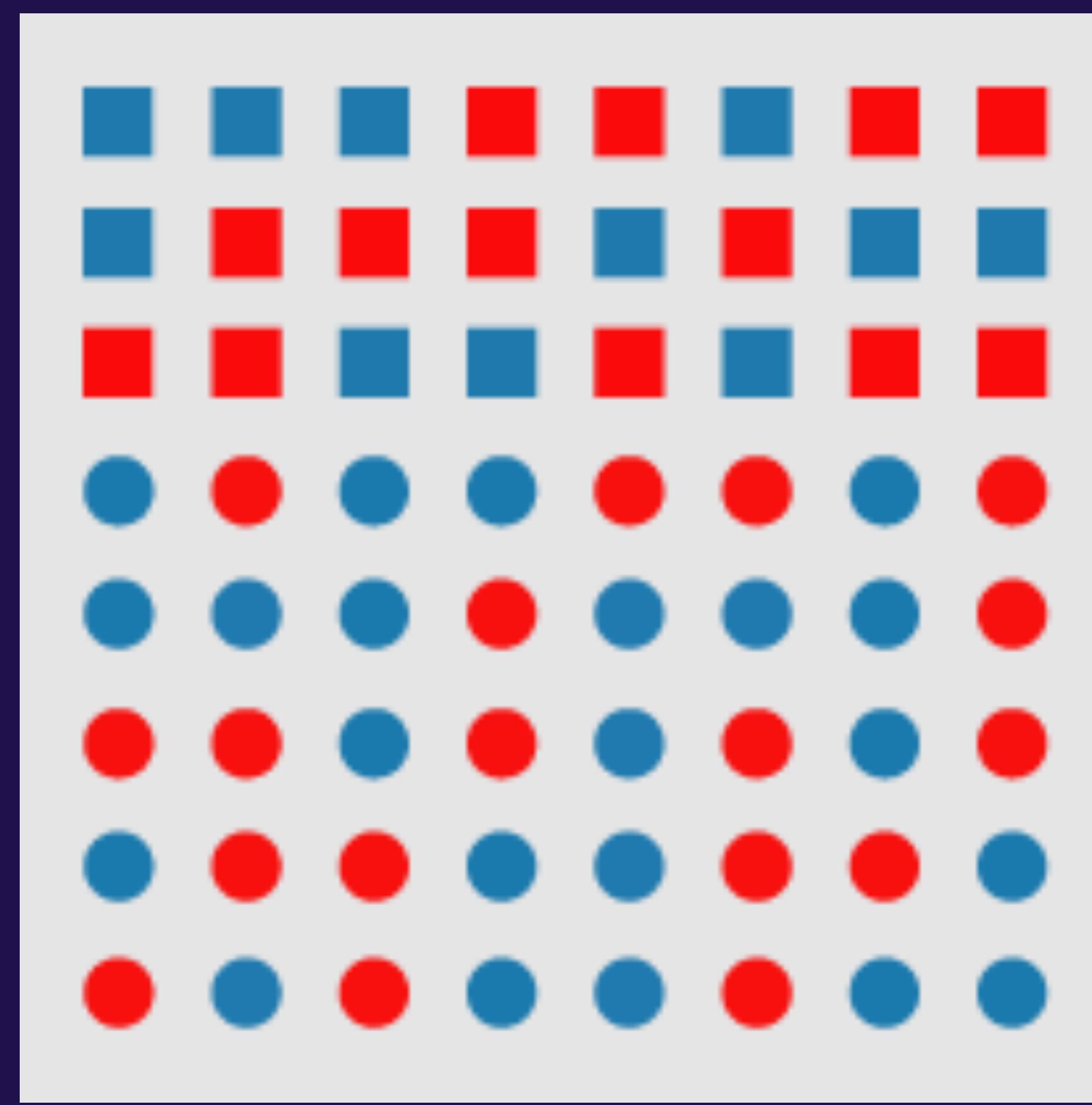
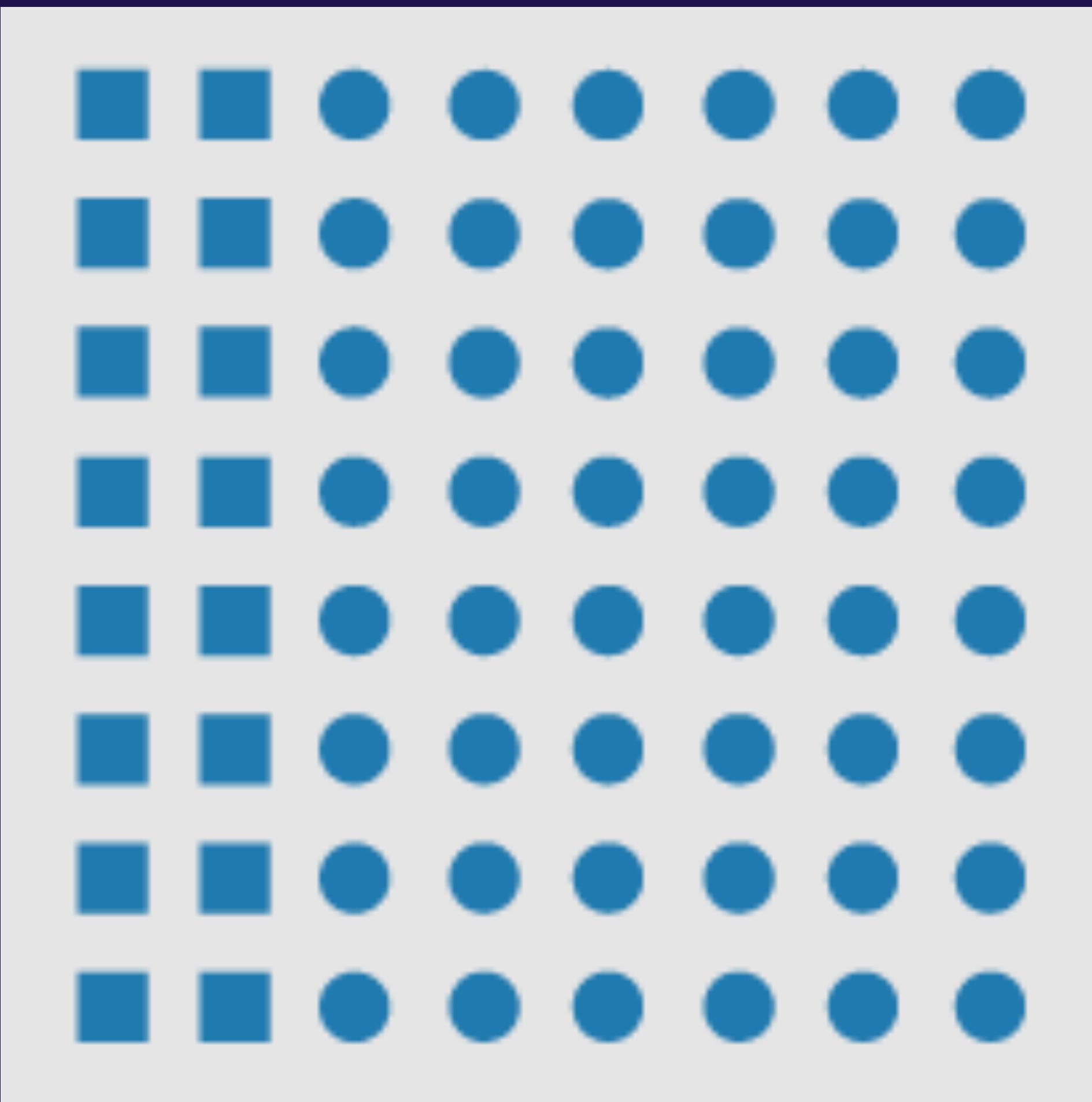






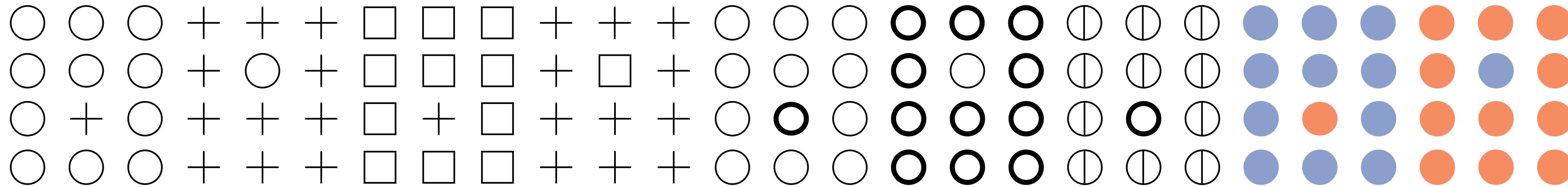




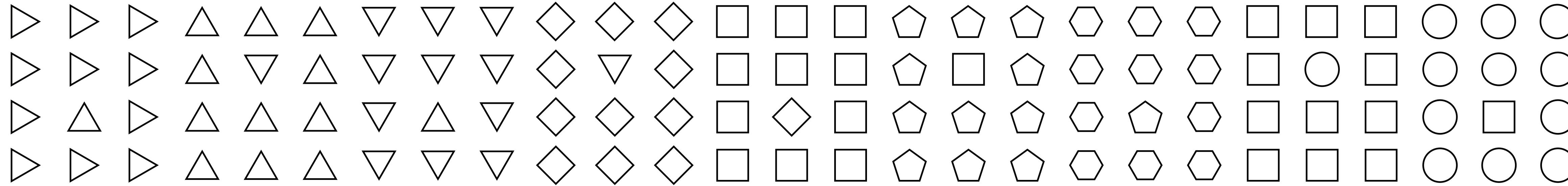


# Choose strong visual boundaries

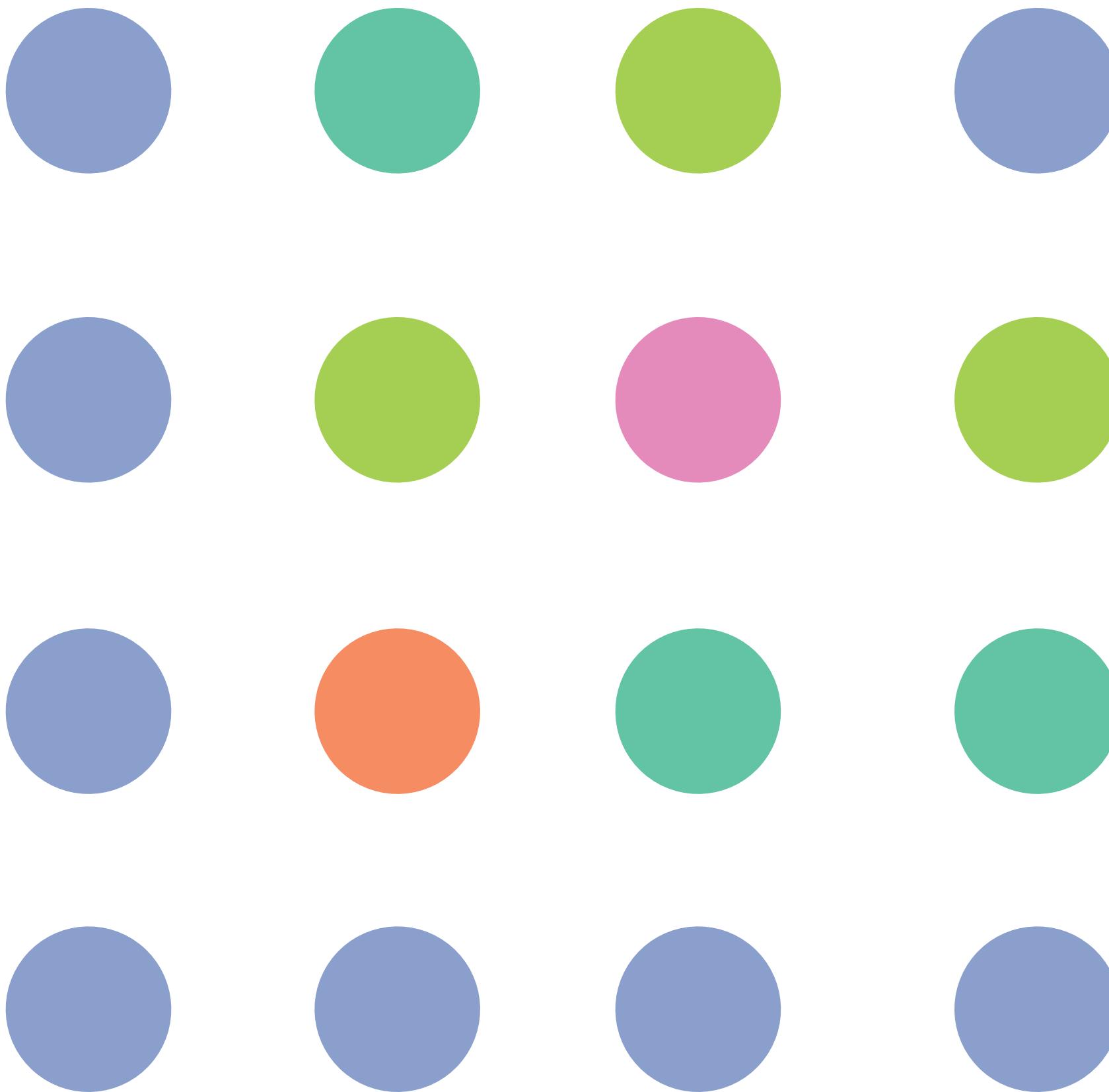
Strong visual boundaries



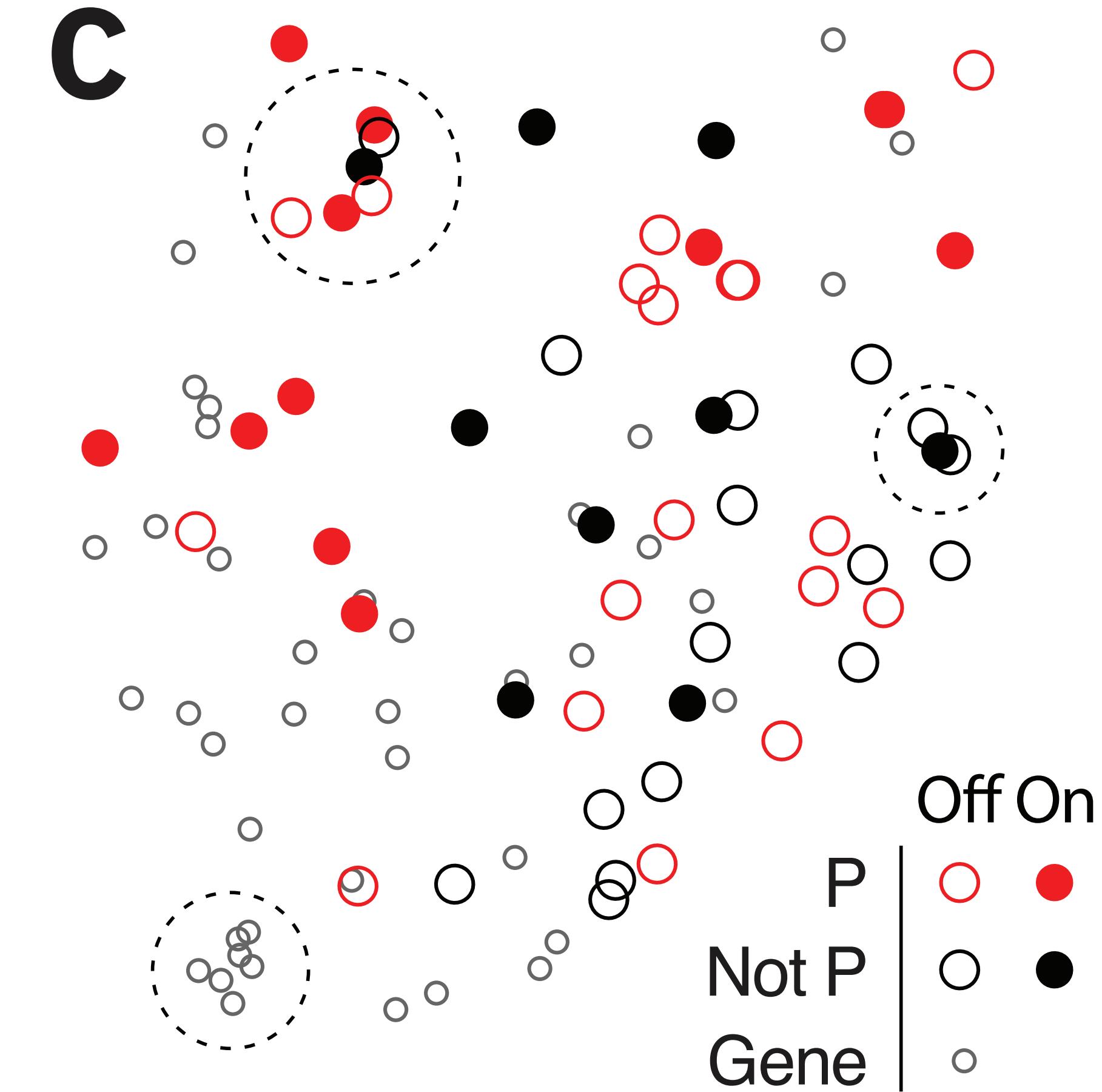
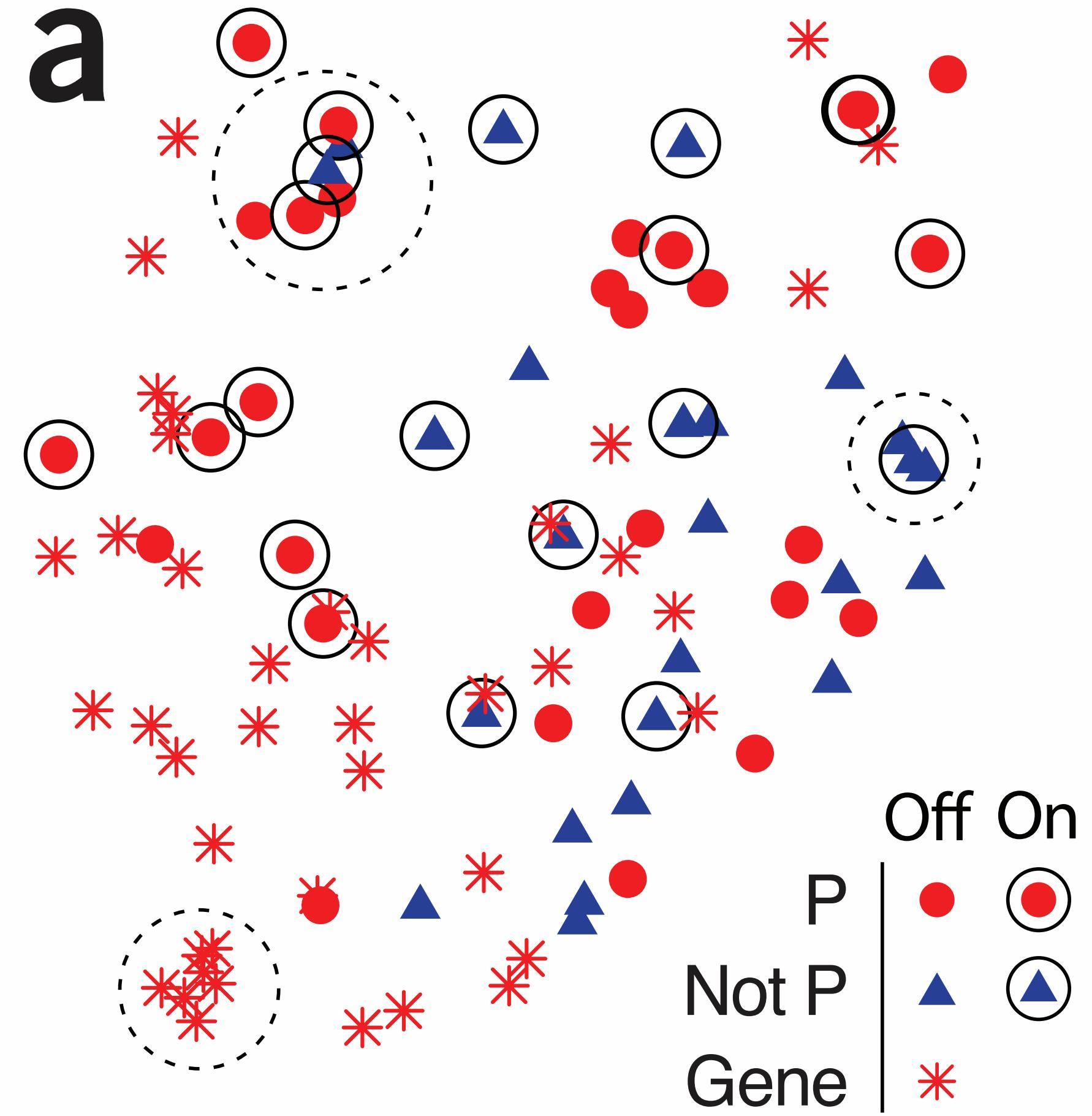
Weak visual boundaries



# Use Colour Judiciously



# Represent Data Hierarchies



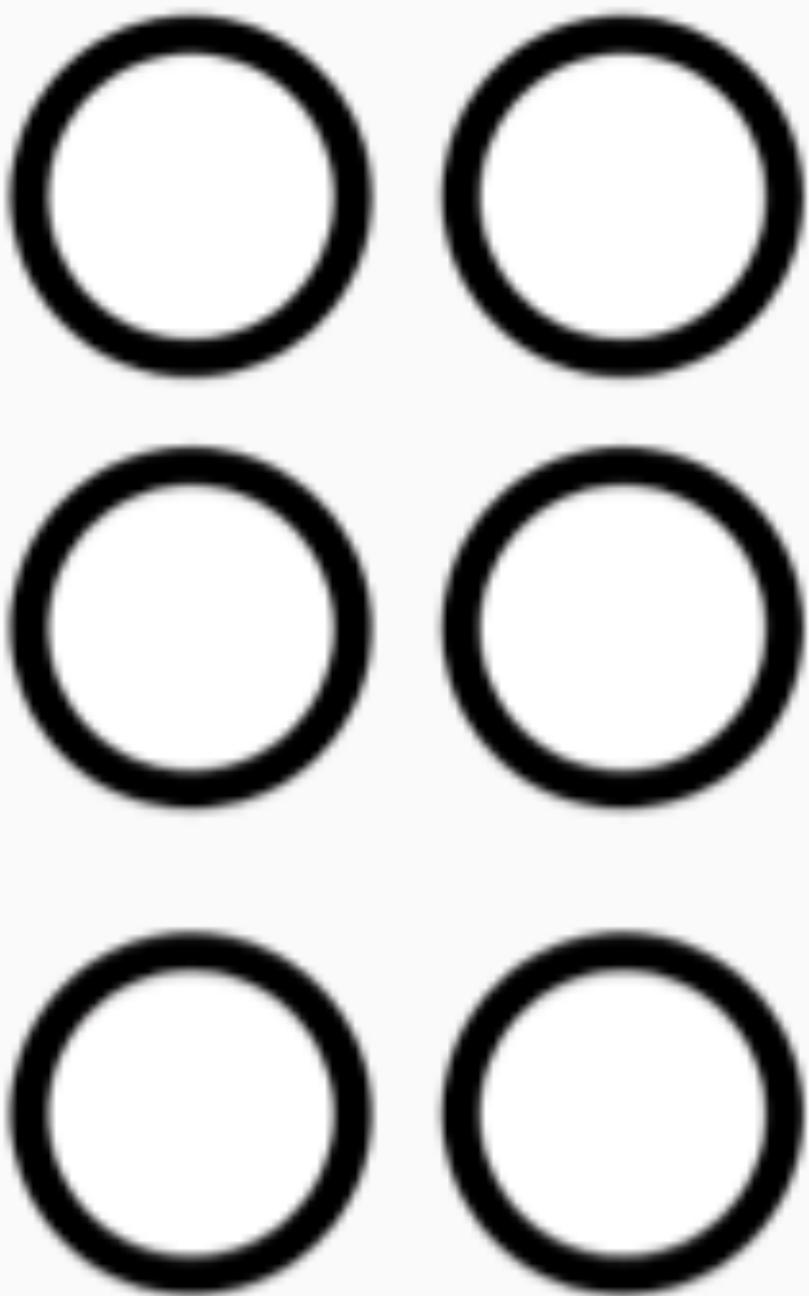
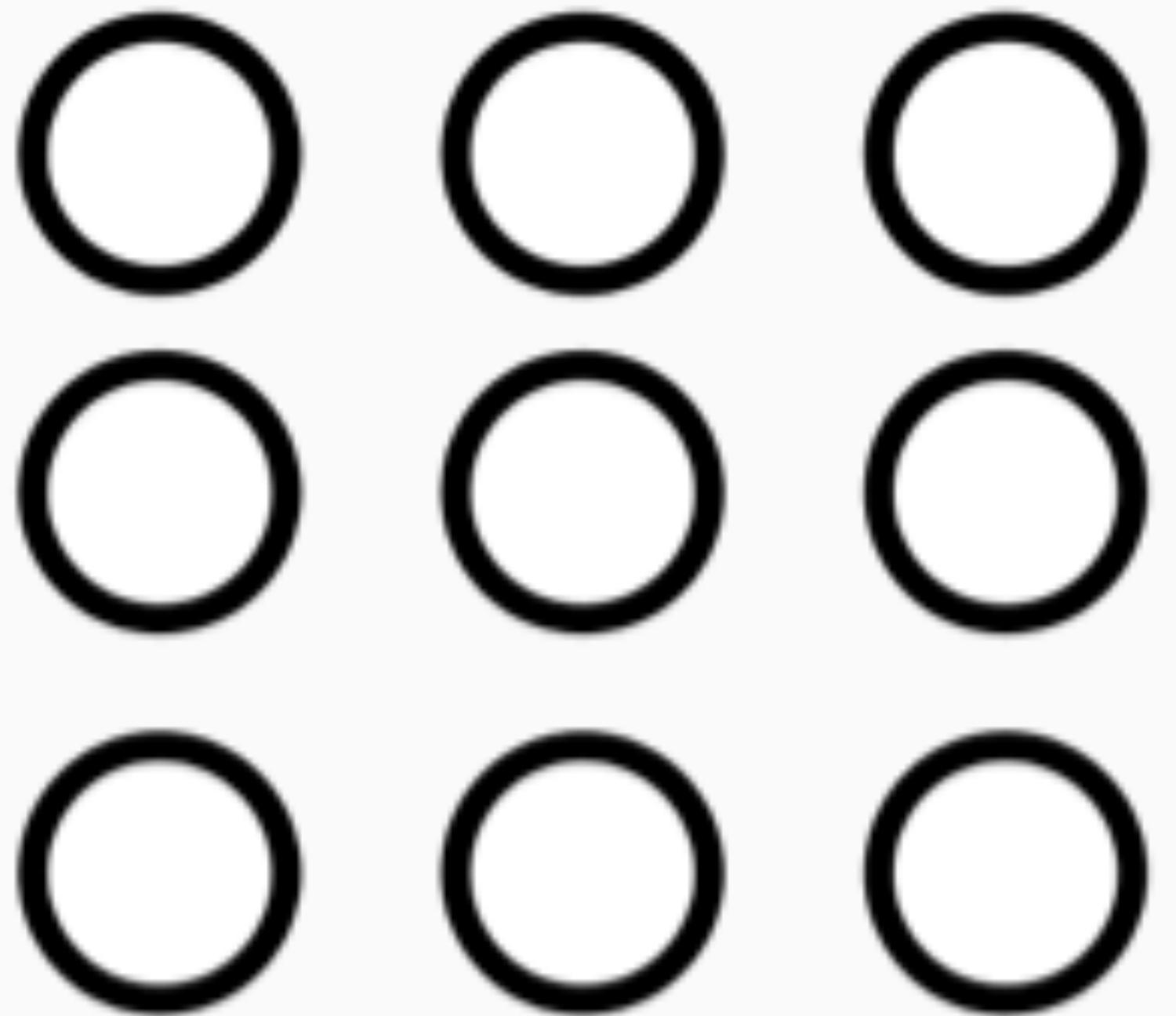
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# Gestalt Principles

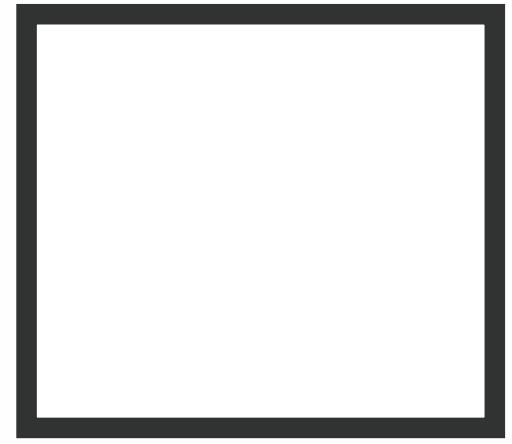


**“The whole is  
different from the  
sum of its parts.”**

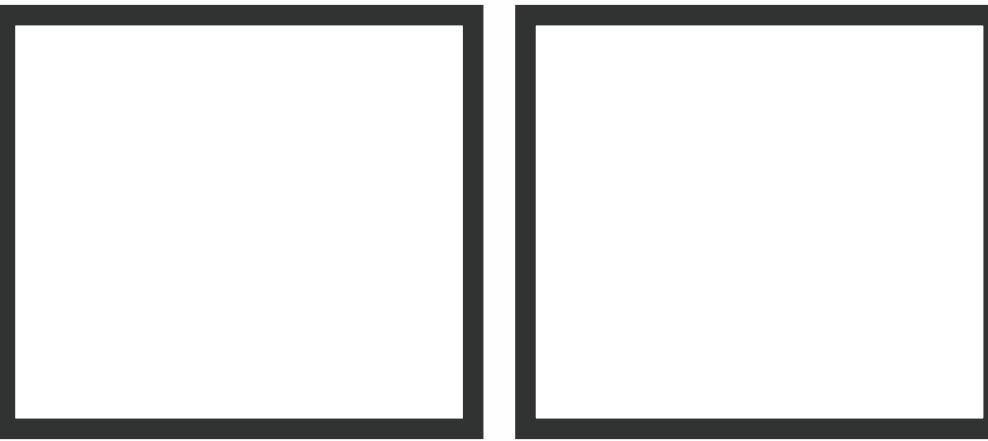
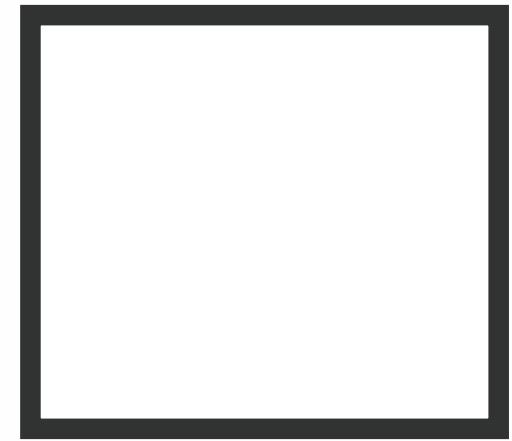
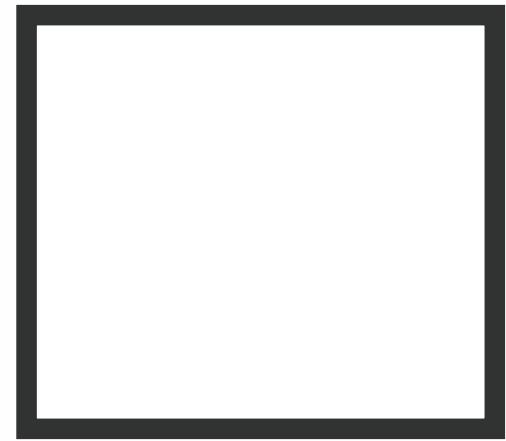
# Proximity



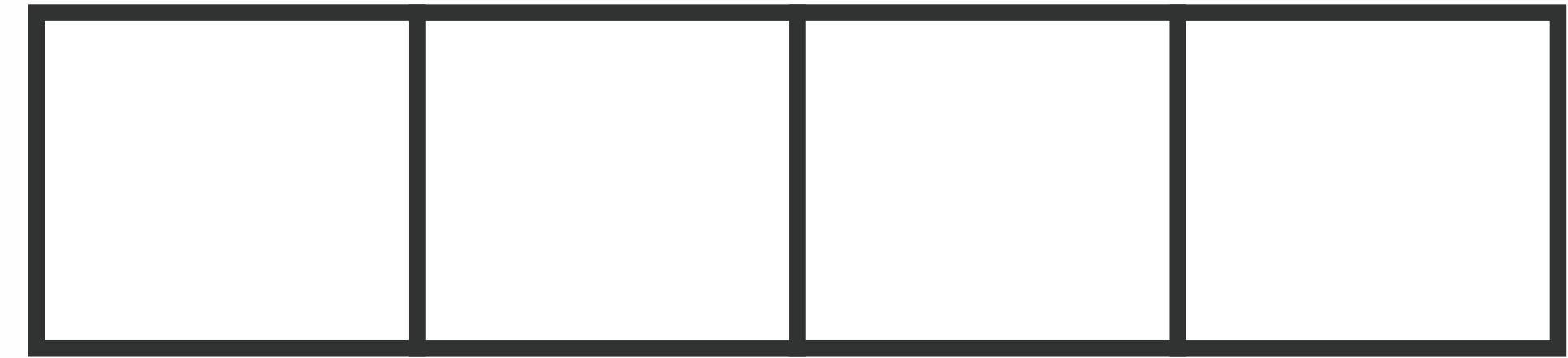
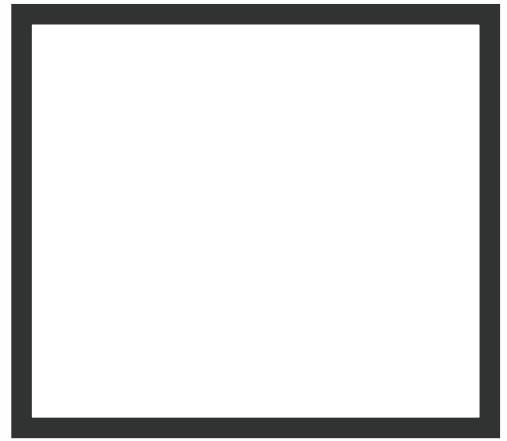
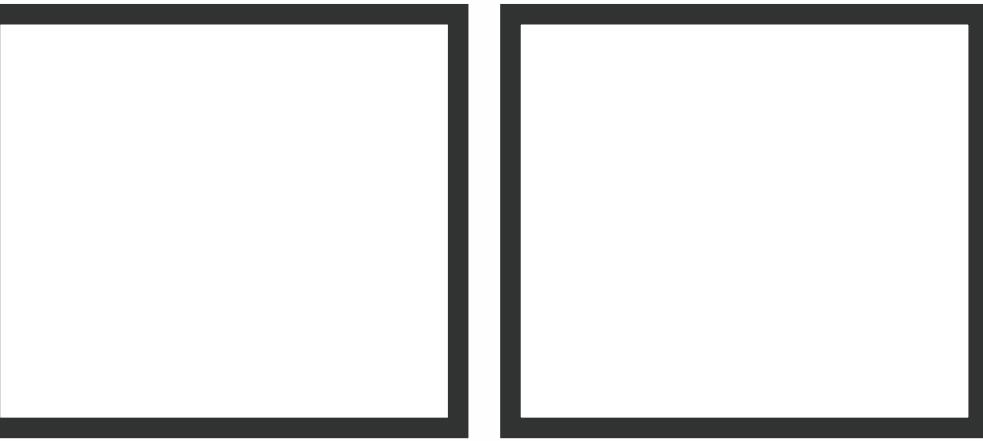
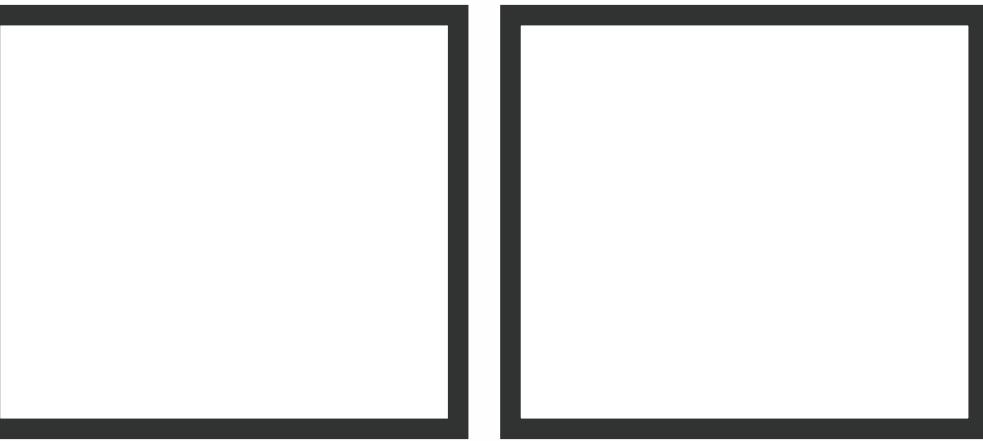
# Proximity



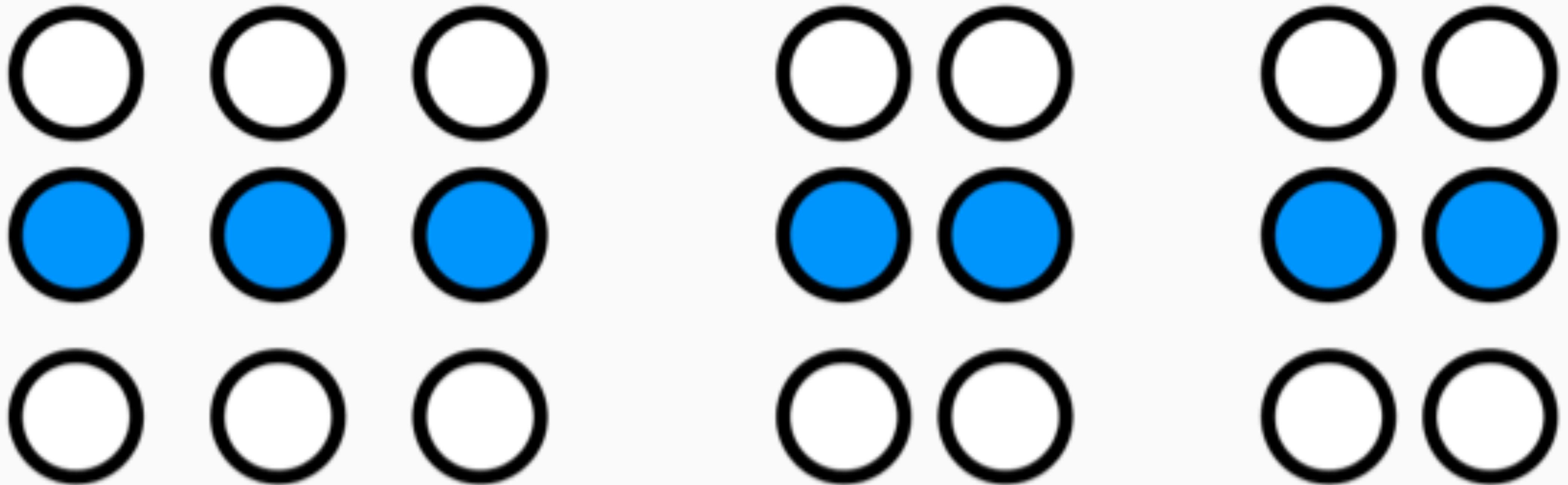
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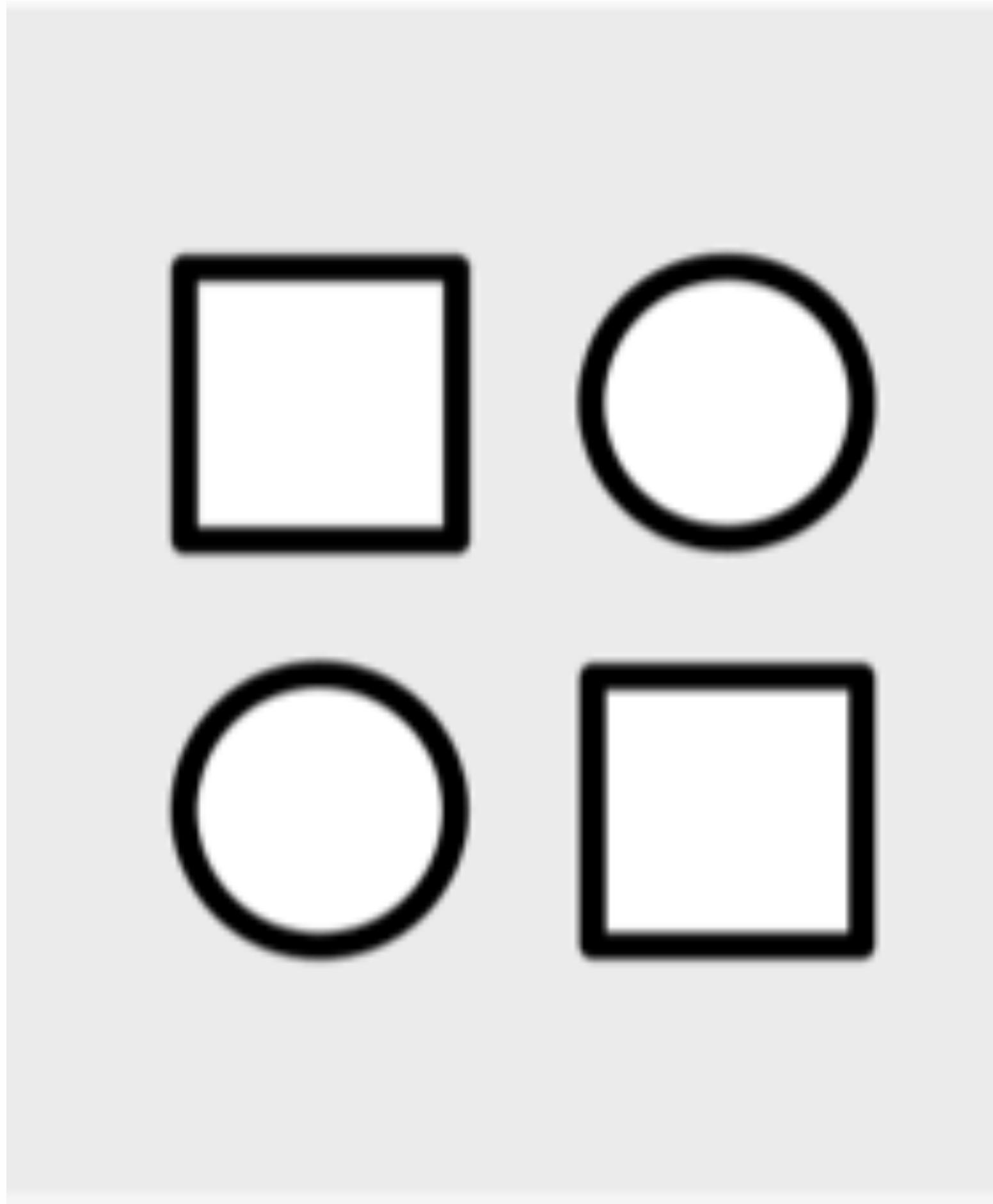
# Proximity



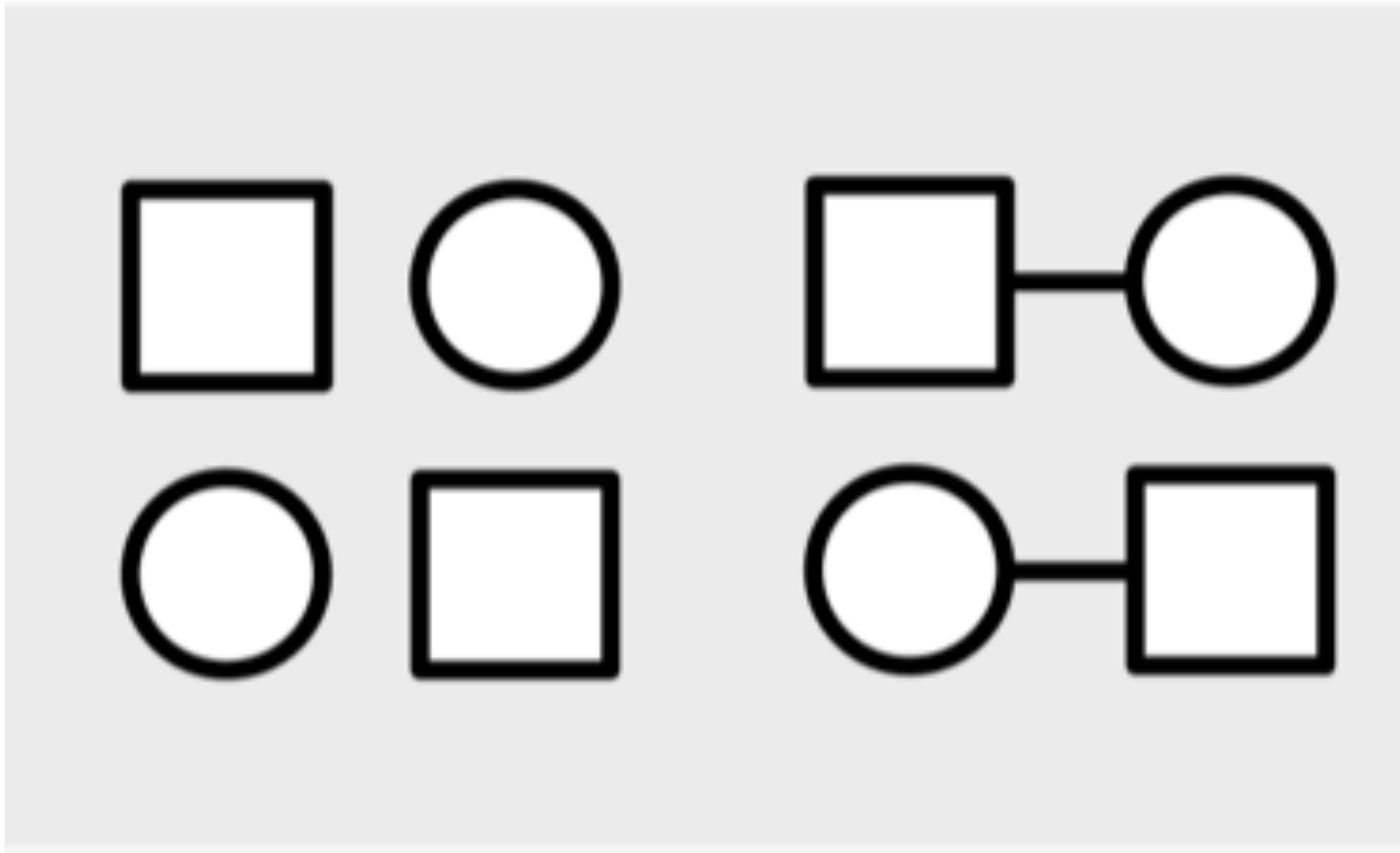
# Similarity



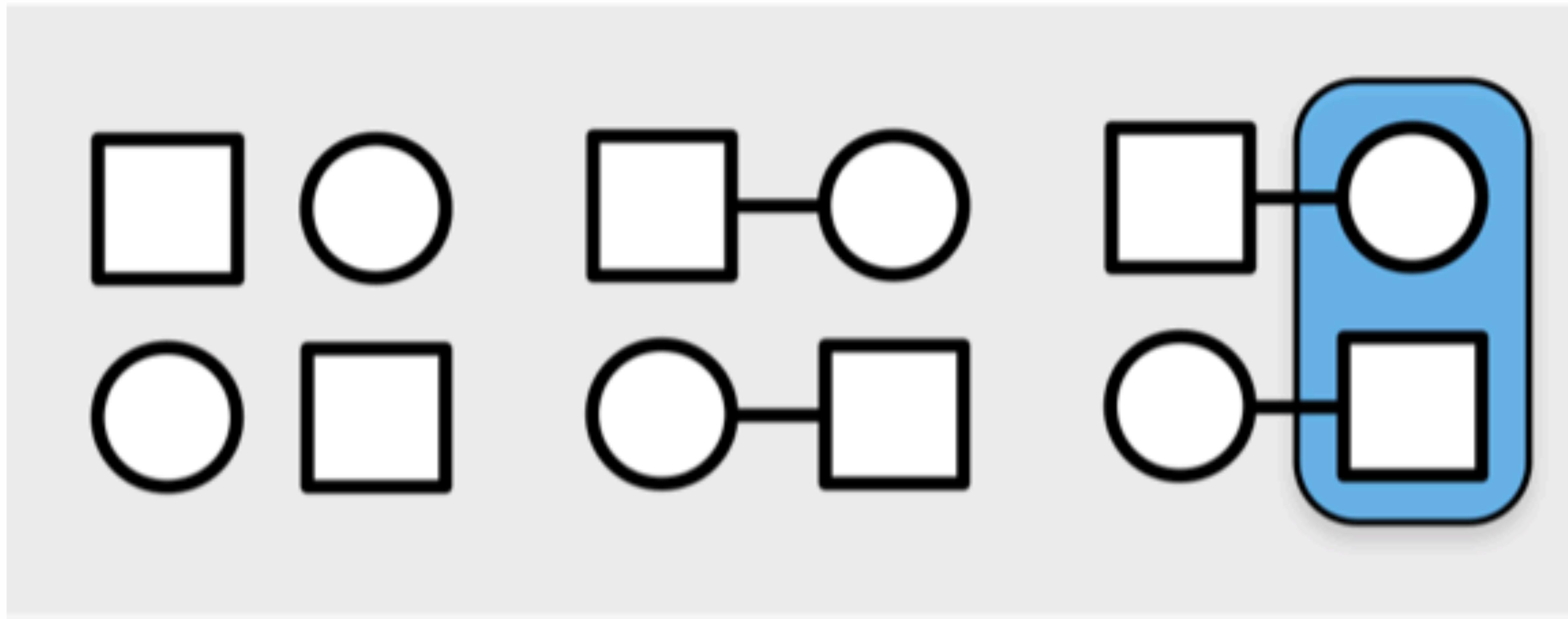
# Connectedness and Enclosure



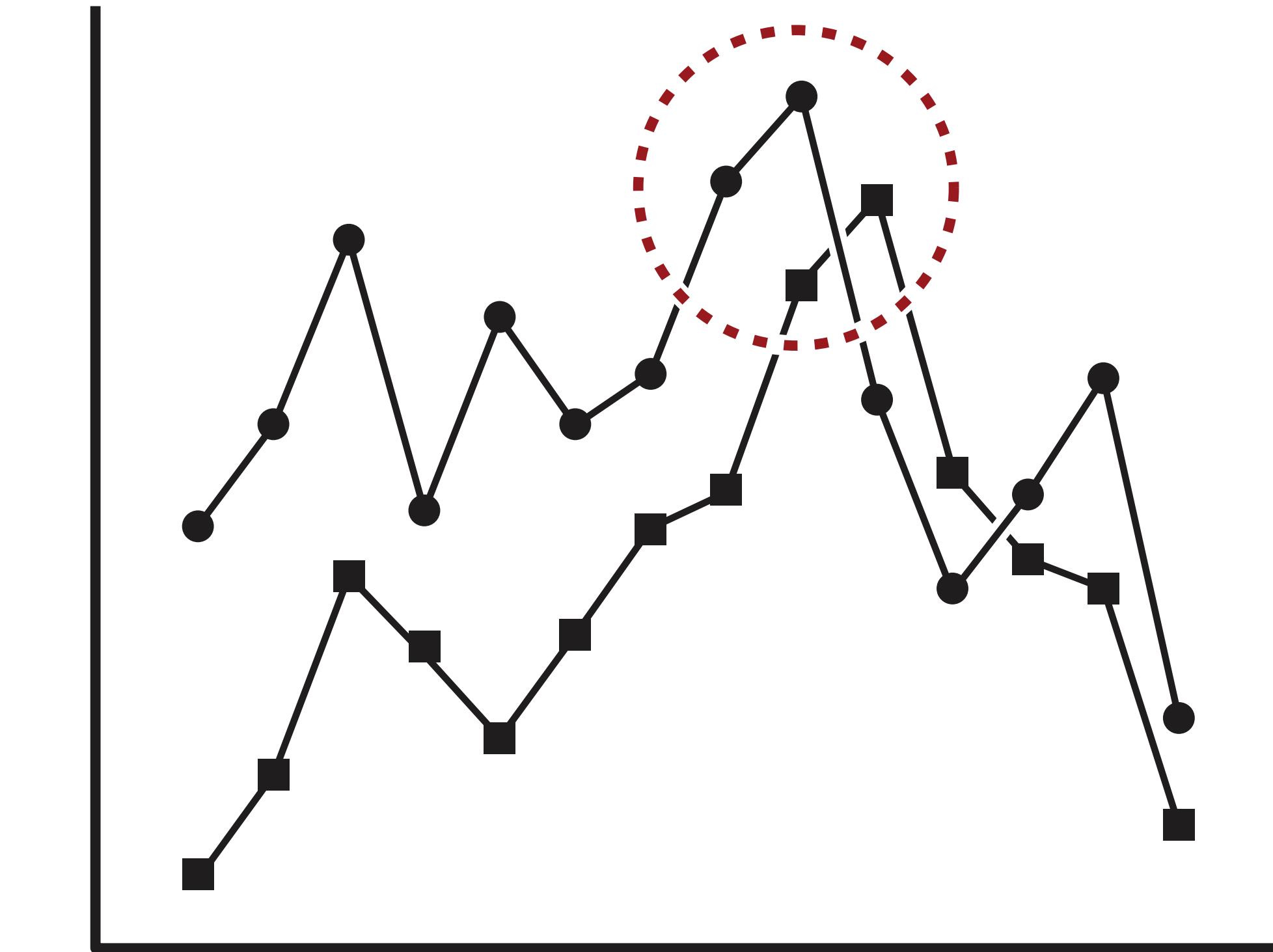
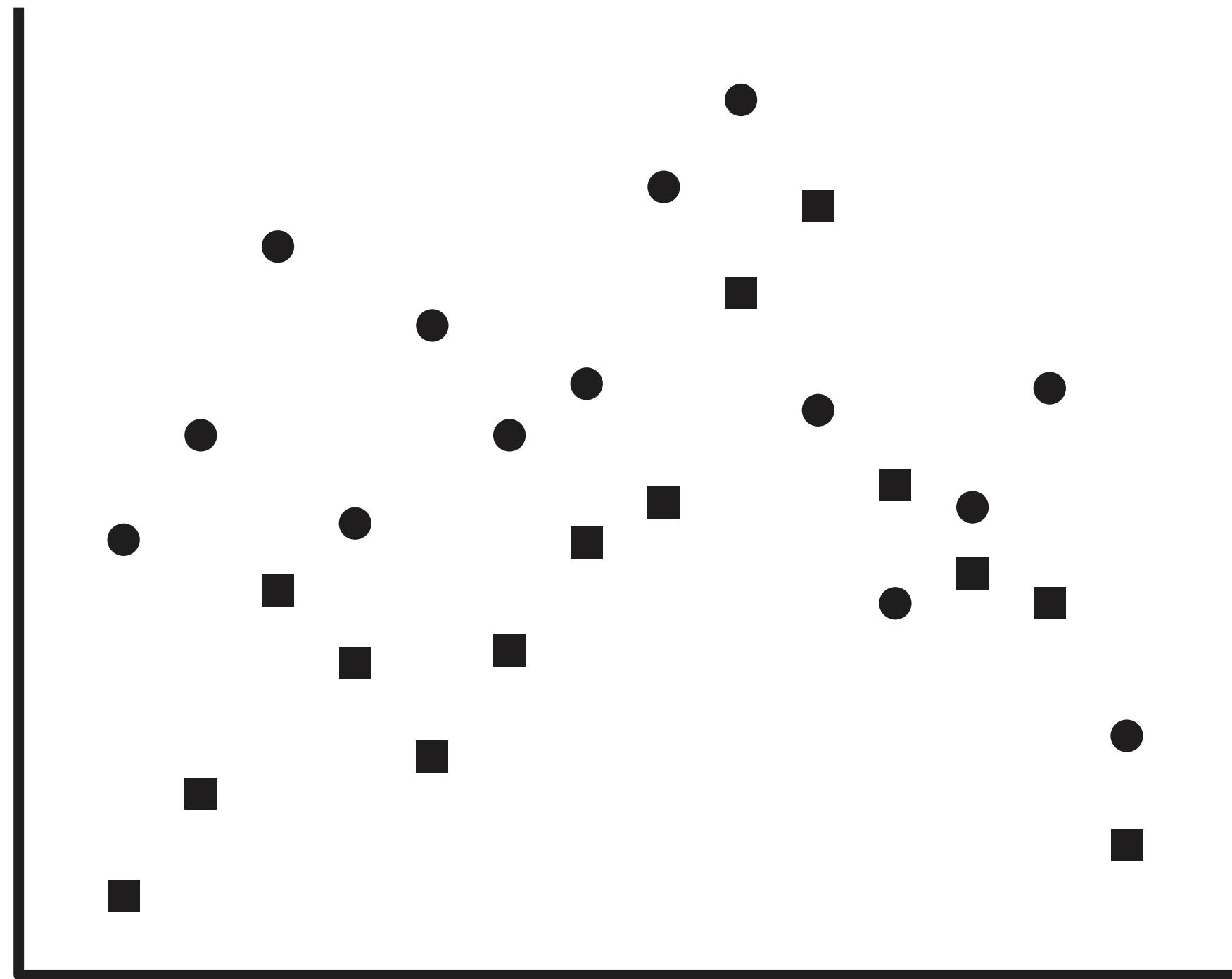
# Connectedness and Enclosure



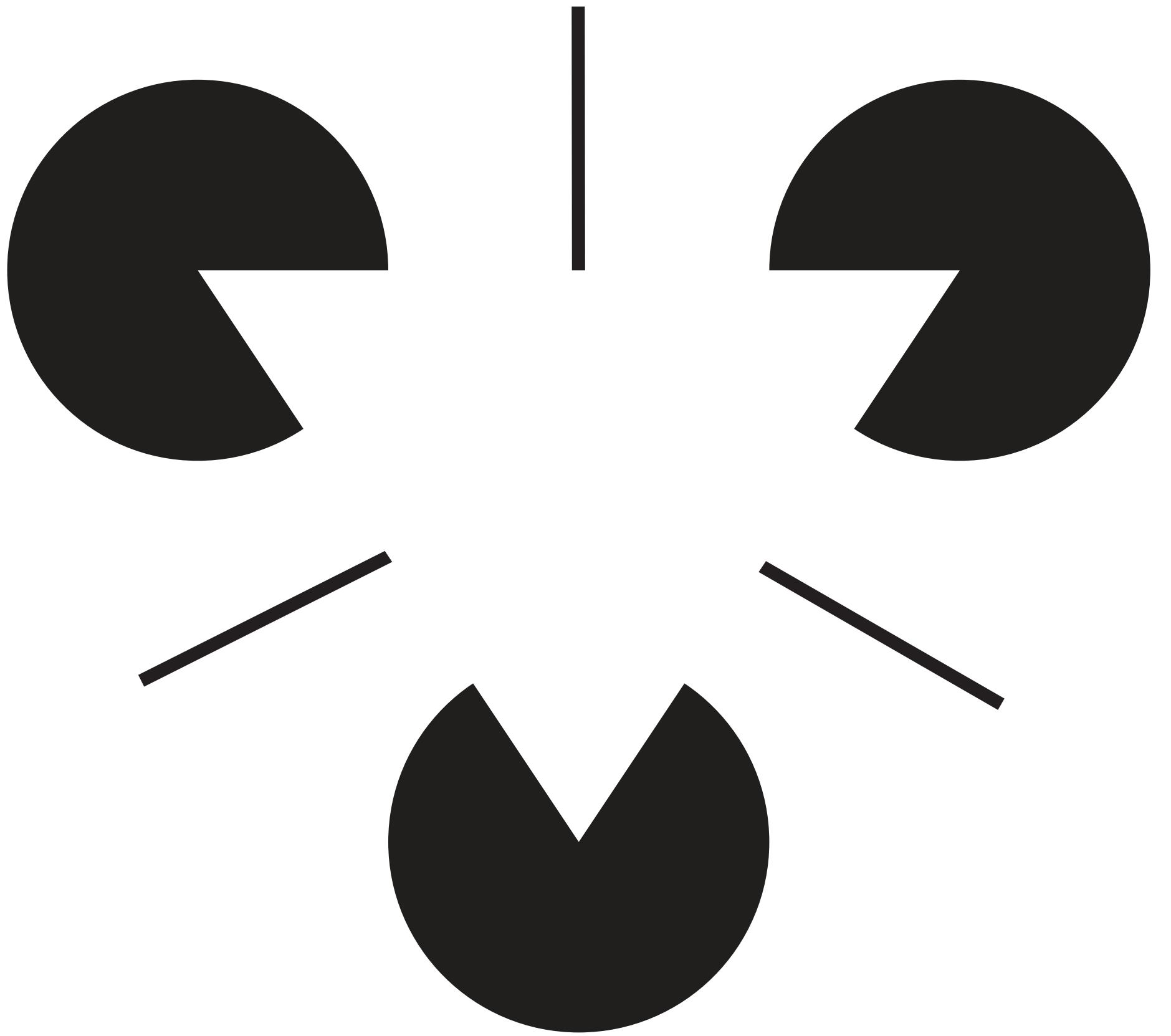
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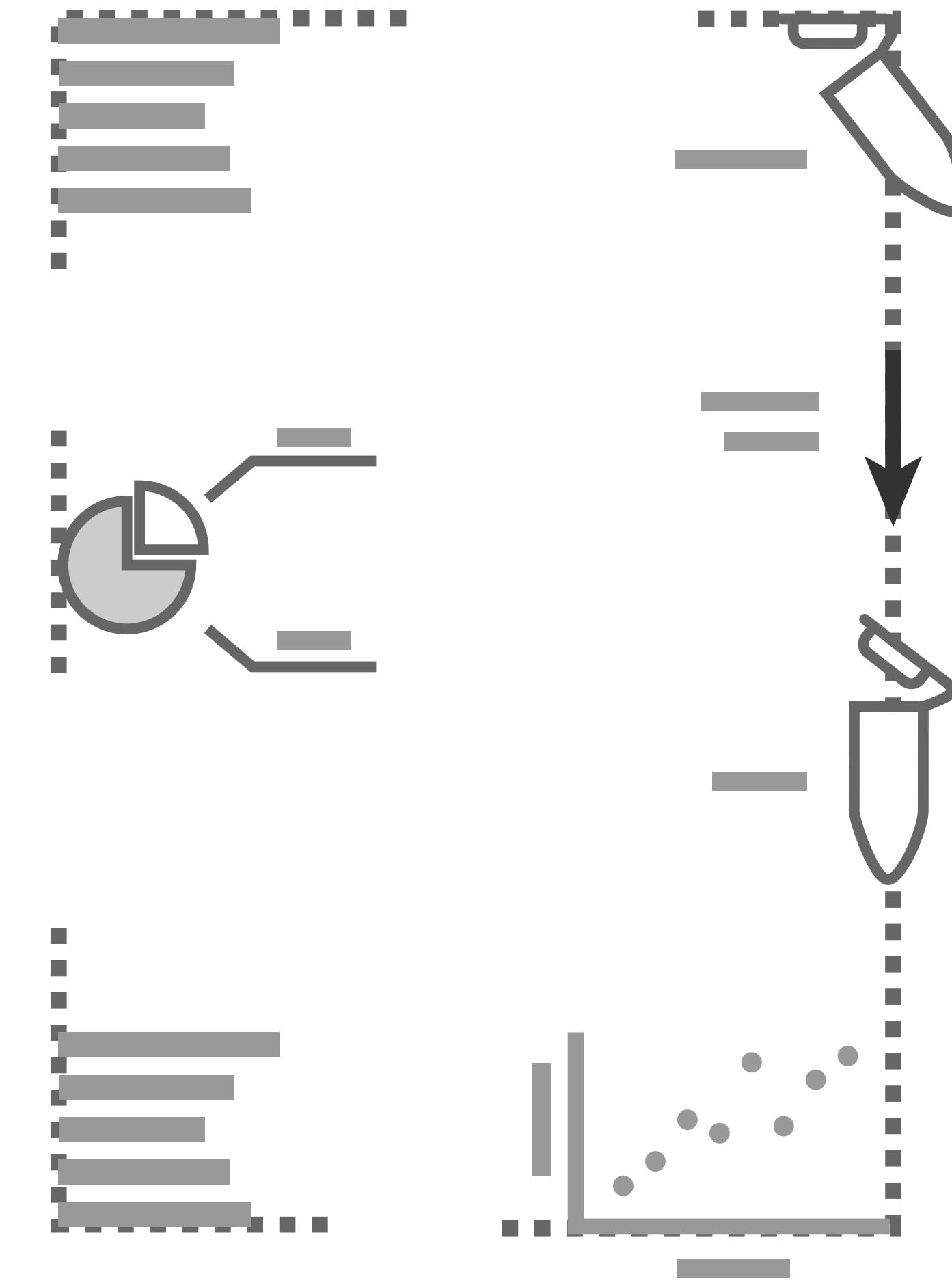
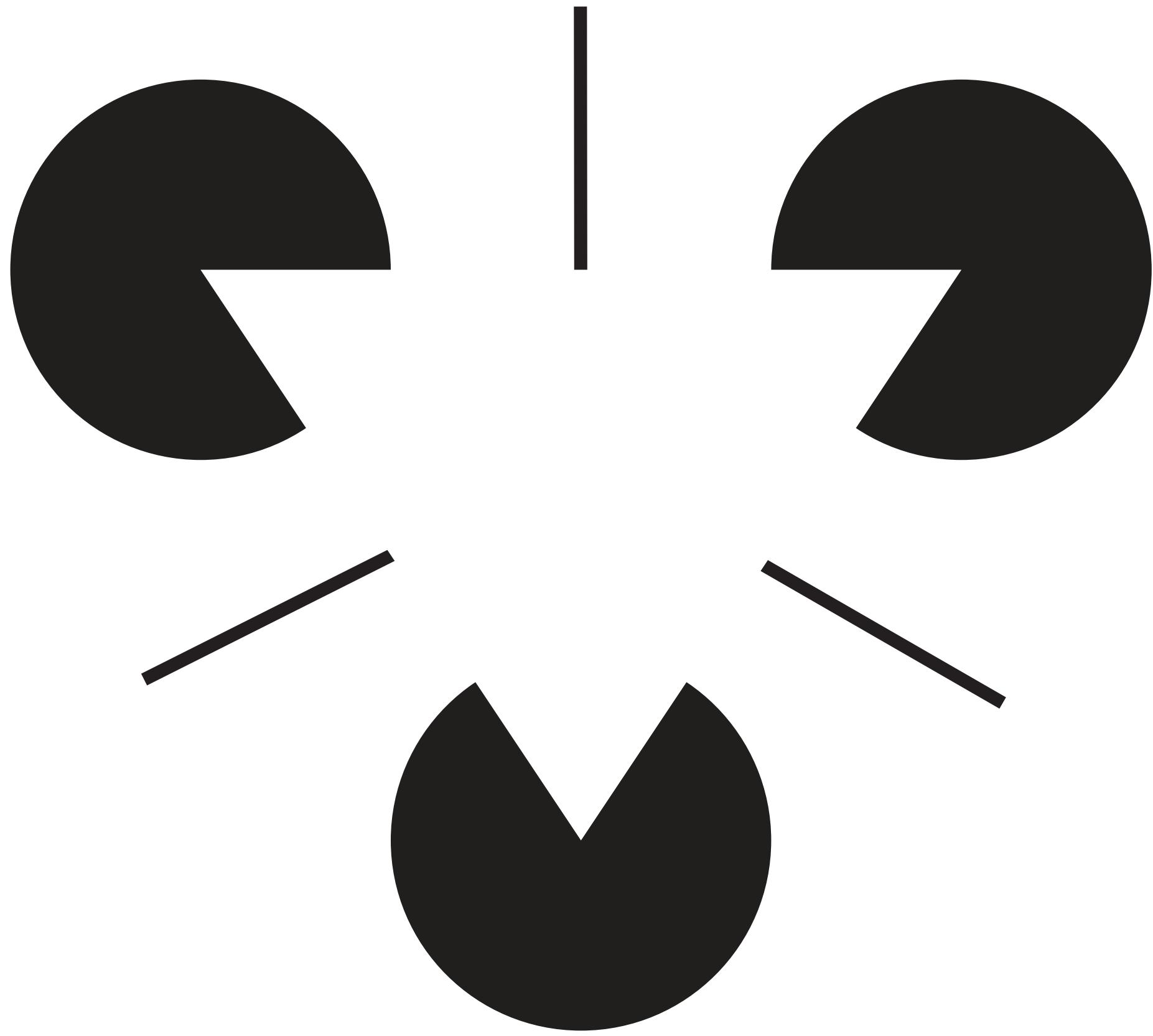
# Connectedness and Enclosure



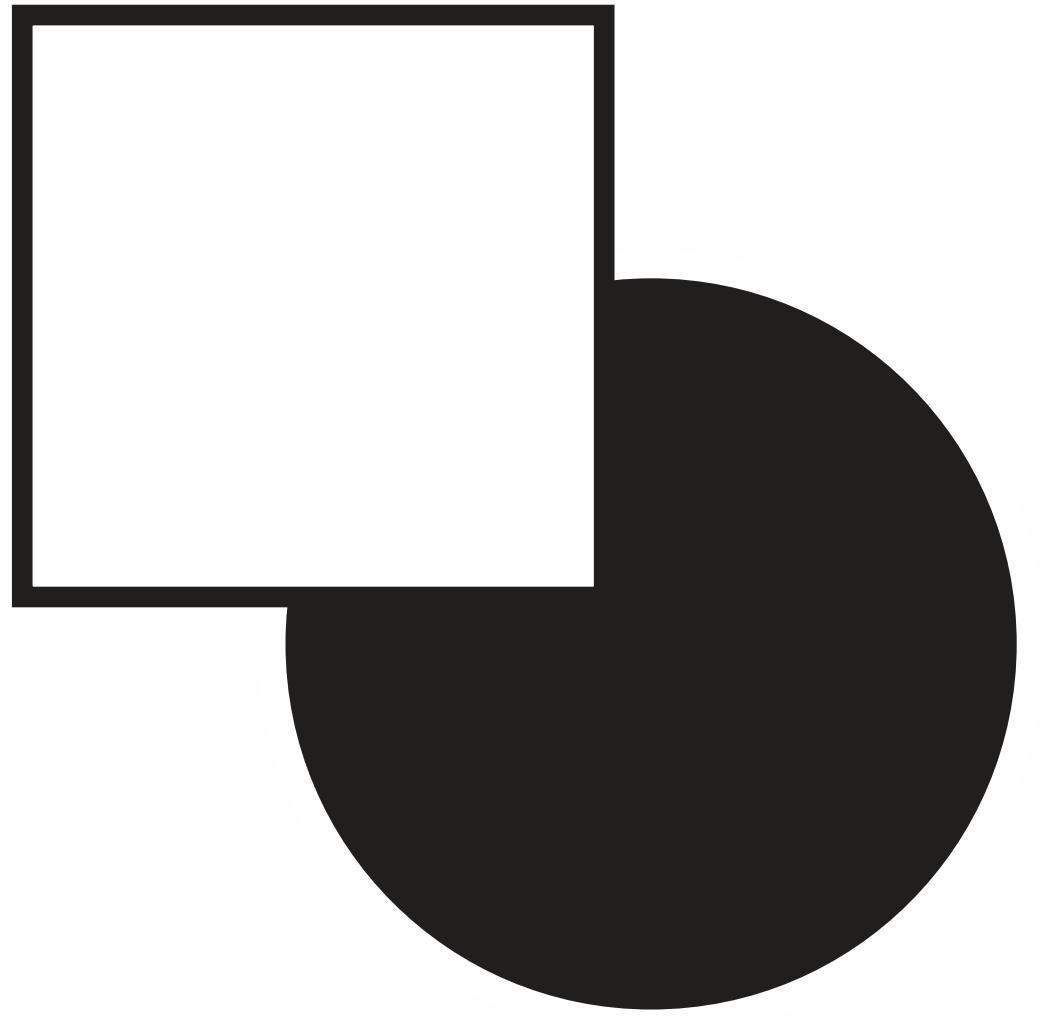
# Visual Interpolation



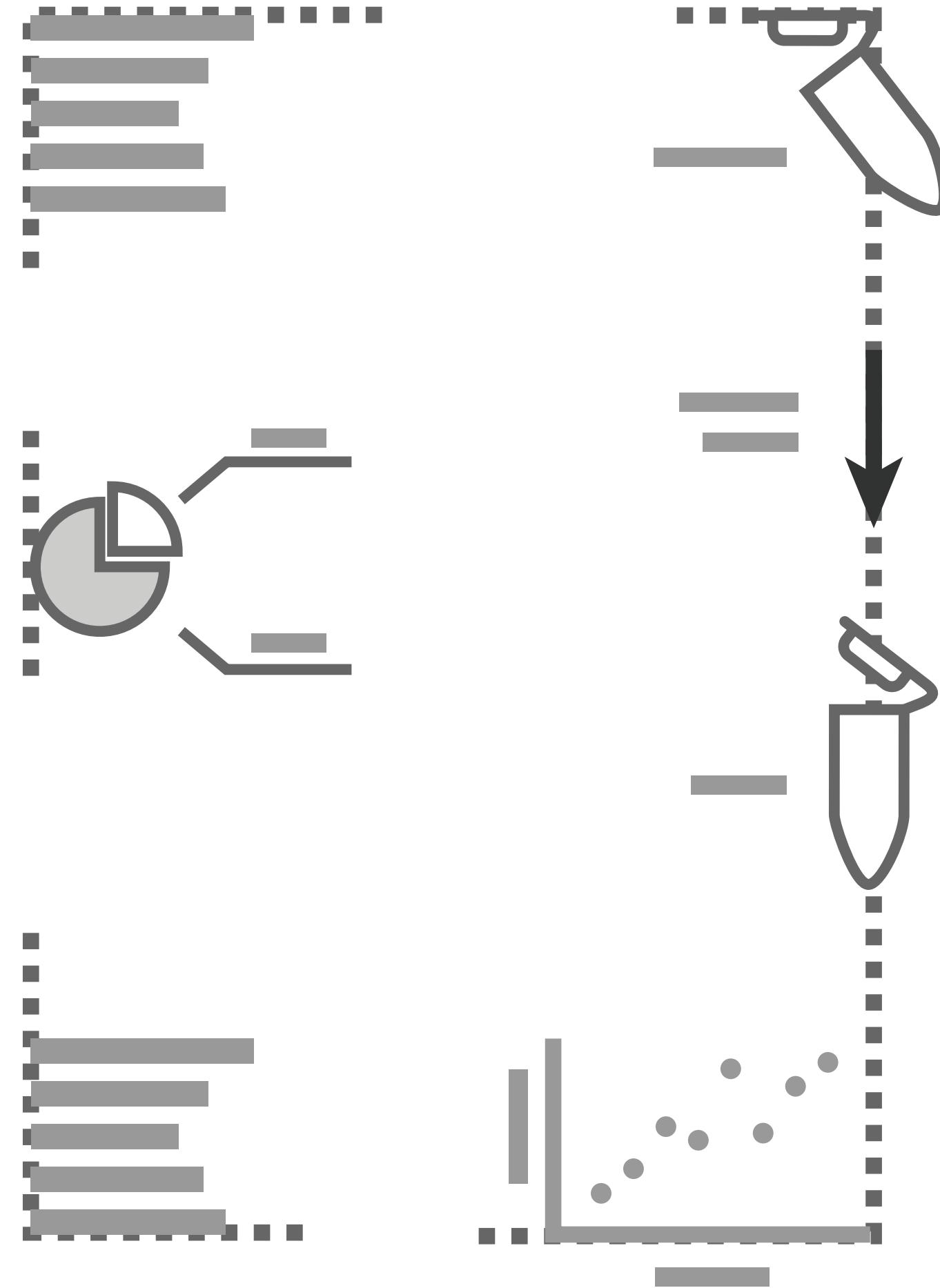
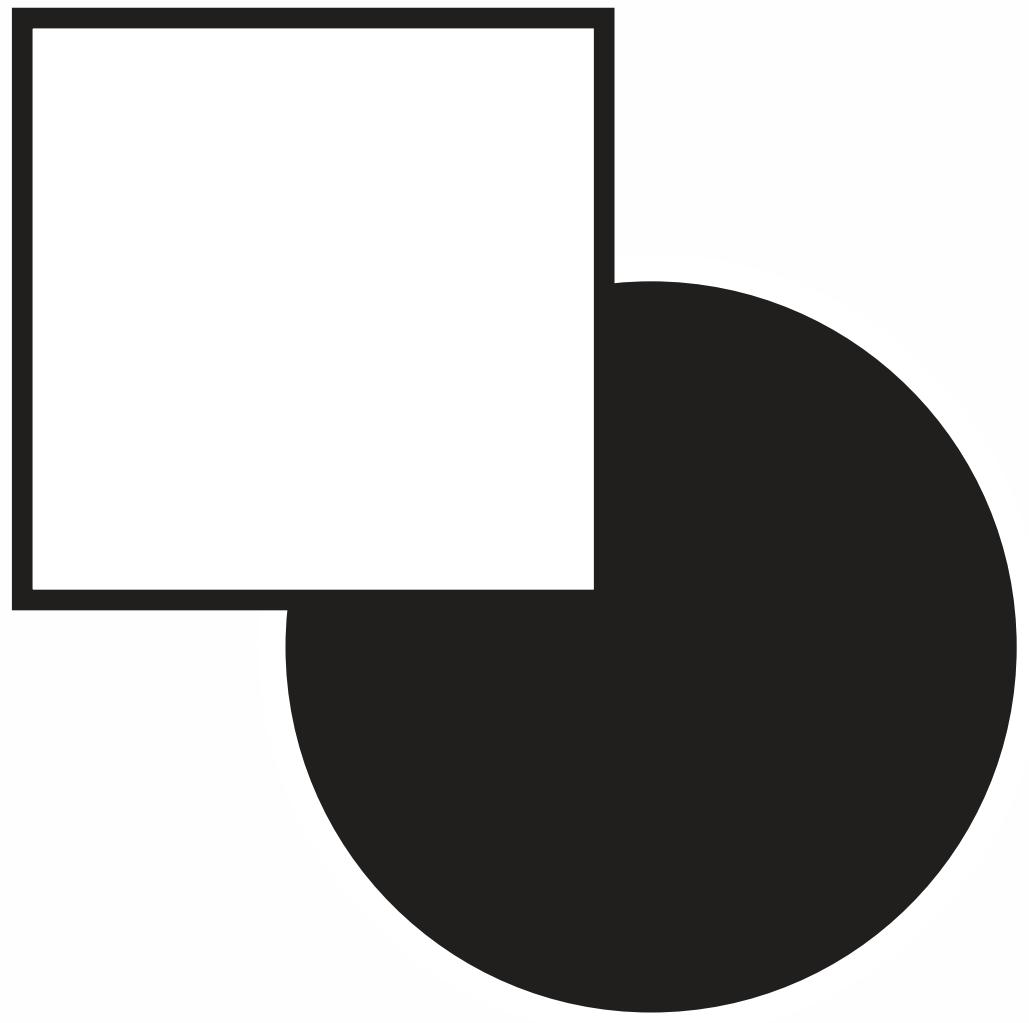
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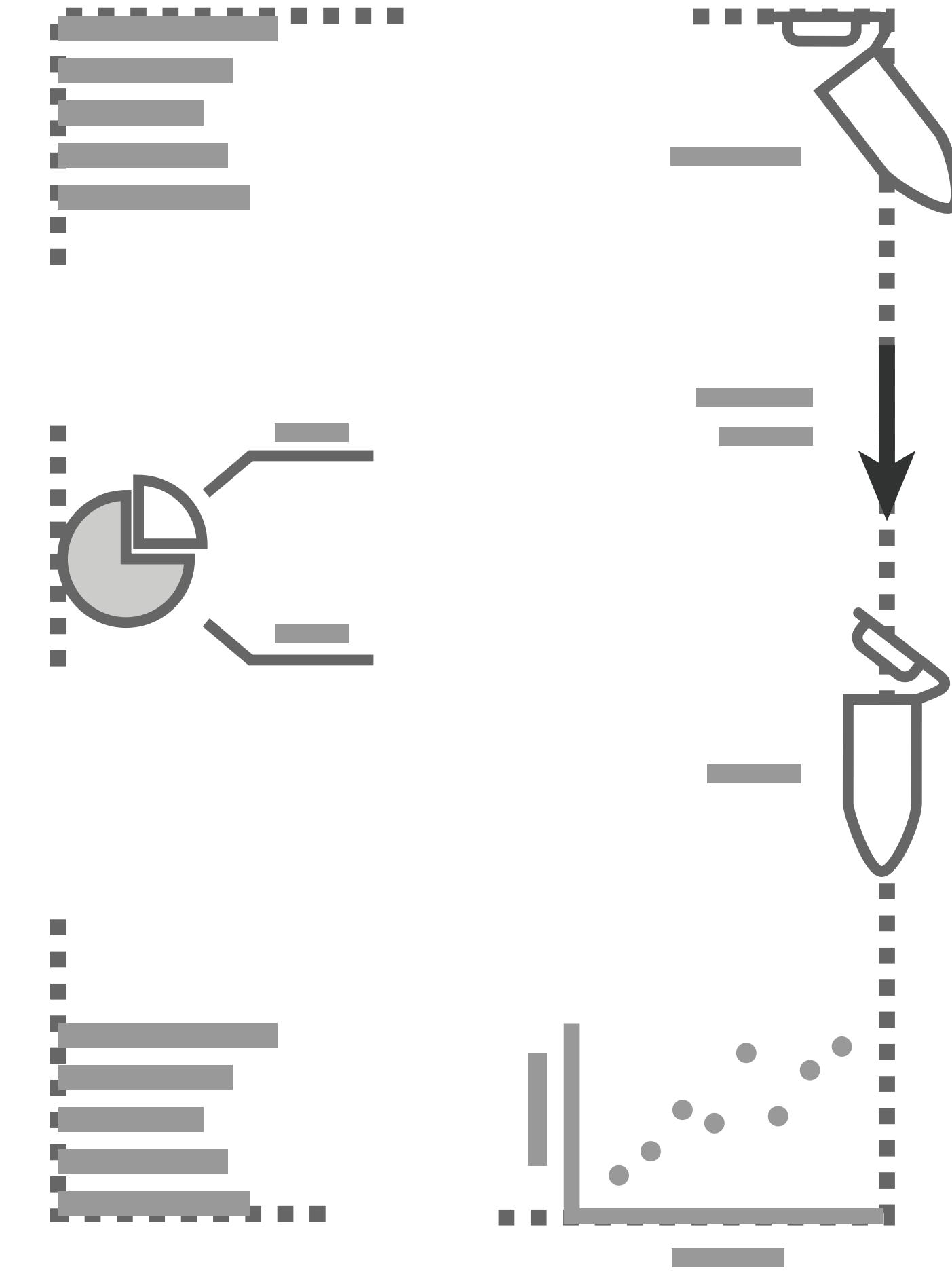
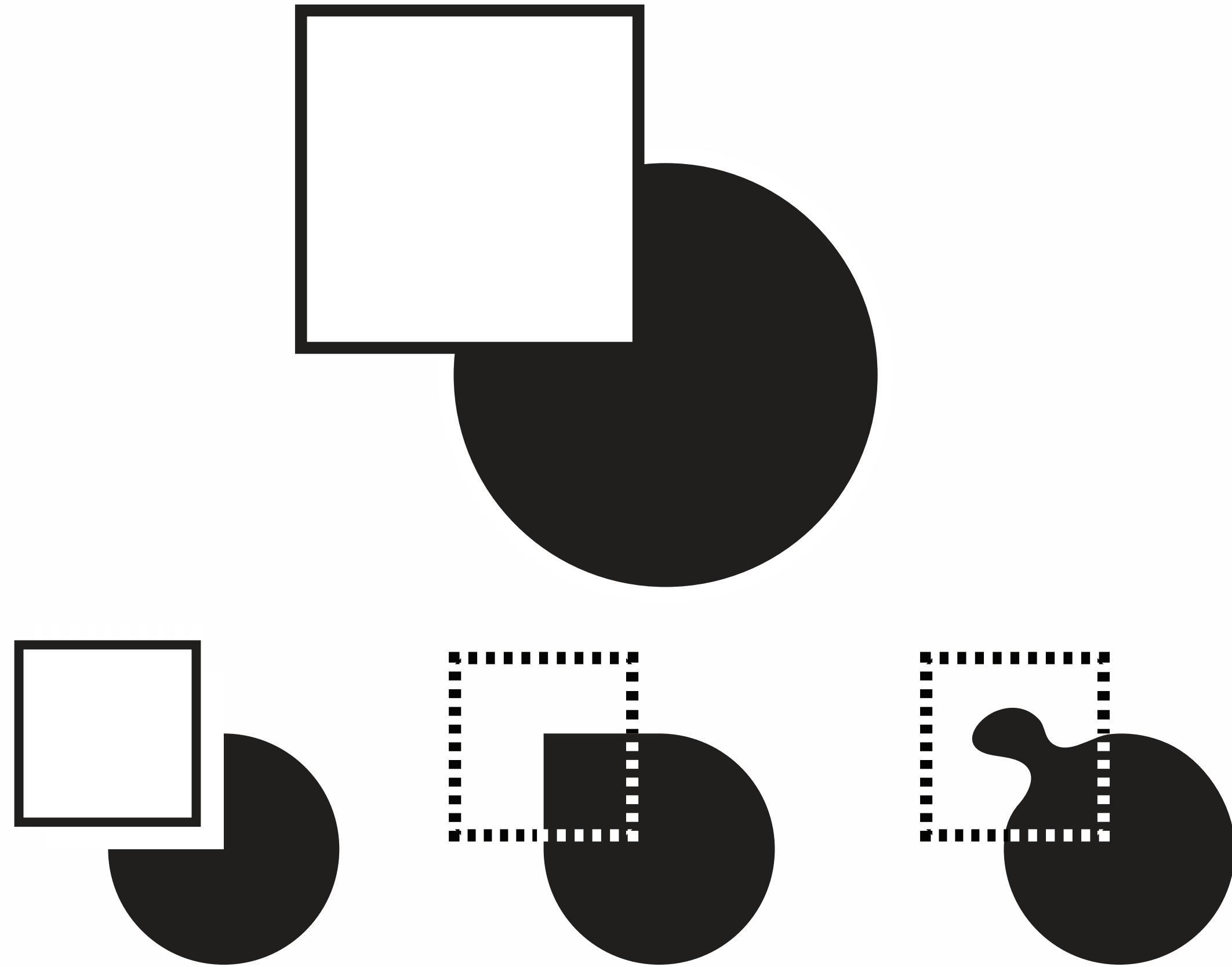
# Visual Completion



# Visual Completion

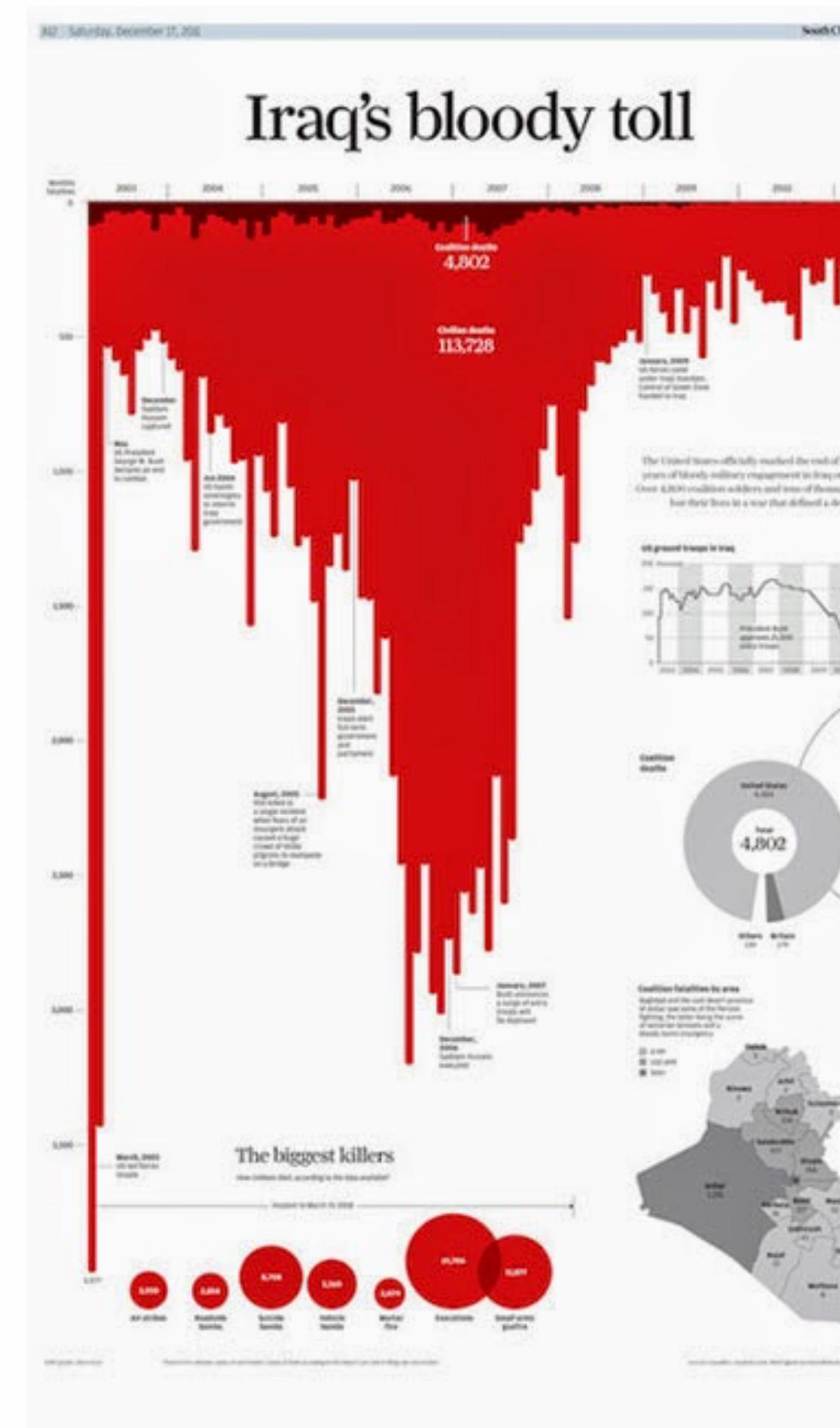


# Visual Completion



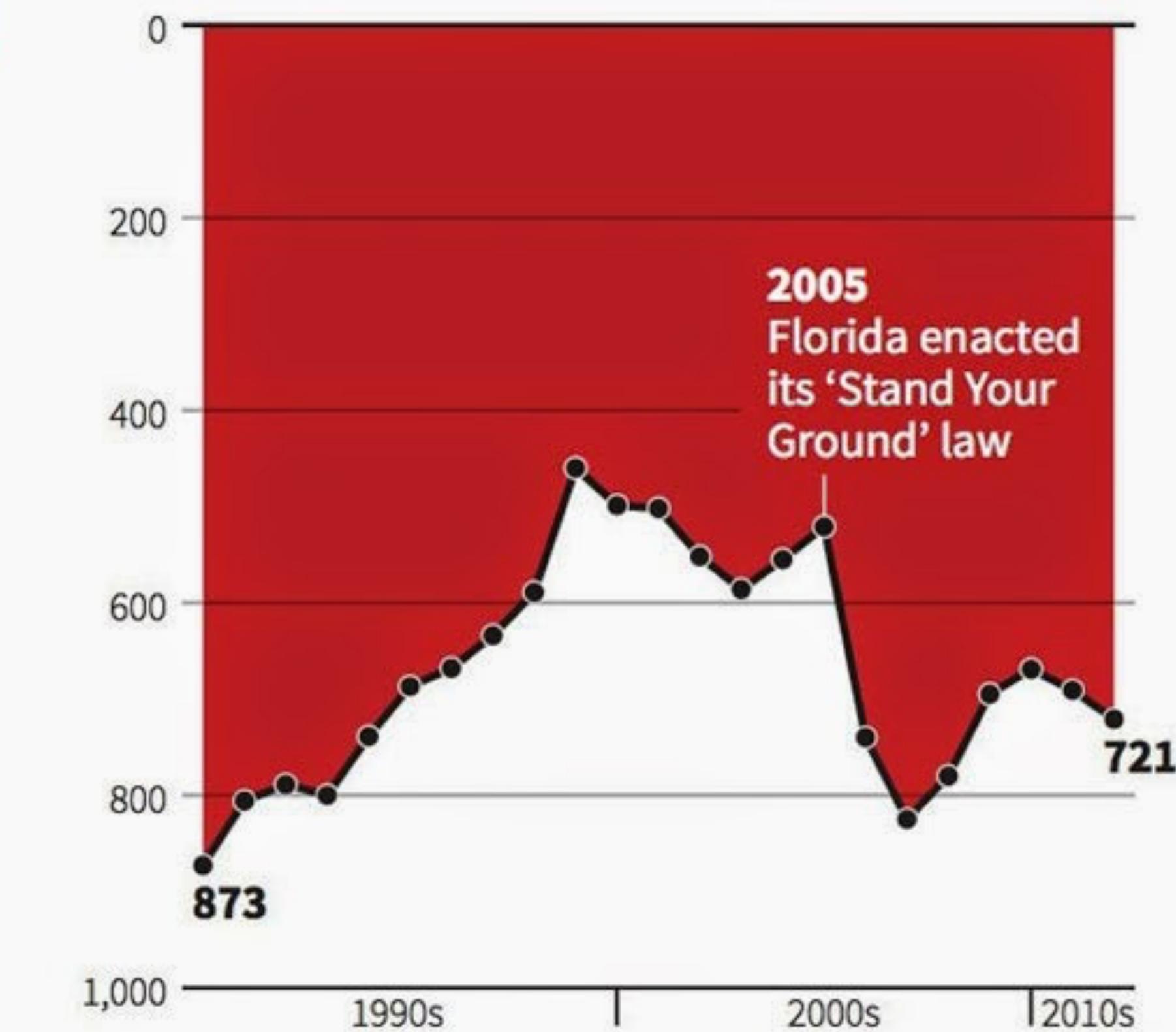
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# Space



## Gun deaths in Florida

Number of murders committed using firearms



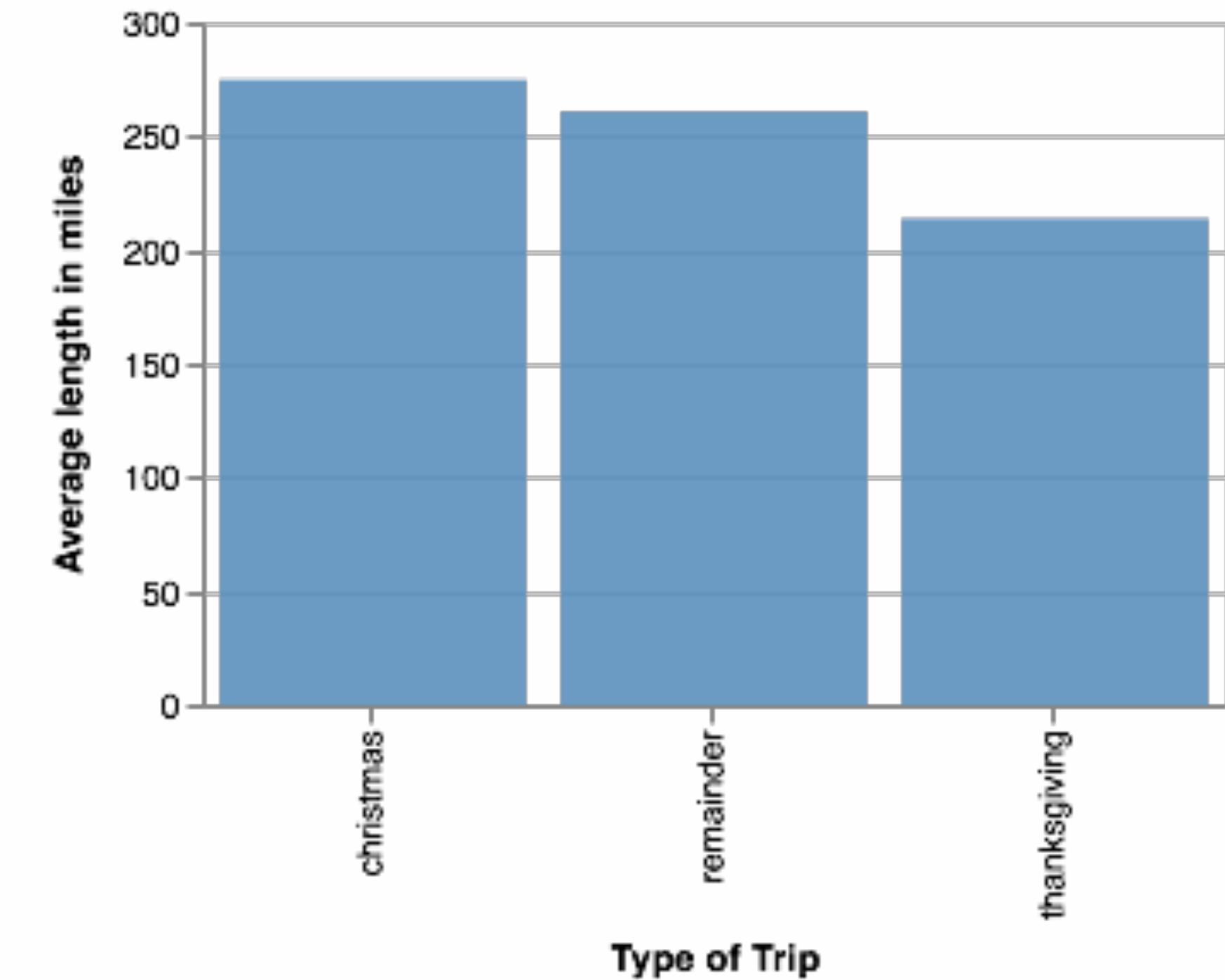
Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTER

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# Choosing a Type of Visualization



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1. Continuous vs discrete data
2. Nominal vs categorical data?
3. proportional data
4. absolute values or relative differences?

1.  
2.  
3.  
4.

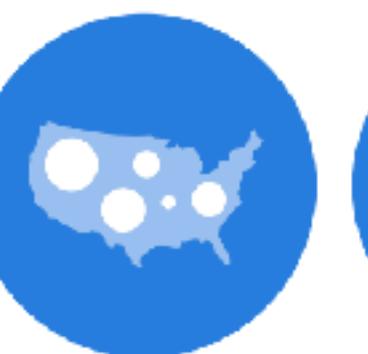
# Proportions

Visualization methods that use size or area to show differences or similarities between values or for parts to a whole.

## Proportions between values



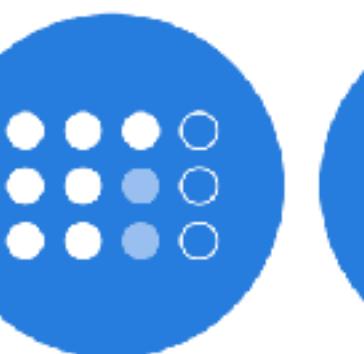
Bubble Chart



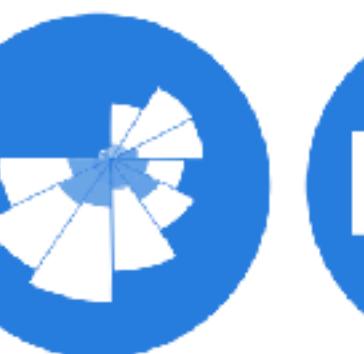
Bubble Map



Circle Packing



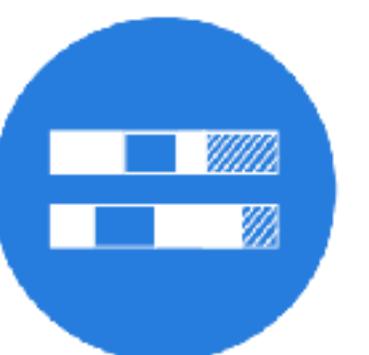
Dot Matrix Chart



Nightingale Rose Chart



Proportional Area Chart



Stacked Bar Graph

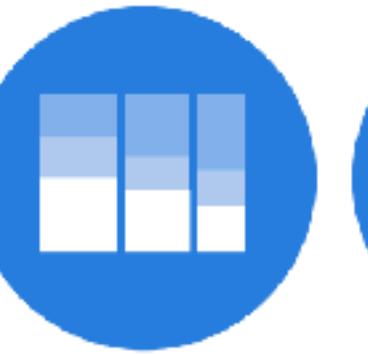


Word Cloud

## Proportions in parts-to-a-whole relationships



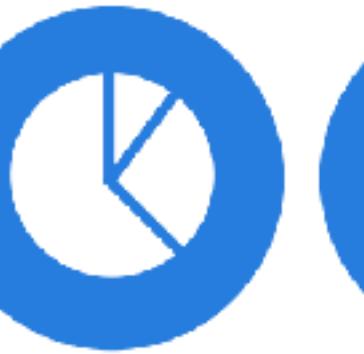
Donut Chart



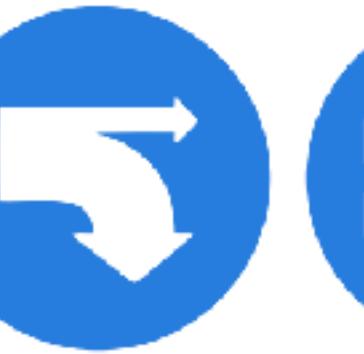
Marimekko Chart



Parallel Sets



Pie Chart



Sankey Diagram



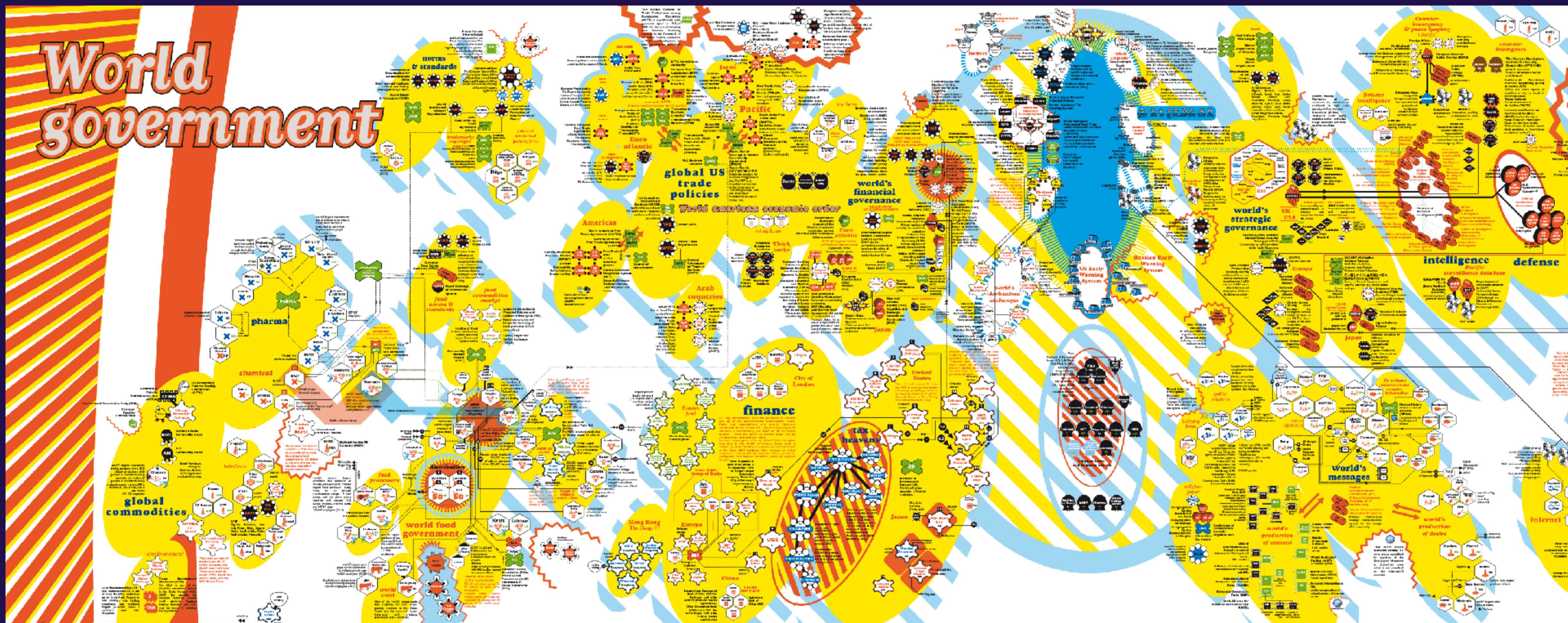
Stacked Bar Graph

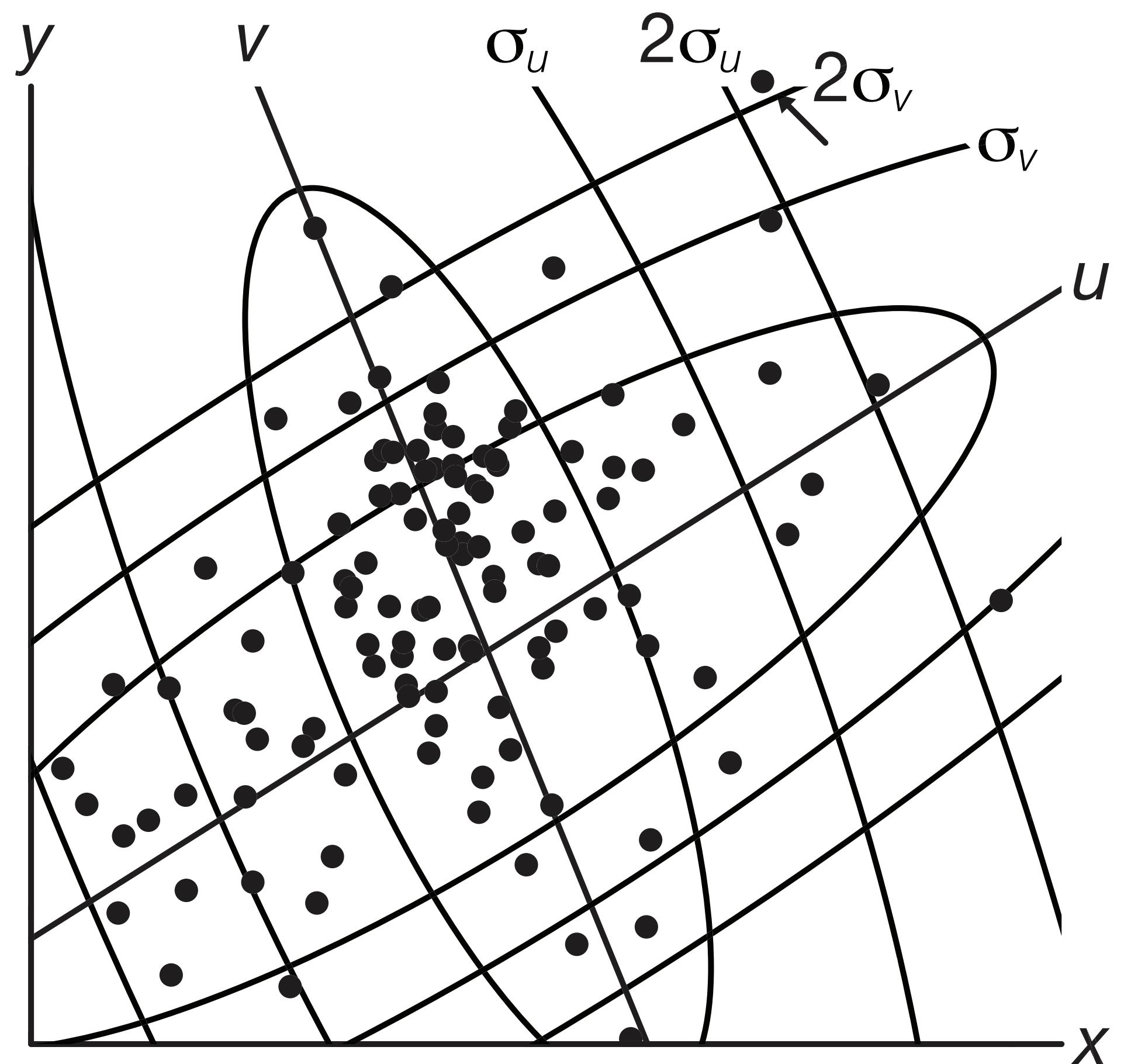


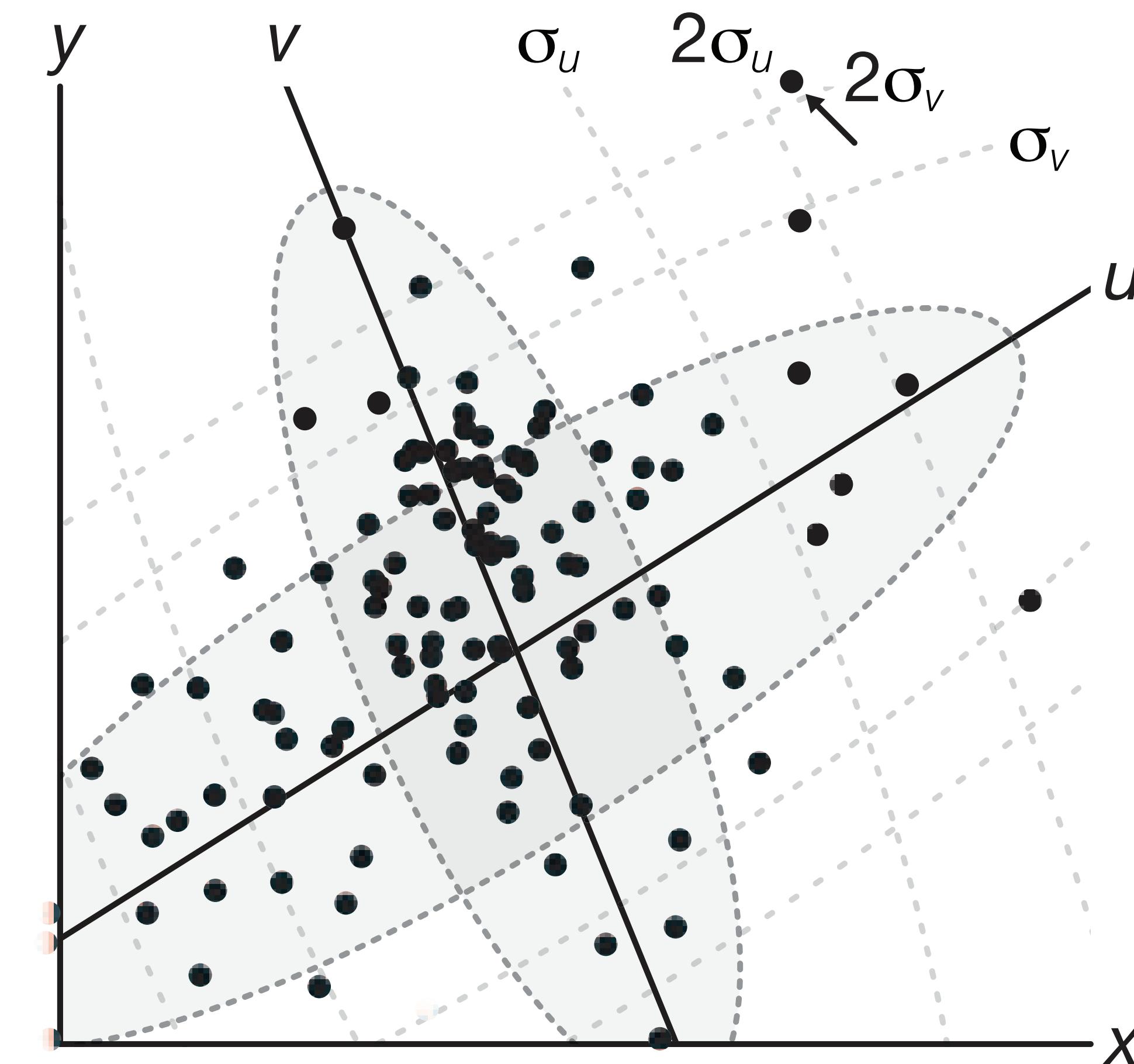
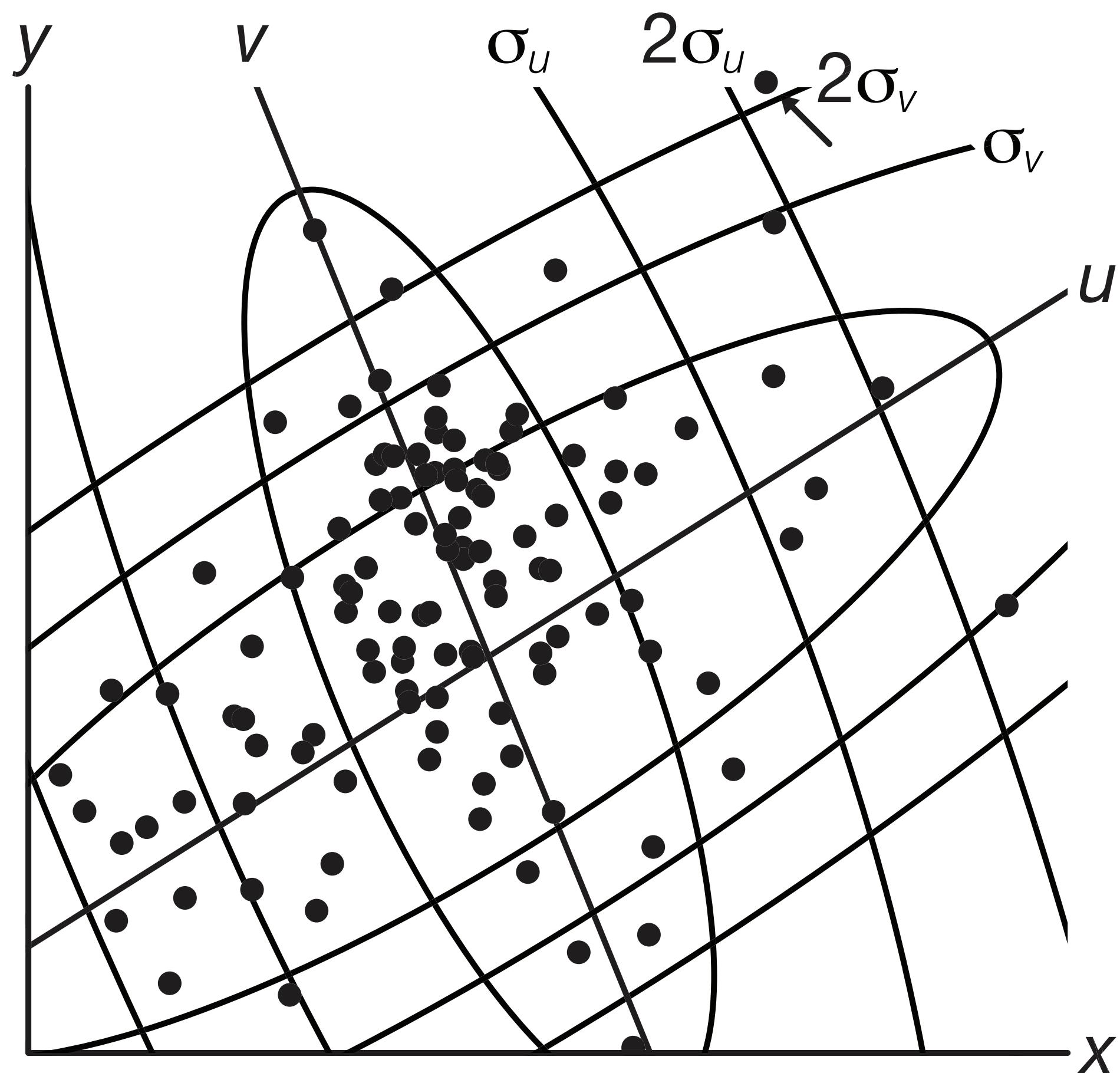
Treemap

in practice

# World government







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8. Data Visualization + Society
9. Exercise: Wireframing

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**... encode biases**

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**... are created by humans**

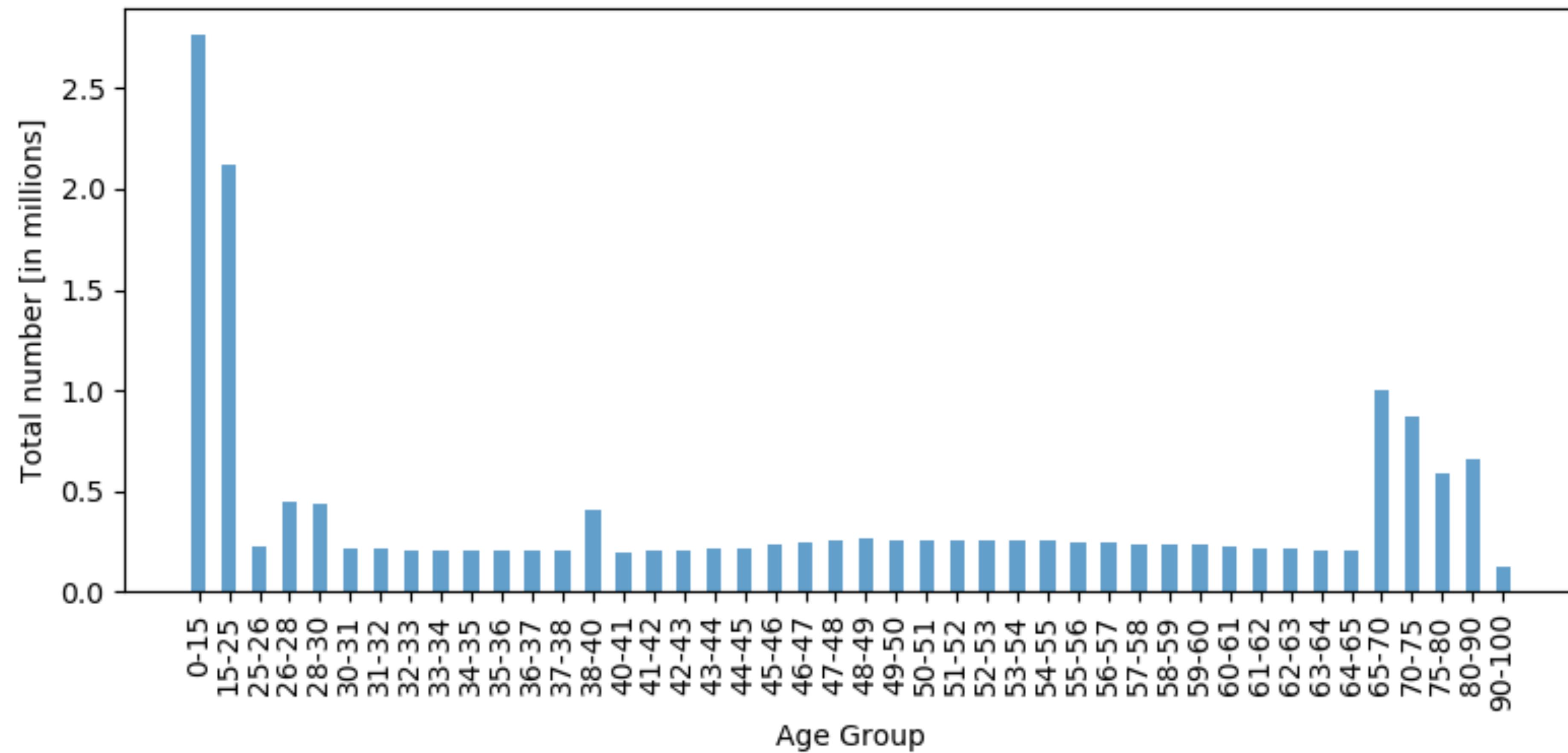
**... encode biases**

**... can be (mis-)used to  
serve an agenda**

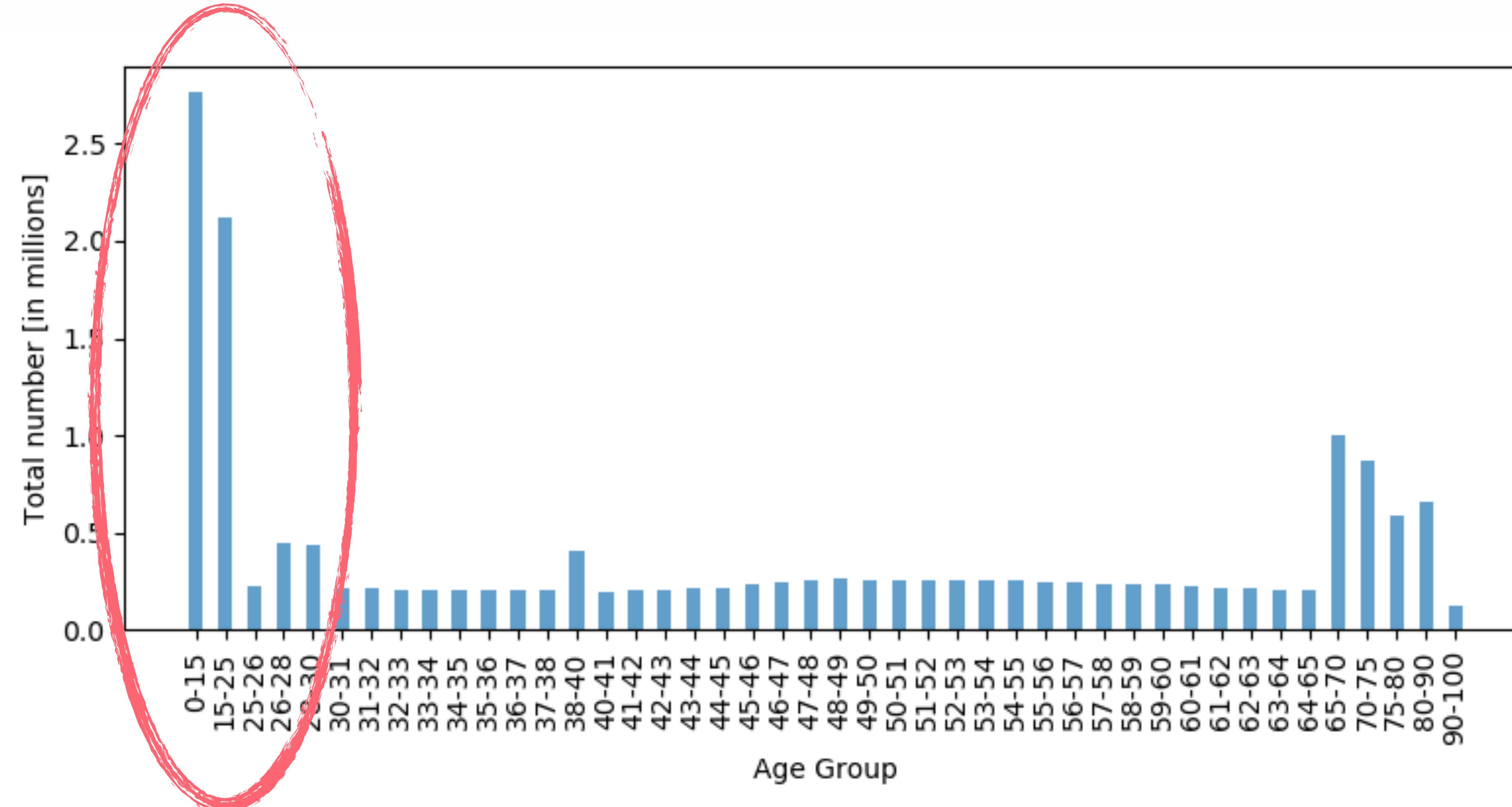
# Where should the Netherlands invest their tax money?

- Daycare and schools?
- infrastructure for the elderly
- Something else?

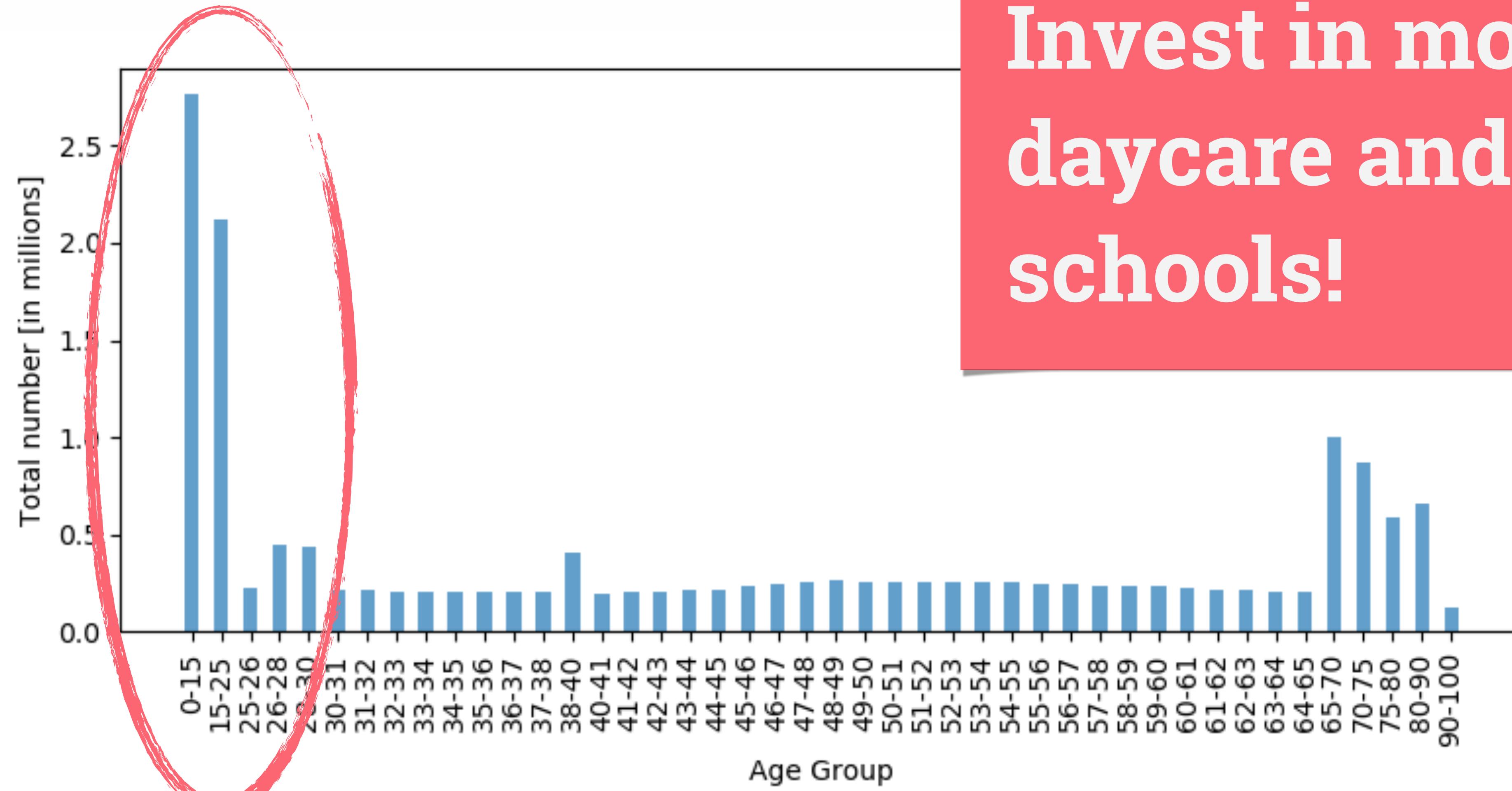
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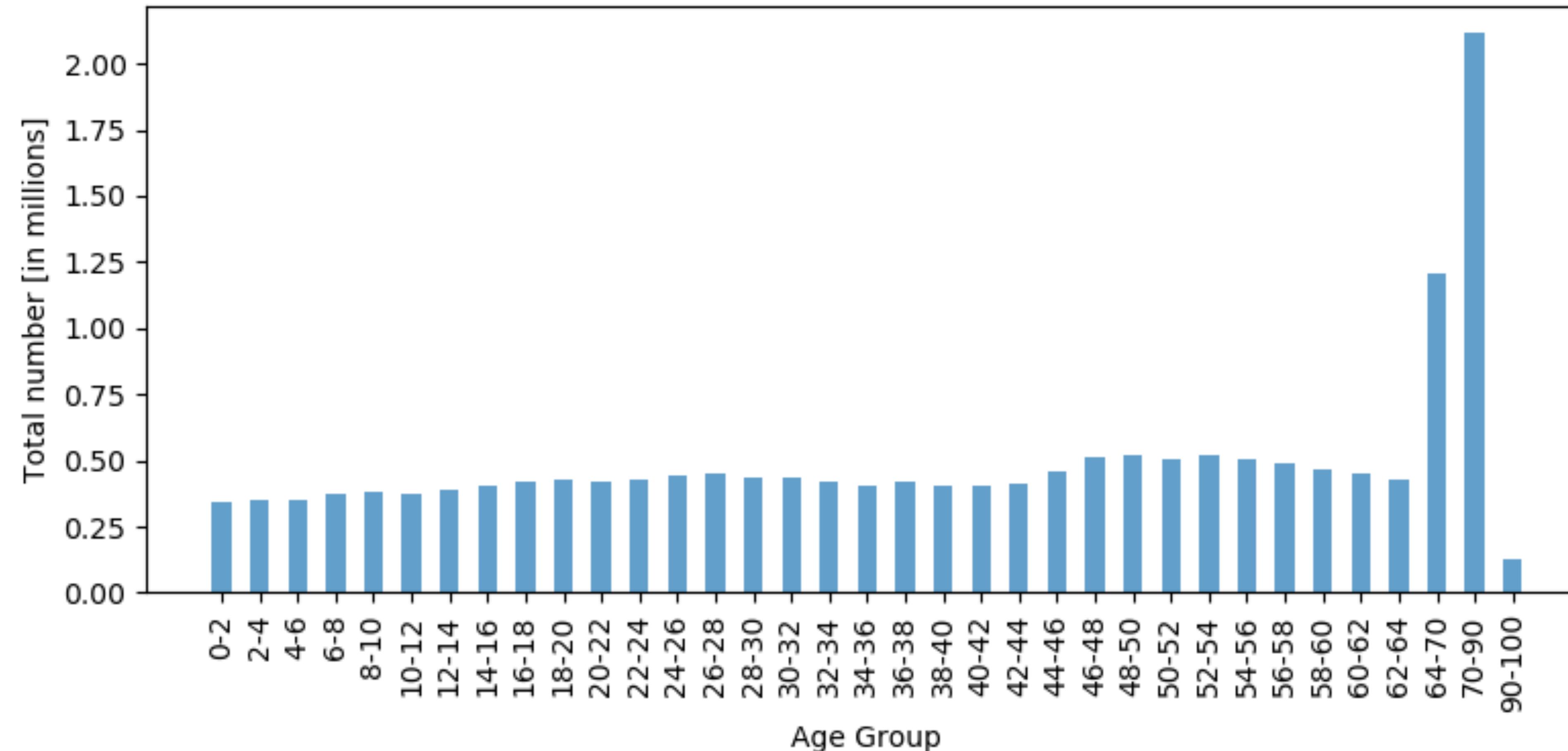


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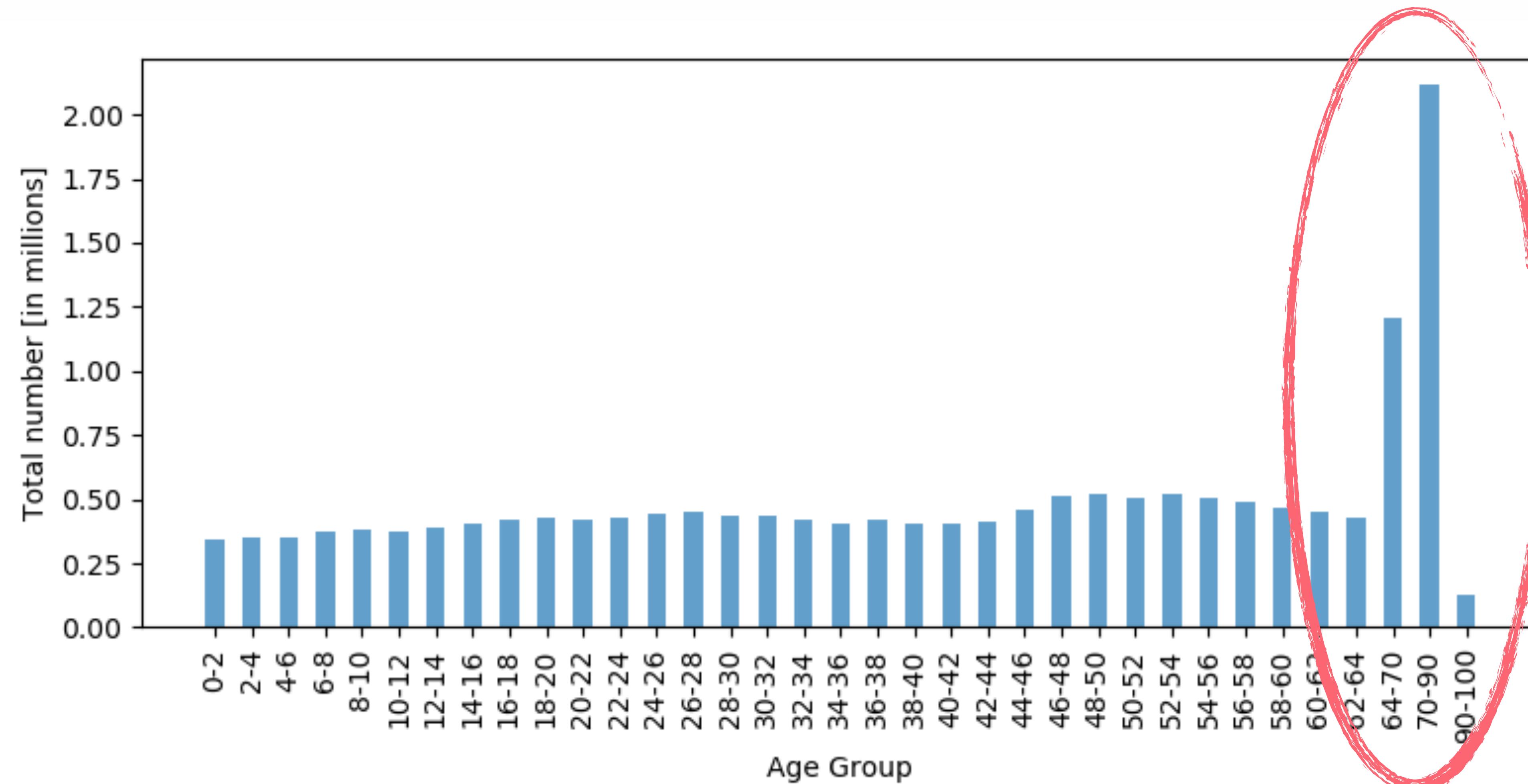


Invest in more  
daycare and  
schools!

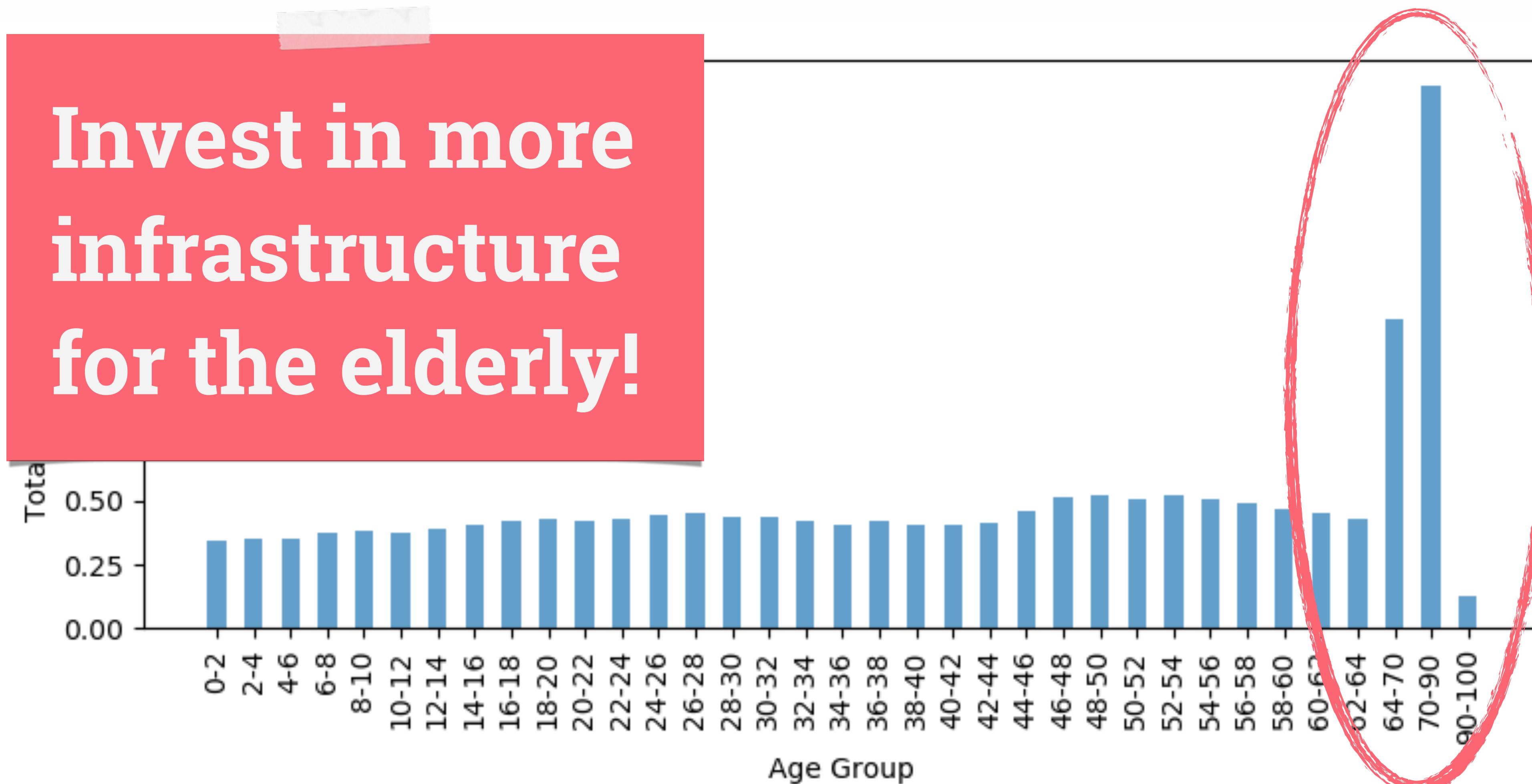
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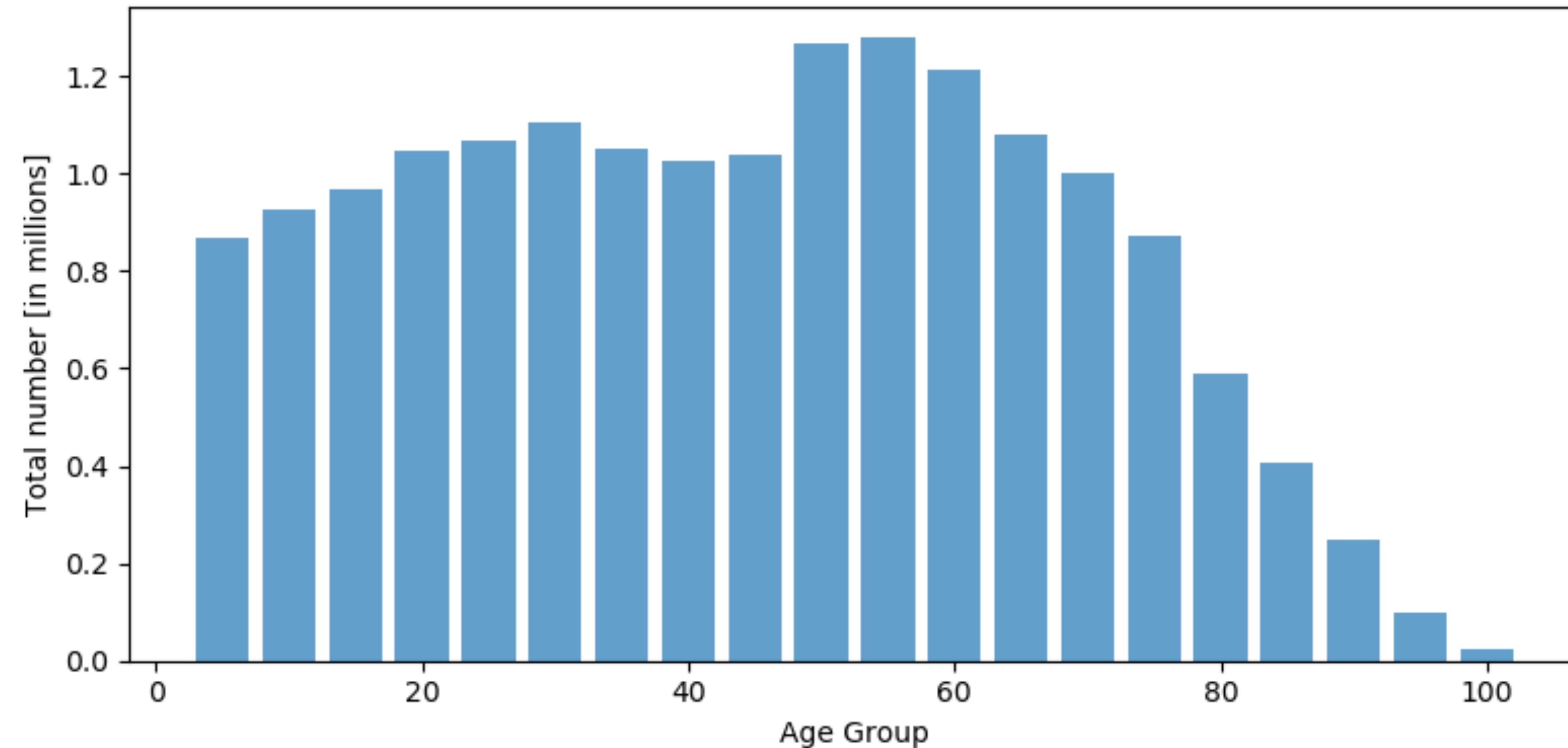
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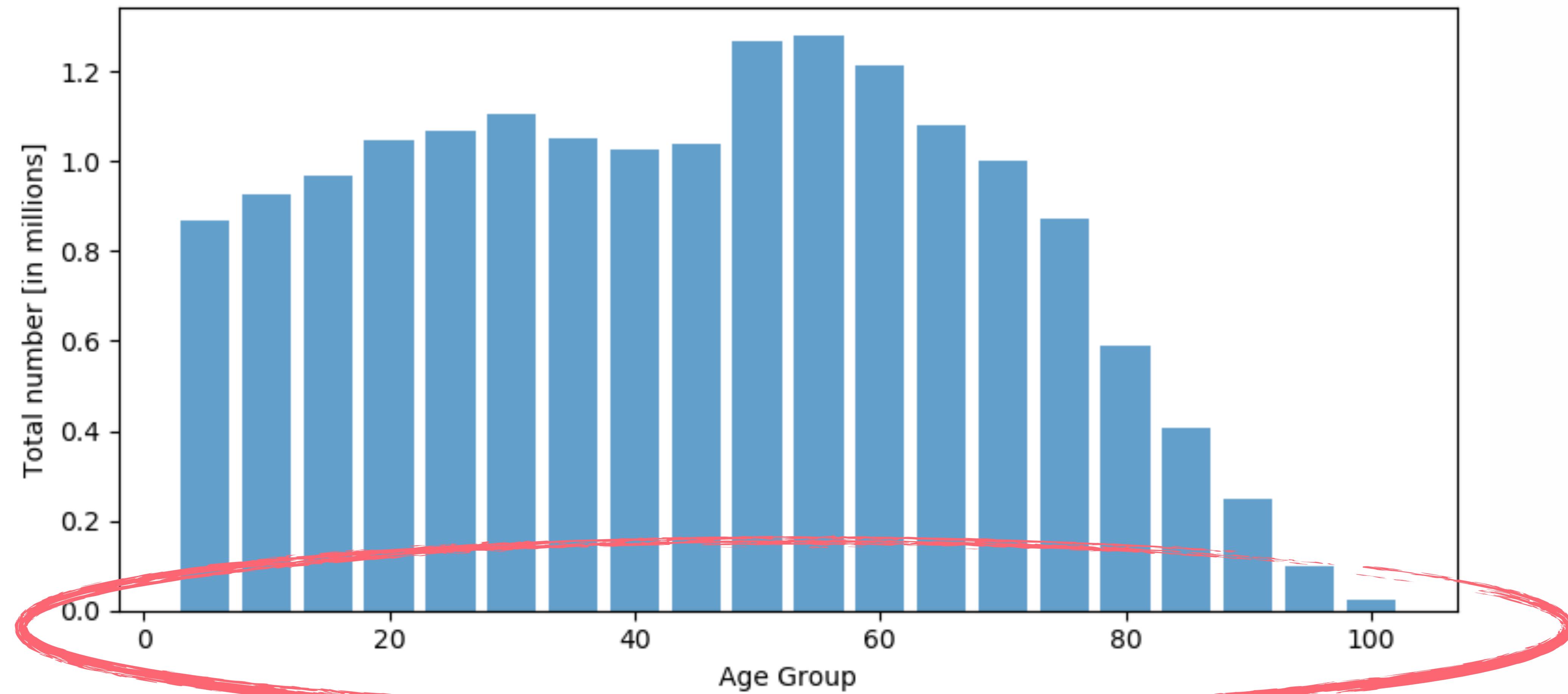
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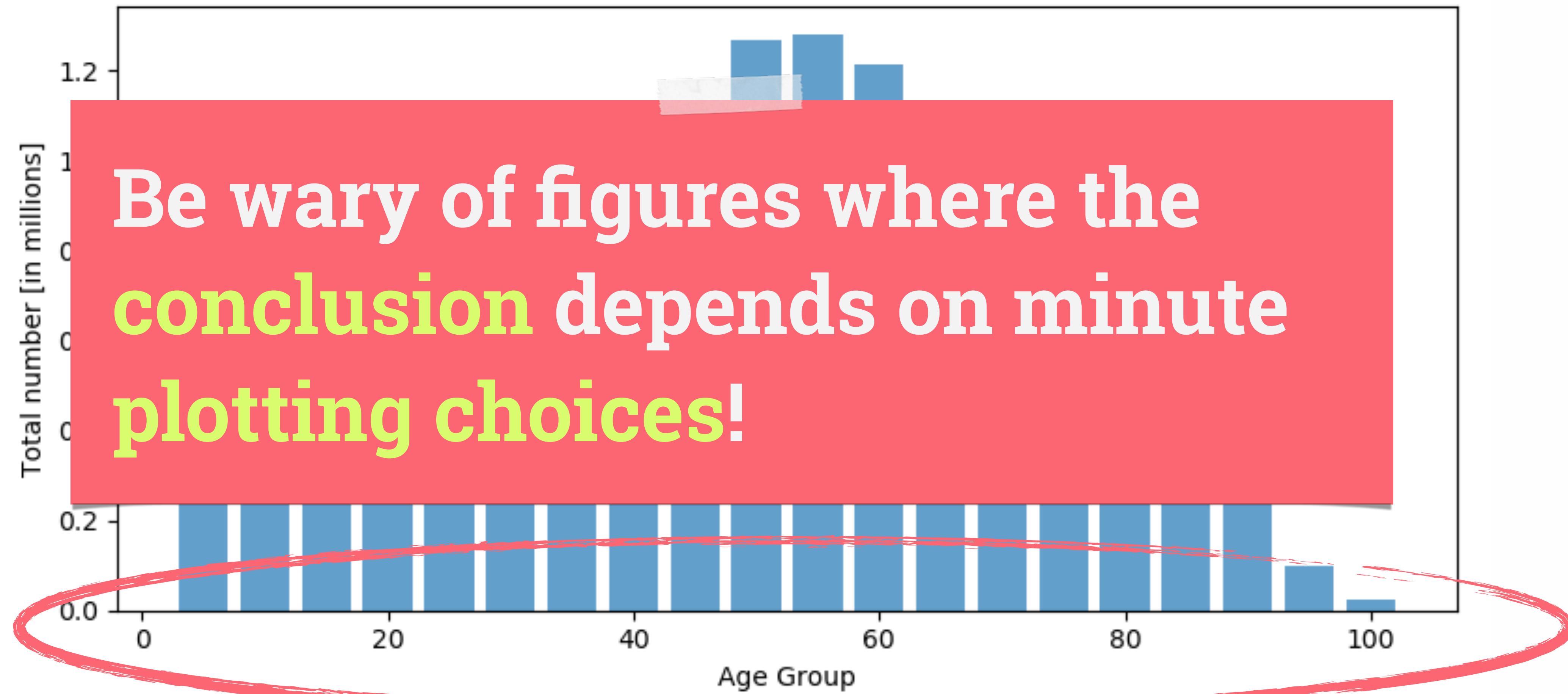
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# Where should the Netherlands invest their tax money?





**Ask yourself: what is the motive of the creator of the visualization?**

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**Aim to represent data faithfully**

**Ask yourself:** what is the **motive** of the  
creator of the visualization?

Aim to **represent** data **faithfully**

Make visualizations **easy to understand**

<http://huppenkothen.org/data-visualization-tutorial/>

(You can **help me improve** this tutorial:  
<https://github.com/dhuppenkothen/data-visualization-tutorial>)

1. Introduction
2. Exercise: Co-creating best practices
3. Accessibility in Data Visualization
4. Pre-Attentive Processing
5. Gestalt Principles
6. Space
7. Choosing a Visualization
8. Data Visualization + Society
9. Exercise: Wireframing

# Exercise: Wireframing

1. Form teams of 5
2. Go to <http://huppenkothen.org/data-visualization-tutorial/11-improveaviz/index.html> and pick a visualization (or use one of your own!) ~5 minutes
1. Discuss: what is the main point of the visualization? What does it do well? What could be improved? ~10 minutes
3. Come up with your own version of a visual representation of the data ~7 minutes
4. Pick a piece of paper and a set of pens/crayons and create a sketch of your new version ~8 minutes

Time: 30 minutes