

Animation

DSC 106: Data Visualization

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UC San Diego

Announcements

Lab 7 due Friday.

Final project proposal (and teams) due next week Tuesday.

No lectures next week since Sam is traveling (only need to attend discussion for attendance).

FAQs:

1. Can I change my project idea after the proposal? Yes.
2. Can I change my team after the proposal? No.

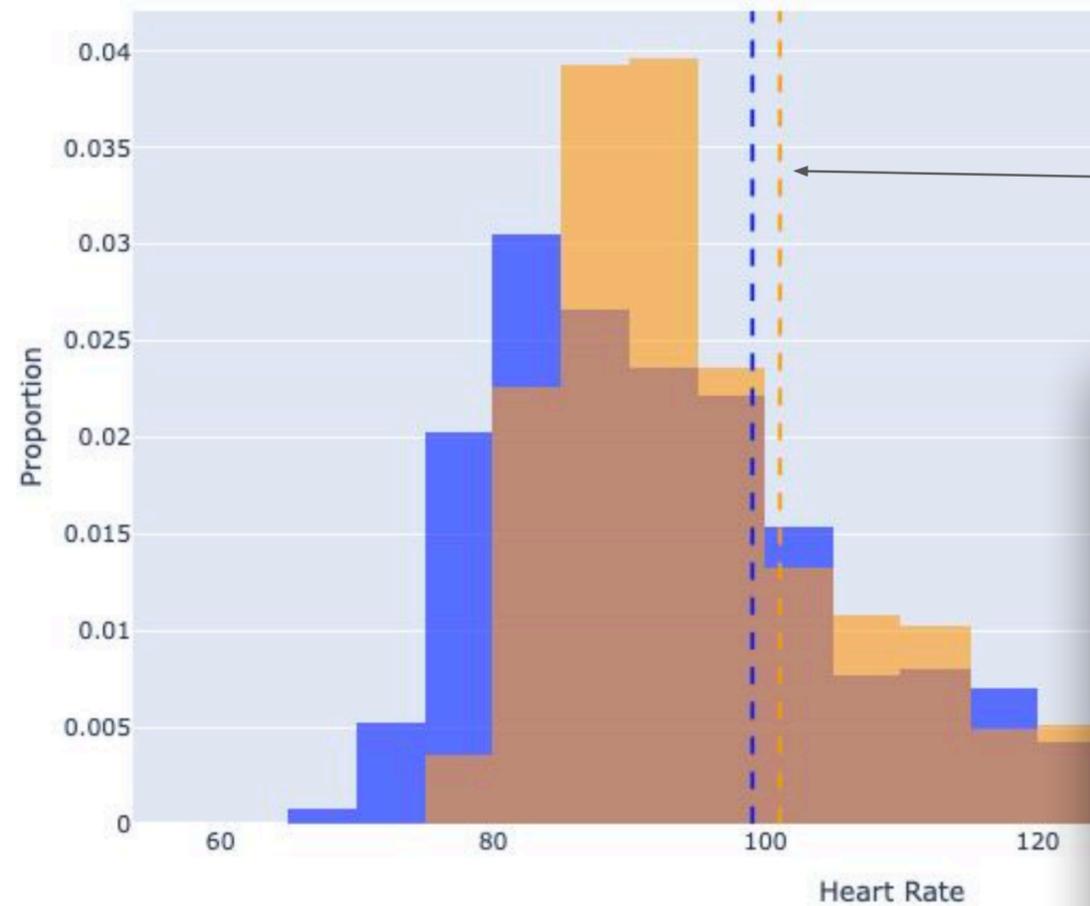
Best Project Awards (Project 2)

Given to 4% of project submissions, chosen by me and Ben

Include this on your resume!

Passing or Failing Students: Who Cares More about their Exams?

A study conducted using health-monitoring armbands to measure stress among students revealed only subtle differences in heart rates between those who failed and those who passed. This suggests that both groups may experience similar levels of stress.

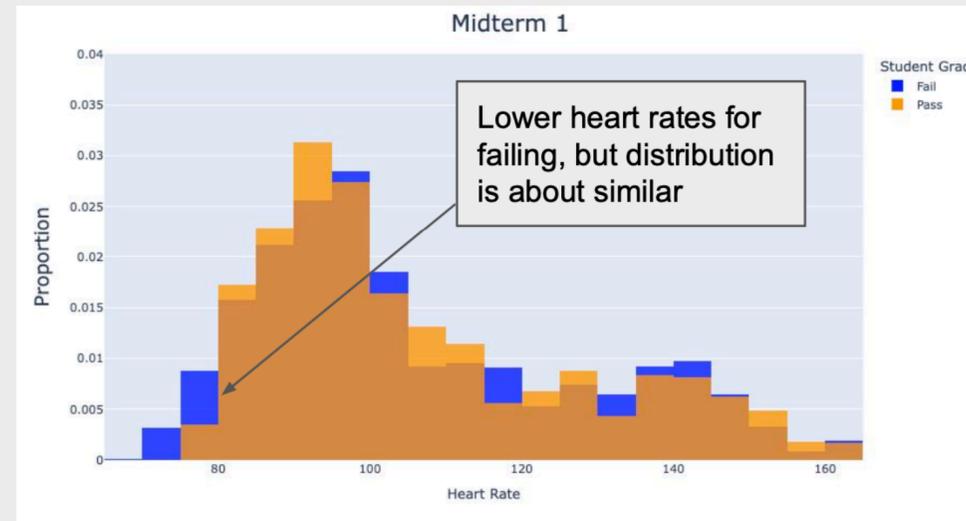


Students who failed exhibited lower heart rates, averaging 99 beats per minute (BPM), compared to those who passed, who averaged 101 BPM—a difference of 2 BPM.

Student Grade

- Fail
- Pass

Failing Students Not Concerned During Exams?

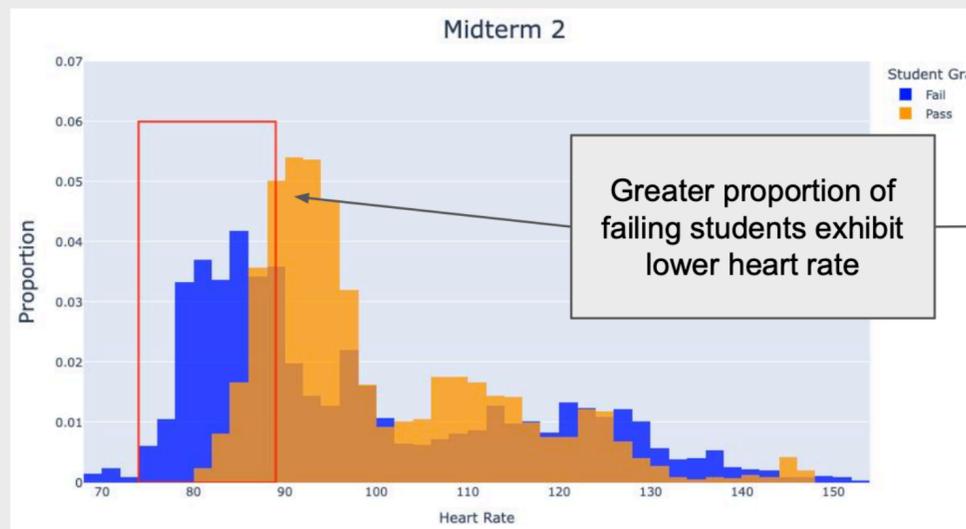


Midterm 1

Lower heart rates for failing, but distribution is about similar

Student Grade

- Fail
- Pass

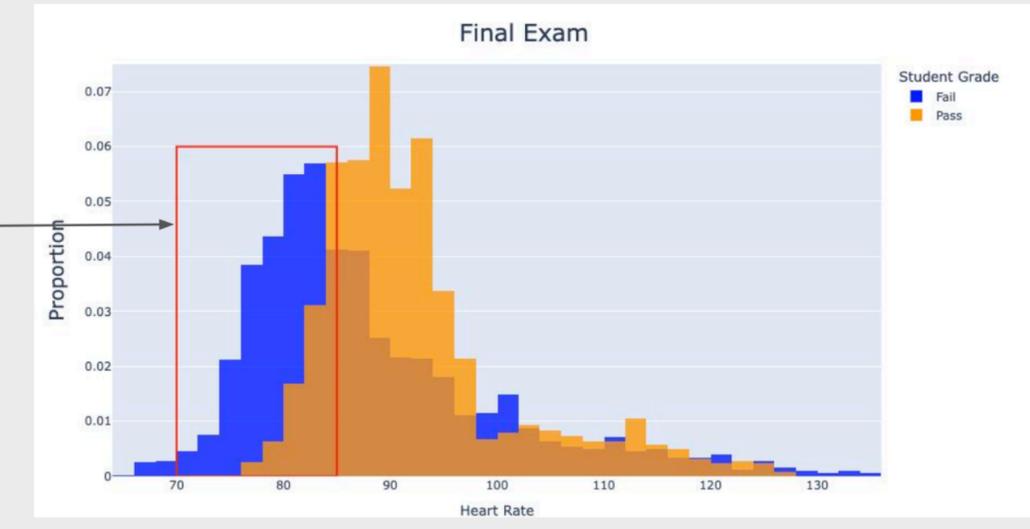


Midterm 2

Greater proportion of failing students exhibit lower heart rate

Student Grade

- Fail
- Pass



Final Exam

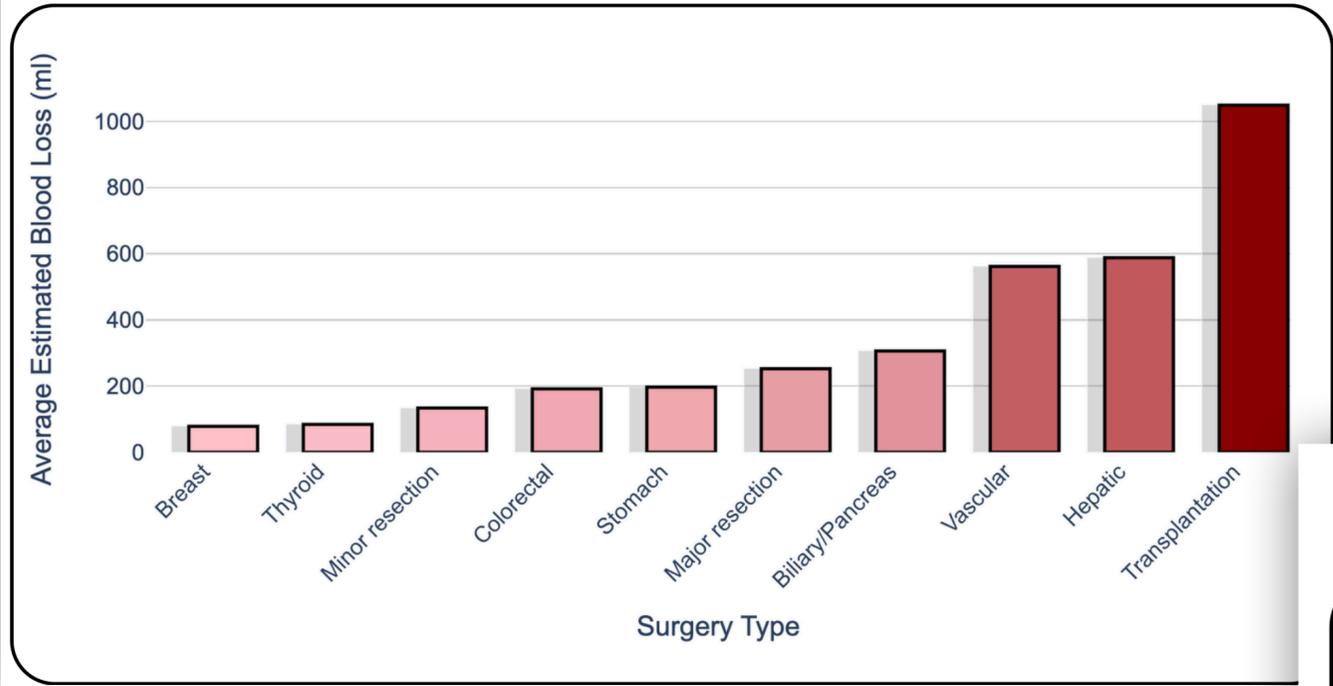
Student Grade

- Fail
- Pass

B.H.

In a study investigating student stress levels during exams through the use of health-monitoring armbands, it was found that students with failing grades showed lower heart rates compared to those who passed, suggesting that they experienced less stress.

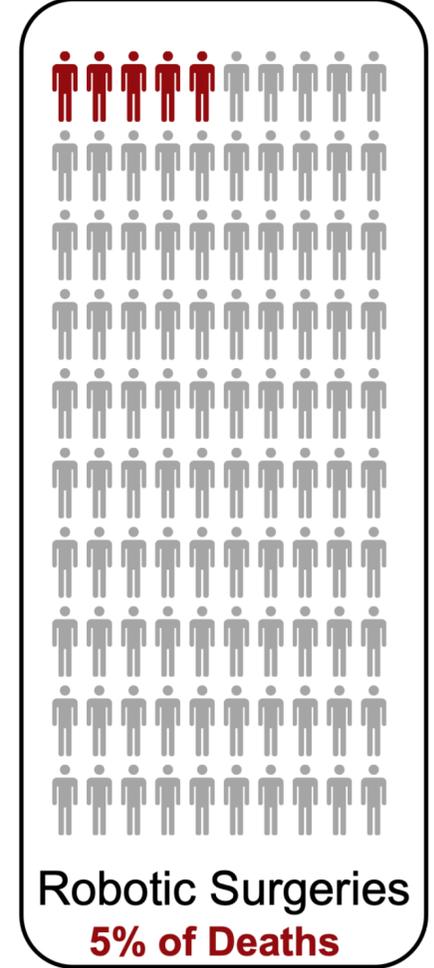
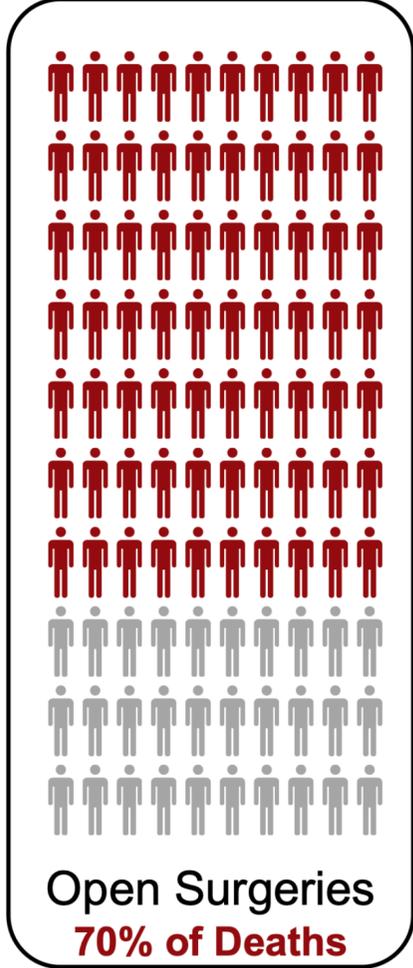
What Surgeries Tend To Result In More Blood Loss?



Are Robotic Surgeries Less Dangerous?

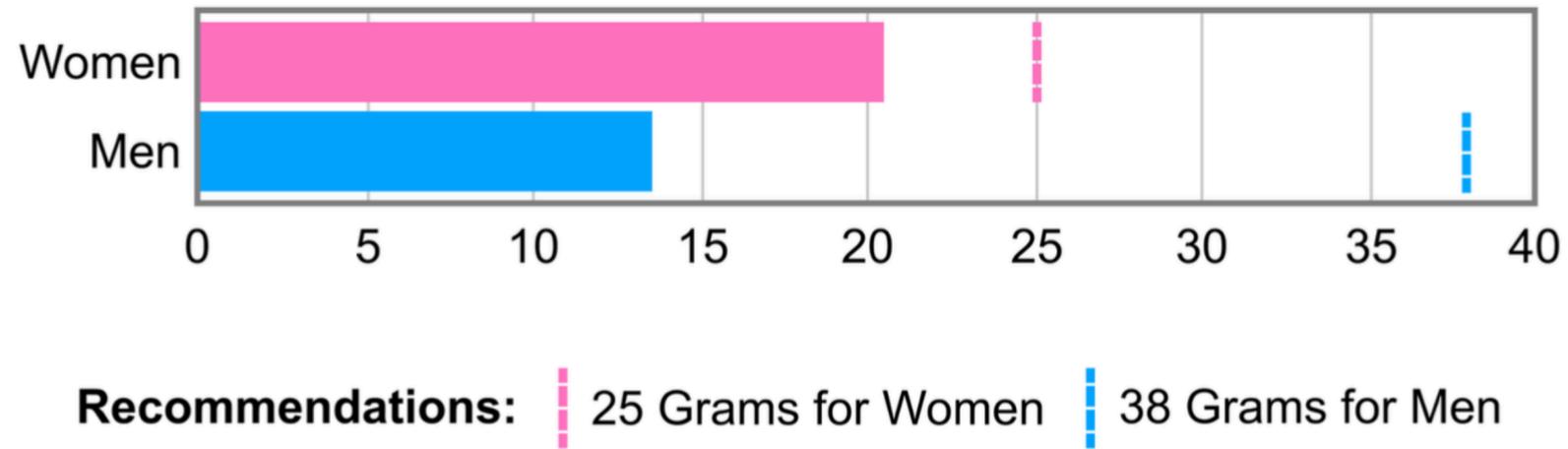
According to data provided by VitalDB, surgeries performed by robots are only responsible for 5% of in hospital deaths, while open surgeries performed by human surgeons are responsible for 70%. Could robotic surgeries be the future of medicine?

 = 1% of in hospital deaths



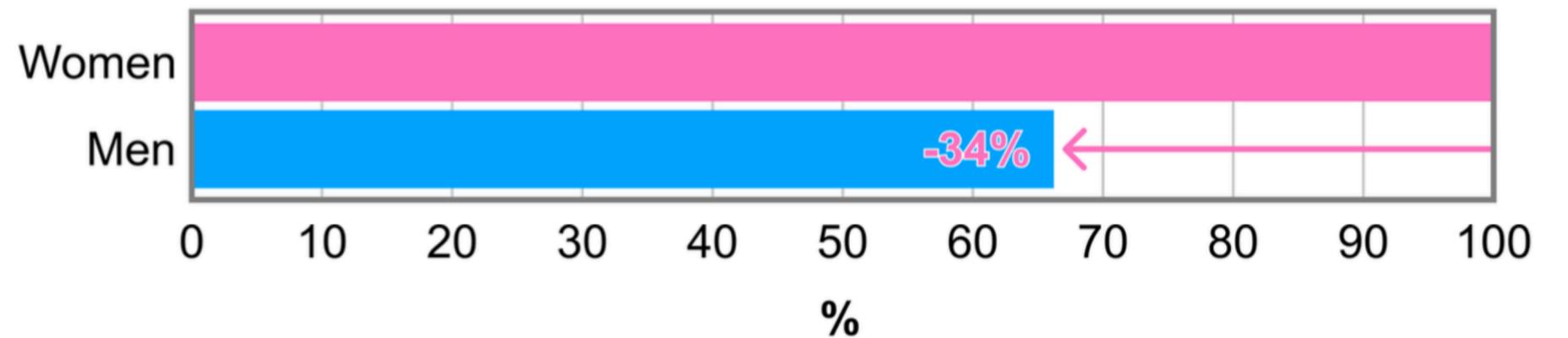
Why Aren't Men Eating Fiber?

Average Daily Fiber Intake in Grams by Gender



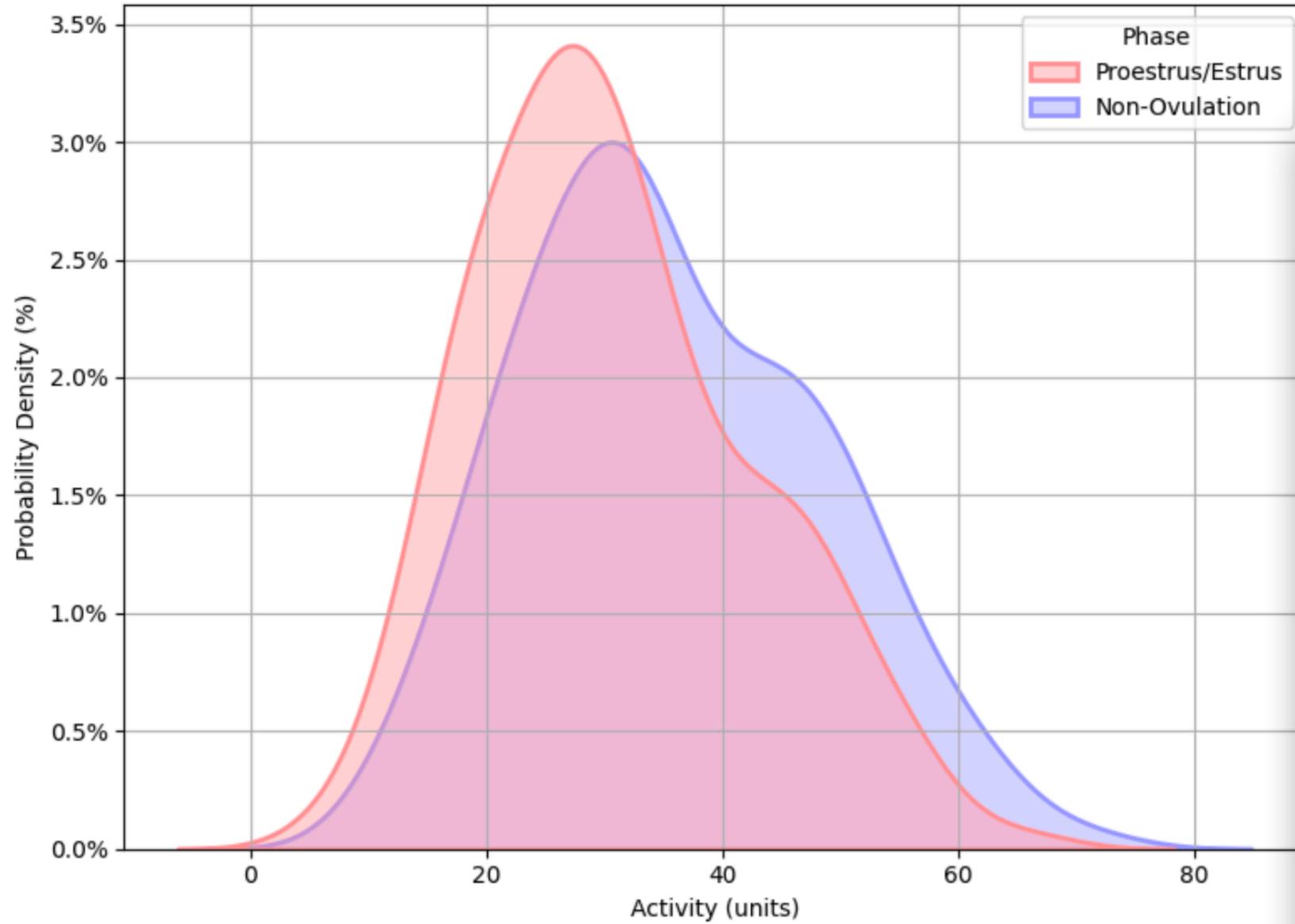
Why Aren't Men Eating Fiber?

Percentage of Average Daily Fiber Intake Relative to Women

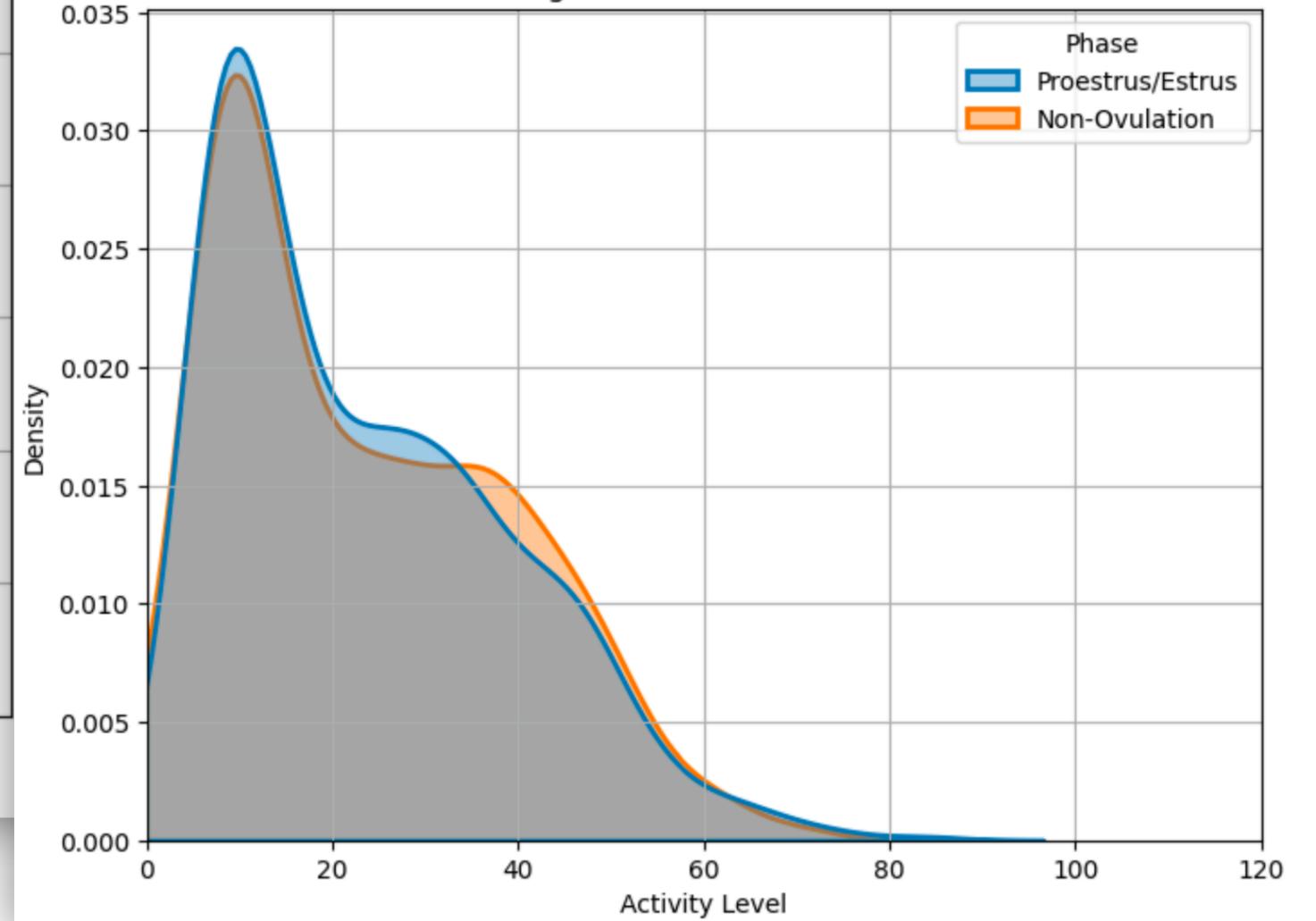


D.P.

Distribution of Activity Levels among Awake Ovulating Females



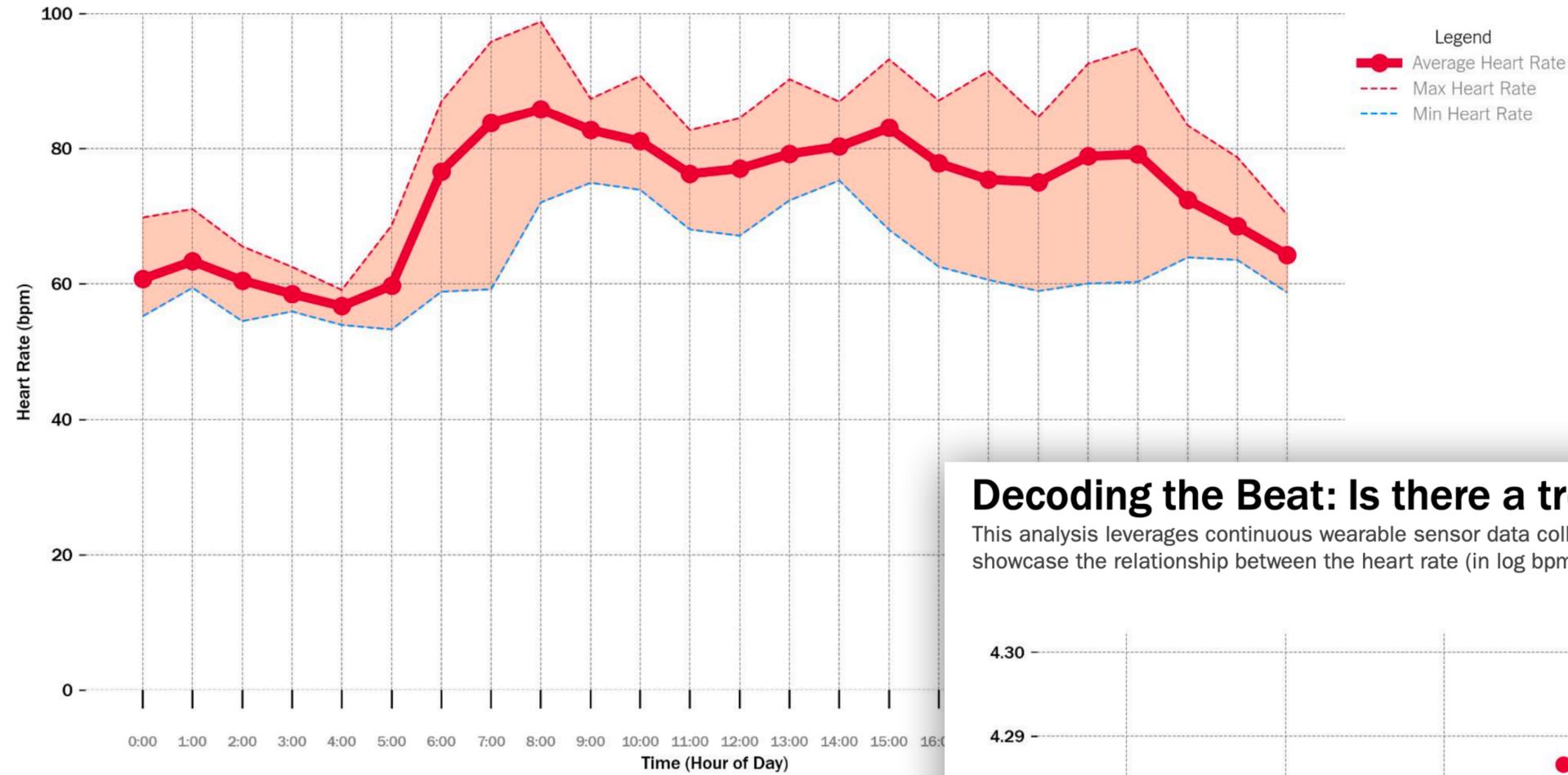
Little Difference in Mice Activity Levels :
Distribution during Ovulation and Non-Ovulation Phases



E.C.

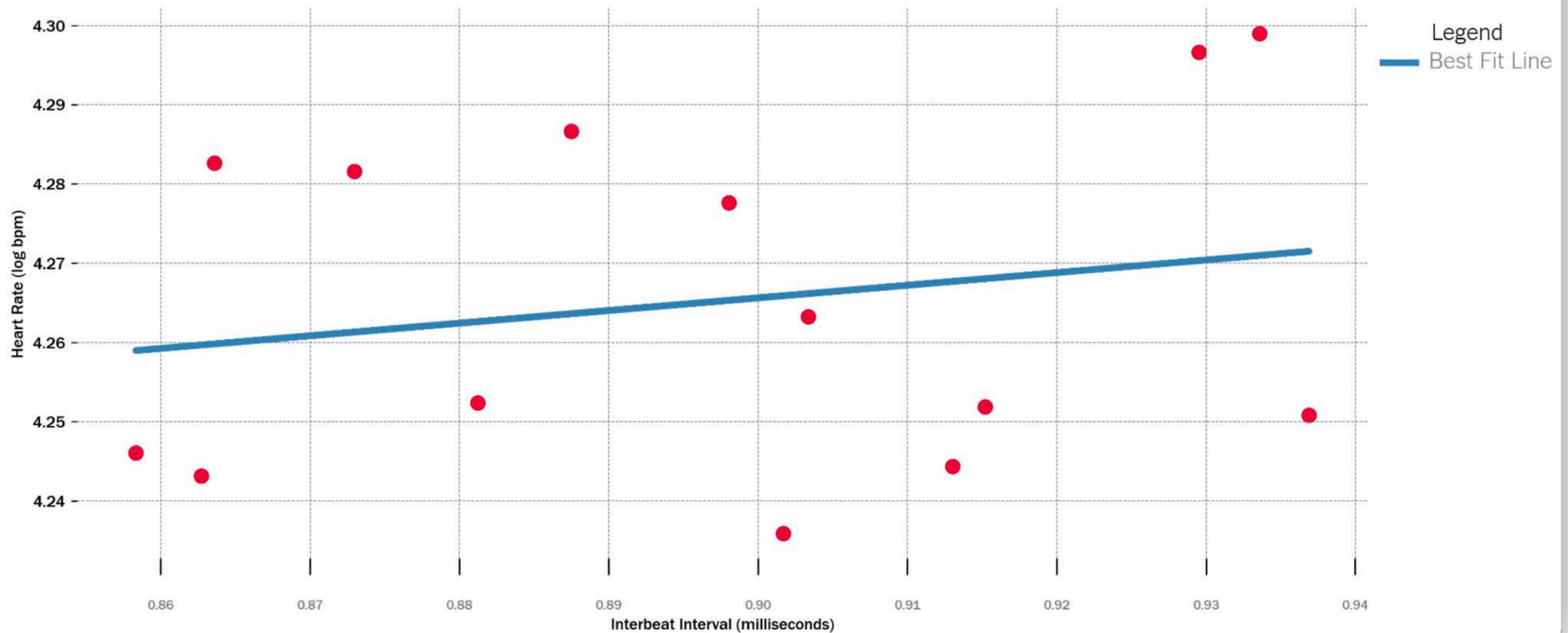
The Rhythm of the Day: How Heart Rate Shifts Throughout the Hours

This analysis leverages continuous wearable sensor data collected by the BIG IDEAs Lab Glycemic Variability and Wearable Device Data v1.0.0 study to showcase the average heart rate of Subject 001 throughout the day as they wake, live, and rest.



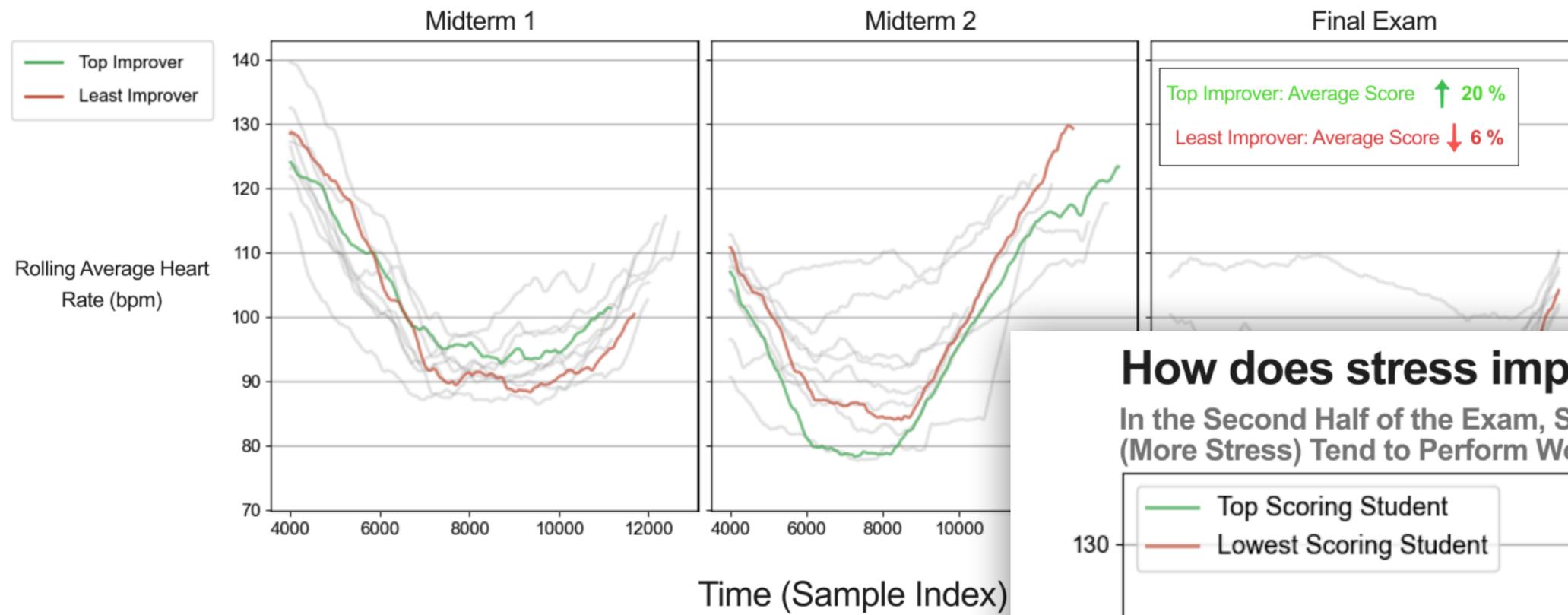
Decoding the Beat: Is there a trend between heart rate and interbeat interval?

This analysis leverages continuous wearable sensor data collected by the BIG IDEAs Lab Glycemic Variability and Wearable Device Data v1.0.0 study to showcase the relationship between the heart rate (in log bpm for visualizability) and the interbeat interval (in milliseconds).



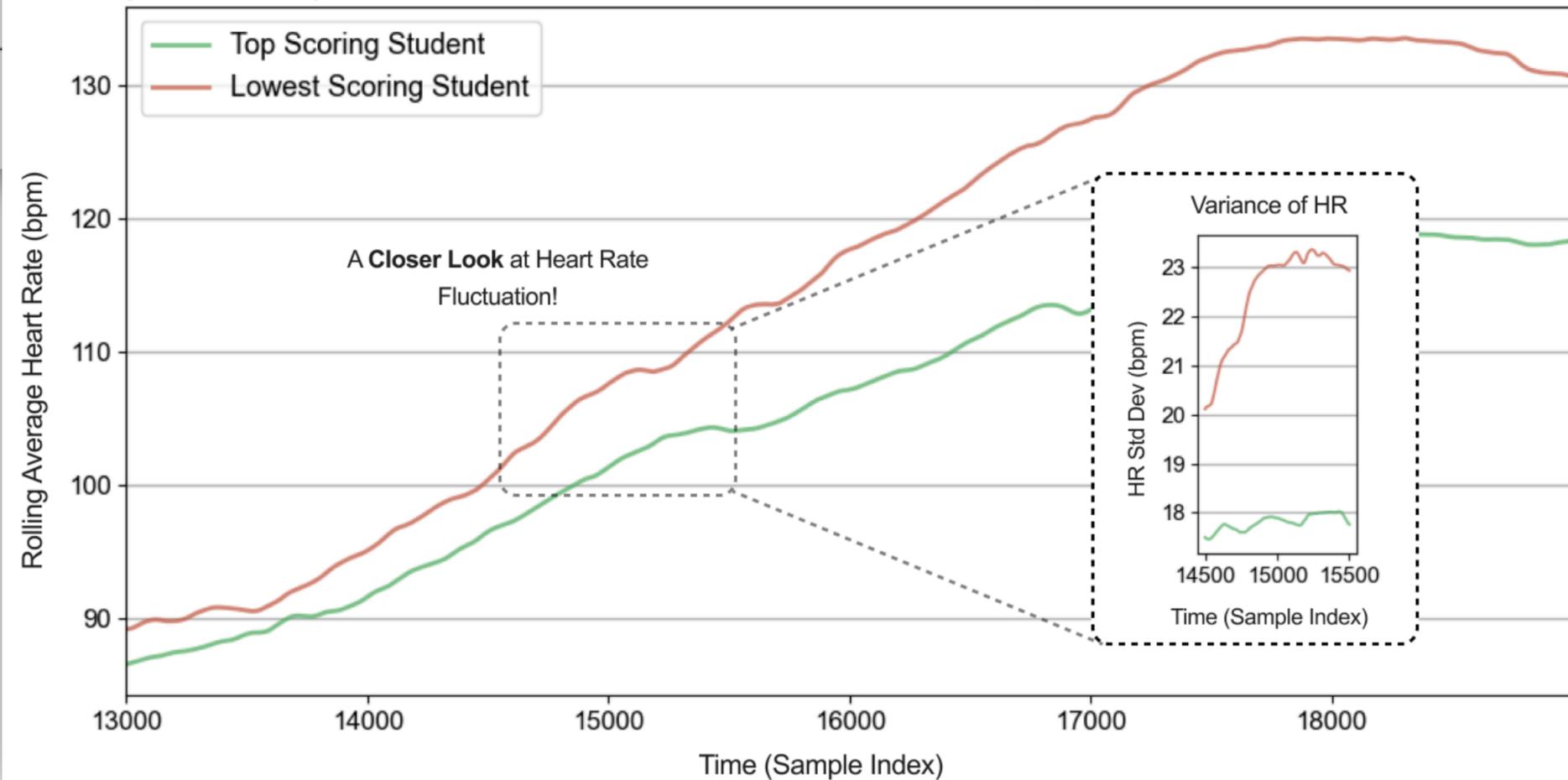
Staying Calm Midway: The Key to Outperform in High-stress Tasks

Staying calm during the midpoint of an exam significantly improves performance. Students who adapted by lowering their heart rate saw a 20% increase, while those who remained stressed improved the least (6% drop).



How does stress impact one's academic performance?

In the Second Half of the Exam, Students With Higher Heart Rate and Fluctuations (More Stress) Tend to Perform Worse in Exams — Just as Expected!



G.X.

Trouble with the Home Row? Get Checked for Parkinson's!

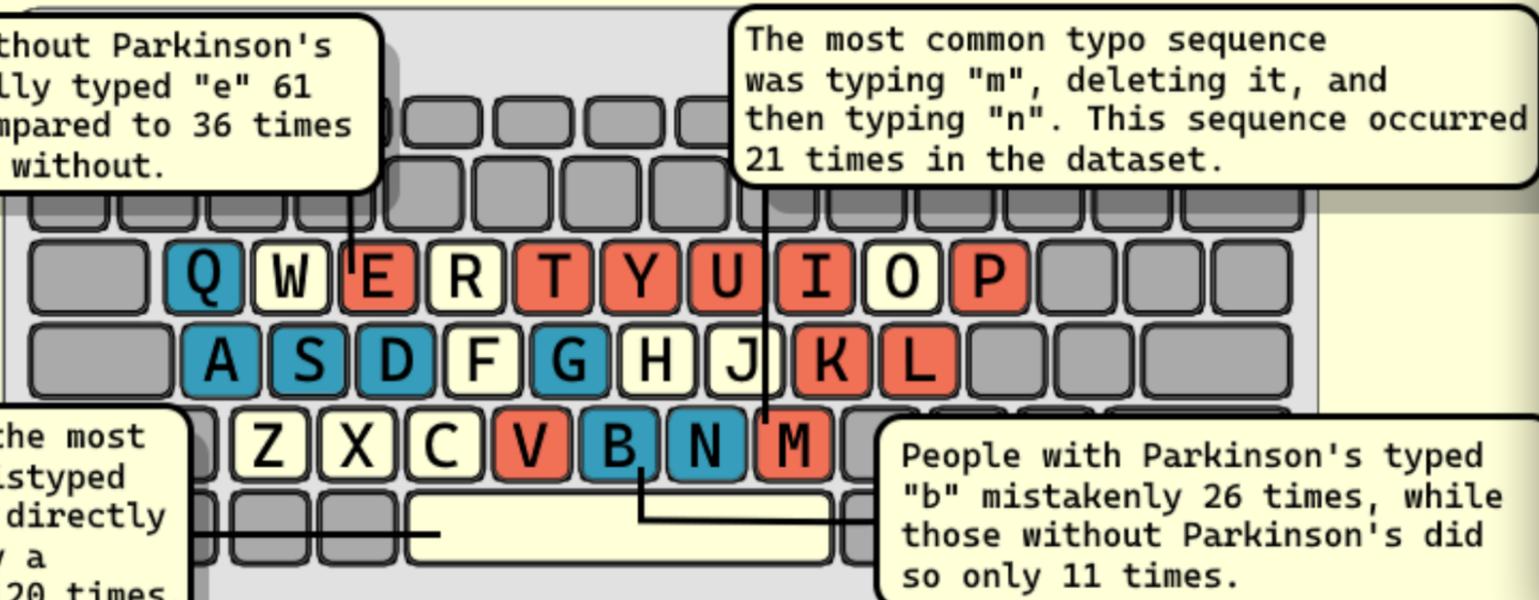
Do people with Parkinson's show a pattern in which keys they type on accident? Keystroke data from 42 people with Parkinson's and 43 people without reveals the answer.

People without Parkinson's accidentally typed "e" 61 times, compared to 36 times by people with.

The most common typo sequence was typing "m", deleting it, and then typing "n". This sequence occurred 21 times in the dataset.

Space was the most commonly mistyped key, being directly followed by a backspace 120 times.

People with Parkinson's typed "b" mistakenly 26 times, while those without Parkinson's did so only 11 times.



Wrongly typed more by people WITH Parkinson's

Roughly equal number of typos by both groups

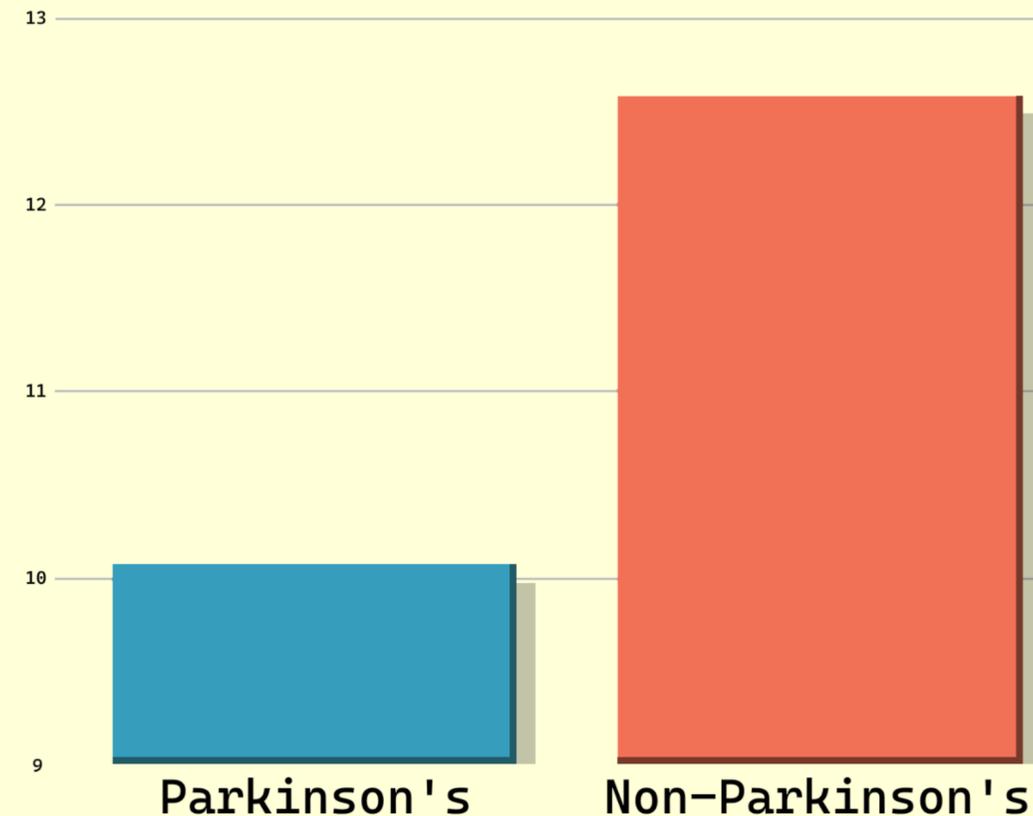
Wrongly typed more by people WITHOUT Parkinson's

P Versus NP Solved at Last!

Do people with Parkinson's make more typos? Quite the opposite!

Average Typos

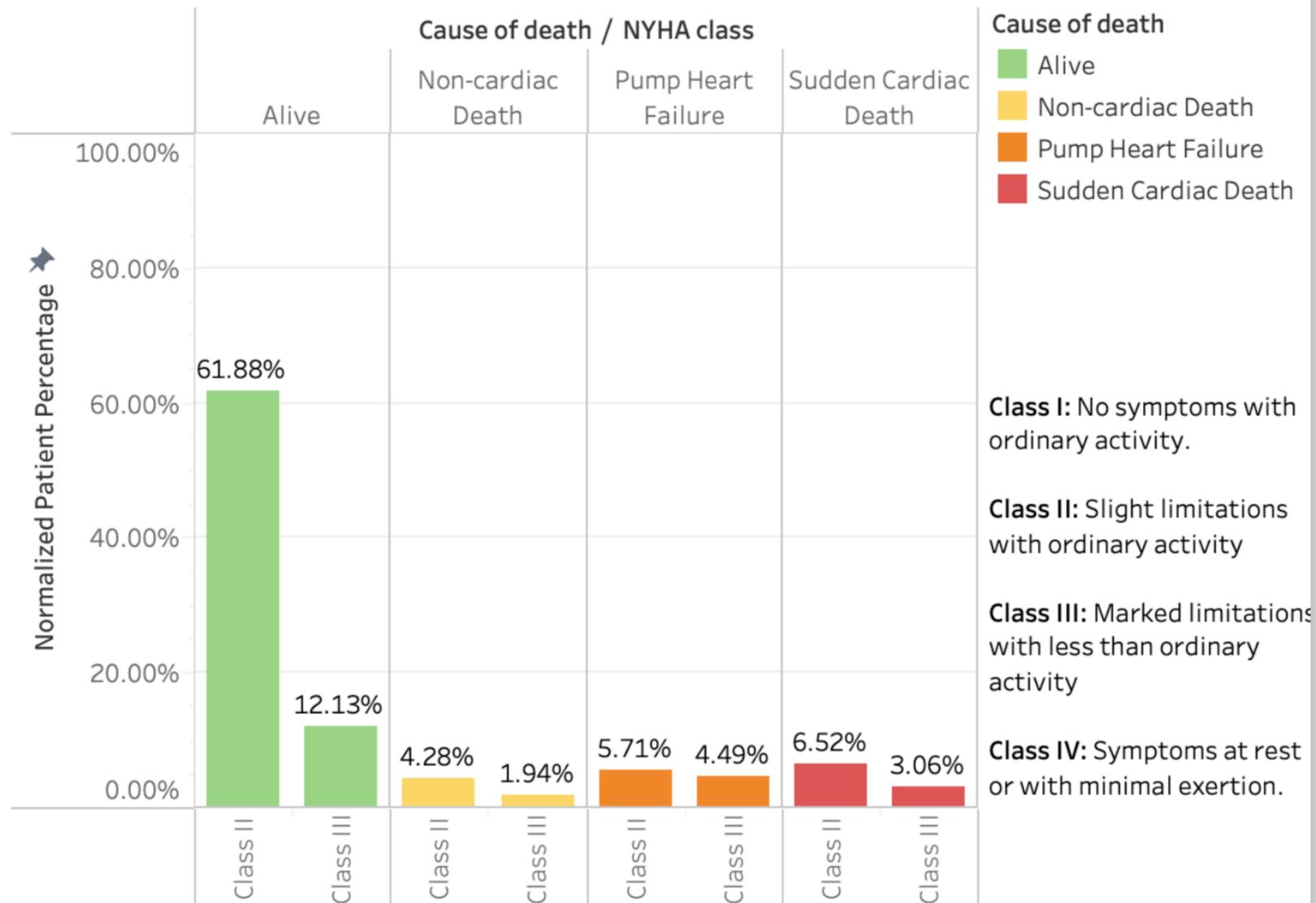
estimated total
per year by all people with and without Parkinson's in America (log scale)



New York Heart Association Classification: Are You At Risk?

The New York Heart Association (NYHA) classify heart condition into four category each having different effects on patients

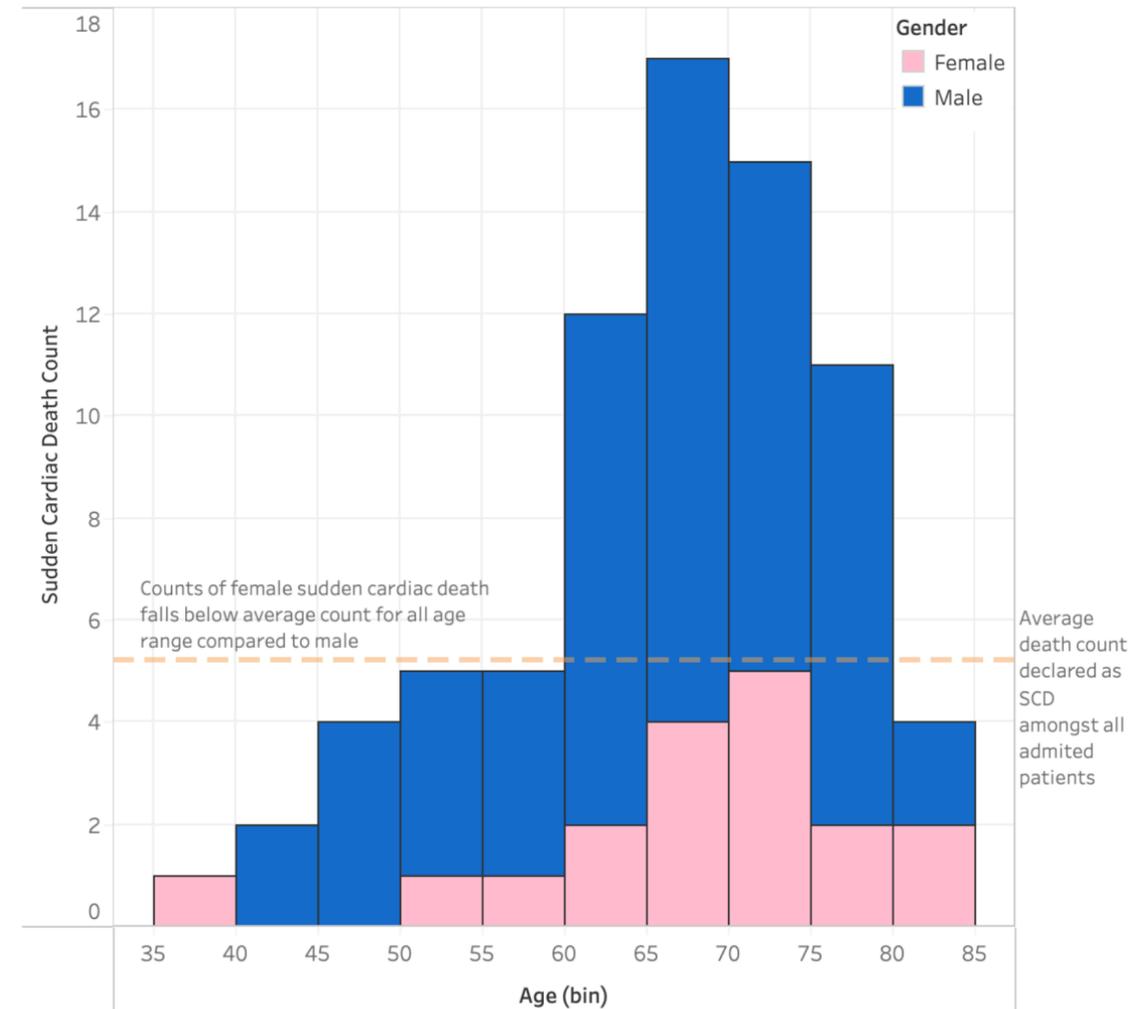
Recorded below are mortality rate normalized in percentage for admitted patients belong to Class II and Class III



Sudden Cardiac Death (SCD): Gentlemen Beware!

Data from the MUSIC (MUerte Subita en Insuficiencia Cardiaca) study designed to assess cardiac mortality.

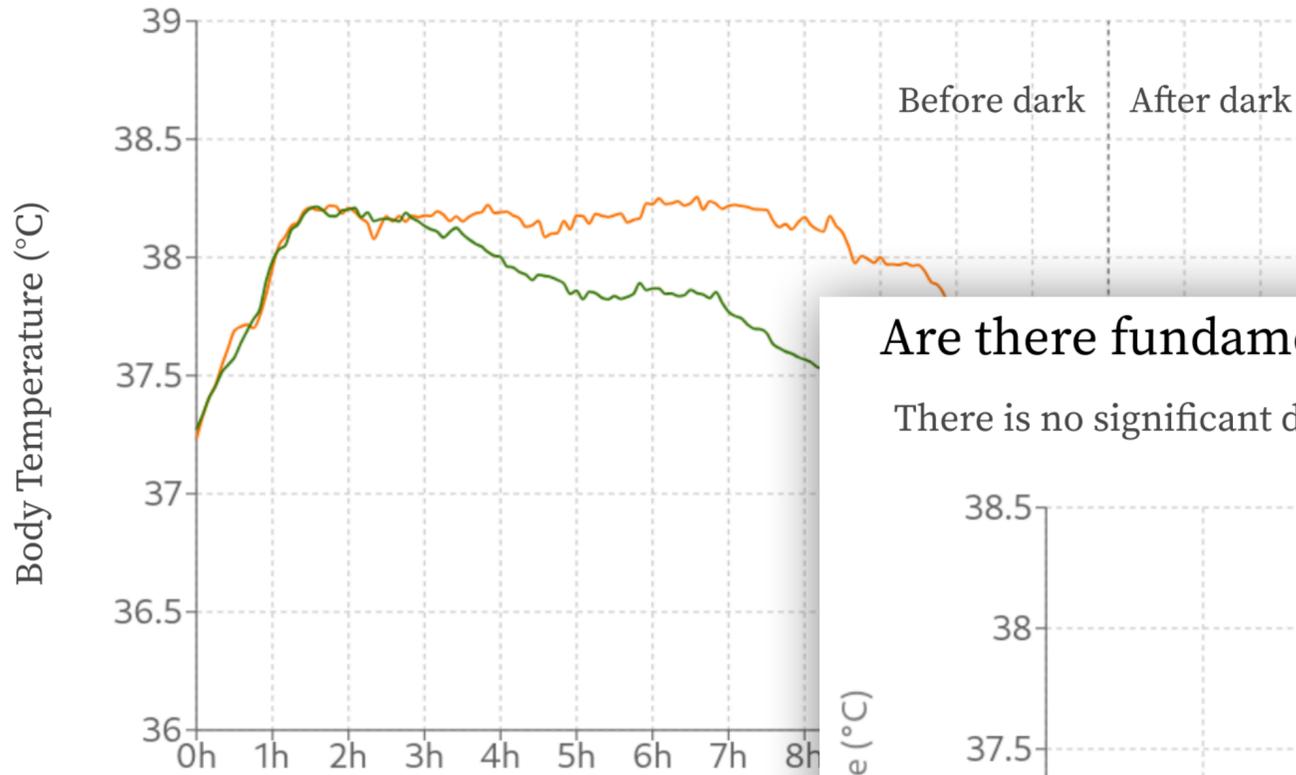
Studies from Heart Failure Clinics of eight University Spanish Hospitals recorded count of cases of Sudden Cardiac Death across genders and ages



N.D.

Does the reproductive cycle (estrus vs. non-estrus days) affect daily body temperature patterns in female mice?

Up to hour 4, there is almost no difference in body temperature but between hours 5 and 15 there is a slight gap in body temperature (~0.25 to 0.4°C). Past hour 16, estrus and non-estrus body temperatures are within 0.15°C of one another.

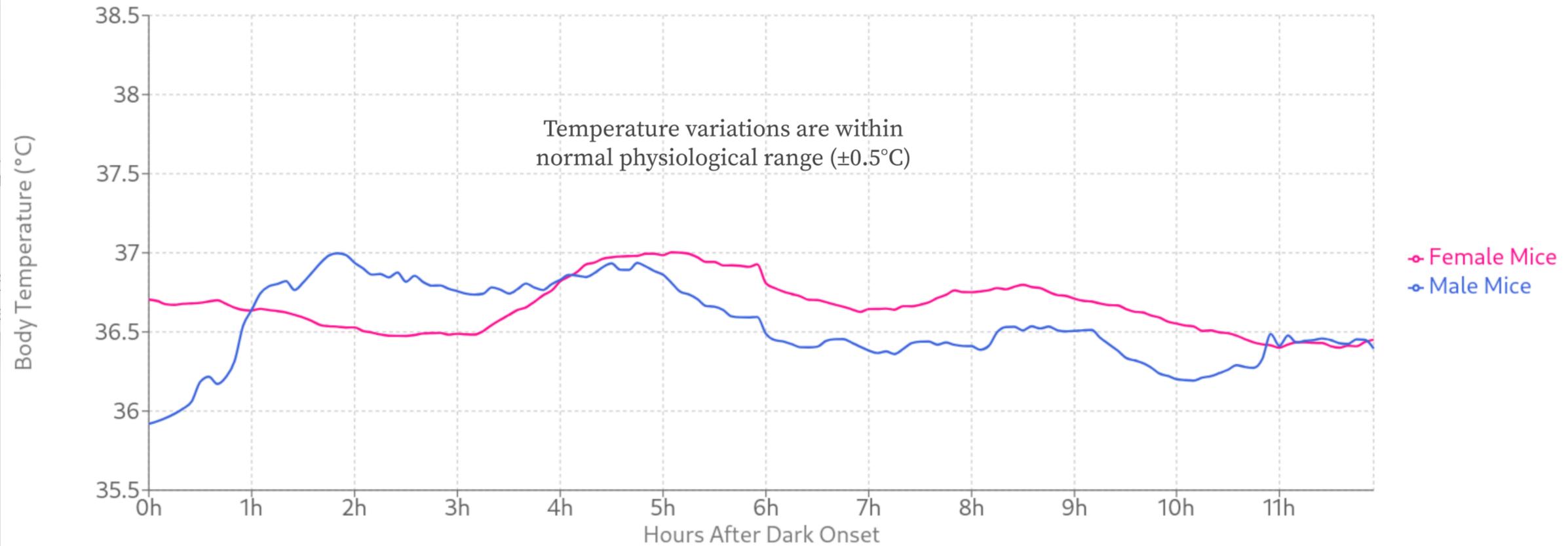


Data Processing: Averaged temperatures for multiple days, showing some elevated temperature

N.T.

Are there fundamental differences in body temperature between male and female mice after dark?

There is no significant difference in body temperature (within a standard measurement error) between the two sex

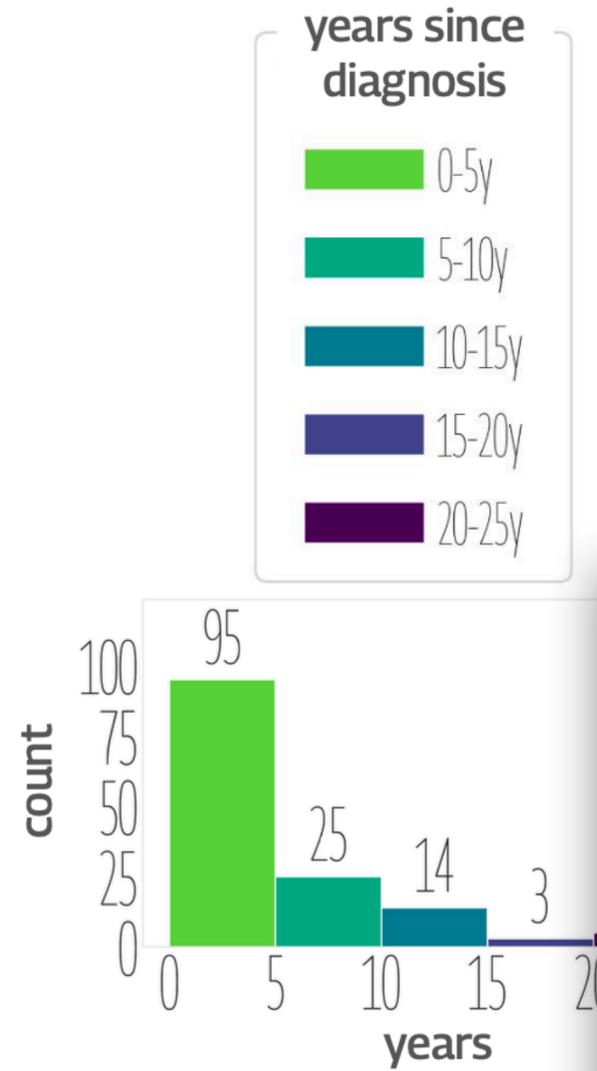
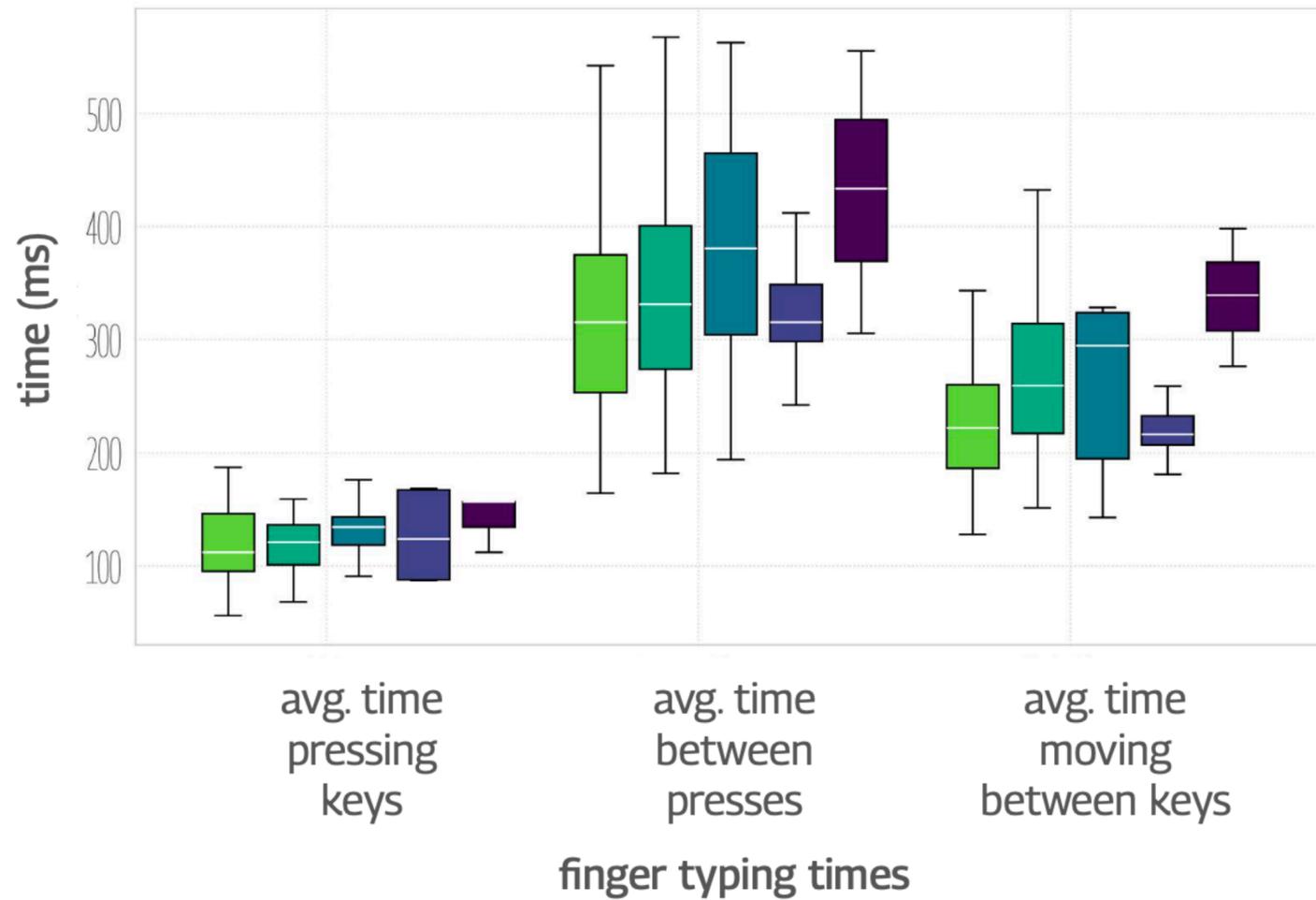


*Analysis focused on dark phase when mice exhibit most stable temperature patterns

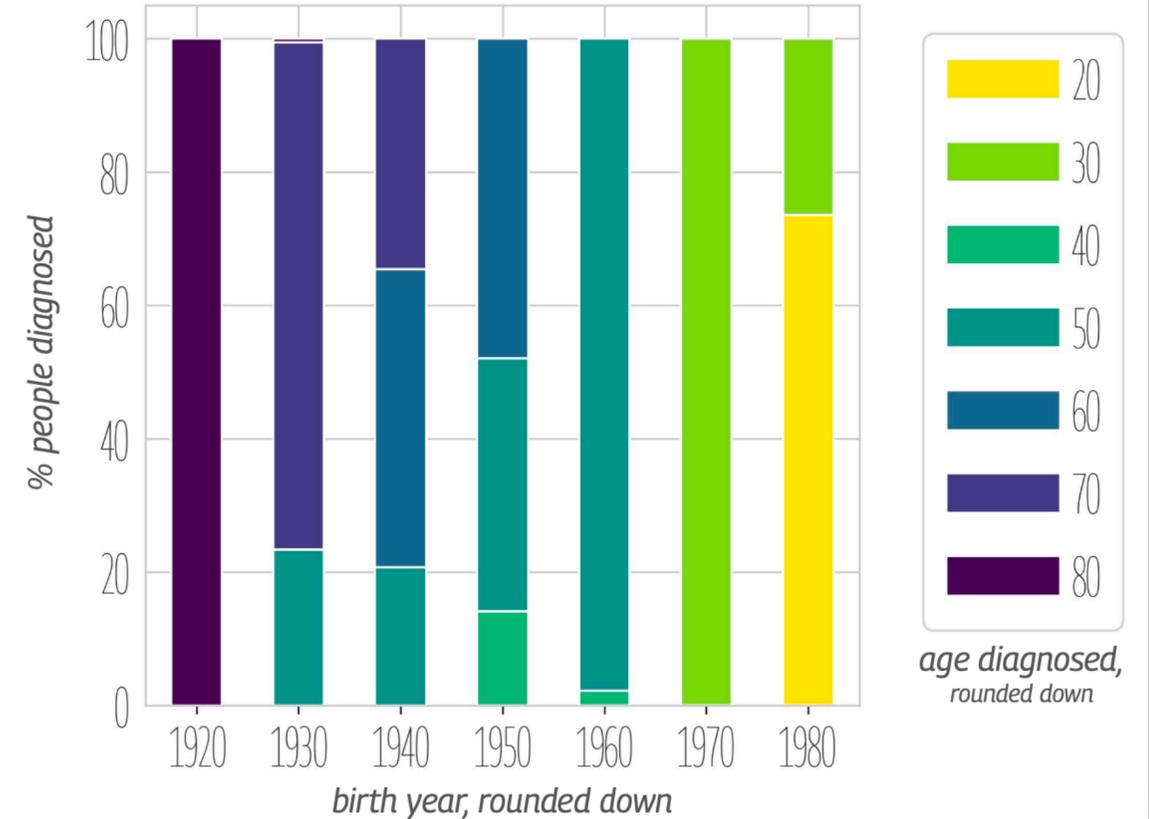
Data processing: Body temperature for both male and female using a smoothing moving average across multiple days during dark phase

Does Parkinson's worsen typing speed over time?

High variance and disproportionate sampling show it's not that simple.



At what age are people diagnosed with Parkinson's? Surveys show it's getting younger.

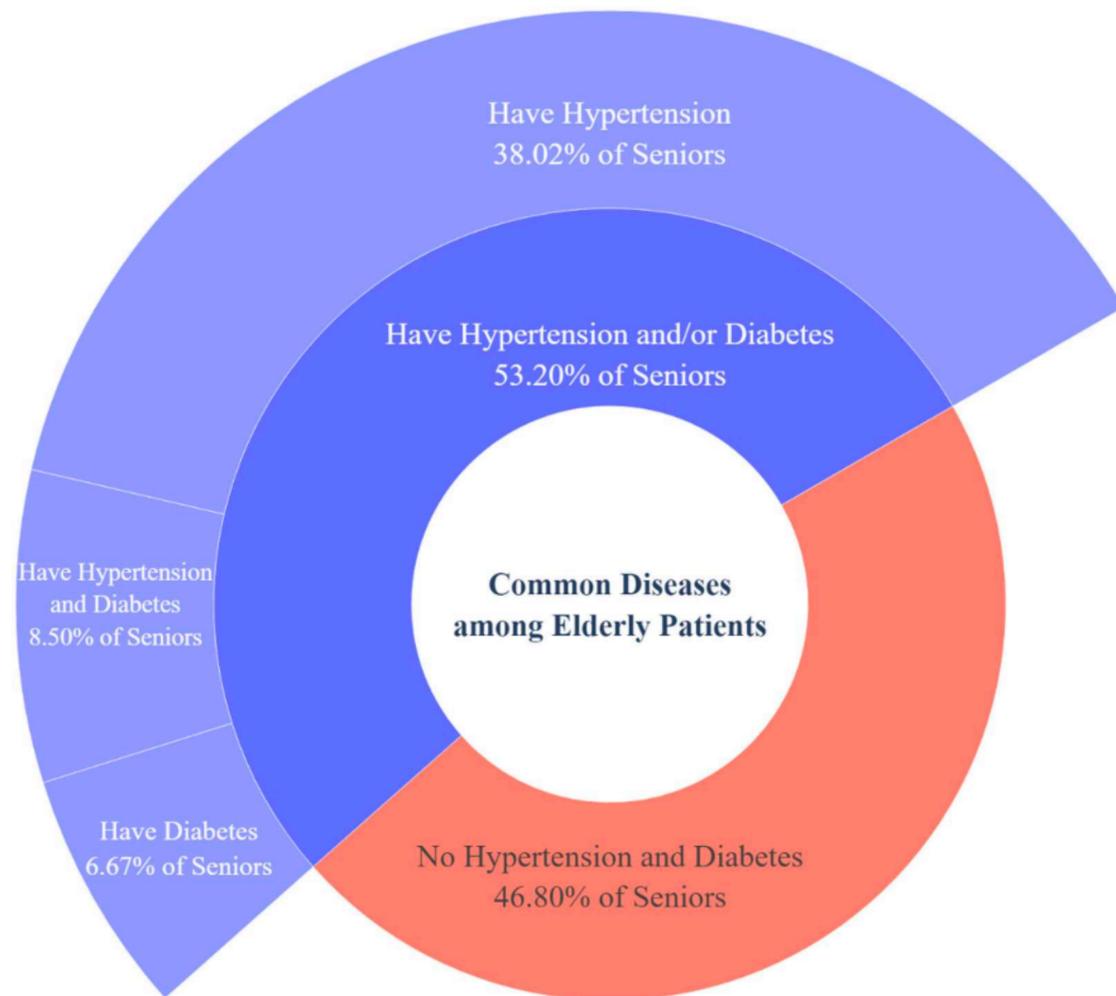


R.B.

Hypertension and Diabetes:

Two of the Most Common Diseases Among Elderly Patients

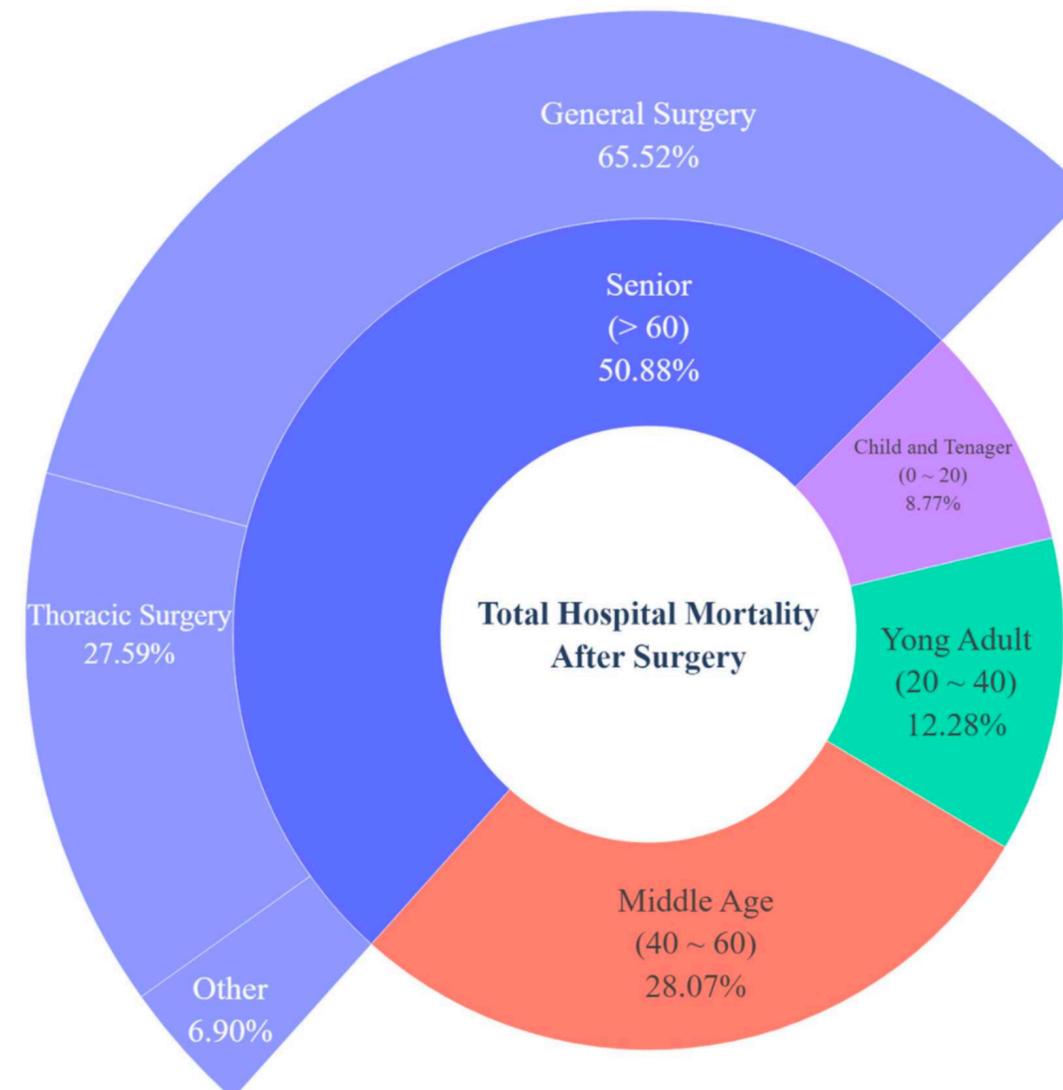
A recent analysis reveals that hypertension and diabetes are among the most common health challenges facing seniors today. Together, these chronic conditions affect more than half of the elderly population, posing significant risks to their overall well-being. Hypertension is significantly more prevalent than diabetes among seniors, highlighting its dominant role in elderly health challenges.



Surgical Risks for Seniors:

Elderly Patients Face the Highest In-Hospital Mortality

Elderly patients (60+) face the highest risk of in-hospital deaths, with General Surgery being the most dangerous department for them. A recent hospital mortality dataset shows that seniors account for the largest share of hospital deaths, significantly outpacing younger age groups. This highlights the urgent need for improved surgical protocols, specialized geriatric care, and better risk assessment to enhance outcomes for older adults undergoing surgery.



Animation

Animation Goals

Direct attention

Increase Engagement

Explain a Process

Understand a State Transition



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Animation Goals

Motion as a visual cue

Smooth motion is perceived at ~ 10 frames / sec (1 frame every 100ms).

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7.5 fps



15 fps



30 fps



60 fps



60 fps



30 fps



15 fps



7.5 fps



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Motion as a visual cue

Smooth motion is perceived at ~ 10 frames / sec (1 frame every 100ms).

Pre-attentive, stronger than color, shape, etc.

More sensitive to motion at our periphery.

Similar motions perceived as a group (gestalt principle of common fate).

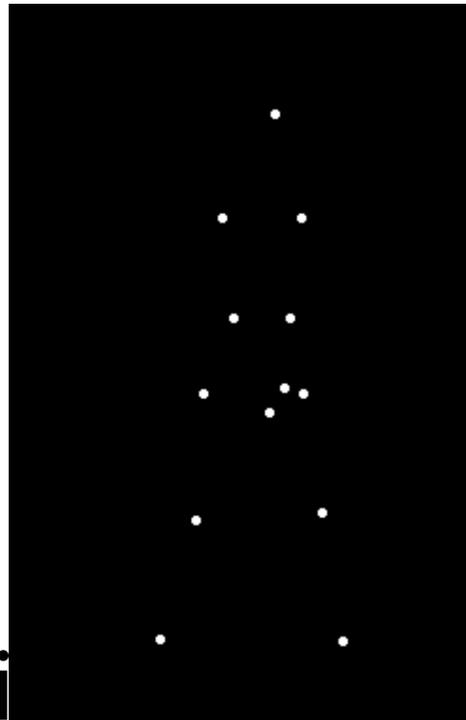
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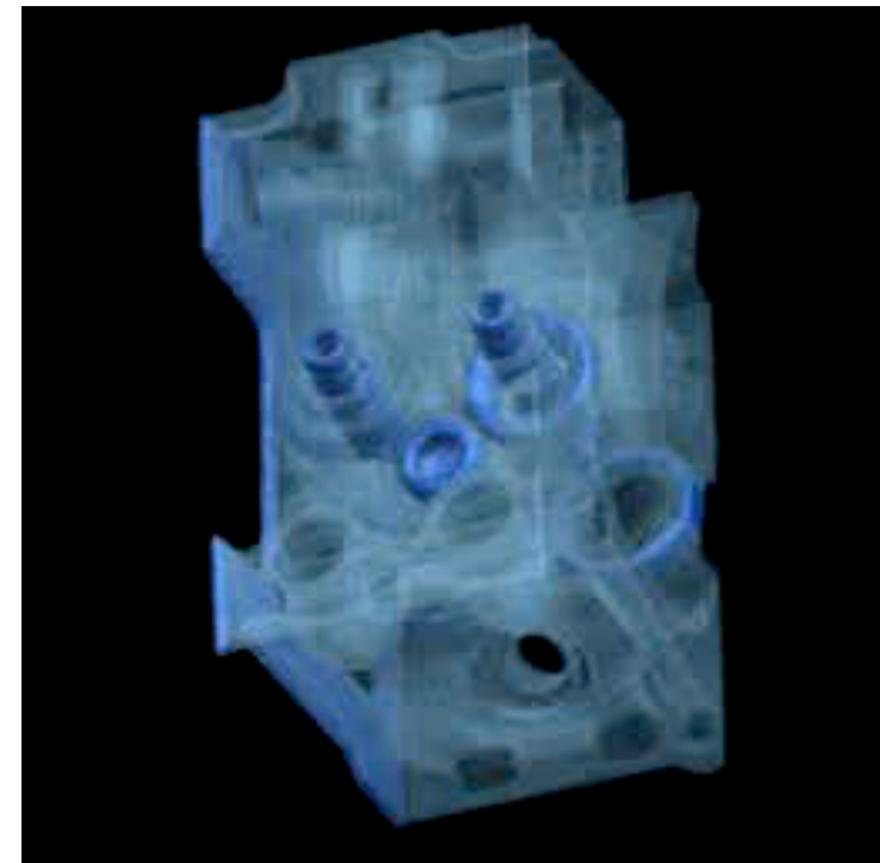
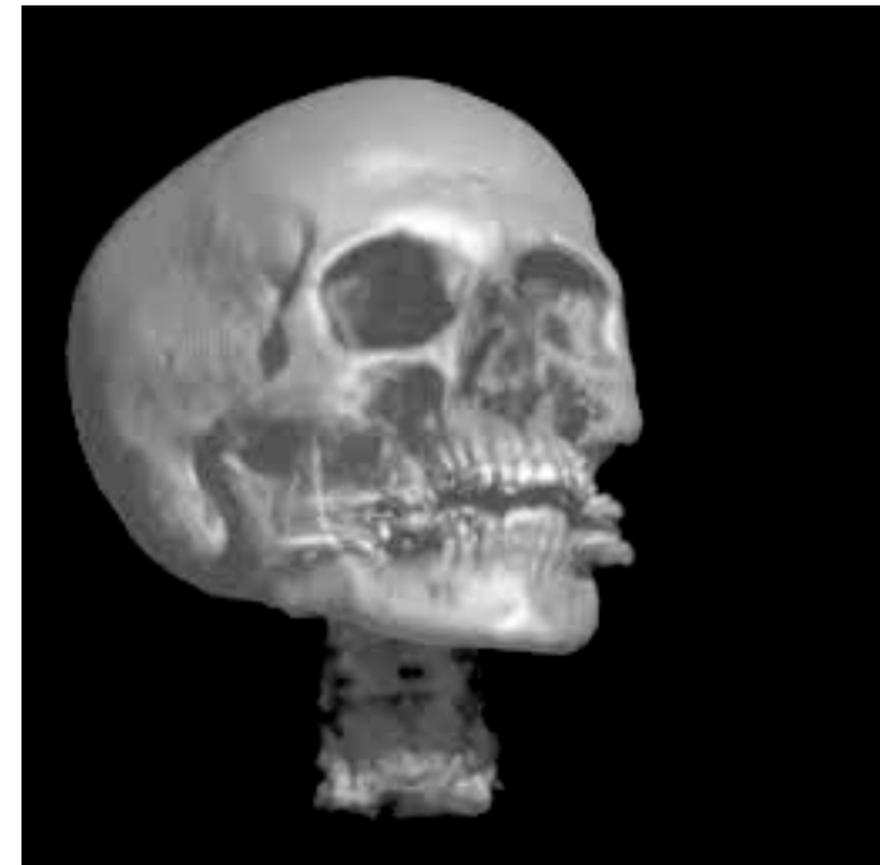
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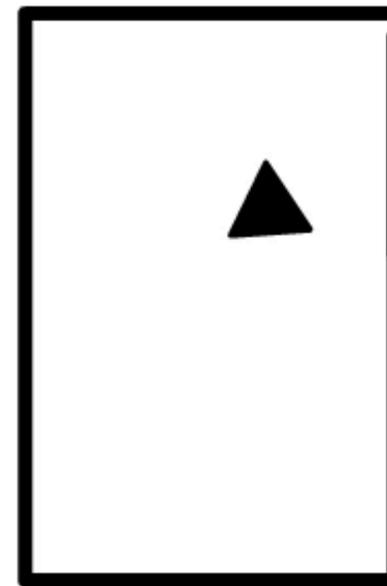
Constructing narratives & anthropomorphizing

Direct attention

Increase Engagement

Explain a Process

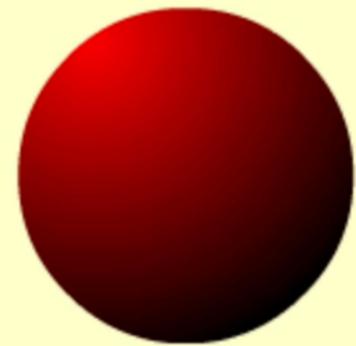
Understand a State Transition

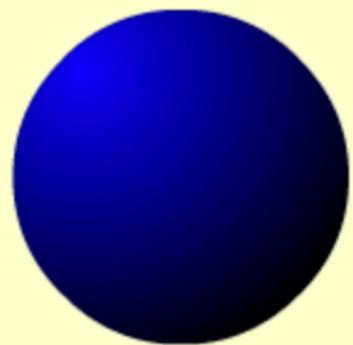
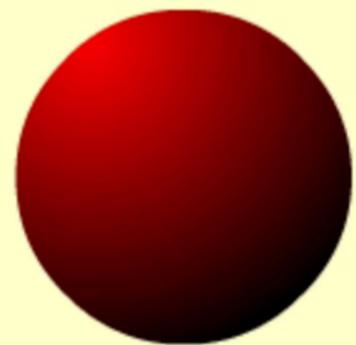


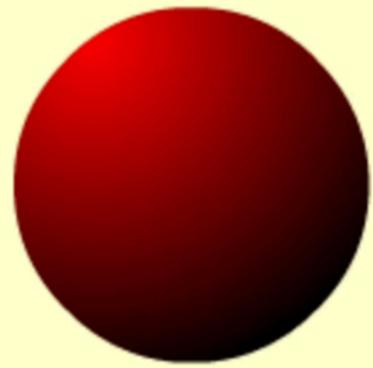
What's happening in this film?

tryclassbuzz.com

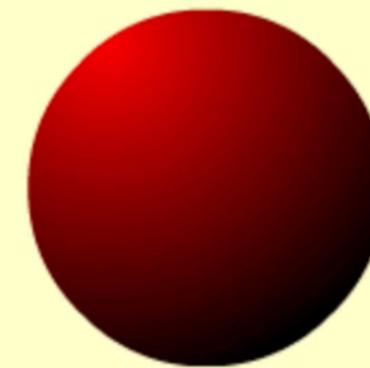
Code: **shapes**







[Michotte 1946]



[Michotte 1946]

Animation Goals

Direct attention

Increase Engagement

Explain a Process – the perception (or attribution) of causality.

Understand a State Transition

Animation Goals

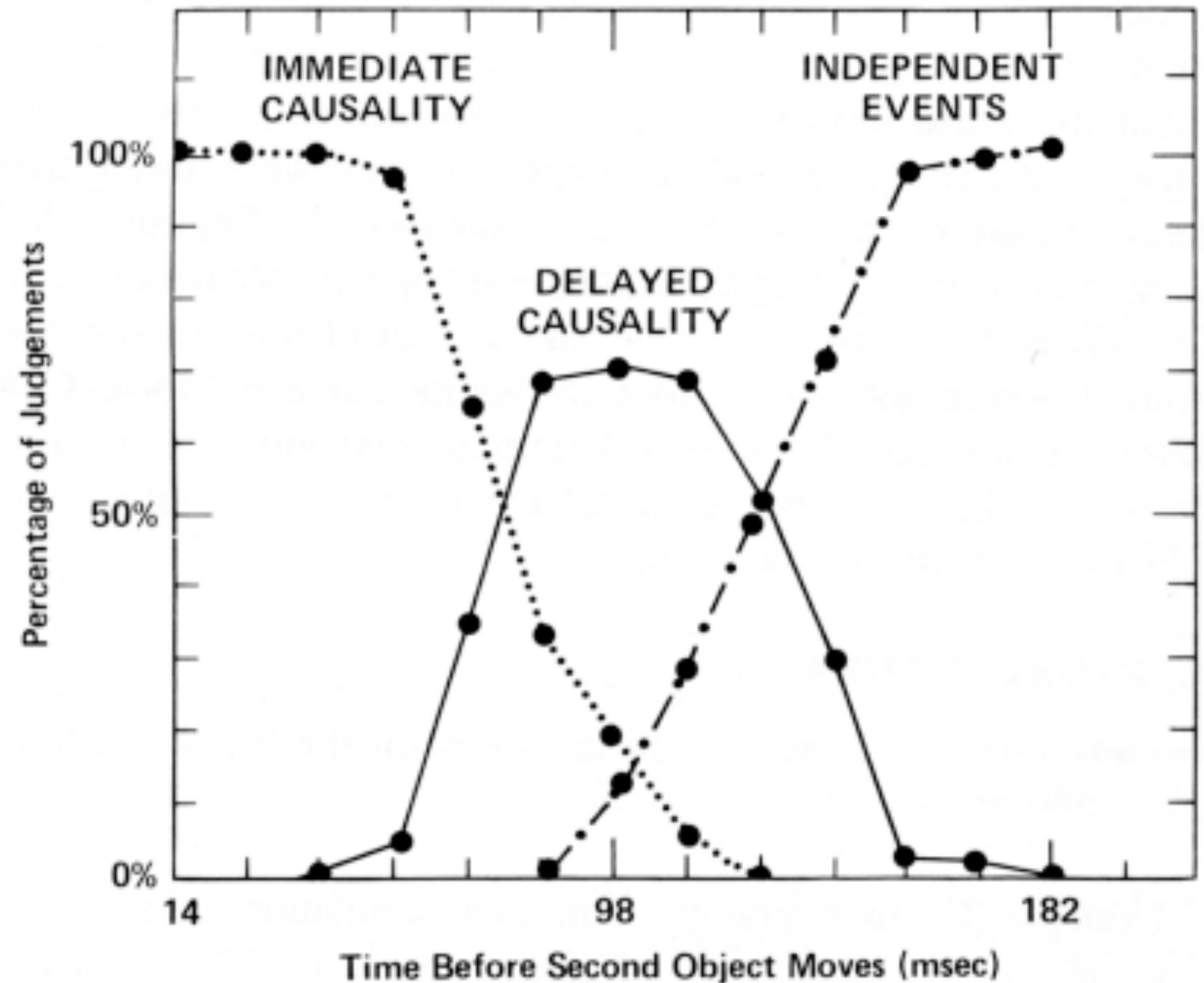
Attribution of Causality.

Direct attention

Increase Engagement

Explain a Process

Understand a State Transiti



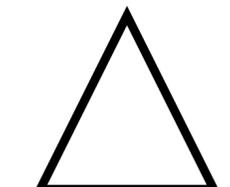
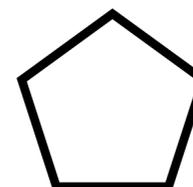
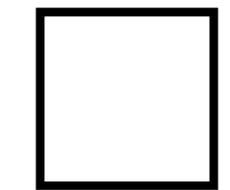
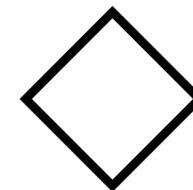
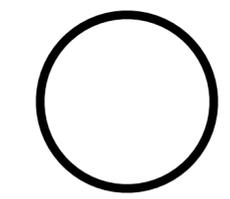
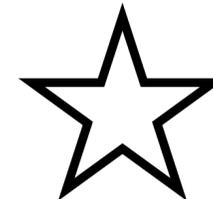
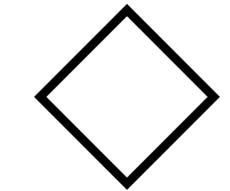
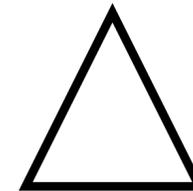
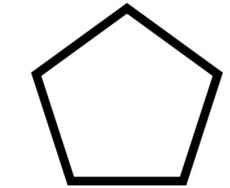
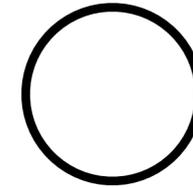
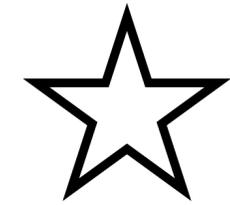
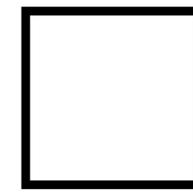
Animation Goals

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Explain a Process

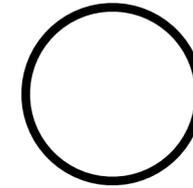
Understand a State Transition



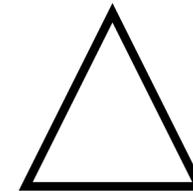
Start

End

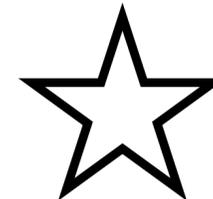
Animation Goals



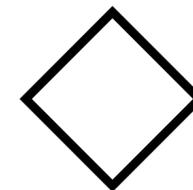
Direct attention



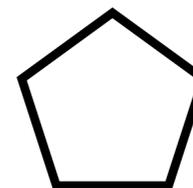
Increase Engagement



Explain a Process



Understand a State Transition



Start

End

Animation Goals

Direct attention

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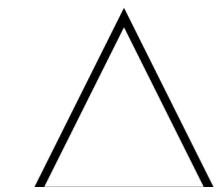
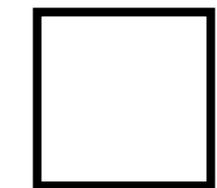
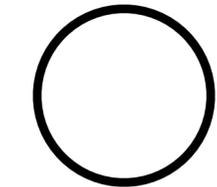
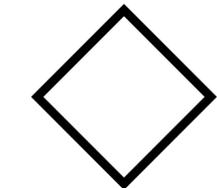
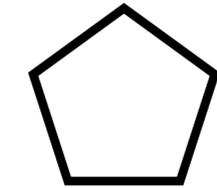
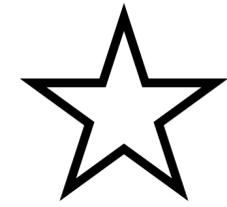
Explain a Process

Understand a State Transition

Animation can show transition better, but...

May be too fast or too slow.

Too many objects may move at once.



End

Animation Goals

How many dots can we track at once?

Direct attention

Increase Engagement

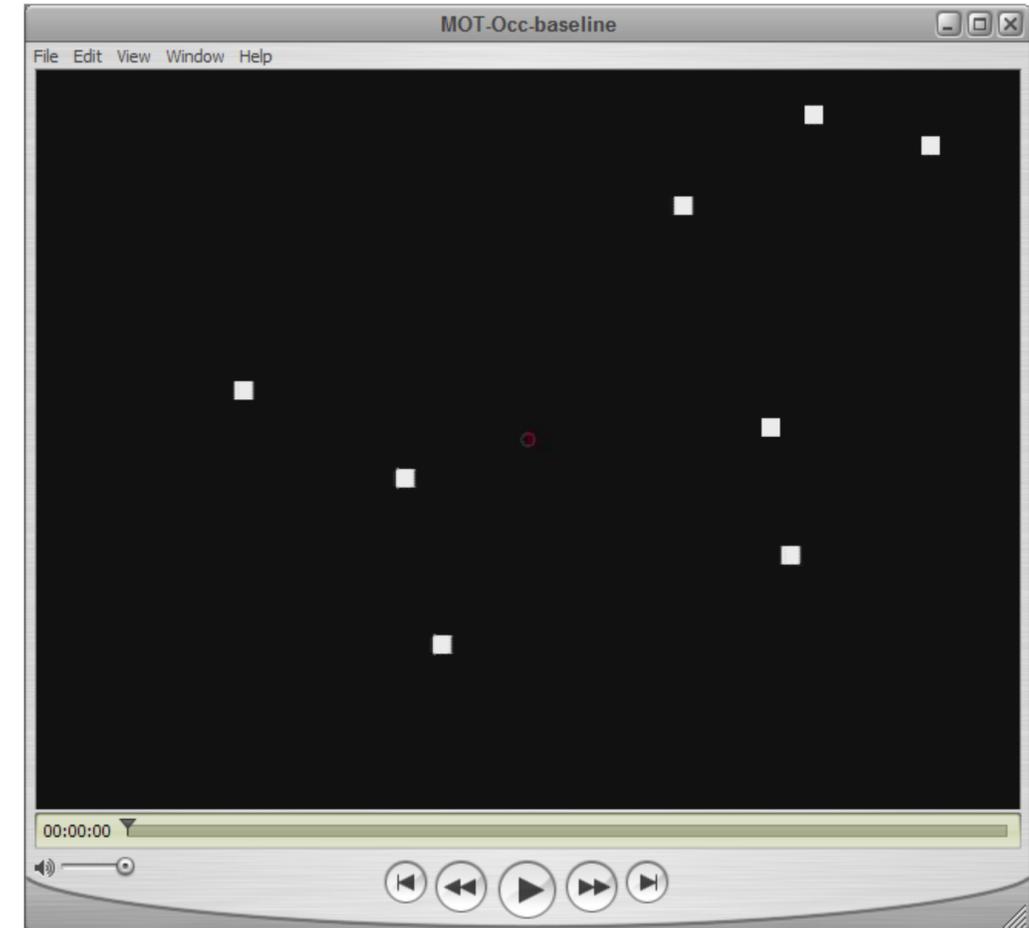
Explain a Process

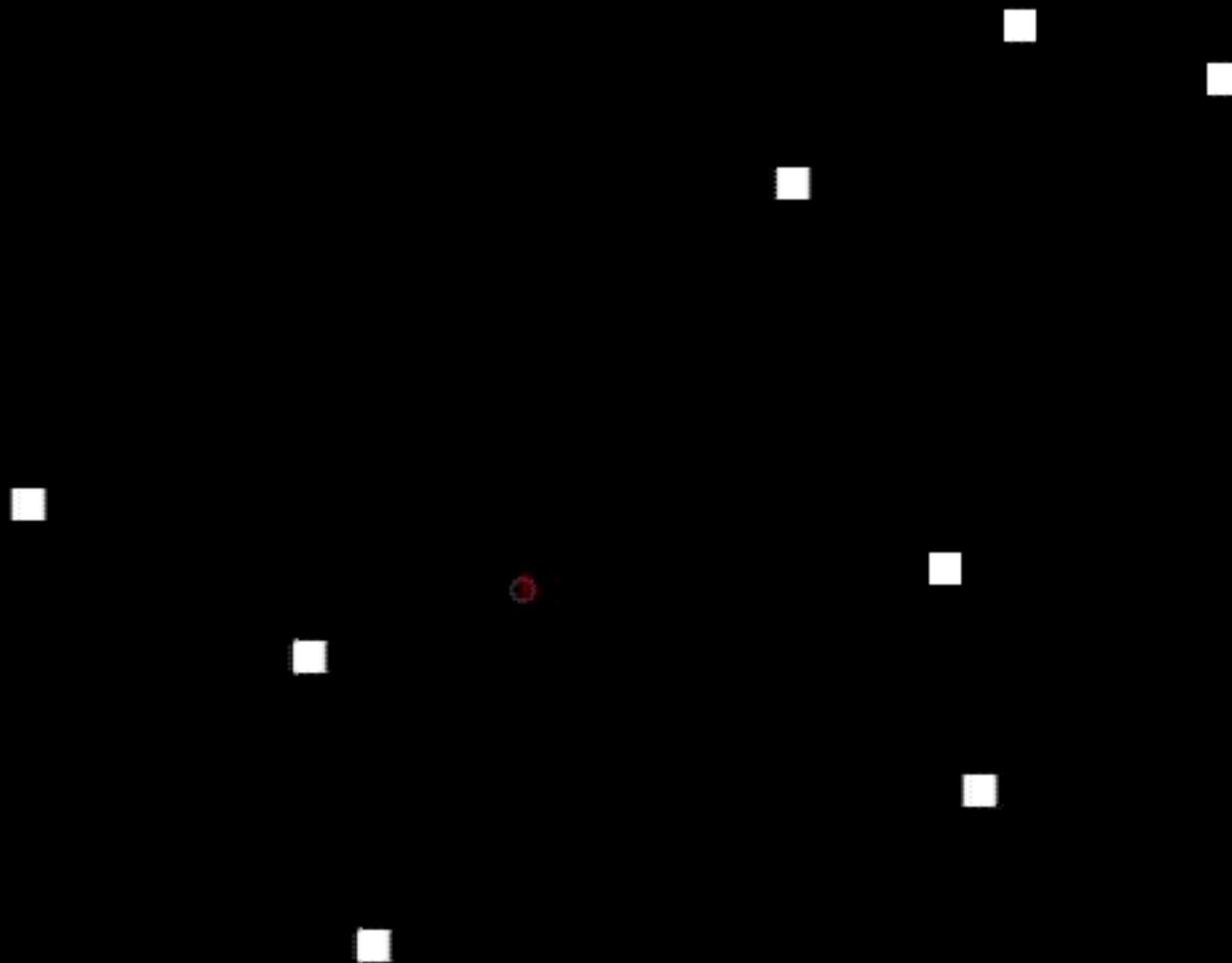
Understand a State Transition

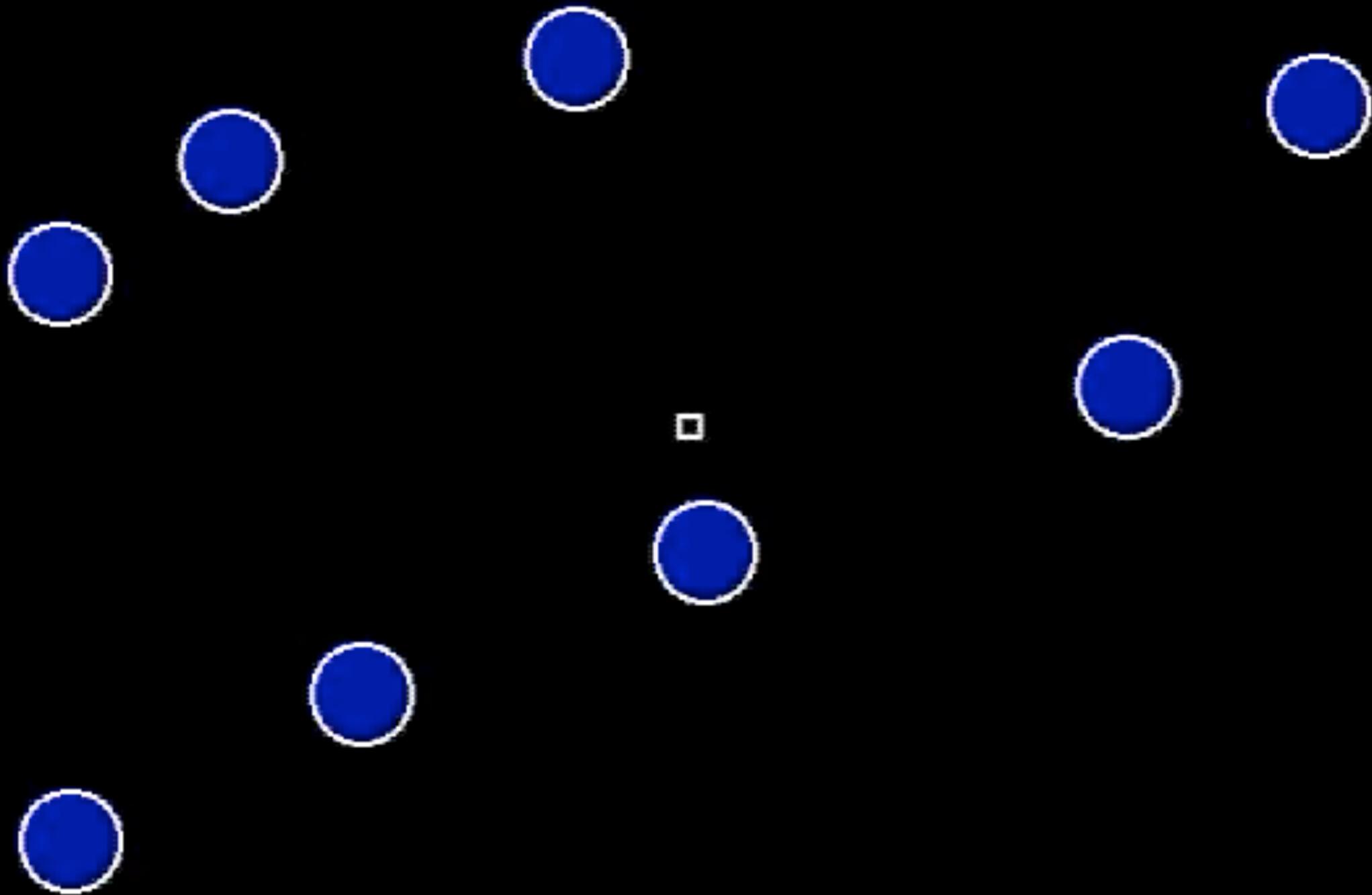
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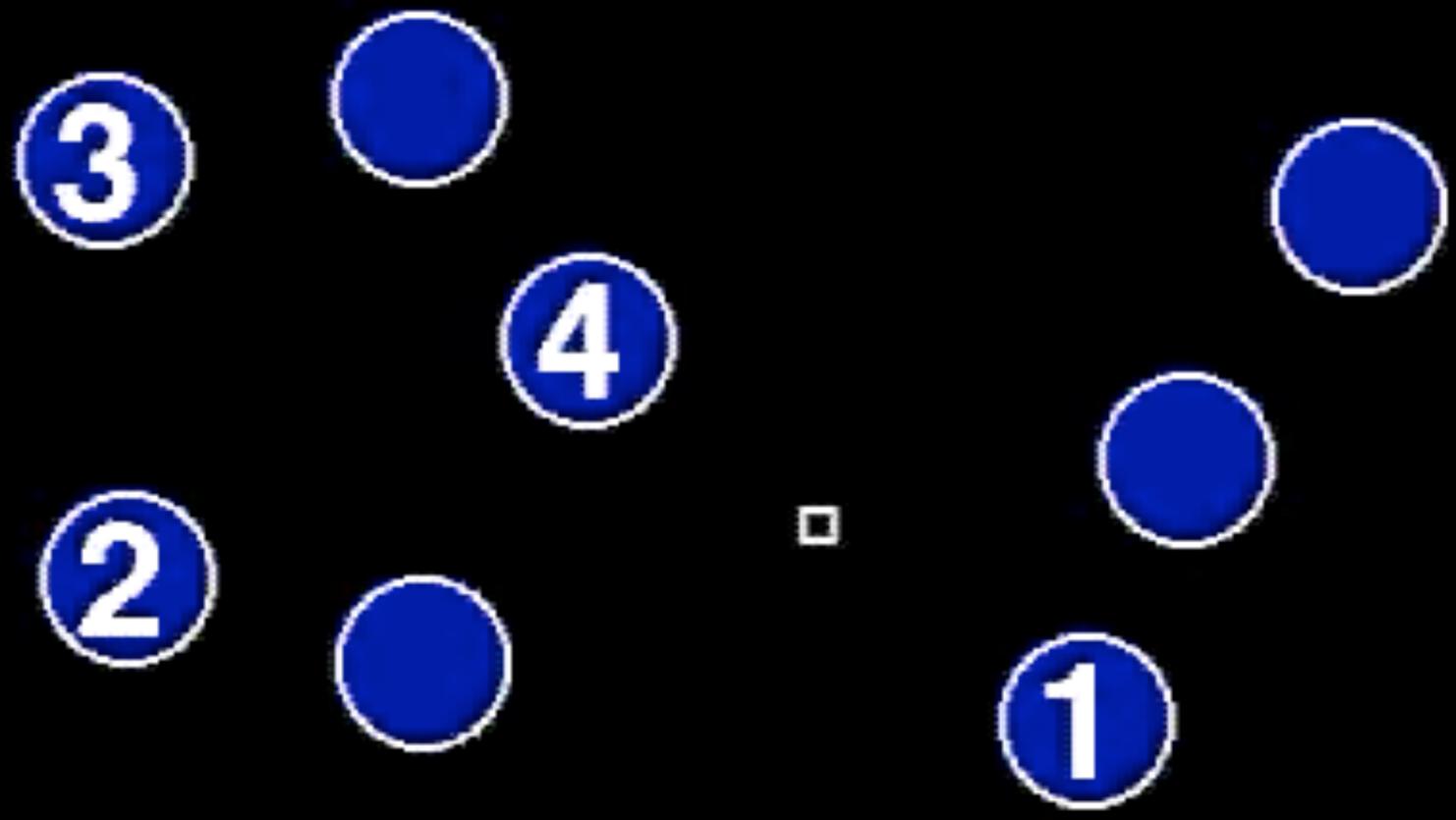












Animation Goals

How many dots can we track at once?

4-6. Difficulty increases significantly at 6.

Direct attention

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Effective Animations



Expressiveness

A set of facts is *expressible* in a visual language if the sentences (i.e. the visualizations) in the language express *all the facts in the set of data, and only the facts in the data.*

Effectiveness

A visualization is more *effective* than another if the information it conveys *is more readily perceived* than the information in the other visualization

Principles of Visualization

Expressiveness

A set of facts is *expressible* in a visual language if the sentences (i.e. the visualizations) in the language express all the facts in the set of data, and only the facts in the data.

Principles of Animation

Congruence

The structure and content of the external representation should correspond to the desired structure and content of the internal representation.

Effectiveness

A visualization is more *effective* than another if the information it conveys is more readily perceived than the information in the other visualization

Apprehension

The structure and content of the external representation should be readily and accurately perceived and comprehended

Principles of Animation

Congruence

The structure and content of the external representation should correspond to the desired structure and content of the internal representation.

Apprehension

The structure and content of the external representation should be readily and accurately perceived and comprehended

Maintain **valid data graphics during transitions**

Respect **semantic correspondence**

Marks should always represent the same data tuples.

Avoid **ambiguity**

Different operations should have distinct animations.

Experiments

Experiment 2

Study Conclusions / Principle of Apprehension

Appropriate animation **improves** graphical perception.

Simple transitions beat "do one thing at a time"

Simple staging was preferred and showed benefits

but timing important and in need of study.

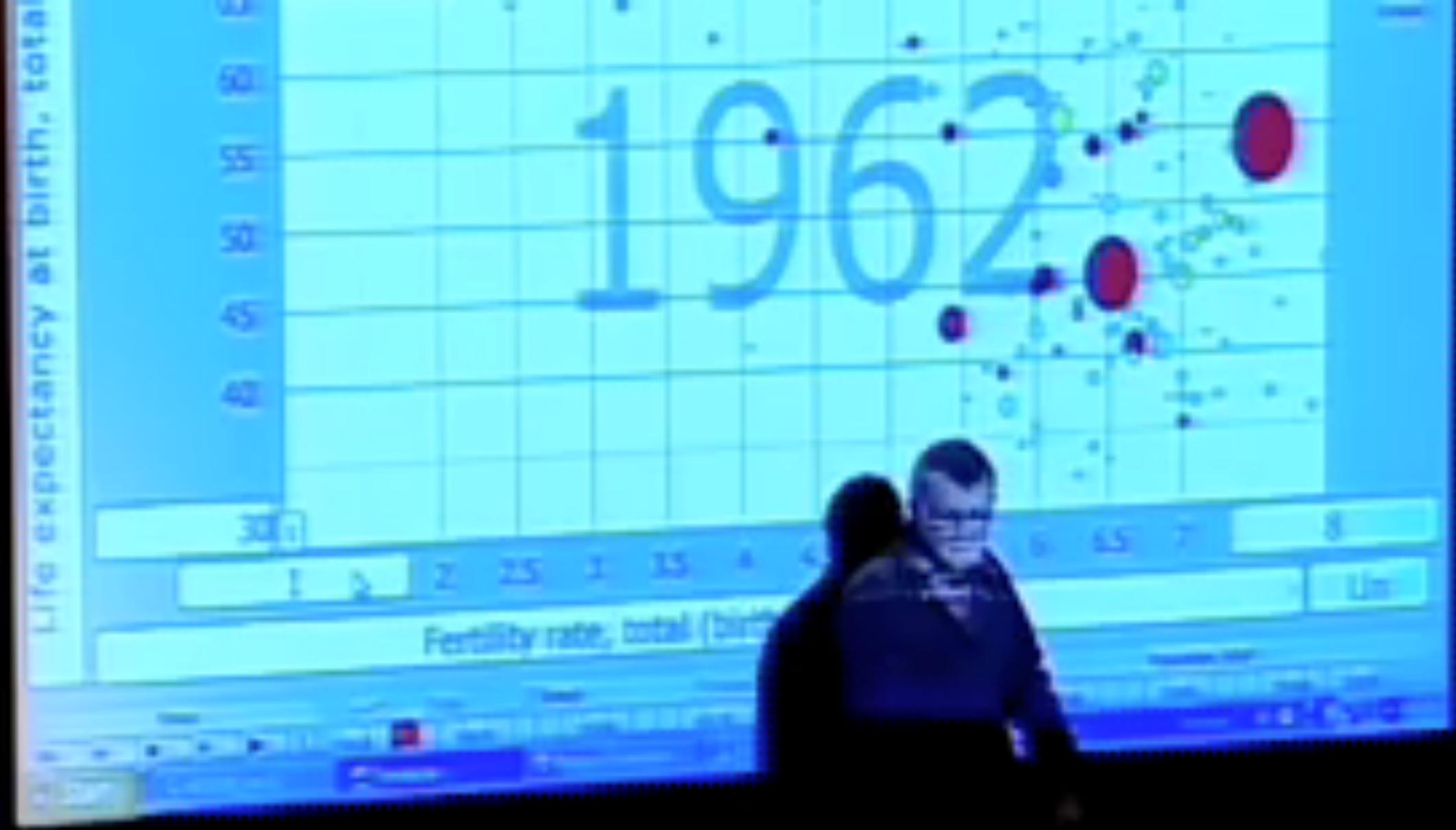
Axis **re-scaling hampers perception**

Avoid if possible (use common scale)

Maintain landmarks better (delay fade out of lines)

Subjects preferred animated transitions

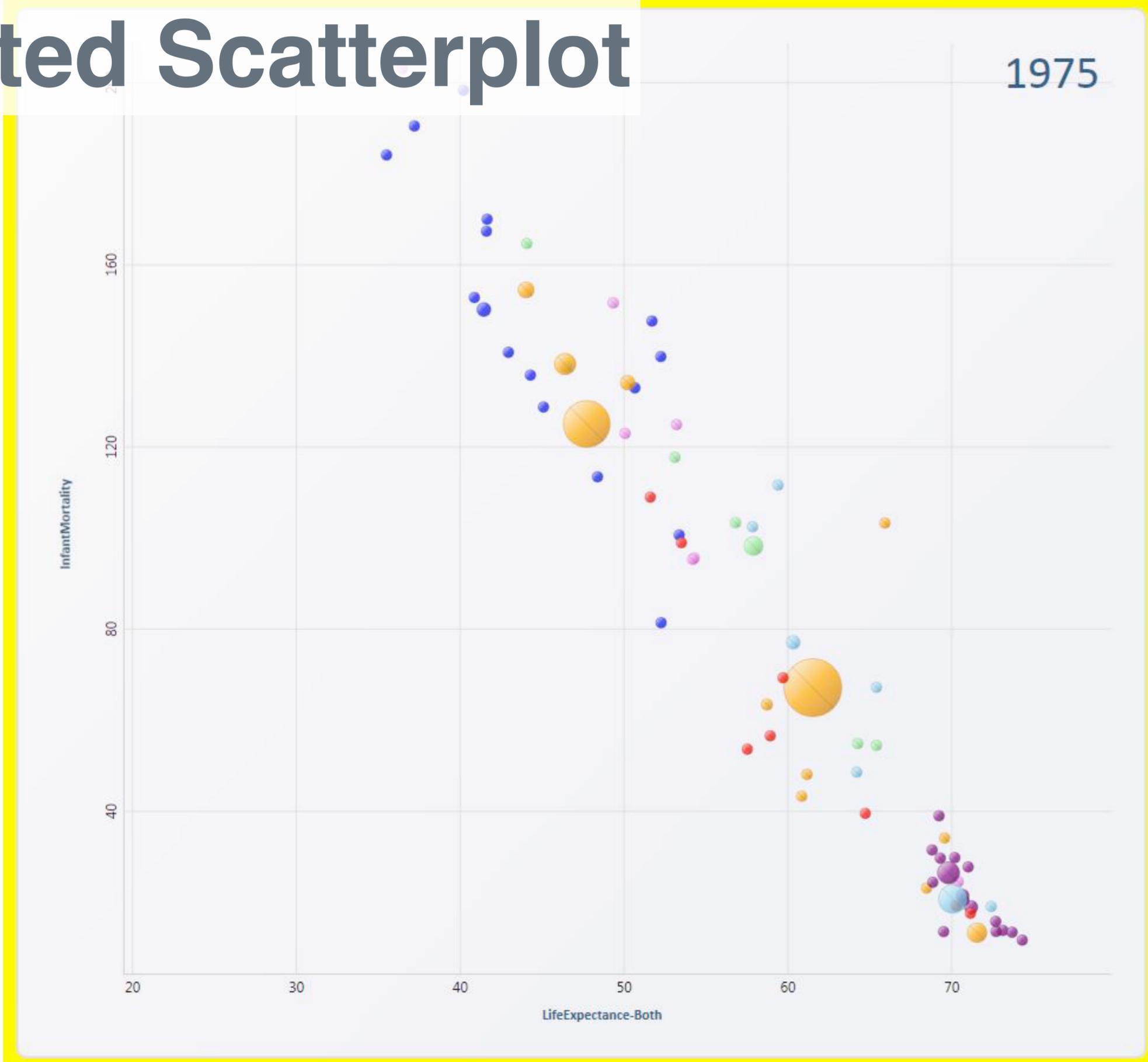




TED



Animated Scatterplot



Color Legend (continent)

- Africa
- Asia
- Europe
- Middle East
- North America
- Oceania
- South America

Task

Select two countries with decreasing InfantMortality, but little change in life expectancy.

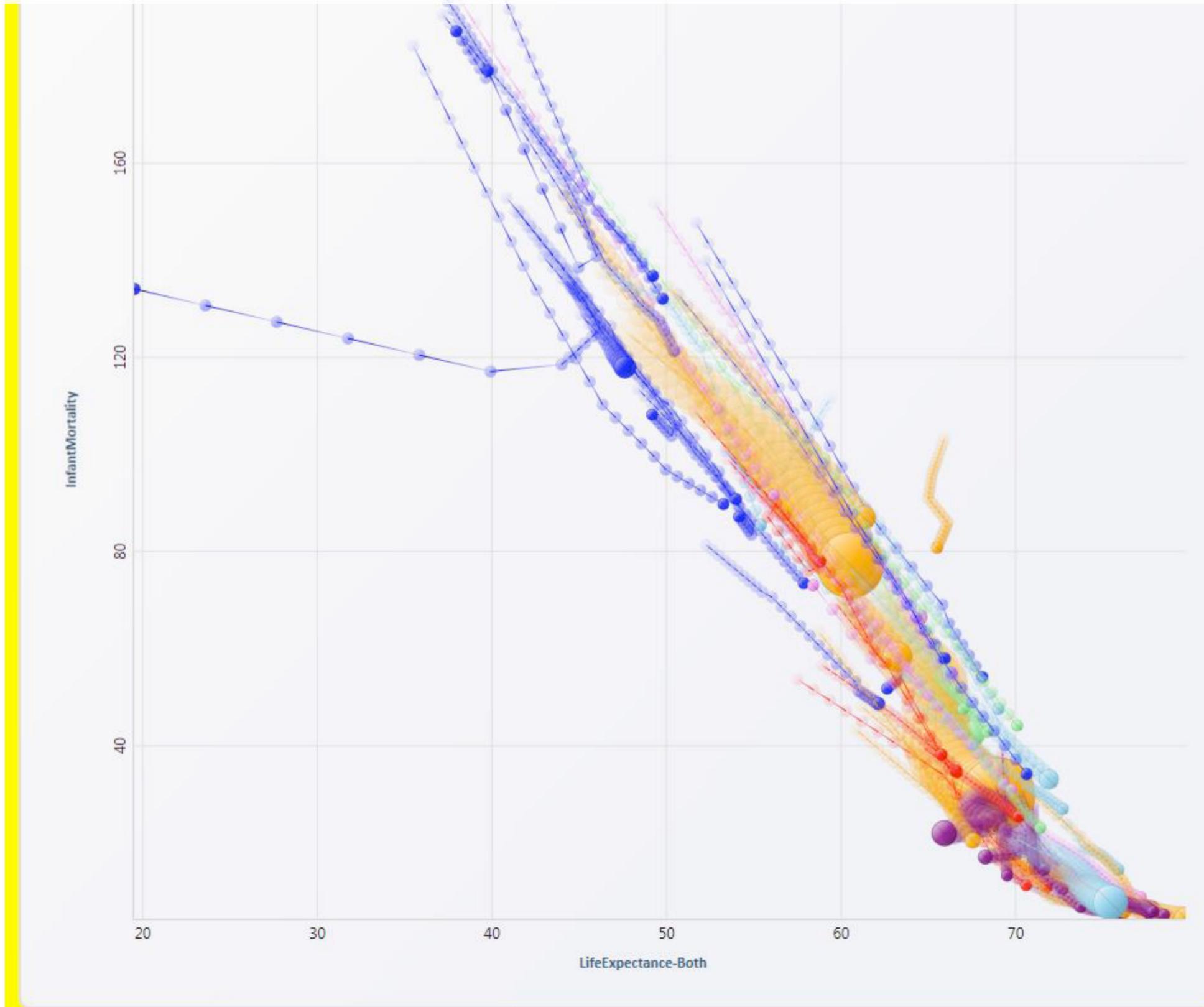
Ctrl-Click on a country (in chart) to set an answer.

Answers set: 0/2

Next

Click on "Next" when finished (or "Give Up" if you cannot find all the answers)

Traces / Connected Scatterplot



Color Legend (continent)

- Africa
- Asia
- Europe
- Middle East
- North America
- Oceania
- South America

Task

Select two countries whose InfantMortality dropped first, then increased later.

Ctrl-Click on a country (in chart) to set an answer.

Answers set: 0/2

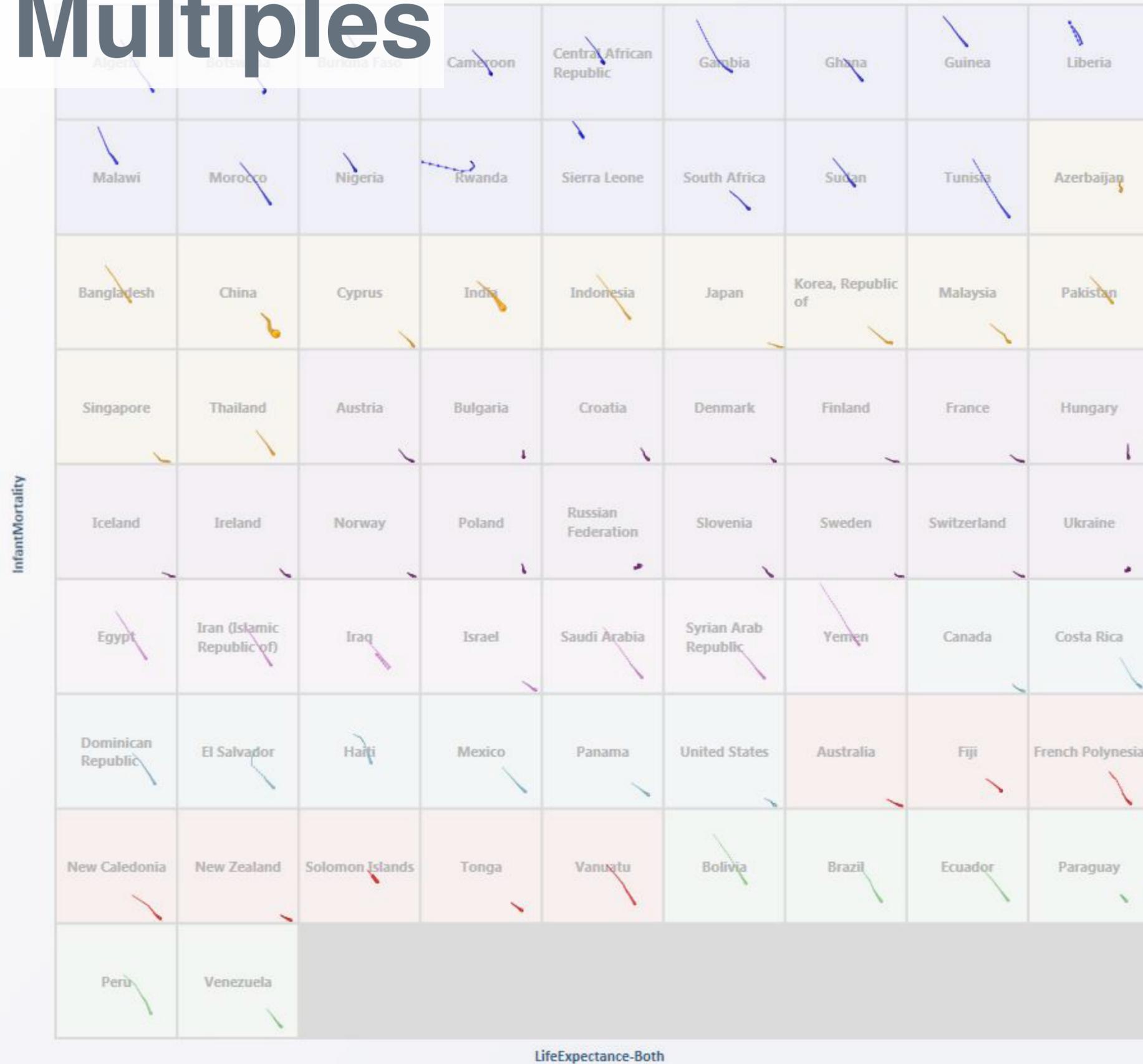
Next

Click on "Next" when finished (or "Give Up" if you cannot find all the answers)

Give Up

Next

Small Multiples



Color Legend (continent)

- Africa
- Asia
- Europe
- Middle East
- North America
- Oceania
- South America

Task

Select two countries whose InfantMortality dropped first, then increased later.

Ctrl-Click on a country (in chart) to set an answer.

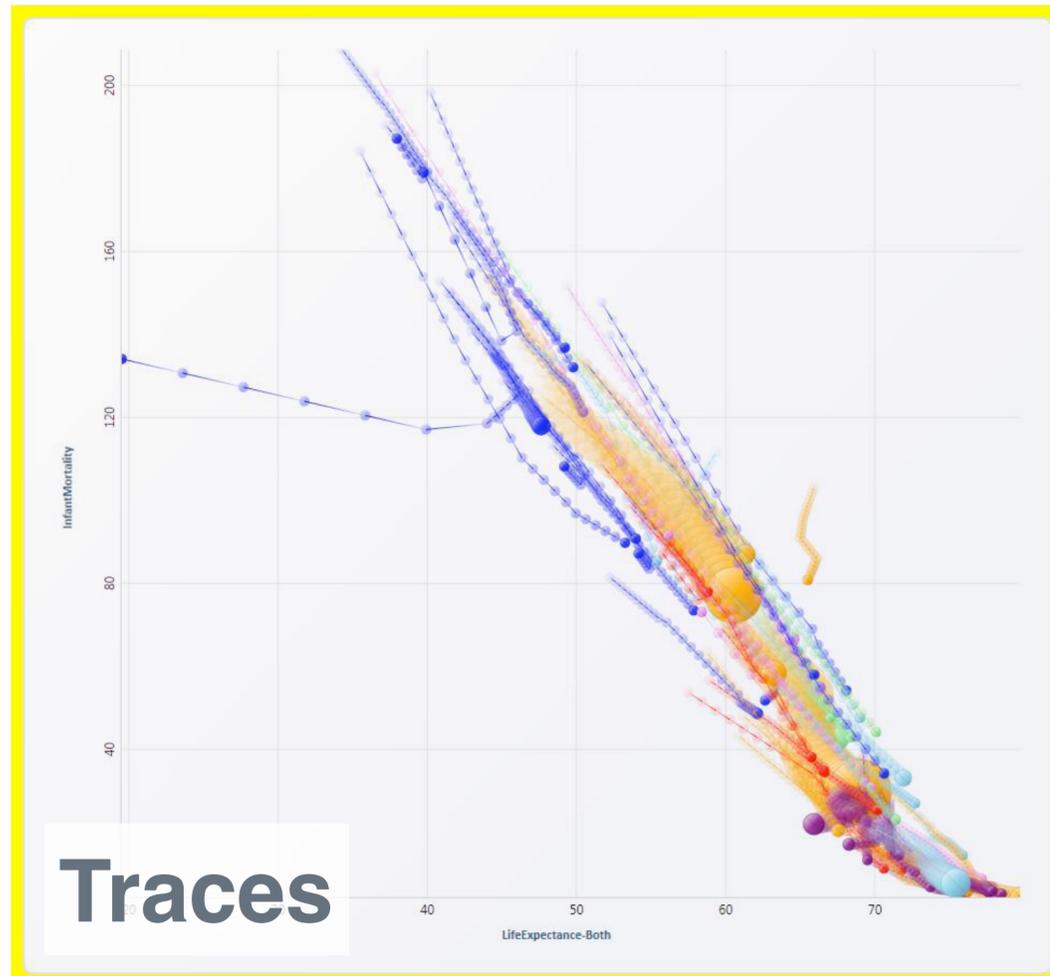
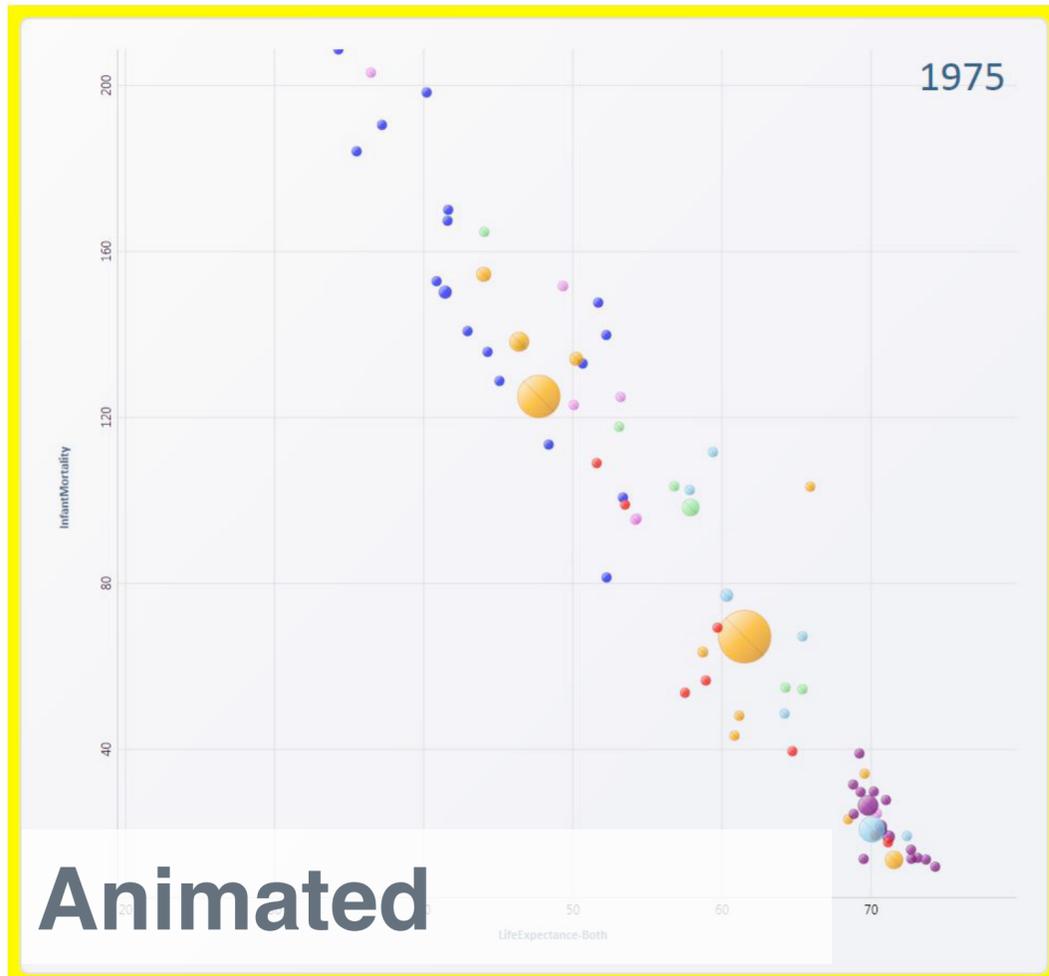
Answers set: 0/2

Next

Click on "Next" when finished (or "Give Up" if you cannot find all the answers)

Study Conclusions

Analysis Task and Presentation Task.
Presentation condition included narration.
Subjects asked comprehension questions.



Which condition would participants:
be more **accurate**, be **faster**, and **prefer**?

tryclassbuzz.com
Code: **anim**

Study Conclusions

Analysis Task and Presentation Task.
Presentation condition included narration.
Subjects asked comprehension questions.

Animations **10% less accurate** than small multiples.

Presentation: Animation **60% faster** than small multiples.

Analysis: Animation **82% slower** than small multiples.

User preferences favor animation
(even though less accurate and slower for analysis!).

Implementing Animation in D3

Simple Bar Animation

This is a simple bar animation. The bar is animated from 200px to 500px width.

Replay Animation



[lectures/animation/simple-bar/main.js](#)

```
d3.select('#rect').transition().duration(2000).attr('width', '500');
```

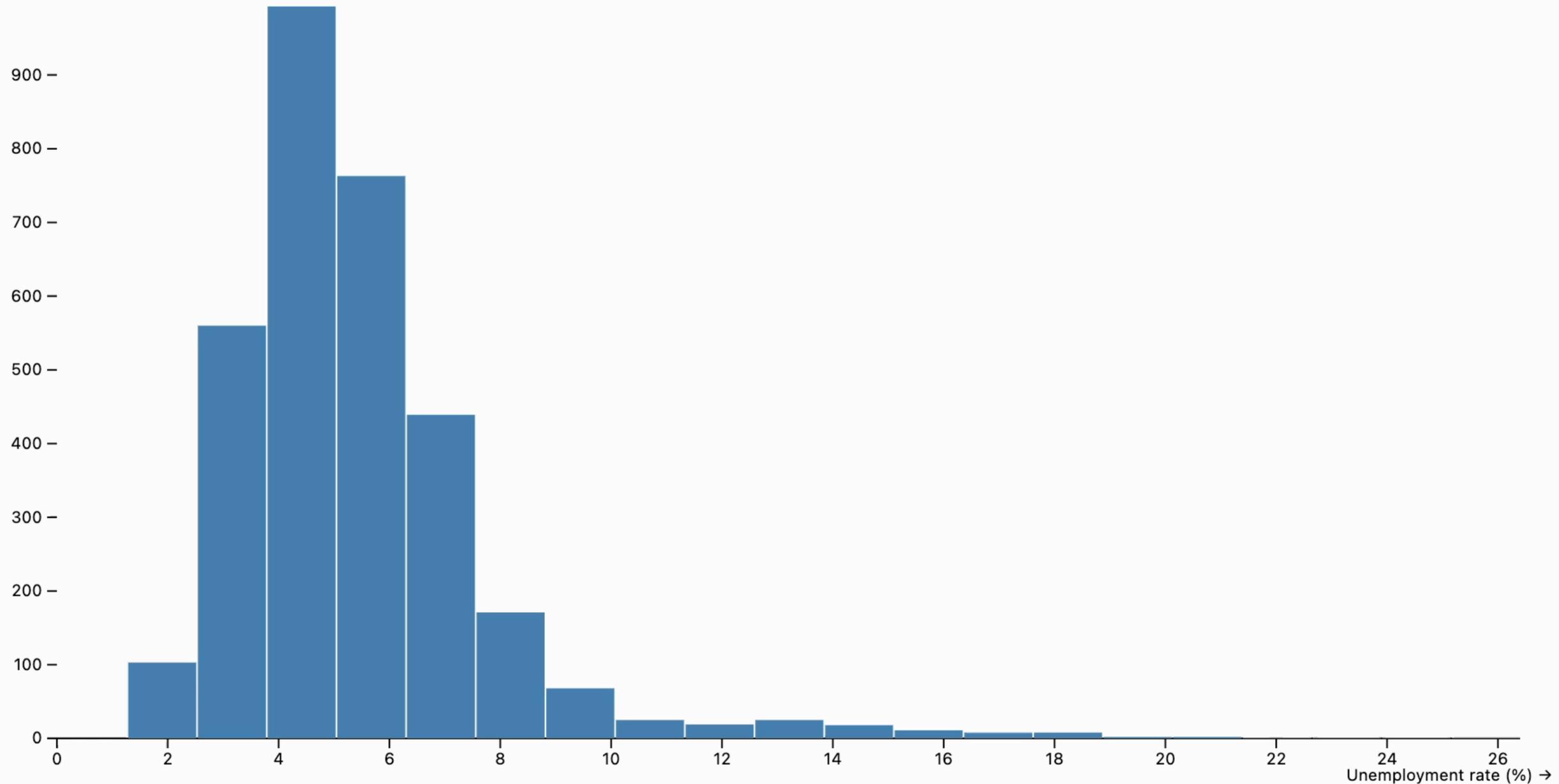
Add `.transition().duration(t)` before changing an attribute to animate it!

Animating Histogram Bins

This is an example where we animate the bins of a histogram, derived from [http](#)

Number of bins:

↑ Frequency (no. of counties)



Read through the code and ask a staff if you have questions about it!