

# Animation

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**DSC 106: Data Visualization**

Sam Lau

UC San Diego

# Announcements

Lab 8 due next week Friday.

Final Project Prototype due next week Tuesday.

## FAQs:

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

# **Animation**

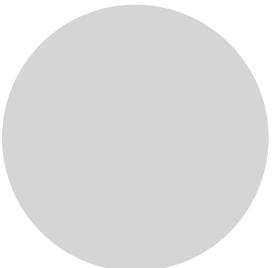
# Animation Goals

Direct attention

Increase Engagement

Explain a Process

Understand a State Transition



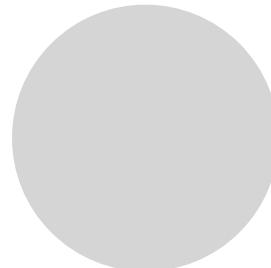
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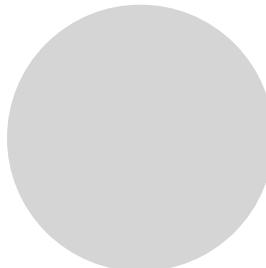
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**Motion as a visual cue**

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



**7.5 fps**



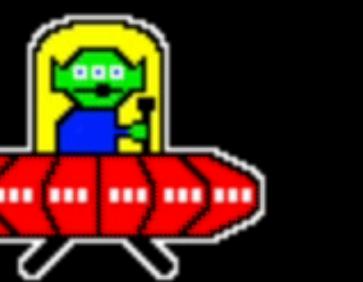
**15 fps**



**30 fps**



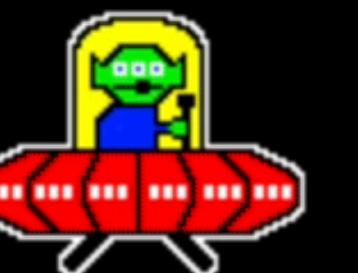
**60 fps**



**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).

# Animation Goals



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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).

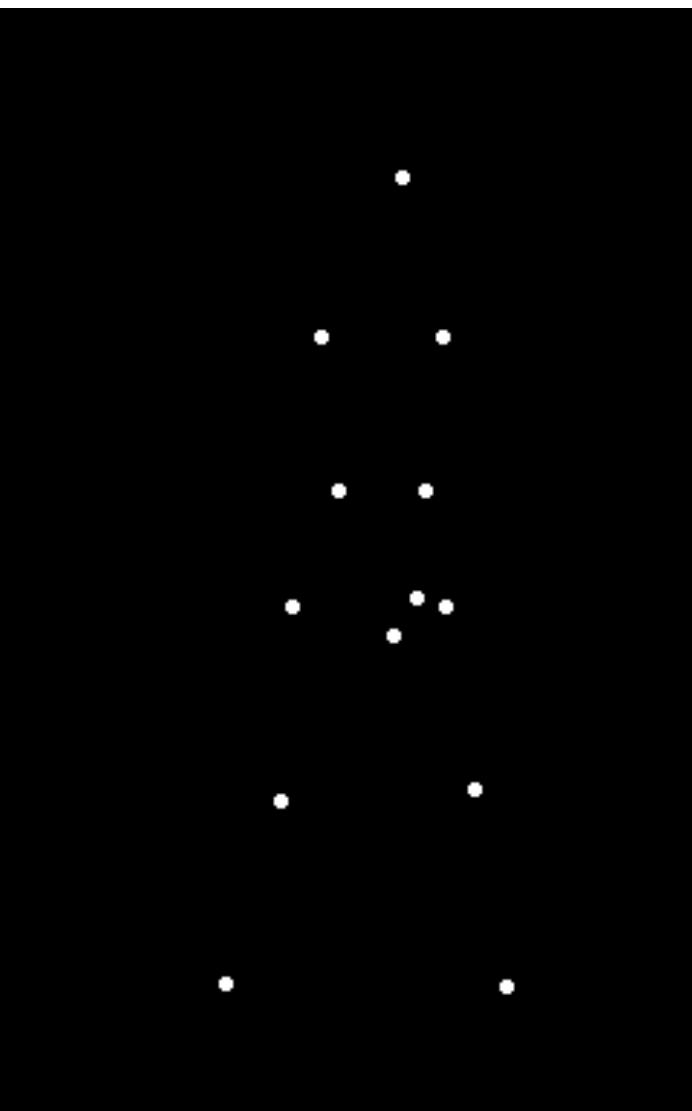
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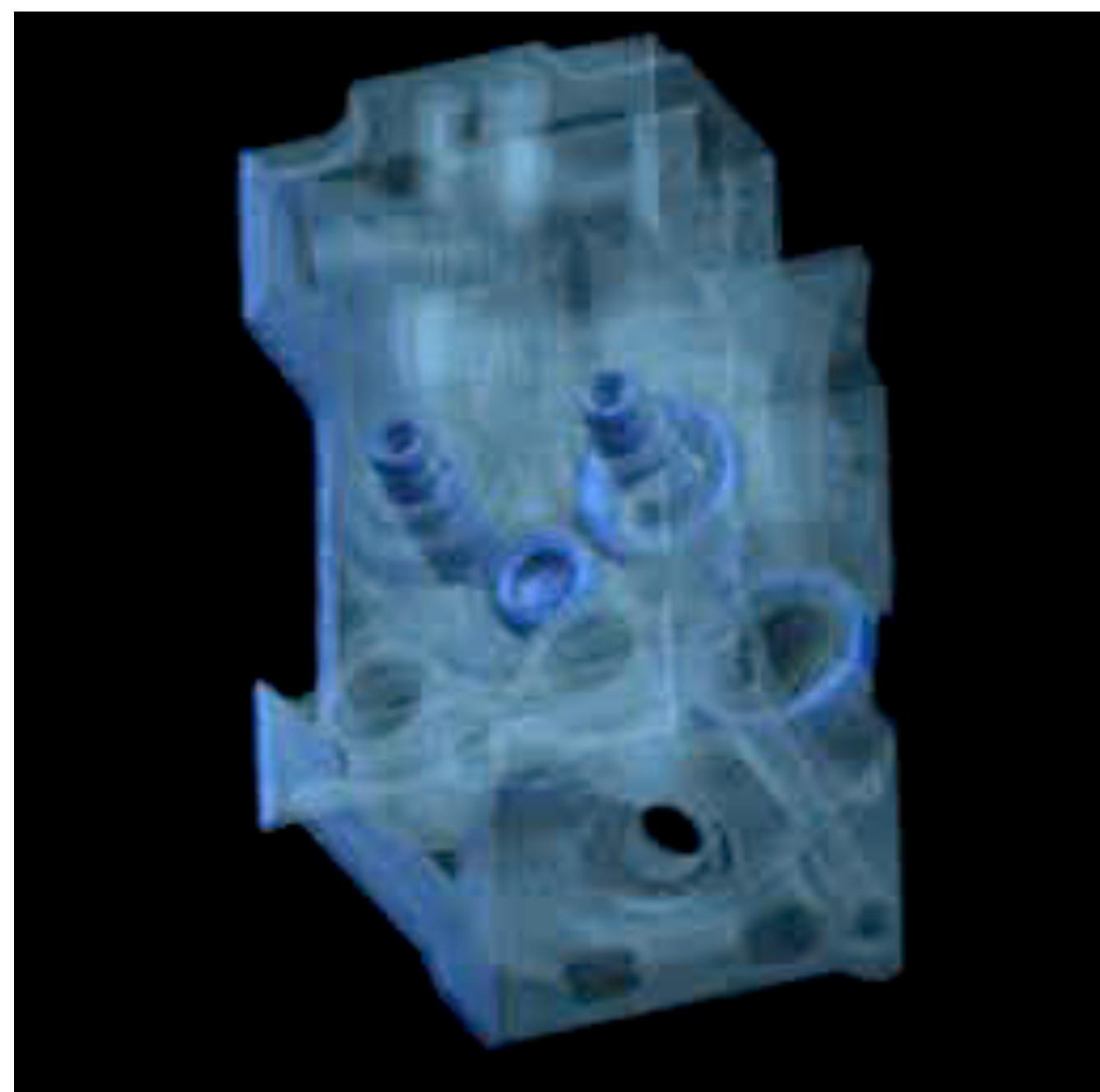
# Animation Goals

Direct attention



**Increase Engagement**

Explain a Process



Understand a State Transition

# Animation Goals

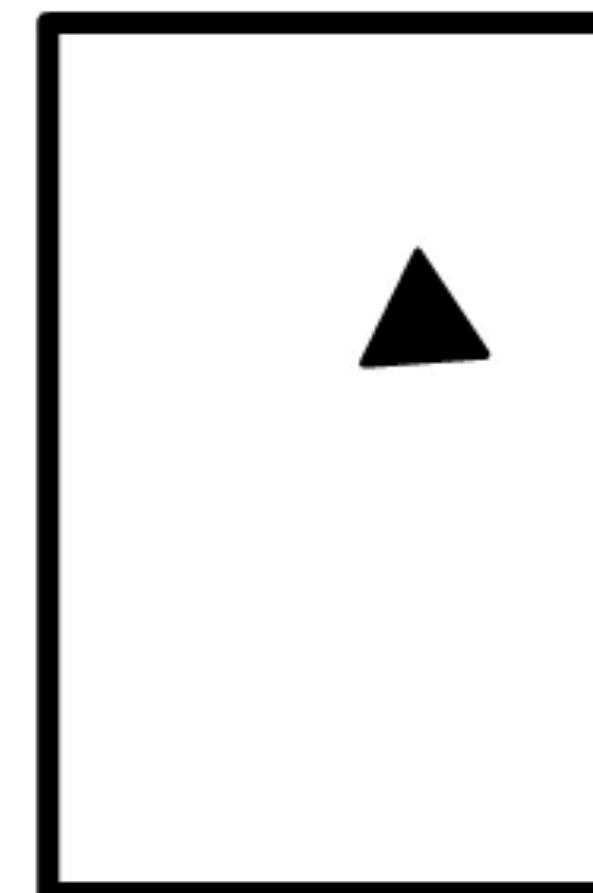
Constructing narratives & anthropomorphizing

Direct attention

Increase Engagement

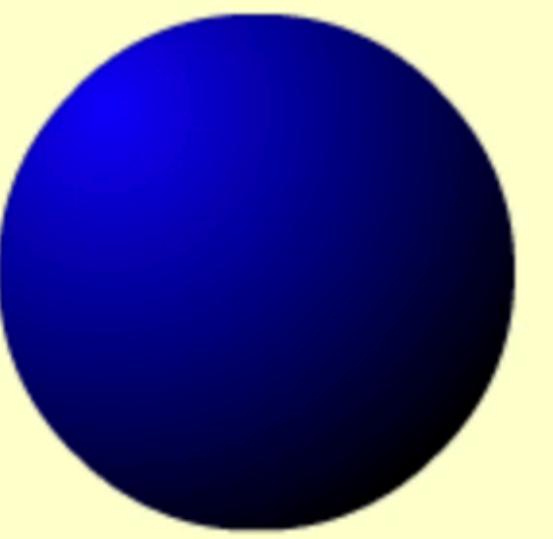
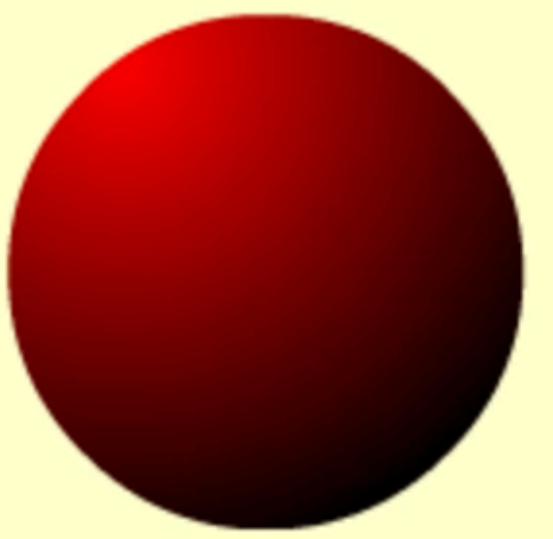
**Explain a Process**

Understand a State Transition

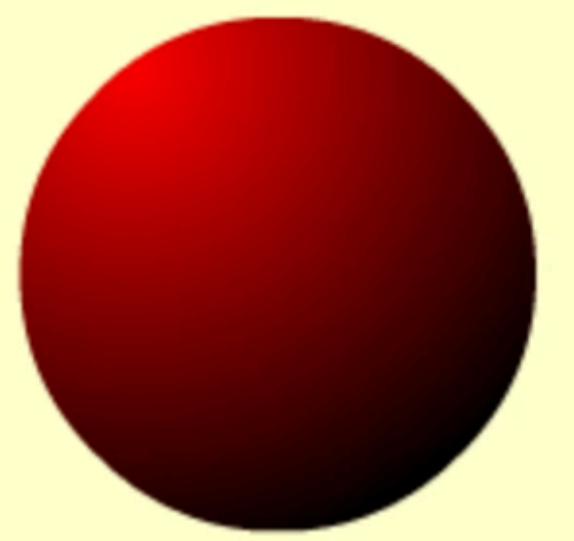


What's happening in this film?

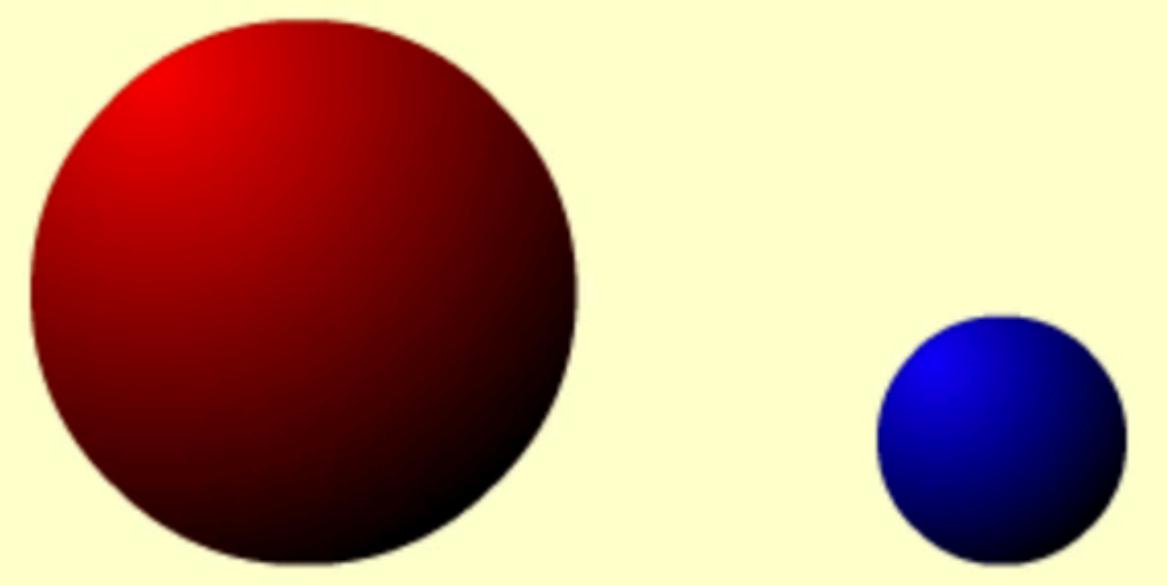
[tryclassbuzz.com](http://tryclassbuzz.com)  
Code: shapes



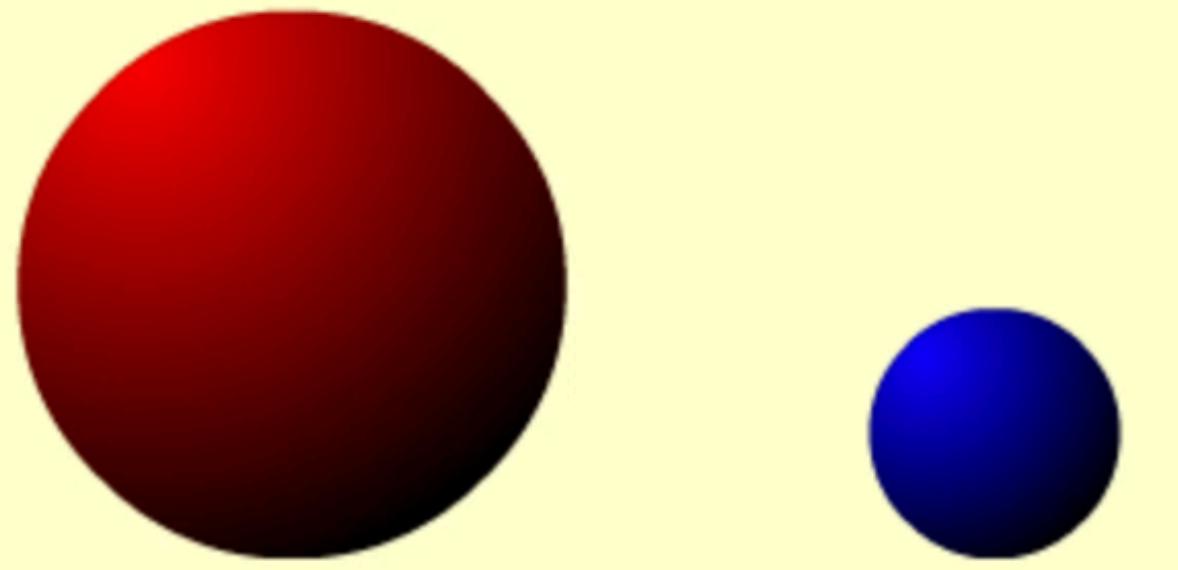
[Michotte 1946]



[Michotte 1946]



[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

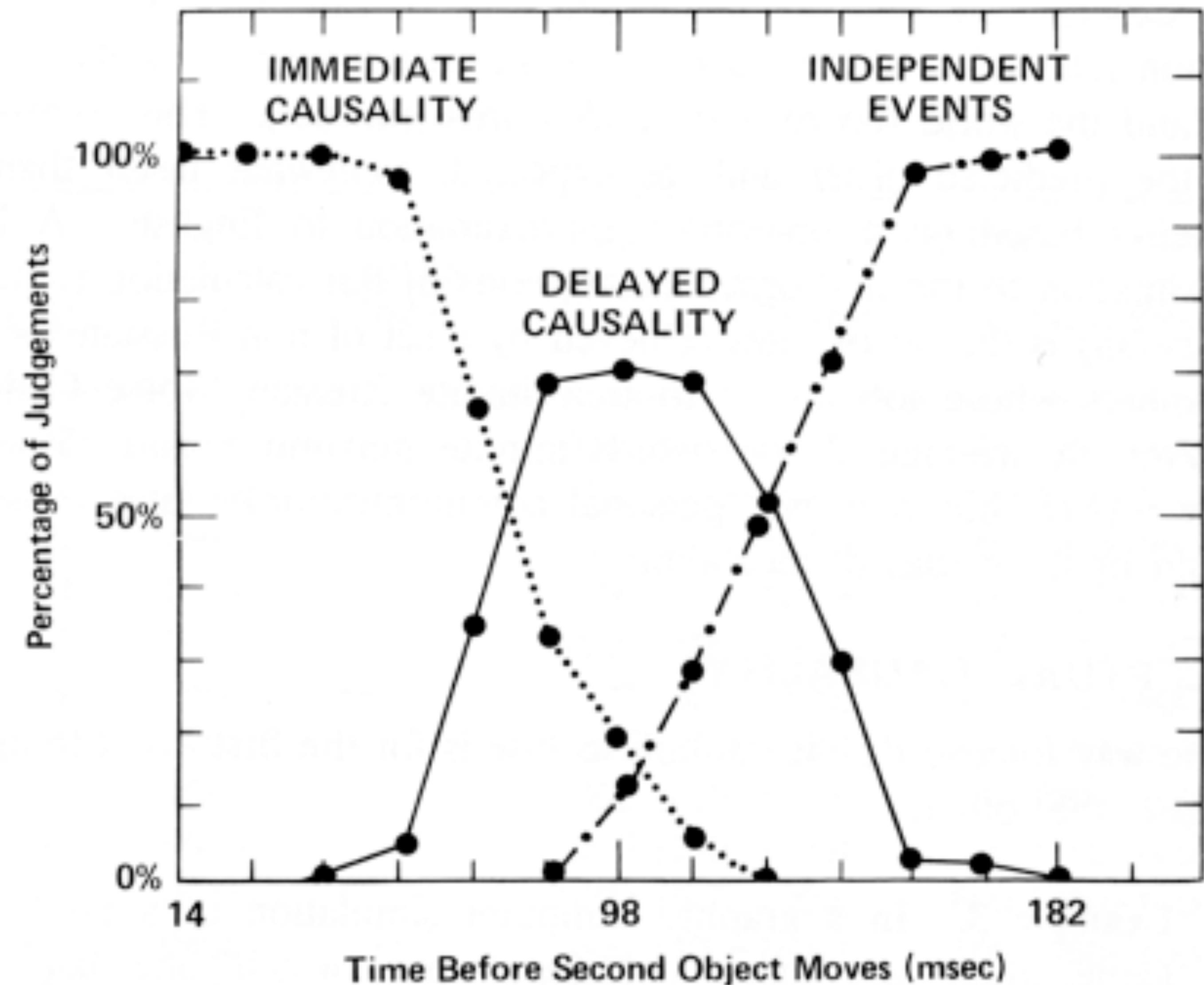
Direct attention

Increase Engagement

**Explain a Process**

Understand a State Transiti

Attribution of Causality.



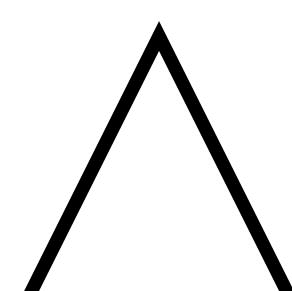
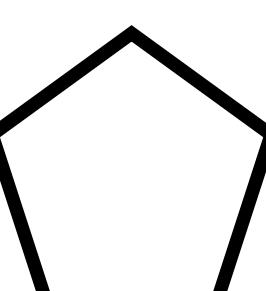
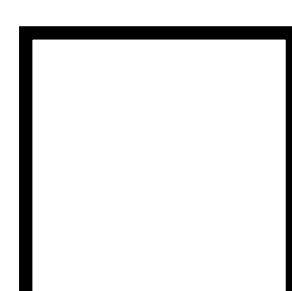
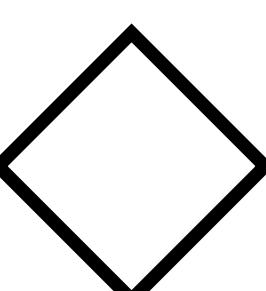
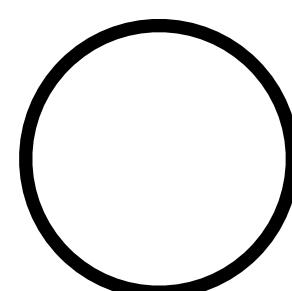
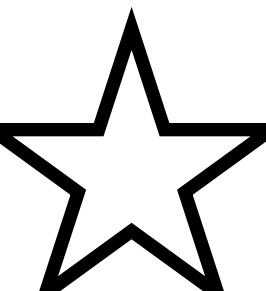
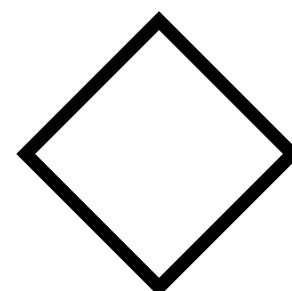
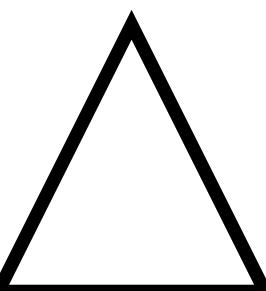
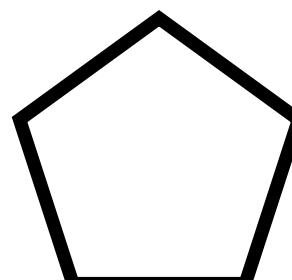
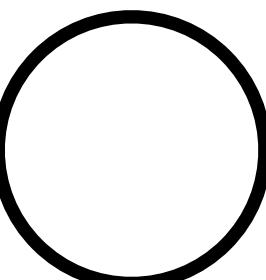
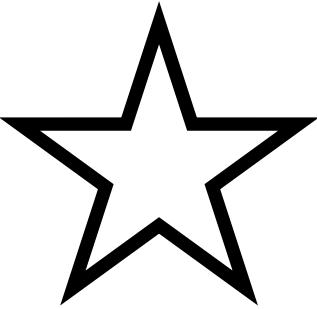
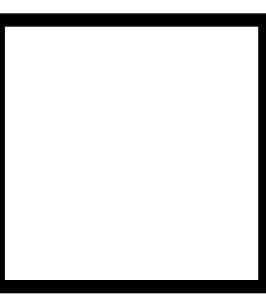
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Explain a Process

**Understand a State Transition**



Start

End

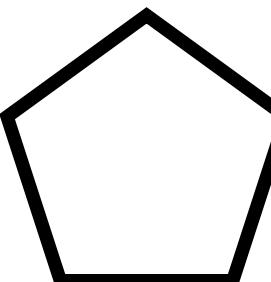
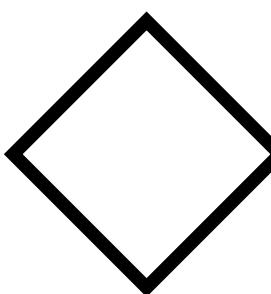
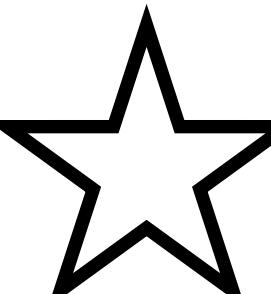
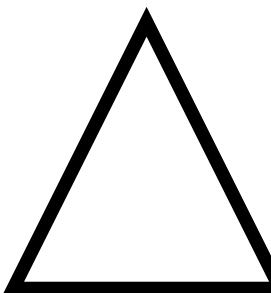
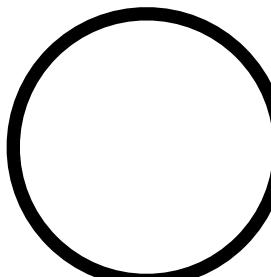
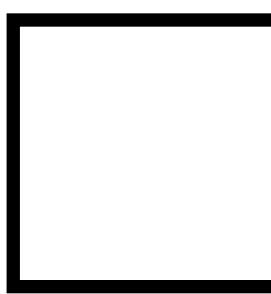
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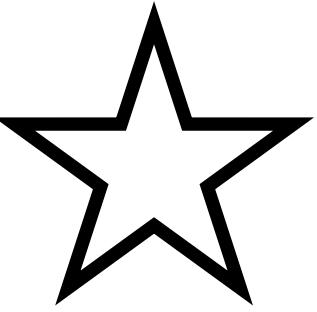


Start

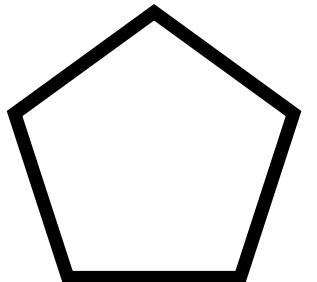
End

# Animation Goals

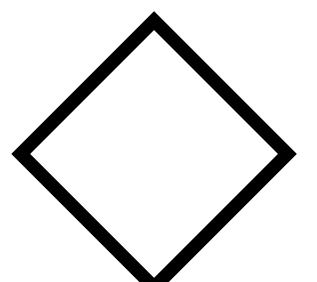
Direct attention



Increase Engagement



Explain a Process

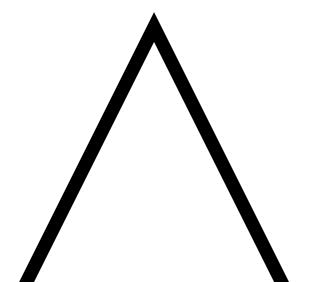
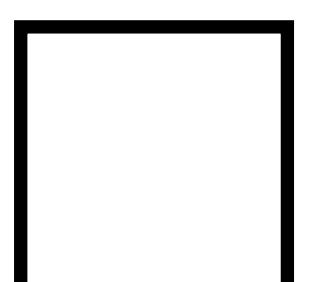
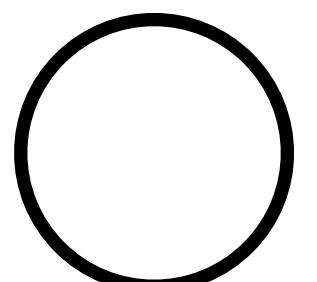


## Understand a State Transition

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

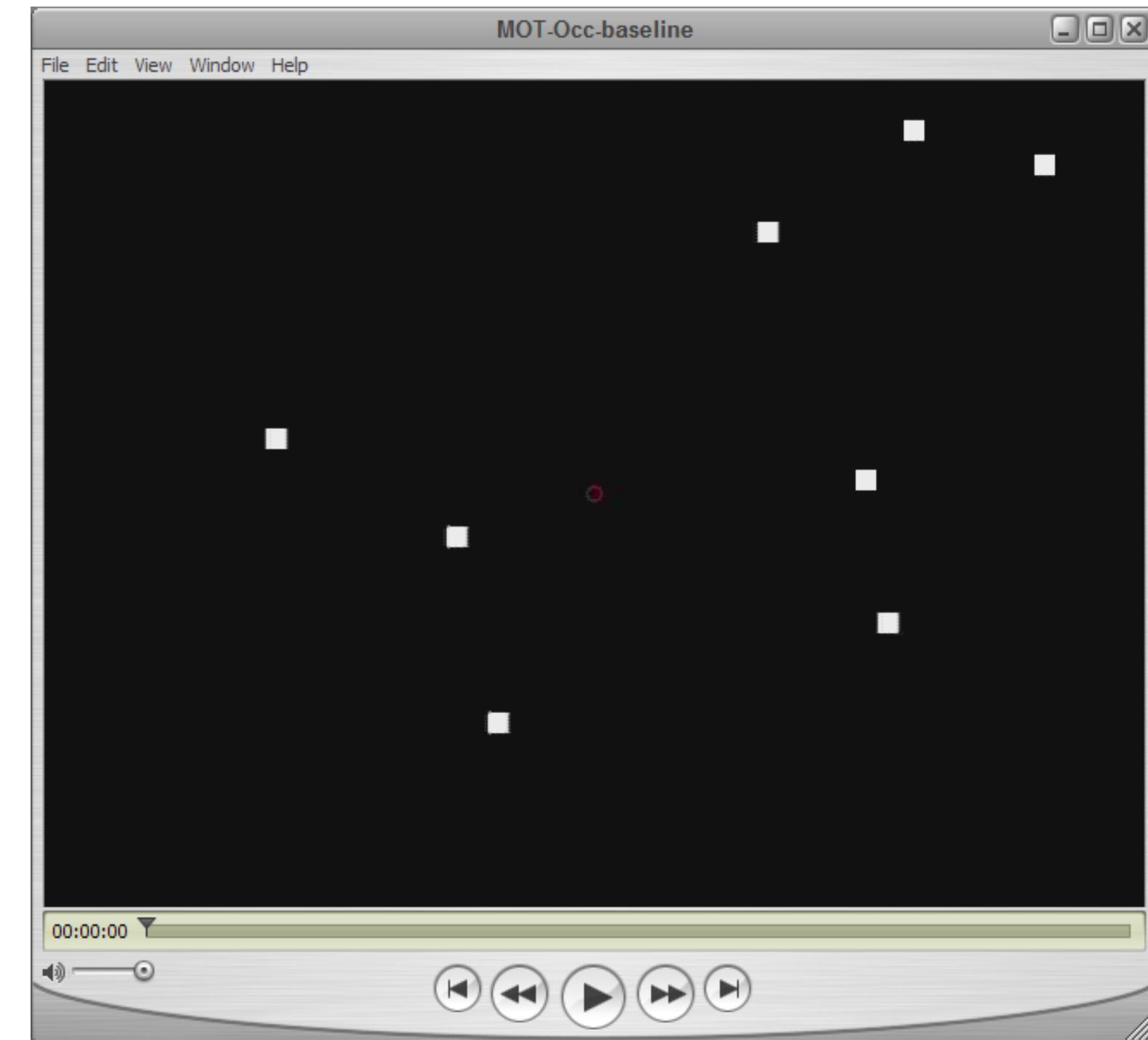
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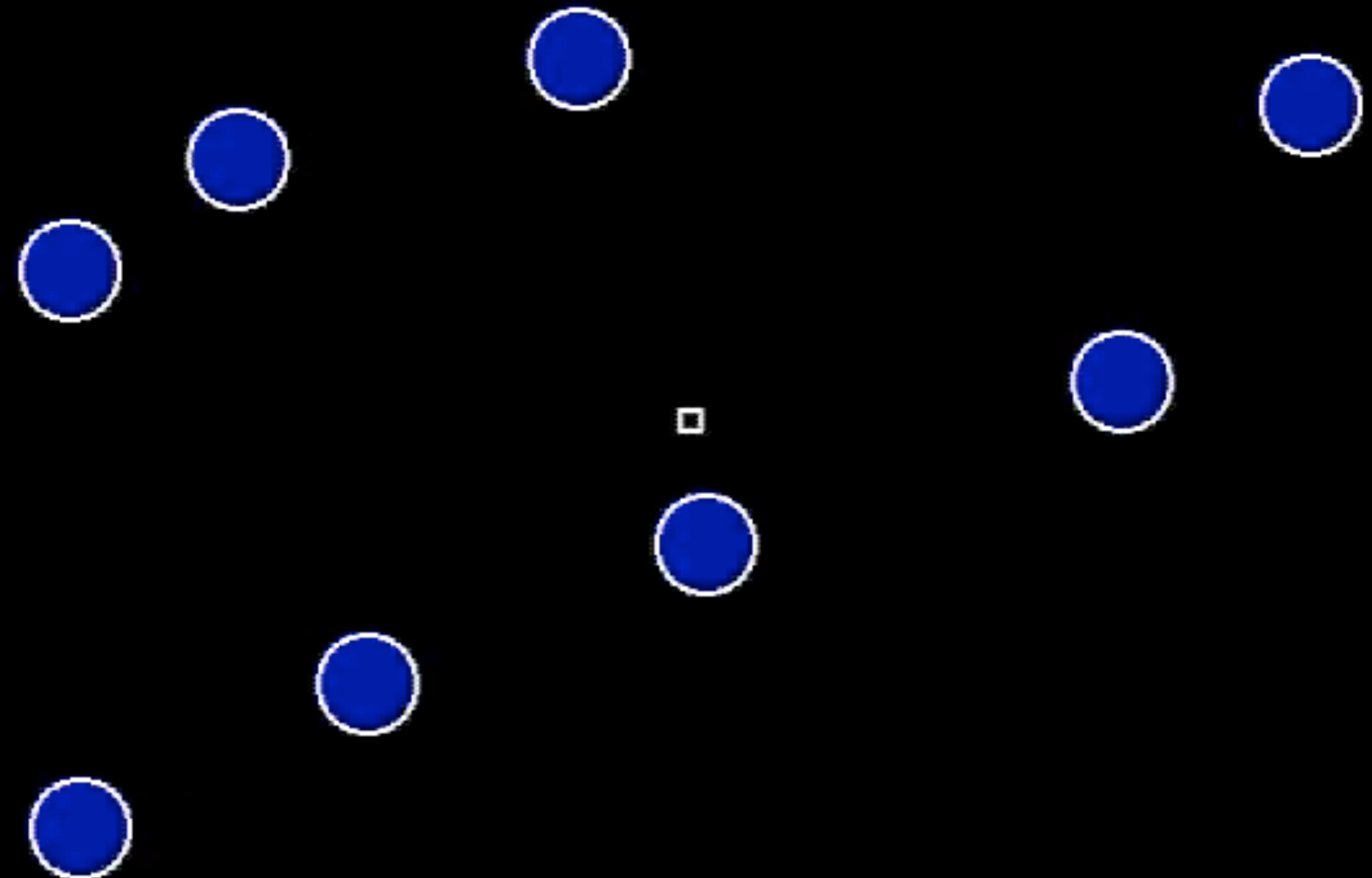
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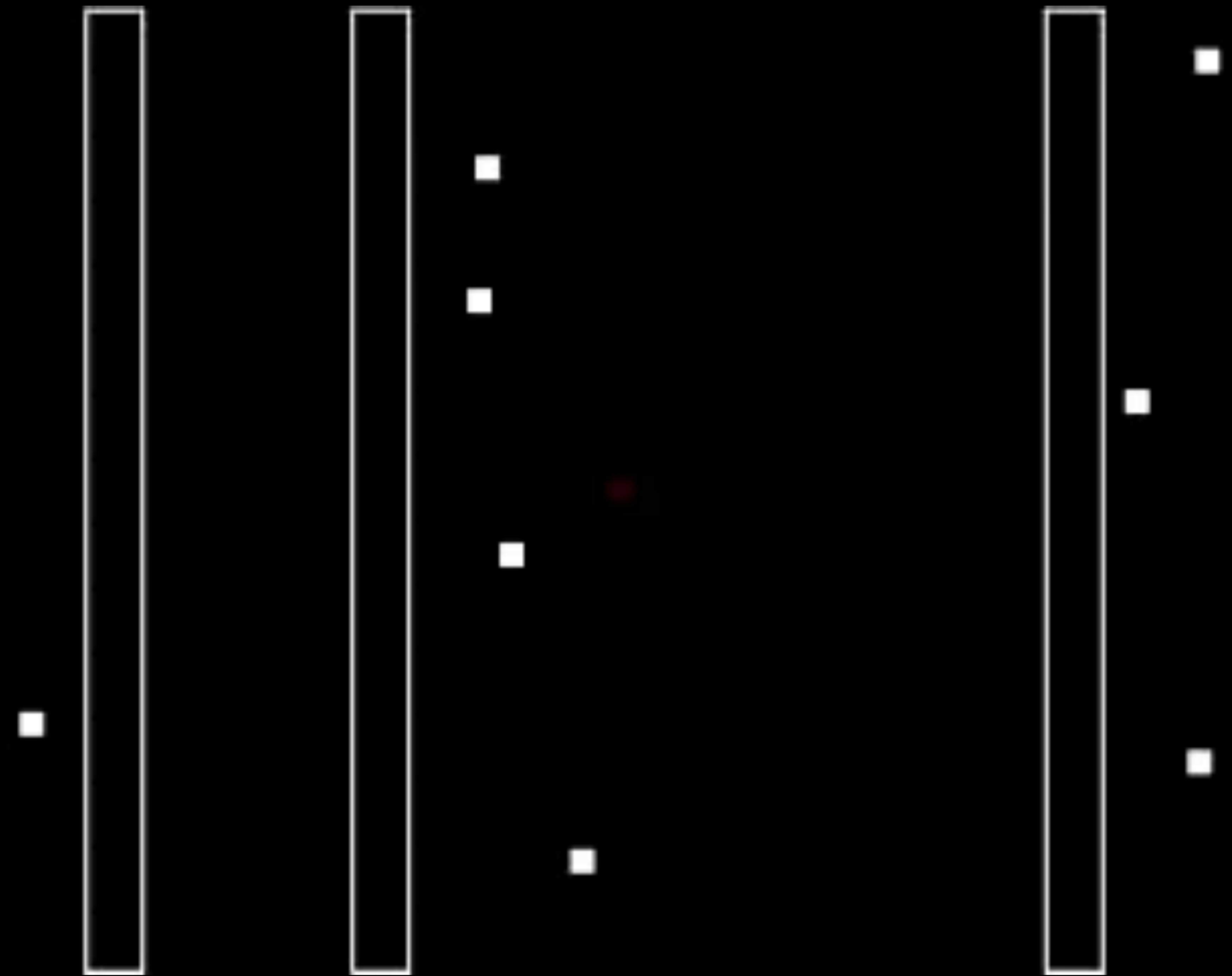
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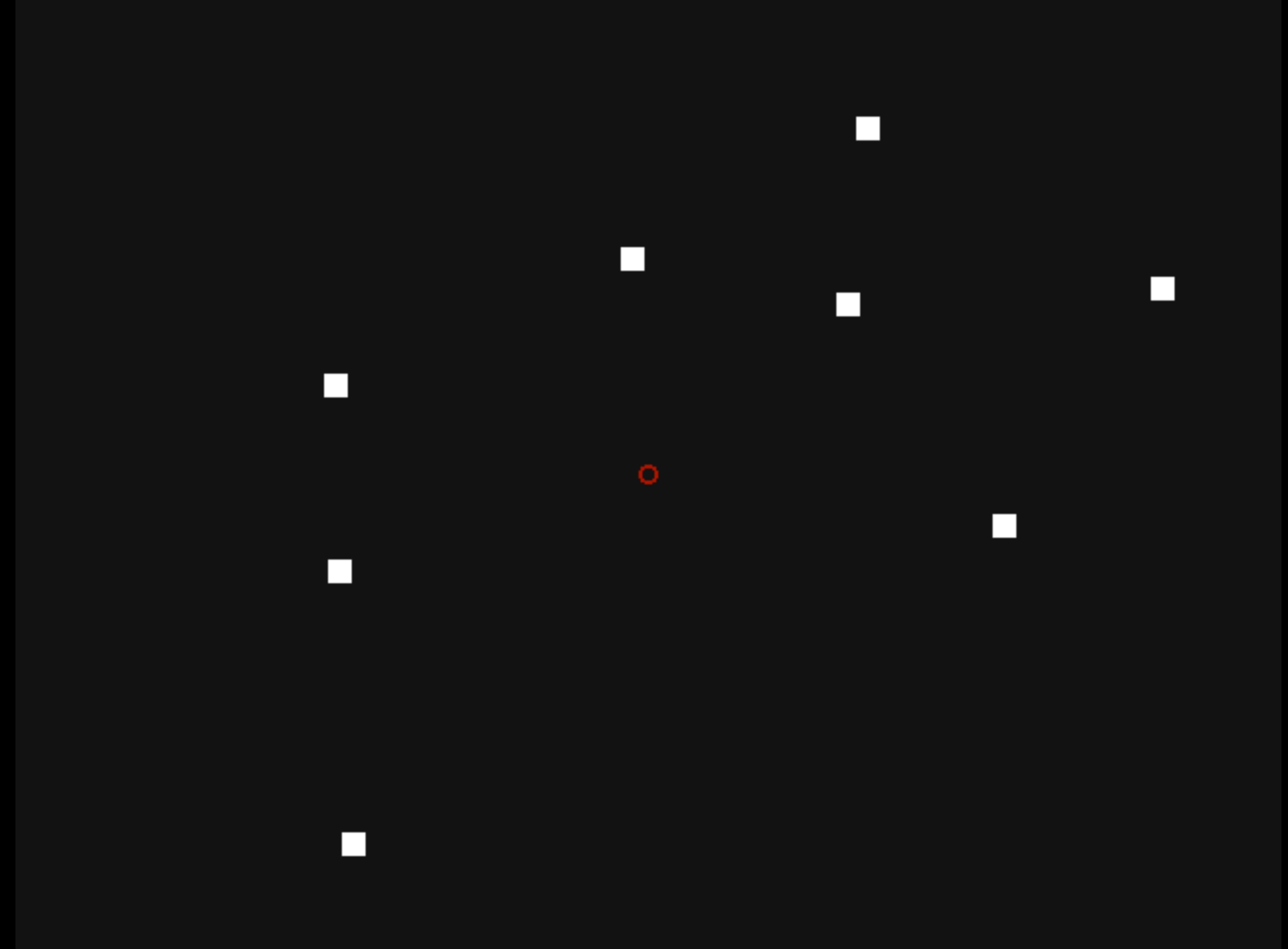
Too many objects may move at once.

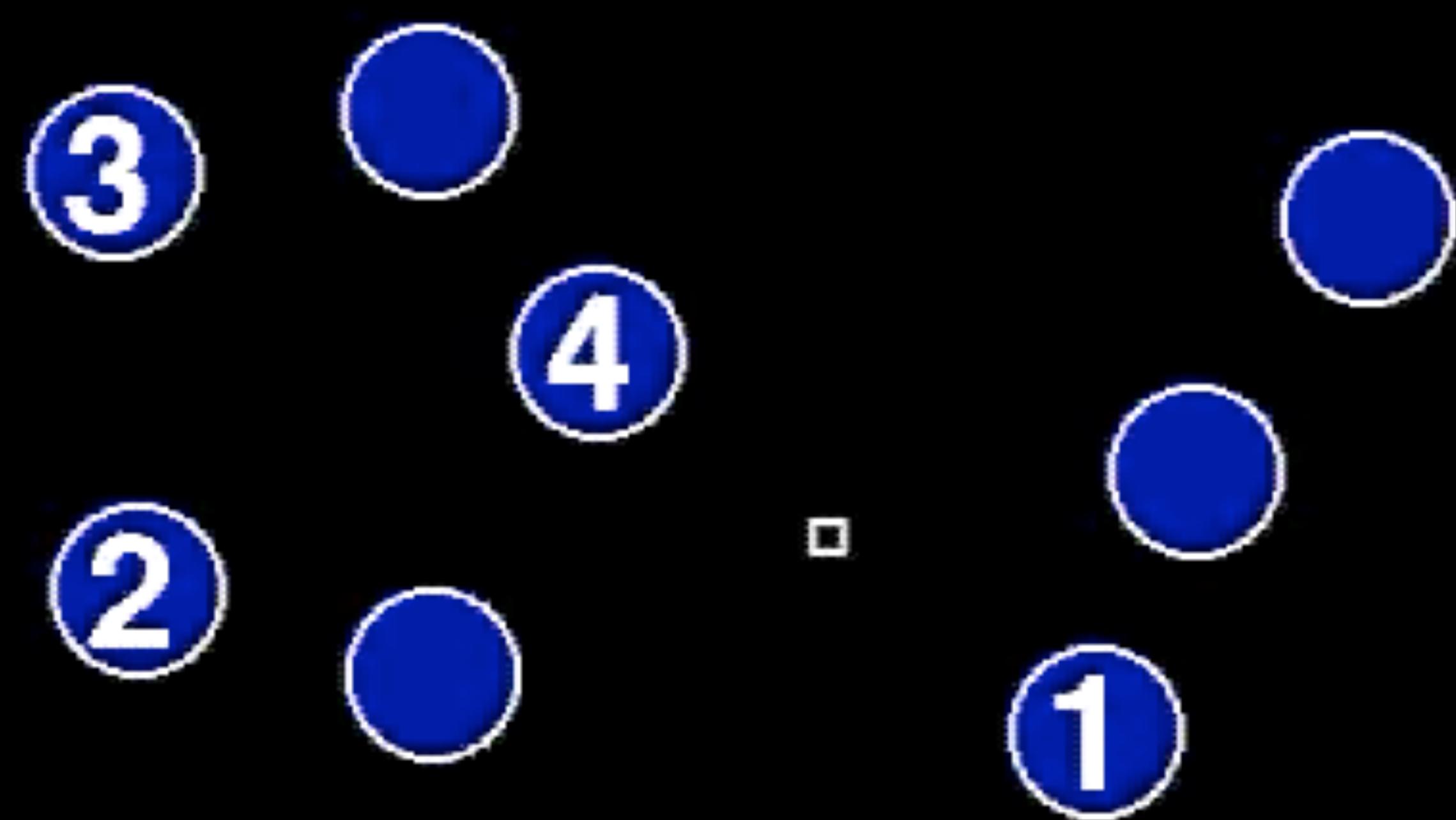












# Animation Goals

How many dots can we track at once?

4-6. Difficulty increases significantly at 6.

Direct attention

Increase Engagement

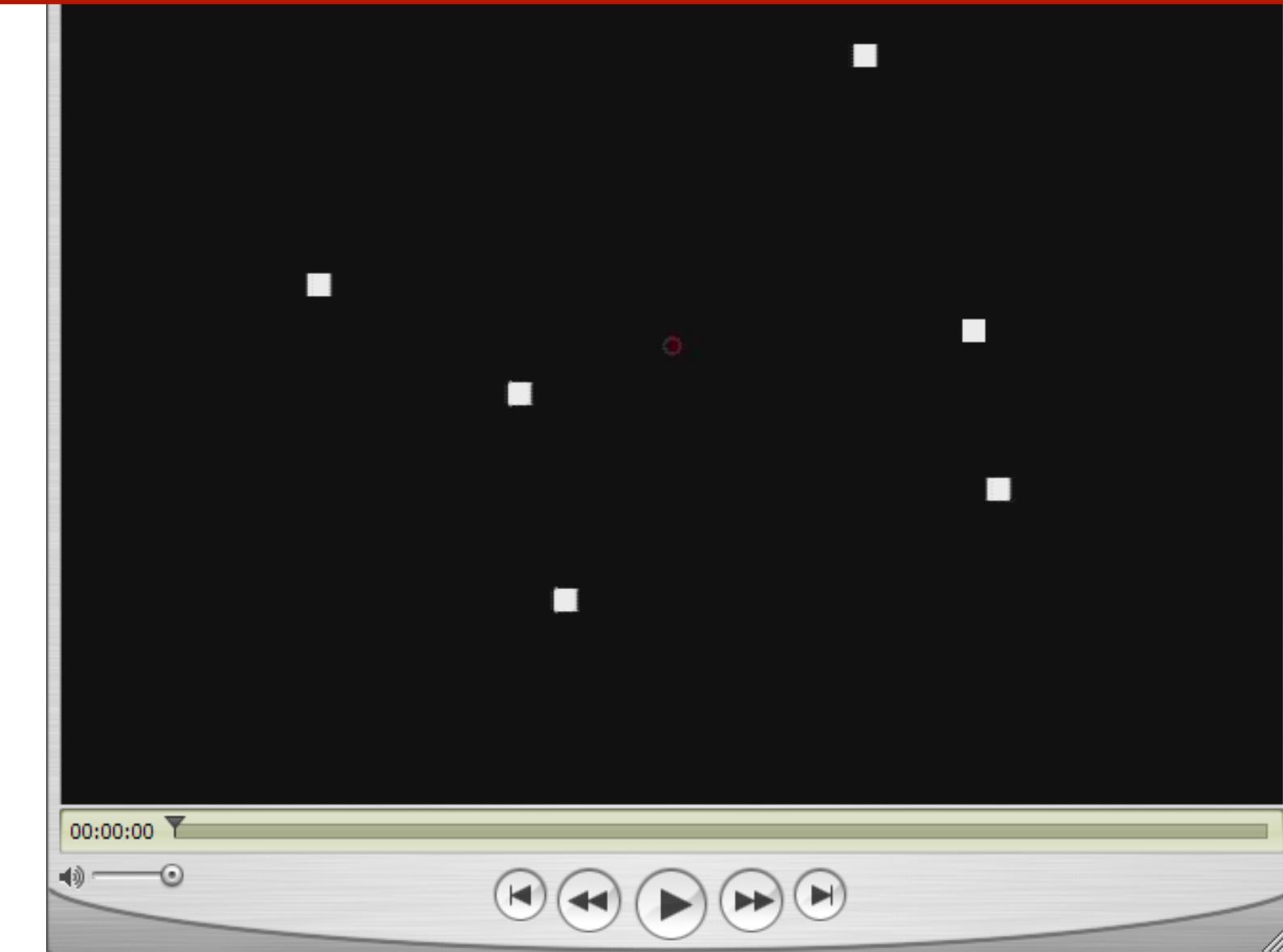
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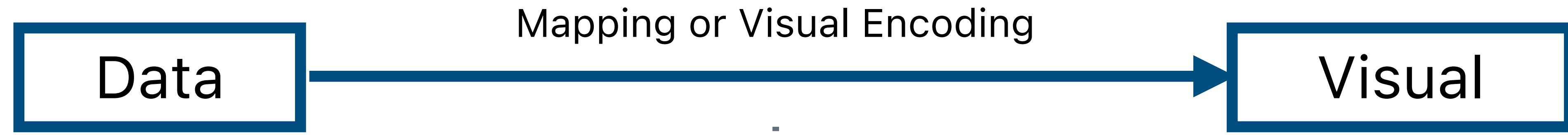
May be too fast or too slow.

**Too many objects may move at once.**



# **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.

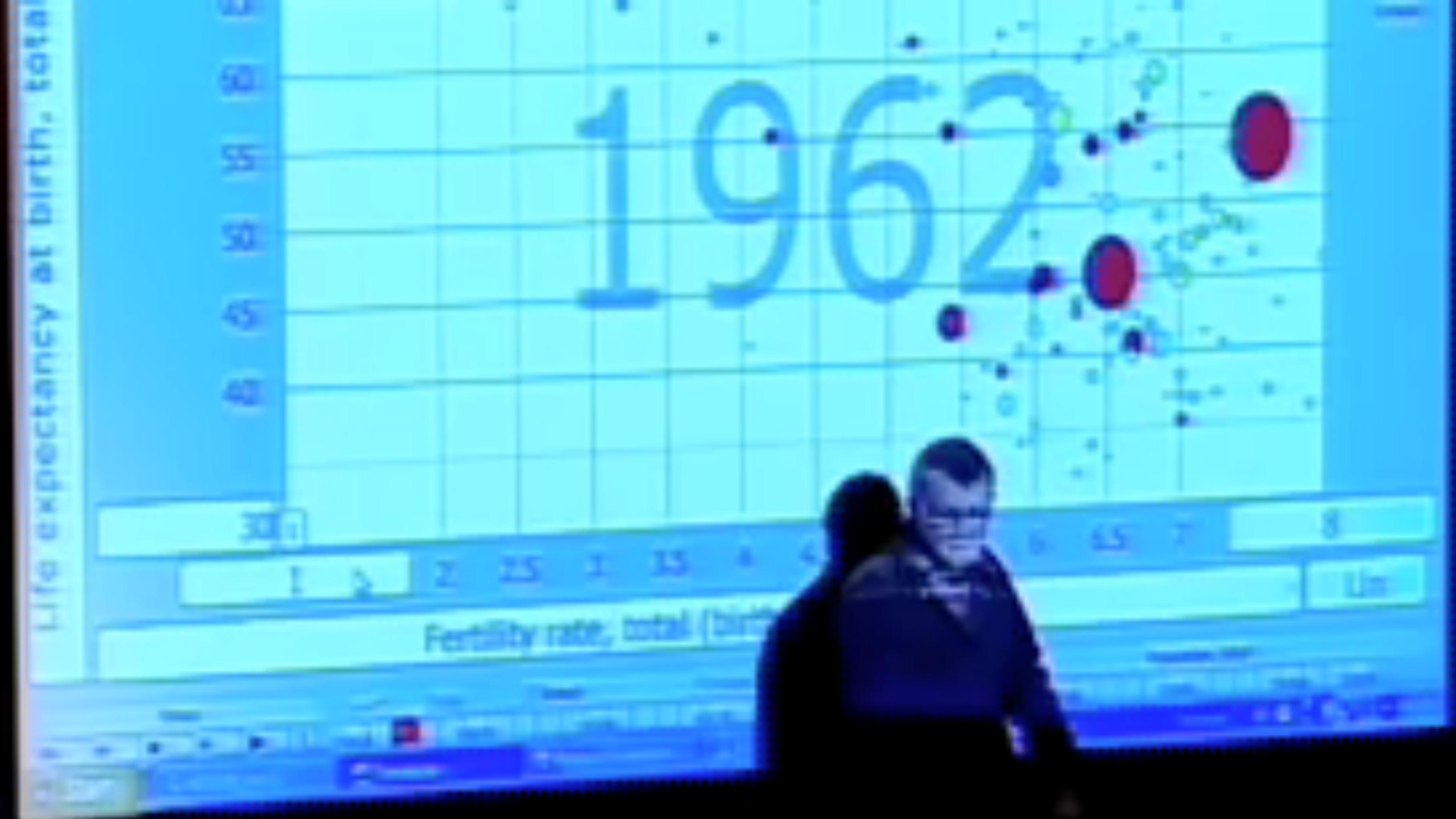
**Axis re-scaling hampers perception**

Avoid if possible (use common scale)

Maintain landmarks better (delay fade out of lines)

Subjects preferred animated transitions



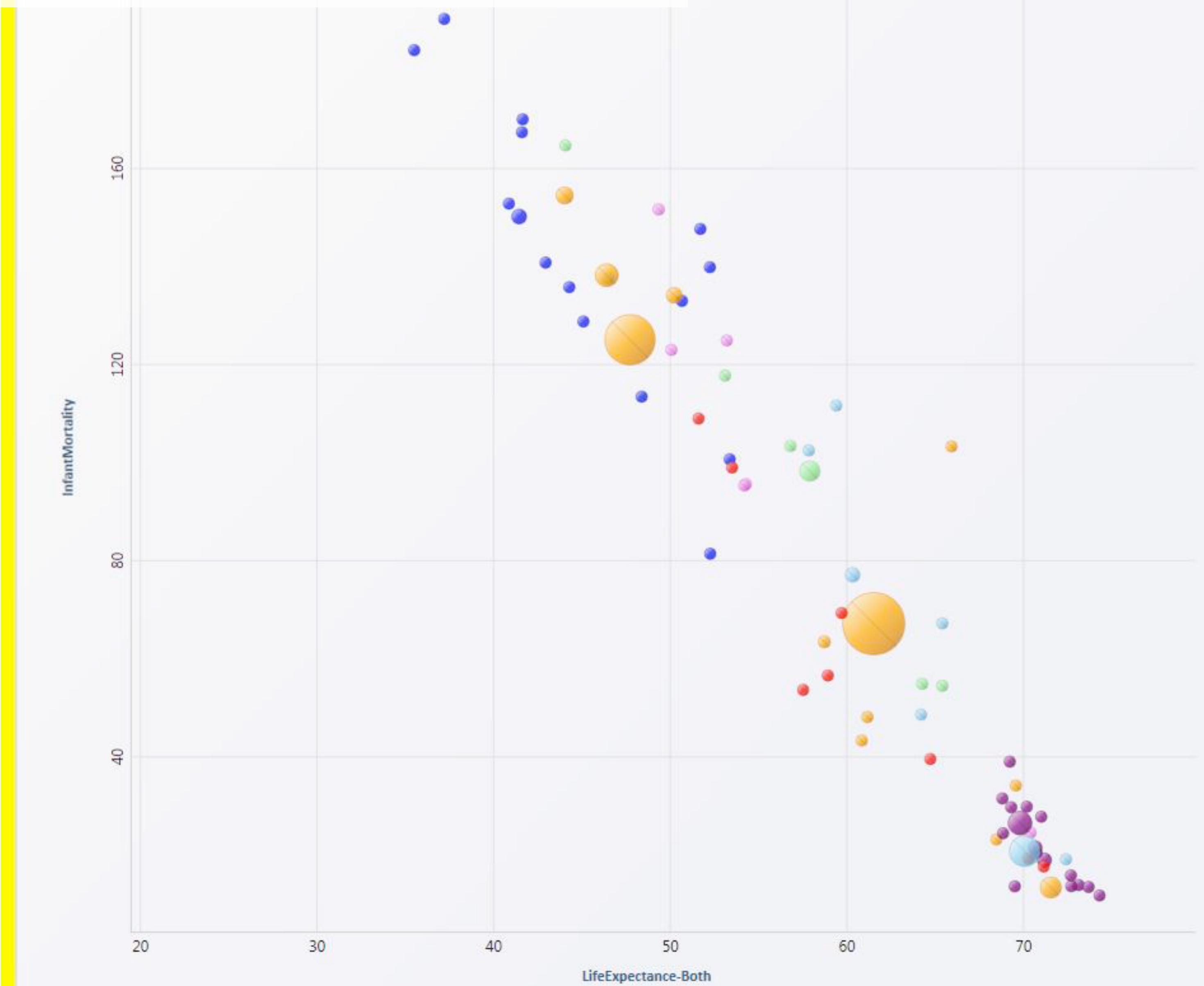


TED



# Animated Scatterplot

1975



## 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

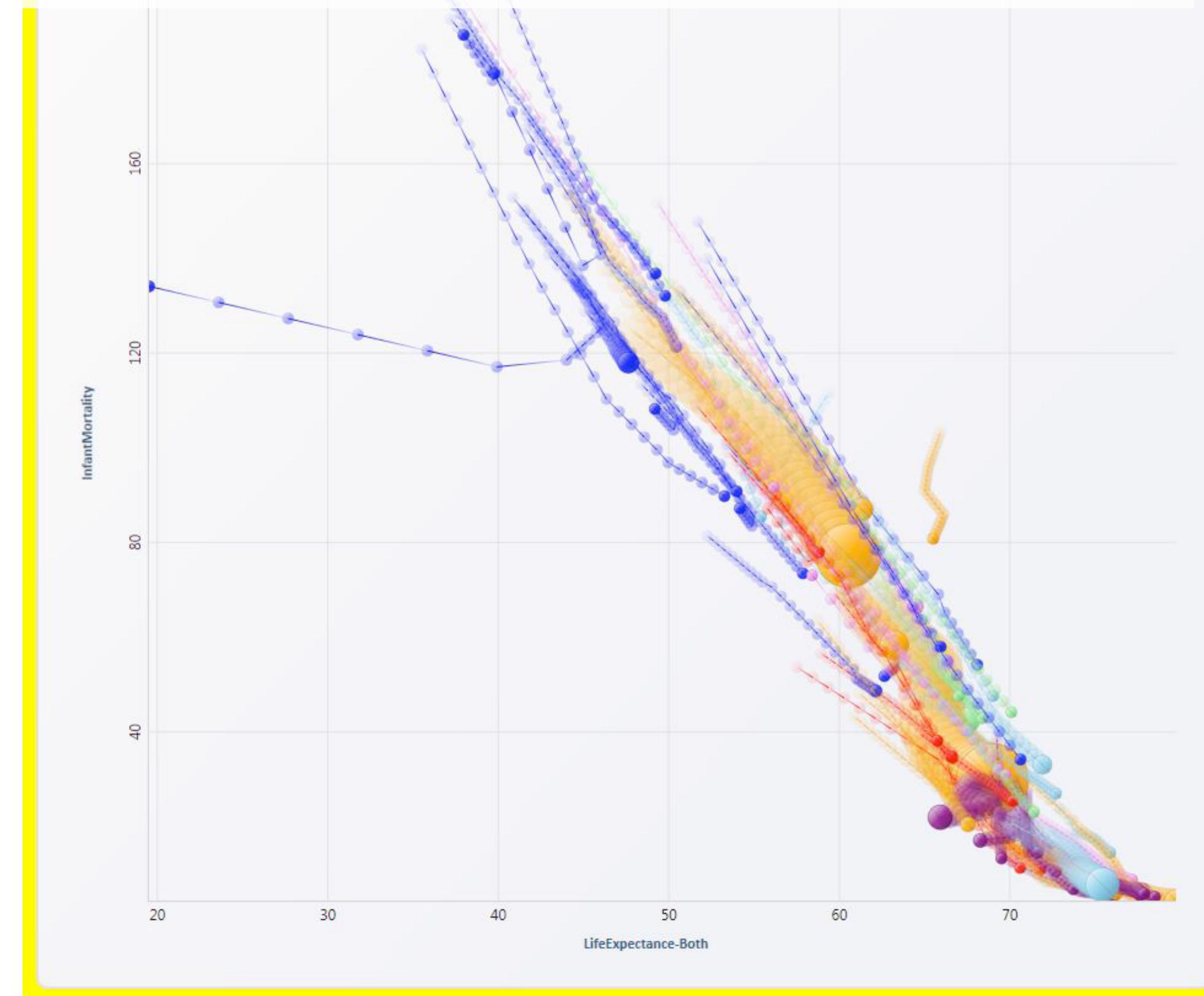
## Next

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

Give Up

Next

# Traces / Connected Scatterplot

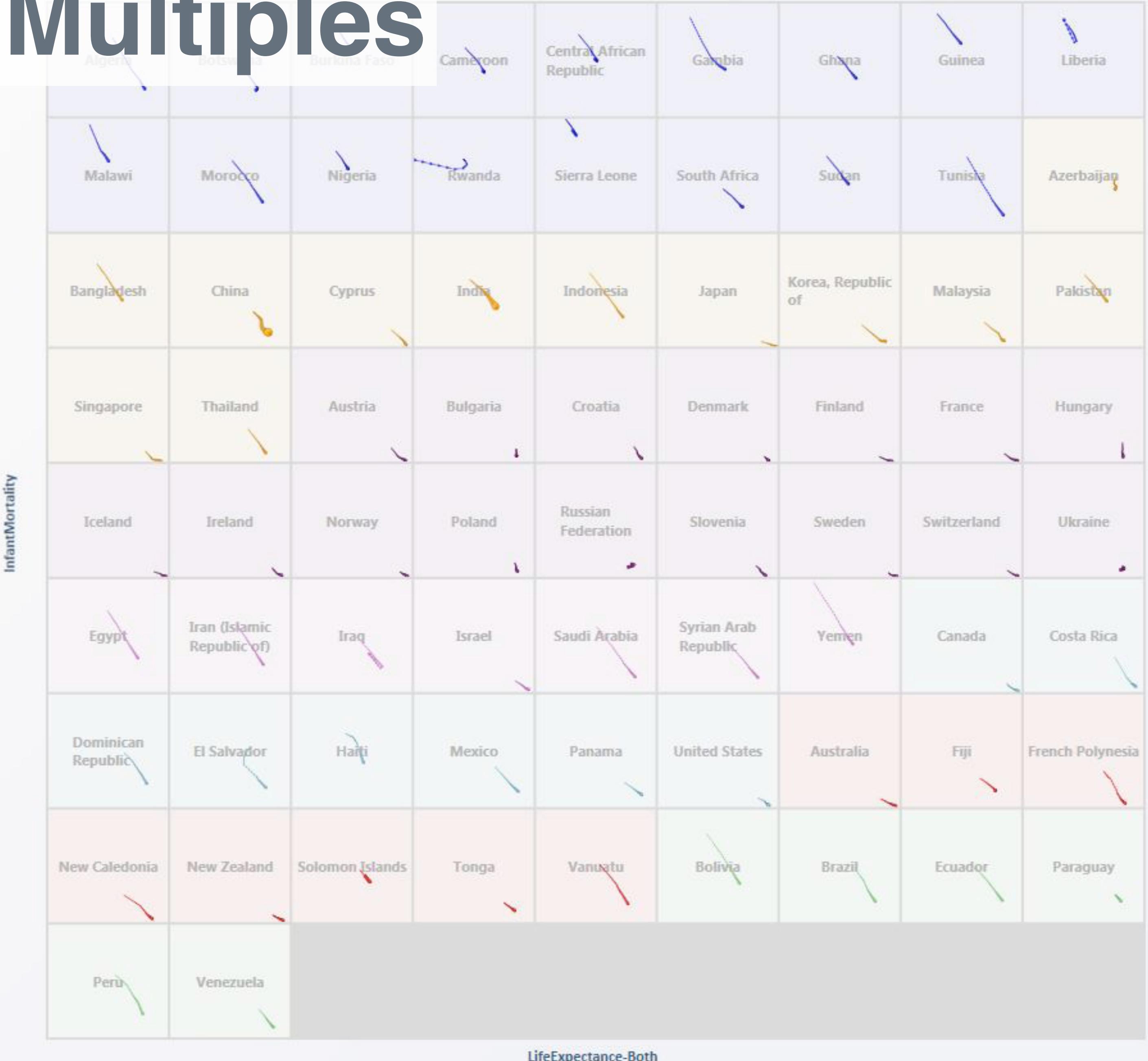


Color Legend (continent)	
Africa	Blue
Asia	Orange
Europe	Purple
Middle East	Pink
North America	Light Blue
Oceania	Red
South America	Green

**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

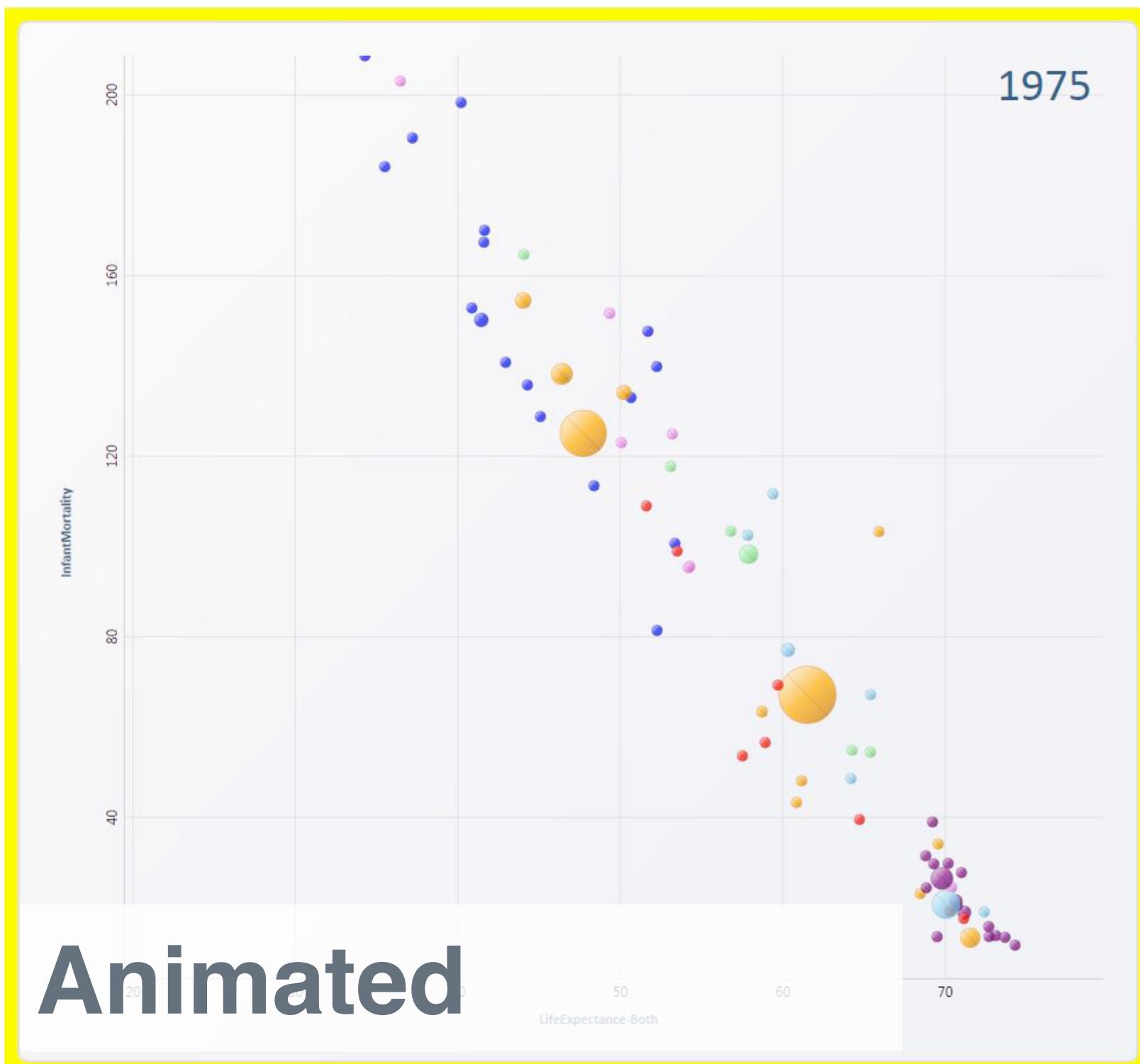
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[Give Up](#)

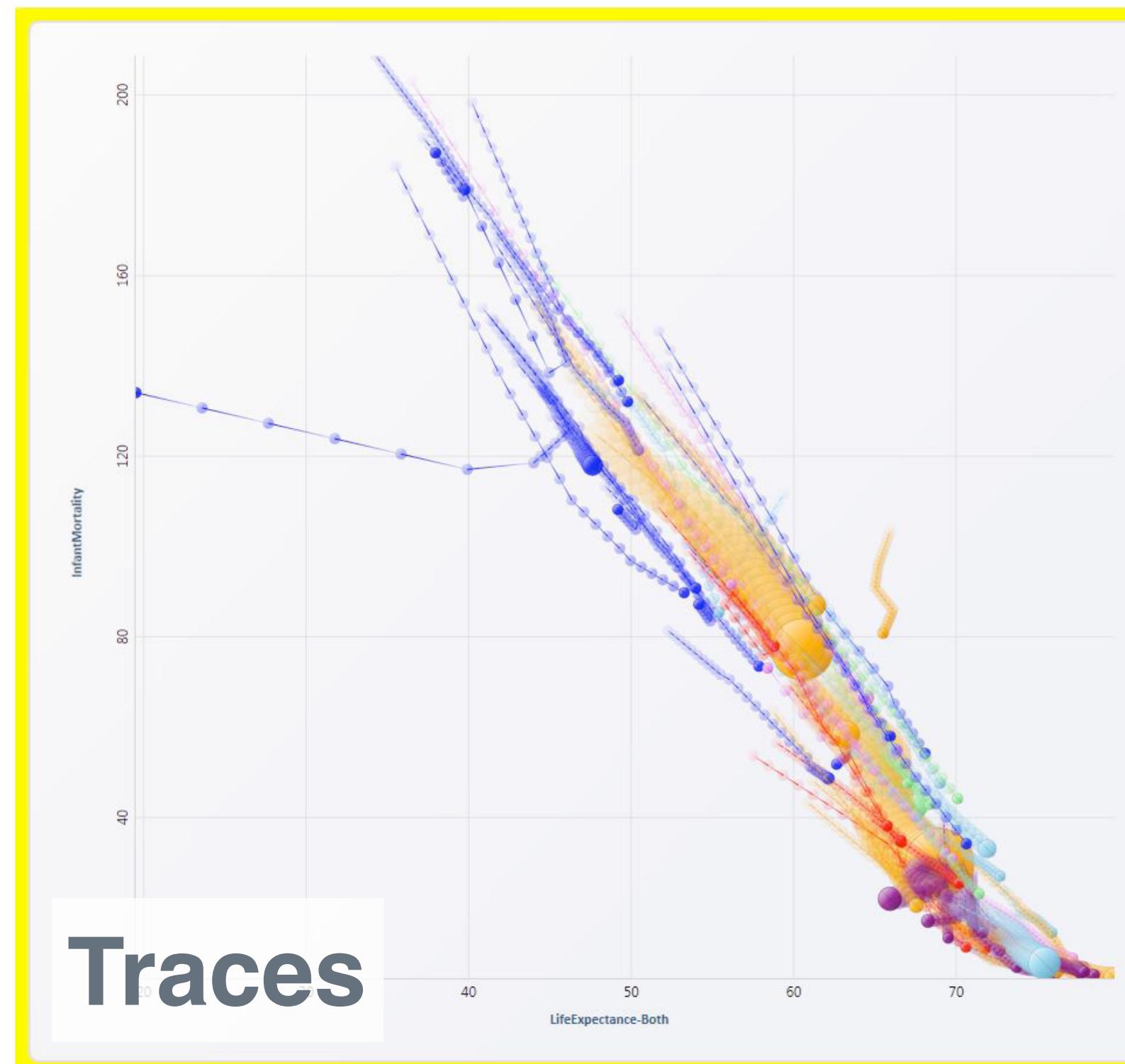
[Next](#)

# Study Conclusions

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



Animated



Traces



Small Multiples

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

[tryclassbuzz.com](http://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

# Using CSS

Using CSS is the simplest way to animate

```
circle {  
  transition: 200ms;  
}
```

= Any time an attribute changes, animate it over 200ms instead of changing instantly

Three cases for animation: new element (enter), changing existing element (update), deleting element (exit).

transition generally only addresses changing existing element!

# Using 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');
```

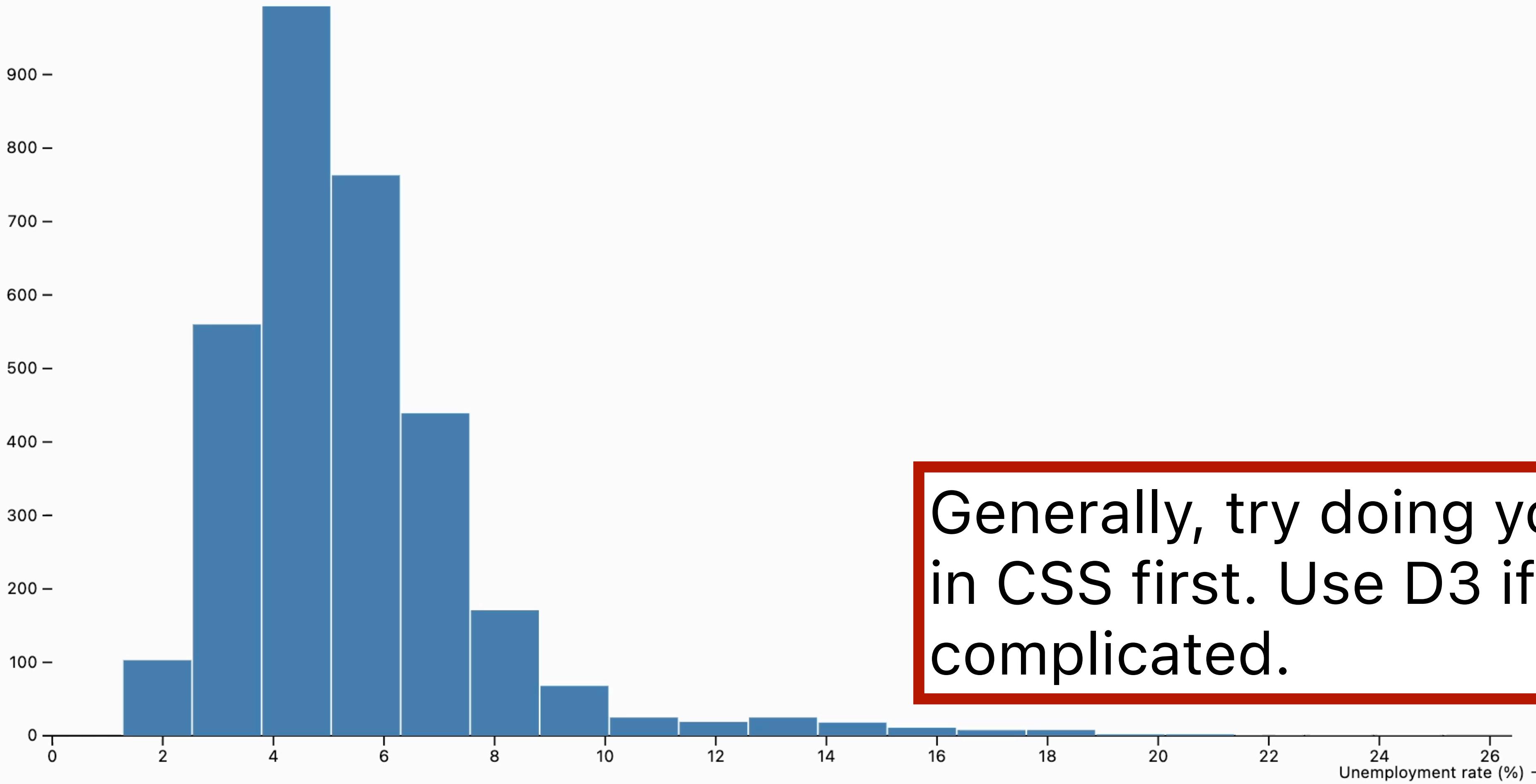
Add `.transition().duration(t)` before changing an attribute to animate it!

## 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!

Generally, try doing your animation in CSS first. Use D3 if too complicated.