Perceptual Benefits of Animation are Task-Dependent: Effects of Staging and Tracing in Dynamic Displays

Scan for GIF

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Background

Dynamic data visualizations can convey a lot of information across time, yet our visual system is limited when perceiving motion.

When tracking multiple objects across space and time, we can typically track up to **four objects**, and the capacity is even lower if we also need to remember the objects' features.

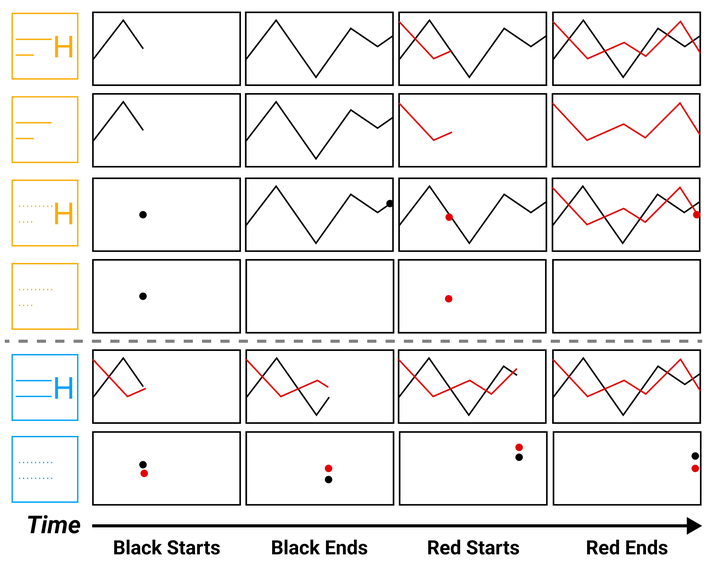
Techniques to improve the processing of dynamic displays:

1. **Staging** the animation to sequentially show steps in a transition.
2. **Tracing** object movement by displaying trajectory histories.
3. **History** preservation that keeps the movement trial of objects

In this work, we examine their effectiveness in dynamic displays:

- We showed participants animated line charts with four lines and asked them to identify the line with the highest **mean**, **variance** and the most significant **outlier**.
- We manipulated the animation to display the lines **sequentially** or **synchronously**, either with or without tracing and history, and compared the results to a static chart as control.

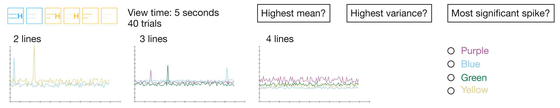
Animation Breakdown



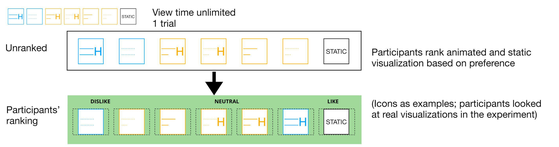
Experiment Methods & Takeaways

Exp #1 Accuracy & Preference by Design

Accuracy



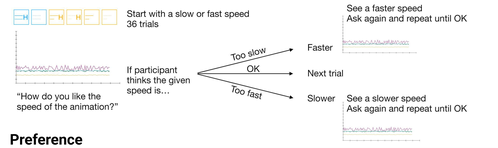
Preference



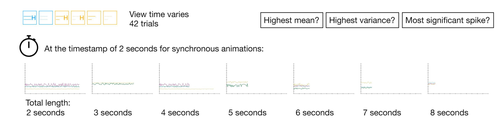
- **More Lines, Less Accuracy**
- Outlier easier than Mean easier than Variance
- Staging hindered task performance.
- Tracing had no effect.
- History improved task performance.

Exp #2 Accuracy & Preference by Speed

Accuracy



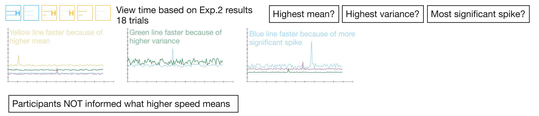
Preference



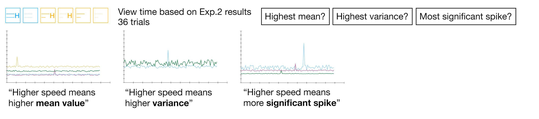
- **Synchronous speed per line = 3x Sequential**
- **Longer display time increases accuracy**
- Staging decreases accuracy.
- Tracing increases accuracy.
- Showing history increases accuracy.

Exp #3 Speed Encoding Effects

Unknown Speed Encoding



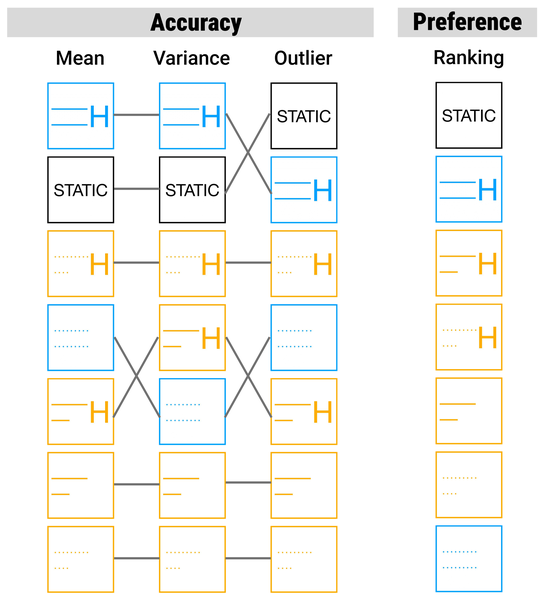
Known Speed Encoding

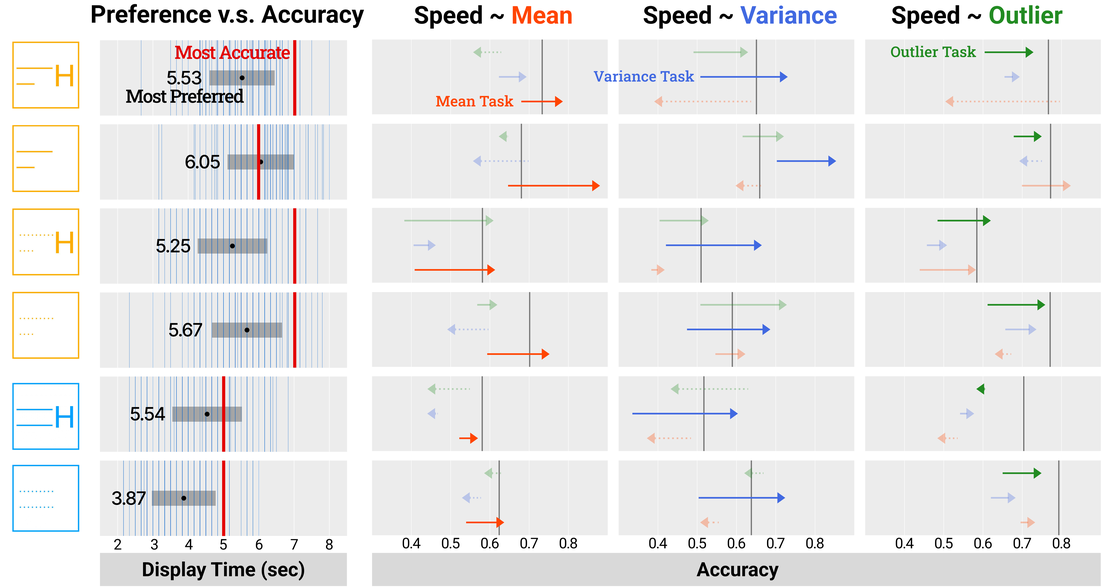


Situations that speed encoding helps

- **Task**: recalling mean value and variance
- **Encoding**: encoding being congruent with the goal
- **Awareness**: participants being told explicitly what speed represents

Experiment Results





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