

Learner Interactivity and the Design of Effective  
Instructional Computer-Based Animations and Simulations

User Control as an Instructional Method  
to Reduce Learners' Cognitive Load  
in Transient Animation

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# Animation Research

- Does animation facilitate learning?  
→ No clear evidence!
- Under which **conditions** are animations useful?
- Different **types** of animation → different effects?  
  
→ Study of **user control** in **transient** animation

# Cognitive Load Considerations

- **Limited capacity**

Information enrichment due to explicit depiction of dynamics

→ Unmanageable amount of information

→ Exceed working memory limits

- **Limited duration**

Information is only temporarily visible due to changes in animated objects

→ Unmanageable speed of animation

→ Exceed working memory limits

# Types of Cognitive Load

- **Intrinsic cognitive load**

Intrinsic to the material being dealt with

Depends on prior knowledge

- **Extraneous cognitive load**

Unnecessary load due to ineffective presentation

Altered by instructional design!

- **Germane cognitive load**

„Good“ load due to learners' active engagement

# Hypotheses

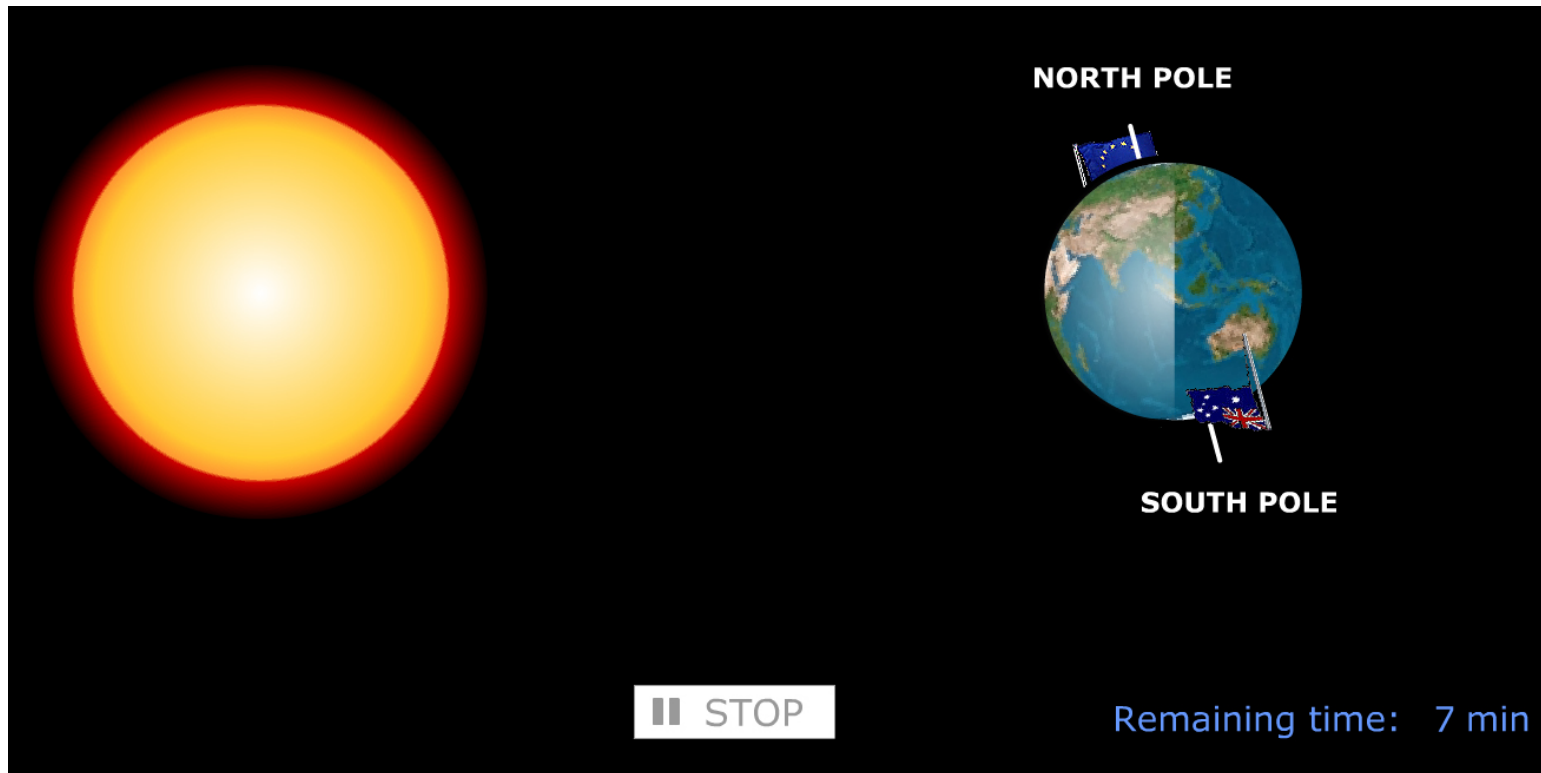
- Cognitive load: learner-paced < system-paced
- Performance: learner-paced > system-paced
- Low element interactivity questions: (factual knowledge)  
learner-paced = system-paced
- High element interactivity questions: (understanding)  
learner-paced > system-paced

# Experiment

Comparison of 4 groups:

- |                         |   |                 |
|-------------------------|---|-----------------|
| 1) Stop-play animation  | } | → Learner-paced |
| 2) Segmented animation  |   |                 |
| 3) Continuous animation | } | → System-paced  |
| 4) Narration-only       |   |                 |

# Material

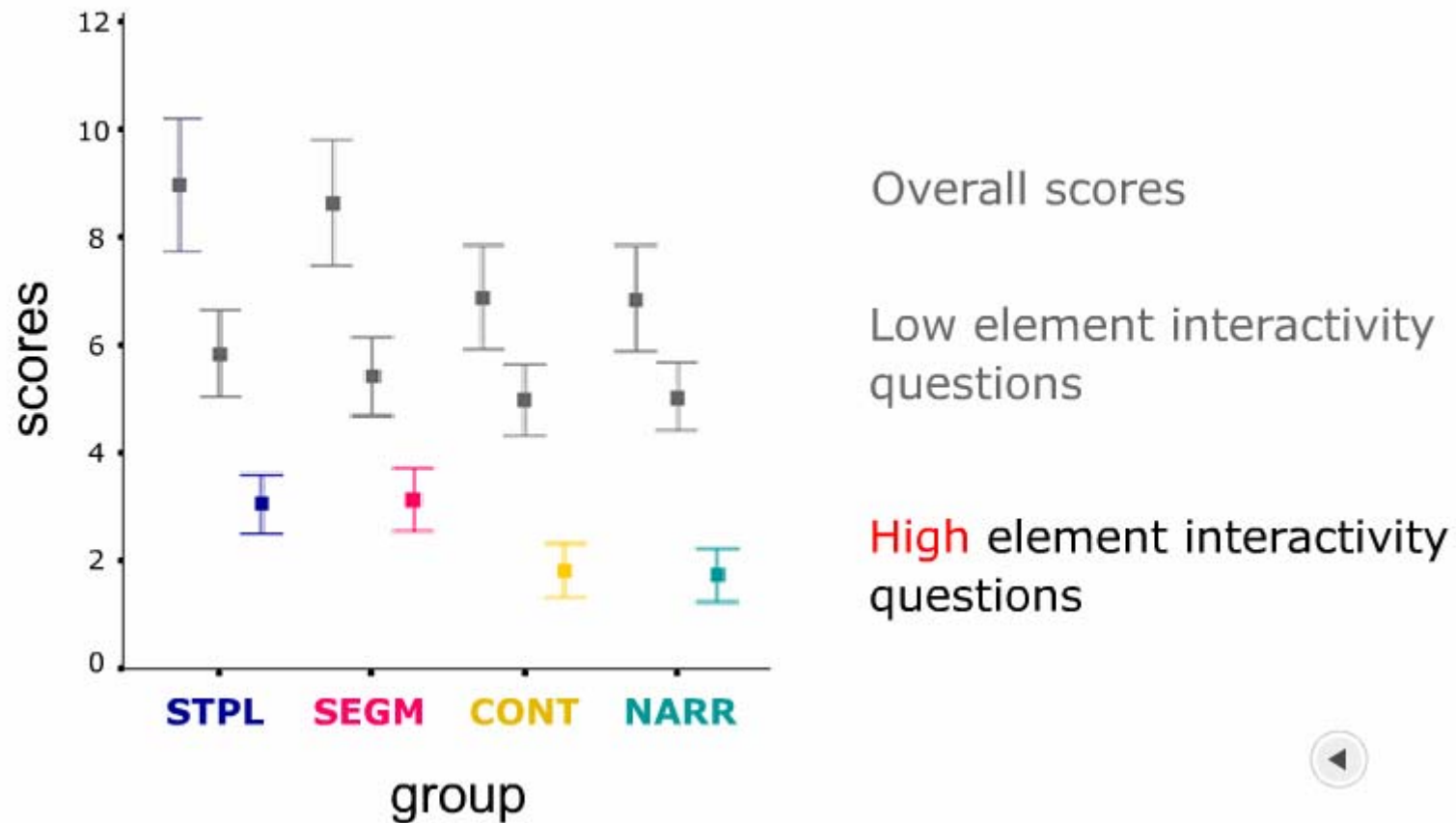


# Experimental Design

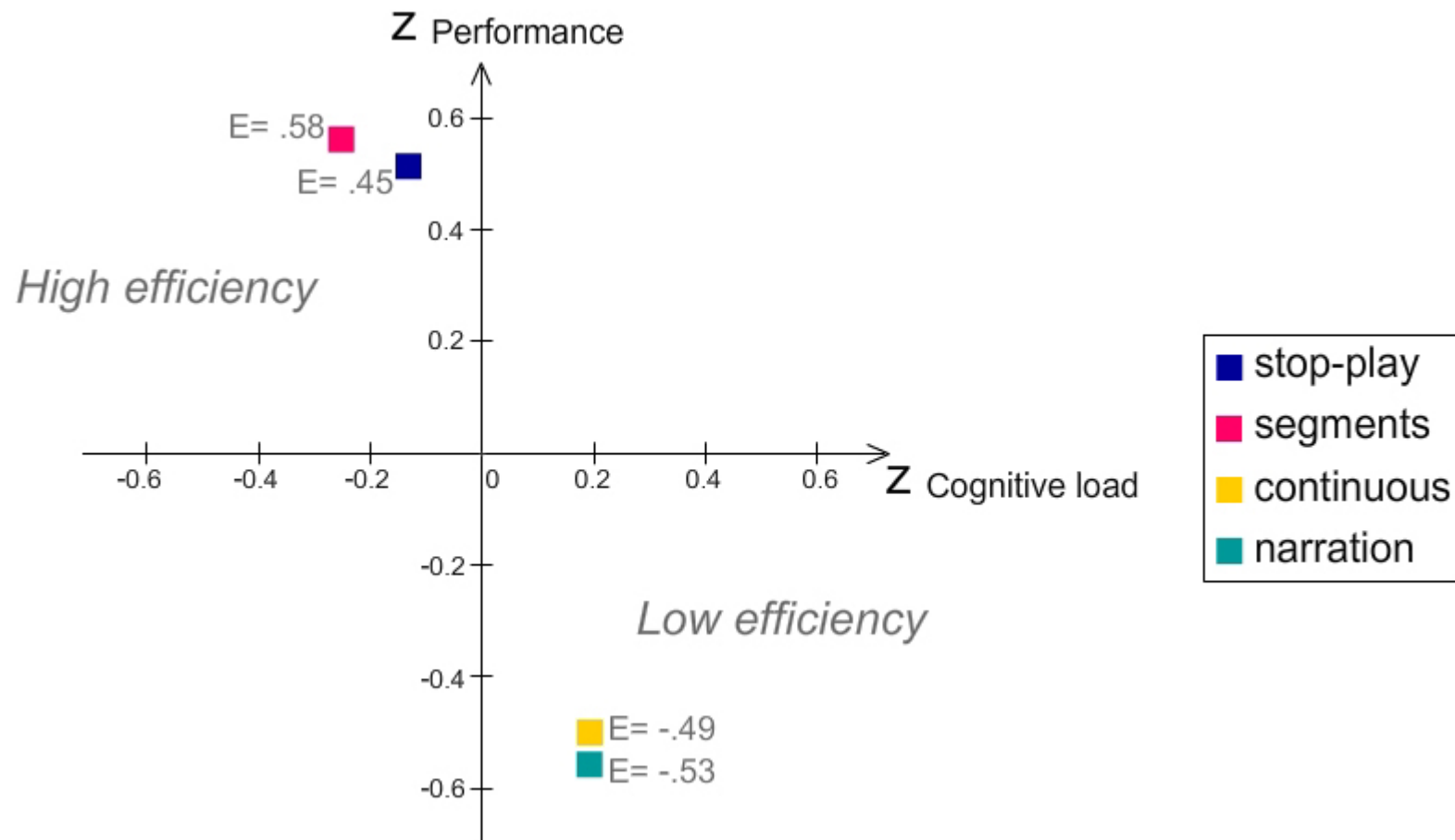
1. Prior knowledge test
2. Animation (or narration-only)
3. Subjective difficulty rating
4. Knowledge test  
(high & low element interactivity questions)



# Results: Learning Performance



# Results: Instructional Efficiency



# Conclusions

- Animation without user control is as inefficient as showing no animation. **continuous = narration-only**
  - Stop-play buttons and pre-defined segments are efficient methods to reduce cognitive load and enhance learning performance. **stop-play = segments**
  - User control leads to less cognitive load, and higher learning performance – even when the available control options are not being used. **stop-play > continuous**
- CLT explanation: Higher germane load of the stop-play group

Thank you for your attention!