Segmenting in Multimedia Learning

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Background & Hypotheses

Mayer's Cognitive Theory of Multimedia Learning (CTML) argues that our ability to learn from multimedia instruction is constrained by our limited processing capacity in visual and auditory channels.[6] This implies that multimedia instruction will be more successful to the extent that it manages the demands on our cognitive processing capacity.

Consistent with this idea, Mayer has investigated several principles of multimedia instruction that manage essential processing in a multimedia lesson. One of these is called the **segmenting principle**, which provides learner control over the pace of instruction and allows the learner to fully represent each part of a system before moving on to the next. This principle has been supported in multiple experiments, with effect sizes ranging from 0.38 to 1.29, but generally used either shorter science lessons[5] or humanities lessons[1] and materials. However, in unpublished work in our lab, we have struggled to replicate this effect.

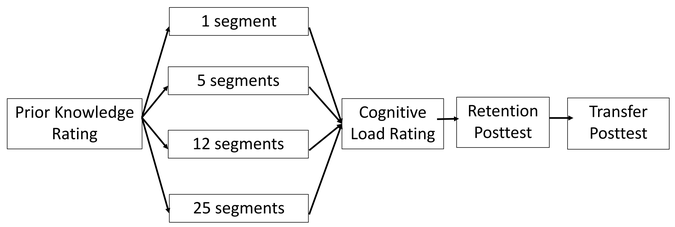
The goal of our study is to understand whether the benefits of segmenting are dependent on the number of segments or segment length. Additionally, we are investigating whether changes in cognitive load are a reasonable explanation of this benefit.

Hypothesis: We predicted that increased segmentation will increase retention and transfer knowledge and decrease essential processing demands as measured through intrinsic and germane loads.

Design

Between-subjects design:

234 UCSD undergrads (125 native English speakers; M_{age} = 20.4 years)

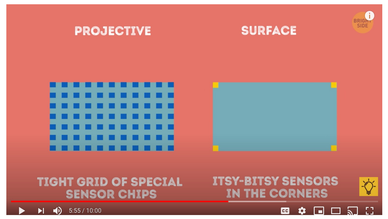


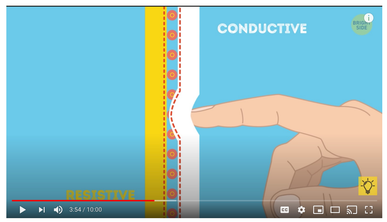
Conditions:

Number of Segments	Segment Duration
1 *(n = 60)*	570 sec
5 *(n = 58)*	≃77.1 sec
12 *(n = 57)*	≃38.5 sec
25 *(n=59)*	≃19.2 sec

Materials

Lesson on How Touchscreens Work:





Prior Knowledge Self-Rating:
How much do you know about how touchscreens work? *(1-5 scale)*
How many kinds of touchscreens are there? List all the types you know.

Cognitive Load Ratings:

On a scale from 0 (strongly disagree) to 10 (strongly agree):

- **Intrinsic**: The vocabulary used in the video was complex
- **Germane**: The video really enhanced my understanding of how touchscreens work
- **Extraneous**: The diagrams in the video were very unclear

Retention & Transfer Posttest:

2 Open Response Retention

How are resistive and capacitive touchscreens different? How do they work? Describe in as much detail as you can and list as many differences as possible.

4 Open Response Transfer

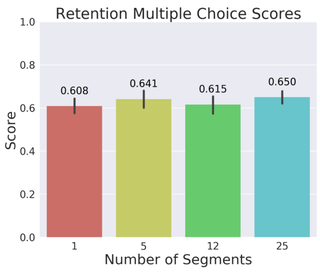
Imagine your smartphone's touchscreen was resistive (rather than capacitive). How would this affect the functionality of your phone? List as many drawbacks as possible.

13 Multiple Choice Retention

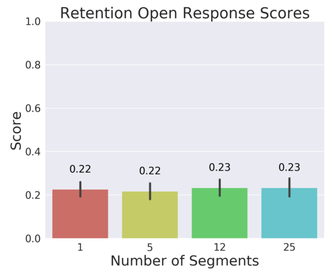
What type of touchscreen is most commonly found in an e-reader?
a) Resistive
b) Capacitive
c) Infrared
d) Surface acoustic wave

Results

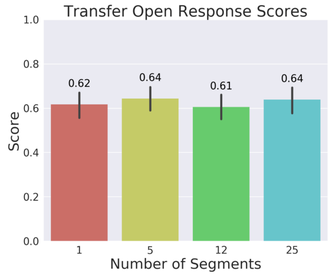
Retention and Transfer Test Performances:



Retention: ($F(3,230)$= 1.113, p >0.05)
Prior Knowledge ($F(1,232)$= 6.575, p = 0.011)



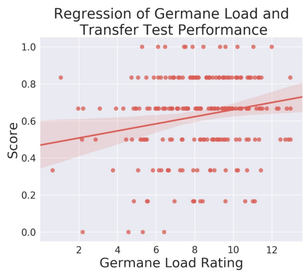
Retention: ($F(3,230)$= 0.1625, p> 0.05)
Prior Knowledge ($F(1,232)$= 6.722, p = 0.010)



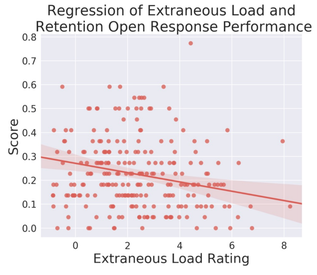
Transfer: ($F(3,230)$= 0.3959, p> 0.05)
Prior Knowledge ($F(1,232)$= 3.890, p = 0.0498)

Cognitive Load:

Neither intrinsic load nor germane load differed across conditions (all p> 0.05)

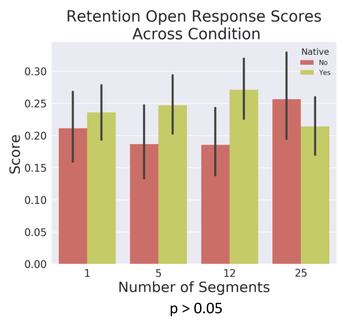


Germane: ($F(1,230)$=5.152, p =0.0241)



Extraneous: ($F(1,230)$=3.981, p =0.0472)

Native Language:



p > 0.05

Discussion

We failed to find a significant effect of segmenting on test performance for both retention and transfer test types.

Segmenting also did not not reduce essential processing demands.

Through exploratory analyses, we did find that germane load positively predicts transfer open response scores and that extraneous load negatively predicts retention open response scores.

Segmenting benefits may differ between native and nonnative English speakers.

Future Directions

Explore the role of participant level variables such as native speaker status and prior knowledge

Identify the relationship between content complexity and segmentation

Investigate how participants spend their time in between segments

References

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2. Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. Applied Cognitive Psychology, 13, 351–371.
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5. Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. Educational psychologist, 38(1), 43-52.
6. Mayer, R. E. (2008). Applying the science of learning: Evidence-based principles for the design of multimedia instruction. *American psychologist*, *63*(8), 760.

- Limitations (if needed)
- -video complexity
- --lab study
- --suspect people didn’t use segments as pauses