A Redundant Redundancy Principle?
Examining the Redundancy Principle Through Cognitive Load

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Introduction

The **Cognitive Theory of Multimedia Learning** (CTML; Mayer, 2021) proposes that instruction should align with the limits of working memory by minimizing unnecessary processing. One key guideline, the **redundancy principle**, states that learners understand material better from graphics and narration than from graphics, narration, and identical on-screen text (Fiorella & Mayer, 2021).

Redundant subtitles are thought to **create extraneous cognitive load** by forcing learners to integrate identical verbal information, leaving fewer working memory resources for meaningful learning.

Although many studies show poorer learning with redundant text, this effect is typically inferred from test performance rather than measured directly.

The present study aims to **directly assess cognitive load** using self-report measures to test the mechanisms underlying the redundancy principle.

Methodology

Experiment 1

Participants (90 undergraduates) learned about **lightning formation** through an animated video presented in one of three conditions: **narration + subtitles (N+S)**, **subtitles only (SO)**, or **narration only (NO)**.

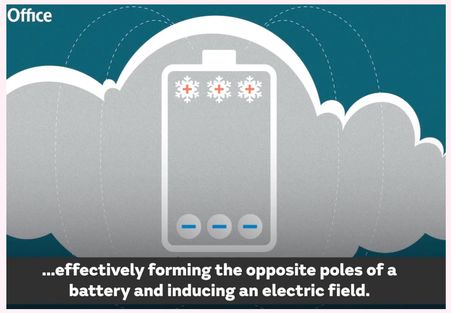
- Learning was assessed with multiple-choice, retention, and transfer tests adapted from Mayer & Moreno (2001).
- Cognitive load was measured using Leppink et al.'s (2013) 10-item scale assessing intrinsic, extraneous, and germane load.

Experiment 2

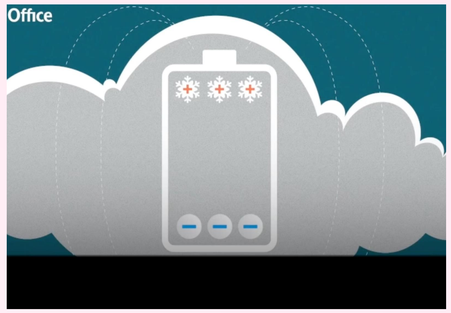
Experiment 2 replicated Experiment 1 (159 undergraduates) but **sped up the lesson video to match the timing used by Moreno & Mayer (1998)**

- The same learning outcome and cognitive load measures were used as Experiment 1

Video lesson



Subtitles Only (SO)

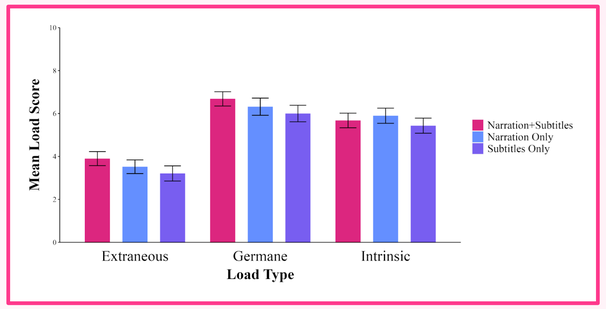


Narration Only (NO)

Narration + Subtitles (N+S)

Results

Experiment 1



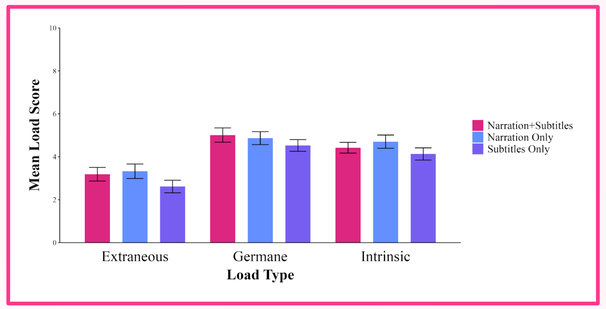
Cognitive load ratings did not differ across conditions for intrinsic, extraneous, or germane load

Learning Outcome	Narration + Subtitles *M (SD)*	Subtitles Only *M (SD)*	Narration Only *M (SD)*
Multiple Choice	0.46 (0.19)	0.53 (0.18)	0.50 (0.17)
Short answer retention	2.5 (2.47)	2.97 (2.46)	3.77 (3.43)
Transfer	2.0 (1.20)	2.43 (1.33)	2.33 (1.81)

One-way ANOVAs showed **no significant differences** between on any learning measure:

- **Multiple choice:** $F(2,87) = 1.05$, $p = .36$, $\eta^2 = .02$
- **Short-answer retention:** $F(2,87) = 1.54$, $p = .22$, $\eta^2 = .03$
- **Transfer:** $F(2,87) = 0.72$, $p = .49$, $\eta^2 = .02$

Experiment 2



Cognitive load ratings did not differ across conditions for intrinsic, extraneous, or germane load

Learning Outcome	Narration + Subtitles *M (SD)*	Subtitles Only *M (SD)*	Narration Only *M (SD)*
Multiple choice	0.57 (0.23)	0.51 (0.23)	0.51 (0.17)
Short answer retention	2.79 (2.46)	2.51 (2.25)	2.32 (1.91)
Transfer	1.87 (1.29)	1.62 (1.38)	1.88 (1.41)

One-way ANOVAs showed **no significant differences** any learning measure:

- **Multiple choice:** $F(2,156) = 1.13$, $p = .33$, $\eta^2 = .01$
- **Short-answer retention:** $F(2,156) = 0.61$, $p = .55$, $\eta^2 = .01$
- **Transfer:** $F(2,156) = 0.62$, $p = .54$, $\eta^2 = .01$

Conclusion

Across two experiments, **we found no evidence of a redundancy effect**. Participants who viewed videos with narration and subtitles performed similarly to those with narration only or subtitles only on all learning measures. **Cognitive load ratings also did not differ across conditions**.

We set out to determine whether redundant subtitles increase extraneous cognitive load but found no evidence of such an effect.

Redundant subtitles may not always hinder learning, calling into question the reliability of the redundancy principle. Differences from previous studies may reflect context sensitivity, greater familiarity with subtitles among modern learners, or task difficulty that was too low to produce overload (Kalyuga et al., 2000; Lee & Mayer, 2018; Mayer & Johnson, 2008; Yue & Bjork, 2017).

Future research should examine when and why redundancy effects occur. This could be done with more complex lessons and direct measures of cognitive load such as dual-task or eye-tracking methods to better understand the mechanisms of multimedia learning

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