



PSYCHONOMIC SOCIETY
62ND ANNUAL MEETING

**Designing Effective Video Learning:
A Classroom Study of Adjunct Questions and
Feedback in Video Learning Modules**

Emma H. Geller, PhD
University of California, San Diego

Adjunct Questions in Instructional Video

- Instructional video affords the ability to test instruction in a controlled and repeatable way
- Questions embedded in a lesson can improve learning
 - Short answer questions tend to be associated with larger effects than multiple choice questions¹
 - “Pre” and “post” questions might both be effective, but facilitate different cognitive activities^{1,2}
 - Feedback can improve learning for both correctly- and incorrectly-answered items during study³
- These effects have mostly been studied in text comprehension, not video
- We have done prior laboratory studies investigating the effect of adjunct questions in a video lesson, but lab studies lack ecological validity
- In this project we test some of these same questions in an online, remote course



¹Hamaker, 1986, ²Rothkopf, 1966, ³Butler, Karpicke, & Roediger, 2008

Research Questions

1. Do adjunct questions improve learning from a video lesson relative to a control video with no adjunct questions?
2. Does the effectiveness of adjunct questions depend on their format, placement, or the type of feedback provided?
3. Is the effect of adjunct questions consistent across many different lectures?



How the course was designed

- Students watched 3 video modules each week (asynchronously)
- Each video was assigned to one of three manipulations:
 - **What type of question** were students prompted to answer?
 - **When** were students prompted to answer the questions?
 - **What type of feedback** was provided to students' answers?

Question TYPE	Question PLACEMENT	Question FEEDBACK
1. Multiple Choice	1. Pre-questions (all at start)	1. None
2. Open Response	2. Post-questions (all at end)	2. Accuracy
3. Control (no questions)	3. Interspersed	3. Detailed
	4. Control (no questions)	4. Targeted
		5. Control (no questions)

- For each video, students were randomly assigned to condition
 - Over 10 weeks, most students experienced each condition at least once



Module & Testing Schedule

Week	PLACEMENT manipulation	FEEDBACK manipulation	TYPE manipulation	Test(s)
0			Lec 1: Foundations of Cog Psy	Prior knowledge survey
1	Lec 2: Neuroanatomy	Lec 3: Neuronal communication	Lec 4: Neuroimaging	Quiz 1
2	Lec 5: Visual System	Lec 6: Perception	Lec 7: Recognizing Objects	Quiz 2
3	Lec 8: Selective Attention	Lec 9: Feature Integration	Lec 10: Divided Attention	Quiz 3 + Exam 1
4	Lec 11: Intro to Memory	Lec 12: Working Memory	Lec 13: Memory Encoding	Quiz 4
5	Lec 14: Memory Retrieval	Lec 15: Memory Errors	Lec 16: Forgetting	Quiz 5
6	Lec 17: Concepts & Categories	Lec 18: Theories of Categorization	Lec 19: Knowledge Networks	Quiz 6 + Exam 2
7	20: Intro to Language	Lec 21: Language Structure	Lec 22: Language & Thought	Quiz 7
8	23: Mental Imagery	Lec 24: Propositional Representations	Lec 25: Dual Coding	Quiz 8
9	26: Judgment	Lec 27: Reasoning	Lec 28: Decision Making	Quiz 9
10	29: Problem Solving	Lec 30: Creativity	Lec 31: Expertise & Intelligence	Quiz 10 Final Exam



Video Module Design

UC San Diego
Local Impact, National Influence, Global Reach

UC San Diego
Local Impact, National Influence, Global Reach

UC San Diego
Local Impact, National Influence, Global Reach

This video contains interactive questions interspersed throughout the video. Do your best to answer each question as it appears. You will be able to test your knowledge in the practice quiz.

When you are finished watching the video, click the "next" button below to advance to the practice quiz. You will NOT be able to backtrack through the module so don't move on to the quiz until you've finished watching the video!

Which statement about the eye is false?

- The retina in the back of the eye translate the physical stimulus of light into a neural stimulus in a process called transduction
- The cornea and lens bend light to enter the eye
- The iris is a muscle that that stretches and compresses the lens and pupil
- All of the above are true

SUBMIT

UC San Diego
Local Impact, National Influence, Global Reach

UC San Diego
Local Impact, National Influence, Global Reach

UC San Diego
Local Impact, National Influence, Global Reach

UC San Diego
Local Impact, National Influence, Global Reach

We thank you for your time spent taking this survey.
Your response has been recorded.

7/9 **77.8%**

What kind of stimulus does an on-center/off-surround ganglion cell prefer? **1/1**

✓ A dot of light surrounded by darkness
A vertically oriented edge
A dot of darkness surrounded by light
A horizontally oriented edge

What type of neuron produces the lateral inhibition that leads to visual "edge enhancement"? **0/1**

Cones
Bipolar cells
Rods
✗ Ganglion cells

What causes a neuron in V1 to fire at its maximum rate? **1/1**

When any edge orientation is presented in a specific part of the visual field
When its preferred edge orientation is presented anywhere in the visual field
✓ When its preferred edge orientation is presented in a specific part of the visual field
When any edge orientation is presented anywhere in the visual field



Outcome measures & analysis plan

- **Immediate posttest (participation coursework):**

- Module quizzes: 3 short answer + 5-9 multiple choice
- Module ratings:
 - How much did you like this module?
 - How much do you feel you learned from this module?
 - How much of the lesson content did you know before watching the video?
 - Did you read the textbook chapter prior to watching this video?

- **Delayed posttests (graded coursework):**

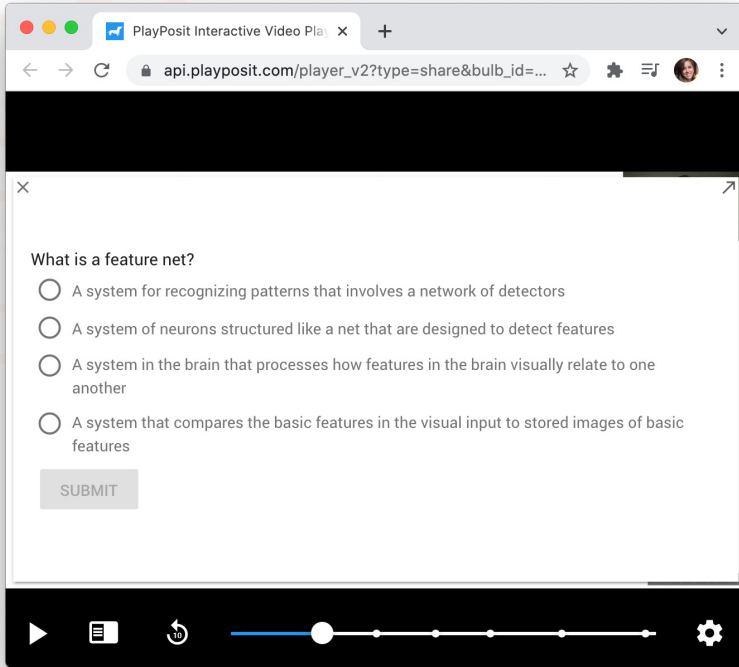
- Weekly quizzes (10): 10 multiple-choice questions, covering 3 modules
- Midterm Exams (2): 30 multiple choice questions, covering 3-4 weeks (~10 modules)
- Final exam (1): 50 multiple choice questions, covering all 10 weeks (31 modules)

- **For each manipulation, we fit a linear mixed model with:**

- manipulation as a fixed effect
- subject and lecture as random effects
- prior knowledge rating as a covariate



Question Type Manipulation



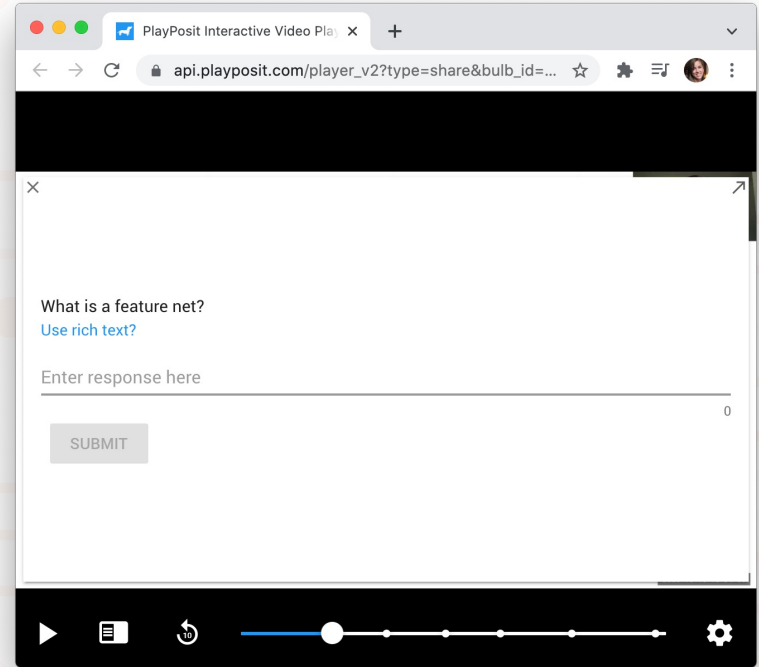
api.playposit.com/player_v2?type=share&bulb_id=...

What is a feature net?

- A system for recognizing patterns that involves a network of detectors
- A system of neurons structured like a net that are designed to detect features
- A system in the brain that processes how features in the brain visually relate to one another
- A system that compares the basic features in the visual input to stored images of basic features

SUBMIT

This screenshot shows a PlayPosit interactive video player interface. The browser address bar displays the URL 'api.playposit.com/player_v2?type=share&bulb_id=...'. The main content area contains a question: 'What is a feature net?'. Below the question are four radio button options. At the bottom of the question area is a 'SUBMIT' button. The video player controls at the bottom include a play button, a list icon, a refresh icon, a progress bar, and a settings gear icon.



api.playposit.com/player_v2?type=share&bulb_id=...

What is a feature net?
[Use rich text?](#)

Enter response here

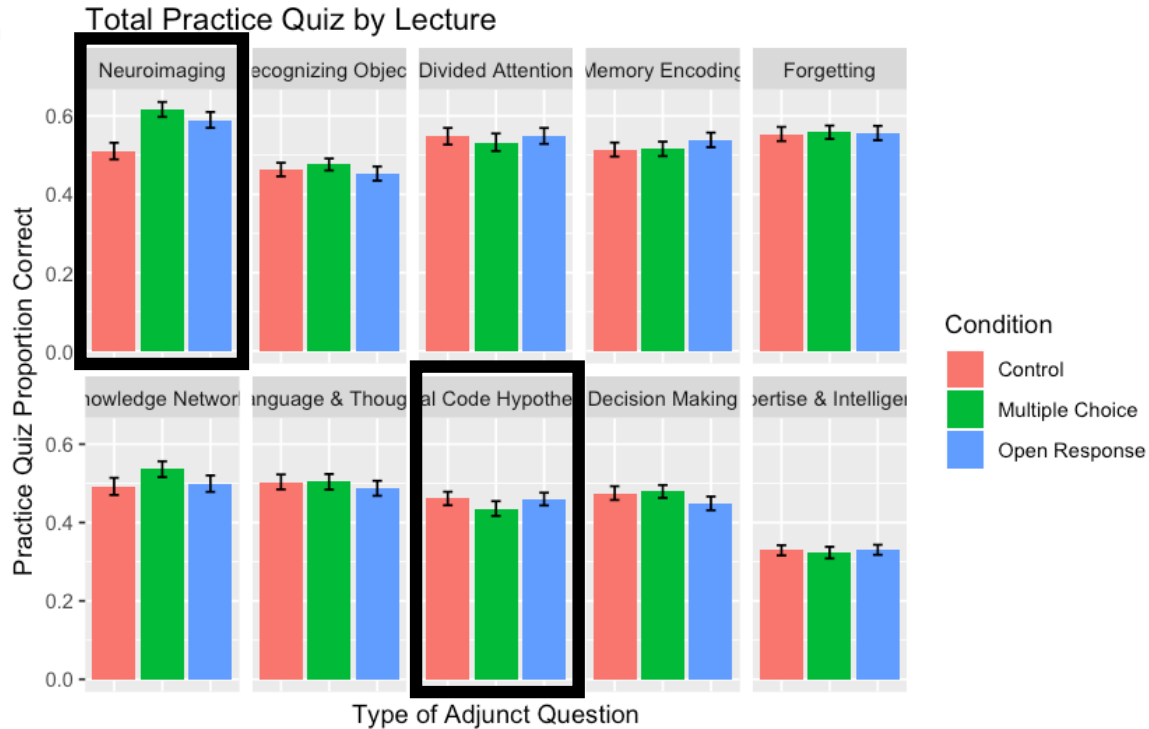
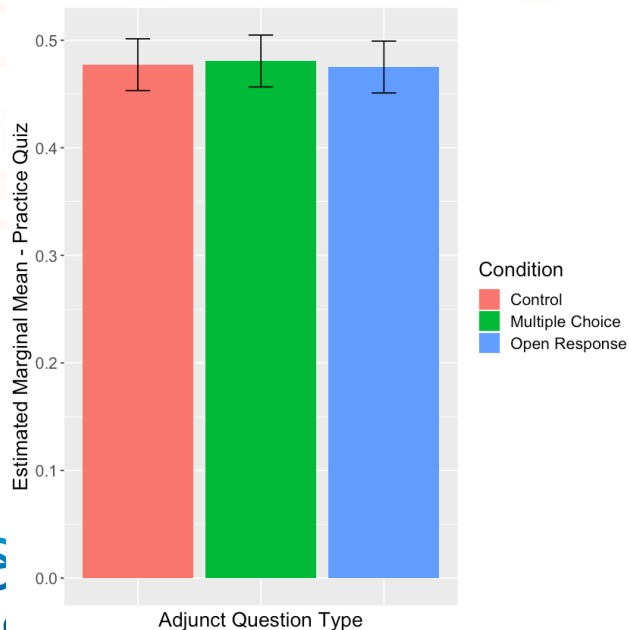
SUBMIT

This screenshot shows the same PlayPosit interactive video player interface. The browser address bar displays the URL 'api.playposit.com/player_v2?type=share&bulb_id=...'. The main content area contains the same question: 'What is a feature net?'. Below the question is a link that says 'Use rich text?'. Underneath is a text input field with the placeholder text 'Enter response here' and a character count of '0'. At the bottom of the input area is a 'SUBMIT' button. The video player controls at the bottom are identical to the first screenshot.



Question Type did not significantly affect practice quiz performance

No significant effect of
Type: $X^2(2)=0.839, p=0.657$



Question Placement Manipulation

Interspersed

Pre-questions

Post-questions

The image displays three overlapping browser windows, each showing a video player interface for a video titled "RECEPTIVE FIELDS". The video content includes text and a diagram of a visual field. The diagram shows a blue rectangle representing the visual field with a white dot in the center, and lines extending from the dot to a brain icon labeled "neuron in V1".

The three windows illustrate different question placement strategies:

- Interspersed:** The video player shows the video content with a question mark icon in the bottom right corner of the player interface.
- Pre-questions:** The video player shows the video content with a question mark icon in the bottom right corner of the player interface.
- Post-questions:** The video player shows the video content with a question mark icon in the bottom right corner of the player interface.

Each window also shows a video player control bar at the bottom with a play button, a progress bar, and a question mark icon. The question mark icon is highlighted with a yellow circle in each window.

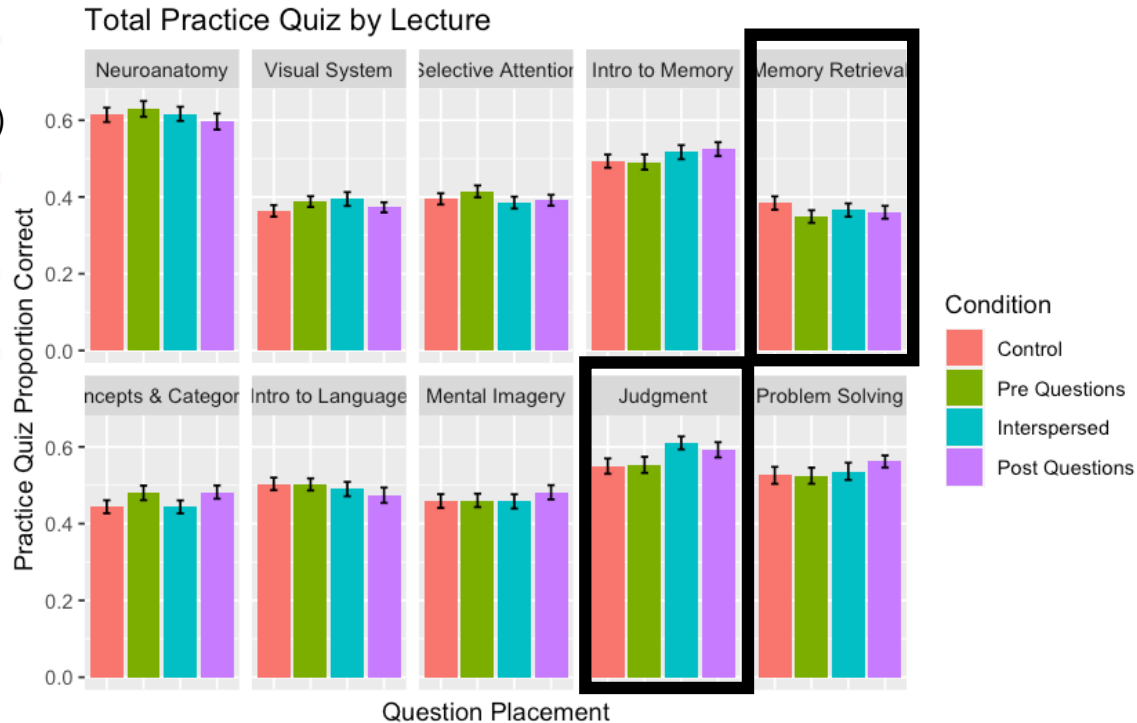
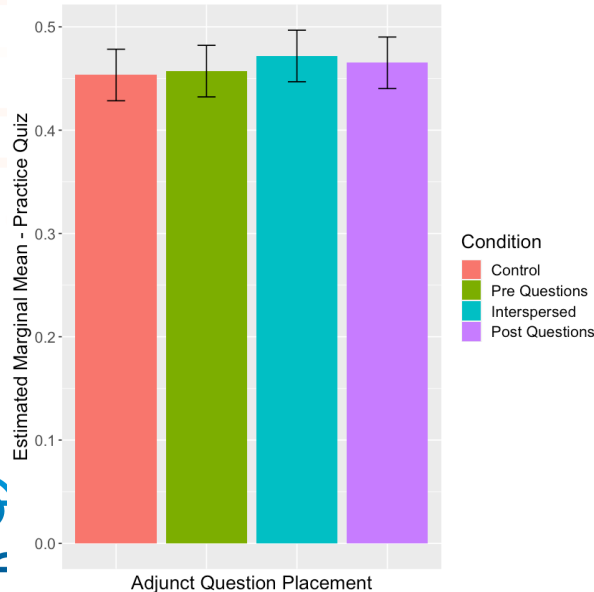


A small but “reliable” benefit for interspersing questions throughout the video

Significant effect of Placement:

$\chi^2(3)=11.977, p=0.007$

- Interspersed $\sim 2\%$ > control ($p=0.008$)
- Interspersed $\sim 1\%$ > pre-questions ($p=0.060$)



Question Feedback Manipulation

No Feedback

Which Gestalt principle describes our tendency as belonging together?

- Proximity
- Good Continuation
- Simplicity
- Closure

0 / 1 pts

Accuracy

Which Gestalt principle describes our tendency as belonging together?

- Proximity
- Correct
- Good Continuation
- Simplicity
- Closure

0 / 1 pts

Detailed

Which Gestalt principle describes our tendency as belonging together?

- Proximity
- Correct
- Good Continuation
- Simplicity
- Closure

Incorrect

Proximity is the best answer here because it based on how close they are to one another, perceive an object as continuing behind and separate objects. Simplicity is a preference possible. Closure is a tendency to perceive c

0 / 1 pts

Targeted

Which Gestalt principle describes our tendency to perceive stimuli that are close together as belonging together?

- Proximity
- Correct
- Good Continuation
- Simplicity
- Closure

Incorrect!

Incorrect

Proximity is the best answer here because it indicates that we interpret things in groups based on how close they are to one another. Simplicity is a preference to interpret a form in the simplest way possible.

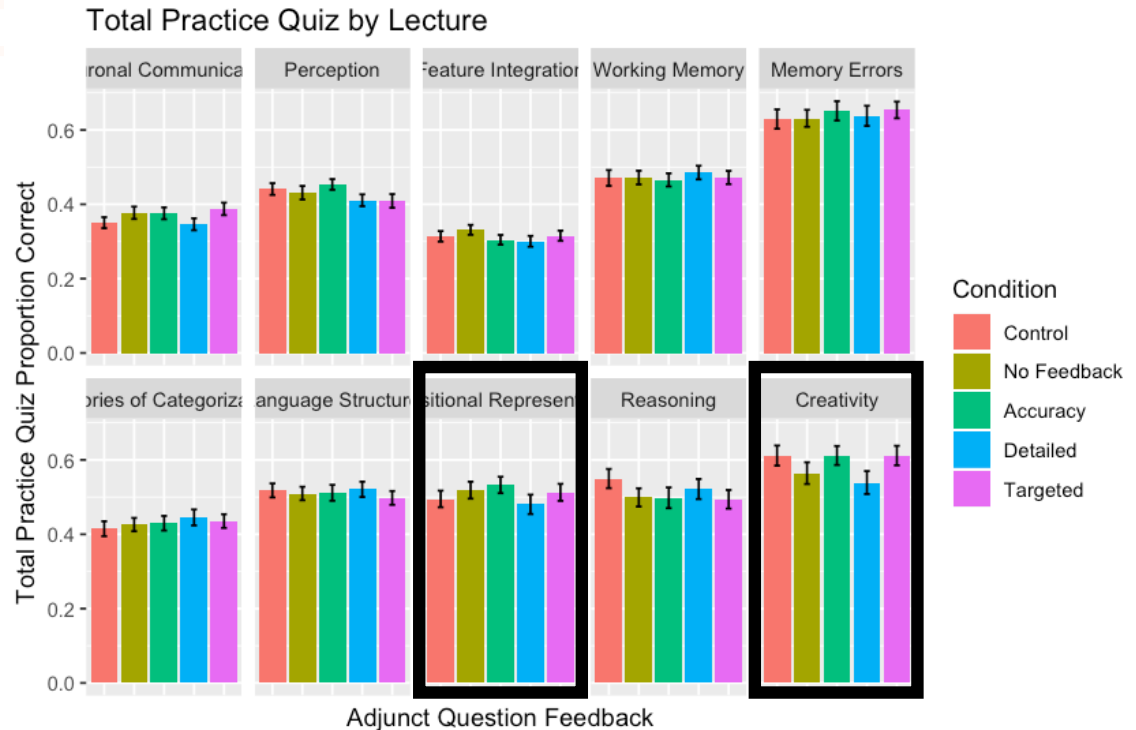
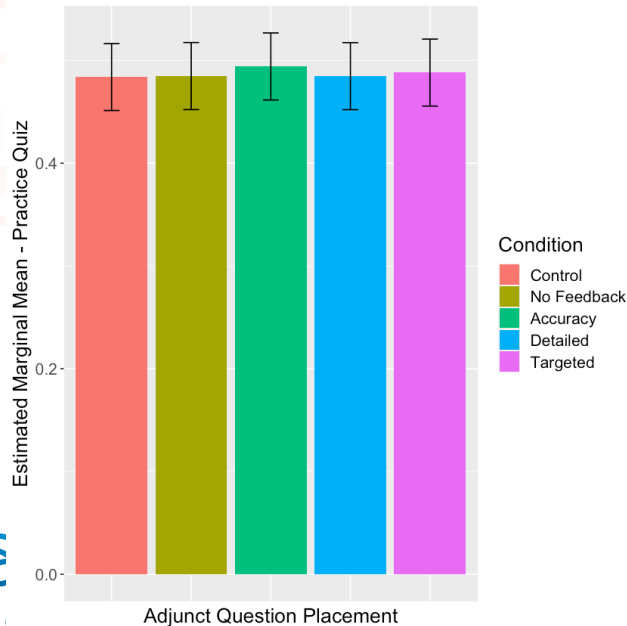
0 / 1 pts

CONTINUE



Question Feedback did not significantly affect practice quiz performance

No significant effect of Feedback:
 $\chi^2(4)=0.715, p=0.949$



Conclusions

1. Do adjunct questions improve learning from a video lesson relative to a control video with no adjunct questions?

Sometimes, but not always

2. Does the effectiveness of adjunct questions depend on their format, placement, or the type of feedback provided?

In this study: Type & Feedback – NO, Placement – YES but small

3. Is the effect of adjunct questions consistent across many different lectures?

No! There is major variability across lecture topics



Limitations & Future Directions

- Analysis of delayed posttest outcomes (quizzes & exams) is limited by ceiling effects and the small number of items per lecture on each test
- We have not reported variability across prior knowledge here, but that is likely to be an important moderating factor
- The manipulations in this study were likely “muddied” as students proceeded through the course and experienced more conditions
- Follow-up studies from Summer 2021 and Fall 2021 focus on manipulations that persist over longer stretches of assignments, with more sensitive tests



Thank You

- Lucinda Yu
- Daniela Rodriguez
- Catherine Kuh
- Ayesha Kabir
- Harper Estus
- Julie Eitzen
- Jiawen Zhang
- Xin Yang
- Natalia Pallis-Hassani
- Shoshannah Bobritsky



Center for Advancing
Multidisciplinary Scholarship
for Excellence in Education

LIME LAB UCSD

HOME PROJECTS PEOPLE PUBLICATIONS CONTACT US

ONLINE EDUCATION

24/7

LIME Lab at UCSD

LEARNING AND INSTRUCTION IN MULTIMEDIA ENVIRONMENTS

The LIME lab at UCSD studies tools and techniques that can be used to improve learning and instruction.

Directed by Dr. Emma H. Geller, we are especially interested in projects that help students understand and apply important topics in math and science. We want to make learning better for all students!

#psynom21