California State University Monterey Bay

Retrieval Practice:

Limiting Learning by "Teaching to the Test" or Generalizing Knowledge by Facilitating Memory Recall

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Prior Research

Cognitive Science has been promising as a "disruptive technology" for education. The application of modern scientific understanding of cognitive processes may lead to qualitative improvement in students' learning (e.g., LearningScientists.org). Among the techniques suggested for improving learning is "retrieval practice" (e.g., RetrievalPractice.org).

"Retrieval Practice" is a study strategy suggested by Cognitive Science to enhance learning. Rather than only recalling from memory during assessment, students retrieve concepts during learning (e.g., clickers, flashcards, practice tests).

Study Design

Some classes received practice tests for 2nd and 3rd test (Quasi-Experimental Design).

Time allocated in class to complete, discuss in small groups, and review correct answers as a class.

Emphasized to students that practice was only a *sample* of test topics to aid studying, but was not comprehensive.

Practice test items were classified as forced-choice or free-response. Test items were classified as on the practice test or not. Test items covered on practice test were classified as either identical in content or requiring transfer. Only objective test items that were identical for all classes were included in analyses.

Preliminary Analyses

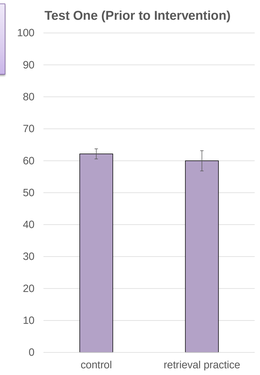
Retrieval practice classes do not differ from control classes prior to intervention.

Gender:
$X^2(1) = 3.862$, p=.070

Under-represented Minorities:
$X^2(1) = 0.233$, p=.646

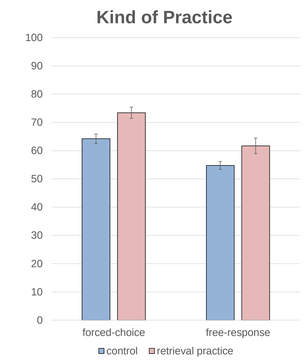
Attendance:
$t(94) = 1.277$, p=.205

Test One (Prior to Intervention):
$t(94) = 0.686$, p = .543



Kind of Practice

Retrieval practice works on topics practiced, regardless of if practice required specific responses or broader free-response.



Extension of Research

There are now dozens of published peer-reviewed studies of the technique. Most cognitive research creates tightly controlled 'classroom' analogs with experimental manipulation of the precise material to be learned, retrieved, and assessed (e.g., Uner & Roediger, 2017).

One concern about retrieval practice is that it may be nothing more than "teaching to the test" so improved test performance does not really show increased learning. Studies published to date defend retrieval practice. For example, in one study students recalled a definition and an example of the concept, and this led to greater ability to identify another example on the assessment (Finn et al., 2017). However, I worry that when the assessment so closely matches the practice, it is not genuine evidence of deeper learning.

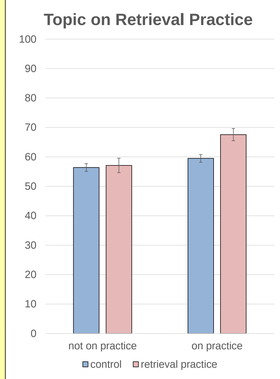
Free-Response & Base

Compare and contrast Ajzen's Theory of Planned Behavior vs. Fazio's Attitude to Behavior Process Model. How are they similar? How are they different?

Which of the following best contrasts the difference between Ajzen's model and Fazio's model of attitude-behavior consistency
- A. deliberate vs. spontaneous
- B. specific vs. general
- C. external vs. internal
- D. general vs. specific
- E. dual-process vs. mono-process

A ***free-response*** practice item required knowing the key difference between two models of the link between attitude and behavior. The test item required the exact ***same understanding***.

Tested Concept on Practice



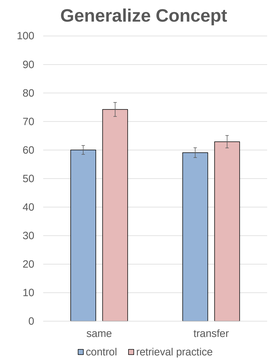
Retrieval practice aids test performance, but only for practiced concepts.

Retrieval Practice :
$F(1,94) = 3.621$, p = .060

Topic on Practice:
$F(1,94) = 63.897$, $p < .0005$

Retr. Practice * On Practice:
$F(1,94) = 18.890$, $p < .0005$

Conceptual Transfer



Retrieval practice works especially when the test question is specifically the use of the concept practiced, but it is not particularly effective with conceptual transfer.

Participants

98 students in *Social Psychology*
- 66% women
- 70% ethnic minority
- 71% first in family to attend a 4 year college
- 63% junior & 37% senior

Forced-Choice & Transfer

Match the special case to broad kind.

____ Anchoring	W. Conformity
____ Blaming the Victim	X. Framing
____ Conjunction Fallacy	Y. Just World Hypothesis
____ Pluralistic Ignorance	Z. Representativeness Heuristic

A ***forced-choice*** practice item required knowing *anchoring* is a kind of *framing*. The test item required a ***conceptual transfer*** to identify a use of anchoring for persuasion.

How many horses have the power of 1 horsepower? That's right. About 1.5 horses! What? James Watt, for whom the modern scientific unit for power is named (i.e., Watt), invented some of the earliest steam car engines. He created the unit "horsepower" that we still use today to describe engines. So why define "horsepower" incorrectly? When selling his early engines he would have 2 horses drawing a carriage compete against his 2 horsepower engine for a "horseless carriage" (i.e., car). Invariably his engine would win (being the equivalent of 3 horses) and investors watching the race were quite impressed. Before the race, Watt gave them the expectation that his engine was comparable to a 2 horse-drawn carriage and exceeding that expectation helped him promote his engine. Watt was using the psychological process of ___ to sell his engine.

- A. social cognition
- B. anchoring
- C. negativity bias
- D. counterfactual reasoning
- E. priming

Repeated-Measure ANOVA

2 (retrieval practice) * 2 (Practice Kind: forced-choice vs. free-response) * 2 (Concept Transfer: no vs. generalize) Repeated-Measure ANOVA to predict percent of test items correct.

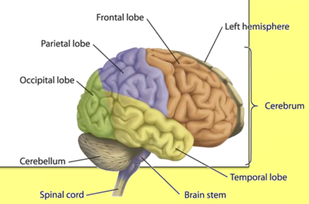
Retrieval Practice:	$F(1,94) = 13.411$, $p < .0005$
Practice Kind:	$F(1,94) = 76.148$, $p < .0005$
Test Item Transfer:	$F(1,94) = 28.542$, $p < .0005$
Retrieval Practice * Practice Kind:	$F(1,94) = 1.178$, $p = .281$
Retrieval Practice * Test Item Transfer:	$F(1,94) = 11.219$, $p = .001$
Practice Kind * Test Item Transfer:	$F(1,94) = 2.479$, $p = .119$
Three-way Interaction:	$F(1,94) = 5.335$, $p < .023$

Conclusion

Retrieval practice works well for teaching specific content that needs to be used in anticipated ways (e.g., Name the four lobes of the brain and their functions).

Retrieval practice did not aid with deeper learning, such as flexible transfer of knowledge.

Sharing results of a retrieval practice activity and test performance with students may provide an opportunity to teach students about study skills (future direction).



Citation and Abstract

Cognitive Science has been promising as a "disruptive technology" for education. Just as social networking sites have reshaped our interactions, the application of modern scientific understanding of cognitive processes may lead to qualitative improvement in students' learning (e.g., LearningScientists.org). Among the techniques suggested for improving learning is "retrieval practice" (e.g., RetrievalPractice.org). Rather than only recalling from memory on tests, students can be asked to retrieve knowledge from memory as a strategy during learning - prior to assessment. There are now dozens of published peer-reviewed studies of the technique.

Most cognitive research creates tightly controlled 'classroom' analogs with experimental manipulation of the precise material to be learned, retrieved, and assessed (e.g., Uner & Roediger, 2017). In contrast, I conducted action research in upper-level college classes. I compared student performance on test items that were identical across semesters. To test the value of retrieval practice, I created practice tests for students to complete individually without notes, then discuss in small groups, and correct through class-wide discussion.

One concern about retrieval practice is that it may be nothing more than "teaching to the test" so improved test performance does not really show increased learning. Studies published to date defend retrieval practice. For example, in one study students recalled a definition and an example of the concept, and this led to greater ability to identify another example on the assessment (Finn et al., 2017). However, I worry that when the assessment so closely matches the practice, it is not genuine evidence of deeper learning. In my study, I purposely chose to include only half of the class concepts on the practice test to assess if students self-awareness during the practice test would encourage further studying. On the practice test, I made half of the items closed responses (e.g., matching) and half open-ended responses (e.g., short answer) to examine if the kind of retrieval matters. I also made half the items nearly the exact same use of the concept as the actual test item, and the other half required generalization of the concept.

I tested the hypotheses using inferential statistics and propose to showcase results with bar graphs that are understandable to educated laypersons without statistical expertise. Results showed that retrieval practice led students to have higher grades on tests, but the benefit was limited to only those concepts that the practice test covered. The practice test did not encourage better studying. I subsequently examined only items on the test that corresponded with items on the practice tests. Students performed better on the test if retrieval practice nearly exactly resembled the test regardless of it the practice test item was closed-ended or opened-ended. The practice test did not lead students to generalize understanding of concepts.

This study suggests retrieval practice aids students in doing better on tests. For this reason I intend to further examine its use, especially to "level the playing field" for students from under-privileged backgrounds who may have missed the opportunity to learn study strategies prior to college. Retrieval practice may best be combined with additional pedagogical techniques that are necessary to foster the deeper learning hoped for in college.

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