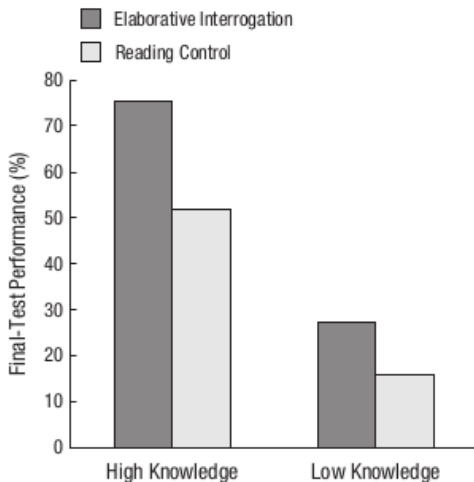# Study techniques: An empirical review

All of the following have been tried and tested. Only a few actually
work.

"elaborative interrogation"

When you read about a fact or concept, come up with an explanation for why it is true.

# elaborative interrogation: moderately useful

Fig. 1. Mean percentage of correct responses on a final test for learners with high or low domain knowledge who engaged in elaborative interrogation or in reading only during learning (in Woloshyn, Pressley, & Schneider, 1992). Standard errors are not available.

self explanation

Explaining to yourself how the new information you just learned is related to what you already know.

Or explaining to yourself the steps you take to solve the problem.

self explanation: moderately useful
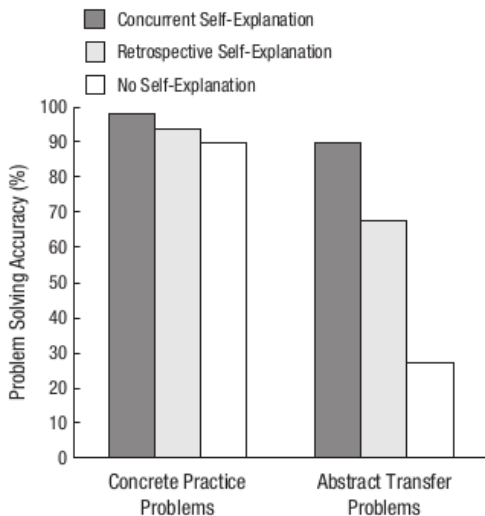
Fig. 2. Mean percentage of logical-reasoning problems answered correctly for concrete practice problems and subsequently administered abstract transfer problems in Berry (1983). During a practice phase, learners self-explained while solving each problem, self-explained after solving all problems, or were not prompted to engage in self-explanation. Standard errors are not available.

summarizing

Writing summaries of texts to be learned.

summarization: mixed results
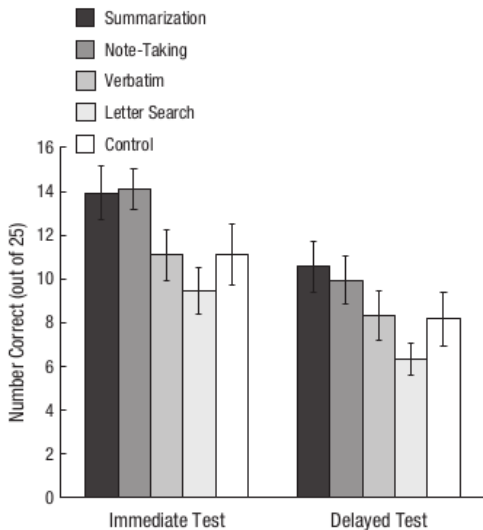
Fig. 3. Mean number of correct responses on a test occurring shortly after study as a function of test type (immediate or delayed) and learning condition in Bretzing and Kulhavy (1979). Error bars represent standard errors.

highlighting and underlining

highlighting: Marking potentially important portions of materials while reading

Easy to do, doesn't take much extra time. But does it help?

highlighting and underlining

A typical controlled test:

3 groups:

- highlight as you read
- read others' highlights
- no highlighting

Then given opportunity to review text the following week.

highlighting and underlining

A typical controlled test:

3 groups:

- ▶ highlight as you read
- ▶ read others' highlights
- ▶ no highlighting

Then given opportunity to review text the following week.

Did it help?

highlighting and underlining

A typical controlled test:
3 groups:

- highlight as you read
- read others' highlights
- no highlighting

Then given opportunity to review text the following week.

Did it help?
No (and may make it more difficult to make inferences, by focusing attention on individual concepts)

keyword mnemonic

Associating a new vocabulary word with a familiar word that can
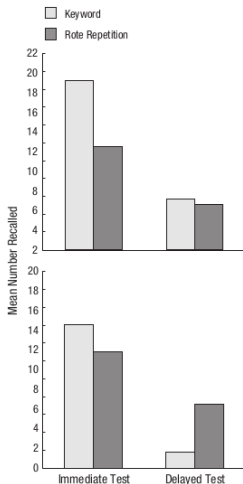be visualized

keyword mnemonic: not very useful

Fig. 4. Mean number of items correctly recalled on a cued-recall test occurring soon after study (immediate test) or 1 week after study (delayed test) in Wang, Thomas, and Ouellette (1992). Values in the top panel are from Experiment 1, and those in the bottom panel are from Experiment 3. Standard errors are not available.
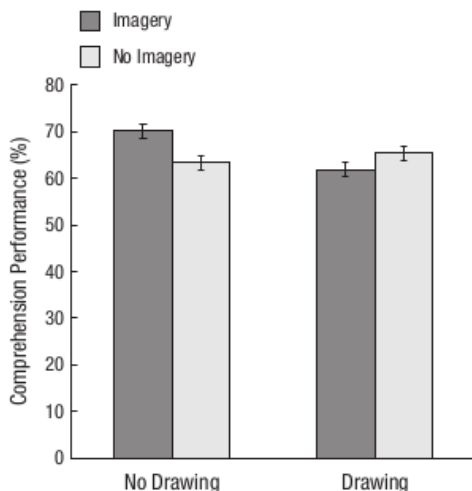
Works best where easy to find a keyword (nouns)

imagery for text

Forming mental images of text materials while reading or listening

Does visualizing while reading text help you remember the material?

Imagery for text: not very useful

Fig. 5. Accuracy on a multiple-choice exam in which answers had to be inferred from a text in Leutner, Leopold, and Sumfleth (2009). Participants either did or did not receive instructions to use imagery while reading, and either did or did not draw pictures to illustrate the content of the text. Error bars represent standard errors.

Rereading

Rereading: Restudying text material again after an initial reading

Rereading: not very useful
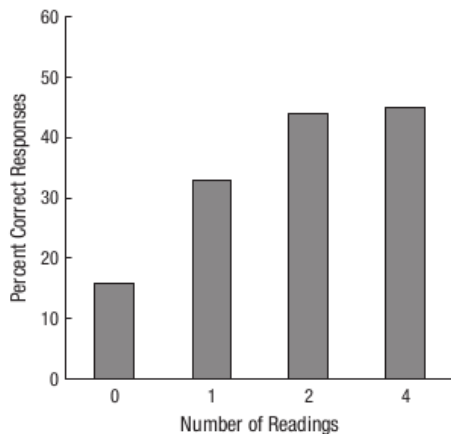
Fig. 6. Mean percentage of correct responses on a final cloze test for learners who read an expository text zero, one, two, or four times in Rothkopf (1968). Means shown are overall means for two conditions, one in which learners read a 1,500-word text and one in which learners read a 750-word text. Values are estimated from original figures in Rothkopf (1968). Standard errors are not available.

Practice testing

Practice testing: self-testing or taking practice tests over material to be learned

Practice testing: very useful!
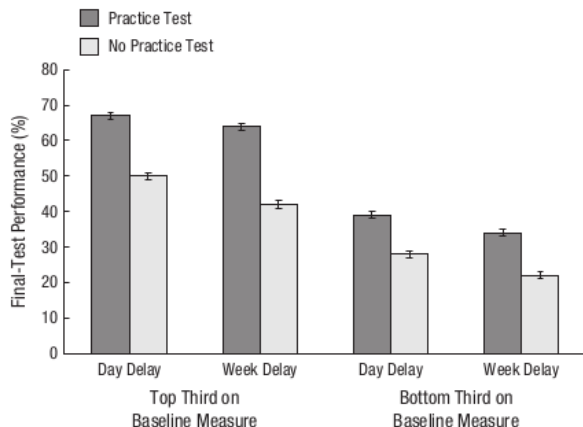
Fig. 7. Mean accuracy on a final test administered 1 day or 1 week after a learning session that either did or did not include a practice test, for the top and bottom thirds of scorers on a baseline measure of ability, in Spitzer (1939). Error bars represent standard errors.

Helps both good and poor students

Practic testing vs. re-study: very useful!
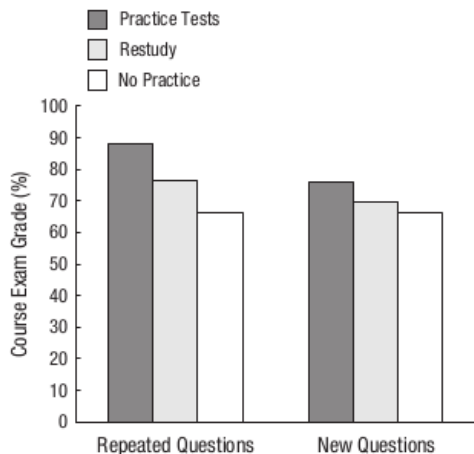
Fig. 9. Grades on course exams covering items that were presented for practice testing, presented for restudy, or not presented during online learning activities that students completed for course points. The course exam included some questions that had been presented during practice tests as well as new questions tapping the same information. For simplicity, outcomes reported here are collapsed across two experiments reported by McDaniel, Wildman, and Anderson (2012).

# Practic testing vs. re-study: very useful!
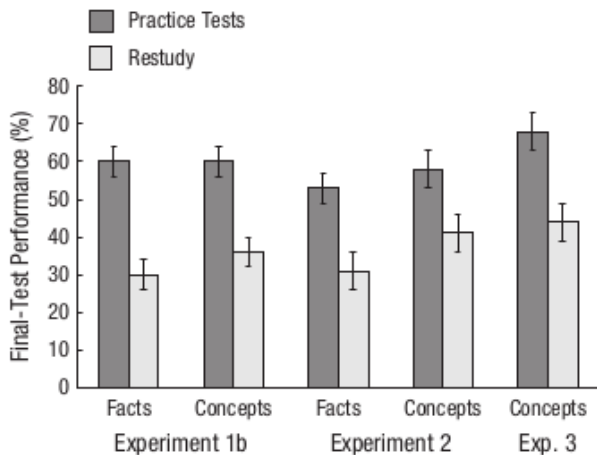
Fig. 8. Accuracy on final tests that consisted of inference-based transfer questions tapping key facts or concepts, administered 1 week after a learning session that involved either practice tests or restudy, in Butler (2010). Error bars represent standard errors.

Learned concepts transfer to other related questions

distributed practice

Distributed practice: Implementing a schedule of practice that spreads out study activities over time

Distributed practice: Very useful! (for long-term recall)
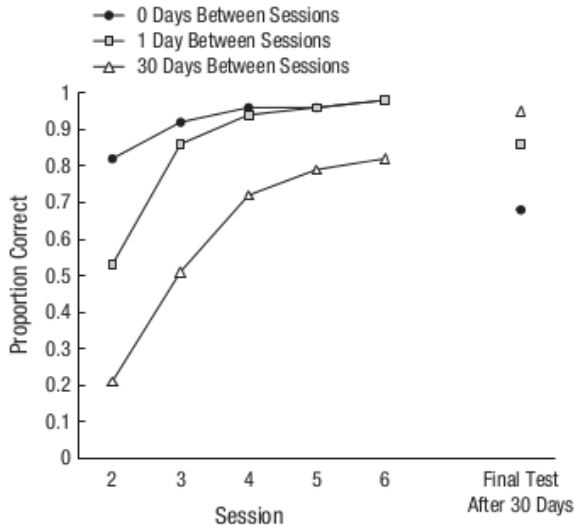
Fig. 10. Proportion of items answered correctly on an initial test administered in each of six practice sessions (prior to actual practice) and on the final test 30 days after the final practice session as a function of lag between sessions (0 days, 1 day, or 30 days) in Bahrick (1979).

Distributed practice: Very useful!
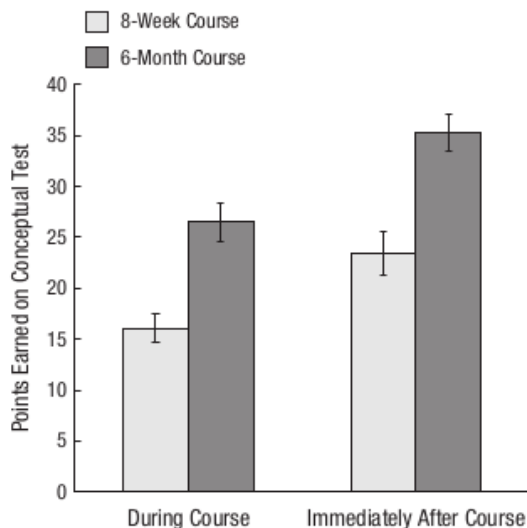
Fig. 11. Points earned on an open-ended test tapping conceptual understanding of content from two sections of a course, one taught over an 8-week period and the other taught over a 6-month period, in Budé, Imbos, van de Wiel, and Berger (2011). Error bars represent standard errors.

Interleaved practice

Mixing different kinds of problems or material within a single study session

Interleaved practice: Moderately useful, depends on the task
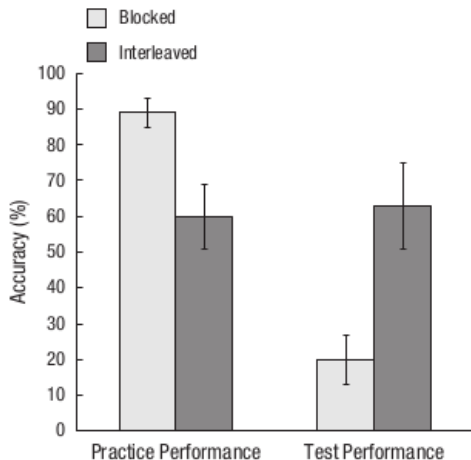
Fig. 13. Percentage of correct responses on sets of problems completed in practice sessions and on a delayed criterion test in Rohrer and Taylor (2007). Error bars represent standard errors.

Procrastination, deadlines, and performance
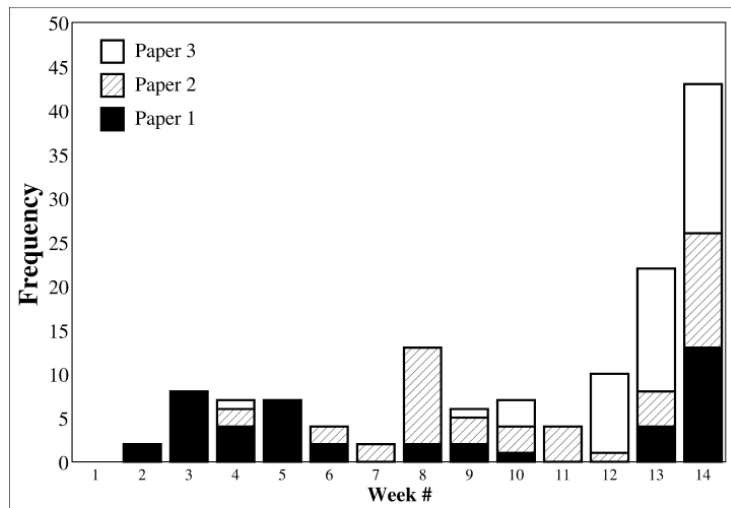
Fig. 1. Frequency distribution of the declared deadlines in Study 1 as a function of the week of class (Week 1 is the first week, and Week 14 the last week), plotted separately for the three papers.

from Ariely and Wertenbroch, Procrastination, deadlines, and performance: Self-Control by Precommitment. *Psychological Science* 2002
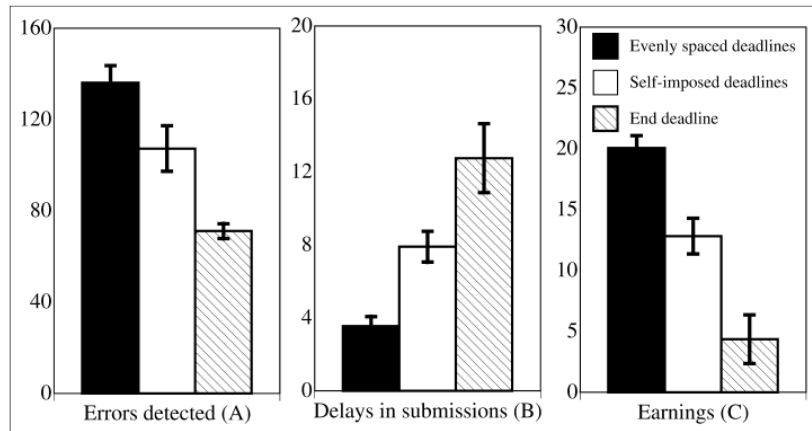
Procrastination, deadlines, and performance

Fig. 2. Mean errors detected (a), delays in submissions (b), and earnings (c) in Study 2, compared across the three conditions (error bars are based on standard errors). Delays are measured in days, earnings in dollars.