

How to Learn and Remember Information More Effectively: Applied Cognitive Psychology (revised 08-12-2021)

by

Robert Crutcher, University of Dayton

*Note: This is very much a work in progress. The first 3 pages are solid. After that, much of the material is new and need editing. I'm continuously revising and adding to this document. Eventually, I'll finalize it. Note that **MIS** is the book **Make It Stick***

Much of what we will talk about in class this semester has important implications for how you learn and remember academic material, including the material covered in this course. The following suggestions are based on solid research from cognitive psychology on human learning and memory. Some of these strategies you may already use; some you may never have tried. Properly applied these strategies will improve your learning and memory skills, but they are not magic tricks. You must apply them properly and systematically. Some strategies may not make complete sense until we've talked about them in their proper context, so as we move through the topics this semester, look back over these suggestions and make notes to yourself. I will touch on each of these at different points during the course of the semester as they become relevant.

These suggestions are relevant not only to this class but to all of your classes and to learning situations that you may face in the future (e.g. law school and medical school).

1. Actively apply the strategy of testing yourself on material you're trying to learn. An excellent way to do this is to look at the section headings and turn them into questions before you read each section. When you get to the end of the chapter see if you can answer your own questions. Save your questions and test yourself before the exam.

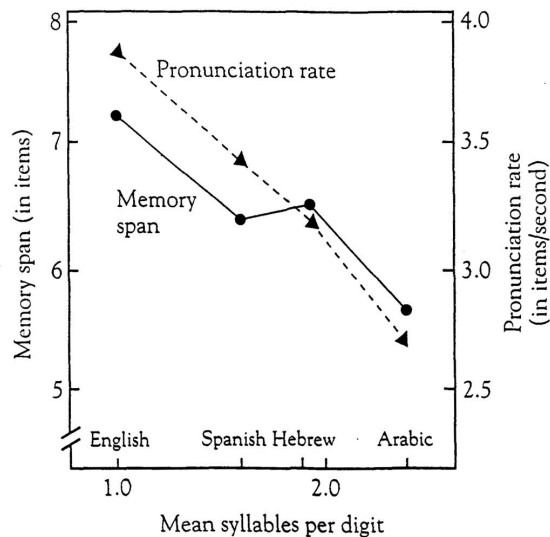
For example, you might look at the heading 'Theories of Object Recognition' and then write out the question 'What are the theories of Object Recognition?' You should do this before you read each section. When you get to the end of a section see if you can answer your questions. Save your questions and test yourself just before the test.

There is a large literature of research suggesting that *testing* yourself on material is much more effective than simply studying the material repeatedly (e.g. see Matlin's discussion of some of this research in Chapter 6 in the section on the Testing Effect).

2. Distributed practice is far superior to massed practice. If you wait until just before the test, you will not perform as well. Massed practice (or Cramming) only helps remember material for a short period of time; Distributed practice is much more effective in remembering material for longer intervals

3. Study figures and graphs and understand what they show. Ask yourself what does this graph show? What is the dependent variable? What is the independent variable? What model or theory does this graph support and how? For example, looking at the following figure ask yourself: “What does this graph show?” The answer is that average memory span (dependent variable) is a function of average number of syllables per digit (independent variable). In other words, memory span decreases for languages in which digits (the numbers 0-9) have more syllables on average and therefore take longer to pronounce. What theory is this evidence for? This is evidence for Baddeley's phonological loop component of working memory-- it supports the idea that the capacity limitation of short-term memory is one of time--i.e. digit span appears to be limited by how many digits one can say in about 2 seconds.

MEMORY SPAN AND PRONUNCIATION RATE FOR NUMBERS IN FOUR DIFFERENT LANGUAGES. NAVEH-BENJAMIN & AYRES (1986).



3. Organize and re-organize the material in various ways. Construct tables or graphs to organize the material. For example, construct a table of the characteristics of the sensory store, short term memory, and long-term memory. Include such characteristics as capacity, duration, etc Use the suggestions from the textbook and those that I have made in class about organizing the material from the chapters in a hierarchy or in a table or outline.

4. Define the terms at the end of each section and generate examples of the concept if relevant. Giving an example ensures you understand the concept and encourages you to elaborate on the material with your own knowledge (e.g. see Matlin's discussion of the 'self reference' effect). Elaboration leads to better retention. Do not simply retrieve the examples I used in class. Try to generate your own examples.

5. Remember what we've discussed about encoding specificity and transfer appropriate processing: one of the best ways to prepare for a test is to try to anticipate the type of retrieval (or test) environment—or in other words, the type of questions. What sorts of cues can you generate to remember the material? Re-reading the textbook or listening to an instructor present the material in class and concluding that you understand is not sufficient preparation for the exam. Ideally, you should TEST yourself on the material before hand, especially helpful is to test yourself in a way that anticipates or matches the test situation. The questions and topics provided on a study or review sheet (if there is one available) may help in this regard. For the topics mentioned try to convert each topic into some sort of question and answer the question. Work with another student: write out questions and test one another on the material.

One of the most common mistakes students make in studying for tests (e.g. in answering the questions on a review sheet) is to answer the study or review questions by copying the answers from their notes or the book. COPYING material will not help as much as actively testing your self on the material or remembering it and writing it down in your own words [Note: abundant research now shows that copying and re-reading are the MOST common strategy learners report using to learn material; and the research also show these are amongst the LEAST EFFECTIVE strategies for learning]. What this means is that you should try to write an answer to a question from memory. If you can't remember, look it up in the chapter or your notes, but don't just copy the answer down. Read it over, think about it, try to relate it to previous material or to what the instructor said in class, close the book (or your notes) and then try again to write out the answer in your own words. If you can't write the answer from memory, in *your own words*, you still don't have it mastered. Study some more and retest yourself.

Final Note: One of the things psychology students find challenging is that they must know many different models or theories and the details of the experiments that support these models. You should know what a particular model or theory claims and what sorts of evidence or experiments support it and how. You can't be vague about this.

08-12-21

New material from *Make it Stick: The Science of Successful Learning*, by Peter Brown, Henry L. Roediger III, and Mark A. McDaniel and my own Thoughts and Ideas:

Learning versus Memory.

When we don't know something, we must *learn* it. For example, I don't know how to play guitar so I have to learn. Learning requires exposure and experience. Acquire a skill for example (e.g. how to ski or play guitar or learn a list of unfamiliar terms -e.g. what is *cognitive psychology*?)

Memory is related but not the same as learning. Once we learn something, we want to *remember* it. For example, I want to remember a song I learned to play or definitions that I've learned (e.g. what is *cognitive psychology*?)

Ebbinghaus emphasized *learning* over *memory*. In other words, he chose unfamiliar nonsense syllables because the goal was to understand how new associations were formed. The formation of new associations is *learning*. Modern cognitive psychology in the 50s and 60s was placed more emphasis upon memory--e.g. how easy it is to learn something might be more a function of how well I remember the steps of a task. How well I learn the steps will be a function of what previous knowledge might be used to understand or remember the steps.

Some principles of learning:

1. To be useful, learning requires memory, so what we learn is still there later when we need it (*Make it Stick*)
2. We need to keep learning and remembering all our lives (*Make it Stick*)
3. Learning is an acquired skill, and the most effective strategies are often counterintuitive (MIS p. 2)

Principle Claims of Make It Stick:

1. Learning is deeper and more durable when it's effortful. (p. 3) [Easily learned, easily lost, we might say]
2. *We are poor judges of when we are learning well and when we are not.* When the going is harder and slower and it doesn't feel productive, we are drawn to strategies that we feel are more effective (e.g. cramming, repetition, and copying), unaware that gains from these strategies are often temporary.

3. Rereading text and massed practice of skills or new knowledge are by far the preferred study strategies of most learners. But they are also among the least productive strategies.

Massed practice -- intensive, repetitive practice (i.e. over and over rehearsing, *cramming*, for example)

Rereading and massed practice give rise to a *feeling of fluency*, which is taken as a sign of mastery. But for true mastery, such strategies are a waste of time

4. Retrieval practice -- recalling facts or concepts or events from memory--much more effective learning strategy than reviewing by rereading. (e.g. flashcards, or online learning technologies like Anki or Quizlet).

5. When you space out practice (distributed practice) and get a little rusty between sessions (or you interleave the practice of two or more subjects instead of blocking), retrieval is harder and feels less productive. However, the actual *effect* is longer lasting learning and more flexible learning. (p. 4 of Make It Stick).

6. Generally ***Interleaved practice*** or study is more effective than ***Blocked practice*** or study. It's more difficult but more effective. It feels less productive but produces deeper, longer lasting learning.

7. Desirable difficulty.

8. Trying to solve a problem before being taught the solution leads to better learning, even when you make errors in the process.

9. The popular notion that you learn better when you receive instruction in a form consistent with your ***preferred learning style*** (e.g. as an auditory or visual learner) is not supported by the empirical research. We do have multiple forms of intelligence but you learn better when you "go wide" (Make It Stick), drawing upon all of your aptitudes and resources, than when you limit instruction to one mode or style.

10. Underlying principles - pp. 4

11. Susceptible to illusions that hijack our judgment of what we know and don't, what we can or can't do -- testing helps overcome these illusions. (p. 4-5)

12. All new learning requires a foundation of prior knowledge. One way in which you do this is by elaboration. This happens when you grapple with material and relate it to what you know, when you struggle to explain the material in your own words--e.g. write out a definition in your own words, or give examples of a phenomenon or theory. When you can explain the concept to another person or relate it something else that you've learned.

Though a good instructor or teacher will try to help you do this, ultimately you have to do it for yourself because your knowledge is unique and different from everyone else's.

If you use mechanical repetition, you rapidly hit a limit to how much you can keep in mind or remember. However, if you use elaboration, there's no limit to how much you can learn.

13. When you go through a set of problems or examples to extract the rules or underlying principles that differentiate one problem from another, you'll be more successful in solving new problems in new situations. **Interleaved** and **varied** practice will be more effective therefore than *consistent* or *blocked* practice.

14. Making mistakes and correcting them is what leads to deeper, more advanced learning. (p. 7 of *Make It Stick*)

15. My point. Every time you learn something or successfully retrieve something you experience pleasure--that pleasure is in part the result of dopamine, a neurotransmitter, which strengthens (consolidates) learning. Think of it as the **pleasure principle**. The more struggle the greater the pleasure often times.

More Notes from Make It Stick:

Empirical Evidence versus Theory;

There's no shortage of ideas and advice about how to learn and remember better. We take in ideas from the internet, from teachers, friends, and our own intuition and experience. It's a mix of theory, lore, and intuition. (MIS) p. 8

Remember though that our own judgements (and those of others, including teachers) are often wrong. (like for example, the false sense of mastery that massed practice imparts) Partly because of how our minds work, how they make inferences [Maybe the book should begin with the topic of how our minds fool themselves -- cover some of K&T's heuristics -- e.g. anchoring effects, similarity heuristic, representative heuristic, etc.

Familiarity can fool us. What comes to mind easily. Remember the example that K&T gave of words that begin with a letter (e.g. 'K' versus say words that have 'k' as the 3rd letter).

Back to my point: The book begins with discussion of visual and cognitive illusions. Because these give show us that our minds are often inaccurate in making judgements and decisions.

When we read over material or look at our notes again (or reread the text) all of these activities give us the feeling of familiarity and make us feel we know the material. But **knowing** and **familiarity** aren't the same thing. I may hear your name and recognize it. The question is: Can I recall or recollect your name.

Retrieval Cues (The Encoding Specificity Principle). Much of memory works via cues. Contexts in which we learned the information. If we vary the context, we ensure that we are much more likely to remember the information.

Rereading textbooks is labor in vain (p. 10) yet it's the number 1 strategy of most people- including up to 80 percent of college students in some surveys. But rereading has 3 strikes against it:

1. It's time consuming
2. It doesn't result in durable memory
3. Often produces an illusory feeling of *mastery* b/c increased *familiarity* with the text feels like mastery.

Studies on reading and re-reading have shown very little benefit of re-reading when it is done in close proximity. More effective if there is a delay between the first reading and the re-reading (see pp. 14-15 of Make It Stick). Some studies show no benefit of all of re-reading immediately (p. 15) -- see the Washington Univ study

"What's the conclusion? It makes sense to reread a text once if there's been a meaningful lapse of time since the first reading, but doing multiple readings in close succession is a time-consuming study strategy that yields negligible benefits at the expense of much more effective strategies that take less time. Yet surveys of college students confirm what professors have long known: highlighting, underlining, and sustained poring over notes and texts are the most-used study strategies, by far." Make It Stick (p. 15). See note 10 below.

Illusions of Knowing:

Students work hard to capture the precise wording of what they're trying to learn, operating under the illusion that mastery equals the exact words rather than the *ideas*. But repeating what you've read is NOT the same as restating (in your own words) what you've read. (pp. 15-16)

This is a great passage from the book. This time I quote:

Too common is the experience of a college professor answering a knock on her office door only to find a first-year student in distress, asking to discuss his low grade on the first test in introductory psychology. How is it possible? He attended all the lectures and took diligent notes on them. He read the text and highlighted the critical passages.

How did he study for the test? she asks.

Well, he'd gone back and highlighted his notes, and then reviewed the highlighted notes and his highlighted text material several times until he felt he was thoroughly familiar with all of it. How could it be that he had pulled a D on the exam?

Had he used the set of key concepts in the back of each chapter to test himself? Could he look at a concept like "conditioned stimulus," define it, and use it in a paragraph? While he was reading, had he thought of converting the main points of the text into a series of questions and then later tried to answer them while he was studying? Had he at least rephrased the main ideas in his own words as he read? Had he tried to relate them to what he already knew? Had he looked for examples outside the text? The answer was no in every case.

He sees himself as the model student, diligent to a fault, but the truth is he doesn't know how to study effectively.

(Make It Stick, p. 16)

Testing: Dipstick versus Learning Tool

People often have a negative reaction to testing, thinking of it solely as a way to measure learning. They seldom think of it as a strategy or a technique to *enhance* learning. (p. 19 of MIS) [Yes, retrieval practice *strengthens* learning]

Important research finding is the power of active retrieval--testing--to strengthen memory; the more *effortful* the retrieval, the *stronger* the benefit.

[Consider comparing these findings to similar findings in the exercise research. Research now shows that short but very effortful bursts of exercise can be more beneficial than extended slow exercise--see the research studies cited by Gretchen Reynolds]

The Testing Effect (p. 28)

Remember what Ebbinghaus found for the forgetting curve? We forget 70% or more of what we've just learned within no time at all. The challenge of learning is to interrupt that *forgetting process*. [Think about the part that isn't forgotten--why isn't it forgotten? Likely because that's the item that has made a connection with something we know -- and that's what we must do with new learning: connect it and integrate it with what we already know.] p. 28

Testing effect or the Retrieval-Practice Effect (p. 28).

"To be most effective, retrieval must be repeated again and again, in spaced out sessions so that the recall, rather than becoming a mindless recitation, requires some cognitive effort. Repeated recall appears to help memory consolidate into a cohesive representation

in the brain and to strengthen and multiply the neural routes by which the knowledge can later be retrieved." (p. 28-29)

Citations from the Make IT Stick Book:

9. The experiment on how rereading does not produce much benefit in later retention is from A. A. Callender & M. A. McDaniel, The limited benefits of rereading educational texts, *Contemporary Educational Psychology* 34 (2009), 30–41. [Referenced on p. 14 of Make It Stick]

10. The survey showing that students prefer to reread as a study strategy is from Karpicke et al., Metacognitive strategies. Data were also taken from J. McCabe, Metacognitive awareness of learning strategies in undergraduates, *Memory & Cognition* 39 (2010), 462–476.

Brown, Peter C. (2014-04-14). *Make It Stick* (p. 258). Harvard University Press. Kindle Edition.