**Making it Stick (a.k.a. Remembering More Without Studying More)**

People tend to have a poor understanding of how our own learning and memory works.

* Cognitive psychologist would say that people tend to have “poor metacognition” (i.e.,we lack knowledge and awareness of our own cognitive processes)
* As a result, we often use ineffective strategies and avoid using effective strategies

**Common misconception #1:** Review-review-review = success

Many students highlight or underline information in the text and then focus their study by re-reading and reviewing those highlighted points.

It may seem that re-reading is leading to learning because when you review the information it increasingly feels familiar. The problem is that when you are re-reading the memory cue (i.e. the content you are studying) is right in front of you. Cues are helpful ways to remember information – but if the text won’t be in front of you when you are tested, it isn’t going to be a very good cue when you need it.

Reviewing information over and over is a form of rote repetition. The issue with this approach is that rote repetition does not guarantee comprehension. Coupled with the feeling of familiarity mentioned above, repetition can make it seem like you understand material when you actually only understand surface level details.

And finally, as the amount of information increases, the more likely you will confuse the information if you simply memorize it using rote repetition.

**Solution:** You should make sure that when you review, you are reviewing for **comprehension:**

Ask yourself questions about the material to ensure you understand the differences between concepts

Continue engaging with the material until you understand it

Ask questions of peers and your professor about the material to ensure you understand it

\*\*Keep in mind that it is rare for professors to ask you to simply reiterate material that you have learned. It is much more likely that you will be asked to apply the information you have learned to a new situation or scenario, or to integrate what you have learned in a new way. Successful application requires comprehension.

**Common Misconception #2:** Testing is an assessment tool, not a learning tool.

Most people tend to associate testing with assessment. It is a way to see how much information you have learned. However, recent research shows that testing is also a valuable learning tool.

When you answer a test question, or struggle to retrieve the answer to a test question, it encourages you think about the material in a different way. This means that you are creating new connections and context for the material, in addition to strengthening the memory for the material by activating it through the process of retrieval. This effectively strengthens the learning that is taking place.

In addition, testing yourself gives you immediate feedback about whether or not you can remember information or not. This can help you to focus additional study on the areas that you have difficulty remembering, instead of re-reviewing the information that has already been learned. Testing yourself also simulates the testing environment that you will experience on an exam, when you are asked to retrieve information without your usual cues (e.g., your textbook or notes in front of you).

A study by Roediger & Karpicke (2006) that examined the retention of information after repeated studying compared to studying followed by test found that retention at 1-week post-study was improved in the study-test group. (16% decrease in retention compared to 35% decrease in retention in the study-study group).



Don’t believe this is an effective strategy? You aren’t alone! When students are asked about effective study strategies, 54% list re-reading as a top strategy whereas only 1% report self-testing as the top strategy. This is an example of poor metacognitive abilities!

**Solution:** Instead of focusing energy on reviewing material by rereading, dedicate some of your study time to **self-testing:**

Ask yourself questions during study (without looking at the reading!!) For example, what is the key point? What did this study test and conclude? How does this relate to what we learned in class the day before? The day after?

 Make use of questions at the end of textbook chapters (or at the beginning of a section)

If you use flashcards, continue to quiz yourself until you master the material. Then trade flash cards with another student in the class to test yourself using their questions. If they phrase their questions differently it will give you practice with thinking about the material in a different way.

On your way to class, take a minute to recall what you learned in the previous lecture and what topics you remember well and what you don’t remember.

**Common Misconception #3:** Studying all at one time is more productive than spacing studying out.

Many students think that studying everything in a very concentrated, focused way is going to lead to better learning and retention than studying smaller amounts of information repeatedly over time. This is likely because students who cram for an exam have probably experienced success on the exam the next day. Where this strategy fails is if you hope to retain the information for a longer period of time (e.g., if you also need to know the information for the final exam).



This data is from Sobel et al., 2011. 5th grade students learned new vocabulary words with a one minute delay or a 1 week delay between study sessions. After 5 weeks, memory for the words was higher in the space (1 week delay) group.

**Solution:** Plan out your study habits to allow for **spaced retrieval**.

Initially keep the intervals between study close (e.g., review material before class, attend class, review material again after class) and then begin to self-test after time has elapsed (e.g., test yourself the following week). After you feel you understand and remember the material, test yourself again after a few weeks.

If you have a cumulative final exam, review your flashcards and notes from the first exam a few weeks after the exam to keep the material fresh in your mind.

Even though it may feel more difficult because you have forgotten information in the interim, you are building more lasting connections each time you re-test and subsequently re-learn the material.

**Common Misconception #4:** Focusing one’s attention on a single topic at one time is more productive than studying multiple topics.

Blocked practice in which you focus on a single subject (or concept within a single subject) at once gives the feeling that you are making greater gains than if you interleave your learning. Repeatedly studying the same thing makes it feel like the answers are easily accessible. But long-term retention is improved when we interleave our study between different topics.

Interleaving our study is essentially a form of spaced retrieval – focusing on something for a period of time, stepping away from it to study something else, and then returning back to the topic to assess our learning after a delay.

Mixing up problem-types and information also helps us to better differentiate between different types of problems and makes it easier to identify the differences in a testing or real-world application.

**Solution:** Set up your study time to interleave problems or concepts

Many textbooks are set up in structured blocks. Once you reach a point in which you understand a certain problem type or concept at a basic level, begin to mix that problem type/concept into your studying in a spaced way. Intermix your testing items with concepts from other chapters or sections. This will help challenge you to identify the concept even when it is intermixed with concepts that are not directly related.

**Other effective strategies:**

**Elaboration** – Finding additional connections to concepts or ideas to elaborate understanding and apply the concept to other domains. Examples include connecting the material to other content in the course, explaining the concept in one’s own words, or applying the concept to another domain outside of the class.

**Generation** – Attempting to answer questions or solving a problem before seeing the answer. Examples include trying to solve problems in the text before attending class and having it explained, or reviewing the upcoming concepts in a textbook and trying to apply current knowledge to anticipate connections that might be mentioned in the reading (e.g., I wonder if this will connect to X, Y or Z?)