

Notes on Effective Learning

Based on
make it stick

The Science of Successful Learning
Brown, Roediger & McDaniel, 2014

January 4, 2016

When you struggle with a problem, that's when you understand it.

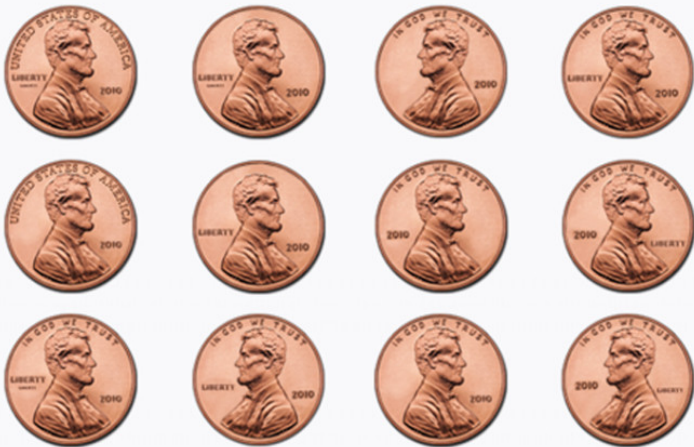
Anyone who struggled hard with a problem, never forgets it.

—Elon Musk
CEO, Tesla Motors, SpaceX

Learning: you're doing it wrong

- Learning is best when it's *effortful*.
- We are *poor judges* of when we are learning well.
- *Rereading text* gives little benefit but leads to false sense of mastery.
- *Massed practiced*, repeating something over and over until learned, rarely works.

Which penny is real?



Learning: doing it right

- *Retrieval practice* is far more effective.
- Flash cards are the simplest example.
- Trying to solve a problem yourself leads to better learning,
- ... even if you try before you know how
- ... even if errors are made

We are all susceptible to **illusions** of learning

- Rereading or highlighting the text gives the illusion of fluency.
- **Testing** helps calibrate our judgements.
- “Shooting an azimuth.”



"Mr. Osborne, may I be excused? My brain is full."

There is no known limit to the capacity for learning

- In 2010 Simon Reinhard memorized 300 random words in 15 minutes.
- In 2008 Ben Pridmore memorized 884 shuffled playing cards in 30 minutes.
- In 2010 Boris-Nikolai Konrad memorized 201 names and faces in 15 minutes.
- **Elaboration** is the practice of putting things in your own words and connecting it to what you already know.

Learning changes your brain

- Every time you learn something you **change your brain**.
- The hippocampus, important in long-term memory, actually creates new neurons throughout your life.
- But only if it has to.
- When learning is hard, you're doing important work.

The Testing Effect

- Tests: assessment vs. learning tool
- Aristotle: *exercise in repeatedly recalling a thing strengthens the memory*

An experiment

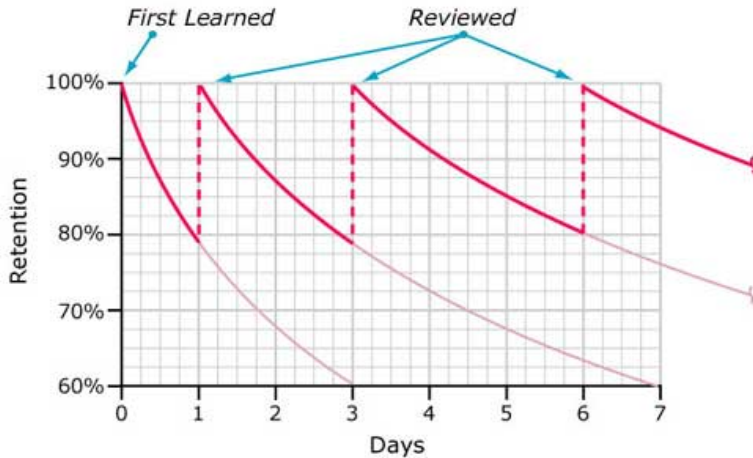
- Subjects were given passages to read.
- Some passages were immediately tested on.
- Other passages were reread.
- **Tested passages were remembered better.**

Another experiment

- Some subjects asked to memorize pairs like *foot-shoe*
- Others asked to memorize pairs like *foot-s__e*
- **Second group did substantially better.**

QUIZZING IS A LEARNING TOOL!

Typical Forgetting Curve for Newly Learned Information



How to practice retrieving from memory

- Quiz, quiz, quiz!
- Use flash cards: www.ankisrs.net
- Use Cornell note taking system
http:
[//lsc.cornell.edu/LSC_Resources/cornellsystem.pdf](http://lsc.cornell.edu/LSC_Resources/cornellsystem.pdf)
- Look up from the book and summarize
- Invent quiz questions as you read
- Don't listen to your intuition! Shoot an azimuth!
- Space out retrieval practice, no cramming.

Relate it to your own experience

Generation: Try to answer a problem before being shown the solution

Elaboration: Explain it in your own words and relate it to your own experience

Reflection: Write out essays on your learning

CHANGE YOUR WORDS— CHANGE YOUR MINDSET

I don't understand

What am I missing?

I give up.

I'LL USE SOME OF THE STRATEGIES I'VE LEARNED.

I made a mistake.

Mistakes help me improve.

This is too hard.

THIS MAY TAKE SOME TIME AND EFFORT.

It's good enough.

IS THIS REALLY MY BEST WORK?

I'll never be as smart as her.

I'm going to figure out what she does and try it.

I can't make this any better.

I can always improve; I'll keep trying!

I can't read

I'm going to train my brain in reading

I'm not good at this.

I'm on the right track.

*We are what we repeatedly do.
Excellence, then, is not an act, but a
habit.*

—Aristotle