Thank you for joining the Huberman Lab Podcast Neural Network—a once a month newsletter with science and science-related tools for everyday life.

For this newsletter, I want to provide you some actionable information in condensed form. It relates to a talk I recently gave (hosted by Logitech) for teachers, and students of all ages.

There were two goals of the lecture:

1. Provide an overview of the major discoveries on neuroplasticity and learning.
2. Share a "Neuroplasticity Super-Protocol" based on those discoveries, so that anyone can teach and learn anything more efficiently.

Note: This version of the "Neuroplasticity Super-Protocol" focuses on behavioral tools. If you want a description of the specific scientific references that support the steps listed below, please watch this video.

NEUROPLASTICITY SUPER-PROTOCOL

1. GET ALERT

We must be alert to trigger neuroplasticity (later, sleep completes the neuroplasticity/learning process). Getting alert involves many mechanisms but mainly the release of epinephrine (adrenaline) in the brain and body. One simple way to become more alert is 25-30 deep breaths (inhales through the nose, and exhales through the mouth). Then exhale your air and hold your breath with lungs empty for 15-60 seconds. Then inhale once and hold your breath. But don't force the breath hold; start to breathe normally immediately once you feel the impulse to breathe. Whether you rely on caffeine or not (I certainly do in the early portion of the day), try this prior to a learning bout.

2. GET FOCUSED

Mental focus follows visual focus. To increase your level of focus on the task you are about to do, stare at a point on a wall or screen, or object for 30-60 seconds before starting (You can blink as needed). You'll be surprised how this takes a bit of effort—that 'effort' you feel is "top-down" attentional engagement and reflects the activity of neural circuits involving acetylcholine release in the brain, and other mechanisms too of course. Then move into the task at hand. Expect your mental focus to flicker on

and off, especially at the start of a work/learning bout. [Obviously, having your phone off and out of the room and web browsers closed or limited to essential tabs only (or even better, the internet turned off) can help.]

3. GENERATE REPETITIONS

Perform the maximum number of repetitions you safely can in a given learning bout. For some types of learning, "repetitions" will be actual repeats of something- learning scales of music, for instance. We progress linearly for other types of learning by repeating the same process, such as reading or doing math problems. Regardless, the same principle holds; work to repeat the process a bit faster than is reflexive for you. This helps the mind from drifting off task and naturally keeps you alert. Will you make errors? Of course, which leads to #4.

4. EXPECT & EMBRACE ERRORS

Provided they don't comprise safety, errors during learning are terrific because they increase activation of the neural circuits that increase alertness. It makes sense, right? If you perform something correctly, why should your brain take notice? When we make errors, it feels "stressful," but that is just an increase in attention that puts us in a much better place to perform and execute learning-related behaviors the next trial—meaning on the next attempt. Computational modeling data suggests that an error rate of ~15% may be optimal and can help determine how difficult we should make a task. But don't worry too much about those specifics. Instead, keep doing repetitions and when you mess up, capitalize on it by doing another attempt (and another) while your forebrain is in that maximally attentive state.

5. INSERT MICRO-REST INTERVALS (AT RANDOM)

This is a non-obvious way to increase repetitions and learn faster. Studies (in humans) have shown that when we are trying to learn something, if we pause every so often for 10seconds and do nothing during the pause*,* neurons in the hippocampus and cortex—areas of the brain involved in learning and memory, engage the same patterns of neural activity that occurred during the actual activity of reading, musical practice, skill training, etc. but 10X faster—meaning you get 10X neural repetitions completed during the pause. These "gap-effects" are similar to what happens in a deep sleep. The takeaway: randomly introduce 10 second pauses during learning. "How often?" I get asked. A ratio of approximately 1 pause per every 2 minutes of learning is good but remember, distributed at random, so not every 2 minutes on the minute.

6. USE RANDOM INTERMITTENT REWARD

The neural circuits that control rewards (all of which are brain chemical rewards, by the way) are closely tethered to the circuits that control motivation and the desire to pursue things, including learning. The question of how often to reward ourselves or others in order to keep motivation high is simple: make it random and intermittent. This is what casinos do to keep people gambling. It works. Predictable rewards lose their motivational impact quickly.

7. LIMIT LEARNING SESSIONS TO 90 MINUTES

Solid research shows that 90 minutes is about the longest period we can expect to maintain intense focus and effort toward learning. Shorter bouts are fine but after ~90 minutes, take a break (see #8). Also, space intense learning bouts 2-3 (or more) hours apart. Most people can't do more than 270 minutes of intense learning bouts per day.

8. AFTER A LEARNING BOUT, DO A NSDR (NON-SLEEP DEEP REST) PROTOCOL

Two studies (on humans) published in the last 2 years show that shallow naps and/or NSDR can enhance the rate and depth of learning. This is an easy practice to incorporate. Within 1 hour of completing a learning bout, do a short NSDR protocol. You have options as to what NSDR you choose: Reveri is a zero-cost (research tested), self-hypnosis app, or take a brief 20 minute nap, or listen to an NSDR script such as Yoga Nidra (I like this 10 minute one and do it daily, or here is a longer 30 minute video that is excellent).

9. GET QUALITY & SUFFICIENTLY LONG DEEP SLEEP THAT NIGHT (& THE NEXT, & THE NEXT…)

The actual rewiring of neural circuits that underlies learning occurs during sleep and NSDR. Think of the learning bout as the "trigger" or stimulus for the possibility that we *might* learn, but sleep and NSDR are when the actual learning- the neural circuit rewiring, occurs. I did an entire episode (4 actually) of the Huberman Lab Podcast on mastering sleep. I provided a summary of key points in Neural Network Newsletter #1. Our goal should be to get sleep right at least 80% of the time—it takes some work to get there but it is well worth it.

FINAL NOTES

In the future, I will talk about the pharmacology of accelerated/deeper learning but remember that behavioral protocols like the ones listed here are necessary no matter what. You don't have to do all 9 every learning session (although numbers 1, 2, 9 are non-negotiable).

I'll be posting more on tools for neuroplasticity in the near future.

New episodes of The Huberman Lab Podcast are out each Monday on YouTube, Apple Podcasts, Spotify and other major podcast platforms. Please subscribe to those channels. We also launched a clips channel, where we'll post short segments from the episodes. I post additional science and science-based tools on Instagram and Twitter.

Thank you for your interest in science,
Andrew