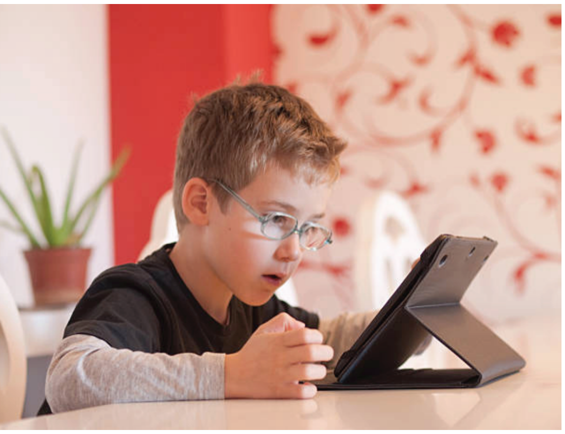


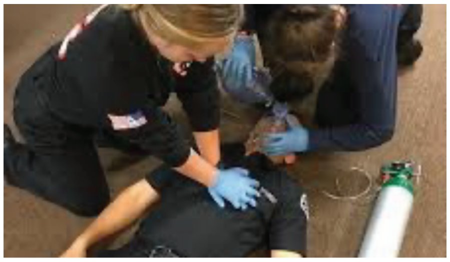
REDUCING SKILL FADE FOR STUDENTS WITH VISION IMPAIRMENTS

What is Skill Fade and Skill Retention?

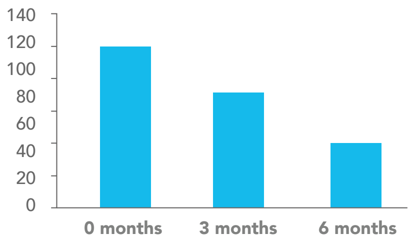
Skill Fade, or Skill Decay, occurs when a person does not use a skill often enough after they have been trained. While this can occur with any skill, such as those needed by surgeons or pilots, it's also a common problem for students. You spend weeks or months helping your student master an IEP goal or objective, only to discover months later that the student's use of the skill has deteriorated.

Skill Fade affects everyone. For example, researchers found that only a quarter of 120 First Responders were still proficient at CPR six months after training.

Skill Retention is the opposite of **Skill Fade**, and many researchers rely on learning theory cognitive architectures to improve Skill Retention.



First Responders still proficient at CPR



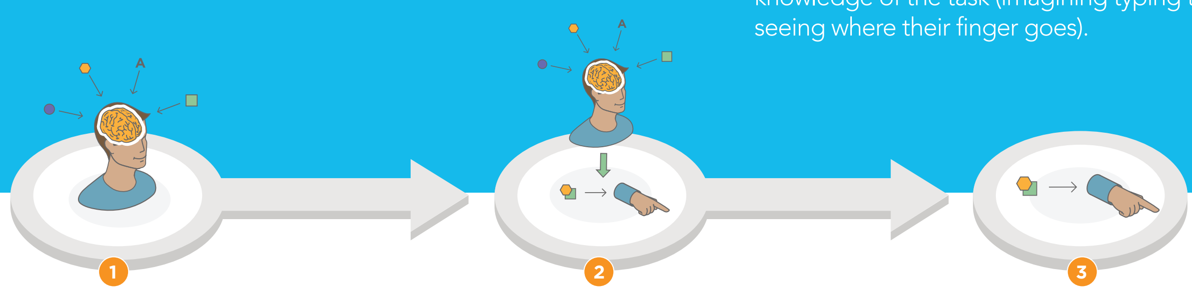
Learning Theory

Learning theory sheds light on how a person learns, and this theory can help us understand how to improve Skill Retention. One popular theory categorizes learning into three stages [1,2]:

1. Memorizing, where your responses are slow and error prone, leading to…
2. Where you start creating a "mental" learned procedure, and some of your responses are faster, leading to …
3. Procedularized knowledge, where your responses are fast and accurate.

Let's look at learning ***How to Type*** as an example of Skill Retention. When learning to type, a learner first **memorizes** the layout of the keyboard, and then uses the keyboard **procedurally** through practice.

Over several months or longer, the learner generally loses their **memorized** knowledge of the keyboard's layout but retains their **procedural** typing skills. Thus, once learned, few learners need to know where any given key is (i.e., where is the letter "r" on the keypad), but rather rely exclusively on their **procedularized** knowledge of the task (imagining typing the letter and seeing where their finger goes).



Stage 1
Memorization: Slow and lots of errors

Stage 2
Develop "Learned Procedure", sometimes rely on memorization: Faster, but some errors

Stage 3
Use the "Learned Procedure": Fast and accurate

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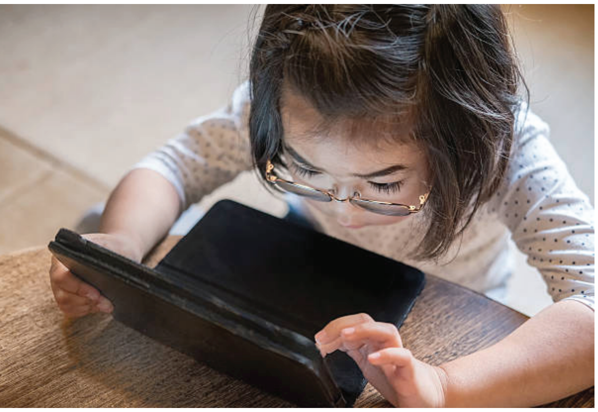
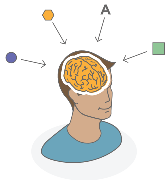
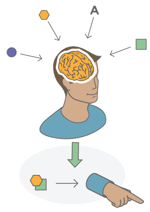


ACHIEVING BETTER SKILL RETENTION

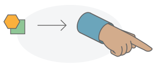
Using the basics of Skill Retention Theory can help guide how often you should reinforce skills with your students.



When your student is in the first stage (memorizing), their performance will improve with distributed practice, such as a little bit of practice once or twice a week over several weeks.



When your student's skill begins to really improve, they are in the second stage. Now your student needs continuous practice for several weeks.



After your student has improved to full mastery, now you need to shift to distributed practice (once a week, for example) to maintain the skill.

In general, the more widely spaced the training is, the longer the skills are maintained. In situations where the learner is experiencing skill fade, spaced training reduces the time needed for retraining.

Skill Retention Theory

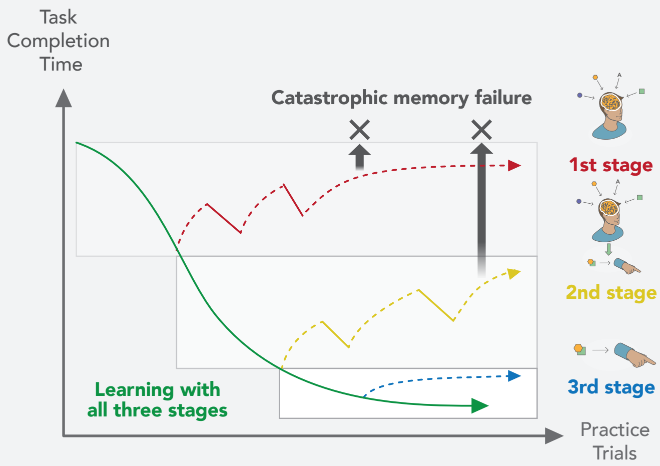
In the diagram on the right created by researchers [1], the GREEN line shows continuous skill practice. As you see, the time to complete the task gets faster and faster, as the learner continues to practice it.

The RED dashed line shows what happens when the learner stops practicing during the first stage of learning: memorization. Catastrophic memory failure occurs, and the learner must restart from the beginning.

The YELLOW dashed line shows what happens when the learner stops practicing at the second stage of learning: transition to procedural learning. There is significant forgetting, but the learner can resume with practice with some knowledge.

The BLUE dashed line shows what happens when the learner stops practicing during the third stage, procedural learning. Instead of catastrophic memory failure, use of the skill is slow but the prior level of mastery resumes quickly.

Learning theory can apply these ideas to reduce Skill Fade. It's a combination of the "Power Law of Learning" and the "Power Law of Forgetting". Mathematically, it looks like:



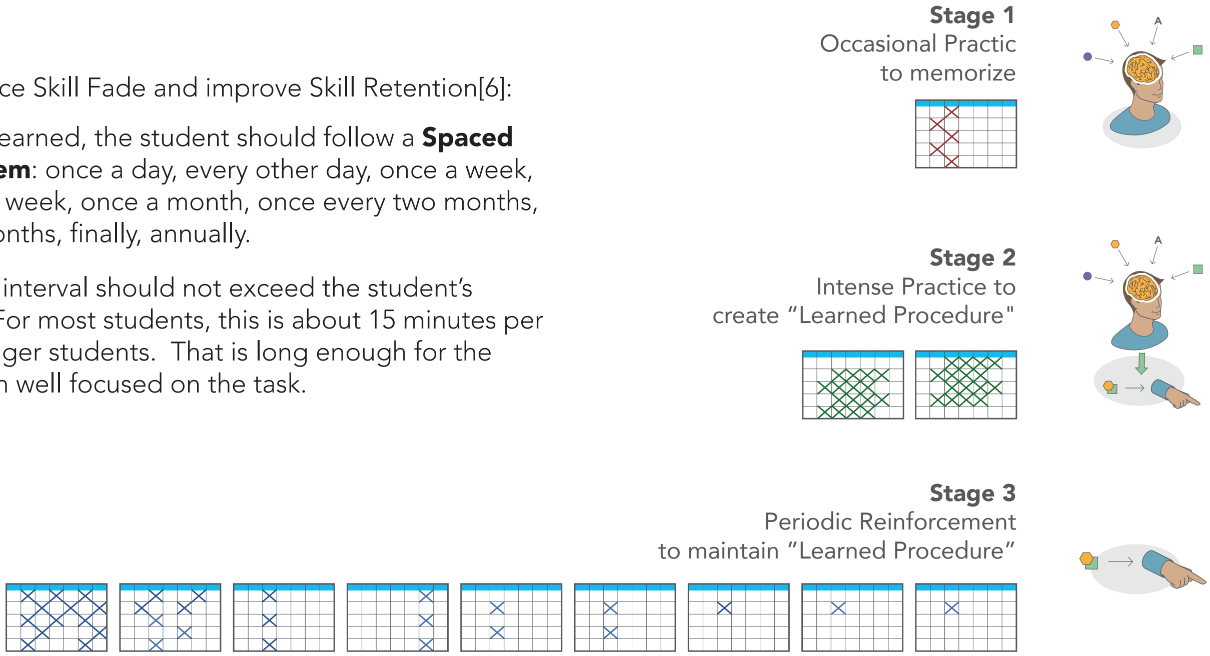
$$B_i = \beta + \ln\left(\sum_{j=1}^{n} t_j^{-d}\right)$$

Researches use this formula to identify how much and how often, practice is needed to reduce Skill Fade. This computation combines the number of times the skill is practiced (n), the amount of time (t) that has passed for each of "n" practice sessions, and how quickly that skill decays (d).

COMBINING IT ALL TOGETHER: A TRAINING REINFORCEMENT REGIMEN

Here's how to reduce Skill Fade and improve Skill Retention[6]:

- Once the skill is learned, the student should follow a **Spaced Repetition System**: once a day, every other day, once a week, once every other week, once a month, once every two months, then every six months, finally, annually.
- The skill practice interval should not exceed the student's attention span. For most students, this is about 15 minutes per day, less for younger students. That is long enough for the student to remain well focused on the task.



Can overtraining help?

Research has found that overlearning – the immediate continuation of learning after the learner has achieved mastery over a task – can produce better results (such as faster completion time of a skill-based task), but its benefits are very short-term [3]. Benefits rarely last more than a month, and it helps declarative knowledge far more than procedural knowledge.

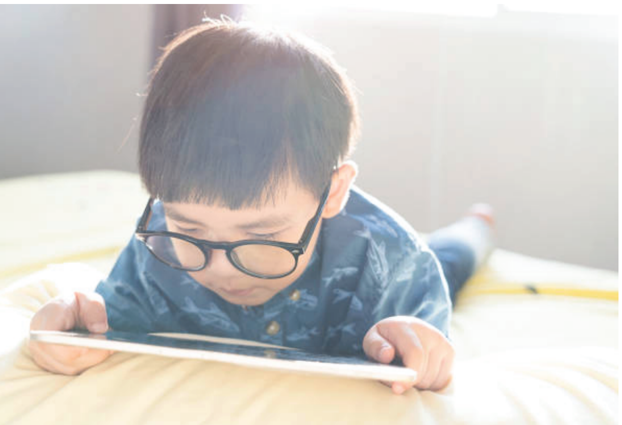
Overlearning does help skill retention between 2 and 28 days, and it does help in situations where the learner is experiencing skill fade. Similar to results seen from spaced training, overlearning reduced the time needed for the learner to re-master the skill [5].

Computer-driven or Self-directed Practice?

Learners made the transition through the three phases of knowledge retention more quickly when their learning was automatically paced by a computer, instead of asking the learner to be self-motivated and practice on their own [4].

What kinds of Positive Reinforcement work best?

Research shows that for computer-based training, positive reinforcement should be both computer-based (integrated into the training, such as a point system and daily goals like used in Duolingo) and combined with the teacher's positive feedback (during phone calls and in-person sessions), lead to improved motivation and faster learning [8]. And when a learner can see their progress, the learner's self-esteem improves which leads to increased engagement [7].



OBJECTIVEED'S REINFORCEMENT LEARNING SYSTEM

Best Practices	ObjectiveEd
Computer-based	iPad, iPhone, most browsers
Teacher can monitor progress	Web-dashboard charts and data can be downloaded
Positive reinforcement for student	Scoring and reward systems to encourage and motivate students
Teacher can customize reinforcement for student	Highly configurable skills to practice
Configurable reinforcement schedule	Skills assigned for practice can be deactivated and reactivated via the dasboard
Digitally quantifiable progress	Per skill progress monitoring with advanced metrics
Skill exercises can be completed in 15 minutes	YES

Bibliography

[1] Kim, J. W., Ritter, F. E., & Koubek, R. J. (2013). An integrated theory for improved skill acquisition and retention in the three stages of learning. Theoretical Issues in Ergonomics Science, 14(1), 22-37.

[2] Ritter, F. E., Tehranchi, F., & Oury, J. D. (2019). ACT-R: A cognitive architecture for modeling cognition. Wiley Interdisciplinary Reviews: Cognitive Science, 10(3), e1488.

[3] Driskell, J. E., Willis, R. P., & Copper, C. (1992). Effect of overlearning on retention. Journal of Applied Psychology, 77(5), 615-622.

[4] Pavlik, P. I., & Anderson, J. R. (2008). Using a model to compute the optimal schedule of practice. Journal of Experimental Psychology: Applied, 14(2), 101-117.

[5] Walsh, M. M., Gluck, K. A., Gunzelmann, G., Jastrzembski, T., Krusmark, M., Myung, J. I., Pitt, M. A., & Zhou, R. (2018). Mechanisms underlying the spacing effect in learning: A comparison of three computational models. Journal of Experimental Psychology: General, 147(9), 1325–1348. https://doi.org/10.1037/xge0000416

[6] Arthur, Jr, Winfred & Villado, Anton & Boatman, Paul & Bhupatkar, Alok & Day, Eric. (2005). Commplex Nonmotor Skill Acquisition, Retention, Transfer, and Reacquisition.

[7] Druckman, D. E., & Bjork, R. A. (1994). Learning, remembering, believing: Enhancing human performance. National Academy Press.

[8] Taylor, T. K., Webster-Stratton, C., Feil, E. G., Broadbent, B., Widdop, C. S., & Severson, H. H. (2008). Computer-based intervention with coaching: An example using the Incredible Years program. Cognitive behaviour therapy, 37(4), 233-246

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