

The Takeaway

Learning is at least a three-step process: initial **encoding** of information is held in short-term working memory before being consolidated into a cohesive representation of knowledge in long-term memory. **Consolidation** reorganizes and stabilizes memory traces, gives them meaning, and makes connections to past experiences and to other knowledge already stored in long-term memory. **Retrieval** updates learning and enables you to apply it when you need it.

Learning always builds on a store of prior knowledge. We interpret and remember events by building connections to what we already know.

Long-term memory capacity is virtually limitless: the more you know, the more possible connections you have for adding new knowledge.

Because of the vast capacity of long-term memory, having the ability to locate and recall what you know when you need it is key; your facility for calling up what you know depends on the *repeated use* of the information (to keep retrieval routes strong) and on your establishing powerful *retrieval cues* that can reactivate the memories.

Periodic retrieval of learning helps strengthen connections to the memory and the cues for recalling it, while also weakening routes to competing memories. Retrieval practice that's easy does little to strengthen learning; the more difficult the practice, the greater the benefit.

When you recall learning from short-term memory, as in rapid-fire practice, little mental effort is required, and little long-term benefit accrues. But when you recall it after some time has elapsed and your grasp of it has become a little rusty, you have to make an effort to reconstruct it. This effortful retrieval both strengthens the memory but also makes the learning *pliable* again, leading to its *reconsolidation*. Reconsolidation helps update your memories with new information and connect them to more recent learning.

Repeated effortful recall or practice helps integrate learning into *mental models*, in which a set of interrelated ideas or a sequence of motor skills are fused into a meaningful whole that can be adapted and applied in later settings. Examples are the perceptions and manipulations involved in driving a car or in knocking a curveball out of the ballpark.

When practice conditions are varied or retrieval is interleaved with the practice of other material, we increase our abilities of *discrimination* and *induction* and the versatility with which we can apply the learning in new settings at a later date. Interleaving and variation build new connections, expanding and more firmly entrenching knowledge in memory and increasing the number of cues for retrieval.

Trying to come up with an answer rather than having it presented to you, or trying to solve a problem before being shown the solution, leads to better learning and longer retention of the correct answer or solution, even when your attempted response is wrong, so long as corrective feedback is provided.