Excerpt from the book ***Range*** by David Epstein:

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Toward the end of the eighth-grade math class that I watched with Lindsey Richland, the students settled into a worksheet for what psychologists call "blocked" practice. That is, practicing the same thing repeatedly, each problem employing the same procedure. It leads to excellent immediate performance, but for knowledge to be flexible it should be learned under varied conditions, an approach called varied mixed practice, or, to researchers, "interleaving."

Interleaving has been shown to improve inductive reasoning. When presented with different examples mixed together, students learn to create abstract generalizations that allow them to apply what they learn to material they have never encountered before. For example, say you plan to visit a museum and want to be able to identify the artist (Cezanne, Picasso, or Renoir) of paintings there that you have never seen. Before you go, instead of studying a stack of Cezanne flash cards, then a stack of Picasso flash cards, and then a stack of Renoir, you should put the cards together and shuffle, so they will be interleaved. You will struggle more (and probably feel less confident) during practice but be better equipped on museum day to discern each painter’s style, even for paintings that weren't in the flash cards.

In a study using college math; problems, students who learned in blocks - examples of a particular type of problem at once - performed a lot worse come test time than students who studied the exact same problems but all mixed up. The blocked-practice students learned procedures for each type of problem through repetition. The mixed-practice students learned how to differentiate types of problems.

The same effect has appeared among learners studying everything from butterfly species identification to psychological-disorder diagnosis. In research on naval air defense simulations, individuals who engaged in highly mixed practice performed worse than blocked practicers during training, when they had to respond to potential threat scenarios that became familiar over the course of the training. At test time, everyone faced completely new scenarios, and the mixed-practice group destroyed the blocked-practice group.

And yet interleaving tends to fool learners about their own progress. In one of Kornell and Bjork's interleaving studies, 80 percent of students were sure they had learned better with blocked than mixed practice, whereas 80 percent performed in a manner that proved the opposite. The feeling of learning, it turns out, is based on before-your-eyes progress, while deep learning is not. "When your intuition says block," Kornell told me, "you should probably interleave."

Interleaving is a desirable difficulty that frequently holds for both physical and mental skills. A simple motor-skill example is an experiment in which piano students were asked to learn to execute, in one-fifth of a second, a particular left-hand jump across fifteen keys. They were allowed 190 practice attempts. Some used all of those practicing the fifteen-key jump, while others switched between eight-, twelve-, fifteen-, and twenty-two-key jumps. When the piano students were invited back for a test, those who underwent the mixed practice were faster and more accurate at the fifteen-key jump than the students who had only practiced that exact jump.

The "desirable difficulty" coiner himself, Robert Bjork, once commented on Shaquille O'Neal's perpetual free-throw woes to say that instead of continuing to practice from the free-throw line, O’Neal should practice from a foot in front of the line and behind it to learn the motor modulation he needed.

Whether the task is mental or physical, interleaving improves the ability to match the right strategy to a problem. That happens to be a hallmark of expert problem solving. Whether chemists, physicists, or political scientists, the most successful problem solvers spend more mental energy figuring out what type of problem they are facing before matching a strategy to it, rather than jumping in with memorized procedures. In that way, they are just about the precise opposite of experts who develop in kind learning environments, like chess masters, who rely heavily on intuition. Kind learning environment experts choose a strategy and then evaluate; experts in less repetitive environments evaluate and then choose.

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References:

In a study using college math problems: D. Rohrer and K. Taylor, "The Shuffling of Mathematics Problems Improves Learning," Instructional Science 35 (2007): 481-98.

butterfly species identification to psychological-disorder diagnosis: M. S. Birnbaum et al., "Why Interleaving Enhances Inductive Learning," Memory and Cognition 41 (2013): 392-402.

naval air defense simulations: C. L. Holladay and M.A. Quinones,. "Practice Variability and Transfer of Training," Journal of Applied Psychology 88, no. 6 t,(2003): 1094-1103.

In one of Kornell and Bjork's interleaving studies, 80 percent of students: N. Kornell and R. A. Bjork, "Learning -Concepts and Categories: Is Spacing the 'Enemy of Induction'?," Psychological Science 19, no. 6 (2008): 585-92.

a particular left-hand jump across fifteen keys: M. Bangert et al., "When Less of the Same Is More: Benefits of Variability of Practice in Pianists," Proceedings cc: the International Symposium on Performance Science (2013): 117-22.

O'Neal should practice from a foot in front: Bjork makes this suggestion in Daniel Coyle 's The Talent Code (New York: Bantam, 2009).

hallmark of expert problem solving: See, for example: M.T.H. Chi et al, "Categorization and Representation of Physics Problems by Experts and Novices," Cognitive Science 5, no. 2 (1981): 121-52; and J. F. Voss et al., "Individual Differences in the Solving of Social Science Problems,"in Individual Differences in Cognition, vol. 1, ed. R. F. Dillon and R. R. Schmeck(New York: Academic Press, 1983).