But I Was Great on the Practice Range!

How does practice repetition influence performance and learning?

If you go to any golf driving range and watch people practice, you will quickly notice that most, if not all, people do at least two things: (1) they hit shot after shot after shot with the same club, and (2) after moving to the putting green, they putt ball after ball after ball from exactly the same spot. And yet, often these same golfers, when playing a round of golf, say in frustration as yet another ball goes into the water, or after another four-putt green, “I don’t understand it; I was playing so well in practice yesterday.”

The problem arises from misunderstanding the distinction between performance and learning (see “Learning to Win From Losing” in chapter 8) and how practice effectiveness and efficiency affect learning. The common view among many golfers is that you can “groove the swing” by making frequent repetitions in a short period of time. For example, let’s say the practicing golfer takes out a 7 iron and hits the first ball poorly. A second ball is struck a little better, and by the sixth ball, our golfer is hitting the 7 iron much better. So, the golfer now hits another 10 or 15 balls in immediate succession, trying to “stamp in” a memory of those good shots. A similar fate occurs on the putting green. The first ball comes up short, the next is long, and the next is close but wide. The golfer continues to stroke putts from the same location until sinking one, and then continues to putt a few more to stamp in the memory of the swing that produced the putt that went into the hole.

What is wrong with this method of practice? Well, a number of things, actually. But the most fundamental problem is that learning does not occur by stamping in memories by rote repetition. The achievement of some objective, such as striking a golf ball, represents a motor problem, and the process of coordinating the activities of the central nervous system represents the solution to the problem. The acquisition of motor skills is a process of solving the problem in ways that become increasingly more reliable with practice.

In many respects, the process of motor learning is similar to the process involved in other types of learning, such as learning multiplication rules. Let’s say, for example, that you were helping students learn longhand multiplication and posed the following problem for them to solve: $22 \times 17 = ?$. Immediately after they had solved the problem, would it be advisable to pose the same problem to them again? No, of course not. The reason

From T.D. Lee, 2011, *Motor control in everyday actions* (Champaign, IL: Human Kinetics).

is that they could (and would) come up with the solution to the problem (374) without going through the multiplication process. If your goal is to help your students learn the process of finding the solution, then immediately repeating the same problem would eliminate the requirement to go through the process of solving the problem again, because they could simply recall the answer. The effective teacher, therefore, uses a variety of questions that require the student to practice the process of longhand multiplication. But note that you could use the same question again later, after the students have forgotten the original solution to the problem. This example points out a very interesting conundrum: having a memory of the solution to the problem actually prevents or discourages us from carrying out the very activities we are trying to learn. We could phrase this another way by saying that forgetting has a beneficial effect on learning!

Motor skills researchers, starting with pioneers John Shea and Robyn Morgan, have addressed this issue of how to optimize the scheduling of practice using a variety of methods. In many of these studies, people are asked to learn several variations of a motor task and are given numerous practice attempts for each task. Two types of practice schedules are often compared: blocked practice and random practice. In blocked practice, the learners make all of their practice attempts for any one version of the motor task in immediate succession. This is a form of drill training, similar to the training of the golfer who hits all of his 7-iron shots in a row, then puts that club away for the remainder of the practice session. In random practice, the learner never practices the same task twice in a row (the golfer in our example would use a different club for each consecutive shot on the golf range). These two practice schedules are the same in terms of the amount of practice and the number of attempts made on each task; the only difference is the order in which the attempts are scheduled.

What is typically found in these types of studies is that blocked practice results in better performance than does random practice during the practice period itself. This is most likely due to the fact that random practice is much more demanding than blocked practice, and by its very nature is prone to less effective performance during the practice period (in the case of golf, while on the practice range). However, as in most studies of motor learning, one must keep in mind the distinction between factors that affect temporary changes in performance and those that have a more permanent influence on learning (see "Learning to Win From Losing" in chapter 8). In studies that measure the retention and transfer of the skills practiced, researchers have found that random practice results in better performance after the completion of practice—and hence, better learning—than blocked practice does.

Random practice might be more effective than blocked practice for several reasons. Some researchers have suggested that the demands of random

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practice add "desirable difficulty" that elevates the effort undertaken during practice. Of course, like most factors that increase the level of difficulty during practice, there will likely be a decrement in performance. The desirable part is that the learner will be better off in the long run because of the increased effort required to match the elevated difficulty of practice.

Another factor that is likely at work here concerns what is called the specificity of practice. Repeated performance of a single task is not typical of the way we perform most of the motor skills in our daily repertoires. To be sure, a golfer does not hit multiple shots in a row with the same club, or take multiple putts from the same distance, when playing a round of golf, just as LeBron James does not attempt 20 free throws in a row during a basketball game. So, why conduct practice in a manner that is so different from the conditions under which you are later required to perform? The take-home message of practice specificity is that we should anticipate the conditions to be confronted later, and then design the practice conditions to match them as closely as possible.

Every shot on the golf course poses a specific and unique problem for the golfer, who responds by trying to solve the problem with a specific and unique activity of the central nervous system. By repeatedly using the same club or putting from the same distance during practice sessions, many golfers run into the frustrating trap of trying to repeat solutions rather than solve problems. Golfers who practice effectively have discovered that solving problems in practice results in learning that helps them solve problems on the course.

In the end, choosing which practice schedule to use boils down to a cost–benefit analysis. The cost of random practice is a demanding practice routine, but the benefit is greater improvement in skill level. The golfer who complains about playing so well on the practice range was likely fooled into thinking that performance in blocked practice was a sign of good things to follow on the course. For this golfer, the cost–benefit analysis has worked in the opposite direction. The benefit of good performance on the practice range came at a cost of poor learning.

Self-Directed Learning Activities

1. Define *blocked practice* and *random practice* in your own words.
2. How could you use the concept of specificity of practice to design a golf practice session?
3. Suppose a golfer were told that she could use only one ball when practicing putting. What benefit do you think this constraint might have on learning?
4. Design an experiment in which you compare skill improvements from blocked and random practice schedules, using any sport skill.

Notes

- Larry Jacoby was one of the first researchers to discuss the conundrum of why forgetting benefits learning. Here are a couple of his articles:

Jacoby, L.L. (1978). On interpreting the effects of repetition: Solving a problem versus remembering a solution. *Journal of Verbal Learning and Verbal Behavior, 17,* 649-667.

Cuddy, L.J., & Jacoby, L.L. (1982). When forgetting helps memory. An analysis of repetition effects. *Journal of Verbal Learning and Verbal Behavior, 21,* 451-467.

- Many types of practice schedules other than random and blocked have been studied in research investigations. However, random and blocked schedules represent the extreme ends of the drilling versus nonrepetitive practice continuum.
- Robert Bjork, a psychologist and avid golfer at UCLA, coined the term *desirable difficulty.*

Suggested Readings

Lee, T.D., & Magill, R.A. (1983). The locus of contextual interference in motor-skill acquisition. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9,* 730-746.

Lee, T.D., & Simon, D.A. (2004). Contextual interference. In A.M. Williams & N.J. Hodges (Eds.), *Skill acquisition in sport: Research, theory and practice* (pp. 29-44). London: Routledge.

Schmidt, R.A., & Lee, T.D. (2011). Conditions of practice. In *Motor control and learning: A behavioral emphasis* (5th ed.). (pp. 347-392). Champaign, IL: Human Kinetics.

Shea, J.B., & Morgan, R.L. (1979). Contextual interference effects on the acquisition, retention, and transfer of a motor skill. *Journal of Experimental Psychology: Human Learning and Memory, 5,* 179-187.

From T.D. Lee, 2011, *Motor control in everyday actions* (Champaign, IL: Human Kinetics).