The Gimme Putt

Can Schmidt's law be used to predict the accuracy of golf putts?

A common gesture in friendly matches of golf is to concede an opponent's short putt when it is almost certain that it would be holed—the so-called gimme putt. This is a courtesy that speeds up play and saves the typical amateur player possible embarrassment. However, because even golf professionals are known to miss short putts, what length of putt would be reasonable to concede? The typical amateur golfer's odds are probably not much better than 50–50 of making a putt of 2 feet (61 cm) or more, even for a straight putt. Certainly, golfer error is a large contributing factor to this success rate. But golfers also miss short putts because of factors that are not under their control. For example, greens have debris such as dirt, small stones, indentations, and other imperfections that cause the ball to move off line and miss the hole. So, how much error in a missed putt is due to the golfer and how much is due to other factors?

Figure 3.4 illustrates some data that were published in a fascinating book by the Golf Society of Great Britain. The data represented by the circles were collected during the 1964 Dunlop Masters Tournament at Royal Birkdale in Great Britain, which featured some of the top professionals of the era. The graph illustrates putting success (putts made) from various distances. There was a rapid drop in putting success as the distance of the putt got farther and farther from the hole. Putts of lengths between 6 and 12 feet (1.8 and 3.2 m) were holed less than half the time, and putts beyond 18 feet (5.5 m) were made fewer than once in eight tries.

The square symbols in figure 3.4 represent the performance of a very precise putting machine that attempted putts at three distances from the hole (6, 20, and 60 ft, or 1.8, 6.1, and 18.3 m). Plotting the results of the putting machine against the results of the professional (human) golfers revealed dramatic differences. If the debris on the greens and other environmental factors were to account for all of the putting errors, then the putting machine's drop in performance as distance increased should have mirrored the golfers'. Instead, the findings indicate that human error contributed significantly to the error in missing putts, especially for putts beyond 6 feet. For instance, at a distance of 20 feet from the hole, the putting machine was holing half of its putts—a success rate that was about four times better than that of the average professional.

Some of this human error can be attributed to perception (e.g., misreading the break in the line of the putt) and decision making (e.g., striking the ball

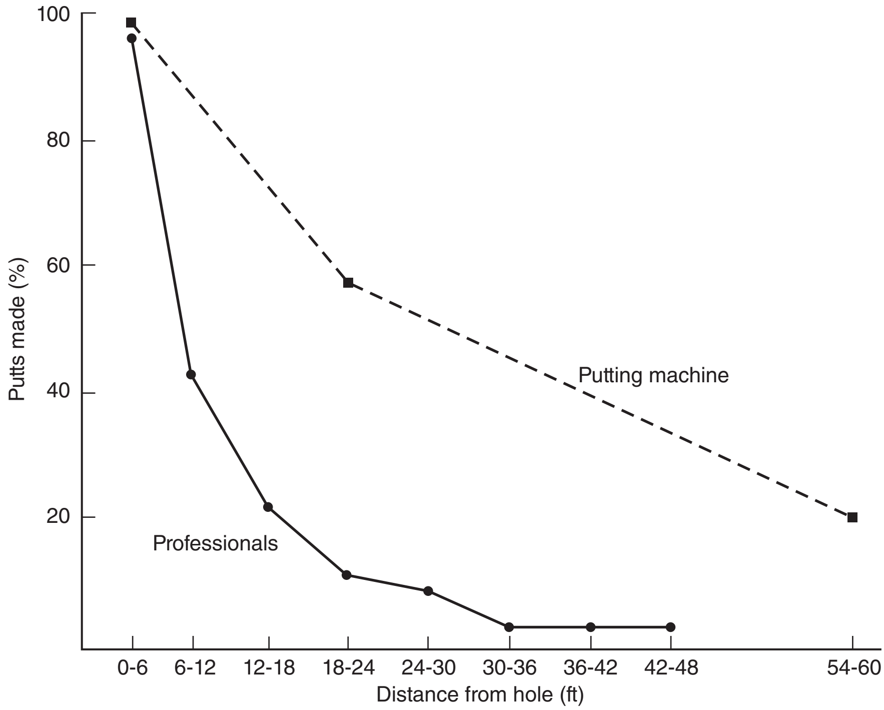

Figure 3.4 Comparison of the success of golf putts made from various distances by a human professional and a golf putting machine.
From data in Cochran & Stubbs 1968.

with too much force), but another important factor is related to a law of motor control—Schmidt's law. The importance of the law relates specifically to error variability—the dispersion of endpoints when we aim at a target (see the story "Cutting Wood and Missing Putts" in chapter 4 for more about variability). Schmidt's law for movements of short duration states that error variability is proportional to the force required to initiate the movement. When we make a brief movement to strike a target (a stroke of the ball, in this case), we do so with a certain amount of force. The force required to propel the ball to the hole is much less for short distances than for long distances. Because force and variability are proportional, we would therefore expect more variability for longer putts than for shorter putts.

An application of Schmidt's law to putting is illustrated in figure 3.5, which represents the error variability of three putts of different distances. In the top case (a putt of a short distance), there is relatively low variability at the point of contact because only a low amount of force is required. The pathway in gray illustrates the spread in possible outcomes that might be expected on, say, 95 percent of all putts. Because putts can be missed as a result of distance or direction errors (or both), the gray error bands in this figure illustrates possible error variability in both parameters. That is, some percentage of the putts would be expected to miss because of poor direction control, some proportion because of poor distance control, and some proportion because of both. Environmental factors notwithstanding, almost all of the short putts in 3.5*a* are expected to go in the hole.

The gray area in figure 3.5*b* represents a longer putt. Here, the variability at the point of impact will result in a wider dispersion of outcomes when the ball reaches the hole. In this example, the ball might be expected to go in the hole, say, on about one quarter of the putts attempted, and more misses would be expected as a result of both direction and distance control errors. Figure 3.5*c* represents the longest putt, which requires even more force and, thus, more force variability accumulated in the central nervous system at the point of impact. In this case, we expect that perhaps only one in eight putts might go in the hole.

When putting is viewed from the point of view of Schmidt's law, the task of the golfer on long putts is not necessarily to sink the ball on the first putt. Rather, the goal is to get the ball close enough on the first putt so that the second putt is no longer than, say, the gray area in 3.5*a*. Holes that take three (or more) putts to complete are usually caused by first putts that result in long second putts (as in 3.5*b* or 3.5*c*), which would then often require a third putt (or fourth or fifth).

We know from Fitts' law (see "The Calculator") that, for most tasks, we must slow down to be more accurate, or conversely, that speeding up will generally result in more errors. Fitts' law is a special application of the speed–accuracy trade-off that describes the effect on speed when accuracy is held constant and target size and distance to the target are covaried. Schmidt's law describes a related but different application of the speed–accuracy trade-off. Schmidt's law describes the relationship between force

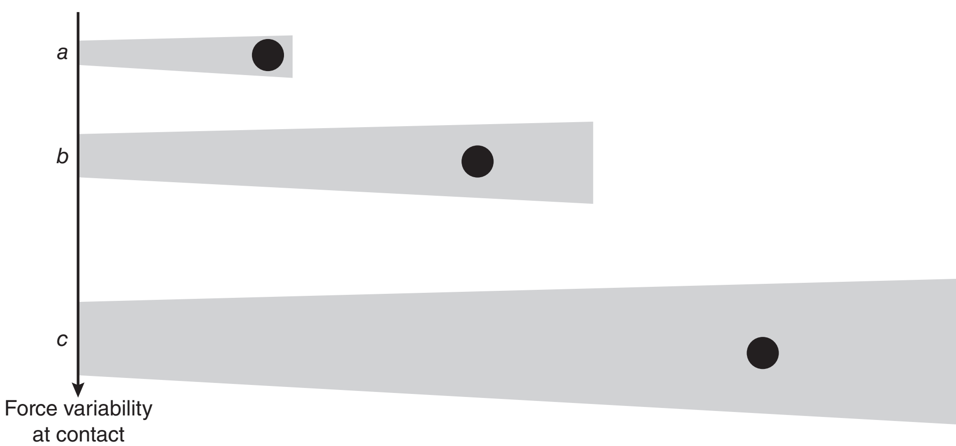

Figure 3.5 Putting variability increases with the length of the putt partially because of force variability principles (Schmidt's law).

and the variability in the error that is accumulated in the central nervous system prior to the initiation of movement. In essence, Schmidt's law states that the greater the force applied to a ballistic movement is, the greater the spread (or variability) of possible outcomes of those movements will be. A larger amount of force variability will result in movement outcome errors that increase both in the distance and direction variability of the movement.

The gimme putt is a friendly gesture that speeds up the pace of play on the golf course. Essentially, it is intended for the case illustrated in figure 3.5*a*, in which the golfer is highly unlikely to miss the putt. Unfortunately, for most amateur golfers, the force variability for even a very short putt is much higher than is illustrated in this figure, perhaps more like the case in figure 3.5*b*. The gimme putt is therefore a generous concession indeed!

Self-Directed Learning Activities

1. Define *Schmidt's law* in your own words.
2. What research methods have been used to examine the relationship between force and outcome variability? What measures are used to define variability?
3. Apply Schmidt's law to another situation (other than golf putting) in which forces, and their variability, differ depending on the requirements of the task. What predictions could you make?
4. How would you conduct a research investigation designed to address the predictions you made in question 3?

Notes

- The statement "95 percent of all putts" does not reflect an arbitrary number. According to statistical dispersion theory, one standard deviation unit is expected to account for 68 percent of all observed values, and two standard deviation units (the standard deviation multiplied by 2) is expected to account for 95 percent of all values. See "Public Opinion Polls" in chapter 4 for more on the rationale underlying this number.

Suggested Readings

Cochrane, A., & Stobbs, J. (1968). *Search for the perfect swing.* Chicago, IL: Triumph.

Schmidt, R.A., & Lee, T.D. (2011). Principles of speed and accuracy. In *Motor control and learning: A behavioral emphasis* (5th ed.) (pp. 223-262). Champaign, IL: Human Kinetics.