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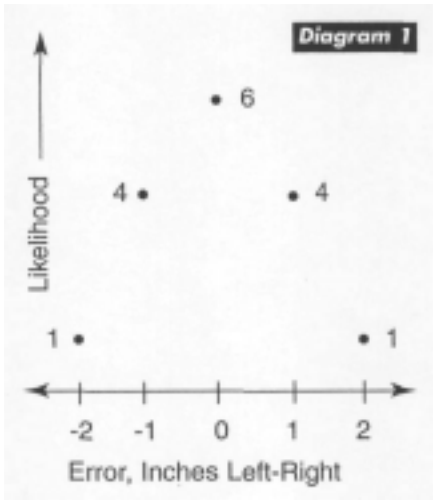
Add It Up

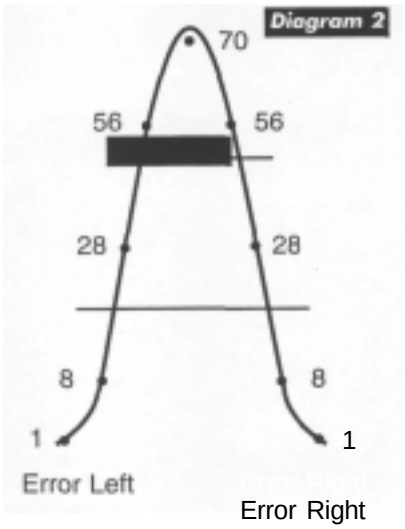
Finding the total of all your errors can lead to total perfection.

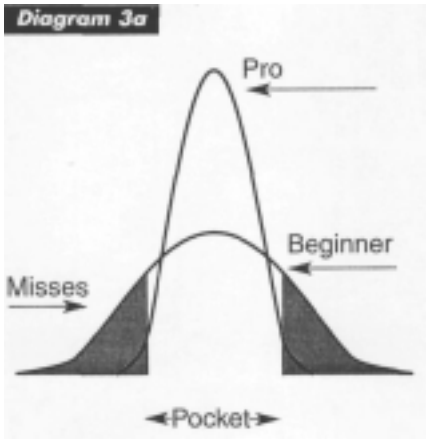
Last month, I tried to convince you that the error in your aiming has lots of sources — misjudging the angle, bad bridge placement, unexpected throw, a swoop in the final stroke — and that you need to reduce the errors that you can control. This time we will look at some of the theoretical background for errors in aiming. With this background, we can make some predictions about pocketing percentages. We might even uncover some faults that, when eliminated, may reduce your misses on certain shots by more than 50 percent.

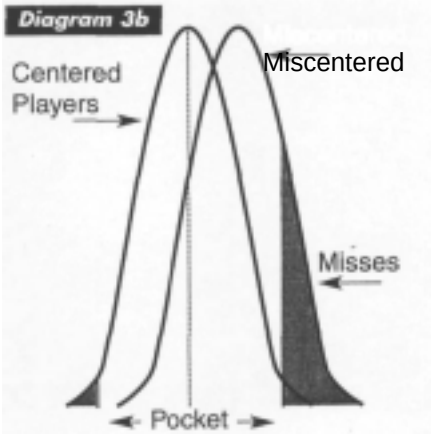
To see what happens when errors add together, let's start with a very simple case of four error sources of equal size. Each one alone causes the object ball to be off by a half inch to the left or the right when it arrives at the pocket. Imagine that the direction of each error is random, like the flip of a coin. If you have bad luck, all of the errors will be to the left, and the ball will land two inches to the left of the center of the pocket. Since even large pockets don't allow that much error, the shot will miss. If you get lucky, two errors will be to the left and two to the right, and the ball will be perfectly centered. An intermediate case is when there are three errors one way and one the other. All of the possibilities are shown in **Diagram** 1. On the vertical axis is the relative chance that each combination will occur. There is only one chance in 16 that all four flips will be "left," while the chance for two of each is six times greater because of the several combinations that result in zero net error.

Carrying this on to eight sources of error, we get the points plotted in **Diagram 2.** Also shown are two pocket sizes. The effective pocket size changes according to how long the shot is, so a shot that is twice as long (object ball to pocket) presents a target half as large. Similarly, if the cue ball is twice as far from the object ball, the target on the object ball is half as large. While a shot that's twice as long might seem twice as hard, look at what this does for the pocketing percentage. The wider pocket accepts all but two of 256 possibilities — those unlucky shots where all of the errors happened to add in the same direction — giving better than a 99-percent success rate. When the pocket size is halved, only 71 percent of the balls are pocketed (182/256). From missing one in a hundred shots, you've gone to only missing a third. Moral: Keep your shots as short as possible.



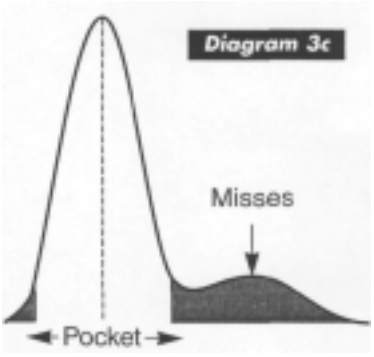






The above analysis is greatly simplified. In the real world there are, uncountably, many tiny errors contributing to every shot. A more detailed analysis would seem to be impossible. Fortunately, situations like this — many small errors adding together — are standard problems in fields as diverse as machining tolerances, noise in TV sets, and IQ tests. The result is that the spread of the errors is nearly always a bell curve, which is also called a "gaussian" or "normal" distribution. It has a very special shape that is drawn in Diagram 2 as the smooth curve. Since it has been studied so thoroughly, we can easily make several kinds of predictions such as the one above about pocketing percentages.

Does your "error profile" really match a gaussian curve? Maybe. If it doesn't, you may need to fix something. Let's look at several kinds of problems graphically. **Diagram 3A** shows the scatter for two hypothetical players, a pro and a beginner. For the pocket width shown, the beginner will make most of the shots, but the pro will almost never miss. The width of the bell curve is usually measured at about 61 percent of its height. For the case shown, the width or typical error for the beginner is twice that of the pro. More practice and better fundamentals — to reduce the size of all

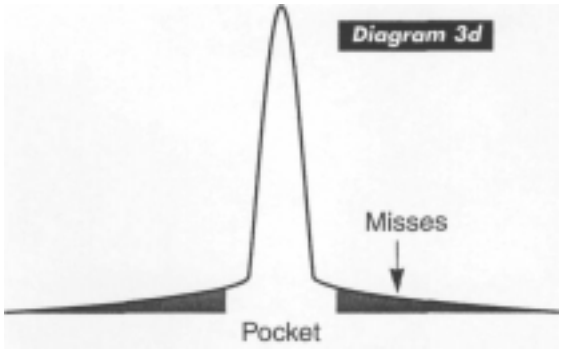


the little errors that contribute to the sum — will reduce the total spread.

Diagram 3B shows another problem. The good curve is for a player who knows where the middle of the pocket is; the other is for someone who shoots on average to the right of center. Again, the centered players will rarely miss. The off-center shooter will miss because he is always slightly off.

Are most of your misses to one side? You need to find the center of the pocket and make sure it's your target every time. For the corner pockets, the center is close to where the rail grooves cross; for side pockets, it is in the middle of the pocket right at the brink of the pocket opening in the slate. During practice, mark the centers of the pockets with stick-on reinforcements and strive to drive the object ball exactly over those marks.

Shown in **Diagram** 3C is a strangely shaped distribution, two humps rather than one. This indicates that on some shots, a single large error pops up. Cling or skid is one result that causes such large errors. Head alignment is another. If you use anything other than your usual eye to sight the shot, a large error in angle selection can result.



A final bad distribution is shown in 3D, where the distribution has a "long tail." Suppose you miscue 1 percent of the time. That will be a single, large error that again is not covered by the standard curve, which only addresses many small errors added together. When a miscue happens, the error will be spread out over a very large range, and even easy shots will be missed.

The bell curve predicts an interesting result for different sizes of tables. Suppose a particular shot is 95 percent for you on a 9-foot table. What are your chances on other sizes of table, assuming the same relative positions of the balls and that the pockets are equal in size? Of course the pocket appears to be smaller on the large table, because the shots are longer. For a 10-foot table, you would make only 89 percent of the shots, or miss about twice as often. On an 8-foot table, you get 98.5 percent, so you would miss one-third as often. On a 7-foot table, the theory says you should miss only once in 800 shots. Of course, if on 1 percent of your shots you miscue or have a head-alignment problem, you will never reach that level of perfection, even on easy shots.

The next time you're on the table, consider these questions: Are your shots centered on the pocket? Do you have any single large sources of error? When you have a shot that should be 99.9 percent, do you carelessly let your distribution spread out and occasionally miss? If your answer to any of these is yes, you've got work to do.