David Alciatore, PhD ("Dr. Dave")

"Fundamentals - Part VII: speed control"

***Note**: Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, and technical proofs (TP), and all of my past articles, can be accessed and viewed online at **billiards.colostate.edu**. The reference numbers used in the article help you locate the resources on the website. If you have a slow or inconvenient Internet connection, you might want to view the resources from a CD-ROM or DVD. Details can be found online at: **dr-dave-billiards.com**.*

This is the seventh article in a series on fundamentals. In the last six months, I've covered the stroke, the basics of aiming, issues involved with cut-shot aiming systems, the effects of bridge length, and the basics of cue ball direction control. This month we will look at speed control, which refers to how firmly you strike the CB to have it stop close to the spot you want for the next shot. Obviously, with good aim and alignment, a consistent an accurate stroke, and knowledge of CB direction, speed control is the critical skill that separates the average players from the great players.

Unfortunately, there is not much that can be really "taught" or explained about speed control. There are some drills that can help you develop speed control "feel" (e.g., see the speed control, stop/follow/draw, and English drills in the "Instructor and Student Resources" section of my website), but there is no silver bullet for success. The only true recipe for success is to practice — and practice a lot — to develop a "feel" for speed control. It also helps to have some natural "feel" ability with good eye-hand-coordination and fine motor control. Having said this, there are still some basic speed-control principles that are useful to know. Let's look at a few.

Let's start with the basic terminology illustrated in **Diagram 1**. When the cue ball (CB) strikes the object ball (OB) at some *cut angle* (i.e., it isn't a straight-in shot), the CB and OB will travel different distances after impact based on the original CB speed and spin (top, bottom or none), and the cut angle. As described in my past two articles, the exact path and direction of the CB motion also depends on the incoming CB spin and speed. In this article, we will look at ball travel distances for both roll and stun shots. With a *roll shot*, the CB is rolling naturally with no sliding when it strikes the OB; and with a *stun shot* (AKA "a stop shot at an angle"), the CB has no spin when it strikes the OB (i.e., it is sliding into the ball with no roll). It is important to remember that a below-center hit on the CB is required to achieve stun at OB impact. At faster speeds and short distances, you don't need to hit much below center, but at slower speeds and/or longer distances, more tip offset below center is required (see **HSV 3.1**, **HSV B.10**, and **NV B.10** for illustrations and more information).

high-speed video

HSV 3.1 – Stop-shot showing loss of bottom spin over distance
HSV B.10 – MOFUDAT stroke drill follow and draw effects

normal video

NV B.10 – Drag spin loss and English persistence

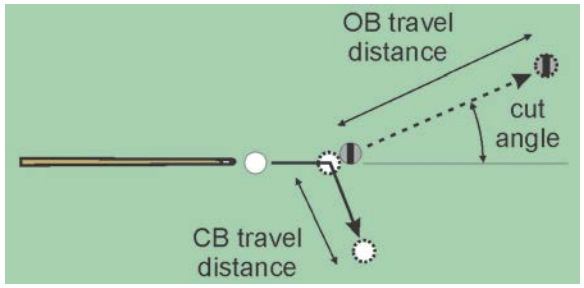


Diagram 1 Basic terminology

Now let's look at some graphs derived from complicated math and physics analyses. Don't get too excited, now! (... just kidding.) If you don't like graphs, don't worry because I'll describe the results in words and show some examples. **Diagram 2** shows how the post-impact CB and OB travel distances vary at different cut angles with a stun shot. The distances (the vertical axis on the graph) are reported as percentages of how far the CB would have travelled if it did not hit the OB. The cut angle is shown on the horizontal scale, varying from small angles close to 0º (i.e., thick hits) to large angles close to 90º (thin hits). Ball-hit-fraction illustrations (the ball-overlap figures) are also included along the cut angle scale so you can easily see how cut angle relates to ball-hit fraction (e.g., a 30º cut angle corresponds to a ½-ball ball). (FYI, if you want more information on how ball-hit fraction relates to cut angle, see **TP A.23**) To help understand the graph in Diagram 2, first consider a 0º cut-angle shot (i.e., a full-ball hit). Point "A" in the graph implies the OB travels the full distance (100%) the CB would have travelled if it had not hit the OB (e.g., see shots "a" and "b" in **Diagram 4**). Point "B" in the graph implies the CB stops in place after impact (i.e., it travels no distance, or 0%). Point "C" corresponds to a 45º cut angle, which is a little more than a ¼-ball hit. At this angle, with a stun shot, both balls travel the same distance, which is half (50%) the distance the CB would have travelled with no impact. For larger cut angles (thinner hits), closer to 90º, the graph shows that the CB loses very little speed (it travels close to 100%), and the OB travels very little (close to 0%). Obviously, the graph does not consider rails or other balls that might change the directions and speeds of the CB and OB after collision.

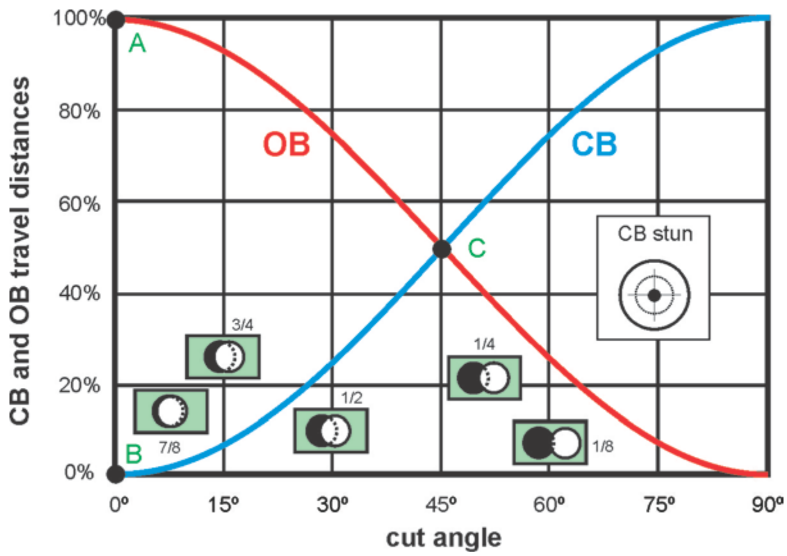
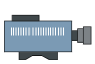


Diagram 2 CB and OB travel distances for a stun shot

TP A.23 – Ball-hit fraction vs. cut angle

Diagram 3 shows the travel-distance graph for a follow shot, where the CB is rolling naturally when it strikes the OB. Compare Diagram 3 to Diagram 2 to see the similarities and differences. Looking at points "A" and "B," we can see that for a square hit (0º cut angle), the CB follows the OB for a distance of about 8% of the distance the CB would have travelled without the collision. The OB travels about 50% of the collision-free rolling CB distance (see shots "a" and "c" in Diagram 4). The ratio of these distances is good to know if you are playing position on a precision follow shot with a fairly full hit. The OB will travel about 6-times (50/8) farther than the CB after impact. If you play pocket speed on a shot, you can expect the CB to travel only 1/6 of the distance to the pocket. If you hit the OB hard enough to send it two table lengths, the CB will follow only about 1/3 of a table length (2 x 1/6). Actually, in this case, the CB would travel farther because the rail rebound slows the OB substantially (about 50% per **HSV B.15**), so the shot speed is actually enough to send the OB more than two table lengths, without rails. Also be aware that the graphs and numbers above are for absolutely perfect balls. **TP A.16** includes graphs and results for non-perfect conditions. For the square-hit roll shot, depending on the ball and cloth conditions, the OB might roll closer to 7-times, or even 8-times, longer than the CB. You should test this out on various tables to see if your number is closer to 6 or 8. It's a little more than 7 on my table. By the way, if you want to see the math and physics behind the graphs in Diagrams 2 and 3, and for additional results, check out **TP 3.2** and **TP A.16**.



HSV B.15 **–** straight-on kick shot rebound losses and spin changes for roll, stun, and draw shots

TP 3.2 – Ball speeds and distances after stun-shot impact
TP A.16 – Final ball speeds, distances, and directions for natural roll shots

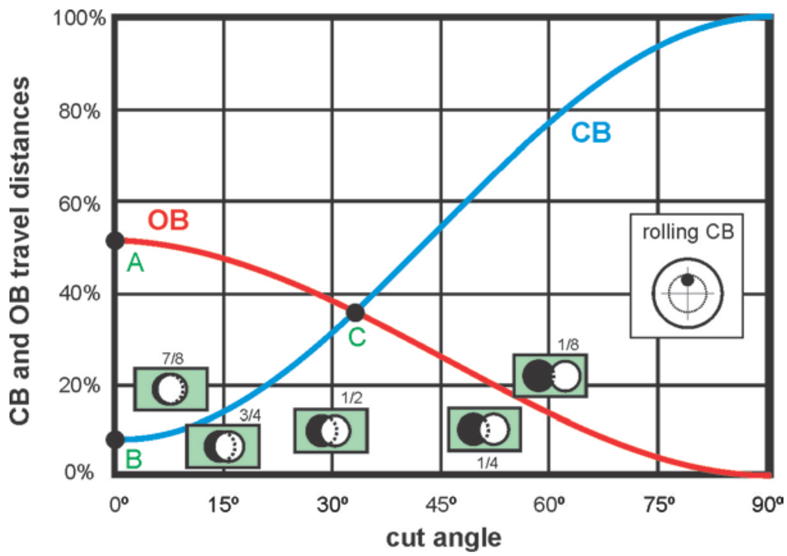


Diagram 3 CB and OB travel distances for a follow shot

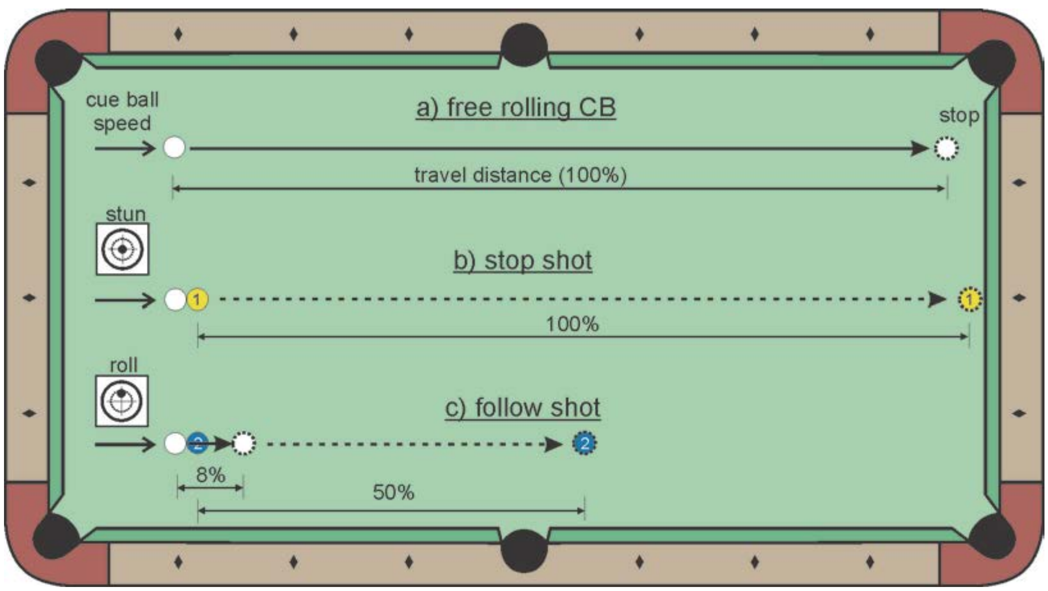


Diagram 4 Ball travel distance comparisons

Another useful conclusion from Diagram 3 concerns point "C" where the CB and the OB travel the same distance after impact. This occurs at a little less than a ½-ball hit, which is slightly more than a 30º cut angle. It turns out the angles at which both balls deflect away from the original CB line are also very close to being equal (about 30º), as a result of the 30º rule (see my past articles on this topic). As shown in **Diagram 5**, this equal distance and equal angle case can be very useful when visualizing and executing a safety. This is an example from a game of 9-ball. There is no good offensive option with 1-ball. The 3-ball and 4-ball block the paths to the corner pockets and a combination would be too risky. The 8-ball also prevents a two-way, straight-back bank shot. The obvious shot here is a safety. With close to a ½-ball hit, both the CB and OB will head at approximately 30º angles relative to the original CB direction. If you have trouble visualizing these angles, you can use my peace-sign trick (see the "30º rule" in the FAQ section of my website for more information). Because the 1-ball is close to the centerline of the table, both the CB and OB can end up close to the side rails. Even if your speed is off a little, the rails and the 6-ball and 7-ball will help stop the balls close to the positions shown. This final position would put your opponent in a tough spot, and you would likely get ball-in-hand on your next shot, giving you a good chance to run-out to win the game. Balls aren't always arranged on the table as nicely as those in Diagram 5, but the principle can be applied in various situations.

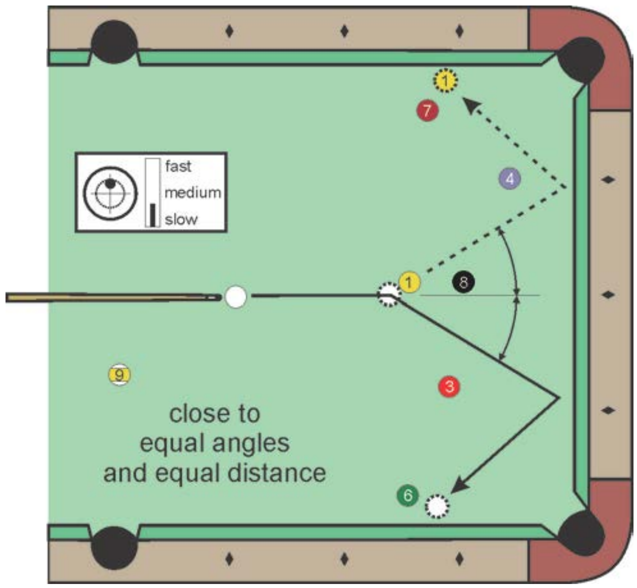


Diagram 5 Example rolling ½-ball hit safety

Well, I hope you are enjoying and benefiting from my series of articles on fundamentals. Next month, we will look at the draw shot in detail since many amateurs often have trouble executing and controlling this very important shot.

I want to close with a speed-control-related phrase a British buddy of mine likes to use when he sees "bangers" at a bar or pool hall. He uses the phrase "He put too much 'American' on the ball" to characterize the typical drunk and obnoxious novice player in a bar or pool hall that always hits the ball harder than he should, and is clueless about getting position for the next shot. This is my British buddy's little joke because he doesn't like when Americans say: "He put too much 'English' on the ball." In the UK, they refer to sidespin as "side," not "English." We don't always agree on terminology, but we share a common love for pool (and good beer) ... and that's good enough for me. Cheers mate!

Good luck with your game,
Dr. Dave

PS:

- If you want to refer to any of my previous articles and resources, you can access them online at ***billiards.colostate.edu***.

- I want to thank "Colin Colenso" and "Jal" on the Internet forums for helping me work through and improve the presentation of the results in my ball motion analysis documents.
- I know other authors and I tend to use lots of terminology (e.g., squirt, throw, stun, impact line, etc.), and I know not all readers are totally familiar with these terms. If you ever come across a word or phrase you don't fully understand, please refer to the online glossary on my website.

Dr. Dave is a mechanical engineering professor at Colorado State University in Fort Collins, CO. He is also author of the book, DVD, and CD-ROM: "The Illustrated Principles of Pool and Billiards," and the DVD: "High-speed Video Magic."