David Alciatore ("Dr. Dave") **ILLUSTRATED PRINCIPLES**
"Draw Shot Primer – *Part VII: Tips of English*"

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*__Note__: Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, and technical proofs (TP) can be accessed and viewed online at __billiards.colostate.edu__. The reference numbers used in the article (e.g., **NV 2.1**) help you locate the resources on the website. If you have a slow or inconvenient Internet connection, you might want to view the resources offline using a CD-ROM. See the website for details.*

This is the seventh and final article in a series dealing with draw shot principles and techniques. In previous months, we explored some of the basic physics of draw shots, compared various aiming systems for predicting the path of the cue ball, looked in detail into the trisect aiming system, studied some real examples where all of this knowledge can pay off in game situations, summarized some recommended "best practices" for good draw technique, and looked at a practice drill that might help you improve. In this final article, we'll look at "tips" of English ... how it is defined, how it varies with tip size and tip shape, and how you can visualize it at the table.

Before beginning, I want to summarize some conclusions from an excellent article by George Onoda concerning draw shots in the August '91 issue of Billiard Digest. (FYI, this and other past instructional articles by various authors can be viewed online via the links at the bottom of the "Instructional Articles" section of my website). In the article, Dr. Onoda described the following suggestions concerning draw shots:

1. For maximum draw, without too much risk of a miscue, the cue ball should be struck half way between its center and its edge.
2. The width of a striped ball (balls 9 through 15) happens to be half of the ball's diameter, so it can be used to practice the maximum recommended tip offset suggested in item 1.
3. Draw shot miscues are often caused by hitting the table before the cue ball.

Before continuing, let's look at the terminology shown in Diagram 1. **Cue tip offset** is defined as the distance between the line of action of the cue stick (through the **contact point** of the ball) and the center of the cue ball. The larger the offset, the more spin gets applied to the cue ball. Coriolis, in 1835, proved that the optimal offset for maximum English is half of the ball's radius (see my October '05 article for more information). This is also the limit usually suggested for safely avoiding miscues (see NV 2.1). A pool ball's diameter (D) is 2 1/4" and its radius (R) is 1 1/8" (R = D/2); therefore, the maximum recommended cue tip offset is 9/16" (R/2 or 0.5R). Notice in the diagram how the contact point and cue tip offset are affected by **cue stick elevation** (the angle of the cue stick above horizontal). It is important to measure the offset from the line of action of the cue stick to the center of the ball, regardless of the amount of elevation. The cue is always elevated some due to required clearance over the rails (see TP A.3). As we will see below, **tip size** and curvature (**tip radius**) also affect how much offset can be achieved. Tip sizes are generally in the 11 to 14 mm range, with 12 to 13 mm being the most common. Tip radius is generally recommended to be between the curvature of a nickel and a dime. A fatter and flatter tip will result in less **table clearance** (the distance between the bottom edge of the tip and the cloth surface, at impact with the cue ball), especially for larger tip offsets. One advantage of a flatter tip is that it can help improve the consistency of center-ball hits. All of the **terms** used above are illustrated clearly in Diagram 1.

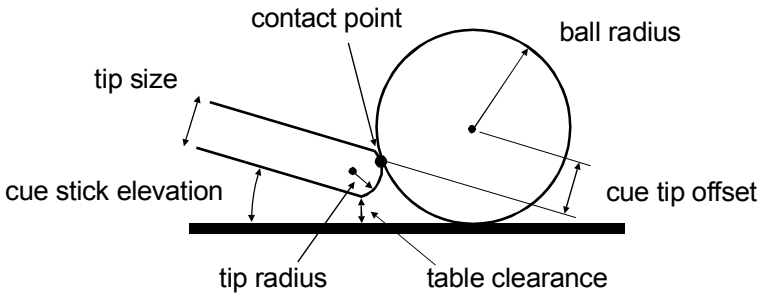


Diagram 1 Cue tip offset parameters and variables

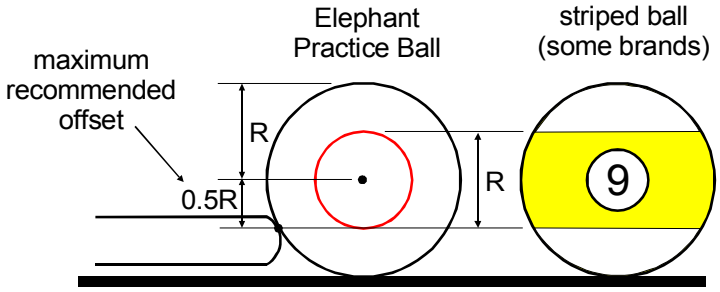

normal video

NV 2.1 – Miscue due to off-center hit with no chalk


technical proof

TP A.3 – Minimum cue stick elevation required for a head-spot-to-foot-spot center-ball-hit shot

Diagram 2 shows two aiming aids that can be used to help you learn how to judge the maximum safe tip offset for applying maximum English. The first is the Elephant Practice cue ball that has a red circle with a radius of exactly 9/16" (R/2), clearly showing the offset limit. The Elephant Practice ball also has a thin black stripe that can be used to help visualize aim (see NV 3.1) and the amount of spin on the ball (e.g., see HSV 4.1). Super-slow motion clips HSV A.16 and A.38 show good examples of the Elephant Practice ball being struck at near the red circle (R/2) limit to achieve maximum English. (Note - an Aramith red-spotted ball, like the pros use on TV, is better for spin visualization in most situations because it is not orientation-dependent like the Elephant Practice ball. If the Elephant ball stripe happens to be lined up with the spin direction, you can't see the spin at all.) The second aid in Diagram 2 (per suggestion 2 above) is a standard striped ball. The edge of the colored stripe happens to be at the half-radius (0.5R) point. This might not be the case with the balls you are using, so be sure to first measure the stripe with a ruler or caliper to verify that the width is 1 1/8" (R) before using one for practice. Also, be sure to clean the chalk marks off before using the ball in normal play because spin-induced and cut-induced throw can be increased significantly if the cue ball happens to hit the marked striped ball on a chalk smudge. I'll look at these and other throw principles and effects in detail in my next series of articles.



R = 1/2 (2 1/4") = 1 1/8" 0.5R = 9/16"

Diagram 2 Maximum offset aiming aids


normal video

NV 3.1 – Practicing contact point and ghost ball visualization


high-speed video

HSV 4.1 – Draw shot
HSV A.16 – Side-English cue-tip reaction for a very large offset, very fast speed, non-miscue shot
HSV A.38 – Draw shot with large offset, light grip, good follow-through, fast speed, and about 7 feet of draw

For suggestion 3 above, Dr. Onoda suggested the following possible approaches to help prevent miscues with large-offset draw shots: elevate the cue, use a smaller tip, and/or develop a more accurate stroke. Elevating the cue is not always a good approach because the stance, bridge and stroke might not be as comfortable, aiming might be more difficult to visualize, follow-through might be limited, and any sideways error in your tip position will result in more cue ball swerve and less accuracy (especially for longer shots). A more accurate stroke is a desirable goal for everybody for all shots (see my May '06 article for some useful advice), and the reason why it is even more important for draw shots is there isn't much clearance between the tip and table for large offset shots. TP A.22 analyzes the effects of cue stick elevation, tip curvature, and tip size on tip offset and table clearance. The most obvious result is that using a smaller and rounder tip allows one to achieve larger offsets while maintaining ample table clearance. It turns out that for a thin tip (e.g., 11 mm) with dime radius, the maximum possible cue tip offset with an average cue stick elevation is about 0.66R, which is much larger than the maximum recommended value (0.5R), so additional cue stick elevation is not necessary. For a fat tip (e.g., 14 mm) with nickel radius, the maximum possible offset is only about 0.59, and at the maximum recommended offset (0.5R), the table clearance is only 0.15 inches (not much room for error). This is much smaller than the table clearance (0.24 inches) for a thin, dime-shaped tip.

Now, as for whether Onoda's suggestion 3 above is correct or not is another matter. Hitting the table first is actually not the most common cause for miscues with draw shots. A more likely cause (based on the numbers in the previous paragraph) is hitting the cue ball too low (e.g., with an offset greater than 0.5R). This would be especially true if the cue tip were not well shaped and chalked (in which case miscues would occur with even smaller offsets). I want to thank Bob Jewett and "Jal" (a user on the BD CCB online forum) for helping reassure me that miscues usually occur with the tip well above the table surface. HSV A.1 shows two interesting shot examples related to draw miscues. The second shot in the clip is obviously a miscue; but in the first shot, the cue tip seems to hit the ball and table at very close to the same time. An illegal jump ("scoop") shot is the result, but it would be a stretch to call the shot a "miscue."


high-speed video

HSV A.1 – Illegal jump shots - scooping under the cue ball (close-up)


technical proof

TP A.22 – "Tips" of English

Some people claim they can achieve more backspin by elevating the cue stick. This might be true for some people, but the reasons might be debatable. As shown in TP A.22, elevation does allow larger tip offsets without risking hitting the table first, especially for a larger tip with a larger radius of curvature. However, as I point out above, extra elevation is not required to achieve maximum recommended offsets, even for fatter and less round tips. Also, the cue ball will lose some of its spin due to friction between the ball and the cloth as it is driven into the table. And as pointed out above, there are other negative consequences associated with cue stick elevation (e.g., swerve for slightly off center hits).

Diagram 3 shows how “tips of English” is defined. This phrase is often used by pool instructors and players to describe how much English should be applied. With “one tip” of English, the cue stick is lowered one tip thickness (“t” in the diagram) below a center-ball hit. For “one and a half tips” of English, the tip is one and a half thicknesses lower than it would be for a center-ball hit. The obvious advantage to this method is that it is very easy to visualize and explain. The obvious problem is that the amount of tip offset will depend on the size and curvature of the tip. TP A.22 reports offsets and table clearances for different tip geometries and for various “tips of English” values. As shown in Diagram 4, for a given number of “tips of English” (e.g., 1.5), a fat, round tip will result in a larger tip offset than a thin, flatter tip.

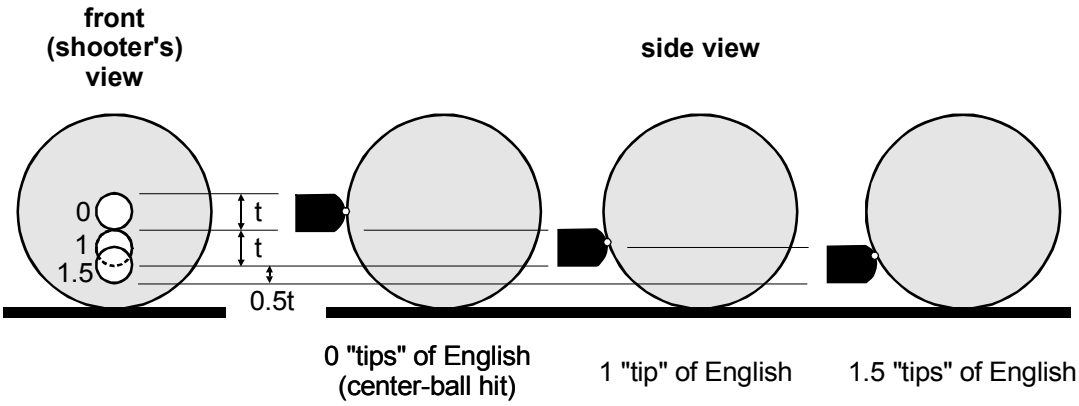


Diagram 3 “Tips” of English

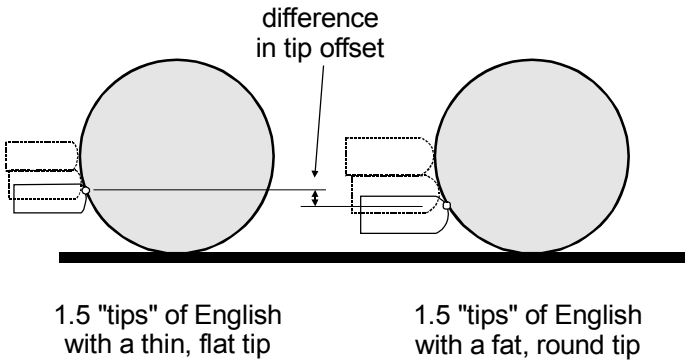


Diagram 4 Thin, flat tip vs. fat, round tip

For the reasons mentioned above, I prefer using percentages or fractions of the maximum offset instead of “tips of English.” With practice, a player will know how far down they can strike the cue ball to avoid a miscue (which should be close to an offset of 0.5R). Knowing the lowest possible position, it is relatively easy to explain and visualize 1/2 (50%) or 1/4 (25%) of that offset. 1/2 or 50% of the maximum is the same regardless of the size or shape of the tip. TP A.22 compares percentage values to “tips of English” values, and the discrepancy can be surprising. For example, for “1.5 tips of English,” the tip offset percentage for a thin tip with nickel radius is about 84% of maximum, as compared to 112% (where a miscue would likely occur) for a fat tip with dime radius. That’s quite a big difference. Strictly speaking, to accurately measure fractions or percentages of English, focus should be on the contact point on the cue ball, and not the center of the cue stick. The reason for this is that the contact point is farther from the center for larger offsets (as can be seen in Diagram 3). However, this is a bit too detailed for most people and it can be difficult to visualize, so I don’t want to make a big deal about it. However, using

fractions or percentages of maximum offset (whether applied to the height of the cue stick center or the contact point) is still a more consistent and accurate approach than using “tips of English.”

I hope you have enjoyed my series of articles on draw shot physics, aiming, and technique. I also hope you have been able to put some of the information to good use in your game. I’ll see you next month with a new series of articles dealing with various throw principles and effects.

Good luck with your game,
Dr. Dave

PS:

- If you want to refer back to any of my previous articles and resources, you can access them online at ***billiards.colostate.edu***.
- If you are unfamiliar with any terms used in this or other articles, please refer to the online glossary and/or discussion threads available in the “Instructor and Student Resources” section of my website.

Dr. Dave is a mechanical engineering professor at Colorado State University in Fort Collins, CO. He is also author of the book: “The Illustrated Principles of Pool and Billiards.”