
Note: Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, and technical proofs (TP) can be accessed and viewed online at www.engr.colostate.edu/pool. 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. See the website for details.

This is the sixth of a series of articles concerning “throw” effects. So far, I’ve looked at basic terminology, examples of where throw can help you or hurt you in game situations, the effects of cut angle and speed, the effects of follow and draw, and the basics of spin-induced throw. All of my past articles are available on my website (www.engr.colostate.edu/pool) if you want to refer back to them. To refresh your memory, **throw** is change in the object ball direction due to sideways forces between the **cue ball (CB)** and **object ball (OB)** during impact. **NV 4.15, 4.16, 7.5, and 7.6** show examples of both **collision-induced throw (CIT)** and **spin-induced throw (SIT)**. See the video demos and the previous articles for more information.



- NV 4.15** – Using throw to make a partially blocked shot
- NV 4.16** – Over-cutting a cut shot to compensate for throw
- NV 7.5** – Frozen ball throw
- NV 7.6** – Frozen cue-ball throw

In previous months, I’ve looked separately at the effects of CIT for cut shots with no English and SIT with no cut angle. So you are probably asking yourself (I hope you are, anyway), “What about when you have a cut shot with English, and how will outside English affect a shot differently from inside English?” Well, that’s the topic of this article. First, let’s look at some terminology.

Diagram 1 illustrates both inside and outside English. **Inside English** is being used in the 1-ball (top) shot, where the cue tip is hitting the right side of the CB, which is on the cut (“in”) side of the ball. **Outside English** is being used in the 2-ball (bottom) shot, where the cue tip is hitting the CB on the right side, which is away (“out”) from the direction of the cut. Notice that in both shots, right English is used; but depending on the direction of the cut, the English is given a different name (“outside” or “inside”). **NV A.18**, a video demo created by Colin Colenso, does a good job at showing various types of English and how they affect shot throw.

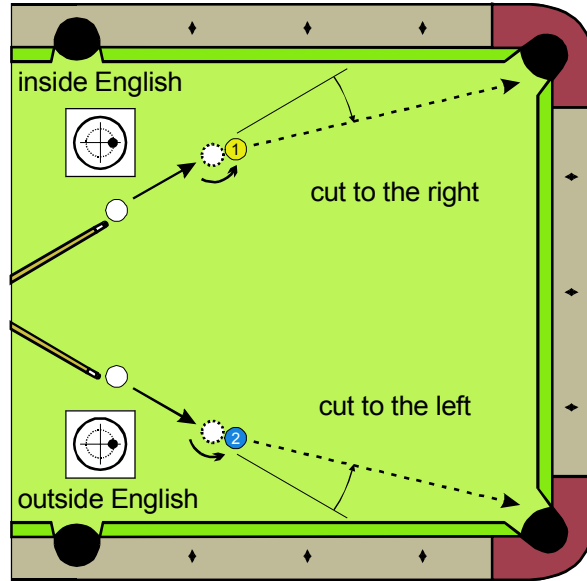
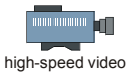


Diagram 1 Inside and outside English



NV A.18 – Colin Colenso's throw test video (effects of speed and English)

It turns out that with just the right amount of outside English, throw can be eliminated completely. In this case, the English is referred to as **“gearing” outside English** because the CB “rolls” on the OB during impact instead of sliding (e.g., see **HSV A.8** and **HSV A.62**), as if the two balls were gears meshing together. With no relative sideways motion between the CB and OB surfaces during impact, there is no sliding friction or throw.



HSV A.8 – Outside English cut shot
HSV A.62 – Cut shot with outside English and slow speed

The amount of English required to achieve “gearing” depends on the cut angle for the shot. If you want to see the math and physics details, check out **TP A.26**; if you don't, just look at Diagrams 2 and 3, which illustrate the results. **Diagram 2** shows how much outside English is required to achieve throw-less, “gearing” action, for any cut angle. The amount of English is specified as a percentage of the maximum recommended English, as described in my July '06 article dealing with “tips of English”. The data for the two example points labeled “A” and “B” in Diagram 2 are illustrated with shots in Diagram 3. Shot “A” is using 40% outside English for a 30° cut angle. Shot “B” is using 70% outside English for a 60° cut angle. For both shots, the OB heads exactly in the impact line (line of centers) direction (i.e., there is absolutely no throw). With the “gearing” action, the cut angle effect (CIT) exactly cancels the English effects (SIT).



TP A.26 – The amount of English required for “gearing” outside English

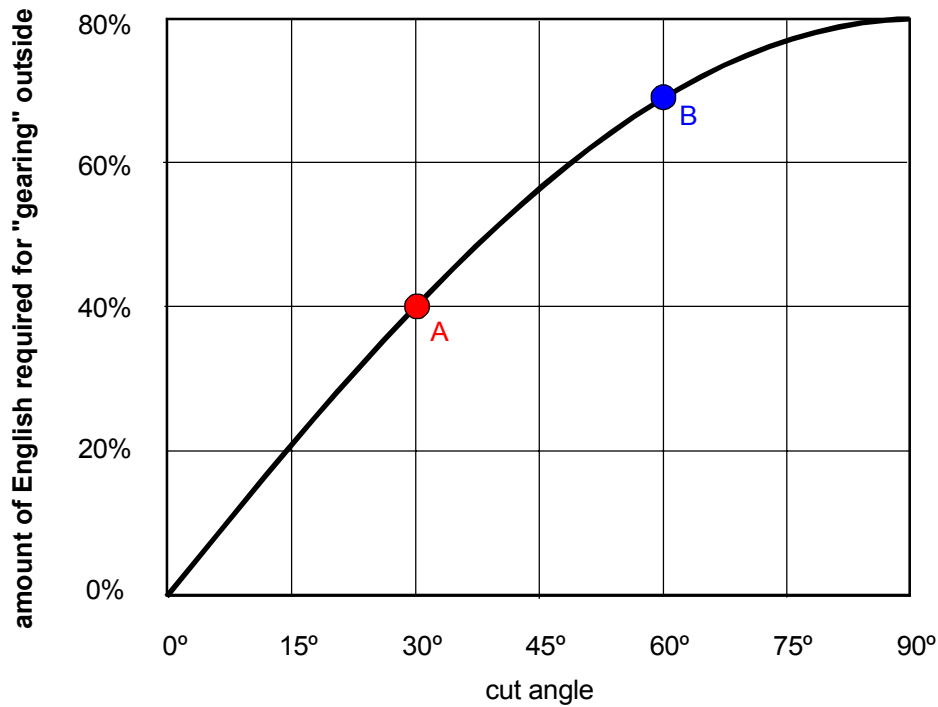


Diagram 2 Percent English required for “gearing” for any cut angle

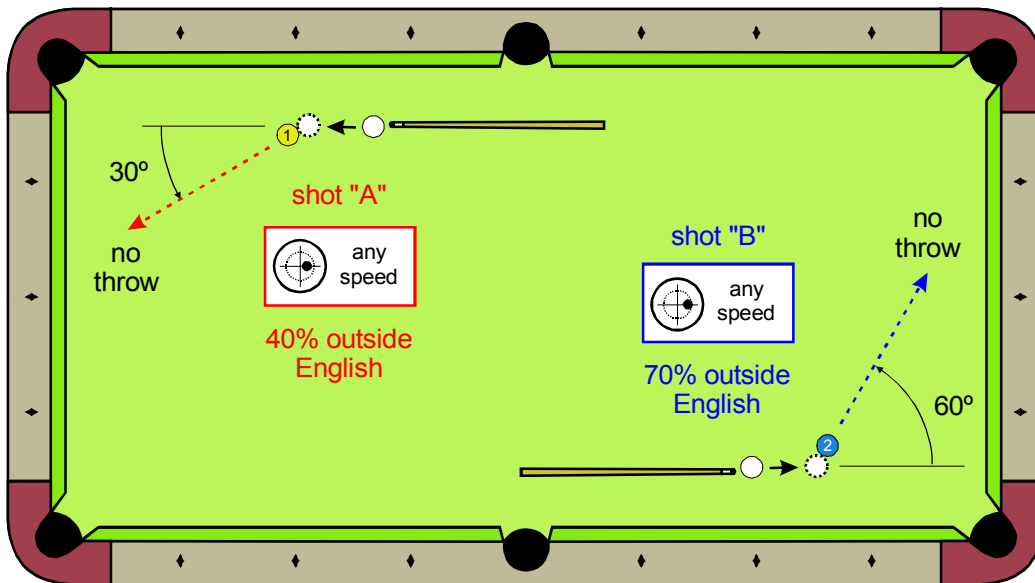


Diagram 3 Example shots from Diagram 2

For the shots in Diagram 3, if one uses more or less English than indicated, there will be OB throw (i.e., the OB won't head in the impact line direction). **Diagram 4** shows examples for the various types of English with the corresponding throw directions. For outside English, the direction of the throw depends on the amount of English as compared to “gearing” outside English. All four shots in Diagram 4 are half-ball hits (30° cut angle); so from Diagram 2, 40% outside English is required for “gearing” action. Shot “A” (the 1-ball shot) shows what happens if you have less than the “gearing” amount (i.e., “insufficient” outside English; in this case, less than

40%). The CIT effect dominates the SIT effect, and the OB gets thrown to the right. In shot "B" (the 2-ball shot), the amount of English is more than "gearing" (i.e., "excessive" outside English; in this case, more than 40%). In this case, the SIT effect dominates the CIT effect, and the OB gets thrown to the left. In shot "C" (the 3-ball shot) the amount of English is exactly "gearing" (in this case, exactly 40%) and as shown in Diagram 3, there is no throw whatsoever. In shot "D" (the 4-ball shot) inside English is being used. In this case, the SIT and CIT effects are in the same direction, and the OB gets thrown to the right. One might think that the amount of throw in shot "D" might be the largest because the SIT and CIT are in the same direction. However, as we will see next month, these effects do not usually add. In fact, there is usually less throw with inside English as compared to non-gearing outside English.

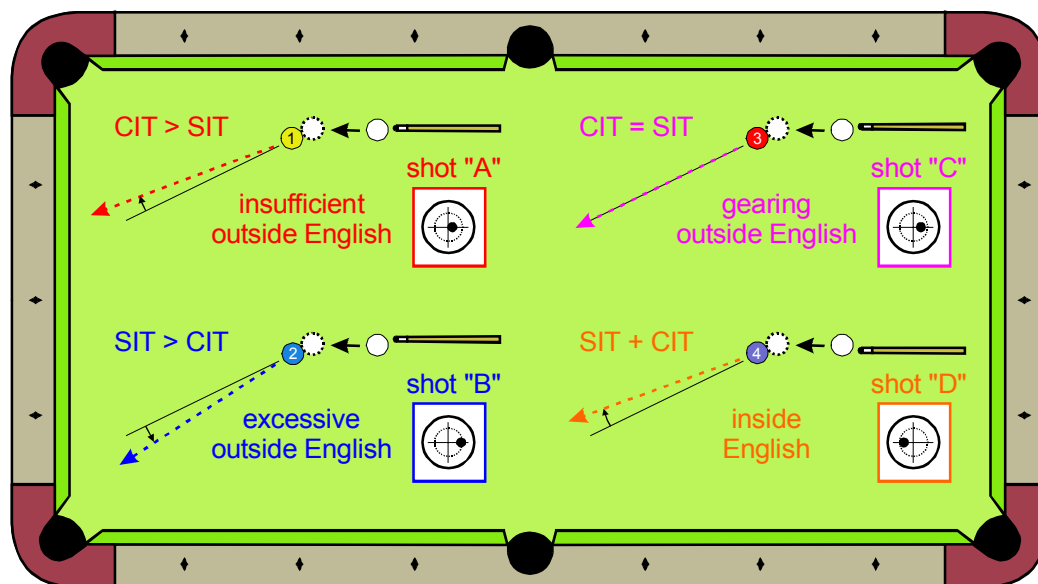


Diagram 4 Examples of throw with various amounts of inside and outside English

At this point, you might be wondering: "If gearing outside English eliminates throw, why shouldn't I use it on every cut shot?" Well, first of all, the type and amount of English you use is usually dictated by the shot. English is required to help you position the CB for the next shot (see **NV 4.25**). Remember, the most important thing in pool (other than having fun, and winning if you are competitive) is making a shot, and the second most important thing is making the next shot. That's where English can help. Secondly, with English comes squirt (see **NV 4.13**) and swerve (see **NV 4.14**). If you are not good at compensating for these effects, throw-less gearing action won't be so helpful anyway. We'll look at squirt and swerve effects and compensation methods in future articles. Finally, if you don't have a good intuitive feel for Diagram 2, it might be difficult to achieve gearing outside English on every shot anyway.



NV 4.25 – Positioning the cue ball at all spots on the table from an easy side-pocket shot

NV 4.13 –Squirt due to high speed English

NV 4.14 – English curve due to an elevated cue

I hope you are enjoying and learning from my series of articles dealing with throw. Next month, we'll look at the details of how throw varies with shot speed, cut angle, and the type and amount of English. I'm sure many of you will be surprised by some of the results, so stay tuned.

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 www.engr.colostate.edu/pool.

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."