
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 seventh article in my series dealing with “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, spin-induced throw, and the difference between inside and outside English. 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

Last month, we looked at the combined effects of cut angle (CIT) and English (SIT). With inside English, CIT and SIT are in the same direction but the effects don’t always add. With outside English, CIT and SIT are in opposite directions and they tend to cancel each other. When the amount of outside English results in absolutely no throw, we refer to the English as “gearing” outside English. The amount of English required to achieve “gearing” depends on the cut angle for the shot (see **TP A.26**). For a half-ball hit (30° cut angle), 40% English is required. For smaller cut angles (fuller hits) less English is required, and for larger cut angles (thinner hits) more is required. If you are unfamiliar with any of these terms, please refer to last month’s article. Also, view **NV A.18** to see the basics of how various types of English affect shot throw.



- TP A.26** – The amount of English required for "gearing" outside English



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

Last month, we looked at only a few inside and outside English shot examples, and we didn’t look at the specifics of how much throw you get in different cases. Well, that’s the topic of this month: how much do you need to adjust for throw for various cut angle shots with various types of English and shot speeds. After six previous articles, we’re finally ready for this culminating look at the big picture.

Diagrams 1 through 4 show example graphs from the throw analysis in **TP A.14**, which reveals how OB throw varies with the type and amount of English, cut angle, speed, and follow/draw/stun. Each graph is a plot of the amount of throw (on the vertical axis) vs. cut angle

(on the horizontal axis), where the throw is the combined result of collision-induced and spin-induced effects. The three curves show throw for three different types of English: none, inside, and outside. The amount of English is specified as the percentage of maximum recommended English (as described in my July '06 article dealing with "tips of English"). Throw in the CIT direction is labeled positive (the top half of each graph), and throw in the SIT direction (from excess outside English) is labeled negative (the bottom half of each graph). Diagrams 1 through 3 are for slow stun shots (where the amount of throw is maximum) with different amounts of English: 25%, 50%, and 100%. Diagram 4 is for a medium speed follow or draw shot. Only cut angles up to 60° are included in the graphs because using English is risky with very thin hits. A thin hit requires much more precision than a thicker hit. Although, if the OB is very close to the pocket, the shot can be more forgiving to errors due to squirt, swerve, and throw.



TP A.14 – The effects of cut angle, speed, and spin on object ball throw

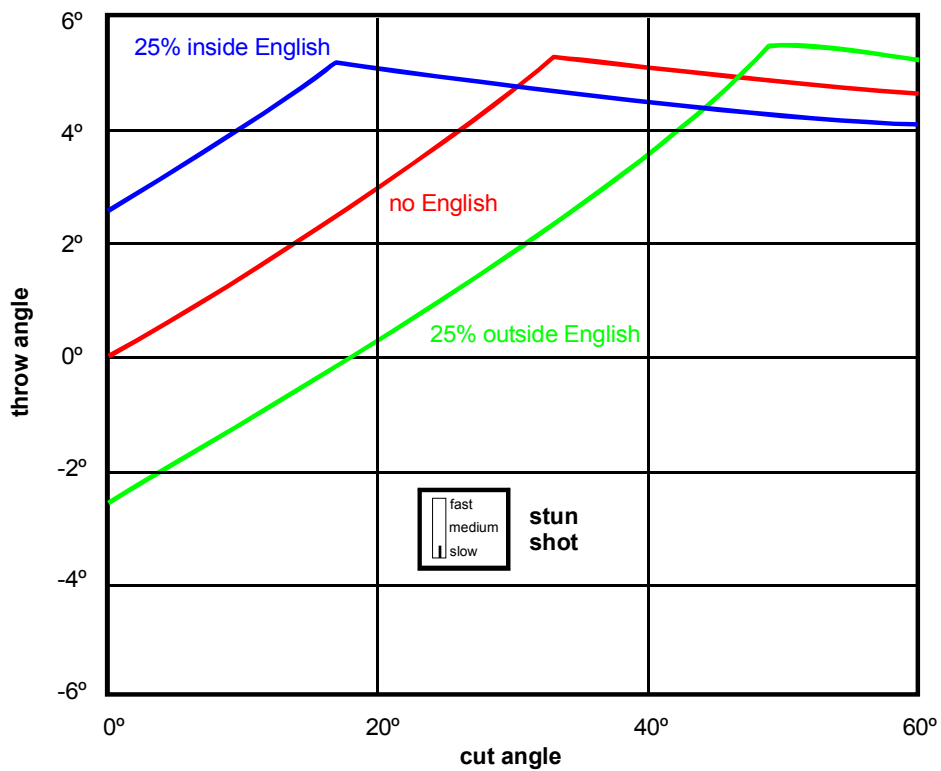


Diagram 1 Throw vs. cut angle for a slow stun shot with 25% English

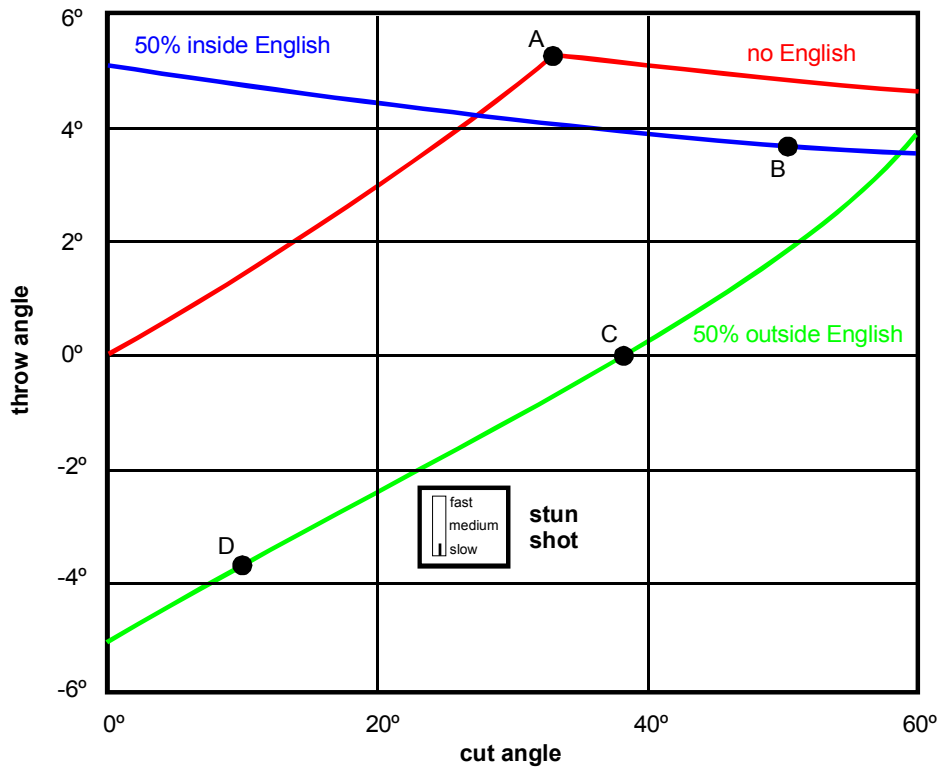


Diagram 2 Throw vs. cut angle for a slow stun shot with 50% English

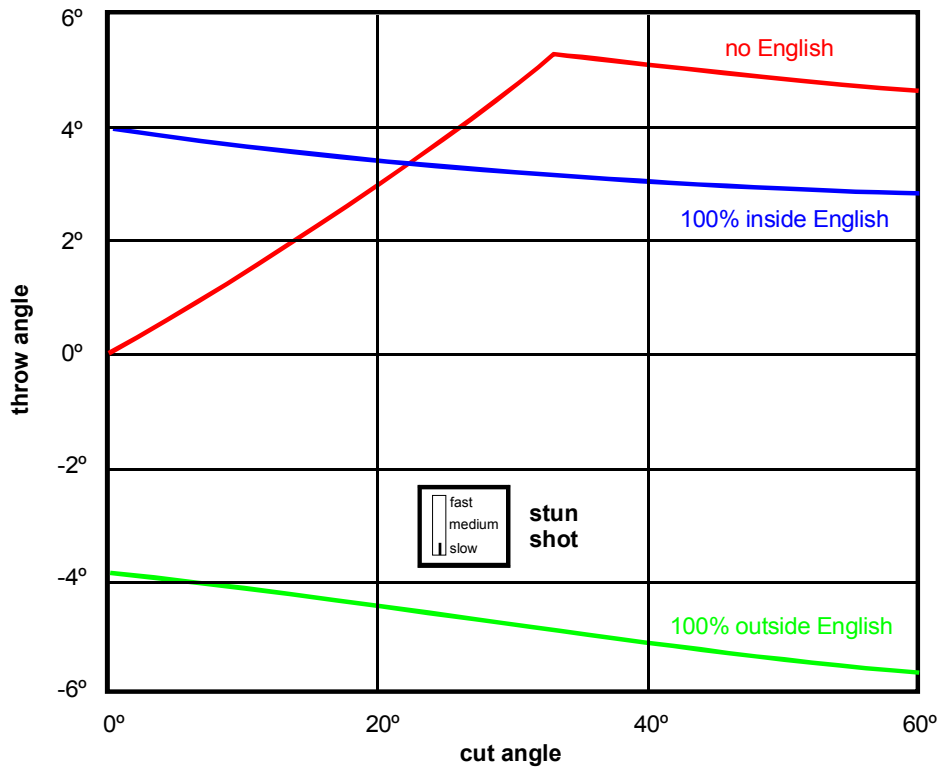


Diagram 3 Throw vs. cut angle for a slow stun shot with 100% English

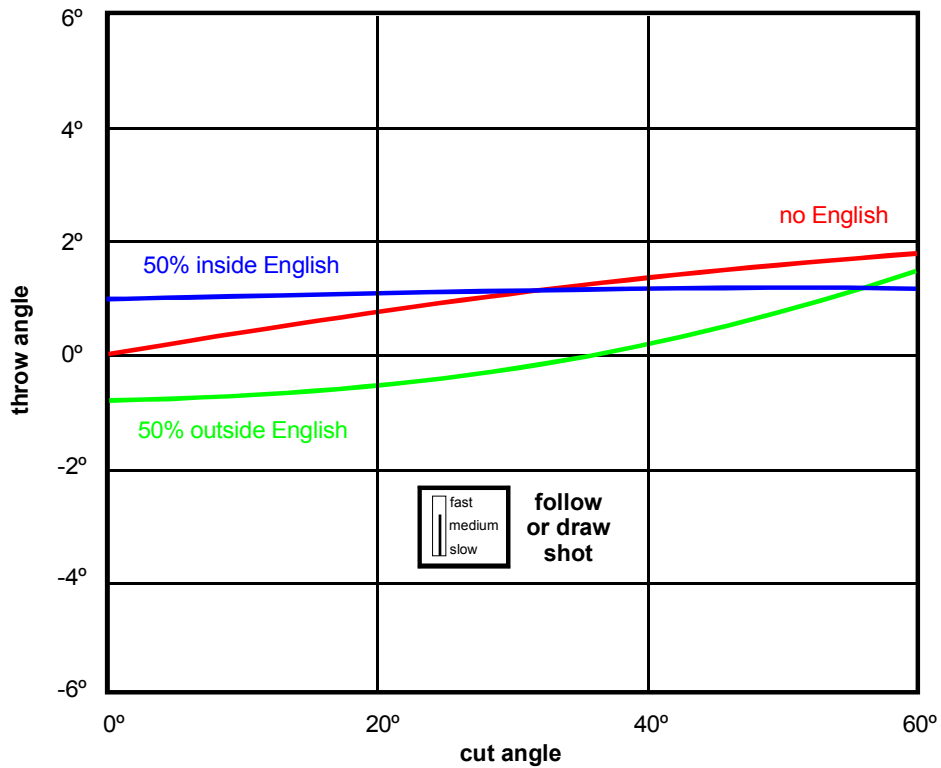


Diagram 4 Throw vs. cut angle for a medium speed follow or draw shot with 50% English

To help interpret the results in Diagrams 1 through 4, **Diagram 5** illustrates the data for the four example points shown in Diagram 2. Shot “A” is a 34° cut shot with no English, resulting in 5.4° of CIT to the right. If you don’t adjust your aim to account for throw with a slow stun shot like this, you will usually miss the shot, sometimes very badly. Shot “B” is a 50° cut shot with 50% inside English, resulting in 3.7° throw to the right, much less than with shot “A.” Shot “C” is a 38° cut shot with gearing outside English, resulting in absolutely no throw. In this case, the OB will head exactly in the impact line (line of centers) direction. Shot “D” is a 10° cut shot with 50% outside English, resulting in 3.7° throw to the left. For a cut angle this small, 50% English is much more than the “gearing” amount, causing the throw in the SIT direction.

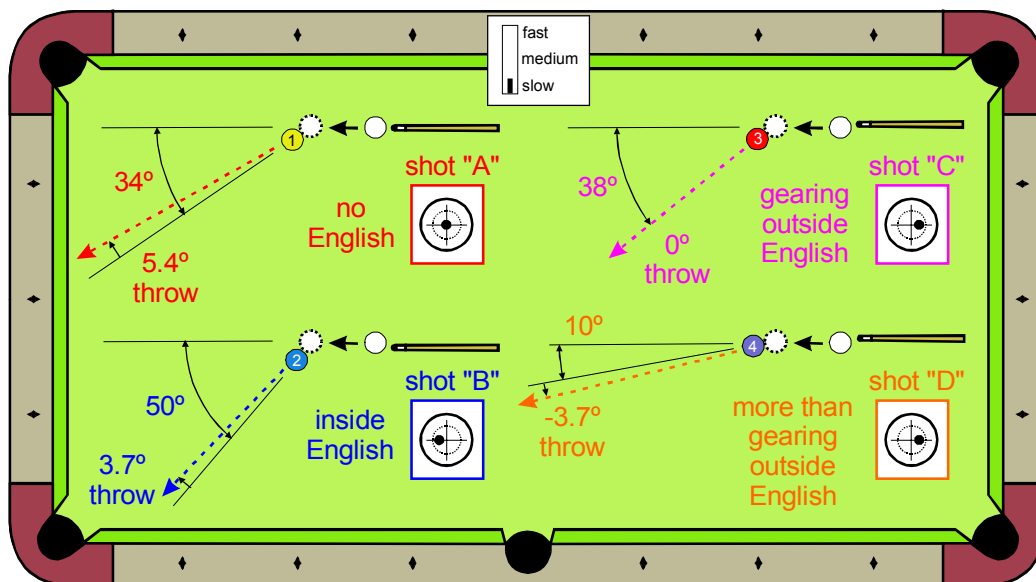


Diagram 5 Example shots from Diagram 2

Here are some conclusions that can be drawn from the diagrams above and from all of the graphs at the end of TP A.14:

- Maximum throw occurs with slow speed stun shots.
- At very small cut angles, inside English and outside English create similar amounts of throw (although, in opposite directions).
- For large cut angles, a small amount of outside English can result in more throw than shots with no English.
- For large cut angles, inside English results in less throw than shots with no English.
- There is less throw with follow and draw shots as compared to stun shots (see my October, 2006 article for more details).
- Inside English increases throw at small cut angles, but actually reduces the amount of throw at larger cut angles.
- Outside English can cause throw in either direction depending on the amount of English and the cut angle.
- For every cut angle, there is a certain amount of outside English (called "gearing" outside English) that results in absolutely no throw (see last month's article for more information).
- Outside English can throw the OB left or right, depending upon whether the amount of English is greater than or less than the "gearing" amount.
- Even for large cut angle shots (thin hits), excess outside English (more than the "gearing" amount) can be applied to throw the OB in the SIT direction.
- With faster speed, in general, there is less throw. An exception is small cut angle shots with small amounts of English (see my 2006 September and December articles for details).

- For fast speed follow or draw shots there is very little throw, regardless of the type of English used.

I want to remind you that with this entire series of articles on throw, I have ignored the effects of squirt (see **NV 4.13**) and swerve (see **NV 4.14**). I have assumed that you have already compensated for these effects in your aim. We'll look at squirt and swerve effects and compensation methods in future articles. To put all of this throw information to good use, you really need a firm understanding of squirt and swerve and how to compensate for them. For example, as we saw above, throw is usually less with faster speeds. However, the effects of squirt and swerve require more aim compensation at higher speed, even with a low-squirt cue. To make matters worse, the effective sizes of the pockets are smaller at higher speeds (see my November '04 through January '05 articles). If you have great intuition from years and years of practice, then maybe you don't need to know all of this stuff (although, I think knowledge, if used properly, can always be helpful). If your intuition is not perfect, then maybe the information in these articles can help speed your intuition-building and learning process.



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 a little closer at outside and inside English. We'll look at examples of when and why each might be useful or necessary.

Good luck with your game,
Dr. Dave

PS:

The discussion of speed effects above reminded me of a funny phrase a British buddy of mine uses. When he first came to America and started playing pool, having played only snooker previously, he didn't like that Americans called sidespin "English" instead of "side" (the term used by snooker players). To get back at us silly Americans, whenever he sees a pool player hitting the ball too hard, he calls it "American" because he thinks many American pool players often use too much speed (especially drunk, macho, cowboy types in bars). Isn't that special? Remember, especially when using "English," don't put too much "American" on the cue ball unless you absolutely need it.

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."