*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 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 fifth 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 (**billiards.colostate.edu**) 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 **cut-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

normal video

Last month, I introduced the basics of SIT. Here is a summary of the most important conclusions from last month:

- Left English throws the object ball to the right and right English throws to the left.

- SIT is maximum for a stun shot.

- Follow and draw both reduce SIT, and they do so by the same amount.

- More English gives you more SIT only up to a point. Additional English actually reduces the amount of SIT (i.e., more English doesn't always give you more throw).

- The amount of throw can increase significantly when a small amount of English is added, especially for a stun shot.

This month, we will look at the effect of shot speed on SIT.

Diagram 1 shows a graph from the throw analysis in **TP A.14** showing how spin-induced throw varies with speed for straight-on (0-degree cut angle) stun shots with different amounts of English. The graph is a plot of the amount of throw (on the vertical axis) vs. the amount of English (on the horizontal axis). The three curves show SIT for three different speeds (slow, medium, and fast). 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"). Right English (the right side of the graph) is reported as a positive number and designated with "R," and left English (the left side of the graph) is negative and is designated with "L." Throw to the left (from right English) is labeled negative (the bottom half of the graph), and throw to the right (from left English) is labeled positive (the top half of the graph).
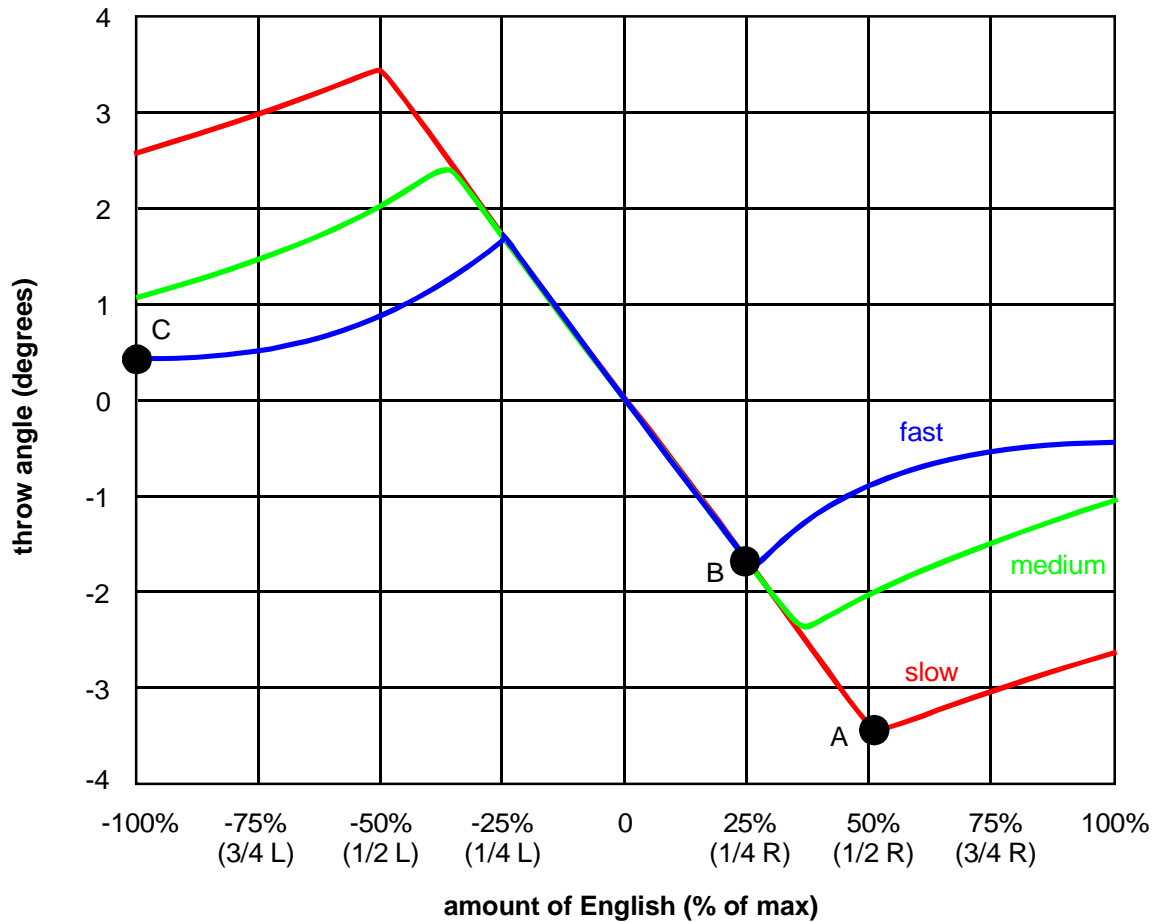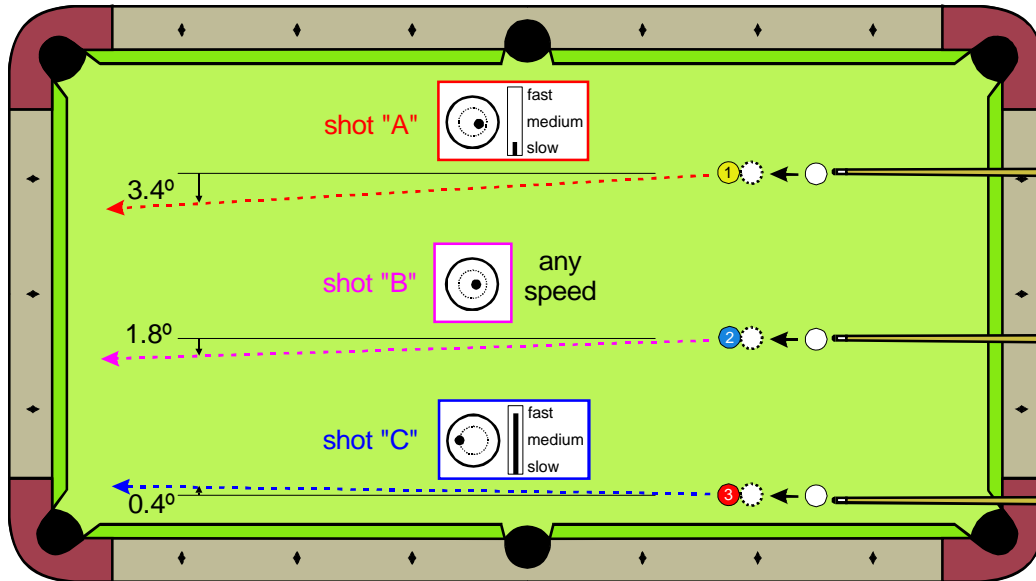
Diagram 1 SIT vs. amount of English

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

technical proof

To help interpret the results in Diagram 1, **Diagram 2** illustrates the data for the three example points labeled "A," "B," and "C." Shot "A" is a slow shot with about 50% right English, which results in about 3.4º of SIT to the left. Shot "B" is a 25% right English shot, which results in about 1.8º SIT to the left at any speed. Shot "C" is a 100% (maximum) left English shot that results in less than 0.5º of throw to the right.

Diagram 2 Example shots from Diagram 1

Here are some conclusions that can be drawn from the graph in Diagram 1 and the examples in Diagram 2:

- SIT is independent of speed (i.e., the throw is the same at all speeds) for small amounts of English.

- SIT is largest for a slow stun shot with about 50% of maximum English.

- More English (e.g., greater than 50% for a slow stun shot, and greater than 25% for a fast stun shot) doesn't always create more throw.

Based on this information, I want to clear up a slight error in my commentary for the example shot shown in NV 4.15. In the video, I recommend using maximum English. Well, that's not the best advice if you want to achieve the maximum amount of throw. Any amount of English beyond 50% actually reduces the amount of throw. I've wanted to correct that video for a long time, but priorities don't always leave time for such activities.

So how can the information in this article be useful in your game? Here are a couple of examples:

1. When you don't intend to use English, make sure you are hitting the center of that cue ball; otherwise, SIT caused by unintentional English might make you miss your shot.

2. If you need to throw an object ball a lot (e.g., as with the shot in NV 4.15), use a soft stun shot with about 50% English. This is one of those cases where more (in this case, English) is not better.

I hope you are enjoying and learning from my series of articles dealing with throw. Over the next few months, we'll look at the combination of CIT and SIT, outside English, and various approaches for dealing with throw and squirt in your game.

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***.

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."