David Alciatore, PhD ("Dr. Dave") **ILLUSTRATED PRINCIPLES**

"90° and 30° Rule Follow-up – *Part IV: English effects*"

***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 3.4**) help you locate the resources on the website. You might also want to view the resources from a CD-ROM. See the website for more details.*

In my previous three articles, I answered a few questions that have come up concerning my series of articles on the 90° and 30° rules (see my January '04 through July '04 articles at **billiards.colostate.edu**). If you are getting tired of reading about these important rules, don't despair ... this is the last article in the series. In last month's article, we looked at the effects of ball inelasticity and friction. In this article, I conclude the series by looking at the effects of side English. As with the inelasticity and friction effects, the effects of side English are not very significant for most shots (more on this later). Honestly, the knowledge presented in these two most recent articles is probably not that useful in your game. I am presenting these effects mostly just to satisfy some people's curiosity and to maybe clear up some misconceptions that some people might have.

If you don't remember what the 90° and 30° rules are and when they apply, see **NV 3.4-3.5** and **NV 3.7-3.10**. Readers with engineering or physics backgrounds might also find **TP 3.1** and **TP 3.3** interesting. Remember, the 90° rule states that for a stun shot, where the cue ball is sliding at object ball impact, the cue ball and object ball paths separate at 90° (i.e., the separating paths are perpendicular). The 30° rule states that when the cue ball is rolling at object ball impact, and when the cut angle is between a 1/4-ball and 3/4-ball hit fraction, the cue ball's path will be deflected by approximately 30°. If these previous two sentences are not clear, you might want to look at the online videos and articles mentioned above.


normal video

NV 3.4 – 90° rule with various cut angles
NV 3.5 – Using your hand to visualize the 90° rule impact and tangent lines
NV 3.7 – Using the 90° rule to check for and prevent a scratch
NV 3.8 – Using your hand to visualize the 30° rule
NV 3.9 – 30° rule example
NV 3.10 – Using the 30° rule to check for and prevent a scratch


technical proof

TP 3.1 – 90° rule
TP 3.3 – 30° rule

Diagram 1 shows the effect of side English on the 90° rule. Throughout this article, I am assuming that the balls collide perfectly elastically, meaning no energy is lost in the collision. The effects of ball inelasticity, which accounts for the small amount of energy loss, were covered in last month's article. For an elastic collision, side English has absolutely no effect on the cue ball's post-impact direction (i.e., the cue ball heads directly in the tangent line direction). The effect of side English on the object ball's direction depends on the type of English applied. **Inside English** refers to sidespin on the same side as the cut (e.g., using left English with a cut shot to the left, as shown in **Diagram 1**). With inside English, or with no English and a cut angle, there is always a relative sideways motion between the cue ball and object ball during impact (see **HSV A.63**). This relative motion creates a friction force that "throws" the object ball off course (e.g., see **NV 4.15**). As shown in **Diagram 1**, the effect of no English or inside English is to shorten the object ball angle a little. The more friction there is between the balls, the more throw there will be (e.g., see last month's article for more information). For more discussion on different types of throw

and various effects related to throw, see the links under “throw” in the “Online Discussion Threads” area at ***billiards.colostate.edu***.

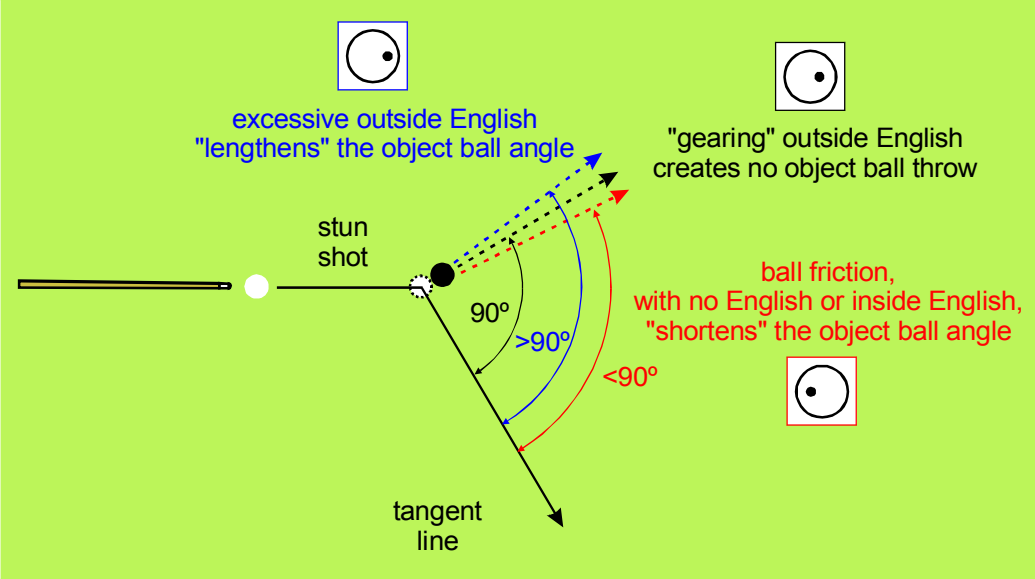

Diagram 1 The effects of English on the 90° rule

normal video NV 4.15 – Using throw to make a partially blocked shot

high-speed video HSV A.63 – Cut shot with inside English and slow speed

Outside English refers to sidespin on the opposite side as the cut angle (e.g., using right English with a cut shot to the left, as shown in **Diagram 1**). With just the right amount of outside English, there will be no relative sideways motion or friction between the cue ball and object ball during impact. This is called “gearing” outside English because the cue ball rolls on the object ball as if the two balls were gears meshing together (see **HSV A.8** and **HSV A.62**). I really like this analogy because I am a “gear-head” mechanical engineer. As shown in **Diagram 1**, with “gearing” outside English, the object ball does not get thrown at all; again, because no sideways friction force is generated during the impact. This is why people often recommend using outside English for cut shots. The other school of thought is to just adjust your aim, increasing the cut angle slightly (see **NV 4.16**). The disadvantage of using English is you need to account for cue ball deflection (AKA squirt) (see **NV 4.13**) and curve (AKA swerve) (see **NV 4.14**). The disadvantage of adjusting the aim is that it takes practice and intuition to know how much to adjust, and the amount of throw can vary with ball conditions and shot speed. Increased ball friction (e.g., with dirty balls) creates more throw, and faster speeds usually exhibit a little less throw.

normal video NV 4.13 – Squirt due to high speed English
NV 4.14 – English curve due to an elevated cue
NV 4.16 – Over-cutting a cut shot to compensate for throw

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

The last case shown in **Diagram 1** (the blue-colored case) corresponds to when the amount of outside English is greater than "gearing" outside English. In this case, the cue ball is spinning fast enough at impact to create relative motion between the cue ball and object ball at impact. This creates a friction force that throws the object ball in the direction of the spin. In this case, the object ball angle is lengthened. **Principle 20** summarizes the effects various types of side English have on the 90° rule.

Principle 20 **The effects of English on the 90° rule**

Inside English reduces the object ball angle below 90°, excessive outside English increases the object angle above 90°, and no English or "gearing" outside English have absolutely no effect on the object ball angle (see Diagram 1).

- The cue ball's path is unaffected by side English.
- The technical details can be found in **TP A.7**.

TP A.7 – The effects of English on the 90° rule

Diagram 2 shows the effects of side English on the 30° rule. As we saw last month, ball friction tends to increase the deflected angle of the cue ball above 30°. With no friction, side English would have no effect whatsoever. Outside English has a similar effect as a normal roll shot with no side English (see last month's article). As shown in **Diagram 2** (see the red-colored shot), the deflected cue ball angle is increased a little with outside English. With inside English (see the blue-colored shot), the cue ball's deflected angle is also increased a little, but not as much as with no English or outside English. **Principle 21** summarizes the effects side English has on the 30° rule and **TP A.8** includes typical numerical values for various cases.

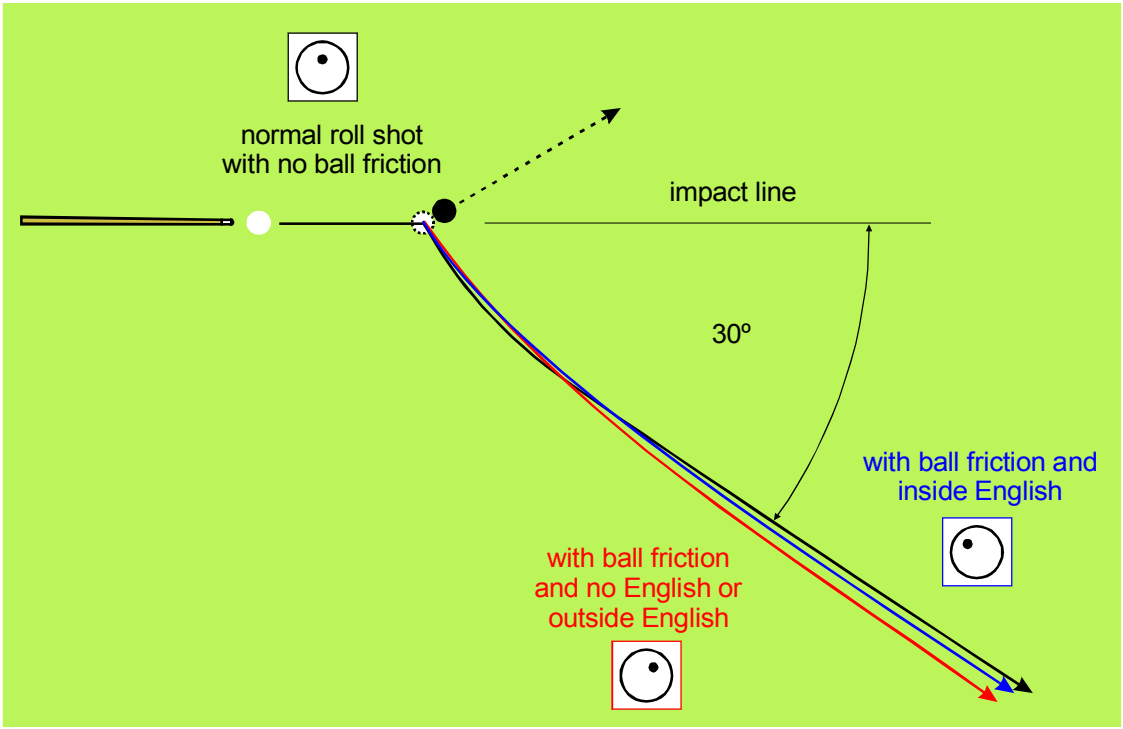

Diagram 2 The effects of English on the 30° rule

Principle 21 The effects of English on the 30° rule

Ball friction increases the deflected cue ball angle above 30°. The angle is increased more with no English or outside English than with inside English.

- The deflected cue ball angle is still very close to 30° for a wide range of cut shots (see my April, 2004 article).
- The technical details can be found in **TP A.8**.

technical proof

TP A.8 – The effects of English on the 30° rule

Bottom line: Side English has only small effects on the 90° and 30° rules. For slow shots, with small cut angles, the effects of object ball throw can be significant and must be accounted for (e.g., see **NV 4.15** and **NV 4.16**). Also, as mentioned above, cue ball deflection (squirt) and curve (swerve) must also be accounted for, especially for large offset English shots over large distances. However, the 90° and 30° rules can be used to fairly accurately plan and predict the path of the cue ball for position play, break-up shots, avoidance shots, and carom shots (see my previous articles).

I hope you have enjoyed my series of follow-up articles on the 90° and 30° rules. Now that I written a total of ten articles on these very important rules, I think it's time to move on. Look forward to some new stuff starting next month.

Good luck with your game, and practice hard,
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***.
- FYI, I have a section on my website entitled "Online Discussion Threads." There you can find links to interesting online discussions from the Billiards Digest Cue Chalk Board (CCB) relating to "Illustrated Principles" topics. Feel free to participate by posting questions or responses.
- FYI, over the next three years I will be presenting a multimedia seminar across the country, sponsored by the *American Society of Mechanical Engineers*. The title is "The Illustrated Principles of Pool and Billiards." The talks are usually open to the public, so periodically check out the dates and locations on my website. It would be fun to have some BD readers (and not just engineers) in the audience. The seminar is geared toward a general audience (even non pool players), but it is usually well received by both engineers and seasoned pool players.

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" (2004, Sterling Publishing).