
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 eighth article in my series dealing with “throw” effects. I hope that you’re not thinking: “Enough, already!” I promise that I’m almost done with throw, and soon I’ll move on to other topics. Please bear with me a little longer. 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, the difference between inside and outside English, and the combination of spin- and collision-induced throw effects. 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, I mentioned that I would cover inside and outside English in more detail and show examples where each might be appropriate. I lied. I’ll try to cover that topic in a future article; but for now, I want to discuss throw and its connection to spin transfer. **Spin transfer** refers to spin the CB imparts to the OB during collision. Recently, there was a bunch of heated debate on this topic in the Billiards Digest CCB online discussion forum, hence my desire to cover this topic in detail now.

You might be asking yourself: “What does spin transfer have to do with throw?” Good question. The answer is: “Spin transfer has everything to do with throw, because you can’t have one without the other.” **Diagram 1** illustrates all of the important terminology and physics. Throw occurs any time there is relative sliding motion between the CB and OB surfaces at impact. In Diagram 1, the relative motion is a result of CB English. The right English (counterclockwise spin) creates a sliding friction force that pushes the OB to the left. This force is what creates the **throw angle**. Because the **throwing force** is pushing on the edge of the OB, it also causes the OB to rotate about its center. Imagine pushing on the outside of a wheel ... the wheel will turn as a result. The spin imparted to the OB is called **transferred spin**. In this case, the throwing force to the left creates clockwise spin on the OB. You cannot have throw without spin transfer because they both result from the same throwing force. The amount of spin transfer can be as high as 35.7% (see **TP A.27**), but it can be much lower. Throw and spin transfer effects will be smaller for new, clean, polished, and/or waxed balls; but in most pool halls, bars, and home pool rooms, the balls won’t usually be so ideal. So you better be aware of and know how to correct for (or use to your advantage) throw and spin transfer effects.

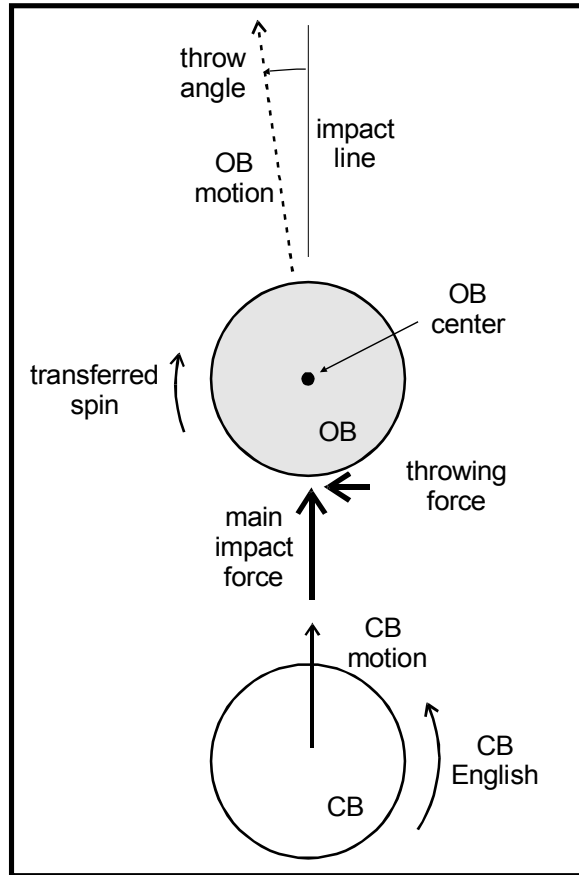


Diagram 1 Throw and spin transfer terminology and physics



TP A.27 – Spin transfer

Diagram 2 and **NV A.21** show an example bank shot where throw and spin transfer are critical effects. Without throw and spin transfer, the shot would not be possible as shown. The goal is to bank the 1-ball cross corner. The problem is the 2-ball. It prevents us from hitting the 1-ball with a cut angle to pocket a normal bank shot. I am assuming that we are using a near level cue stick so swerve is not much of an effect (i.e., I am not considering a masse shot as an option here); therefore, I am assuming that the CB hits the 1-ball squarely or very close to squarely. If you didn't know about throw and spin transfer, you would not think this shot is possible. However, by applying left English with slow to medium speed, the shot can be made fairly easily. The left English on the CB throws the 1-ball to the right, looking from the shooter's perspective. The throwing force imparts right (counterclockwise) spin on the 1-ball. The spin causes the 1-ball rebound angle to lengthen, allowing us to pocket the bank. More detail and explanations are provided in the video (NV A.21), so be sure to watch it several times and try the shot out yourself.

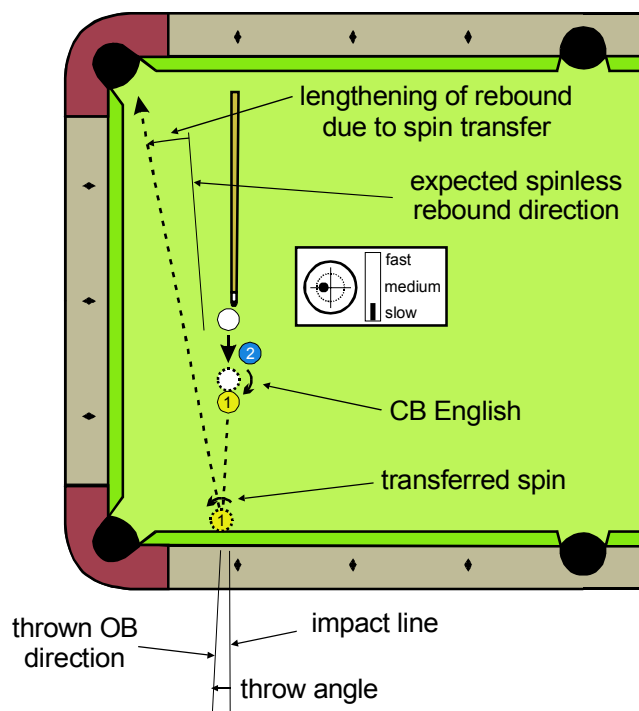


Diagram 2 Bank shot example using throw and spin transfer



NV A.21 – Bank shot using throw and spin transfer

Per my December '06 article, to get maximum throw, use a soft stroke and about 50% stun English (i.e., side spin only). The amount of throw and spin transfer for the shot in Diagram 2 will depend on ball conditions, so if you want to try out the shot yourself, which I highly recommend, you might need to experiment with speed and/or the amount of English. Remember, above 50% English, more isn't better (i.e., you don't get more throw with more English). If you are using new, clean, and/or polished balls, you might not be able to get enough throw and spin transfer action. If that's the case, visit your local bar or pool hall, and you will likely get more action than you need or want. Also, the condition of the cushion and cloth will affect the rebound angle (e.g., humidity can make the cushions more sticky than normal, creating more reaction to the transferred spin), so the required speed and English will vary from table to table.

I'm sure there are some folks out there who firmly believe that throw and spin transfer don't exist. Well, I hope this article helps convert them over a little. My whole recent series of articles should convince people without a doubt that throw does exist. If throw doesn't exist, I should be committed to a mental institution; because if it doesn't exist, I have been in an extreme delusional state these last eight months. Either that or my pool balls have been violating the *laws of throw-less physics*. As for spin transfer, Diagram 1 provides conceptual proof of why it must exist. The force that creates throw must also cause the OB to spin. If that's not proof enough, **HSV A.66** provides a high-speed video demonstration of the effect; and for the physics nerds out there, **TP A.27** provides a physics-based mathematical proof. If the non-believers in the congregation are still skeptical, the only thing else I can do is ask them to just have faith ... spin transfer does exist, and it can affect pool shots.



HSV A.66 – Straight-on shot with English and slow speed

I hope you are enjoying and learning from my series of articles dealing with throw. Next month, I'll look at another example of throw and spin transfer that some people claim proves that throw and spin transfer don't exist. You probably know the bottom line of next month's article already: the claim is a bunch of hooey.

Good luck with your game,
Dr. Dave

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