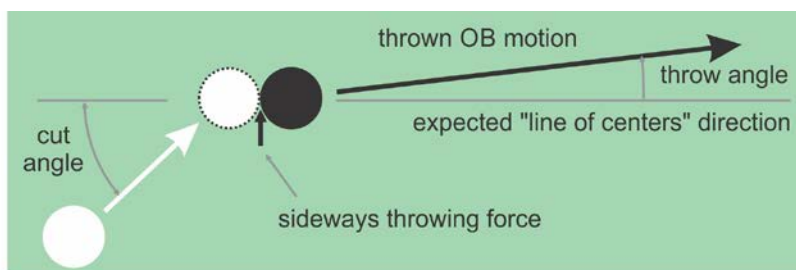
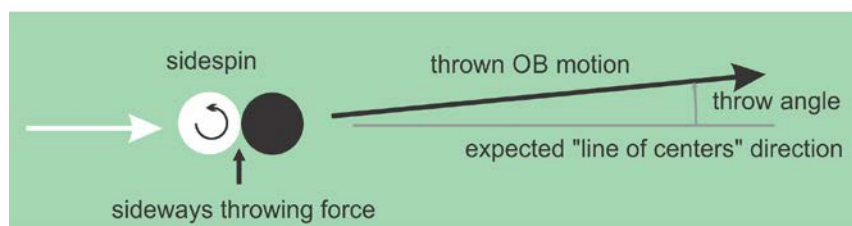


Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, technical proofs (TP), and all past articles are available online at billiards.colostate.edu. Reference numbers used in the articles help you locate the resources on the website.

I recently posted an online video ([NV J.42](#)) that demonstrates the top 10 most important things you need to know about throw, which are summarized below. Throw refers to offline motion of the object ball (OB) caused by friction between the cue ball (CB) and OB during a hit. As shown in **Image 1**, when throw is due primarily to cut angle, it is called **cut-induced throw (CIT)**; and when it is primarily due to sidespin, it is called **spin-induced throw (SIT)**.



(a) cut-induced throw (CIT)



(b) spin-induced throw (CIT)

Image 1 Cut-induced throw (CIT) and spin-induced throw (SIT)

1. No Throw with Gearing Outside Spin

As shown in **Image 2**, with a cut to the left and left spin, the OB gets thrown to the right. And with lots of right spin, the OB gets thrown to the left. Therefore, there is an amount of spin that will result in no throw whatsoever. It is called **gearing outside spin** since the CB rolls along the OB while in contact, like a meshing gear. In [NV J.42](#), notice how the vertical 11-ball stripe remains vertical with gearing outside spin. Anytime there is throw, sidespin is transferred to the OB, which causes the vertical stripe to wobble, as is clearly visible in the video.

You might be thinking: “Should I use gearing outside spin on every shot so the OB will always head in the direction I expect?” Well, it is not that simple. First, sometimes position play requires you to use other types and amounts of sidespin. Also, you need to be able to judge the gearing amount of spin, which is different for every cut angle. Also, when using sidespin, you must be good at adjusting your aim for CB deflection caused by squirt and swerve, which can be difficult to judge over a wide range of shot speeds and distances.

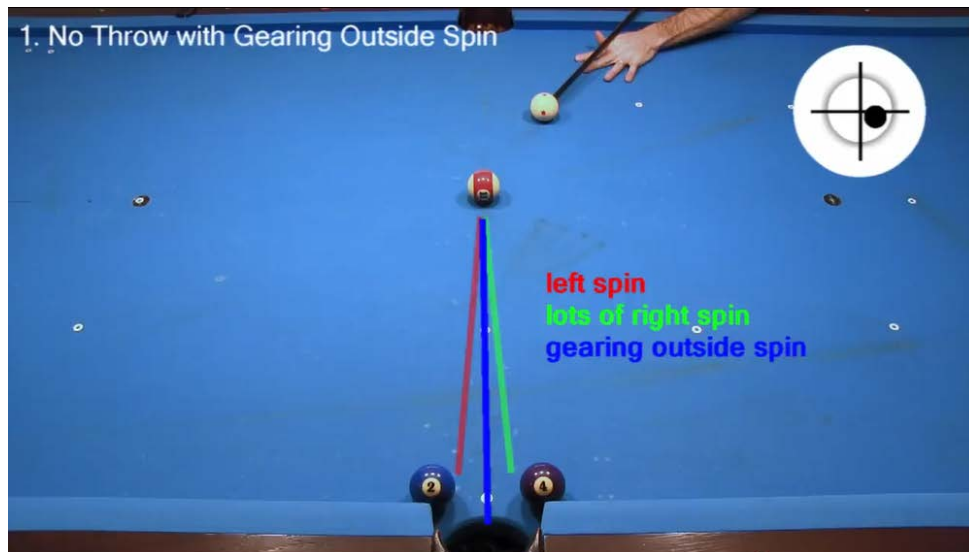


Image 2 Using a Mirror to Check Aim, Alignment, and Stroke

2. Throw Can Often be Ignored

On most shots, you can ignore throw, especially on short shots on tables with big pockets. But on a longer shot or with tighter pockets, throw can cause a miss, especially if the shot calls for slow stun, where throw is maximum, which is discussed more later.

3. Aim Thinner to Account for CIT

One option to compensate for throw is to simply aim to overcut the shot slightly. As mentioned above, another option is to use gearing outside spin. You can also use faster speed and backspin that both reduce throw. Then only a small correction for throw is required. You can also use faster-speed and topspin, where there will be very little throw. **Image 3** shows a good example where you need slow stun to get shape on the 8 after shooting the last stripe. As demonstrated in [NV J.42](#), with a pure ghost-ball aim, you would miss the 11 due to CIT. But you can pocket the ball and win the game if you aim to over-cut the 11 slightly. This will shift the tangent-line forward a little, so you also need a touch of backspin to keep the CB on-line.



Image 3 Adjusting aim for throw

4. Shots with the Most Throw

As mentioned above, one type of shot where you must compensate for throw is a soft stun shot. Another type of shot where you must compensate is a slow roll shot. The amount of throw will not be as much as with a soft stun shot, but it can still cause a miss. Another shot where you absolutely need to adjust for throw is if you are using an amount of spin much greater than the gearing amount. All these shot types are demonstrated in the video, along with various approaches for dealing with them.

5. Frozen and Small-Gap Combos

Another type of shot that requires understanding of and correction for throw is frozen or small-gap combinations. One reason is: the 1st OB is guaranteed to be sliding with stun into the 2nd since it does not have time or distance to start rolling. Remember, throw is maximum with a stun shot. In **Image 4**, the 11 and 13 are frozen. If you hit the 11 along the line of centers, the 13 will head straight. But if you send the 11 to the right, it will throw the 13 to the right (as shown in the image). And if you send the 11 to the left, it will throw the 13 to the left.



Image 4 Small-gap combination throw

With a very small gap, the 13 still goes in the throw direction even though the 11 will cut the 13 when hit at an angle. And when the gap is large, the cut effect dominates and the 13 goes in the cut direction. However, as demonstrated in the video, when the gap size is exactly $\frac{3}{8}$ " , the throw cancels the cut over a wide range of angles. So, with a $\frac{3}{8}$ " gap, regardless of the angle or direction the 11 is driven into the 13, the 13 still goes straight! This is one of the most amazing physics principles of pool! I did not just make up this number. It comes from a thorough physics and math analysis (see [TP B.21](#)), and it also works at the table.

The video also shows several frozen-ball examples where understanding throw is very important. Be sure to check those out online.

6. Maximum Throw

It is important to know the maximum throw you can get. Under typical conditions, maximum throw is generally about 1 inch per foot of OB travel, or $\frac{1}{2}$ a ball per diamond on a 9' table. See the video for demonstrations.

7. Maximum CIT

As we have seen, CIT is largest with slow-speed stun. At faster speed, the ball surfaces do not engage as well, resulting in less friction and throw. Throw also changes with cut angle. Obviously, there is no throw with a straight shot with no sidespin. For small cut angles (for example, a $\frac{3}{4}$ -ball hit), there is only a small amount of throw. With a thin cut (for example, a $\frac{1}{4}$ -ball hit), there is again less than maximum throw, but more than with a full hit. CIT is maximum close to a $\frac{1}{2}$ -ball hit. See the video for demonstrations and examples of how to apply this information.

8. Maximum SIT

To get maximum SIT with a straight shot, use slow-speed stun with about $\frac{1}{2}$ of maximum sidespin. With less spin, you get less throw. With maximum spin, you might think you would get maximum throw, but you would be wrong. Again, when the relative speed between the ball surfaces gets faster, the surfaces do not engage as easily, resulting in less friction and throw. You get even less throw with maximum spin and fast speed.

You can get SIT even with very large cut angles, but lots of sidespin is required. As demonstrated in the video, even with a cut angle close to 90° ; you can hit the ball a touch fuller and throw the it in with maximum sidespin. Some people might think such a shot is impossible, but they would be wrong.

9. Follow and Draw Reduce Throw

Throw is smaller with follow and draw shots. With full topspin or bottom spin, the amount of throw is about one fourth of the throw expected with a stun shot at the same speed. The reason for this is the friction force is not pointing sideways (in the throw direction) as with a stun shot. Instead, it is pointed up or down slightly, so there is less force available in the horizontal direction. Although, some draw shots can have more throw than one might expect. With slow speed or large distance, the backspin wears off on the way to the OB and the CB slows down due to drag, and this can even lead to soft stun which will produce maximum throw.

10. Cling/Skid/Kick

Since throw depends on friction between the ball surfaces, throw can vary with the condition of the surfaces at the contact point. As demonstrated in the video, if you put some saliva at the contact point, there is almost no friction or throw (see **Image 5**). If the ball surfaces are dry, smooth, and clean, you get the expected amount of throw, which can be large with the stun shot used in the video. If there happens to be a chalk mark on the CB or OB at the point of contact, you get much more throw than expected. This is called cling, skid, or kick. Wipe chalk marks off the CB every chance you get (before each break and with ball in hand), and keep the OBs as clean as possible, to limit how often cling might occur. Sometimes cling is out of our control, but by keeping everything clean, we can reduce its frequency.



Image 5 Ball surface condition effects

I hope the information in this article gives you an improved understanding of important throw effects. And I also hope this understanding will help you miss fewer shots and enable to make shots you before never thought possible. Everything described is demonstrated in online video [NV J.42](#). Be sure to watch the videos and try everything out at the table. Reading is good, and watching is better, but trying is best. If you want more information or want help with learning how to adjust your aim for throw and CB deflection caused by squirt and swerve when using sidespin, see my [System for Aiming With Sidespin \(SAWS\)](#) available at [DrDaveBilliards.com](#). It covers everything in detail and provides many game-situation examples.

Good luck with your game,
Dr. Dave



[NV J.42](#) – Top 10 Things You Need to Know about THROW



[TP B.21](#) – Small-gap-combination throw effects

PS:

- I know other authors and I tend to use lots of terminology, and I know not all readers are totally familiar with these terms. If you ever come across a word or phrase you do not fully understand, please refer to the [online glossary](#) at [billiards.colostate.edu](#).

Dr. Dave is a PBI Advanced Instructor, Dean of the Billiard University, and author of the book: [The Illustrated Principles of Pool and Billiards](#) and numerous instructional DVD series, all available at: [DrDaveBilliards.com](#).