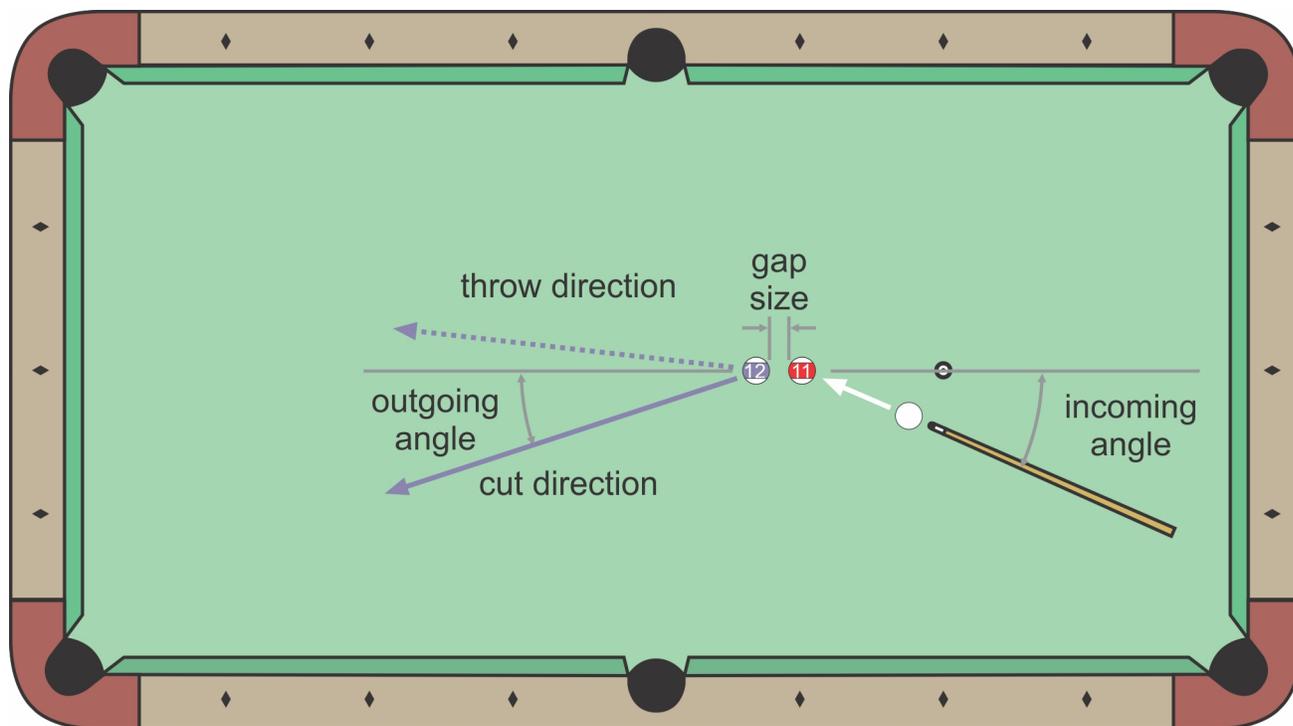


Supporting narrated video (NV) demonstrations, high-speed video (HSV) clips, technical proofs (TP), and all of my past articles are available at [billiards.colostate.edu](http://billiards.colostate.edu). Reference numbers used in the articles help you locate the resources on the website.

Do you know how to aim combination shots, where the gap between the two object balls (OBs) is fairly small? Do you know how and when to account for throw, and do you know when the cut-angle effect is more important than the throw effect. And do you know the gap size that guarantees the 2<sup>nd</sup> OB will go straight over a fairly wide range of cut angles? This article will answer all of these questions.

**Diagram 1** illustrates important terminology related to small-gap combinations, where the cue ball (CB) is being hit squarely into the 11, sending the 11 along the same line into the 12. If the 11 and 12 were frozen (gap size = 0), a direct hit on the 12 (incoming angle = 0) would send the 12 straight up table (outgoing angle = 0). At close to a ½-ball hit between the 11 and 12, again with no gap, where the center of the 11 is aimed at the edge of the 12, the 12 would head in the throw direction. Throw is largest with a stun shot, where the 1<sup>st</sup> ball slides without top or bottom spin into the 2<sup>nd</sup> ball. Stun is guaranteed for frozen or small-gap combos since the 1<sup>st</sup> ball doesn't have distance or time to develop forward roll before hitting the 2<sup>nd</sup> ball. Maximum throw with typical ball conditions is about 1" (2.5 cm) per foot (30.5 cm) of travel. Throw is less at faster speed and at cut angles thinner or thicker than a ½-ball hit.



**Diagram 1** Small-gap combination terminology

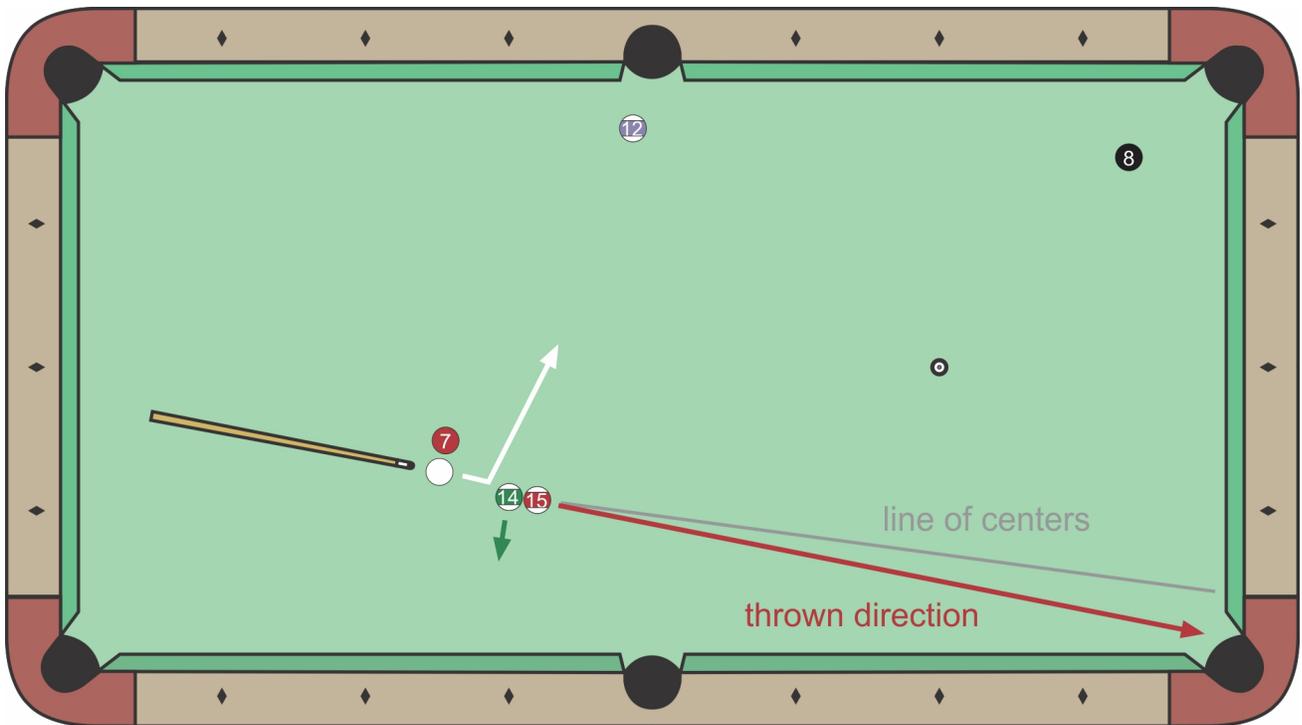
When the gap size between the balls is very small (nearly frozen) the 2<sup>nd</sup> ball reacts much like as with the frozen-ball case. If the gap size is much larger (for example, 1" or 25 mm), even at a small incoming angle and slow speed, the cut effect is still larger than the throw effect, and the 12 goes in the cut direction. At large incoming angles, the 12 can be cut a larger amount (with a large outgoing angle) as the gap size increases.

So if the 2<sup>nd</sup> OB throws in one direction when the gap size is really small, and cuts in the other direction when the gap size is large, there must be a gap size in the middle where the two effects cancel. I did a

thorough math and physics analysis ([TP B.21](#)), and determined that the magical gap size is exactly 3/8" (9.5 mm). Fortunately, 9.5mm is just slightly smaller than the diameter of typical low-CB-deflections shaft, in which case it is easy to judge the optimal gap size with your tip. Alternatively, you can visualize the gap size as 1/3 the radius of a ball ( $1/3 * 1/2 * 2 * 1/4" = 1/3 * 1/2 * 9/4" = 1/3 * 9/8" = 3/8"$ ). Alternatively, you can visualize 3/8" as between 1/4" and 1/2", which many people can picture fairly easily.

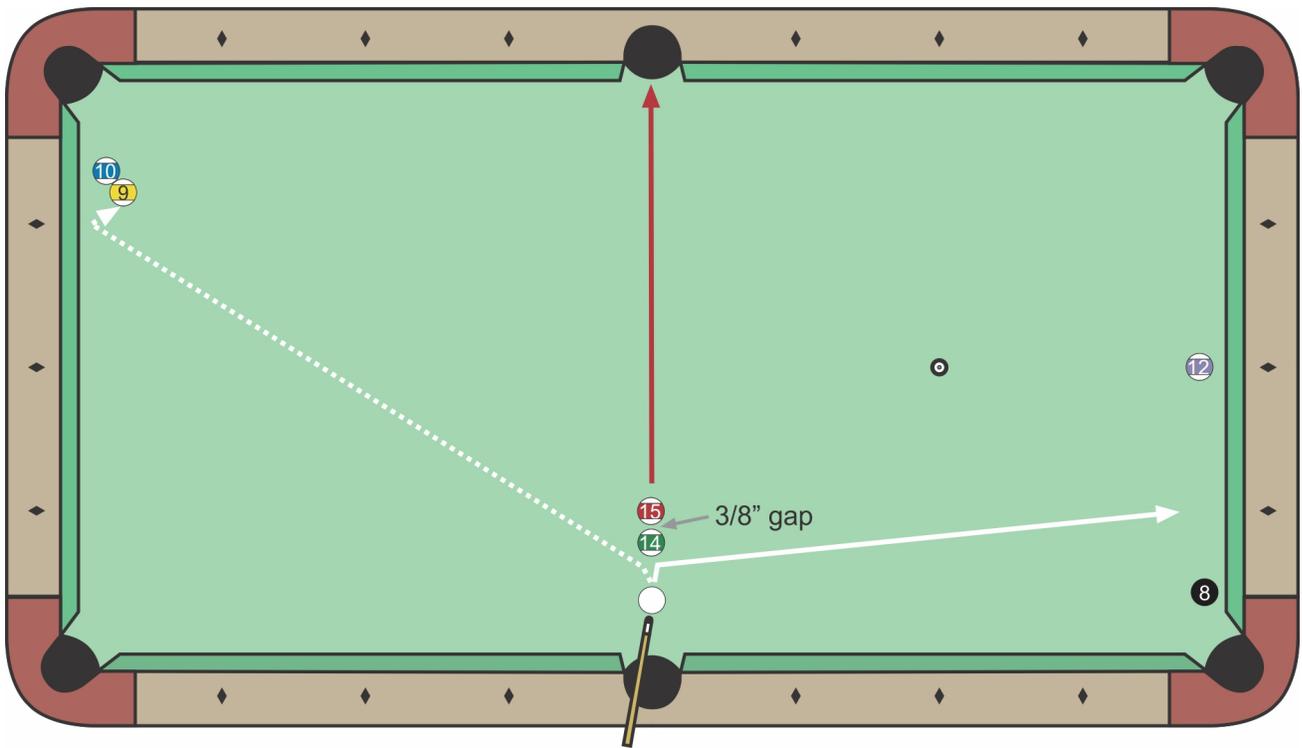
As clearly demonstrated in online video [NV J.1](#), with a 3/8" gap size, throw cancels cut very closely over a fairly wide range of incoming angles, especially at slower speeds. Beyond about a 30° incoming angle (a 1/2 ball hit between the 11 and 12), the cut effect becomes larger than the throw effect and the 12 heads in the cut direction.

Now let's look at several game-situation examples where an understanding of combo throw effects can help you make shots and win games. These and many more examples are demonstrated in online video [NV J.1](#). In **Diagram 2**, you are playing 8-ball shooting stripes, and the 14 and 15 are frozen with the line of centers heading well to the left of the corner pocket. However, by hitting the 14 to the right of the line, you can throw the 15 into the pocket. Here, you only need about half of maximum throw, so hitting the 14 into the 15 with about a 3/4-ball hit, twice as full as a 1/2-ball hit, will provide enough throw to pocket the ball, leading to an easy out.



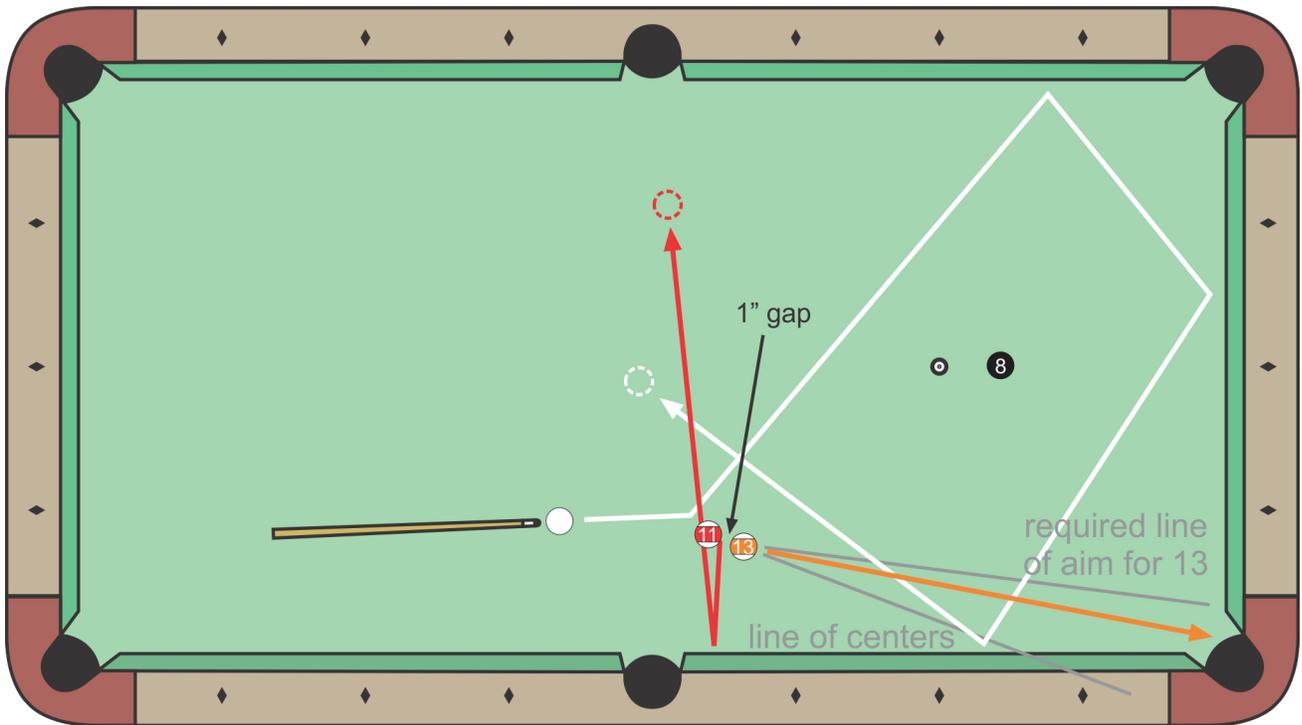
**[Diagram 2](#) Frozen-ball combo throw**

In **Diagram 3**, there is about a 3/8" gap between the 14 and 15, and the line of centers heads into the heart of the side pocket. As mentioned above, because of this gap size, you can hit the 14 over a wide range of angles and still pocket the 15. If the 9 and 10 were not on the table, a good play would be to hit a little on the right side of the 14 with stun or slight draw to get position on the 12 down table. With the 9 and 10 cluster on the table, a better play is to break out the cluster. The natural angle heads in a good direction, so if you hit on the left side of the 14 with follow, you can pocket the 15 and get the break out for an table clearance.



**Diagram 3 Magical 3/8" gap**

In **Diagram 4**, there is about a 1" gap between the 11 and 13, so you can easily cut the 13 into the corner even though the line of centers heads well to the right of the pocket. You need to aim this shot very differently than a non-combo cut. If you aimed to cut the 13 into the heart of the pocket, not adjusting for throw, you can miss the shot since the 11 will throw the 13 toward the rail. To pocket this shot (especially on a table with tight pockets), you need to aim to overcut the 13. If you plan to use fairly slow speed to hold the CB for the 11 in the near side next, you need to compensate for throw quite a bit since throw is maximum for a slow 1/2-hit shot with stun. A better approach here might be to use more speed to send the CB off three rails to get position on the 11 in the opposite side (as shown in Diagram 4). With more speed, you don't need to compensate for throw as much, and you won't need to cut the 11 as thinly, both of which will make the shot a little easier.



**Diagram 4 Large gap combo cut**

I hope this article helps you better understand throw effects, applied to small-gap combos, so you can make shots like these and win more games. Here is a quick summary of the important effects to remember:

- When the gap between the OBs is  $\frac{3}{8}$ " (9.5mm), the 2<sup>nd</sup> ball heads very straight (i.e., the throw effect cancels the cut effect) over a fairly wide range of 1<sup>st</sup>-ball angles.
- When the gap between the OBs is very small (much less than  $\frac{3}{8}$ " or 9.5 mm), the 2<sup>nd</sup> OB heads in the throw direction, with the largest throw occurring close to a  $\frac{1}{2}$ -ball hit with slow speed.
- When the gap between the OBs is larger than  $\frac{3}{8}$ ", the 2<sup>nd</sup> OB always heads in the cut direction; although, throw reduces the cut more at slower speed.

Online video [NV J.1](#) also demonstrates all of the effects and shots in the article. Check it out when you get a chance. Like most things, it is better to see it rather than just read about it. Better still, try the shots out yourself at a table.

Good luck with your game,  
Dr. Dave



normal video

[NV J.1](#) – Small-Gap-Combination Throw Effects and Game-Situation Examples



technical proof

[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](http://billiards.colostate.edu).

*Dr. Dave is a PBIA 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](http://DrDaveBilliards.com).*