TECHTALK

Bob Jewett

An Experiment in Throw

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Readers of the instructional columns and letters of this magazine may have noticed a recent controversy about the phenomenon of throw. Its very existence, except for a very small set of shots, has been put into question. Authority has been invoked on each side.

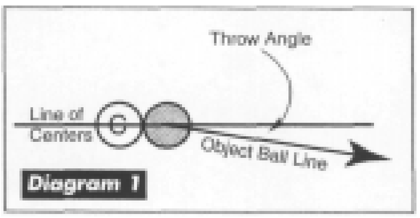


Diagram 1

Fortunately, this is not a matter that you have to leave to respected authority; you can decide the matter for yourself. Below I describe a simple experiment, and if you have a little spare time and a table, you can do some testing on your own. If you readers send in your results, I'll tabulate them and *Billiards Digest* will donate a one-year subscription to the two best experimenters.

First, we need to clearly understand what we mean by "throw." When the cue ball collides with an object ball, the simplest theory of aiming says that the object ball will move away from the cue ball along the line joining their centers at the instant of contact. Throw is the departure of the object ball from this ideal line due to the spin or motion of the cue ball. If throw happens on a shot, there will be an angle between the line of centers and the line the object ball takes away from the collision. In **Diagram 1,** this is drawn as an angle larger than zero.

In one standard demonstration of throw, two object balls are frozen together and the combination is shot from an angle. Unless the contact point is wetted, the second object ball is always thrown, with an angle of up to six degrees. I think the result that an object ball can throw a ball it is frozen to is not questioned by any rational being, human or otherwise. But we are going to test a much tougher situation — whether the cue ball can throw the object ball.

Yes, you could argue that the cue ball is pretty much like an object ball and a collision from the cue ball is more or less like pushing a frozen object ball into another, but let's try to do the real thing and see what happens.

The difficulty — and the challenge of designing the experiment — is in knowing the line of centers of the cue ball and object ball at the instant of collision. Taking a belt and suspenders approach, here are two different methods to measure the angle — if any — of cue ball/object ball throw.

In **Diagram** 2 is a very simple shot. The object ball is on the head spot, and the cue ball is straight towards the head cushion and an inch or so away. The balls are close together so that we know the line of centers well. A problem with testing for throw is that the results can be polluted by both squirt and swerve. Having the object ball close to the cue ball reduces both factors. In addition, to make sure the cue ball does not have time to swerve, you must play the shot just firmly enough to drive the object ball to the foot cushion and back to the head cushion. This also reduces the effect of table slope.

To make sure the balls are in the same position every time, either use some donut-shaped paper reinforcements or tap the balls firmly into place. To get a reference line, shoot a shot with no spin on the cue ball. Place chalk or some other marker on the rail to indicate the center position. Shoot a few more shots to see if you have a consistent reference. At this point, you could estimate how much random variation you have just for your center-ball shots. It

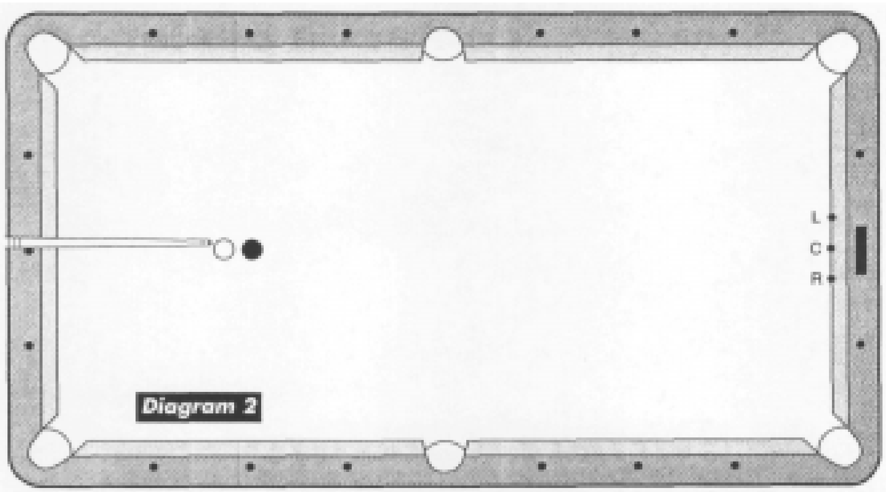


Diagram 2

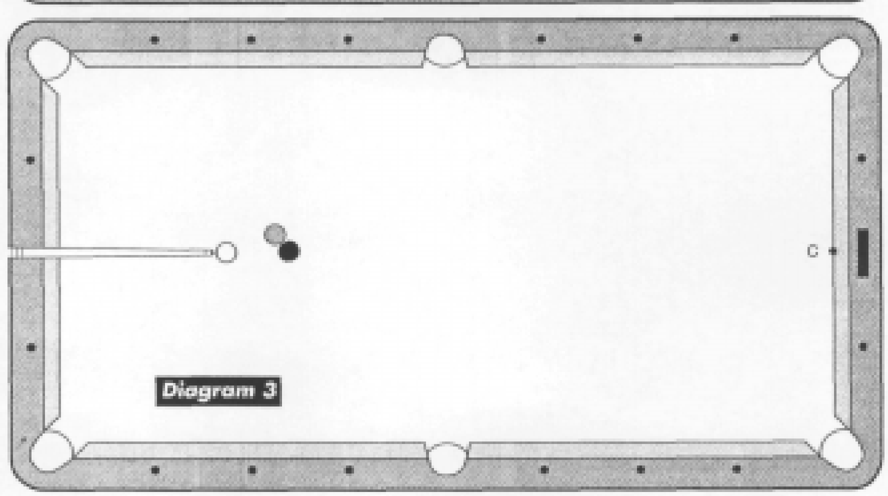


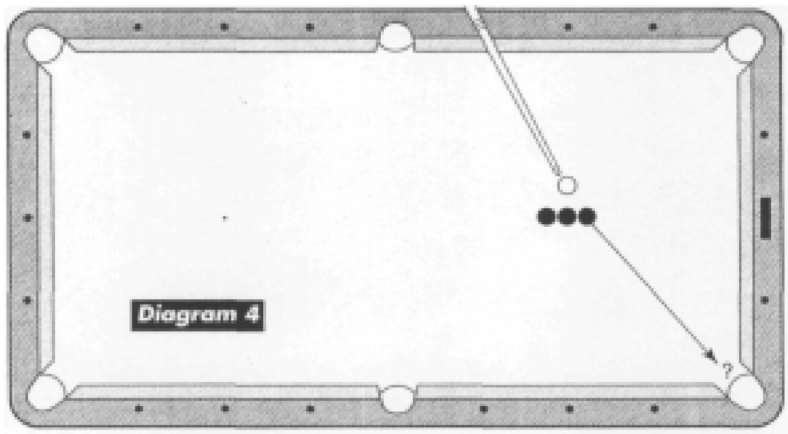
Diagram 3

should be less than half an inch, if you set up consistently. This spread should be part of your report.

Now set up the shot again. Shoot the shot with left English and no follow or draw; hit the cue ball right on its equator. Make sure your stick is as level as possible and pointed straight up the table, parallel to the center line. Note where the ball hits the foot cushion and mark it. Shoot several more times and check how accurate your mark is and how consistent your shots are. If the mark is not the same as for the center-ball shot, note whether it is to the left or right and by how much. Next, do the same for right English. For extra credit, note where the object ball hits the head rail.

It may be that you will double-hit the cue ball because it is so close to the object ball. This may be distracting, but it shouldn't change the path of the object ball, which will be long gone by the time the tip hits the cue ball a second time.

In **Diagram 3** is a second way to do the experiment. Place an object ball on the head spot as before. Now freeze the cue ball to it pointed straight down the middle of the table. Freeze a third ball to both of them, and then move the cue ball back as shown. The test is to see how far to the right the object ball can be brought by using side spin on the cue ball. The added ball keeps you from cheating by simply cutting the ball to the right.



For this test, you may — due to less than perfect aim and stroke — hit the blocking ball first, which will keep you from getting the object ball maximally to the right. Shoot the shot ten times, and only record the result that is farthest to the right for each of right, left and no side spin. On this test, the position of the object balls is critical, so you will definitely need some positioning aid.

This setup comes up in normal play, and happens often at one-pocket when multiple balls have been spotted, as in **Diagram 4.** Can you make the back ball of two spotted balls straight into a corner pocket? If not, how about for three balls? Does spin on the cue ball help?

Write up your results and either mail them to me in care of this magazine [122 S. Michigan Ave., Suite 1506, Chicago IL 60603], or e-mail them to Jewett® sfbilliards.com. For bonus points, note whether the balls are old or new, clean or dirty, and what kind of cloth you are playing on.

One last point to ponder: Physics predicts an interesting connection between throw and transferred spin on the object ball. Because throw is caused by tangential or sideways force, if the object ball is thrown, it must also have acquired side spin in the collision. Conversely, if the object ball has side spin after the collision, it must have been thrown.