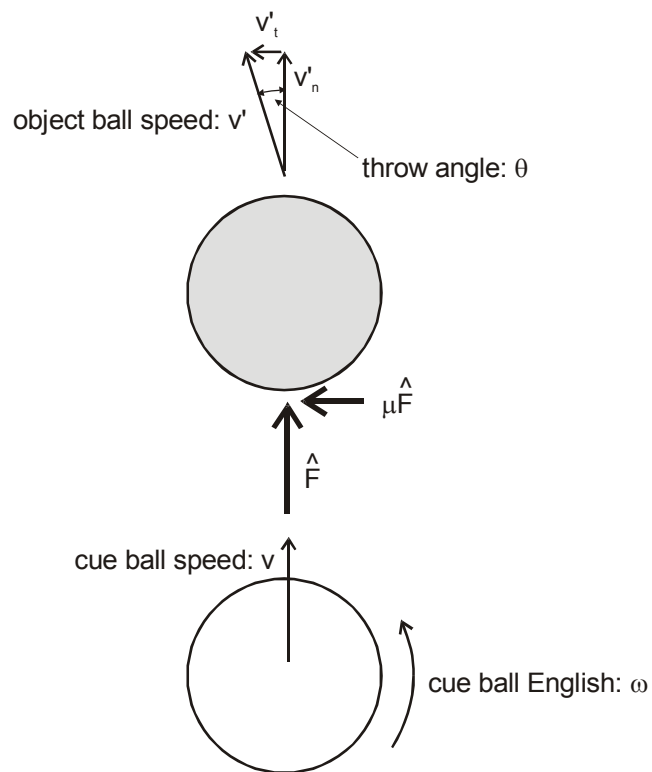




## TP 4.3 English-induced throw effects

supporting:  
“The Illustrated Principles of Pool and Billiards”  
<http://billiards.colostate.edu>  
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Object ball speed in the normal direction from the coefficient of restitution:

$$v'_n = e \cdot v$$

Assuming no topspin or bottom spin, all of the cue ball speed is delivered to the object ball, so from linear impulse ( $F'$ ) and momentum:

$$F' = m \cdot v$$

From linear impulse and momentum in the tangent direction:

$$m \cdot v'_t = \mu \cdot F'$$

so

$$v'_t = \mu \cdot v$$

Therefore, the throw angle is given by:

$$\theta = \text{atan}\left(\frac{v'_t}{v'_n}\right) = \text{atan}\left(\frac{\mu}{e}\right)$$

$\mu$  and  $e$  both vary with speed and the amount of English. The maximum throw angle occurs at small speeds. Here are typical values for a slow, head-on collision:

$$e := 0.92 \quad \mu := 0.06$$

$$\text{atan}\left(\frac{\mu}{e}\right) = 3.731 \text{ deg}$$

**NOTE** - the analysis presented here is a simplified view of spin-induced throw. To see a more complete analysis that also considers cut angle, vertical plane spin, and speed effects, see **TP A.14**.