

The Mathematical Formula That Proves Cow-Tipping Is a Myth

The Atlantic (<https://www.theatlantic.com/technology/archive/2013/09/the-mathematical-formula-that-proves-cow-tipping-is-a-myth/279357/>) · by Megan Garber



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Cow-tipping: the ultimate ~~urban~~ rural legend.

In an article for *Modern Farmer* (<http://modernfarmer.com/2013/09/cow-tipping-myth-or-bullcrap/>), Jake Swearingen explains why the activity -- a pastime that has inspired so many drunken teenagers across so many stretches of pasture -- is one that exists, in the end, only in our minds.

Reason number one: The phenomenon is not documented anywhere on YouTube. Like, anywhere. And if there's one place where cow-tipping would be documented, it would be YouTube.

Reason number two: Actual farmers don't think cow-tipping is real. "There's more cows that have been tipped in people's imaginations," Nate Wilson, a veteran dairy farmer, tells Swearingen, "than in the real world."

Reason number three: Cows don't actually sleep standing up. Horses do; cows tend to rest on their stomachs. So the core logic of cow-tipping -- taking advantage of a slumbering beast while it's doing its slumbering -- is based on a lie.

The big reason, though -- reason number four -- is simpler. And also more complicated. Physically, mathematically, scientifically ... cow-tipping is simply not feasible. As Swearingen explains,

Cows, after all, stand on four legs and will quickly shift their weight to a wider, more stable stance if pushed against. And Lillie and Boechler's calculations are based on an unmoving cow in equilibrium in which slow, steady force could be applied without pushback — an optimum (and unrealistic) state for cow tipping. Pull out your high-school text book and look up Newton's Second Law: Force equals mass times acceleration. A cow has a lot of mass, and you'll want to move that mass quite quickly, before the cow can react. Which means you'll need to generate a lot more force.

Swearingen is basing that analysis on a 2005 study (http://www.theregister.co.uk/2005/11/09/cow_tipping/) conducted by University of British Columbia researchers Margo Lillie and Tracy Boechler -- and on an equation the pair created to determine the force required to, yep, tip a cow. (You have to factor in not just the animal's mass, but also its ability to brace itself against would-be tippers.) As Boechler explained of the equation (http://www.theregister.co.uk/2005/11/09/cow_tipping/), "a cow of 1.45 meters in height pushed at an angle of 23.4 degrees relative to the ground would require 2,910 Newtons of force, equivalent to 4.43 people."

In other words:

$$\text{Force} = \frac{m * g * \cos x * b}{a + b}$$

m is the mass of the cow	682kg (1503 lbs)
g is the gravitational force	9.81 m/s ²
x is the angle of the lever	66°
a is the length of the lever above the center of mass	0.79m
b is the length of the lever below the center of mass	0.79m

$$\frac{682 \times 9.81 \times \cos 66^\circ \times 0.79}{0.79 + 0.79} = 1,360 \text{ n}$$

In *other* words: Tipping a cow -- toppling a beast that weighs nearly a ton -- would require a coordinated effort among four-or-maybe-five (and-maybe-even-more) people. And those people, if humanity's previous attempts at cow-tipping are any guide, would probably be drunk as they make that effort. "It just makes the physics of it all, in my opinion," Lillie tells Swearingen, "impossible." Not to mention extremely uncool to the cow.

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