

# Three Aviation Myths

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Over our flying careers, from our first instructor to well-meaning amateurs in discussion groups, we collect a lot of aeronautical "facts." Many of these are wrong, and some are downright dangerous. These three articles will debunk three very common myths.

## Myth 1

*"Aircraft overbank in a turn because the outside wing is going faster, generating more lift."*

### Sanity Check

Let's assume for a moment that this is true, and see exactly how big the effect is. Let's take a hypothetical aircraft with an 8 metre wingspan doing a rate 1 turn (360° in 2 minutes) at 100 knots. Let's simplify more and assume that the wings are rectangular, so the lift centroids of the wings are 4 metres apart.

The distance travelled in 2 minutes (360° for a rate 1 turn) at 100 knots is  $100 \times 2/60 = 3.3$  miles. So the diameter of the circle is  $3.3/\pi = 1.06$  miles, or a radius of 0.53 miles, which is a radius of 982 metres.

This means the outside wing centroid is flying at a radius of  $982 + 4 = 986$  metres, with the inside at 978 metres. So the ratio of the centroid speeds is  $986/978 = 1.0082$ . Since lift is proportional to the square of airspeed, the lift ratio will be  $1.0082 \times 1.0082 = 1.0164$ .

In other words, the outside wing is getting 1.6% more lift than the inside wing. But wait! There's more! As you bank more for a tighter turn, the horizontal difference of the centroids reduces with the cosine of the bank. For example, at a 45° bank, the lift difference is down to 1.2%.

Can you honestly say that you could detect a 1% difference? Is your aircraft really that precisely rigged? Is your passenger the same weight as you? Flying with nobody in the right seat would completely swamp this effect.

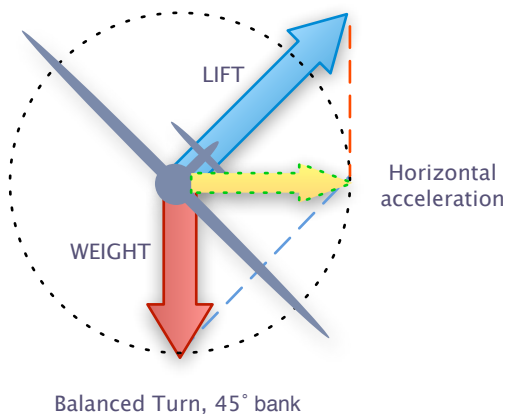
### The Reality

Why do some pilots swear overbanking doesn't exist while others are justifiably scared of it? The fact is that if you fly the aircraft correctly, without use of aileron or rudder once the bank is established, it will not overbank. And if you mistakenly use aileron to correct what you think is an overbank in the circuit, you end up slipping with crossed controls and putting yourself at risk of a stall/spin fatality.

So does overbanking really happen? Why do so many pilots think it does?

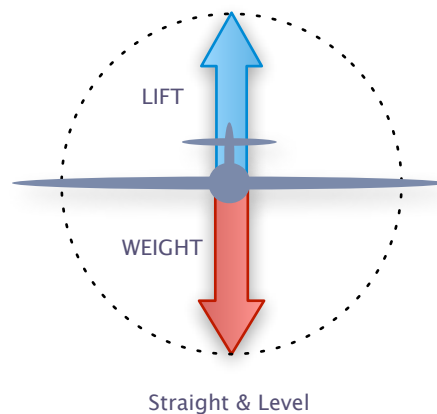
The diagrams show three scenarios: straight and level flight; a level (balanced) turn; and an unbalanced (descending) turn.

In straight and level flight, the weight of the aircraft is equal to the lift, with zero resulting force and therefore zero acceleration.



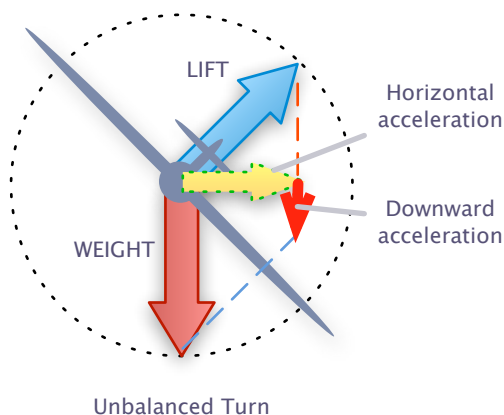
In a stable balanced turn, the lift is no longer vertical so straight-and-level lift is not enough to overcome gravity. To

avoid descending, the pilot adds nose-up elevator to increase the angle of attack and the lift until the vertical component of the lift is equal to the weight. Now the vector sum of lift and weight are not zero: there is a horizontal force.



Newton's Second Law says  $F = ma$ , or acceleration is proportional to force and in the same direction. This means there is a horizontal acceleration— which is after all the whole point of banking the aircraft— that's what makes it turn.

In an unbalanced turn, the pilot simply banks the aircraft but does not add up elevator. Now the vector sum of weight and lift includes a downward vertical component. This means the aircraft is accelerating downward as well as horizontally, so it is turning toward the ground. Airspeed increases, and so does lift, but not enough to remove the downward acceleration. All it does is tighten the turn. This is not overbanking. It is the beginning of a spiral dive. A pilot who doesn't think it through might think it is overbanking, because they are turning more tightly than they planned and turning toward the ground.



To prove this to yourself, try the following on a calm day, with an instructor if you are at all concerned. Get up to a nice safe height and set up a straight and level cruise. Then bank to 30 degrees, using aileron only to establish the bank, and rudder only to overcome adverse yaw while establishing the bank, with enough up elevator so your altitude remains absolutely constant. Centre the aileron and rudder and add up elevator trim until there is no control pressure and the altitude stays constant. Now remove your hands and feet from the controls, and see what happens. Does it overbank?

So if you use aileron (and rudder if required) only to establish and exit the bank, and use the correct amount of elevator throughout the turn, you will not overbank.