Aircraft Control Functions
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For most students, transitioning from two-dimensional control to three dimensions can be a challenge. Both feet and both hands are working controls to tell the airplane to go up, go down, go right, go left, go fast, go slow. They need to put things together one piece at a time.

Here's a lesson I've found that helps put all the controls together for them.
It's a lesson I give to all my students, at any level, because it shows them a side of the airplane most, including many experienced pilots with advanced ratings, have never seen. With a new student, I'll do this usually on the 2d lesson (First lesson is a short, "you play with it awhile" get acquainted lesson; then comes this longer (usually takes a bit over an hour) "Here's what the airplane does" lesson.

I begin on the ground, of course, by explaining that every control affects every other control.

- Elevators are the primary pitch control. They also affect power, roll, yaw, altitude, and airspeed.

- Ailerons are the primary roll control. They also affect power, yaw, pitch, altitude, and airspeed.

- Rudder is the primary yaw control. It also affects power, roll, pitch, altitude, and airspeed.

- Throttle is the primary thrust control. It also affects altitude, roll, pitch, yaw, and airspeed.

I will explain this on the ground, then demonstrate in the air. I'll skip the ground part here for brevity. Here's what I do in the air.

First, I let the student know that we'll spend most of the lesson just watching the airplane. Neither one of us will be fully on the controls; we'll tweak something and watch what happens. (A new student will get wide-eyed when you tell him this.)

Now, at a safe altitude (2500 agl or better) and away from the traffic pattern, I trim it up for a slow cruise (~55%).

Hands and feet off the controls. First, I announce I will keep the wings level with rudders during this demonstration *(What? I thought Ailerons are the bank control !?!?)* I will smoothly apply full power. Watch what everything does. Everything. Smoothly from 55% to firewall, hands off the yoke, hold wings level with the rudder. What happens?

1. Nose goes up, though you haven't touched the primary pitch control.

2. No airspeed change, although you have significantly changed the control some consider to be the primary airspeed control.

3. Altimeter will go up, in spite of the fact that no one has touched what some consider to be the primary altitude control.

OK, now the same drill, but with feet off the rudders. Trimmed for 55% power, level flight, hands and feet off everything, smoothly apply full throttle.

1. Nose goes up and left.

2. Altimeter will go up, then – if you don't catch it -- down.

3. No airspeed change at first.

4. Watch it awhile, the nose will eventually come down, turn will probably tighten (some airplanes will surprise you here).

5. NOW the airspeed begins to come up as the nose comes down further and the turn tightens.

6. With the nose coming down and bank increasing, you could redline both the airspeed and tach.

7. Bring the left wing up with rudder only. Nose will come up, airspeed will go down and could decelerate to the point of a stall. WHY? We haven't touched the primary roll, pitch, power, or airspeed control?

Recover. STRAIGHT AND LEVEL, 55% power. Now we'll do the same drill, holding wings level with rudder, but we'll apply power quickly.

1. Nose comes up quickly.

2. Airspeed comes down quickly. (What? From halfpower to fullpower you ***de***celerate?!?!?)

3. If you don't catch it, the airplane will probably stall.

Recover. STRAIGHT AND LEVEL, 55% power. Holding wings level with rudder, gently throttle back to idle.

1. Nose comes down (although we haven't touched the primary pitch control).

2. No change to airspeed (although we have significantly changed what some consider the primary airspeed control).

3. Altimeter comes down (although we haven't touched what some consider the primary altitude control).

Recover. STRAIGHT AND LEVEL, 55% power. Feet off the rudders, gently throttle back to idle.

1. Pitch comes down (although we haven't touched the primary pitch control).

2. Altimeter comes down.

3. Some airplanes will gently, almost imperceptibly, begin moving right and airplane will bank right even though we're not touching either the primary yaw control or the primary roll control.

4. No change to airspeed (except in those few airplanes that will begin turning right, in which case airspeed will slowly increase).

5. Also in those right-turning airplanes, as the turn tightens and nose continues to pitch further down, RPM will increase.

Recover. STRAIGHT AND LEVEL, 55% power. Now we'll do the same drill, wings level with rudder, but we'll remove power quickly.

1. Nose comes down quickly.

2. Altimeter unwinds.

3. Airspeed comes up; most airplanes will redline. (What? From halfpower to idle you accelerate?

4. If you just watch (assuming neither ASI or tach redlines; don't let it do that), the nose will come up, often decelerating to the point of a stall.

Recover. STRAIGHT AND LEVEL, 55% power. Hands off everything. Gently apply left rudder.

1. Nose goes left (as expected)

2. Left wing goes down (But ailerons control bank!?!?)

3. Nose goes down (But elevator controls pitch !?!?)

4. Airspeed comes up (But we have touched neither of the controls usually associated with airspeed).

5. RPM goes up (but we haven't touched the throttle).

6. Altitude goes down, though we have touched neither of the controls commonly associated with altitude.

Now, before you redline the airspeed, gently go from left rudder through neutral to right rudder. Don't touch anything else.

1. As the nose goes right, wings will come level and nose will also go up. Deceleration will be significant, depending on how quickly you go from right to left rudder. Potential for a stall here, the deceleration will be so pronounced.

2. As the nose comes up RPM will also go down.

3. When you roll through wings level into the right bank, nose will come down again, airspeed and RPM will come up again.

4. Altitude and Airspeed both fluctuate with pitch oscillations.

Recover. STRAIGHT AND LEVEL, 55% power. Next demonstrations are a bit trickier because they deal with the yoke, which controls two axes; we want to demonstrate only one axis at a time. Make sure your student understands you're attempting to apply pressure to only one control at a time; I usually do this, if in a side-by-side, by deliberately and obviously applying pressure to the yoke with one finger only, and pointing out to my student that's what I'm doing. If a tandem, I tell him that's what I'm doing.

1. Feet on the floor. Gently push down with one finger on the left yokehorn (or up on the right yokehorn). Try not to put any pressure on the elevator.

2. Left wing will go down as expected.

3. Nose will yaw left (although no pressure is applied to the primary yaw control).

4. Nose will go down (although no pressure is applied to the primary pitch control).

5. Airspeed will go up (although no pressure is applied to the primary airspeed control.)

6. RPM will increase (although nobody's touching the primary power control).

7. Altimeter will go down (although nobody's touching either of the controls normally associated with altitude).

Recover. STRAIGHT AND LEVEL, 55% power. With one finger push gently, firmly, on the center of the yoke. Try not to affect ailerons.

1. Nose will go down, as expected.

2. Airspeed will go up.

3. RPM will go up.

4. Altimeter will go down, but not as quickly as might be expected by those who believe the elevators to be primary for altitude).

Recover. STRAIGHT AND LEVEL, 55% power. With one finger pull gently, firmly, on the center of the yoke. Try not to affect ailerons.

1. Nose will go up, as expected.

2. Airspeed will go down.

3. RPM will go down.

4. Altimeter will go up.

5. Some airplanes will bank gently left, but it's hard to determine whether it's due to yaw or unintentional aileron inputs.

Now the last one, an adverse yaw demo. Recover. STRAIGHT AND LEVEL, any cruise power. Feet on the floor, explain to the student you'll try to do this without pressure on the elevators. Tell him to pick a spot on the horizon, watch what the nose does. Tell him which aileron you're going to use so he'll be ready.

Apply HARD left aileron. The nose will at first go right, then will come around and catch up with the rest of the airplane. (*this is very subtle in most airplanes, student will often need two or three attempts to see it, and sometimes you'll have to tell him what to watch for before he does see it. In the Champ it is very pronounced and students will see it immediately.*)

Straighten her out. Apply HARD right aileron. The nose will at first go left, then will come around and catch up with the rest of the airplane.

After this 1.0 – 1.5 hours of watching the airplane, and a good debriefing explaining WHY the airplane has responded to control inputs the way it did, your student will understand the control functions as few other pilots do.