

What To Do About Pilot Errors

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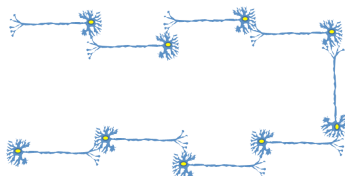
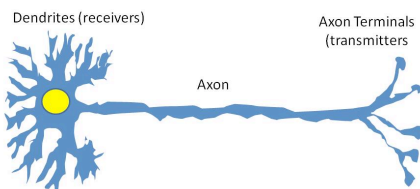
MARGINAL NOTES:

Some for clarification, some for embellishment, but most for fun.

When we think about learning to fly, we have to address a major safety concern. How can I avoid “Pilot Error” - the number-one cause of airplane accidents? Normally we think something like “I’m not going to make any mistakes. I’m going to be *real* careful.” But in spite of our good intentions, NASA found that professional pilots who fly every day, make an average of 15-errors per hour. Worse than that - they make 45-per hour in the busy times during takeoff through climbout, and approach through landing. That’s one error every minute-and-a half!

What is an error? In human terms, an error is where an action or inaction did not match the intent. For instance, if you intended to increase the volume and actually turned it the wrong way – that’s an error. If you meant to put the gear down and actually raised it – that’s also an error. Granted the effect of an error might be catastrophic, or just annoying – but the error itself was merely the result of our not quite hard-wired brain.

Let’s take a look at what is really going on in all that “gray matter” in your skull.



Electrical connections between neurons

The nervous system is primarily made up of highly specified cells called neurons. They are similar in function to the wires that transmit electricity. Neurons are long cells with a receptor end and a transmitter end. There are an estimated 10^{14} neurons in the brain with several million more running to each muscle and sensor. Each end of the neuron connects to several other neurons allowing an infinite combination of connections. Chemical reactions cause a synapse - an actual electrical current to flow along the discrete path. Learning occurs when a particular transmittal path is used repeatedly.

The central nervous system consists of the brain, spinal cord. The peripheral nervous system consists of sensory nerves, and motor nerves. Sensory nerves send signals to the brain - which evaluates the need to send a signal to the appropriate muscle via motor nerves. If the incoming signal is alarming enough it will go straight from the spinal cord to the motor nerve rather than through the brain. This happens when we pick up a horseshoe at the blacksmith shop that is no longer red, but is still hot.

Blacksmith: Ha! Burned you didn't it?

Me: No, just doesn't take me long to look at a horseshoe.

What to Do About Pilot Errors

The brain is a fantastic computer. At any one time only a small portion of its capability is activated. Computers were originally conceived as an analog of the human brain. Many of the processes and protocols come from the study of neurology.

Neurons which cause us to do something stupid are called morons.

A centipede was happy, quite
Until a frog in fun, said
“Pray, which leg comes after which?”
This raised her mind to such a pitch
She lay prostrate in the ditch
Considering how to run.

Anon.

Have you ever found the cereal box
in the refrigerator? Or worse, the
milk in the cupboard?

Operator errors are also classified
as gastro-cerebral events.

Even the most advanced computer has unfailing memory, but it is incredibly stupid. The human brain on the other hand is fallible but can learn from its mistakes. Why is it that when we intend to do one thing, our body does something else? We will look at some of the reasons and suggest ways to keep errors to a minimum. As we have seen, the brain is an incredibly complicated piece of machinery. Each microscopic nerve cell is connected to between five and 1,000 other nerve cells.

Even the simplest of tasks involves chaining together billions and billions of these cells. When we intend to move the index finger of our right hand, it just moves. We don't have to think about the electrical pathways that just became connected. When we stop to think all of the synapses that had to be completed just to move our finger, we wonder how we get anything done at all.

This network of nerve impulses works quite well most of the time. But when our intended actions are very similar to others – or our process is interrupted and we skip a step we thought we had completed - or when the intent would be satisfied by more than one action – sometimes we literally get our wires crossed.

Ask yourself “How do I know when I am *making* an error?” Remember, anything involving feedback happens *after* you have made the error. How can you tell you are making an error while you are making it? Obviously, you can't. If we could, we would stop and do it right. This is very important to understand. Not only are you wired so you will make errors, but you can't tell when you are making them. Wow! Now I wonder how we get anything done right! Let's look at the sources of errors, and identify some error-catching strategies.

We will look at **operator errors** – where our actions do not match our intent. **Judgmental errors** occur where our actions matched our intent, but a panel of experts would agree that we did not consider all the factors. We will cover judgmental errors in another article.

Operator Errors

When we make a mistake we do not like to admit it. We look around to see if anyone was watching. Our ears burn and we get somewhat defensive. It is common to pretend we intended to do it that way, or to find someone to blame it on.

We will look at three major sources of errors related to the physical construction of our Master Computer:

Interference
Interruption
Inattention.

We will use real world examples to illustrate each of these concepts. To avoid having to annotate references I will choose hypothetical examples from the experience of – well – me. I think the statute of limitations has run out on most of them. Keep in mind that you can probably think of examples from your own experience, but they are probably too deeply repressed.

Try counting from one to ten with someone saying “seven” between each of your numbers. It’s unnatural to say “seven” just after your friend. It usually comes out:

3-7-4-7-5-7-6-7-8
instead of 6-7-7-7.

Interference occurs when two or more concepts are very similar. Once when my mom served a delicious meal of liver and onions I announced that “This leather is very good – I meant this *liver* is very good.” As soon as the words were out of my mouth, I knew it wrong and I had a lot of explaining to do. Let’s analyze this error. The two concepts are very similar. The words sound very similar. In fact a piece of cooked liver looks very much like leather. The neuronal pathways are almost identical. I won’t even mention that in some cases liver can be nearly as tough as . . .

As a brand new instrument pilot I climbed up through an overcast for the first time by myself. My complex clearance read “FLY RUNWAY HEADING FOR RADAR VECTORS TO VFR ON TOP . . .” When I broke out on top into the clear blue sky I was so exhilarated I proudly announced “I’M VHF ON TOP. CANCEL MY ILS.” Well, they were all aviation words anyway.

We have all misspoken ourselves at one time or another. The same crossing of similar concepts is responsible for the common gear-up roll-outs after gear down landings. The pilot tried to raise the flaps and pulled up the gear instead. The guilty pilot says something like “I knew I was supposed to raise something after landing, so I raised something.”

There’s a wonderful scene in a nearly silent French film called “Mr Hulot’s Holiday” where the awkward Mr Hulot annoys everyone in the lobby to the distress of the proprietor who is feeding his fish a large aquarium. As Hulot bumps into him, his mechanical pencil falls from behind his ear into the fish tank. He removes his coat and rolls up his sleeve, regarding Hulot with disgust. As he starts to reach for the pencil, he sees his watch on his bare arm and reaches in with the other one – sleeve and all.

Interruption: Our priorities get all messed up when we are interrupted. Our intent gets displaced for a minute. When we get back to it we might skip a step or two. As we are going through our check list the tower calls traffic for us. We were interrupted in the middle of step-3, and when we got back to our checklist we continue with step-4 because we remember *doing* step-3.

Most often, step-3 is unimportant – but this is often the cause of taking off with the wrong flap setting or landing with the gear up. This has happened so often that most operators expect the pilot or flight crew to start over if interrupted in the middle of a checklist sequence.

Inattention generally causes errors of omission. We tend to get lax when we are comfortable in our environment. There is an airline accident report where the cockpit voice recorder showed the captain and first officer discussing real estate deals, the cost of living and the current administration all the way down the non-

Ignosecond: ref: SNL –
The instant when, just as you slam
your car door you see your keys in
the ignition.

To err is human. Let's work on
catching and correcting them.

Don't waste time kicking yourself
for making an error. You are flying
at over 100 kts. The place where
you made the error is way behind
you. You are in the resulting
situation and need to correct it.

Once safely on the ground you can
kick yourself.

precision approach to just before the crash. They missed all required call-outs, cancelled warning horns and ignored checklists. It is hard to imagine being that comfortable on an approach in actual instrument conditions, but this is the way we operate when we have done something a million times. During our early driving lessons can you remember the amount of attention and adrenaline required to park your car? Now you can do it while thinking about who you are going to meet. Inattentive errors usually happen in an ignosecond (ig/s).

It is interesting how much fun we have watching other people make errors. It is more fun when we can anticipate them as in Hulot's case. Why is it funny? It is not funny when we make them. Other people's errors are funny because we can see how easily that could be us.

Some errors are not funny. Leaving your parked car in neutral instead of park is funny only if it rolls down hill all the way through the parking lot and doesn't hit anything. It gets very serious if it crashes into another car.

We have to separate the error from the result. The error was the same. We parked and walked away. The result could be humorous or tragic. As far as the error itself was concerned we should not dwell on our guilt. The most constructive thing we can do is to review the situation to avoid similar errors in the future.

As mentioned earlier, NASA found that airline pilots in real line flying make 30-45 errors per hour in the high activity periods of departure and approach. Remember – an error occurs when our action does not match our intent. Turning the transponder past the desired digit is an error. Overlooking a required call-out is an error. Taking off without the passengers is an error. Some are of little importance – others are not. As far as any tragic results of our error, it may change our whole life. We are ultimately responsible for what we do.

What to do about Operator Errors: We spend way too much time feeling guilty about our errors. We rationalize, look for something to blame, or try to ignore them. First, is important for us to realize that we are going to make errors. We should be thankful that we do. It identifies us as a member of the human race. So the first thing we need to do is get rid of the guilt we have about our errors. Don't waste an instant feeling guilty. The time we spend looking for excuses should be used to fix the situation that we have caused. If we take time to "assess the blame" we will probably make more errors rather than solve the new problems our errors have caused.

Instead of saying "I am going to do this perfectly. I am not going to make any errors." We now know that this is impossible.

I'M GOING TO CATCH EVERY ERROR I MAKE.

Say to yourself **“I’m going to catch every error I make.”** This is something constructive. We have admitted that we are human, that we make errors, but we are trying to catch them - and when you catch them you can be proud of yourself. Once you have caught the error – FIX IT!

Concentrate.

Well, OK, how am I supposed to catch my errors? There are three basic tools we can use. The first is concentrate on what we are doing. Don’t think about other things as you do critical things – especially after they have become routine. The FAA “sterile cockpit” rule requires commercial flight crews to talk about nothing but the flight situation during taxi through climb out to level-off. This rule also applies from descent through engine shutdown. It is a prudent thing to do in light airplanes as well.

Break The Mental Set.

The second tool is called the “break-set” technique. It is the practice of second-guessing yourself. You break-the-mental-set that something has been done. For instance, as you go through the landing checklist you get to “GEAR DOWN.” You look down to check. You are pretty sure you just put them down, but you check anyway. Now be careful. If you are expecting the gear lights to be lit, they will appear that way – even if they are not. This is very natural and very common. Your mental set is that the wheels are down. I have seen this happen twice while watching professional pilot crews. In both cases I broke the silence at about 1,000 agl and said “I have a question, is the landing checklist complete?” They both nodded and looked again at the gear lights - then looked up again! Then it hit them both at the same time. There was a tangle of fingers as they both reached for the gear handle.

The way to use the break-set technique in this situation is to expect everything to be where it is not supposed to be. When you get to the place in the checklist where it says “GEAR DOWN” say to yourself “No! the gear is UP!” You will then try to verify that it is up, but you can’t - because the green lights are lit.

This works in little things too. You’ve just called ready for takeoff and are waiting for the landing traffic. You have a few seconds, say to yourself “I’m not ready for takeoff. My transponder isn’t on.” Yes it is. “The radios aren’t set up.” “The engines aren’t running.” First, you may catch actual errors. “Aha! The transponder *isn’t* on.” Second, you may catch others that you weren’t looking for. “The engines *are* running, but they are getting hot because I forgot to open the cowl flaps.”

Watch For Killer Items.

The third tool is watch for killer items. Obviously some errors have more dire consequences. If you were on short final and someone asks if the landing check was complete, where would you look? In the Cessna 152 you would probably look at the carburetor heat. In the Piper Arrow, Learjet or 777 you would probably look at the landing gear.

So the take-away from all of this is:

I'M GOING TO CATCH
EVERY ERROR I MAKE.

- Don't feel guilty about making an error. There is no way to tell when you are doing so. When you catch yourself having made an error, think "Good for you! You caught it, now fix it." If someone else catches it, say "Thanks" and get on with the task of correcting it.
- Purposely try to catch every error you make.
- Concentrate. Pay attention to the feedback you get after your action. Use checklists or other devices to help you catch your errors.
- Break the Mental Set. Try to prove to yourself that it is in the wrong position, or was done incorrectly.
- Finally, watch for killer items. Keep a mental list of those things that could ruin your day and develop techniques or devices to make sure they get handled correctly. As we gain more experience we learn of others. Keep your eyes and ears open.



The Curley Prop Fleet is still growing.