SOARING Rx

BY DR. DANIEL L. JOHNSON

Jeb *Tries* a Low Pass

The thermals had been weak and hard to work. There was a south wind, and it was strong and gusty. Jeb was pleased to have stayed up and flown locally for an hour. As Jeb floats back toward the airport, he begins to think about how to approach the pattern. *A little low, good thing I'm upwind of the field.* Induced drag is lower close to the ground. *I can fly my downwind leg in ground effect. That's a clever way to resolve my low altitude.*

I'm not aiming, today, to trash the low pass, or to disparage Jeb for attempting one. A low pass can be done safely. In addition, it's not my goal to teach you how to fly a low pass properly. I simply want to point out that this maneuver runs a gauntlet of easy-to-make, wholly natural errors - illusions of perception and of thinking that would give your loved ones the willies if they knew.

I want to focus on two types of illusions that lead to pilot errors. *Perceptual illusions* are misinterpretations of reality that stem from the way our senses work. *Cognitive illusions* are misinterpretations of reality that stem from the way the brain works.

In soaring, our senses and brain, working quite normally as designed, can (and often do) produce illusions that lead to serious errors. Familiarity with these illusions (coupled with good training) might prepare us to compensate decisively, when they arise. On the other hand, they might not: one of my continuing points is that the false view of reality created by illusion is *natural*, and *feels comfortable and correct*. It's recognized as wrong only when conflicting reality is able to penetrate confidence, complacency, or panic. A new, more accurate picture of reality is preceded by a period of confusion that might be brief or long, depending on the particular situation.

Jeb glances at his altimeter. 600 ft AGL. He is nearly at the south end of the runway, flying north. The wind was 15 kts south when he took off, and now the wind tee is pointed towards him. He remembers a glider ride once, years ago. The pilot dove low, and zoomed across the desert floor, close over the sage. Past the end of the runway, the pilot raised the nose and slowed, turned, and landed. *What a thrilling and easy way to stretch a glide.*

As we approach a field, we must judge its size and distance. Our judgment is based on our current and past experience with fields and terrain. We integrate memory of experience with today's perception, project this into the immediate future, and add to this our sense of the glider's performance (itself not precise) to imagine where the glider will fly.

There are two opportunities for error here, through "cognitive illusion" that's based on memory. First, if we are approaching a strange field, our memory tends to bend it to fit our most familiar similar field (not always our home field). This may utterly blind us to the differences, leading us to misjudge our altitude, the field's length or width, or obstructions.

Jeb is approaching a familiar field, but in an unusual way. Either it's not going to look – in speed, size, or angle – as it usually does to him. This can easily cause misjudgment. When he makes the reversal turn, everything may be out of kilter from his normal position on final.

In a standard pattern, we reserve altitude as energy to be used for distance or to be spent via drag in order to manage the descent into the field accurately. In a low pass, we "store" kinetic energy – steadily eroding due to drag – to be used for the altitude needed to make the reversal turn. This difference can readily be misjudged. In a low pass, we don't have the angles available that Tom Knauff teaches in his TLAR approach.

Errors of memory, or errors of integrating memory into today's perception, can occur because *cognitive illusions*. These lead to errors of thinking, for they may distort our conscious thought, without our being aware of their influence and without understanding, we're wrong. For example, as we approach a site for landing, we need to properly estimate our altitude throughout the approach. What we're accustomed to seeing influences what we are conscious of seeing. The runway may seem to us narrower or wider, longer or shorter, or differently sloped than it actually is, based on the appearance of the runways we're most familiar with, or based on the surroundings.

I need to keep drag low to get this done, so I should lower the gear after I slow for the reversal turn. He takes his hand off the gear lever. He lines up with the runway and pushes the nose down sharply. *What do I announce on the radio?* "Glider seven-eight Papa downwind runway 18." *That was dumb. Yes, I'm downwind, but this isn't where anyone will look for me.*

Jeb's ship has retractable gear. He has been in the habit of extending it exactly when he commits to landing, at the beginning of the pattern. His decision to *postpone* its extension creates a "prospective memory" task. This refers to needing to remember – and sometimes forgetting – to perform an intended action at a later time. (Thanks to soaring pilot R. Key Dismukes, http://human-factors.arc.nasa.gov/publications/NASA-TM-2010-216396.pdf)

"Bonanza 4423 Whiskey, 5 mile final runway 18." *Now what do I say? Didn't he hear me? He's still pretty far out. I have time; I'm going to be turning final in a few sec* Jeb says nothing on the radio. He's too busy taking it all in (perceiving), and making decisions (thinking), to commit scarce attention to any secondary (but nonetheless advisable) actions.

Distance and slope estimation

Glide path and distance judgments are based on visual cues; with repeated landings, we tend to use the same cues repeatedly, which gradually sink with repetition and experience into unconscious automaticity. A radical change in flying an approach does not mean these habits are thrown away; a habit of perception might emerge unexpectedly, perhaps triggered at a particular point in the procedure. When it emerges, the world outside doesn't fit our expectation. Until we resolve the discordance, we feel uncertain or confused. This resolution may be rapid or it may take too long.

Size constancy

We tend to interpret all similar-appearing things as being of the size of the one with which we're most familiar. This includes gliders, cars, ships, poles, and towers. Some of these are near airfields. The low obstructions we ignore in a normal pattern are rather important when we're within a wingspan of the ground.

Speed constancy

When we're high, the ground creeps by when our airspeed is 100 knots. When we're low, the ground races by even at 50 knots – and if there's a 20-knot tailwind, 50 apparent knots is, in most gliders, below stall speed. Jeb has an opportunity to misperceive his actual speed as being much faster than it actually is, by looking outside rather than glancing at his ASI. This might leave him at the downwind end of the runway needing very much to zoom up a couple of hundred feet for a reversal turn, and not having any spare kinetic energy to spend on the maneuver. Ever arrived at the grocery checkout with a gallon of ice cream and empty pockets?

The runway looks close. He glances at the ASI. *Yikes! I'm nearly at redline!* He briskly, smoothly levels out close above the runway and keeps the airspeed a notch below redline. It gets *really* bumpy. His head bangs the canopy. He reaches up and tugs his shoulder straps hard. He's surprised by the turbulence close to the ground. And it takes a surprising amount of pressure on the stick to keep it forward, to keep the glider from ballooning up.

The speed is incredible. The ground rushes by. Pumped-up by the speed, he loses track of just how far he's come along the runway.

A couple of crows are reviewing the quality of local carrion on the runway ahead. Jeb lets the nose raise a little to clear them. Just then, the birds take off, see the glider on a collision course, and tumble into full-avoidance mode. Jeb sees one barely miss his left wing. For a fleeting moment, he is relieved to *not* find out what happens to the wing when it hits a crow at 120 kts. Then he runs into more turbulence. *Wait a minute. The yellow arc is smooth-air speed!*

He is pretty well down the runway, and his speed is below a hundred knots. *I wonder how high this speed will take me, Oh, high enough to turn around.* He releases the forward stick pressure. The nose balloons up. He banks somewhat to the right, so that when he reverses, there will be a better chance of being lined up

with the runway. *How much speed should I have when I start my reversal turn?*

Presumption

The most frequent error of thinking – the most frequent cognitive illusion – is, in my observation, being presumptuous: thinking we know enough; thinking things will be as we expect them; thinking other pilots will not surprise us; thinking the wind has not changed since we last checked it; and thinking there will be no animals on the runway. False confidence has its roots in presumption.

For example, Jeb assumes that the crows will hunker down for safety. Birds, my friend, do not hunker, especially when set upon by what looks like a giant raptor. They take flight. Since he didn't see them in time to abort the low pass, Jeb's best plan for the crows would have been to stay low, keep his course, and let them plan the evasion themselves. Birds are much more maneuverable than gliders. (Don't you sometimes want an air horn on your glider?)

He is climbing nicely, the airspeed needle dropping, the wind noise quieting. This calms him. He enjoys the ride upward for a moment. Suddenly, he's aware that there's no clue whatever to deck angle and bank. *Geez, there aren't any clouds!* He sees nothing but sky ahead and in his peripheral vision. Suddenly, he feels disoriented.

It's hard to black out pulling G's in a glider because we're in the *chaise longue* position. Even so, if we're volume depleted from sweating or dehydrated from not drinking, we might black out, and complete a low-altitude maneuver fatally.

Nevertheless, blacking out is pretty simple. Game over. More interesting is that an effect of G forces is to distort our vestibular perception, amplifying or minimizing the effects of acceleration or turning, especially if our head is tipped or turned while we pull the G's. This can result in awkward and humiliating or dangerous climbs or turns. (And we do not want to look awkward, do we?)

Disorientation

Our perceptions are not reality. They are a cartoon of reality, one that we believe, because it's normally so reliable. However, its reliability and accuracy depends on a constant flow of redundant and overlapping information, especially from visual fixation on known objects. Jeb was flying on a blue day, and when he first pulled up for his reversal turn, he at first saw only blue sky – and had nothing but the notoriously inaccurate seat of his pants by which to judge bank and climb angle.

This loss of visual fixation can bring error in two ways: false perception of the glider's status in the three dimensions of the air (perceptual illusion) and a false notion of how to manipulate the controls to make all right with the world again (cognitive illusion).

Jeb looks to the right. *Ah, there's the horizon.* A relief. No runway. He is somewhere east of the field, close in. He feels, momentarily, a powerful urge just to kick the rudder around so he can see the runway, but focuses himself: *It's still where it was; just fly attitude.*

Lack of training

It's been understood for decades that when faced with an urgent situation, pilots generally do exactly what they were taught. This is a reason that we try to teach everything a pilot might reasonably encounter. (Though things like electrical fires we teach vicariously.) When Jeb completed his reversal turn, he felt his airspeed and position were way out of whack. How well had he trained for recovery from an abnormal approach?

Jeb glances at the panel – he's about 300 ft AGL and 30 kts above stall. It seems to him like a like a good thing to reverse well above stall speed. In the back of his mind, an old instructor's voice croaks, "*And where will you roll out of this turn relative to where you need to be, to land and stop before the end of the runway?*" An answer didn't come directly to mind, but he is pretty sure he can work it out.

He banks steeply into his reversal turn, not quite a wingover, and nervously watches the ASI needle drift down the dial toward stall speed. The glider banks steeply left, the airport ro-

tates toward the nose, which begins to drop. He's happy to be pointing toward the runway. "Glider seven-eight Papa, final runway 18."

As he turns, Jeb sees an approaching low-wing airplane climb and turn west beyond his nose. In his earphones, he hears, "Bonanza 4423 Whiskey going around one-eight. Glider, what the hell are you doing?" Jeb's too busy to answer.

He rolls out of his turn, looks down at the runway. He had felt low, now he feels too high because he sees he's barely north of the runway's end. He pulls full spoiler, hits the right rudder, and pushes the stick left into a steep slip.

The glider drops too fast. *Oh, right. Fifteen knot headwind. No wonder downwind went so fast.*

He glances at the airspeed as he retracted spoiler and levels out of the slip. Oops! Too close to stall. He stows the spoilers and pushes the nose down to regain airspeed. He feels a bump of turbulence, and is abruptly 10 knots faster. Nothing looks quite right. He feels a little panic, and an urge to dive for the runway and slam on the brakes. Instead, he re-opens the spoilers and the world starts to line up OK.

Ok. Fundamentals: Level wings. Attitude for fifty knots. Spoiler for glide slope. Stay on the centerline. His brain pauses. Something is missing. He starts to flare. The radio barks "GEAR!" *Yikes!* He grabs the lever, pushes the gear out. *Now flare. Level. Straight.*

Prospective memory

Jeb had assigned himself, as he began the pass, the task of remembering to drop the gear at a future moment. He had many distractions, and forgot; someone with a handheld radio saved him.

Distraction also hindered Jeb from telling the Bonanza pilot what was happening and what to expect. Failing to make position calls, too, is a failure of prospective memory. I believe that the surest way to remember the gear is to irrevocably link the decision, the commitment to land, to dropping the gear. Once I realize that I must land, the gear comes out. If the gear is not out, landing is optional.

The main wheel touches, hard; Jeb bounces; lands again, pulls full spoiler, brakes, and stops, with some runway to spare. As the glider stops, he stows the spoilers and for a few moments sits motionless on the runway, using the ailerons to keep the wingtips off the ground, letting the tension dissipate.

Then he lowers a wing, unbuckles, and lifts himself free. Fred jogs over from the tow cart with the ground-tow rope. "Sure looked fun, Jeb. That Bonanza driver sounded pissed. Eight-mile final, my hat! That's rude. You're the glider; you have the right of way."

"Yeah," Jeb says. *I'm lucky my pants are dry.* "Kinda windy today. Embarrassing about the bounce."

"It's OK, Jeb," chirps Fred. "Any landing you can walk away from is a good one. It was good to see that wheel come out. Let's get this thing off the runway."

Later, Jeb is putting the glider back into the trailer. David walks up. He is the day's safety officer. "Can I help you disassemble?" he asks.

"Sure," says Jeb. "I'll be glad of it." They begin working together.

"Jeb," asks David, "have you ever done a low pass before?"

"No, but I've seen a few, and my first glider ride, years ago, the pilot did one with me."

"Jeb," says David softly, "you're my friend, and I like you. What you did today looked unusually stupid for a guy as bright as you are. Please don't do that again until you've had some dual with our instructor. We need you around for awhile, and so do your kids."

"Yeah," says Jeb. "Thanks for not beating me up."

My point here is not to say that we should never fly the low pass, that it's too dangerous, but to point out that there are many ways we can humble or exterminate ourselves with it. There have been accidents and deaths when people have done as Jeb did. These are best reduced with training, practice, and planning. Success is not an accident.

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