BY DR. DANIEL L. JOHNSON

Why We Blunder in the Turn

We cannot perceive error that is outside of training, experience, and expectation

Anyone who's achieved excellence in a high-skill activity has developed finely-tuned perceptions – and can discern features or patterns that are incomprehensible to non-professionals.

For example, I write well, but once, walking the dog with a favorite friend who's a famous writer, who'd shared manuscripts, I said, "I'm quite sure that you are sensitive to nuances in writing to which I'm completely blind."

"Yes," he said.

Another time, I took a professional jazz musician to a jazz concert. Though I enjoyed the music, he talked continually about nuances I could not hear: their quotations of both classical and jazz idioms, their inventive use of keys and harmony – always diplomatically saying, more or less, "As you can tell..." But I couldn't. I lack his training, experience, and ability. Though happy with the music I was deaf to everything that thrilled him most.

I am a skilled photographer; yet when I work with a professional, he instantly perceives subtleties of light, color, and form that I can hardly see.

Experience brings perception and discernment. The December 26th issue of the New England Journal of Medicine contained an article showing that the accident-risk of driver distraction (cellphone use, conversation, etc.) is much greater for inexperienced drivers than for skilled ones.

We have all experienced the transition from neophyte to skill. When we first begin learning any skill, driving an aircraft, ballroom dancing, playing an instrument, piloting an aircraft – every motion requires our full attention. As we gain experience and skill, these motions become integrated into patterns that are performed *in toto*, requiring much less attention.

Gliding is no different. We become sensitive to nuances of the ship, of the air, of procedure and navigation as we seek training and gain experience. We merely think of moving the glider to a different spot in the air, and learned patterns of perception and response make the adjustment simple that was once impossible.

Yet even the greatest among us must function within the limits of human perception, and we are susceptible to illusions that are the natural product of the "receiver operating characteristics" of our five senses. Beyond standard illusion, we all tend to perceive what we *expect* – and this is itself a danger. It is built in at a subconscious level, it's not an intellectual problem. (Well, that, too.)

No matter how raw or how good we are, at some point we cross the limits of perception and recognition, and we do something clumsy or end up damaged. An example is

The low-altitude stall-spin

We keep hearing about pilots of both brief and long experience who die in low-altitude stall-spin accidents. None of these has stalled at high altitude and spun into the distant earth. They've all been low-altitude stalls, shortly after takeoff or during landing.

Why? Well, it's simple: when we stall, we must fall nose-down awhile in order to regain airspeed sufficient to control the aircraft. If this starts when we're already close to the ground, we whack it hard, perhaps fatally.

Tom Knauff has for decades taught pilots to recognize a developing stall with his Six Signs. If we notice these, we can react and correct the situation before the airstream detaches, and releases us like a tomato dropped into the soup tureen.

Six signs of a stall	Perception
1. Excessive back stick pressure	Feel
2. Nose-high attitude	See
3. Low airspeed (ASI)	See
4. Quietness	Hear
5. Mushy controls	Feel
6. Shudder or buffeting	Feel

How Could an Intelligent Person Miss all That?

Let's consider some of the ways we might naturally miss any of these six signs. (We won't belabor the fact that in Tom's presentations hardly anyone can name all six signs, let alone list them in order.)

The truth is that when we recognize *any* of them, we shouldn't start thinking about Tom, and what a great instructor he is, or think of pleasing him by remembering the other five and listing them in order – we should *put the nose down*. Even if the ground is close at hand.

1. Excessive back stick pressure (Feel)

Though this is the first sign of a potential stall, it is the most difficult to recognize. Why? Because it's *relative* – relative to general piloting experience, relative to the ship, relative to the particular flight situation, relative to airspeed, and to CG.

It also is contingent on *awareness* of stick pressure. This has two sides: one is that not every pilot is conscious of this. The other is that during stress, we increase muscle tension, which increases pressure, which we subconsciously *expect* because we produced it.

For example, a while back I realized that I was returning exhausted from flights. It was a long time before I realized that during challenging conditions, I was stiffening my whole body during the entire flight. Consciously relaxing decreased the after-flight fatigue, but more importantly increased the ease of flying because I wasn't moving the controls against my own unintended stiffness.

When we are low, the simple fact of being there is quite distracting, decreasing our awareness of any other detail that might be important.

The fact that back-stick pressure is relative to the flight condition and as well as experience also makes this harder to recognize below pattern-entry altitude (which includes maneuvering near a ridge). We don't spend a lot of time

practicing and training at altitudes of 150-600 ft agl. Partly, this might be the simple desire to get high and go soaring. Partly, this might be a bias that being low, even over the airport, is taking excessive risk.

But we cannot become familiar with the sensations of maneuvering close to the ground, unless we practice it. One excellent way to do this is to go to the gliderport on crummy, non-soarable days – and do a lot of launches, including low-altitude work, in a planned way, in safe conditions. A few years ago, I was able to do many, many auto tow ground launches. This experience was wonderful for making me comfortable with safely maneuvering close to the ground, and I'm grateful for having done it.

2. Nose-high attitude (See)

This second sign of a stall is relative to speed and to the surrounding terrain. Near a ridge, or below pattern-entry altitude, the horizon is not the distant, thin, faint line that reliably shows the water level. Even when we give ourselves extra margin by going fast, we can subtract from this margin with abrupt maneuvers or steep turns.

It's important to remember that an aircraft can be stalled from any attitude, at any speed. A recent NTSB analysis of a Cirrus fatality, in which the pilot and instructor were maneuvering at about 200 ft agl, showed that when the pilot experienced an incipient stall in a steep fast turn, he accidentally hit the wrong rudder, snap-rolling the aircraft instead of recovering. When the attitude is unusual, due to playing around or to unexpected turbulence, *nothing* looks normal, and the best attitude of the nose may not be knowable in the microseconds available for contemplation and analysis, which the NTSB staff may do at their leisure while our surviving friends grieve.

Then there'ree the co-conspirators of visual and vestibular illusions that distort perception imperceptibly. The important point about illusions is that we *don't* at first know they're happening and can at best only recognize that we're in circumstances in which they occur.

Slope and perspective are different when viewed down lower than they appear from up high, which leads to miss-judgment, and the act of swiveling our head during turns causes us to miss-judge bank angle and angle of attack. In addition, our eyes and our consciousness both "lead" our motion vector. We not only look a bit ahead, we perceive changes *before* they happen, which delays correction when our perception is inaccurate.

All these sources of illusion together may not cause gross misjudgment such as the illusions we play with in demonstrations, but together such natural illusions cause errors which, when we're on the edge of safety, cause clumsiness or error that may lead to an accident (that thing we *weren't* planning to have).

3. Low airspeed /ASI (See)

A low (or, perhaps more important, a *decreasing*) airspeed is the third event that's recognizable.

But why are you looking at your ASI? If you're about to stall it's not exactly the best place to focus. If the control response is "live," you're OK at the moment.

The ASI is always worth a glance to make sure we've got enough margin. When thermalling, we don't want it too high, so the turn radius is tight; we don't want it too low, because then we don't climb well. And a spin just doesn't help our average rate of climb much at all.

Landing, we want the airspeed high enough so that we don't stall by flying into the reverse side of a turbulent vortex, or induce a stall in a steep turn down close (either to impress the girls or to correct one bad judgment by making another).

The inset shows that stall speed increases nicely with bank angle, which means that the 30% margin we might like also increases.

I was taught that a 45-degree bank is the safest bank angle in pattern turns because we slip out of a steep turn, we don't spin out. I like them for the nice, tight pattern they create. But they do need almost 10 knots of extra speed. Don't dawdle and then bank steeply. It's a way to fall down the stairs, so to speak.

More important, we misperceive our speed when close to the ridge or landing spot because of *vection* – the sense of movement that comes from objects passing by in our peripheral vision. As we get closer to the ground, vection increases and even slow speeds *feel* fast – and then we don't feel the *need* to glance at the ASI.

Slips and skids make the ASI *incorrect*. Fortunately, the ASI then reads low; though unpredictably. Unfortunately, skids create spins. Another good reason for making the 45-degree turn standard in the pattern is that it removes the temptation to rudder the plane around, which is what creates many fatal stall-spins. I think it's good to practice and be comfortable with both 30-degree and 45-degree turns in the patterns, so we have a broad repertoire to adjust our course depending on wind, traffic, and surprises.

4. Quietness (Hear)

Yes, decreased wind noise is an indication of airspeed. Still, the proper degree of wind noise requires experience, and is relevant to the particular aircraft. One with turbulence-creating joints or vents will make quietness more useful than a well-faired, slick canopy.

Are you paying attention to wind noise in the pattern? If so, what might you *not* be attending to that might be more informative? Are you slipping to a landing? That's a lot noisier than straight flight.

So, it's a clue – but it's a pretty imprecise clue. If we suddenly realize that it's too quiet, it's nose-down, wings-level until the noise is back and we're safe again.

5. Mushy controls (Feel)

Perhaps we don't pay continual close attention to the liveliness of our controls, so we may not quickly notice when the controls gradually get less live and responsive. When we do notice, we need to put the nose down first and check the ASI next.

My own experience is that when I feel *incorrectly* as though the airspeed is good, the angle of attack OK, and enter a stall

STALL SPEED V. BANK ANGLE

Bank angle	Load factor	% change Vs	Vs
0	0	0	40
45	1.4	20	48
60	2	40	56
75	4	100	80

or incipient spin, my first thought isn't, "Oh, the nose needs to go down." As the nose falls through the horizon in an incipient spin the instinctive thought is, "Did the elevator fall off?" The controls feel *disconnected*.

The safety challenge, of course, is that at low altitude – over ridge or turning to final – mushy controls are a siren-level emergency alert. Nose down, wings level, descend as low as safely possible to get back safe airspeed. It's hard to point the nose at the golf course when we can already read the jacket logos.

6. Shudder or buffeting (Feel)

As we all know, speed is what permits and produces flight. The minimum speed required to sustain flight is Vs, the stall speed, and below that speed, we fall like a snowball.

Honestly, if we have been distracted from noticing any of the first five signs of a stall, and we're close to the ground – by the time we feel the buffet, and acknowledge in our foggy mind that, Yes, Margery, this *is* a stall developing – we are in Deep Trouble.

One of the problems, even here, is that some aircraft, especially those with nice laminar-flow wings, transition from smooth flight to full stall with very little buffet. A big, fat wing stalls slowly and gracefully. Thin wings are like high heels – they look great, but when they go down, they go fast and hard.

The points here:

With experience – experience equals training and *practice* – we become more sensitive to the nuances of flight. If we do not practice, we won't gain skill, and aren't likely to recognize situations.

A low-altitude stall-spin is of course something we cannot practice!

But, then, we aren't *wanting* to get experience in low-altitude stall-spins – in oder to avoid them, we are wanting two different experiences:

A: The sound, sight, and feel of a *stall* from many different attitudes, especially turning, including uncorrdinated turns. Training normally includes stall work though never enough, I think.

B: The sound, sight, and feel of *low-altitude* flight. I think we should deliberately teach this. Ideally, we have a local ridge, which we can first fly in low-turbulence conditions, just to gain experience in low-altitude flight.

I also think that we would be greatly helped by using un-soarable days to take repeated low tows, carefully planning brief, low flights back to landings on various parts of our local airstrip from different directions. Years ago, I was able experience repeated low-altitude flights in auto tow ground-launching. It was wonderful training for low-altitude flight.

On a calm, cloudy morning with, say, 1200-foot ceilings, we'll have the local airport pretty much to ourselves, and the flights will be so brief that we can take short turns and get everyone involved.

What we don't practice, doesn't become a skill – and without skill we won't recognize when we're nearing the edge.

Besides, it's fun.

Acknowledgements

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SOARING MAIL

LETTERS FROM THE SOARING SOCIETY

Developing a discipline

I am fifteen miles out on final glide. My super fancy, JSW flight computer tells me I am plenty high, and to fly 90 knots.

As I approach (the world famous) Ridge Soaring Gliderport, I call on the radio to announce my intentions. "Delta Uniform Oscar entering the upwind leg for a left-hand landing on 27."

As I enter the upwind leg, I slow down to 60 knots. I added half of the wind speed to the recommended minimum no-wind, landing speed to approximate the best speed to fly. I put the landing gear down, and set the trim for this speed.

Another glider is landing first and is on its base leg.

As I approach the I.P (initial point) which is about halfway along the downwind leg, I perform the USTAL pre-landing checklist:

Undercarriage – down

Speed – set (Best L/D speed plus half of the wind)

Trim – set

Airbrakes – checked

Look – for other traffic, obstructions, activity on runway.

The other glider is down, and clear of the runway.

On the downwind leg, I "monitor" the variometer and make adjustments with the dive brake to accommodate a normal descent rate of 2-4 knots, "Monitor" means check occasionally.

I pay close attention to pitch attitude and the airspeed indicator. Flying an appropriate airspeed is paramount to my safety.

I pass "Point A" opposite my intended touchdown point.

Check airspeed and descent rate. Make adjustments if necessary.

THE SOARING SOCIETY OF AMERICA, INC.

The Soaring Society of America (SSA) is a nonprofit organization. The purpose of the Society is to foster and promote all phases of soaring. The SSA is a division of the National Aeronautic Association (NAA), the U.S. National Aero Club, which represents the U.S. in the Federation Aeronautique Internationale (FAI), the world sport aviation body comprised of all national aero clubs. NAA has delegated to the SSA the supervision of FAI related soaring activities, as follows: Record attempts, competitions, FAI badges, and selection of the United States Team for the World Gliding Championships. Soaring Magazine is the official journal of the SSA.

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I pass point "B," a 45-degree angle back to the intended touchdown point.

Check airspeed and descent rate. Make adjustments if necessary.

The turn onto the base leg is made at an intentional 45-degree bank angle. It only takes about five seconds, during which I pay close attention to pitch attitude to absolutely control the airspeed, and keep the yaw string absolutely straight.

I look right to ensure no other aircraft is making a straight-in approach. I look left at the runway and perceive a familiar landing approach angle based upon the easy to learn, TLAR system. (That Looks About Right.)

The angle is a bit shallow.

A glance at the airspeed indicator confirms my airspeed is a bit slow. . .

Why is the airspeed slow?

It is instinctive behavior. We all come to aviation with ingrained, instinctive and learned, behavior. At one time, we all thought the elevator was the up and down control.

Look at the score card for this time line: Thinking the elevator is the up and down control 15-30 years. Discovering the elevator is actually the angle of attack control and practicing – perhaps months: maybe a few years.

If we are low, we instinctively attempt to hold the aircraft up with "Excessive back stick pressure."

Which is the first sign of a stall.

Whenever you are low, you will be slow. Guaranteed.

Each and every one of us will instinctively behave in exactly the way described whenever we experience increased stress at a too low altitude.

Landings. Rope breaks, low altitude thermalling, weak ridge lift.

Excessive back stick pressure. It is paramount to develop certain habit patterns. One is to absolutely fly a constant, appropriate airspeed, especially when close to the ground. *Especially* during turns close to the ground.

It is done by an awareness of an appropriate pitch attitude, elevator stick pressure, and reference to the airspeed indicator.

It is done by developing a discipline in all of your flying to absolutely control the airspeed exactly. Plus or minus nothing, Especially when close to the ground.

—Tom Knauff