Perceptual errors in the turn from base to final.

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Abstract: One of the most frequent fatal glider accidents is a stall during the turn to final. There are several perceptual distortions that may contribute to this. The best prevention is to actually glance at the airspeed indicator frequently to stay comfortably above turning stall speed, and to make a coordinated or slipping turn. This presentation summarizes ways in which the human perceptual system is prone to error.

Keywords: pattern accidents, low stalls, misperceptions at low altitude, circuit stalls, pilot illusion.

Introduction:
Every action pilots take depends on their systhesis information, involving selection, perception, and comprehnsion of information. If this is erroneous, training and skill may be competently applied to wrong infomration.

Our perceptions are not reality. They are a finely detailed cartoon of reality, one that we believe, because it's normally reliable. However, perception's reliability and accuracy depends on a constant flow of redundant and overlapping information, especially from visual fixation on known objects.

Selection: Researchers are keenly aware that *selection bias* jeopardizes all observation. The turn to final is an experience, not an experiment. It is important to attend to the most relevant information – and to deprecate unimportant or misleading observations, in order to correcly interpret dynamically the status of pilot and glider in the three-diminsional environment, and to avoid embarrassment or catastrophe at the ground, which is uncompromisingly stiff.

Perception: False perception of the glider's dynamic status in the three dimensions of the air (perceptual illusion) of course yields a false notion of how to manipulate the controls to make right actions (cognitive illusion). The important point is that the glider pilot *cannot* be aware of error until *perceptual conflict* occurs. The result is quaintly called an Undesired Aircraft State.

Eventually the pilot with illusory perceptions, because they're wrong, will sense something contradictory. This does *not* immediately correct the illusion. There are good reasons for this:
- The clashing information or sensation is displaced from consciousness, ignored, or misinterpreted (incorporated into the cognitive illusion).
- The clashing information is attended to, but the pilot cannot integrate it into the incorrect gestalt. The pilot feels *confused*, for this is not The Voice of Mother. The confusion is useful, because it causes the pilot to seek additionaly confirmatory information (such as a quick glance at the airspeed indicator).

There are two key challenges at this point: One is that, when very low to the ground, there may not be time for a reflective moment to resolve the confusion. The other is that the moment of confusion is an *interrupton* and *distraction*. Any such may bump a planned action out of the *prospective memory* queue.

Prospective memory refers to the fact that in all activities, we often must line up a sequence of actions, all of which are deferred until their time. Interruption and distraction can bump actions items out of the queue, especially the next in line.

An item may also be bumped from prospective memory due to illusion – for example, if the expected consequences of an action are perceived. For instance, if the glider enters sink during a distraction that occurs just as the pilot reaches the time to extend landing gear or spoilers, the subconscious brain may pass a “job done” token to consciousness, and the pilot may emerge from one illusion only to enter another.

More experienced pilots may be more prone to this because action sequences are often done habitually, as a single item, like a musician playing a scale, chord, or arpeggion.

Training: Training does not prevent illusion, but it should teach the pilot *where to focus attention*. For example, the airspeed indicator, the rudder position, the yaw string or ball, and the runway of intended landing must be repeatedly and frequently

checked. Anything that hinders the pilot from continually re-checking on these important sources of perceptual information is a distraction during the turn to final.

Formal named illusions that may be in play:
Vection illusion: This is the name for "false motion." When an aircraft turns above 300 meters/1000 ft or so, the ground hardly seems to move, and it seems to pivot in the air even during a fairly broad turn. This is a vection illusion that may hinder the pilot from effectively center a thermal, but creates no danger.

The *pivot altitude* is that altitude at which an aircraft, in making a coordinated turn, seems to the pilot to pivot about a point on the ground that's just at the wingtip. Above that altitude, there is the false sense of a small turn and slow speed. Below that altitude there is a sense of a broad turn and high speed – at the same aircraft velocity. The turn to final is below pivot altitude for most aircraft.

The fact that gliders normally stay high, well above pivot altitude, habituates perception to a slow-speed illusion. As the pilot flies a circuit/pattern to land, the sense of speed steadily increases during descent even though the aircraft is often actually slowing. This creates an illusion of increased speed, which can be corrected cognitively only by checking the airspeed indicator.

Speed constancy: We tend to interpret the apparent movement of external objects as always representing the same speed. This is the heart of the vection illusion above. Errors of memory, or errors of integrating memory into today's perception, exacerbate this illusion.

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 is particularly important when landing off-field or at a novel field.

False horizon: When there are hills or mountains nearby, this is serious. While we're above everthing, we see the real horizon. As soon as we descend below any hump of earth, any ridge line becomes a false horizon.

Neglect: We commonly fail to discipline ourselves to attend to all the clues that can correct illusion. Tom Knauff's famous didactic presentation, The Five Signs of a Stall, regularly reminds us that we do not train ourselves to use all the information available to us in order to correct the cognitive illusions that are inevitable.

Conclusion:

We may forget, through the familiarity of success, that we can fly only because of speed. An aircraft is designed to stay in the air safely only within limits, bounded on the upper end by flutter, where control surfaces might snap off, and at the lower end by the stall speed, below which we fall out of the air. The airspeed indicator stands by to correct speed illusions.

Awareness of illusions and misperceptions is important, if only to teach us that we must continually seek redundant information, to verify our status in the three-dimensional dyamic environment we occupy as a pilot. We cannot be smug during the turn to final; we must always check the basics: airspeed, attitude, yawstring or ball.

It's airspeed we want, and we put the nose at -whatever attitude keeps the airspeed where it's meant to be: 1.3 VSO + % the gust velocity (more, if it's really gusty).

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