SEEING IS NOT ALWAYS BELIEVING

by Richard A. Hansen, M.D., AME

"Watch what you're doing!" my instructor shouted. "Don't you know you're dropping like a rock?" I was training in our club's Cessna 152, practicing steep turns, and had inadvertently steepened the turn to a 60 degree descending spiral. The airspeed had climbed into the yellow zone, and with a quick glance at the instrument panel it was apparent that we were descending more than 1000 feet per minute. With a quick pull-back on the throttle, and a pull-up on the yoke the descent was broken. And the ailerons rapidly corrected the bank angle. The next steep turn went well, and the remainder of the lesson preparatory to a check ride was uneventful.

Later I wondered about the incident. What happened to the pilot-in-command during those brief seconds. As all our fellow pilots know, in a light trainer plane the steep turn should be at 45 degrees, not 60. That is the angle where the G-forces double, and wing lift rapidly fades away. My health is excellent, vision clear, and the plane was flying normally. So what happened?

It appears to me that this happened because of a transient illusion called spatial disorientation (SD), which is defined as "an incorrect perception of one's linear and angular position and motion relative to the plane of the earth's surface or other significant object." This is different from the erroneous perception of a navigation parameter, often referred to as geographic disorientation, or simply getting lost. Regardless of a pilot's experience or proficiency, sensory illusions can lead to differences between instrument indications and what the pilot "feels" the aircraft is doing. Some have called this somatosensory system the "seat-of-the-pants" sense, which we all are aware of when we fly, especially in steep turns, slips, climbs, and landings. This sensory information is caused in flight by the pull of gravity, resulting in what we call G-forces.

Commonly in a pilot's training we exercise caution when flying at night, in obscure weather or clouds (IMC), or over water, where the normal visual indicators of horizon, city lights, mountains, roads, and charted landmarks are missing. Then there are medical conditions which can increase one's susceptibility to spacial disorientation, particularly visual illusions. These include drugs and alcohol, fatigue and task overload, or sudden anxiety.

Naturally, there is imminent danger when spatial disorientation occurs. Many crashes occur when pilots become disoriented, and they forget or neglect to trust their flight instruments. The conflict between bodily sensations and the attitude indicator, altimeter, turn coordinator or airspeed indicator must be resolved in favor of a quick decision based on the indicated airspeed, angle of turn or descent, etc. In the U.S. Navy a false perception of bank is called the "leans." The leans are among the most commonly experienced spatial disorienting illusions, and have the capacity to cause fatal accidents, not only in military aircraft, but civil aviation also.

There are three main sensory systems involved in spatial orientation and disorientation. Vision is by far the most important of these senses, for both VFR pilots and instrument flying. Hearing plays a minor but also important role, as in the quiet sounds just before a stall, the wind noise that could indicate an open door, or in estimating engine RPMs before checking the tachometer. The vestibular system is second to vision in helping us feel angular and linear acceleration. In other words, from the semicircular canals in the inner ear we get our sense of position and motion. The somatosensory system involves many body structures, including the skin, joints and muscles. We experience pressure feelings when airborne, called "flying by the seat-of-the-pants," to help pilots determine which way is down and how steep we are turning by sensing the force gravity exerts on our body.

There are two parts to our visual system, both of which affect a pilot's flying skill. The ambient mode of our vision relies mostly on peripheral vision, and is primarily concerned with the question of "where." This not only helps us decide when to round out over the runway, but provides us with spatial orientation. Ambient vision is processed at the subconscious level, automatically and without conscious effort. Focal vision, on the other hand, is concerned with seeing things, avoiding another plane, interpreting the cockpit instruments, reading the charts, and seeing where we are in reference to the ground.

Both the eyes (visual) and the inner ear (vestibular) systems play a critical role in spatial orientation. The three semicircular canals in each ear provide angular and linear acceleration information to stabilize the eyes when motion of the head and body would otherwise result in blurred vision. Secondarily, when visual clues are absent, as when flying under the hood or at night, we still preserve our sense of position and motion. On the ground these senses operate quite well. But aloft is an entirely different story, as last year's accident statistics clearly show. Over 56 per cent of SD related mishaps occur during the day, indicating that aviators must remain alert and scan the sky constantly when we fly.

So, what happened when I descended in that steep spiral? Transient spatial disorientation, in broad daylight, occurred with the combination of turning and descending and accelerating G-forces, while an inexperienced PIC was not paying close enough attention to the instruments or his rapidly changing outside reference points. Fortunately, the error was corrected quickly. And I learned that we are all susceptible to these flying illusions, one of which is the boastful delusion "it can't happen to me!" In retrospect, I've determined to fly more safely, trust my instruments implicitly, and remember to pay attention to every body signal the Master Designer made to help a pilot fly well.

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