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SAFETY FIRST

A column dedicated to GA safety education

By Warren V. DeHaan, OD, ATP, CFII
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MOTHS FLY TO THE LIGHTS. DON'T YOU!

R. C. Thompson presented an excellent article in last summer's FPA ONLINE BULLETIN "Safety First" column on the dangers of nighttime final approaches to an airport. In this follow up article, I'm going to discuss a danger that has similar visual misperception issues, but occurs farther from the airport, and long before the final approach for landing begins.

I have become convinced that pilots involved in several night crashes I investigated have, as their probable cause, a misunderstanding that "flying to the lights" will ensure terrain clearance. These crashes occur on nights where there is enough light for the pilot to believe he or she can see the underlying terrain well enough to fly close to it. This ambient light on the underlying terrain may be provided by moonlight, city lights reflecting from a base of overcast, or snow covered or light colored terrain, for example.

The crashes occur when the pilot is navigating by visual references, in visual meteorological conditions, often with very good visibilities of the destination lights of the city or airport in the distance, and while the pilot is descending to the destination. The pilot may be operating under VFR or on an IFR flight plan with a visual approach clearance. They often happen in uneven terrain where the exact shape of hills or mountains is somewhat obscure. Most notably, the crashes typically occur very near the top of the ridge that the pilot "almost" cleared. On one crash, the impact was actually above ground level, but he hit the trunk of a very sturdy tree not far below the treetop. On many of these crashes, the impact is so close to the top of the ridge that the wreckage goes over the top and slides a considerable distance down the far side.

This scenario is sometimes described as a variation of the "Black Hole Illusion." However, that term is commonly used to describe a landing-short, final approach to an airport. What I am defining as a "Flying to the Lights" crash happens when the pilot is still far from the airport, often more than 10 or 15 miles and often in hilly or mountainous rural country. It is similar to the "Black Hole Illusion" with respect to not having sufficient peripheral visual cues for judging ones height above terrain.

Technically, these and many aviation "illusions" are not really illusions at all, but rather are simply misperceptions and misunderstandings. In the true sense of the word, illusions are species-specific misperceptions that everyone experiences the same way, and cannot be overcome. See Figure 1, which is Roger Shepard's "Turning the Tables" il-

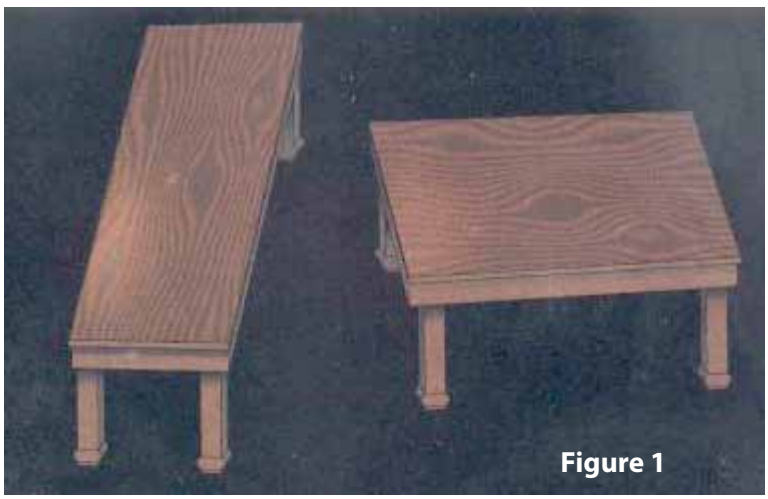

Figure 1

lusion. The length and width of the tables are equal and yet, we all misperceive to the extent that they certainly don't look equal to us, no matter how hard we try to see them that way.

Most of our aviation "illusions," are simply mistaken visual perceptions that can be overcome with experience and training and therefore are not illusions in the academic sense. "Flying to the Lights" is just such a mistaken understanding that can be overcome and for which we can compensate.

How could a pilot hit a ridge if he is flying a line of sight to the lights of his destination airport? You would think that there could not be an obstruction to hit if he has a clear line of sight. That is true up to a point. However, a crash into terrain may occur if he settles slightly in the last few seconds, without enough time to pull up, or if he is not watching intently at the instant the lights disappear. Several studies on helicopter pilots reveal that a human's vestibular apparatus is not very sensitive to vertical accelerations and that we mostly rely on visual cues for that function. With nearby peripheral visual cues sparse, it is difficult to "feel" oneself settling more than expected. A little downdraft (atmospheric sink), or a little too steep a descent coupled with a distraction at the wrong time, such that the increase in the descent path is not noticed, and it could be all over. Watch for sink any time, but especially on the lee side of any ridge.

What many pilots do not understand is that even though there is no unexpected sink, nevertheless their descent path may not be the same slope as their line of sight. It may be steeper, and that fact may not be noticeable when flying to distant lights if nearby visual cues are sparse. Please see Figure 2.

An indistinct horizon or a false horizon may be another cause of flying a descent angle that is steeper than is safe. At night, many of the usual visual cues are absent, such as streaming of the underlying and close-by terrain. In the daylight, or with an abundance of ground lighting, we can see that the closer we are to the ground, the faster the streaming occurs below us. That cue is missing when the terrain below is dark. Additionally, at night you cannot see how close-by objects move in relation to each other.

Size constancy is one of our strongest visual cues to judging distance and it may be poor or absent at night. With size constancy, we subconsciously compare the relative retinal image sizes of nearby familiar objects whose real size is known, especially of man-made objects. Did you ever notice when houses and vehicles start to look like toys instead of real things after takeoff (which is when size constancy breaks down)? For many people that occurs when you climb above 800-1000 feet. Many of the usual visual cues for judging distance are missing at night, such as association, brightness differences, shading, texture, texture gradients, linear perspective, aerial perspective, height-in-the-plane, color contrasts, and movement parallax.

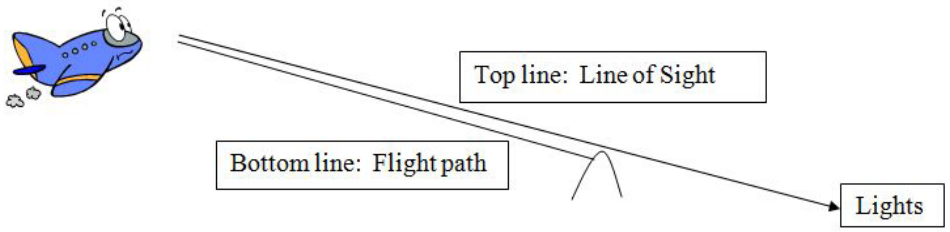

Figure 2

To prevent this kind of crash, the most important compensation is to provide for a wide safety margin at night. Even if you think you can see well enough to clear the ridge when flying near it, the best idea is to give yourself at least a few thousand feet of safety margin. More if it is a very dark night.

Use everything at your disposal. Compare both barometric and GPS-derived altitudes with the charted terrain. Double check your descent rate on your VSI and notice if it increases. Think about how your flight path will be affected by changes in configuration of gear and flaps, trim, and power settings.

Switch to the sectional chart on your iPad if you have a geo-referenced subscription and look at the topography below and ahead of your airplane symbol. Of course, you can always be safe by flying above the Maximum Elevation Figure "MEF" as depicted in the blocks outlined by the tick lines on a sectional or world aeronautical chart. The problem is that the highest obstacle may be 50 miles away and 4000 feet higher than the terrain below you, and your goal is to get down to a reasonable altitude to eventually enter the traffic pattern when you arrive at the terminal area (which may, for example, be 7000 feet below the MEF).

Even if you are VFR, or on an IFR visual approach clearance, you can still stay above the IFR altitudes (the enroutes, the MSA, the arc if there is one, the initial approach fix altitudes) until you get closer in and need to descend to traffic pattern altitude. If you have some sort of terrain warning device, respect its warnings. Even an older Garmin 396 portable will give you the call "Terrain, terrain, pull up, pull up."

If you really want to enhance your safety when you're on IFR at night, don't accept a visual approach clearance. The controller may offer it, but you do not have to accept it. You are the boss of your flight and the controller is there to serve your needs and the needs of other pilots. Even if you are in a little Cessna 150, you are the captain of your ship, so don't be reluctant to exert your authority for the purpose of making your flight safer.

What this really boils down to is something that always makes sense when flying: Give yourself a generous safety margin. We all make mistakes from time to time, but if we monitor our performance and have allowed a wide safety margin, those mistakes can be corrected before they lead to an accident.