Collision Avoidance

It's up to all of us

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The word *MIDAIR* sends shivers down the spine of any airman. But how many of us are aware of where midair collisions are most likely to occur and, more importantly, what we can do to prevent them? The old cliche, "An ounce of prevention is worth a pound of cure," could not be more appropriate.

Let's dispel some common misconceptions first. I take issue with the following statements (in italics) from National Transportation Safety Board reports involving midair collisions of U.S. general aviation aircraft between 1973 and 1976:

- *ALMOST all midair collisions occur in the takeoff or landing phase.* Yes, but 45% occurred outside the traffic pattern.
- *Most midair collisions occur at uncontrolled airports.* True, but of those occurring during the takeoff or landing phase 29% occurred at controlled airports.
- *Almost all midair collisions result in fatalities.* Not true; about 43% resulted in fatalities.
- *Most midair collisions involved flight instruction or a solo student.* Again, not true; only 25% were in this category.

This leads us to a number of conclusions. Aircraft are just about as likely to come together while en route as in the traffic pattern. Being in a controlled environment is no guarantee against a midair. Our chances of surviving a midair collision are better than 50-50. Although the risk of a midair involving flight instruction or a solo student is high, other kinds of operations are not immune.

Electronic equipment, both on the ground and in the aircraft, is a tremendous aid in avoiding midair collisions. The design of the aircraft itself can help or hinder our efforts at collision avoidance. In the last analysis, the greatest defense we have against a midair collision is ourselves. Our ability to avoid midairs depends on how well we know the capacities—and limitations—of the Air Traffic Control (ATC) system, our aircraft and ourselves.

ATC provides various types of radar services. For details of specific types of radar assistance to VFR aircraft we should consult the Basic Flight Manual and ATC Procedures portion of the *Airman's Information Manual.*

The primary purpose of ATC radar is the separation of IFR aircraft. Radar Traffic Advisories are provided on a "work load permitting" basis; in no way do advisories relieve pilots of our responsibility to see and avoid other aircraft nor are we guaranteed separation from all aircraft. Radar does not "see" all aircraft. Aircraft that are not equipped with transponders, that are at low altitudes or are in areas of poor radar coverage may not be "observed." These limitations apply whether we fly VFR or IFR. While in VFR weather conditions we can neither assume nor expect that ATC will advise us of *all* the traffic in our area.

Aircraft design is a major limiting factor in our ability to see and avoid other traffic. Each individual model has its own advantages and disadvantages. The question for each pilot is not whether a high wing is better than a low wing, or vice versa, but what limitations does the aircraft I fly place on my ability to see and avoid other traffic?

In straight and level flight our field of vision is blocked downward and in front of the nose (Fig. 1 & 2). This is true for both high- and low-wing aircraft. The degree to which our vision is blocked depends on the design of the aircraft and how high we sit in the seat. For this reason many student pilots cannot find landmarks that are literally right under their noses. The wing of a high-wing aircraft will block vision above and behind the aircraft, somewhat in the shape of a cone. The wing of a low-wing aircraft, on the other hand, will block an area below and behind the aircraft, somewhat in the shape of an inverted cone.

In a turn, a low-wing aircraft will have a good field of vision in the direction of the turn (Fig. 3). However, the wing will block the area opposite to the turn. With a high-wing aircraft the reverse is true—the field of vision is blocked in the direction of the turn and unobstructed in the area opposite the turn (Fig. 4).

During climbs and descents, both with high- and low-wing aircraft, the actual flight path may be blocked (Fig. 5 & 6). Whether the flight path is blocked and the degree to which it is blocked will depend on many factors, such as aircraft design, speed, flap setting and even the height of the pilot.

Aircraft manufacturers place obstacles in our field of vision. Some are due to structural considerations and are unavoidable, such as braces, struts and compasses.

We can compensate for aircraft limitations. The clearing turn is a primary method. As can be seen from Fig. 5, depending on aircraft attitude and airspeed, visibility in the flight path may be blocked. Shallow turns should be employed at regular intervals to "clear" the aircraft's flight path.

Turns present other problems. Once in a turn, the direction of the turn is blocked in high-wing aircraft, and the direction opposite the turn is blocked in low-wing aircraft. The solution with either is to clear the area before initiating a turn, then complete the turn as rapidly as practicable. Descents present the same problems as climbs (Fig. 6). The solution is the same.

Due to manufacturing considerations, windshields are often obstructed by braces and assorted instruments. We must be sure to move our heads and check for aircraft hidden by these obstructions. Pilots add to the problem by putting charts, computers and other paraphernalia on top of glareshields, where they interfere with visibility when they are reflected in the windshield. Some pilots further compound the problem by flying with windshields so dirty, they're flying IFR! Except for the manufactured obstructions, windshield clutter can be eliminated with a little discipline.

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It is the pilot's responsibility to see and avoid other aircraft

The key to the see-and-avoid concept is vision. Light comes through the lens of the eye and is focused by the lens on the retina, at the back of the eyeball. The retina is made up of cones and rods, the light-sensing cells. The cones are sensitive to colors; the rods are sensitive to black-white images. When we look directly at an object the light is focused on the fovea, a section of the retina directly opposite the lens where visual acuity is the greatest. This region is composed entirely of cones.

Visual acuity, the relative ability of our eyes to resolve detail, is of primary concern. A person with 20/20 vision can detect an aircraft with the fuselage diameter of a Cessna 210 at approximately 4½ miles. A nearsighted person would not be able to detect the aircraft until it was closer. Visual acuity decreases rapidly with myopia (nearsightedness).

Visual acuity decreases also rapidly toward the periphery of vision. During daylight hours we cannot depend on peripheral vision to detect approaching aircraft. At night, when only black-white images are seen, looking directly at an object can cause it to seem to disappear. This effect is known as night blindness. The object seems to disappear because the black-white images fall on the cones, which are sensitive to colored light. At night we should use our peripheral vision, using the sides of our eyes so the light is focused on the rods to see objects. (It usually takes at least 30 minutes for the eye to obtain complete dark adaptation).

Another night phenomena is the *autokinetic effect* (or stare vision). When we stare at an object in the dark it may seem to move erratically. This is caused by an involuntary continuous horizontal movement of the eyes. It is so rapid that we are unaware of it.

Relative motion is another prime factor. Our eyes can much more readily detect a moving object. This is a major limitation to seeing and avoiding other aircraft. Aircraft on a collision course will appear relatively motionless.

Accommodation time is the period required for our eyes to change focus from an object at one distance to an object at another distance. It is estimated that it takes about 3 to 5 seconds to shift our eyes from outside the aircraft, to the instrument panel, and back outside again.

Distraction, which can come from many sources, must not be overlooked. We all too often become absorbed with an equipment or navigational problem to the extent that we virtually ignore the outside environment. On long cross-country flights it is easy to daydream away the empty hours. Passengers can become a distraction, too.

Other limiting factors are glare and hypoxia, which reduce visual acuity. The effects of hypoxia are increased by smoking, fatigue and tension.

Where available we can, and should, make use of ATC radar. When receiving radar traffic advisories, either VFR or IFR, we must remember these points:

- Acknowledge receipt of all traffic advisories.
- Inform the controller if the traffic is in sight.
- Advise ATC if a vector or deviation to avoid the traffic is desired.

Remember that ATC often will not report all potential conflicts. Be alert.

Some ATC facilities provide *Conflict Alert* service. ATC equipment uses transponder and Mode C (encoding altimeter) information to alert controllers of possible conflicts between participating aircraft. Should a conflict occur, the controller will issue a "Conflict Advisory." This service is provided to both IFR and VFR pilots that have aircraft with this equipment and are utilizing radar services. Not only will it alert controllers of possible conflicts between aircraft obtaining radar services, but any aircraft that is transponder and Mode C equipped.

While operating on an IFR flight plan in visual weather conditions, we must be continually aware that it is the pilot's responsibility to see and avoid other aircraft. Separation is being provided only to known IFR aircraft, in many cases. Don't spend too much time "inside the aircraft." Instrument flight rules allow us to digress plus or minus 100 feet altitude, 10 degrees heading and 10 knots of airspeed. We must use this latitude to get our heads out of the aircraft on a regular, organized basis.

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The ability to detect other objects is linked to relative motion

Don't follow ATC instructions blindly. Remember that as pilot in command you are, by regulation, the final authority and have the responsibility. At an airport with a temporary air traffic control tower in operation a midair collision recently occurred. One aircraft, after being properly cleared for an intersection takeoff, was hit by a second aircraft just after liftoff. The second aircraft had departed without ATC authorization. Both pilots failed to see and avoid the other. It is our responsibility to decline any clearance if we consider it hazardous.

The most important collision avoidance procedure we have is *scanning*. Proper scanning is not instinctive. It must be learned. Therefore (except for learning by experience), it must be taught. Remember the definition of learning by experience? That's where the *test* comes before the *lesson*. Solo flight is not the place to pick up the skills of collision avoidance. Collision avoidance precautions are a required part of the curriculum for a private pilot certificate.

Because of the limitations brought about by visual acuity and accommodation time, we cannot scan in one continuous sweep. We must divide the area being scanned into quadrants. After this is done, a proper scan is accomplished by "stop and look," then move on to the next quadrant, and "stop and look." Don't forget to check behind the braces and struts. At night, detection of other aircraft depends almost entirely on peripheral vision. Use the same scanning procedure described above, but avoid looking directly at objects, especially for long periods of time.

Our ability to detect objects is related to their relative motion and contrast. There are steps that we can take to make ourselves more conspicuous. Day or night, we should always fly with the anti-collision beacons *on*. As recommended in the *Airman's Information Manual*, when departing or arriving we should always turn on the landing lights. This is standard operating procedure for the military and for air carriers. Many air carriers have additional lighting that illuminates the vertical stabilizer, an option now being made available for many general aviation aircraft.

The use of clearing turns has a secondary advantage with respect to collision avoidance. The relative motion during this maneuver will help alert other pilots in the area of our presence.

There are other ways we can lengthen the odds of being involved in a midair collision. Avoid flying into the sun, where glare can reduce forward visibility to zero. If at all possible, fly above haze and smoke layers. Carry and use supplemental oxygen when required to improve visual acuity. Before flying at night, be sure to let your eyes adapt to darkness. Don't allow distractions to interfere with collision avoidance procedures.

When traffic is spotted, *never* assume that it has you in sight. An aircraft on a collision course will tend to remain stationary in the windshield. If it is flying in the same direction, at the same speed, its relative size will remain the same. If it has a greater speed, it will appear to get smaller. If it is flying toward you, or away at a slower speed, it will appear to get larger.

If the other aircraft is on a collision course, or nearly so, take immediate corrective action. Head-on or overtaking, alter course to the right to pass well clear, *keeping the other aircraft in sight* (Fig. 7). If the other aircraft is approaching from the side, generally the best procedure is to turn toward the aircraft. The object is to pass behind it while keeping it in sight at all times.

The altitude of the other aircraft can be estimated by comparing it with the horizon (Fig. 8). If the aircraft is on the horizon, it is at your altitude; if it is above or below the horizon, it is either above or below your altitude. Once an aircraft is detected, don't allow it to distract you to the exclusion of everything else. There may be other targets.

These are general guide lines. Virtually every midair collision is avoidable—this is one area of aviation safety that is literally up to us. □