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II.C. Visual Scanning and Collusion Avoidance

Objectives

The student should develop knowledge of the elements related to proper visual scanning and collision threat avoidance, and develop knowledge regarding in-flight and landing illusions, as well as how to avoid trusting them.

Key Elements

- "See and avoid"
- Clearing procedures
- Trust your instruments

Elements

- "See and avoid"
- Proper visual scanning
- Clearing procedures
- Recognizing hazards
- Collision avoidance
- Conditions that degrade vision
- In-flight illusions
- Landing illusions

Schedule

1. Discuss objectives
2. Review material
3. Development
4. Conclusion

Equipment

- White board
- Markers
- References

Instructor's Actions

1. Discuss lesson objectives
2. Present lecture
3. Questions
4. Homework

Student's Actions

Participate in discussion
Take notes

Completion Standards

The student understands the importance of maintaining a vigilant traffic scan and consistently scans for traffic. In the onset of an illusion, the student understands it as an illusion and trusts the instruments to maintain safe flight.

References	FAA-H-8083-25B, *Pilot's Handbook of Aeronautical Knowledge* (Chapter 17) FAA-H-8083-3B, *Airplane Flying Handbook* (Chapter 1) AC 90-48, *Pilot's Role in Collision Avoidance* https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_90-48D_CHG_1.pdf

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Instructor Notes

Introduction	Overview—review objectives and key ideas. Why—visual scanning and collision avoidance are important in creating safe skies.
See and avoid	*[Part 91, AC 90-48C]* Maintain vigilance at all times while operating an aircraft, regardless of whether the operation is conducted under IFR or VFR.
Proper visual scanning	Remain alert to all traffic movement within the field of vision. Periodically scan the entire visual field to ensure detection of conflicting traffic. Use short, regularly spaced eye movements, bringing successive areas of the sky in the central visual field—no more than 10° per movement, observe for at least one second. At one glance, only a very small center area (the fovea, in the rear of the eye) has the ability to send a clear, sharply focused image to the brain. All other visual info will be of less detail. Peripheral vision can be useful in spotting collision threats—apparent movement often detected by the peripherals. At night, visual search depends almost entirely on the peripherals. Poor visual scanning increases the risk of midair collisions.
Clearing procedures	Before takeoff—prior to taxiing onto the runway, scan the approach area for traffic. Maneuver appropriately to provide view of area. Climbs and descents—execute gentle banks left and right at a frequency which permits continuous scanning of the airspace. Straight and level—execute appropriate clearing procedures at periodic intervals. Traffic patterns—avoid entering the pattern while descending; enter at pattern altitude and scan for other traffic. At VOR sites—maintain vigilance in the vicinity of VORs and intersections de to converging traffic. During training operations—maintain vigilance and make clearing turns prior to practicing a maneuver. Verbalize clearing procedures (“clear left, right, above, below”)

Blind spots—low wing and high wing aircraft have their respective blind spots. In low wing aircraft, momentarily lower the wing in the direction of the intended turn to look for traffic before turning.

Recognizing hazards

Approaching aircraft have very high closure rates. It takes a pilot at least 12.5 seconds to spot the traffic, identify it, realize it as a collision threat, and have the airplane respond.

VORs and Class B, C, D, and E surface areas are high hazard areas where aircraft tend to cluster—exercise vigilance even when in a radar environment.

To determine relative altitude, use the horizon as a reference point: if the aircraft is above the horizon, it is probably on a higher flight path, and if it is below the horizon, it is probably on a lower flight path.
Any aircraft that appears to have no relative motion is likely to be on a collision course—if it shows no lateral or vertical motion, but increases in size, take evasive action.

If on an obvious collision course, take immediate actions in compliance with the FARs. Be familiar with Right-of-way rules *[91.113]* and anticipate that the other pilot may also make a quick maneuver. Continue watching the other aircraft and scanning for other aircraft in the area.

Collision avoidance

Study maps, checklists, and manuals before flight, with other proper preflight planning (radio frequencies, material organization) to allow for more scanning time.
Keep a clean windshield—dirty or bug smeared windshields can greatly reduce vision.
Move to see around blind spots caused by aircraft structures, and maneuver the aircraft if necessary.
ATC will provide radar traffic advisories as long as their workload permits—use whenever possible.

Degraded vision

Diet and physical health have an impact on how well a pilot can see, especially in the dark.
Anything that may affect a pilot's physical or mental condition will reduce visual acuity—illness, medication, stress, alcohol, fatigue, motion, hypoxia, etc.
CO poisoning, smoking, alcohol, certain drugs, and a lack of oxygen can greatly decrease night vision. Deficiencies in Vitamin A and C have been shown to reduce night acuity.

Small print and colors become unreadable unless adequate lighting is available—aeronautical charts and instruments become hard to read.

In darkness, vision becomes more sensitive to light. Exposure to darkness for at least 30 minutes is required for complete dark adaptation. Adaptation is impaired by exposure to cabin altitudes above 5,000', CO inhaled in smoking and from exhaust fumes, a deficiency of Vitamin A in the diet, and prolonged exposure to bright sunlight.

Close one eye when using light to preserve some degree of night vision, since any degree of dark adaptation is lost within a few seconds of viewing a bright light.

Excessive illumination can produce glare—uncontrollable squinting, watering of the eyes, and even temporary blindness. Light reflected off canopy, surfaces inside aircraft, clouds, water, snow, and desert terrain.

Smoke, haze, dust, rain, and flying toward the sun can reduce the ability to see other aircraft.

Empty field myopia—induced nearsightedness. Associated with flying at night, in IMC, and/or reduced visibility. Nothing to focus on—the eyes automatically focus on a point slightly ahead of the plane. Search out and focus on distant light sources, no matter how dim, to help prevent empty field myopia.

In-flight illusions

Spatial disorientation can only be prevented by visual reference to reliable, fixed points on the ground, or to flight instruments.

The leans

Can create the illusion of banking in the opposite direction—abruptly correcting a banked attitude that was entered too slowly can result in the motion sensing system in the inner ear not being stimulated. The pilot will tend to roll the aircraft back to its original turning attitude, feeling the aircraft is straight and level, or will feel compelled to learn to the perceived vertical plane until the illusion subsides.

Coriolis illusion

Abrupt head movement in a prolonged constant rate turn stops stimulating the motion sensing system—can create the illusion of rotation or movement in an entirely different axis. The disoriented pilot will maneuver the aircraft into a dangerous attitude to stop the perceived rotation. Don't make sudden head movements, especially when in prolonged constant rate turns in IFR conditions.

Graveyard spin

Recovery from a spin that has ceased stimulating the motion sensing system can create the illusion of being in a spin in the opposite direction. The pilot tends to return the aircraft to its original spin.

Graveyard spiral

An observed loss of altitude during a prolonged constant rate turn that has ceased to stimulate the motion sensing system can create the illusion

	of a level descent. The disoriented pilot may pull back on the controls, tightening the spiral, and increasing the loss of altitude.
Somatogravic illusion	A rapid acceleration (often during takeoff) or a rapid deceleration may create the illusion of being in a nose up or nose down attitude respectively. The disoriented pilot will put the aircraft in a nose low (dive) attitude or nose up (stall) attitude.
Inversion illusion	An abrupt change from a climb to straight and level flight can create the illusion of tumbling backwards. The disoriented pilot will push the aircraft abruptly into a nose-low attitude, intensifying the situation.
Elevator illusion	An abrupt upward vertical acceleration, usually due to an updraft, and create the illusion of being in a climb, making the disoriented pilot push the aircraft into a nose-low attitude. An abrupt downward vertical acceleration, usually due to a downdraft, can create the illusion of being in a descent, making the disoriented pilot pull the aircraft into a nose-up attitude.
False horizon	Sloping cloud formations, an obscured horizon, a dark scene spread with ground lights and stars, and certain geometric patterns of ground light, can create the illusion of not being aligned with the horizon properly. As a result, the disoriented pilot may put the aircraft in a dangerous attitude.
Autokinesis	A static light, when stared at for many seconds, will appear to move about. The disoriented pilot will lose control of the aircraft in their attempt to align it with the light.
Landing illusions	To prevent landing illusions, anticipate them during approaches, inspect unfamiliar airports visually from the air, use glide slop or VASI systems when available, and maintain optimum proficiency in landing procedures.
Runway width illusion	A narrower than usual runway can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot tends to fly a lower approach, with the risk of striking objects along the approach path, or landing short. A wider than usual runway can create the illusion that the aircraft is at a lower altitude than it actually is. The pilot tends to fly a higher approach, with the risk of leveling out high and landing hard, or overshooting the runway.
Runway and terrain slope illusion	An upslope in the runway, terrain, or both, can create the illusion that the aircraft is at a higher altitude than it actually is—the pilot will fly a lower approach.

A downslope in the runway, terrain, or both, can create the illusion that the aircraft is at a lower altitude than it actually is—the pilot will fly a higher approach.

Featureless terrain illusion

The absence of ground features, as when landing over water, darkened areas, and terrain made featureless by snow, can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot who doesn't recognize this will fly a lower approach.

Atmospheric illusions

Rain on the windscreen can create the illusion of greater height, and atmospheric haze can create the illusion of distance—the pilot will fly a lower approach.
Penetration of fog can create the illusion of pitching up—the pilot may steepen the approach/descent, often quite abruptly.

Ground lighting illusions

Lights along a straight path, such as a road, and lights on moving trains, can create the illusion of runway and approach lighting systems. The pilot may attempt to land on a path, road, or train as a result.

Bright runway and approach light systems can create the illusion of less distance to the runway, especially where few lights illuminate the surrounding terrain. As a result, the pilot may fly a higher approach.

Conclusion

Brief review of the main points.
Maintaining a proper, efficient visual scanning and keeping an eye out for traffic is very important. In the case of illusions, it is extremely important to understand when and where they may happen, and how to best prevent them from getting us into a dangerous situation.

CFI PTS

Objective: To determine that the applicant exhibits instructional knowledge of the elements of visual scanning and collision avoidance by describing:

1. Relationship between a pilot's physical condition and vision
2. Environment conditions that degrade vision
3. Vestibular and visual illusions
4. "See and avoid" concept
5. Proper visual scanning procedure
6. Relationship between poor visual scanning habits and increased collision risk
7. Proper clearing procedures
8. Importance of knowing aircraft blind spots
9. Relationship between aircraft speed differential and collision risk
10. Situations that involve the greatest collision risk