



Sport / Private Ground School

Lesson 11

Human Factors





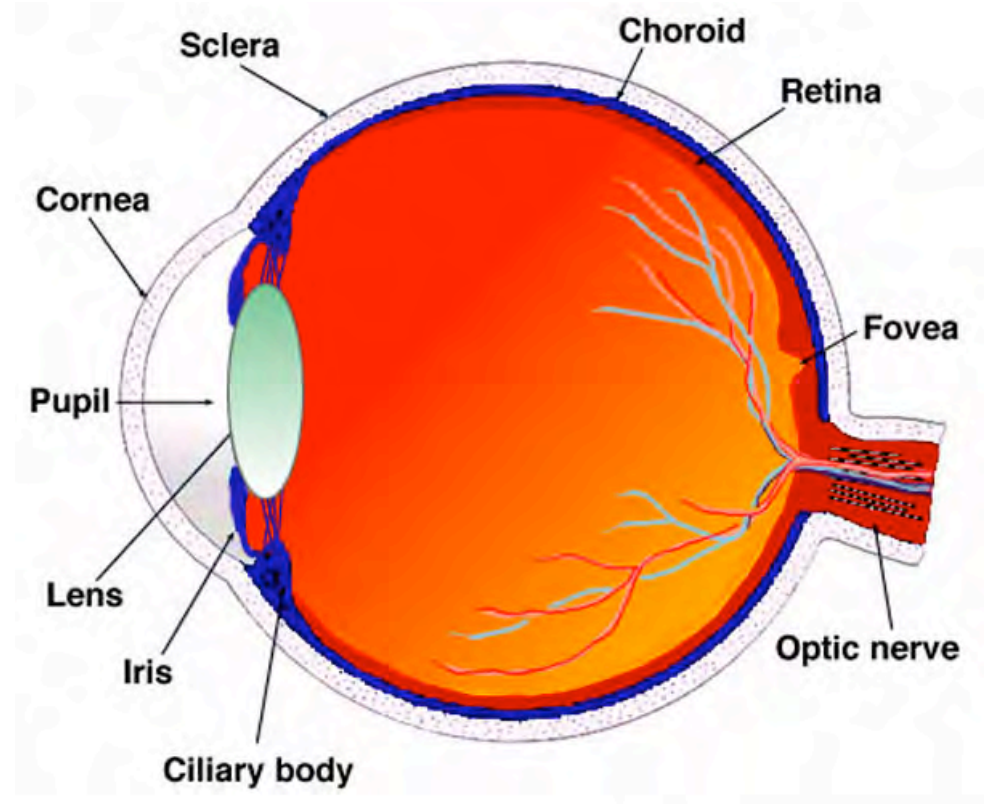
See and Avoid





Vision

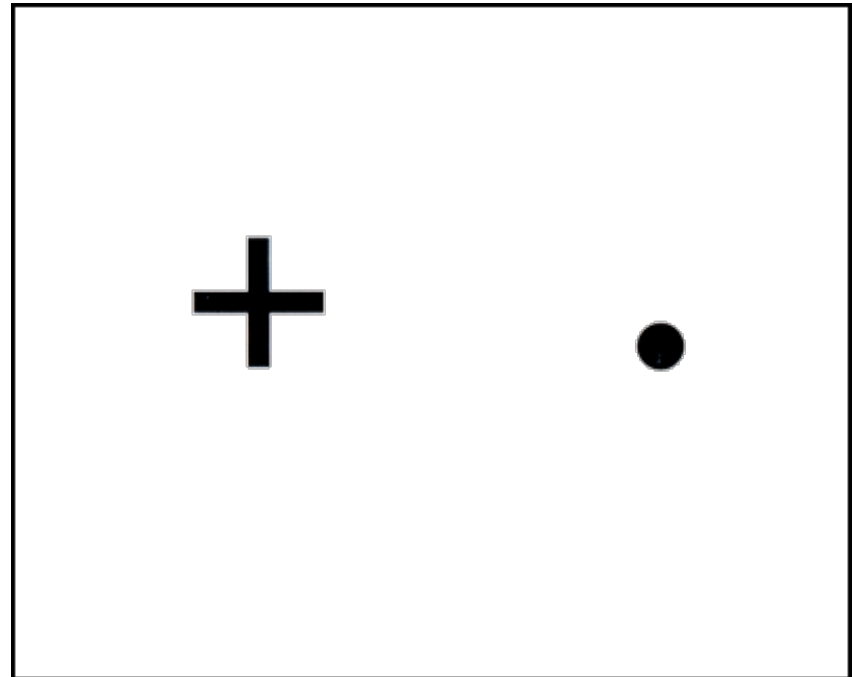
- Eye Components
- Rods (120M)
 - very sensitive
 - low light levels
- Cones (6M)
 - need much more light
 - 3 types
- Fovea = focal point
 - only cones
- Blind Spot = where optic nerve exits





Vision

- Blind Spot
 - optic nerve exits





Visual Illusions

- Most prevalent when flying at night or in poor visibility
- Landing illusions caused by other factors:
 - Rain/haze can cause you to fly lower approach
 - Flying over featureless terrain/water, tendency to fly lower approach
- Averted Vision
 - Look to the side



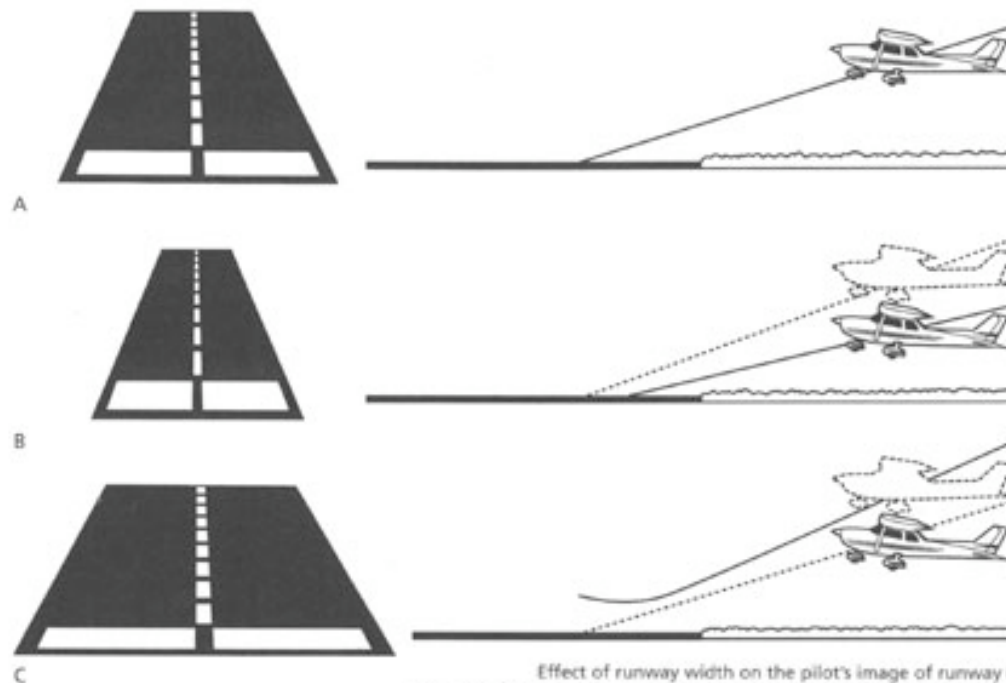
Visual Illusions

- **Empty Field Myopia:** Nothing to focus on in the distance – eyes focus on the end of the cowling
- **Flicker Vertigo:** (early morning / late evening) The propeller rotates at a certain RPM which causes a flicker when viewing into the sun
- **Autokinesis:** Momentary movement or sudden movement – stare at object and it moves
- **False Horizon:** Eye focuses on what appears to be a horizon – edge of a lake, line of lights, river, or road



Visual Illusions

- Runway Width: lower approach on a narrow runway / higher approach on a wide runway

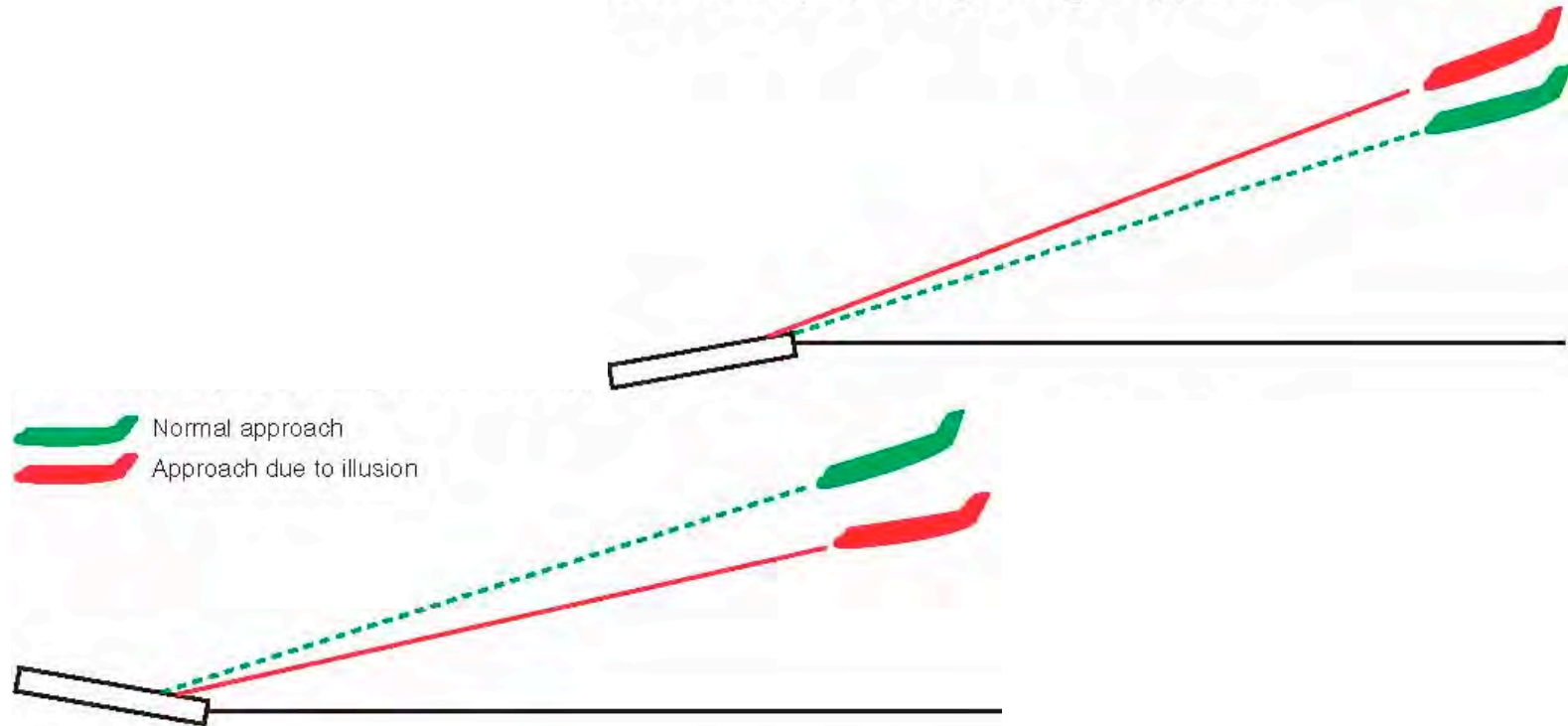


Effect of runway width on the pilot's image of runway (left) and the potential effect on approach flow (right). A: Accustomed width—normal approach. B: A narrow runway makes the pilot feel higher than actually, the approach is too low and flares too late. C: A wide runway gives the illusion of being closer than it actually is—the pilot tends to approach too high and flares too soon.



Visual Illusions

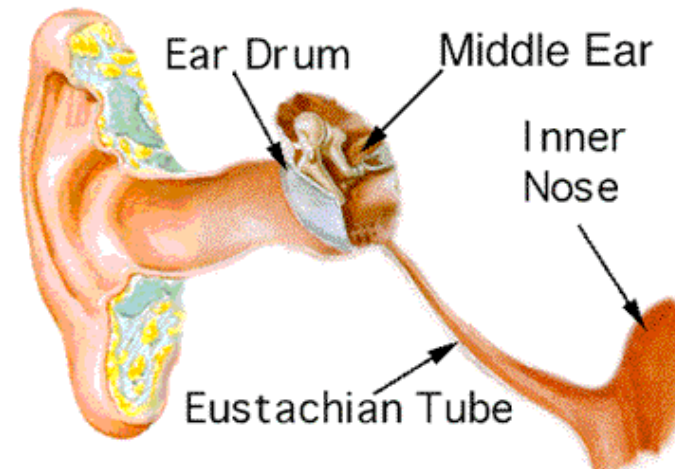
- Runway Slope: low approach on an upslope runway / higher approach on a downslope runway





Sinus/Ear Blockage

- Cold/allergies/respiratory infection can cause blockage
- Changes in altitude cause trapped air to expand/contract resulting in pain
- Particularly bad during descent
- Fix: swallowing, yawning, Valsalva





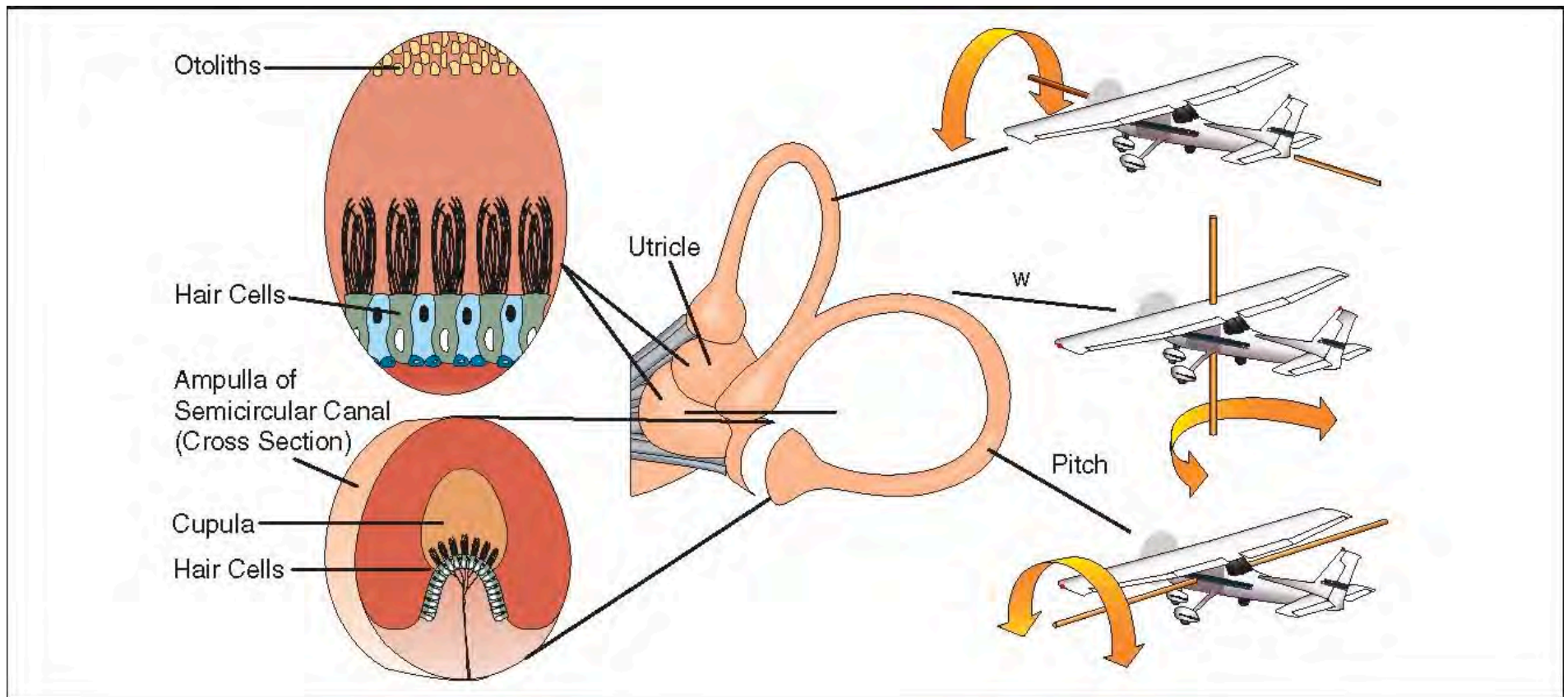
Spatial Disorientation

- Not knowing which way is up/down
- Results from visual cues not matching vestibular or kinesthetic sense
- Fix: don't fly into areas of diminished visibility, but if you do... **MUST** rely on instruments



Spatial Disorientation

Balance Organ – Vestibular System or Semicircular Canals





Motion Sickness

- Caused by continued stimulation of that part of the inner ear that controls sense of balance – vestibular system
- Symptoms (progressive): loss of appetite, salivation, perspiration, nausea, disorientation, headache, vomit
- Cure: open air vents, loosen clothing, use supplemental oxygen, focus outside airplane, avoid unnecessary head movements, land



Hyperventilation

- Rapid or deep breathing which can be caused by emotional tension, anxiety, or fear.
- Symptoms: headache, decreased reaction time, impaired judgment, euphoria, visual impairment, drowsiness, lightheadedness, tingling fingers/toes, numbness, pale/clammy appearance, muscle spasms
- Avoid the occurrence or alleviate the symptoms by slowing your breathing rate, breathing into a bag, or talking aloud



Dehydration

- Excessive loss of water from the body
- Can occur in any environment
- Worse at high altitude where air is dryer, and at high temps





Carbon Monoxide (CO)

- Attaches to hemoglobin 200 times more easily than oxygen – displaces oxygen
- Can occur in any environment
- Symptoms: lightheadedness, loss of muscular power, faint, weakness, tiredness, unconsciousness
- Prevent by using a blend of heat and fresh air in winter / turn off heat open all vents / land



Altitude and Oxygen

- 12,500 – 14,000': flight crew required to use oxygen after 30 minutes
- Above 14,000': crew required to use oxygen the entire time
- Above 15,000': oxygen must be available for all occupants





Hypoxia

- A state of oxygen deficiency in the body
- Causes:
 - Lack of available oxygen
 - Inadequate transport of oxygen
 - Inability to use oxygen
 - G-forces
- Symptoms:
 - Headache, decreased reaction time, impaired judgment, euphoria, visual impairment, drowsiness, lightheadedness, tingling in toes/fingers, numbness, cyanosis, limp muscles



Hypoxic Hypoxia

- Lack of available oxygen
- The result of operating at high altitudes (low atmospheric pressure)
- Can happen suddenly (rapid decompression) or slowly (operating at high altitude for extended periods)



Hypemic Hypoxia

- Inability of blood to carry oxygen to cells
- Most commonly caused by carbon monoxide poisoning
- Large accumulations of CO in the body can result in symptoms such as a loss of muscular power
- Made worse by smoking
- Remedy: turn off heater, open vents



Histotoxic Hypoxia

- Inability of cells to use oxygen
- Results from ingestion of alcohol, drugs, poison



Stagnant Hypoxia

- Caused by poor circulation
- Results from shock, not pumping blood effectively, or a constricted artery
- Excessive G-forces – steep turns, dive recovery



Stress and Fatigue

- Good vs. Bad Stress
- Acute vs. Chronic Stress
- Physical – sleep loss / environmental
- Psychological – work / family issues
- Physiological – fatigue / sleep loss





Scuba Diving

- The Bends – as low as 8,000 MSL
- Dive instructor will inform you
- At least 12 hours between non-decompression stop diving and flying
- At least 24 hours between decompression stop diving and flying





Aeronautical Decision Making (ADM)

- A systematic approach to consistently choosing the best course of action for a given situation
 - Defining the problem
 - Choosing course of action
 - Implementing the decision and evaluating the outcome
- A continuous loop, may require multiple iterations



Risk Management

- Four risk elements
 - **P**ilot: experience, health, fatigue
 - **A**irplane: performance, equipment
 - **E**nvironment: weather, terrain, obstacles
 - **E**xternal Factors: consider why flight is being made/how critical is it?



Situational Awareness

- Perception of all operational and environmental factors that affect the airplane, pilot, and passengers during a specific time



Situational Awareness

- Aviate
- Navigate
- Communicate



Controlled Flight Into Terrain (CFIT)

- An Airworthy aircraft is flown, under the control of a qualified pilot, into terrain, water, or obstacles
 - Low Visibility
 - Night
 - Mountains
 - Unfamiliar Locale



Avoiding CFIT

- Gather all Weather / Terrain info
- Understand the significance of the information
- Aircraft capabilities
- Pilot's skill and training
- Operating environment



Reduced Visibility

- May descend to an unsafe altitude or inadvertently impact ground
- 180 degree turn
- Land as soon as practical
- AC61-134 - CFIT



Cockpit Management

- CRM – Crew Resource Management
 - Human Resources
 - Internal and External aircraft
 - Procedures and Checklists
 - Hardware
 - POH
 - Autopilot
 - Navigation Systems
 - Printed Resources
 - A/FD
 - Charts



Single Pilot Resource Management

- Define SRM
- Task management
 - Prioritize tasks
 - Fly the airplane
- Automation management
- Risk Management
- Situational Awareness
- AVOID Controlled Flight into Terrain



DECIDE Model

Helpful for remembering decision making process

- **D**etect: detect a situation requiring a decision
- **E**stimate: estimate the need to react
- **C**hoose: choose a desirable outcome
- **I**dentify: identify actions that could result in desirable outcome
- **D**o: perform the identified action
- **E**valuate: evaluate the effect of the action
- Repeat as necessary



Decision Making

Factors Leading to Go-No Go Decision:

- Weather
- Airplane
- Airport
- Experience
- Physical Conditions
- Mental Conditions
- When does this start? *From the beginning!*



Fitness for Flight

I'M SAFE – beyond FAA minimums

- **I**llness: even minor illness can impair performance
- **M**edication: can impair judgment, alertness, coordination, vision
- **S**tress: can lead to distractions or poor decisions
- **A**lcohol: 8 hours bottle to throttle - minimum
- **F**atigue: alertness reduced
- **E**motion: anger, depression, anxiety can lead to taking self-destructive risks



Operational Pitfalls

- Pilots have a tendency to demonstrate they have “the right stuff”, which can ultimately lead to dangerous or even illegal practices
- All experienced pilots have fallen prey to some dangerous tendencies:
 - Peer pressure
 - Get-there-itis
 - Scud running
 - Continuing VFR
 - Loss of positional or situational awareness
 - Inadequate fuel reserves
 - Operating below minimum en route altitude
 - Neglecting flight planning, preflight inspections, checklists



Hazardous Attitudes

- Antiauthority – Don't tell me!
- Impulsivity – Don't just sit there, do something!
- Invulnerability: It won't happen to me
- Macho: I can do it. I'm the best!
- Resignation: What's the use?



Antidotes to Hazardous Attitudes

Attitude	Antidote
Antiauthority	Follow the rules. They're usually right.
Impulsivity	Not so fast. Think first.
Invulnerability	It could happen to me.
Macho	Taking chances is foolish
Resignation	I'm not helpless. I can make a difference



Personal Minimums

Self-imposed minimums vs FAA minimums

- Total Experience
- Recent Experience
- Familiarity with airplane
- Familiarity with route
- Current weather conditions
- Current personal condition

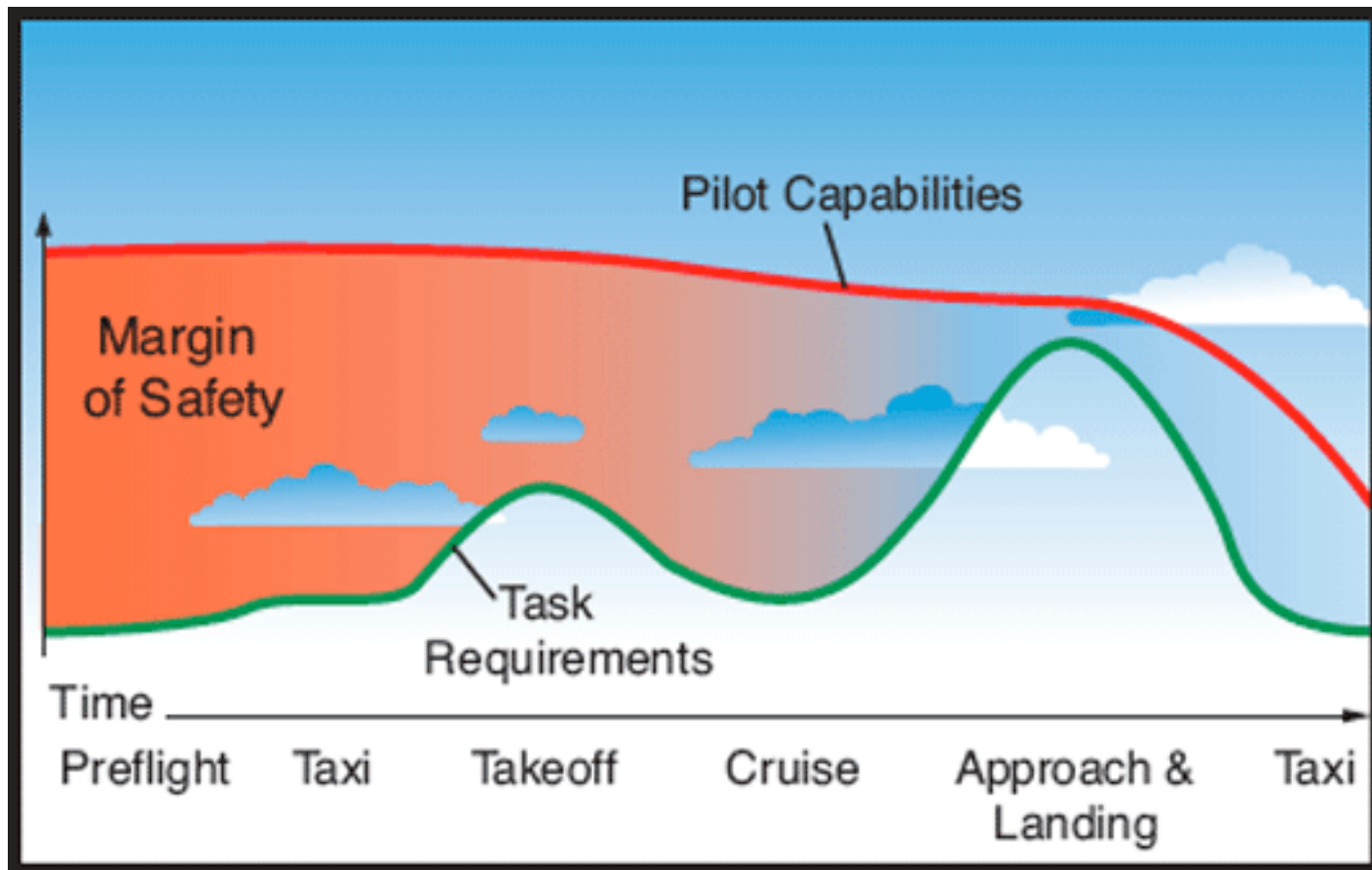


Making the Go-No Go Decision

- Marginal items in two or more categories
- Can change personal minimums
 - Increase experience by stretching your boundaries but in a *safe way*
 - Positive event
 - More training



Margin of Safety in Flight





Accidents

- Most accidents the result of *human error*
- Usually not one cause, but a chain of poor judgment or decisions
- Break any link in the chain, and the accident will be prevented



Additional Resources

- AIM Chapter 8: Medical Facts for Pilots
- Medical Handbook for Pilots (AC 67-2)
- PHAK Ch. 15 – Aeronautical Decision Making / PHAK Ch 16 – Aeronautical Decision Making
- Jeppesen Ch. 10 – Applying Human Factors Principles