Essential Question: 14, 16 April 2021

What are the most common and dangerous hazards to pilots and aircraft, and how can risk be managed?

Questions/Key Points	Notes

How might we use modern technology to make communications more reliable?
 	
Should all aircraft have de-icing systems?
	• Communications
	  ○ Radio and ATC
	  ■ https://www.faa.gov/air_traffic/publications/atpubs/aim_html/chap4_section_2.html
	  ■ Radios are the primary method of communication with ATC
	  ■ Lots of things can go wrong with radios!
	  ■ Pilot speaking on the wrong frequency
	  ■ Pilot/ATC misunderstands what the other said (there are ways to prevent this, use proper phraseology
	  ■ Stuck mic when the button is unintentionally held down and blocks the whole frequency
	  ○ Language
	  ■ Mainly when ESL pilots aren't that good at English which causes misunderstanding or miscommunications
	• FOD
	  ○ Foreign Object Debris
	  ○ https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=15394
	  ○ Examples include rocks, birds, luggage, aircraft parts, etc
	  ○ FOD on runways, taxiways, and ramps can get sucked into engine intakes (esp on turbine engines that are low to the ground)
	  ○ FOD can also cause tires to burst and other structural damage via projectile impact
	  ○ AF4590 - Concorde crashed b/c of FOD from a Continental Airlines aircraft
	• Weather
	  ○ Icing
	  ○ https://www.weather.gov/source/zhu/ZHU_Training_Page/icing_stuff/icing/icing.htm
	  ■ Icing happens when supercooled water droplets hit aircraft surfaces and freeze instantly
	  ■ Icing disrupts the smooth flow of air over the wing and can increase the stall speed of the aircraft
	  ■ Anti-ice systems exist on some aircraft, but unequipped aircraft aren't certified to fly within icing conditions
	  • De-icing systems use heat, liquid, or vibrations to remove ice as it builds up
	  ○ Wind
	  ■ https://community.wmo.int/activity-areas/aviation/hazards/turbulence
	  ■ Wind shear - can literally drop the aircraft out of the sky
	  ■ Downwards convective airflow creates unexpected drops in altitude which can be fatal at low altitudes
	  ■ Turbulence - light and moderate turbulence is fine; the main danger on commercial aircraft is that people/items will be thrown around the cabin
	  ■ Wake turbulence - small, light aircraft following larger aircraft can be thrown into an unusual attitude in a wake turbulence encounter

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VFR into IMC is one of the top killers in GA. How can we reduce the accident rate?	■ Wingtip vortices descend slowly behind the wake of the large aircraft. Small aircraft should try to fly at or above the approach path of the larger aircraft and land beyond the touchdown point. ○ IMC ■ This is dangerous when VFR pilots (visual flight rules) fly into IMC (instrument meteorological conditions). ■ If the pilot isn't instrument rated, they are at danger of becoming disoriented and stall/spinning ■ Even if the pilot is instrument rated, VFR pilots are still responsible for maintaining visual separation from other aircraft and obstacles, which increases the risk of midair collisions or CFIT ● Mechanical ○ Powerplant ■ Engine failures ■ Most dangerous in single engine aircraft on takeoff at low altitudes ■ More altitude=more time to plan, find a landing spot, and possibly try to restart the engine ■ Multi-engine aircraft can handle single engine failures very well ■ Concerning to passengers on commercial flights because it looks spectacular and there will probably be banging/fire/smoke/debris coming off of the engine, even though the situation is almost always well managed by the flight crews
Mechanical failures are rare because of maintenance requirements, so it shouldn't be a concern to the typical passenger.	■ https://www.ntsb.gov/investigations/Pages/DCA18MA142.aspx ■ SWA1380 - had a contained engine failure; 1 passenger died, which was the first in a very long time ■ Fan blade was fractured due to prolonged stress; ended up cracking at cruising altitude; debris broke a window and the passenger was sucked out and stuck in the window (this was the person who died) ○ Structural ■ https://www.skybrary.aero/index.php/Ageing_Aircraft_-_Structural_Failure ■ Most aircraft survive much much longer than cars or other vehicles because the maintenance is highly regulated and frequent ■ Older aircraft can have structural issues due to prolonged stress/wear, or aging materials ■ Structural issues can also be caused by pushing the aircraft beyond its limitations, like speed, bank angle, wing loading, etc. ■ Hard landings can damage the airframe ● Aerodynamic
How can pilots be better trained to avoid stalls before they occur? Why does GA emphasize stall recovery over avoidance when airlines have the opposite policy?	○ Stalls ■ When the airplane doesn't have enough airspeed and/or exceeds the critical angle of attack ■ Insufficient smooth airflow over the wings means they don't generate enough lift to support the weight of the aircraft in the air ■ In GA aircraft, stalls are generally not dangerous if done correctly, and they're a part of training ■ Stalls are dangerous at low altitudes where the pilot might not have enough altitude to recover before impacting the ground

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Human factors are the most variable factors in aviation safety, but how can we deal with this?	■ If one wing stalls before the other, it can develop into a spin, which is much more dangerous. ■ While GA training tends to emphasize stall recovery, airline training focuses on stall avoidance - why? ● Fire/smoke ○ Onboard fires are very dangerous ○ Can cause structural failure by melting/heat stress ○ Aircraft are also full of highly flammable fuel ○ Smoke in cabin can incapacitate pilots/crew, also can't see through it ● Human Factors ○ CFIT ■ Controlled flight into terrain ■ Usually caused by pilot error ■ Cockpit warning systems are widespread in high performance/complex aircraft ○ SOP ■ Standard operating procedures ■ Most common in airlines/other commercial operations ○ Get-there-itis ■ Pilots are sometimes willing to stretch/push their personal minimums when they're in a situation where they feel that they need to get somewhere ■ Most common in GA; 121 carriers have dispatchers

Summary

Aviation safety is complex, and there are a multitude of factors that make flying safe. There are also a ton of things that can go wrong when flying. Experts generally agree that most fatal accidents are caused by a multitude of factors rather than a single thing going wrong, with multiple issues snowballing into a worsening situation.