ACUTE STRESS

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Acute stress may be defined as the realization that the immediate environmental situation has placed demands on an individual which possibly will not be handled successfully. It differs from chronic stress in that the demands and the effects of a failure to handle the demands are localized in time. There are optimal levels of acute stress which cause an optimal level of arousal and performance. When the level of acute stress exceeds these levels, accidents occur.

Consider the following hypothetical accidents:

A student pilot in a T-38 starts his engines for a solo flight, but an alert crew chief notices that the gear doors do not close. When he cannot communicate the problem to the student, the crew chief has the student shut down the left engine while the crew chief climbs up to the cockpit to reset the proper hydraulic switch. Shutting down the engine causes the stability augmentation system to drop off line. The student then restarts the left engine and taxis to the runway. He does not reaccomplish the check list, and takes off with the stability augmentation system off. During the climb, he notices the lack of a stability augmentation system. He levels off without reducing power and attempts to engage the stability augmentation system. In doing so he enters the regime of flight for maximum sensitivity for the flight controls and a small disturbance produces a vertical pilot induced oscillation. The aircraft goes through a violent maneuver during which the bearings on one engine fail. The student manages to recover by letting go of the stick, and decides (correctly) to shut down the failed engine and return to base.

During the violent maneuver, the seat cushion has been raised out of the seat pan, and is now lodged over the forward lip of the pan, tilting the cushion back and preventing the student from reaching the rudder pedals. Under the acute stress of the situation, the student fails to appreciate the implications of this situation. Without being able to reach the rudder pedals he will be unable to correct for the yaw during single engine operation. Upon landing he will be unable to steer the aircraft or to apply the brakes to stop it.

Under stress, his mental processes narrow down to one factor: Get this plane back on the ground! He does not remember that the gear will have to be lowered by the alternate system because he has shut down the engine, which normally provides hydraulic power for gear extension. In this state, he also forgets to calculate the correct airspeeds for base turn and final approach, corrected for his heavy fuel state. Nevertheless, when he contacts the tower to advise them of the situation, he states that, other than the loss of engine, he has no problem.

He begins his base turn two miles from the runway, thirty knots below the correct airspeed, pulling hard on the stick to keep his altitude. The only thing that keeps him from stalling the aircraft is the hard seat cushion draped over the seat pan which prevents him from getting the stick full back.

Realizing the aircraft is slow, he tries to light the afterburner on the good engine. This is the only way to save the aircraft, but at the low airspeed, a high power setting causes the aircraft to yaw and lose lift on one wing. Unable to correct the yaw or the resulting roll, the student takes the engine out of after-burner.

The aircraft struck the ground at a high rate of descent, about one mile from the end of the runway. After surviving this highly stressful accident, the student stated that the touchdown was mild, but that the gear may have failed during the landing roll because he remembered that he didn't have to climb down very far to exit the cockpit. Actually, the gear sheared off at ground impact and was thrown over half a mile from the impact site. The aircraft came to a stop when it plowed into a sand dune, and with sand pouring over the canopy rail, the student would have had to climb UP to exit the plane. An excessive level of acute stress can impair mental processes. In this situation, it is reasonable to conclude that the student was stressed, despite his apparent lack of concern for the seriousness of the situation. Stressors do cause stress.

Consider a test pilot who stretches a mission in order to accomplish the planned maneuvers for a test program which is behind schedule. Enroute to his recovery base, the last fuel tank fails to feed into the main tank. The failure is not the pilot's fault, but it was his decision to continue the test below planned fuel minimums which produced the critical situation when the failure occurred. He declares an emergency and heads for the nearest usable runway. He is the recognized expert on this aircraft, and was the pilot who developed and tested the precautionary flame out pattern. Upset with himself because he will not recover as planned, he misreads his airspeed by 100 knots, decides not to go around because of his low fuel state, and runs off the far end of the runway. The situation should have been routine for this pilot. It should not have caused an excessive amount of stress, but it did. The stress was self imposed.

Consider an instructor pilot with previous experience in an aircraft which had a tendency to blow up when the engine caught fire. Suppose he lost a few close friends because they were a bit slow in deciding to eject. Now, put this pilot in a new aircraft with a student. Give him a fire light. Let him roll into a tight turn and ask the student if he sees smoke trailing behind the aircraft. Introduce a student who is not familiar with the condensation that forms in the wingtip vortex under a high g turn. The student reports the "smoke" that he was instructed to see. Student and instructor both eject safely. The airplane crashes - unnecessarily. The stress on the instructor was acute and severe. It may also have contributed to the student's error. A fire light in the trainer aircraft was not supposed to cause that much stress. The fact that it did underlines the previous conclusion: stress is self imposed.

Consider a student pilot in a T-37 on an initial solo flight away from the traffic pattern. During a practice approach to a stall, the left wing drops. He becomes preoccupied with raising the wing, using both aileron and rudder. This causes the approach to a stall to become a full stall and enter a spin to the right. The entry to a spin from a level attitude can be disorienting and frightening, especially when it is unintentional. Since the last recognizable attitude was left wing low, it should not be surprising

to learn that this stressed individual thought that he had entered a spin to the left. Since we have learned that stress tends to impair the mental process, it is understandable that the presence of a ball that is fully deflected to the left was interpreted as evidence confirming the "left" spin. In the T-37 aircraft, the ball on the left turn and slip indicator always moves left in any spin. We should not be surprised to learn that the airplane crashed. Amazingly, the student pilot did eject in time to survive.

Not all pilots survive stressful situations. Consider the pilot of Blue Four, the fourth aircraft in a formation scheduled to practice a bombing attack during marginal weather. The planned activity was radar bombing, which can be accomplished quite well in poor weather. When in actual combat situations, radar bombing is done one ship at a time; during peacetime, we fly to a range in formation. It's not supposed to be more hazardous in formation; it just turned out that way. In addition to watching his radar scope inside the cockpit, number four in a formation must also watch out for the other aircraft in formation. One more thing: in the interest of range safety, the pilots on this flight were required to acquire the target visually to insure that they did not drop bombs on the wrong target. In combat, that's not required. Radar bombing of unseen targets at night and in weather is often accomplished.

Blue Four proceeds to the target area, watching outside for the rest of the formation, watching his radar scope for the target, and trying to look outside to visually identify the target. The weather is marginal. The flight leader breaks up the formation on the range and begins his run. He has a good radar return, but cannot identify the target visually. Blue Two and Three make their runs with the same results. The leader decides to abort the bombing mission and calls for the flight to rejoin. Two and Three manage to find their leader, but Blue Four does not answer. He has crashed, wings level, slightly nose low, looking for the target - or for the rest of the formation. We'll never know. Blue flight returned without him.

We are reasonably sure that Blue Four was overstressed because we can talk with the other members of the flight, and they were stressed. We do not know how many of this year's accidents occurred because of stress. We can't always talk with the people involved. However, we are reasonably sure that acute stress is a factor in aircraft accidents.

Aviation will always provide a stressful environment. We probably can't change that, but before a stressful environment can result in an accident, the human must impose a level of stress upon himself, and then fail to handle the combination of the situation and the stress, resulting in a measurable strain: a failure in the system.

Against this background, there are some questions to consider:

Can we identify an individual who is under stress?
Can we keep a person with chronic stress away from stressful situations?
Are chronic and acute stress additive in nature?
Can we determine how much stress a specific individual can tolerate before a strain results?
Can we reduce the stress before a strain results?

There may not be answers to these questions at present. They serve to define a problem. If we can agree on the problem and can understand the importance of solving the problem, then we have taken the first step towards its solution.