

Startle!

A fire warning, sudden stall, an engine failure on takeoff, a cockpit alert: some pilots react quickly and appropriately, some act after a long delay, a few freeze. Exploring the best way to train pilots to cope with 'startle and surprise' is gathering momentum around the world.

The words 'Air France 447' are today synonymous with an inadequate response to an abnormal situation by a largely technologically trained crew.

The crash into the Atlantic Ocean in June 2009 of the Airbus A330 was found to be largely the result of the crew's inability to understand, nor cope appropriately with, temporary inconsistencies between airspeed indications causing the autopilot to disconnect. Those inconsistencies were later thought to be the result of ice crystals blocking the aircraft's pitot tubes.

It was found that the crew's actions ultimately caused the aircraft to enter an aerodynamic stall from which it did not recover.

The words 'AirAsia 8501' have the same resonance. The investigation of its crash into the Java Sea in December

2014 found that while a faulty part contributed, the crew's subsequent action led to a total loss of control.

The investigator's report said that when the crew was required to manually fly the Airbus A320, there was an unexplained and crucial nine-second delay before a pilot attempted to take control. By that stage the aircraft was banking at 54 degrees.

The report from Indonesia's National Transport Safety Committee stated, "Subsequent flight crew action resulted in inability to control the aircraft... causing the aircraft to depart from the normal flight envelope and enter a prolonged stall condition that was beyond the capability of the flight crew to recover."¹

1 Jacdec, NTSC/KNKT Final Accident Report PK-AXC.

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Australian researchers at the University of Southern Queensland (USQ), led by Dr Wayne Martin from USQ's Department of Aviation and Logistics, are looking at how 'startle' impairs pilots' decision making during unexpected critical events. Numerous studies so far indicate it can be as long as 30 seconds before they're thinking clearly.

Wayne Martin says that in a 2015 simulator study of the effects of startle on 18 pilots flying IFR, only five did a good job in responding. Seven were badly affected by the startle stimulus and displayed behaviours significantly delayed or dangerously unstable.

"Three of those pilots continued descent so low that they became visual, with two receiving EGPWS warnings 'Pull Up, Pull Up'.

"Two continued with their unstable approaches and landed, while one went around from a very low altitude."

The researchers say one of the common themes emerging from the ever-increasing reliability of aircraft, is that some startled pilots either take no action, or take inappropriate action, resulting in an 'undesired aircraft state' or even an accident. If a real threat is signalled by the startle, the response can be even worse.

"There's a conditioned expectation of normalcy among today's pilots," says Dr Martin. "If aircraft perform nominally day after

day, year after year, and pilots are rarely exposed to actual malfunctions, then it's not hard to see how this conditioned expectation of boring sameness and normality can develop."

The French civil aviation investigating body, BEA, found the crews of Flights 447 and 8501 acted in a similar manner, in that they failed to respond appropriately to startle indications.

The BEA's investigating officer, Nathalie de Ziegler, said there was a need for "increased academic and operational understanding of aircraft flight regimes, improved stall recognition, being able to revert to basic and raw-data flying without delay, and importantly, to understand stalls as a 'startling incapacity'."²

Dr Martin says the problem is that the level of expectation for novel or critical events is so low that the level of surprise or startle which pilots encounter during such events, is higher than they would perhaps have had some decades ago, when things routinely went wrong.

He says research into the startle response is gathering speed, globally.

"There are still many unanswered questions about the best type of training to 'futureproof' pilots against the effects of startle and surprise.

2 CAT Magazine, 4.2016, p8.



"I have two studies coming up: one where at least half the pilots will receive some training prior to their sim exercise, including a comprehensive briefing on real world examples where startle and surprise have had disastrous outcomes. That briefing is accompanied by discussions on scenario-based 'what would you do if...' situations.

"The second will involve the pilots being exposed to a startling situation, followed by discussion and briefing, with further repetitions to get to a standard of competency. Those pilots would also be given the same briefing package as the first group, after the exercise, to take away for post-exercise reading."

Wayne Martin says that the studies are trying to establish what form of training is the more effective in preparing pilots for unexpected events.

"At this stage, however, there's no way to know how long that training would remain effective, given that the pilots concerned will leave the sim to work in virtually trouble-free environments."

A Change in Thinking

CAA's Principal Aviation Examiner, Bill MacGregor, says after the crash of Air France 447, there was a global rethink on training.

"When the Airbus A320 was first introduced, it was this magic electronic jet that did everything, and all you had to do was sit there.

"So pilots were introduced first to the technology of the aircraft, and then they worked backwards, learning how to cope when this electronic bit was taken away, when that electronic piece was removed, when mock emergencies were introduced."

But Bill says after the Flight 447 tragedy, Airbus and Boeing radically changed their thinking about recommended training.

"Instead of introducing the pilot to the technology first, the pilot is introduced to the basics of flying the plane, then slowly to the technology.

"That change in training is being made on the basis that when things go awry, we revert to what we learned first, even if that first learning was 20, 30, years earlier.

What Does This Mean for General Aviation?

Bill says modern GA aircraft and microlights are coming up with "some fantastic stuff", but that means student pilots are not being trained to the depth that they used to be.

"Even though it's getting safer and safer to fly, the majority of aeroplanes are still the 40 to 45 year old Cessna 152, 172-type

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aircraft. They're still piston engine technology and they still fail, and you still have to hand fly them.

"Things like advance stalling, or flying the aeroplane to the edge of its envelope. We fly in the middle of the performance envelope, instead of pushing out towards the edges, to see what the aeroplane is capable of – slow flight, high speed flight, rolling, turning, pitching.

"Because we've got better technology we're not pushing it so hard. I just have this sense that we are training to the technology rather than training to the flight envelope of the aeroplane."

Bill's advice to instructors? Declutter the glass cockpit.

"Just learn the basic instruments – fly it on attitude, fly it on trim, fly it on power.

"Then slowly introduce the capabilities of the technology. Because once all the bells and whistles are introduced, they are distractors. It's hard to tear your eyes away from the information in front of you on the screen, instead of looking outside.

"I feel like startle is a bit of a startling word. Basically it's about understanding that the technology is not always going to save you – and you need to be prepared to go back to basics."

For Instructors

One of CAA's Aviation Safety Advisers, Carlton Campbell, recipient of the CAA Flight Instructor Award in 2015, says training in startle must reflect reality.

"When I was an instructor in Queenstown, I had permission from several farmers to use their property to land on.

"Many training organisations don't have that luxury and they do their failures down to 500 ft and then go around. They would simulate the below-500 ft when they got back to the airfield which doesn't offer much realism in terms of an engine failure.

"That last 500 feet ends up being unfamiliar in a variety of scenarios when you have limited options for simulating it.

"So a student with me would typically put the power in to go around, and I'd say 'no, all the way to the ground thanks'. And you could see their mind ticking over 'I've never done this before!' They were ill-prepared for the real scenario of engine failure. That last 500 feet is the critical bit, whether you get it on the target paddock or not.

"So my recommendation is that we make the training as real as possible, within the resources that we have."

Carlton's second recommendation is that startle training is done over and over and over. He says, as an example, two-thirds of his training flights would have incorporated engine failure after takeoff.

"We had pilots from all over the world with varying levels of training and experience under their belt. But frequently, I could tell from their surprised reaction and delayed response to simulated abnormal situations, that continued training beyond basic competency ('overtraining') had been missing from their flight instruction.

"The simulations I'd offer showed up the inadequacies of training that wasn't real, for instance, the expectation of the pilot was that we were going to go around at 500 ft."

Carlton's particular area of expertise is in mountain flying.

"When we would train students in mountain flying, we'd get them to turn using all the available space, and at medium angles of bank.

"But they'd come around the second 180 degrees part of the turn, and they'd find the terrain looming in their face, and they'd constantly be wanting to put on more bank, but more bank doesn't necessarily tighten the radius of the turn.

"They suddenly felt as if they were going to hit the hill and they were saying 'I don't know what to do!'

"I've flown with one or two pilots who've been so overwhelmed they've taken their hands off the controls."

"In fact, the technique is to apply back pressure to reduce the radius of the turn."

There is also a very small number of pilots, says Carlton, who have an almost fatalistic response when faced with something beyond anything they have experienced before.

"At Milford for example, on a hot summer's day you get significant sea breeze funnelling in and when you're on approach to land towards the sea, you get a lot of turbulence and wind shear.

"I've flown with one or two pilots who've been so overwhelmed they've taken their hands off the controls.

"But with overtraining for that situation, the startled reaction is eliminated."

Carlton says that before instructional technique courses were beefed up, the 'ranting' instructor could provide 'startle'.

"The students became stressed by the ranting, and could not respond effectively, in terms of flying skills. Very few people do, to verbal bullying.

"If we're going to lay our stress on to the student they are likely to fail, because they cannot think straight.

"Instructors – all of us – are guilty of doing this at times."

Carlton's advice to other instructors, in summary, would be to train in all forms of startle, using the principle of the student 'overlearning' a response, and make the training compare realistically to the experiences the pilot is likely to face.

"I'd be surprised if any pilot has not experienced a startle situation somewhere," he says. ■