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AIR PILOTS - COMMERCIAL AIR TRANSPORT

SAFETY BRIEFING NOTE 06

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THE RISK OF STARTLE REFLEX

The Context

A startle reflex may arise during flight as a result of a sudden and unexpected development which, especially if it affects the 'Pilot Flying', can trigger an instantaneous and potentially inappropriate response in relation to the control of an aircraft. Its occurrence, and the resultant risk which may follow, is suspected to have its origins in the vastly enhanced reliability of modern aircraft types. This system reliability means that the chance of encountering events which may induce a startle reflex are very low so that individual experience of it will be very rare even over a complete career. Of note is that there is no evidence of any relationship between vulnerability to startle reflex and the response to it and age or flying experience. The key point is that any pilot affected by it may be initially convinced that a situation has arisen which is of sufficient urgency to preclude any delay before acting.

Such evidence as is available suggests that whilst startle reflex can occur in any stage of a flight, it is more likely during quiet periods, particularly the cruise and during flight in IMC or dark night conditions, since sufficient visual reference to ensure that a flight path control input does not unknowingly hazard the aircraft is usually sufficient to prevent any inappropriate action. The problem seems to most typically arise when 'normal' flight path management is interrupted, for example by un-commanded autopilot disconnection, primary flight instrument failure or the unexpected consequences of mode control inputs relevant to pitch or airspeed. Startle reflex is clearly differentiated from the response to relatively common 'surprise' because it triggers an involuntary physical response to address a perceived - but not necessarily actual - risk to flight path control. This will occur several seconds ahead of any rational review of what has occurred and can quickly result in circumstances from which recovery would be increasingly difficult.

It is likely, although unproven, that many instances of inappropriate startle reflex response are effectively dealt with by good crew resource management, since it appears that startle reflex is rather unlikely to affect both pilots simultaneously. Unfortunately, the 'safety culture' in many operators is still insufficient to persuade pilots to report such events when they are effectively managed and they will be difficult if not impossible to detect by routine flight data monitoring. The apparent rarity of startle events with unsafe outcomes may also be attributable to the widely suspected but entirely unproven possibility that individual pilots' vulnerability to startle reflex whilst flying varies without there being any way to proactively assess this. However, with equal confidence, this may also be attributed to the fact that since the most significant consequences tend to arise when the 'Pilot Flying' is affected, the 'Pilot Monitoring' should, if necessary, be able to intervene ahead of the affected pilot's recovery. Such intervention must be rational and proportionate, based on a cross check of both pilots' key flight instruments and aimed at preventing the development of a more challenging recovery task.

Two examples of accidents triggered by pilot responses to startle reflex

Examples of fatal accidents in which loss of control followed inappropriate response to entirely manageable instrument failures feature prominently in the history of startle. The following two examples both occurred in dark night/IMC conditions and in both cases the Pilot Flying was the one affected by startle:

- In 2009, startle reflex led to the 'Pilot Flying' in an Airbus A330 in the cruise in mid Atlantic level at FL350 failing to simply maintain the established stable pitch attitude when the autopilot, autothrust and all three airspeed indications briefly failed at the same time due to transient pitot probe icing. Instead, he responded by making a large and rapid nose-up input. An ineffective response from the other pilot did not involve a prompt takeover of control and the aircraft quickly entered a stall from which recovery was delayed until it was too late¹.
- In 2016, a CRJ200 freighter was in the cruise over northern Sweden in dark night VMC at FL 330 when the Pilot Flying's PFD suddenly began to indicate a sharp increase in pitch attitude and the autopilot disconnected. The indication was false and followed failure of the associated IRU. It was also contrary to the indications on both the other PFD and the standby instrument but the immediate startle-induced physical response was to push forward on the control column. The other (junior) pilot did not respond until explicitly asked for help by which time recovery was on the verge of being impossible².

Discussion

Although responding to 'surprise' can be effectively achieved as part of simulator training, it is very difficult indeed to present pilots with realistic startle reflex scenarios in this way. Whilst it is generally recommended that pilots pause before responding to an abnormal situation in which no immediate danger is apparent, the speed and severity of the inappropriate flight path control action which may follow as an immediate consequence of startle reflex may need a more rapid - but still progressive - initial response by a 'surprised' pilot. If the reflex-affected pilot is the relatively more senior one, a verbal intervention alone may not be sufficient. It may be necessary for the unaffected pilot to take control before the difficulty of recovering exceeds their ability to achieve it. Since this solution depends on sound situational awareness and lies very firmly within 'Crew Resource Management' (CRM) it can therefore be addressed by classroom or online training. This must clearly distinguish startle reflex from surprise and stress that if intervention has led to a change of control, returning this to an affected pilot should only occur when they have fully recovered, which may take rather longer than recovery from the immediate reflex-driven response.

Safety Recommendations

To Aircraft Operators

- Awareness of startle reflex and its potential consequences for flight path control, especially in pitch with reference to the need to check all three attitude indicators if an unaffected pilot observes unexplained control inputs, should be covered in recurrent ground training even when not required to by your safety regulator.
- CRM training should include the importance of a rapid and effective response to any evidence that startle reflex following a sudden unexpected in-flight situation has triggered an inappropriate flight path control response in the other pilot.
- All pilots should be exposed to sufficient manual flying practice to maintain confidence in their skills when these are called for suddenly and unexpectedly.
- Internal safety reporting of any successfully resolved startle reflex events should be encouraged and the identity of reporters protected.

To Pilots

- If you are Pilot Monitoring, be alert to the possibility that one day, probably on a dark night and/or in IMC, you may have to intervene quickly to ensure that the other pilot's initial pitch control response to a sudden unexpected change from 'normal' flight does not rapidly develop into a situation from which recovery is difficult or impossible.
- Be aware that flying experience is no defence against vulnerability to startle reflex.
- If you observe a flight path control change after an apparent startle reflex response has affected the other pilot, don't delay in acting and if necessary be prepared to take control until the affected pilot has fully recovered from the experience.
- If in command and 'Pilot Flying' with a significantly less experienced second pilot, a pre-flight briefing stressing that in the event of any sudden, significant and apparently inappropriate flight control input during previously stable flight, a 'Pilot Monitoring' should first compare all the available attitude and airspeed displays and announce any differences between them so as to support an optimal response to any unexplained flight path deviation.

¹ see <https://www.bea.aero/docspa/2009/f-cp090601.en/pdf/f-cp090601.en.pdf>

² see https://www.havkom.se/assets/reports/RL-2016_11e.pdf