STARTLING EVENTS

The BGA Safety Team describes research into coping with startle and surprise

MANY of us have wondered what we would have done in the situation faced by Capt 'Sully' Sullenberger, who in 2009 landed an A320 airliner in New York's Hudson River after losing both engines two minutes after take-off in an encounter with a flock of Canada geese. This seasoned airline captain was an experienced glider pilot, who 'loved flying the gliders because gliding is the purest form of flight', but he is clear that 'the flight characteristics and speed and weight of an Airbus are completely different from the characteristics of the gliders I flew' [1]. In any case, we probably mused less about the handling of the aircraft than the decision to land on water when two airports were only a few miles away. This and subsequent decisions and actions led to all 155 passengers and crew surviving, with just five suffering significant injuries [2].

Human factors

The Hudson landing is one of five case studies in a recent EASA publication, by authors at the Dutch NLR, on the effects of startle and the human factors aspects when something takes us by surprise [3].

Human factors increasingly emerge as important aspects in gliding accidents.

US Airways Flight 1549 after ditching in the Hudson River (Wikipedia)

HUMAN FACTORS INCREASINGLY EMERGE AS IMPORTANT ASPECTS IN GLIDING ACCIDENTS

Structural failure is virtually unheard of in a correctly maintained and rigged glider, flown according to its flight manual within its flight envelope; and if we fly as trained we should always be able to complete a flight safely. It's relatively rare that a pilot's handling skills cause a serious accident. Increasingly, therefore, we find that human frailties are the cause of accidents, through distraction, confusion, fatigue, dehydration, stress and psychological phenomena such as goal fixation and confirmation bias. It's fair to assume that no pilot crashes deliberately, so these human factors are what happens when human limitations are exposed by the demands of flying a glider.

Tackling human factors

If you learned to fly fairly recently, you'll have studied human factors during your training. Many of the aspects studied will have been physical or physiological: hypoxia, shortcomings of the visual system, disorientation in cloud, the effects of alcohol and carbon monoxide. You'll have discussed fatigue, dehydration, illness, blood sugar levels and anxiety, the need to keep current, and perhaps some perceptual illusions such as ground-rush. This may have given the reassuring impression that if you're well prepared, satisfy the 'I'M SAFE' criteria and are at the healthy end of the currency barometer, then all will be well provided you stay alert to illusions and keep a good lookout. The assumption in these cases is that you will be mentally effective enough to assess and avoid potential problems.

Unfortunately, other factors involve failure of the mental faculty needed for their correction. Forgetfulness, distraction, and the failure to see or recognise something are all hard to tackle: advice not to panic or forget is about as useful as telling an insomniac that the solution is sleep. Yet, according to the NLR paper, there are things we can do to tackle the effects of startle and surprise.

Overload and mental block

Sullenberger and co-pilot Jeff Skiles spotted the unfortunate geese barely a second before impact. The thuds as they collided were followed by notable deceleration, the sound of damaged engines slowing down, and the smell of burnt goose. Sullenberger described an adrenaline rush, elevated pulse rate and blood pressure, and Skiles felt that his brain swelled as with a bad head cold. Sullenberger recalls thinking 'This can't be happening. This doesn't happen to me'. Patrick Harten, the air traffic controller handling the flight, 'Simply could not wrap my mind' around the prospect of landing in the Hudson' [4]. Despite these classic responses to sudden surprising events, the two pilots stabilised the aircraft, started the auxiliary power unit, assessed their options and flew the aircraft to a survivable ending; and the controller offered level-headed support while instigating the emergency procedures.

Startle and surprise are normal reactions to abnormal events and prepare us for fight or flight. Physical responses include blinking, inhibited movement, elevated heart rate and blood pressure, and muscle tension that can lead to unintentional control movements. Tasks and thought processes are interrupted while the brain attempts a quick-and-dirty analysis that, if inconclusive, can prolong the physical and mental stress. Situational awareness can be lost and reasoned analysis suppressed [5,6], leaving us reliant upon well-learned responses, reflexes and instinct. Our thoughts can be monopolised by a single process such as maintaining airspeed and, if the situation overloads us, panic can set in. Our reactions seem tuned to deal with simple, familiar and immediate threats rather than the complex and protracted challenges of an aviation emergency.

Workload management

The Hudson landing is striking for the way the pilots pared down their workload, stabilised the aircraft, formed a plan and rebuilt their workload to a near-textbook ditching and evacuation. They were aided in this by their familiarity with the aircraft, its systems and performance, and procedures – including prioritisation and crew resource management – that their training and experience gave them. Sullenberger could thus give much of his capacity to the crucial judgement to land in the river rather than try an uncertain glide back to the runway.

To help pilots in similar circumstances, there seem to be four key components:

- Deep mental models ('schema') of the working and performance of the aircraft, its systems, and navigation options.
- Prior consideration of possible scenarios and responses to prepare the pilot and let some decisions be made before flight.
- Trained procedures, supplemented by checklists, to reduce the need for real-time analysis.
- A learned strategy, similar to 'fly the aeroplane' and 'aviate – navigate – communicate', to avert overload and guide prioritisation of limited mental resources.

While the first three should follow naturally from our usual training and Threat & Error Management – and being current increases our capacity – the last is the NLR innovation.

Unload – Roll – Power

To recover from a loss of control, such as stall or spiral dive, commercial pilots are that taught that (if they judge it appropriate) they should unload the wings, roll level, and increase power. To guide pilots following startle or surprise, the NLR adapted this to:

- **Unload** mentally. As deliberate actions are thought more effective than a vague 'take your time': lean back to reduce focus upon a single instrument; breathe deeply; relax muscles; and check your colleagues.
- **Roll** into situational understanding by asking what you observe and sense before reaching initial conclusions.
- **Power** up the analysis by asking whether any information is missing, ambiguous or inconsistent.

The NLR carried out simulator exercises with a number of KLM pilots and found a notable though not universal improvement in their ability to make observations and collect the information needed to sort out various surprise situations. Even initially sceptical pilots proved to be impressed.

Application to gliding

There are certainly startling events in gliding – G Dale's description of a mid-air collision and the 'Aussie bail-out simulator' [7] provide memorable examples – and we can be surprised by strong sink, inadvertent stall, a launch failure, a navigation error, or the apparent failure of the aircraft to respond as expected. There are examples in our accident records where these have led to undue focus on a single task, panic, incorrect diagnosis and rushed decisions. Accidents have happened when pilots persisted in mistaking open airbrakes for sink, or identified control failure when they were operating the wrong lever. Gliders have stalled when the pilots manoeuvred sharply to avoid overshooting the intended landing area, when the airfield presented simpler options; and when intent upon getting back to the airfield without the necessary height. Hearing of such accidents, we all hope we'd have been sufficiently clear minded to have acted differently – but the pilots in question had to cope with startle and surprise. Some situations require prompt practised reactions, but techniques such as the NLR's might help us cope better with other such events, especially if we can develop training to support them.

Sullenberger was able to control his reactions, stabilise the aircraft, assess the situation and make a sound decision to ditch in the Hudson rather than an uncertain attempt to reach a runway. A gliding parallel would be to reject a dubious final glide and land safely in a field. You might not have Tom Hanks play you in a movie, but you should walk away with your glider intact.

Tim Freegarde and the BGA safety team

■ EASA's weighty study [3] gives more details of the startle effect and its mitigation; the CAA's CAP 737 discusses the wider topic of human factors [6]. We'd love to learn more about addressing human factors problems in gliding: please get in touch if you have relevant expertise.

[1] C B Sullenberger III, Highest Duty: my search for what really matters (2009) *https://tinyurl.com/flyright2209*
[2] Accident Report NTSB/AAR-10/03 (2010) *https://tinyurl.com/flyright2210*
[3] J N Field et al, *Startle Effect Management*, EASA (2018) *https://tinyurl.com/flyright2211*
[4] US Airways Flight 1549 Hearing (2009) *https://tinyurl.com/flyright2212*
[5] M A Staal, *Stress, Cognition, and Human Performance: a literature review and conceptual framework*, NASA/TM-20040212824 (2004) *https://tinyurl.com/flyright2213*
[6] CAA, *Flight-crew human factors handbook*, CAP 737 (2014) *https://tinyurl.com/flyright2214*
[7] G Dale, *Bailout Advice* (2018) *https://tinyurl.com/flyright2215*

■ Clubs can obtain printed copies of Safety Briefings from the BGA Office.

PREVIOUS 'FLY RIGHT' ARTICLES

- *The Perils of Distraction* (Apr/May 19)
- *Keeping Safe in Thermals* (June/July 19)
- *Why It Is Good to Think Ahead* (Aug/Sep 19)
- *The Effects of Wind Gradient* (Oct/Nov 19)
- *A Fun but Safe Introduction* (Dec 19/Jan 20)
- *Stop the Drop* (Feb/Mar 20)
- *Avoiding Upset* (Apr/May 20)
- *Backroom Boys* (June/July 20)
- *Cockpit muddle* (Aug/Sep 20)
- *Safe rotation* (Oct/Nov 20)
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- *'Hopefully' is not an option* (Oct/Nov 21)
- *Act when the launch fails* (Dec 21/Jan 22)
- *Time to Solve a Knotty Problem* (Feb/Mar 22)
- *RTFM: Read the Flight Manual* (Apr/May 22)