ERODED MARGINS

What have gliders got in common with NASA? The BGA safety team looks at incidents caused by the normalisation of deviance

During the lift-off of Space Shuttle *Columbia* on 16 January 2003 a piece of foam insulation broke off, hitting a wing. The problem was spotted, but not acted on possibly because failure of the foam insulation had become the norm (photo courtesy of NASA)

THE term *normalisation of deviance* was coined by sociologist Diane Vaughan in the aftermath of the 1986 Space Shuttle *Challenger* disaster [1]. It's one of the main reasons that gliders end up in trees and overhead cables.

Challenger broke up just over a minute after lift-off when flame leaking from a solid rocket booster damaged the spacecraft structure. A Presidential Commission [2] found that primary O-ring seals had failed repeatedly on previous flights but that, as they had flexed or re-formed before the back-up seal could be affected, their failure had become first acceptable, and then the norm. Physicist Richard Feynman identified a 'slow shift towards decreasing safety factor' within the Shuttle programme:

The argument that the same risk was flown before without failure is often accepted as an argument for the safety of accepting it again… The fact that this danger did not lead to a catastrophe before is no guarantee that it will not the next time…

Erosion of margins

It is quite natural to adjust our behaviour in light of what we observe and discover. The snag is that a limited sample of a few successful events may lead us to neglect the small risk of a catastrophic outcome, or to accept the risk if it avoids a more likely but less grave result, such as inconvenience, embarrassment or delay [3]. The usual solution in aviation is a mix of standard operating procedures and threat & error management – which means that we've either individually, or collectively, analysed the situation beforehand. Three examples are the minimum heights around circuit, when soaring a ridge, and for selecting a field.

A minimum final turn height of 300ft ensures not only that we can clear obstacles on the approach, but that we have energy in hand if we encounter wind gradient or turbulence, the wind proves stronger than

STRAIGHTEN UP & FLY RIGHT

expected, we need to adjust our landing area, or wet wings cause a loss of performance. It also gives us time to stabilise the approach and deal with the workload.

Similarly, a decent height margin above the ridge gives us energy to cope with sink and options to manoeuvre, and identify and fly to a landing site. While we may be able to carry some of the energy as speed, a height margin also keeps us clear of treetops and cables. For the same reasons, late field selection is a major cause of field landing accidents, because it leaves us fewer options, less time and greater workload.

Yet, if conditions are benign and luck is on our side, it is quite likely that reduced margins will not punish us, and we may learn that we can get away with another lift-seeking turn, or a gratifying extension to an instructing or introductory flight. The minimum first becomes a target, and then the reduced margins become the norm – as does the idea that we don't need to comply with our previous decisions or instructions.

Unfortunately, if one of the rare but foreseen events eventually occurs, we might not have the clearance, energy, options or time to make a safe recovery, and several gliders each year end up in trees, hedges or cables. Common causes are persisting too long with a marginal final glide, often after drifting downwind; too low a final turn and approach, perhaps to avoid a trudge back to the launch point; skimming too close to a wooded ridge; late field selection; deviating to avoid ground obstacles; and failing to take account of wet wings or windshear.

Press-on-itis

Seventeen years after the *Challenger* tragedy, its sister shuttle *Columbia* broke up during re-entry when the port wing structure melted after its leading-edge heat protection was damaged by insulation debris during the launch. Foam loss, which had been a major concern early in the Shuttle programme, had become commonplace, and was evident in over 80 per cent of the missions subsequently examined. Normalisation of deviance was again identified [4]:

With each successful landing… NASA engineers and managers increasingly regarded the foam-shedding as inevitable, and as either unlikely to jeopardise safety or simply an acceptable risk.

One driving factor is **loss aversion** – our reluctance to give up a goal or admit defeat. Within a day, NASA knew from launch imagery about the foam loss and impact, but it cancelled requests for further investigation because it threatened the mission and an already tight schedule for future launches. Supported by an unhealthy dose of optimism and over-confidence, and coupled with **plan continuation bias** which makes us understandably hesitant to depart from a prior plan, such **'press-on-itis'** was identified behind 42 per cent of fatal approach and landing accidents in commercial aviation [5].

Individual actions

Glider pilots are just as susceptible to these 'cognitive biases'. We'd far rather a glorious finish than the trouble and delay of a field retrieve; if we could just cross that gap in ridge lift then we'd be back on task; and we don't want to be thought over-cautious. Besides, we got away with it last time…

It helps to analyse eventualities and decision criteria, plan options and be willing to use them. A field landing is less daunting if a retrieve is already prepared and we've left time in hand. Prior planning makes us less likely to succumb to **normalcy bias, confirmation bias** or **denial**, which delay our recognition and acceptance that things are going wrong. We can then stick to our planned minima and temper any sense of defeat by taking pride in a sound decision. These are all individual actions, but the safety atmosphere in which we operate can be an important factor.

Club culture

Vaughan concluded that flawed individual decisions often stemmed directly from NASA's culture and structure. Posters promoting safety were widespread, but the agency's focus was upon operational objectives. Poor communications structures hindered safety issues from reaching the right people, and engineers felt that raising safety concerns could lead to ridicule by their peers and managers.

Likewise, it is easy in a gliding club to lose a general safety priority amid a fervour to start flying, keep up a good launch rate and deliver promised training and First Flights. Maintaining a healthy safety culture is a key club responsibility.

One club chairman, investigating a run of tug incidents, unearthed a subliminal focus upon launch delivery that put off fixing problems till the end of the day; happily, after airing his observations, he easily convinced his team that safe decisions deserved more regard. In another club, the CFI analysed logger traces to persuade his instructors that low final turns were more than a rare aberration; aware that they were setting an example, they promptly restored the intended margins. In both cases, good pilots had felt an expectation – perhaps self-imposed – to deliver performance and 'value for money'. The sense of duty can be especially strong amongst volunteers.

Yet in a club environment, it is largely the individual pilots who create the safety culture through their priorities, actions and results. Discipline amongst experienced pilots sets an example to their juniors, and careful flying generates the expectation that accidents are shocking and rare. We can all contribute by setting sensible margins and decision criteria, and taking pride in adhering to them. Minimum heights above the ridge, for final turns and field selection should be minima rather than targets; and we should be strict about what are tolerable defects and acceptable practices.

We can learn from NASA's experience. After all, once their rocket fuel was spent, the Space Shuttles were all gliders.

Tim Freegarde and the BGA safety team

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

■ An excellent series of articles on threat & error management by Arthur Gatland is available from the BGA website [6].

[1] D Vaughan, The Challenger Launch Decision, U Chicago Press (1996)
[2] Report of the Presidential Commission on the Space Shuttle Challenger Accident (1986) *https://tinyurl.com/flyright2109*
[3] R Hertwig & I Erev, Trends Cogn Sci 13 (12), 517 (2009) *https://tinyurl.com/flyright2110*
[4] Columbia Accident Investigation Board report (2003) *https://tinyurl.com/flyright2111*
[5] Flight Safety Digest 17 (11-12), 1 (1998) *https://tinyurl.com/flyright2112*
[6] A Gatland, *Soaring NZ*, June p16, August p18, October p24 (2010) https://tinyurl.com/flyright2113

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