Investigation of Fatal Hang Glider Accident at the Remarkables, Queenstown on 29th March 2003

Report to NZ Police, Queenstown

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Summary

After reviewing the circumstances of the fatal hang glider accident at the Remarkables, Queenstown on 29th March 2003 I have identified two key questions for human factors analysis:

- Is it possible that the pilot could have unintentionally failed to attach the passenger to the hang glider? (Pre-Launch).

- Could the pilot's decision making after the emergency have been any better? (Post-Launch).

The omission of a necessary action is a relatively common type of error in aviation and other activities. The necessary conditions for its occurrence are that the operator is skilled and that a well-practiced activity is carried out in familiar surroundings. Both of these conditions apply in the present instance. In addition, three further omission-inducing factors were definitely present. These were distraction from the changing winds and launch positions and associated activities; stress induced arousal from the glider tipping over prior to launch and increased tension and frustration leading to a "hurry-up" syndrome resulting from repeated delays in launching. A fourth omission-inducing factor was almost certainly present. This was that after the glider tipped over, the passenger was probably detached from the glider by someone other than the pilot. As memory for self-enacted actions is stronger than memory for observed actions, an additional attentional demand of recalling this observed action and forming an intention to re-attach the passenger would have had to be carried out before launching. From this analysis, my conclusion is that the omission of a necessary action (i.e. not attaching the passenger's carabiner to the hang loop) was highly likely in the circumstances. Unfortunately, the pilot did not recognize that the circumstances were highly conducive to error and did not return to the start of the procedure or take 'time out'.

The pilot acknowledged that he became aware that the passenger, Ms Zeri, was not properly attached to the glider within 5-10 seconds after launch. He attempted to hold on to her with his legs and then attempted to fly towards the original intended landing site which he estimated would take approximately 6 minutes. He acknowledged that he did not analyze any other options. There is no doubt that the pilot would have been experiencing a high level of stress at this point. The effects of stress on decision making are well known and include a tendency towards rapid responding, failure to process all the available cues, and premature closure on a salient option. All of these seem to have occurred in the present case. The only way of avoiding these effects is in pre-flight preparation and planning for critical events. It is customary in aviation to mentally prepare strategies for managing unexpected events. The retrieval of these strategies from long-term memory avoids the debilitating effects of stress on short-term working memory. There is no evidence that the pilot was able to respond to the critical situation with any planned or prepared strategy. Thus when confronted with the situation his response was ineffective.

Background

I was originally contacted by email by Detective Sergeant Graham Bartlett of the Queenstown Police on 24th May 2003 regarding a fatal tandem hang gliding accident that occurred on the 29th March 2003 at the Remarkables, Queenstown. In this accident, a passenger on a commercial hang gliding flight operated by Skytrek Hang Gliding Ltd fell from the hang glider after takeoff and was fatally injured. The pilot of the hang glider was Mr Stephen Richard Parson. On 9th July 2003 I was requested by Constable Travis Hughes of the Queenstown Police to investigate and report on this accident.

This report covers the circumstances of the accident and the events leading up to it.

I have been provided with the following materials by the Queenstown Police:

- Copy of the Skytrek Hang Gliding Ltd Operations Manual (Undated – 36pp).
- Caption Sheet POL 262 Police v Stephen Richard Parson.
- Transcript of Video Interview with Stephen Richard Parson on 2nd April 2003.
- Preliminary report from Professor John Raine dated 18th May 2003.
- Video Tape of interview with Stephen Richard Parson on 29th March 2003.
- Video Tapes (2) of interview with Stephen Richard Parson on 2nd April 2003.
- Report by Mr Bill Degen of the NZHGPA to the Queenstown Police dated 2nd May 2003.
- Report by Mr Glenn Meadows of the NZHGPA to the Queenstown Police dated 4th April 2003.
- Transcript of a telephone conversation with Mr Hugh Banner of HB Climbing, Wales 2nd July 2003.
- Copy of an email from Mr Hugh Banner of HB Climbing, Wales 9th July 2003.
- Statements by Mr Keith Allen Woodham, John Frances O'Neill, David Mathew Gourlay, and Mr Christopher Bryan Davis (all employees of Skytrek Hang Gliding Ltd).
- Statements by Laura Lee Hewitt, Tiffany Kay Smith (members of the tour group).
- Statements by Mr Callum Edwards and Ms Coral Sneddon of the Frankton Arms Tavern.
- Statement by Geoffrey George Christopher concerning a hang glider incident at Mt Maunganui in 1997.
- Caption Sheet POL 262 Police v Brendon Kerrison Sinclair concerning a tandem paragliding incident at the Skyline Gondola, Queenstown on 30th July 2001.

Qualifications

I am an Associate Professor of Psychology at the University of Otago.

I have a first class honours degree in psychology from the University of Exeter and a PhD in psychology from the University of Exeter. I have been a lecturer in psychology since 1978. I was a foundation member of the New Zealand Ergonomics

Society and I am currently a full member of the Human Factors and Ergonomics Society. I am also a full member of the International Society of Air Safety Investigators. I have attended a course on aircraft accident investigation at Cranfield University in the U.K.

I am also the holder of a United Kingdom Private Pilot Licence and a New Zealand Private Pilot Licence although I am not currently active. I also have a 'Bronze C' qualification from the British Gliding Association and a 'Silver C' qualification from the Federation Internationale Avionique for glider flying. I was an active member of the Otago Gliding Club for a number of years.

I have been working in the area of aviation human factors for over 20 years. I have co-authored a textbook on aviation human factors ('*Flightdeck Performance: The Human Factor'*) published in 1990. I have also recently edited a book (*'Human Performance in General Aviation'*) published in 1999. I have conducted research on pilot decision making, aircraft accident analysis, human error, and pilot training. The results of this research have been published in over 50 papers in academic journals, conference proceedings and industry publications. I am currently an Associate Editor of the International Journal of Aviation Psychology.

My research on pilot decision making and aviation safety has attracted funding from external bodies including the Health Research Council of New Zealand, the Federal Aviation Administration (U.S), the Civil Aviation Authority (N.Z) and NASA.

I have been an invited keynote speaker to aviation conferences and meetings including the New Zealand Civil Aviation Authority Safety Forum (2002). I was invited by the U.S Federal Aviation Administration to join an expert panel on aeronautical decision making in Washington, DC (Jan 2002).

I have been involved with the development of the human factors aspects of the New Zealand Civil Aviation Authority accident and incident database. I have also assisted the Transport Accident Investigation Commission in their investigation of aviation accidents in New Zealand.

General Background to Human Factors Investigation

It has frequently been asserted that 75-80% of aviation accidents are due to human factors. In other words, mechanical or structural failures beyond the control of the crew account for less than 25% of all aviation accidents. In the remaining cases actions taken, or not taken, by the crew are considered to be the root cause of the accident. As a result of this, the investigation of the performance of the crew has assumed a pivotal position in modern aircraft accident investigation. In the case of large scale investigations of airline transport crashes a separate human factors group is normally established in addition to groups devoted to structures, powerplants, weather, maintenance records etc.

The human factors group would normally consider all aspects of human performance that might be relevant to the accident. In addition to the behaviour and actions of the

crew during the accident flight itself, the human factors investigation would also consider other aspects of crew performance from the experience and training of the crew members to their current status in terms of drugs and alcohol, stress and fatigue etc. Medical evidence might also be considered if relevant. Conditions in the workplace, social relationships and organizational factors might also be included.

The primary focus of the human factors analysis would be the task or tasks that the crew member was trying to perform on the accident flight. Successful performance of any task requires a match between the resources and capabilities of the human and the demands and requirements of the task itself. These demands can be affected by the circumstances prevailing at the time – for example the presence of unusual weather conditions, or by equipment failure. The resources and capabilities of the crew member can be affected by their experience and training, by their personal characteristics, by temporary states of motivation, effort, illness or fatigue and by task-induced changes in physiological status such as arousal.

The Nature of Human Error

Three main kinds of human error can be distinguished:

- Violations involving deliberate acts of sabotage or rule-breaking.
- Mistakes where the actions are not correct in the circumstances.
- Slips and Lapses where an unintended action is performed or an action is omitted.

The origins of each of these categories of human error are quite different from one another as are the factors that shape and promote such errors. Following a brief description of the circumstances of the fatal hang glider accident that occurred on March 29th 2003 I will discuss the errors that appear most likely to account for the accident.

Analysis of 24-72 Hour Time Period Prior to Accident

The U.S. National Transportation Safety Board considers that "it is of utmost importance to collect information related to the events and activities the operator experienced during the 24-72 hour time period prior to the accident" (Govesky, Chesterfield & Bures, 1993, p. 1-7). Matters normally considered include food, drug and alcohol intake, sleep and rest, work schedules, personal relationships, unusual events or activities, mood etc.

Unfortunately no systematic attempt was made to collect this information in the present case. The pilot apparently declined to provide blood and urine samples. He spent part of the evening prior to the accident drinking approximately 1.5 litres of beer at a Frankton pub. He may have had up to 8 hours rest at home before picking up passengers the following morning. The day of the accident was his seventh consecutive day at work since his last day off on March 22nd. He had flown 86 tandem flights that month, averaging just under 4 flights per day. His activities in February

seem to have followed a similar pattern with 4 days off and 24 days worked, averaging just over 4 flights per day.

There is no information on other aspects of Mr Parson's life (e.g. personal and working relationships, financial worries etc). There is no information on food intake in the 24 hours prior to the accident.

Outline of the Hang Glider Accident on March 29th 2003

Mr Parson began collecting company staff at 0800. Two uneventful flights were completed from the Remarkables, probably around 0930 and 1000. A lunch break was scheduled after the third (accident) flight.

The exact sequence of events involved in the launching of the third flights is difficult to determine as the statements are confusing (e.g. different terms used to describe the various launch points).

There was an initial set up at the 'Carpark' site where the glider was assembled and Ms Zeri fitted into her harness. She was then given a practice run, clipped on to the glider by Mr Parson and a full hang test conducted. The wind shifted direction and Mr Parson unclipped himself and Ms Zeri. The other two pilots moved to another launch position. Mr Parson also moved his glider to the new position. The wind switched again and the gliders were moved again to a northerly position.

Mr Parson again clipped himself and Ms Zeri to the glider and conducted a hang test. At this point the glider was tipped on its nose by a gust from behind, slightly injuring the passenger and trapping both pilot and passenger underneath the glider.

It is not clear who unclipped the pilot and passenger at this point. They may both have been unclipped by the launch assistant. Alternatively, the pilot may have unclipped both himself and the passenger. The third possibility is that the pilot unclipped himself and Ms Zeri was unclipped by the launch assistant. One witness (Tiffany Smith) states that "One of the staff…disconnected Elani from the glider" so the third possibility (pilot unclipped himself, passenger unclipped by launch assistant) seems most probable.

The glider was repositioned. The pilot clipped himself in, called the passenger over and then launched. The fact that there was a critical problem (passenger not attached) become almost immediately apparent and the pilot then decided to try and reach the original intended landing place whilst holding on to the passenger.

Questions to be Answered

- Is it possible that the pilot could have unintentionally failed to attach the passenger to the hang glider? (Pre-Launch).
- Could the pilot's decision making after the emergency have been any better? (Post-Launch).

I will address each question separately.

Critical Factors: Pre-Launch

- In comparison to the previous 2 launches that day this one was more complex due to the shifting wind patterns. As duty pilot, Mr Parson would have been paying close attention to the wind shifts and making decisions about the appropriate launch point. This monitoring would have taken up limited attentional capacity.
- As duty pilot, Mr Parson had to call the Queenstown control tower for clearances and to cancel clearances. This was done several times. One witness (Bryan Davis) states: "Steve was dealing with the tower getting clearances on each move". This task would also have taken up some limited attentional capacity.
- There were two aborted attempts at launching with Ms Zeri culminating in the glider being tipped over with both pilot and passenger caught underneath. This would have undoubtedly been stressful leading to increased symptoms of arousal – elevated heart rate etc. This is confirmed by Mr Parson himself.
- The delays caused by switching launch sites would have resulted in increased tension and frustration (inability to achieve goal) and a desire by the pilot to remove the frustration and diminish the tension as soon as possible.

At least three factors that increase the likelihood of an unintended slip or lapse (such as omitting to carry out an action) are clearly present in this case. These are:

- The presence of distractions taking up limited attentional capacity
- Increased arousal
- Increased tension or frustration

Errors involving Omission of an Intended Action

Effects of distraction on attention and performance: The inadvertent omission of an intended action is one of the most commonly occurring kinds of errors. Familiar examples include omitting to turn off a car's headlights after use in daylight or leaving the last sheet of the original under a photocopier's lid. Unintended errors (e.g. slips and lapses) are extremely common in everyday activities as well as in industrial and occupational areas (e.g., engineering maintenance). The vast majority of such errors are either noted and corrected, or else have trivial consequences and are soon forgotten. Published data from the nuclear power plant industry suggest error rates for omissions of around 1 in 10^2 actions. Basic error rates for a wide variety of basic tasks range from 0.5% to 50% (see for example, http://panko.cba.hawaii.edu/HumanErr/).

Professor James Reason (1990) notes that two conditions are necessary for such errors:

- A skilled operator working on a familiar task in a familiar environment.
- The presence of competition for attention (e.g. distractions).

Both these conditions are satisfied in the present case.

Interruptions and distractions increase the probability of an omission error considerably (estimates range from a five to tenfold increase in probability). Sequences of actions are particularly vulnerable as the diversion of attention leads to one of two logically predictable outcomes: either a step is unintentionally repeated or a step is omitted. These two error types correspond to the operator picking up the activity and assuming either that they are not as far through the sequence as they in fact are, or assuming that they are further along than they in fact are. In the latter case an omission error will occur (e.g. not extending the flaps for take-off in an aircraft).

In the present case, the action of clipping the passenger in suffers from a further problem in that it is not functionally related to the desired goal (i.e. to fly). This is also the case in other omission errors such as leaving originals on a photocopier. The task is completed when the last copy comes out and attention is required to initiate completion of the final step (remove original). Anything that competes for attention (e.g. worrying about wind shifts) increases the likelihood that a step (especially one that is not functionally related to goal achievement) will be omitted.

It is especially likely that the second of two similar actions will be the one most likely to be omitted (Reason, 1998). In this case, the clipping on had to be performed twice. The pilot clearly clipped himself on.

Effects of increased arousal on attention and performance: The effects of increased arousal on attention and performance have been studied scientifically for several decades. Evidence shows that operators suffer from 'attentional narrowing' where performance on most aspects of a task is impaired. Participants in these studies have shown relatively little impairment on what they subjectively regard as the core component of their task but show significant impairments on any other components of the task. Thus pilots and nuclear power plant operators have been found to over focus on one aspect of the task. Stress can cause people to focus on only one aspect of a stimulus at a time. For example, the presence of red in the Australian Air Force markings led to many planes being shot down by American forces in the Pacific arena in World War II. Under combat stress, the Australian markings were often mistaken for those of the Japanese (also red) even though there were other shape cues to the correct identification (King, Stanley & Burrows, 1987, p.27).

In this case, given the fluky and unpredictable changes of wind direction, it is likely that the pilot's focus of attention was on determining whether the wind strength and direction were suitable for take-off. Having already conducted two complete hang checks, the ability to focus on the need to conduct a third hang check would have been compromised by the increased arousal levels subsequent to the glider tipping over.

Effects of tension and frustration: In contrast to the previous two launches, this third launch must have been extremely frustrating. Moving the gliders from one launch point to another and then having the winds change again would have raised tension levels. This was a commercial operation with paying customers and professional pilots. Pilots are generally highly goal-oriented individuals. This doesn't imply any neglect of safety considerations but does imply that they have a strong desire to complete operational goals. There is no suggestion that conditions were dangerous or

unsuitable for flying on March 29th. However, the constantly changing wind conditions and the associated need to move people and equipment about the hillside were preventing goal achievement and would have been experienced as somewhat frustrating by the pilot. The tension and frustration would be relieved by launching and getting the glider in the air. Each abandoned launch would have increased the level of tension and frustration.

One analysis of confidential reports of incidents submitted to the NASA-run Aviation Safety Reporting System (McElhatton & Drew, 1993) labelled these as 'hurry-up' errors: "Hurry-up errors appear most likely to occur in high workload operational phases, specifically in pre-flight…External distraction and schedule pressure are significant predisposing conditions". In 38% of instances pilots made errors of omission. One of the witnesses (Tiffany Smith) was quite clear that at this point : "It seemed a little bit rushed…I felt like they were rushing, 'cos it was the correct wind".

Conclusion

Many different factors lead to omission errors. The more omission-inducing factors that are present, the greater the likelihood of an omission error occurring. In this case three of the factors that are known to greatly increase the likelihood of an omission error were present. My conclusion, based on the scientific evidence, is that there is a high likelihood that Mr Parson omitted to attach Ms Zeri to the hang glider prior to the third launch.

An Additional Error-Inducing Factor (Pre-Launch).

This factor is considered independently since there are some discrepancies in the witness statements regarding the events that following the incident of the glider being tipped over by a wind gust prior to the third launch. There is no doubt that Mr Parson twice attached Ms Zeri to the hang glider and that she was attached prior to this incident. Mr Parson was not sure who unclipped Ms Zeri at this point. One witness (Tiffany Smith) stated that "One of the staff…disconnected Elani from the glider". This would, presumably, have been the launch assistant (David Gourlay). Mr Gourlay stated that "Steve and Eleni had to be released from the hang loops… Steve and Eleni were disconnected". This strongly implies that they did not release themselves.

If Mr Parson did not disconnect Ms Zeri himself (as seems likely from the statements above) then this would have been an additional error-inducing factor. This is because memory for self-enacted actions is both stronger and more accurate than memory for actions that are imagined or observed to be performed by others (Koriat, Pearlman-Avnion & Ben-Zur, 1998). This is thought to be due to the richer multimodal encoding of self-performed actions (e.g. there are both visual and tactile cues). Memory for self-enacted actions is also thought to take place 'automatically' without conscious attention.

In the present case, Mr Parson had personally attached Ms Zeri to the hang glider and then released her. He then attached her again. After this the glider was tipped over and the strong possibility exists that she was released by the launch assistant. If so, Mr Parson would have automatically formed a stronger memory trace for attaching Ms

Zeri (having done so twice) than for releasing her (performed once). He would have had to consciously note that she had been unattached from the glider and form an intention to re-attach her himself before launch. This required him to pay close conscious attention at just the right moment before launch. The factors described above (distraction, arousal and tension) would all have impaired his ability to do so.

The likely presence of this fourth factor provides another omission-inducing factor that would have increased the probability of an omission error even further.

Previous Cases involving Hang Gliders

Coronet Peak: 30th July 2001
A twelve year old fell from a paraglider. The buckles on her harness had not been done up by the pilot. He had been interrupted by a cell phone call whilst performing the passenger harness securing sequence.

Mount Maunganui, Tauranga, 14th March 1996
A very experienced instructor attached his student to a tandem hang glider and then launched without clipping himself on to the frame. The instructor fell about 5 metres. The student managed to keep control of the hang glider and land in the sea. The instructor stated afterwards in a statement to police: "This sort of thing happens from time to time…Almost every year at the various world championships and competitions there are cases of pilots not clipping themselves in".

Australian Transport Safety Bureau
Incidents involving sport and recreational aircraft are not normally investigated by the ATSB so the number of incidents on the OASIS database are not indicative of the possible total number of such events. Six incidents where the pilot was not attached to the hang glider were found. In one case the problem was that the hang loops were attached to a non-structural part of the glider. It is especially noteworthy that one of the cases involved the pilot clipping himself in, unclipping himself and then failing to reclip himself back in.

13/09/1979	Pilot neglected to hook in before attempting completely unassisted takeoff with unfamiliar harness. Practice of unassisted takeoffs disapproved by hang gliding association
1/01/1981	Pilot failed to attach harness to suspension loop. After take-off aircraft entered steep dive, possibly result of whip stall. Pilot was unable to control aircraft. Held onto a-frame for short while before falling free.
30/12/1981	**Prior to departure pilot unclipped harness from glider to make adjustment. Pilot then failed to reclip to harness.** Safety officers failed to ensure checks were made prior departure. Detached from ahg, deployed chute. landed safely.
16/04/1988	Pilot failed to connect his support harness to the hang gliders airframe before take-off.

	Possibly keenness to become airborne distracted pilot from completion of vital actions.
16/11/1989	Hang loops were attached to non-structural part of hang-glider. Pilot did not follow approved pre-flight assembly procedures, restraining strap parted due overload, releasing harness and pilot during flight.
27/10/1990	The pilot did not check that his harness was attached to the glider prior to launch. Lack of attachment between harness & glider prevented the pilot having normal control so was unable to avoid trees.

Other Cases of Distraction and Error

There are numerous reports in aircraft accident databases of the effects of distraction on pilot performance. These range from accidents involving commercial transport aircraft to gliders. For example, a Northwest Airlines MD-82 crashed on takeoff at Detroit on Aug 16th 1987. The crew were interrupted midway through their pre-takeoff checklist by a runway re-assignment. They were also somewhat preoccupied by the weather conditions and possible wind-shear. The checklist was not completed and consequently the flaps were not extended as they should have been.

Reports of distraction leading to omission errors can be found in many areas of aviation. The following examples of omissions leading to glider accidents come from the New Zealand Office of Air Accidents Investigation reports.

Gliding (Grob 103)	5 May 1990 (90-070)	Canopy not latched before takeoff. Blew off at 300ft
Gliding (Blanik)	18 Mar 1990 (90-049)	Pre takeoff checks paused and then not completed. Airbrakes not locked shut.
Gliding (KA6)	5 Feb 1990 (90-030)	Pin connecting rudders not attached. Not noticed on pre-flight inspection.
Gliding (Jantar II)	10 Mar 1985 (85-032)	Canopy detached. Not locked before takeoff
Gliding (Ventus Motor Glider)	5 Dec 1990 (90-007T)	Pilot was distracted whilst rigging the aircraft and omitted to connect the tailplane which detached in flight.

The following examples of pilot distraction leading to omission of necessary actions were obtained from the Australian Transport Safety Bureau database.

DATE_OCC	AC_MODEL_NAME	SUMMARY
30/09/1990	PA-31	The aircraft landed with the landing gear retracted. The pilot reported that his sleep pattern had been disturbed the night prior to the accident by sick children and that he had spent the previous day working on his boat. He was probably suffering from the effects of short term fatigue. During the accident circuit he was distracted by strong cross wind conditions and although he completed his pre-landing checks he did not notice the unsafe gear light or the landing gear warning horn.
22/04/1993	150G	Pilot advised that he was distracted assisting the passenger who was sick and allowed the aircraft to descend into the ground.
26/11/1993	114	The pilot joined the circuit for landing on runway 23. He later said he was distracted by other traffic and forgot to extend the landing gear. The aircraft subsequently landed with the landing gear retracted.
10/12/1993	PA-30	Landing on runway 36 the pilot was distracted and forgot to lower the landing gear.
21/05/1994	PA-30	The pilot was conducting solo circuits. During the third circuit, the presence of an aircraft inbound to Wangaratta distracted the pilot from the pre-landing checks. The landing gear was not lowered. When the gear warning horn sounded, the pilot applied full power for a go around. A normal circuit and landing was then flown. Later inspection found damage had occurred to the right propeller and DME aerial during the go around.
26/08/1994	58	The aircraft landed wheels-up on runway 12. The pilot advised that he had been distracted by a series of radio transmissions and had forgotten to extend the gear.
29/09/1994	PA-34-220T	While performing the daily inspection the pilot was distracted and forgot to carry out a final check of the nose locker door. The pilot abandoned the takeoff when at lift-off speed the door came open. The left tyre burst due to heavy braking required to bring the aircraft to a stop before the end of the runway.
19/05/1995	210L	The aircraft was observed from the Tower to have made a gear up landing on runway 29L. The crash alarm and common crash call were activated and the Safety Officer notified. The pilot reported that he had become distracted in the circuit by slower traffic and forgot to select the landing gear "down".
9/03/1996	PA-28RT-201	The instructor had initiated a simulated power failure for the pilot to carry out forced landing practice onto the eastly direction runway. When established in the glide, and positioning for a landing, the pilot and instructor became aware of an ultralight aircraft operating in the circuit area which distracted their attention. As a result they both forgot to carry out the final landing checks, and landed the aircraft with the landing gear retracted.

27/05/1996	M20E	The aircraft landed with the landing gear retracted. The pilot subsequently reported that he was distracted by his downwind checks and failed to extend the gear.
15/08/1996	Drifter 582	The floatplane was being used to conduct conversion training. The instructor advised that he was distracted during the landing phase and did not carry out the prelanding checks. The aircraft alighted onto the water with the landing gear extended and nosed over, coming to rest inverted.
28/11/1996	PA-30	The pilot reported that he selected the landing gear down on the downwind leg. He did not complete his pre-landing checks because he was distracted by his attempt to identify the wind direction from a damaged wind sock. He did not realise the landing gear was still retracted until the aircraft had touched down on its lower fuselage. The aircraft slid to a stop on the runway. A passenger later observed that he did not see the orange unsafe landing gear light at any stage. Investigation found that the landing gear circuit breaker was popped.
8/01/1997	DHC-2	The pilot reported that he was distracted by the crosswind and, as a result, he did not complete his downwind checks nor lower the landing gear. He did complete his finals checks but did not recognise the gear was not down. The aircraft landed on its floats. The aircraft systems were all serviceable.
9/01/1997	200	The pilot was distracted by the late arrival of a passenger during his final walk-around aircraft inspection and he left a pod locker open. Shortly after takeoff, the pilot realised his error but he was unable to return due to deriorating weather conditions. The flight was continued to Perth where the aircraft landed safely. One item of baggage was later found at the Mount McClure airstrip. A second bag has yet to be recovered.
21/02/1997	PA-24	The pilot was practising circuits and landings. On the third circuit the aircraft landed with the landing gear retracted. The pilot said he became distracted in the circuit and forgot to lower the landing gear. He also said that he did not hear the landing gear warning horn sound.
11/04/1997	177RG	A Cessna 177 arrived at Jandakot aerodrome at about the same time as a Beech Baron. The Baron was cleared to join the circuit on finals but was unable to do so and joined on the upwind leg. The Cessna was then cleared to enter the circuit on finals. The aircraft landed with the landing gear retracted. The pilot later reported that he was distracted and had forgotten to complete his finals checks and to lower the landing gear.
18/04/1997	R182	The aircraft landed with the landing gear retracted. The pilot reported that after joining the circuit he became distracted by other slower aircraft in the circuit area, together with the associated radio transmissions necessary to achieve separation. As a result he did not ensure that the landing gear was down and locked before landing.
5/03/1998	177RG	The pilot reported that he was conducting circuit practice. Another aircraft was also in the circuit and flew an unusually long and wide downwind and base leg pattern. This distracted the pilot and he landed the aircraft with the landing gear retracted. (See also 9800675).

21/05/1999	A36	The pilot was undergoing an aeroplane flight review. The pilot had landed at the end of the review, and as the aircraft was slowing down on the runway he commenced his after landing procedures. He correctly identified the flap lever, and was then momentarily distracted by a radio call. At the same time the instructor was checking an intersecting runway for traffic. After the distraction, the pilot selected the landing gear switch instead of the flap switch, and inadvertently retracted the landing gear instead of the flap.
24/09/2000	PA-28R-180	The pilot landed the aircraft without extending the landing gear. The pilot had been distracted by radio calls involving another aircraft, and was unfamiliar with the airfield. The aircraft came to rest on the runway.
31/05/2001	DHC-2	During the approach for a water landing in De Havilland Beaver aircraft, the pilot was distracted when he became aware of a strong and gusty wind, overlooked the pre-landing checks and landed on the water with the landing gear extended. As a result the aircraft overturned, breaking off the front left landing gear and dislodging the engine cowls. The pilot reported that during the previous take-off, from land, he had also been distracted by sudden turbulence and had neglected to perform the normal after take-off checks including retracting the landing gear.
23/10/2001	210N	At 5 NM on final approach to runway 23, the pilot commenced the pre-landing checks but without extending the landing gear as he intended to do this further in. However, he was distracted due to radio communications for separation purposes with an incoming BAe-146 aircraft and failed to lower the landing gear. This resulted in the aircraft making a wheels-up landing. The aircraft sustained substantial damage to the lower fuselage, propeller and engine but the pilot was unharmed.
24/11/2001	172N	The aircraft was towed out of the hangar and parked with the towbar still attached. The pilot was distracted during flight preparation and forgot about the tow bar, and boarded the passengers. The aircraft was started, then as the propellor moved through about 45 degrees it struck the tow bar that was still attached. The aircraft was shutdown and returned to the hanger for engineering inspection. The aircraft sustained a minor damage mark on the propeller blade.
24/05/2002	PA-44-180	While conducting a touch and go landing on runway 05, the pilot landed with the landing gear selected up. The aircraft sustained substantial damage to the propellers and underneath the fuselage. Despite the landing gear warning horn sounding, the pilot reported being distracted while attempting to sight an aircraft cleared for a touch and go landing on a crossing runway.
10/06/2002	404	The pilot took off with out a take-off clearance. The pilot reported that he was distracted with a problem with the co-pilot's seat which led to him believing that the clearance had been issued.

20/08/2002	PA-28-161	While taxiing for takeoff, the pilot called ready at the holding point for runway 24L and was instructed to hold short. ATC then observed the aircraft enter the runway and commence the take-off run without a clearance. A take-off clearance was immediately issued. The pilot later reported being distracted by the passengers' conversation.
6/09/2002	M20C	During the approach, the pilot was distracted by nearby glider activity and did not extend the landing gear. There were no injuries but the aircraft sustained substantial damage.
14/09/2002	CJ-6	The aircraft landed on grass runway 01 with the landing gear in the up position. Damage occurred to the propeller and flap. The pilot reported distracting events in the circuit area prior to landing.
5/12/2002	PA-30	While on left downwind for runway 29C, the aircraft door became unlatched. The pilot reportedly became distracted by gusty conditions, an increased noise level and extra workload from reassuring the passengers. The pilot inadvertently neglected to lower the landing gear and the aircraft landed with the landing gear retracted. The aircraft sustained damage to the propellers and underside of the fuselage.
9/02/2003	310R	On arrival in the circuit, the pilot selected the landing gear down. Approximately 100 m after touchdown, the aircraft settled onto the runway with the landing gear retracted and the aircraft came to a stop 550 m further down the runway. The six people on board evacuated the aircraft and were unharmed. The pilot later reported that he had become distracted with a developing propeller synchronisation problem and had not verified that the landing gear was locked down. An inspection revealed that the gear lever was in the centre locked position.
29/07/2003	95-B55	The pilot reported that shortly after becoming airborne the right engine failed. As the airspeed had only just reached VMCA, he had difficulty maintaining control of the aircraft and elected to close the left throttle and land straight ahead. The pilot reported that he had selected the auxiliary fuel tank during the taxi and had become distracted during the pre-takeoff period and forgot to re-select the main fuel tanks for the takeoff. As there was sufficient fuel in the main tanks, but very little in the auxiliary tanks, it is likely that the engine failed due to fuel starvation.

The Management of Distractions and Interruptions in Aviation

As the examples above demonstrate, distractions and interruptions are a significant problem in aviation. A variety of strategies and procedures have been developed to manage this problem. The most basic strategy is problem awareness and vigilance by the pilot for circumstances involving distraction or interruption. The Skytrek Operations Manual addresses the problem of distraction for pilots during the hang check:

"DO IT!! Do not be distracted by anything else going on at this point" (p. 13).

A similar warning for launch assistants is given for the launch:

"Concentrate on what you're doing, not taking photos, answering the phone etc" (p.18).

Checklist procedures have been developed to help overcome the problem of human vulnerability to distractions and interruptions. Checklists are used in all areas of aviation. In simpler aircraft, checklists may be memorized and performed from memory. In complex commercial aircraft these are written down and conducted by two pilots. Where the conduct of a checklist is interrupted, good practice involves going back to the start of the checklist and beginning again. This prevents the possibility of resuming the checklist at a point further along than the point actually reached before the interruption.

In the present case, the pilot had completed the mental checklist procedure twice before the glider was tipped over. When the launch procedure was interrupted by this significant and stressful event the pilot should have recognized the error-inducing potential of the situation and returned to the start of the procedure. Taking time out to prevent the "hurry-up" syndrome would also have been prudent.

"If a procedure is interrupted for any reason, returning to the beginning of that task and starting again will significantly reduce the opportunity for error" (McElhatton & Drew, 1993, p.6).

Critical Factors: Post-Launch

The pilot acknowledged that he was aware that Ms Zeri was not properly attached to the glider within 5-10 seconds after launch. He attempted to hold on to her with his legs and then attempted to fly towards the original intended landing site which he estimated would take approximately 6 minutes. It is safe to assume that this critical emergency situation would have led to an intense stress reaction. This includes changes in heart rate, respiration rate, output of adrenaline as well as changes in various other metabolic and endocrine functions. The emotional effects of these changes are experienced as fear and anxiety. These changes are known to affect individuals' ability to process information by:

- Narrowing the focus of attention (as referred to above)
- Impairing the ability to hold and manipulate information in 'working memory'

Working memory is the part of memory that holds and manipulates information that is the current focus of attention e.g., being given a phone number to dial or doing mental arithmetic. Working memory is critical in carrying out behaviours that involve conscious attention and planning. Many other behaviours that have been practiced over and over again can be performed 'automatically' without the need to use working memory. These behaviours are not affected by stress. In experienced pilots, the skills needed to control the aircraft are well learned and can be performed automatically and thus are not impaired by stress. However, the ability to process unexpected or novel information is greatly impaired by stress.

It is clear that in the present case, the critical in-flight emergency arose without warning as far as the pilot was concerned. Within seconds his body would have been engulfed in a flood of biochemical changes. His ability to reason about the situation and to compare and evaluate his options would have been greatly impaired. The result of this was that the pilot considered no other option than to proceed to his original destination as quickly as possible. His statements clearly indicate that he did not engage in any conscious analysis or reasoning:

"…my thought was just to get down…I just, I was in a one thought"

Empirical studies of decision making under stress have shown that people may exhibit "a frantic and disorganized, rather than a logical and orderly review of decision options" (Stokes & Kite, 1999, p. 63) as well as showing 'premature closure' on a decision before all options have been considered. There is also a tendency to respond quickly, at the expense of accuracy, to a situation.

The tendency to respond quickly without examining all the available cues or considering all the available options may lead to a tendency to continue with the originally intended course of action even where a better option might in fact exist. This appears to have been the case in the present instance.

The Management of Stress and Decision Making in Aviation

There are limited means of managing the disruptive effects of stress on decision making in-flight. Controlled breathing to reduce heart rate and avoid hyperventilation can make a difference. Once initiated, however, the biochemical changes that affect attention and memory cannot be quickly halted or reversed. The primary means of managing the disruptive effects of stress must take place prior to takeoff. Planning and preparation can help overcome the disruptive effects of stress on decision making by reducing the need to treat the emergency situation as novel and unexpected. Well trained behaviours can be maintained under stress and the ability to retrieve a 'pre-packaged' solution to a problem is also relatively unaffected. This means that the pilot needs to identify potential critical events in advance and prepare a possible response to each contingency.

When the critical event actually occurs, the pilot is able to move directly from recognition of the situation to appropriate action bypassing surprise and the damaging effects of stressful emotions. The crux of the matter is therefore on pilot preparation for critical events. The fact that failing to clip on to the hang glider is a known hazard would suggest that preflight preparation and planning for such an event ought to be a part of every pilot's repertoire. In other areas of aviation pilots are taught to prepare their actions for events such as engine failure on take-off, or in the case of sailplane/gliders, cable or towline breakages on launch.

Obviously, each flight has its own unique combination of variables (wind speed and direction, launch site, passenger characteristics etc) which preclude an entirely overlearned or 'automatic' response to an emergency. Nevertheless, classes of events can be anticipated and a general response planned e.g., "If engine-failure occurs below 300ft then I will land straight ahead". Under severe stress it is much easier to

carry out a planned action with appropriate skill-based modifications than it is to weigh up all the potential options and their associated pros and cons.

There are a couple of well-known sayings in aviation that sum up the importance of preparation and planning for critical events:

"Poor preparation and planning leads to poor performance"
"Fail to plan = plan to fail"

Conclusion

The realization, almost immediately after launching, that Ms Zeri was hanging in a precarious position would have undoubtedly generated extreme stress for the pilot. The effects of stress on decision making are well known and highly consistent with the behaviour of Mr Parson. The only way of overcoming the debilitating effects of stress on decision making is to have anticipated potential critical events in advance and to have planned responses to these situations. Good aeronautical practice requires this. A well-prepared pilot should always have a plan available for any foreseeable contingency. There is no evidence that Mr Parson had prepared a contingency plan for the unlikely but possible event of an unattached passenger and he was therefore not able to function effectively when this contingency arose.

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