Bristol & Gloucestershire Gliding Club

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BGGC Bronze Lectures 2010

Human Performance

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Areas for Discussion

- Human Performance - What is it?
- Vision and Lookout
- Orientation
- Respiration
- Temperature
- Effects of Pressure and Altitude
- Am I safe to Fly?
- Summary and Acknowledgements

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Human Performance - What is it?

- Human Performance or human factors is a term used to describe the study of human performance and limitations relating to the piloting of an aircraft.
- Human Performance sounds like “Management Speak”, but is an important factor in flying safety. Accident analysis over the past few years shows the significance of pilot actions contribute to the cause of the accident.
- Human Performance is a vast topic and this presentation touches on the basic principles related to gliding and the BGA Bronze badge requirements.
- To underscore the relevance of Human Performance to gliding we will discus some local accidents, where Human Performance played a significant part, at the end of the session
  - Spinning Fatality
  - Disconnected Elevator
  - Trial Lesson Accident
  - Heavy wheels up Landing

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Vision and Lookout (1)

- If you can't see you are in trouble. If you wear glasses or contact lenses you should carry a spare pair of glasses in case you become intolerant of the contact lenses or lose or break your glasses.
- Gliding and lookout go together. You are either scanning the field of view or glancing at the instruments. Your focal range is varying from a metre to infinity.
- The "at rest" focal point, when you are operating at altitude and clear of cloud is 1-2 metres. If you have just focused on the instruments and returned to the lookout you should focus your eyes on a more distant object, such as a cloud or ground feature.
- Lookout is not a random process and safe and effective lookout needs a "method". The recommended approach is a series of organised short, regularly spaced eye and the movements, progressing over the full field of view.
- Other methods divide the area to be scanned into 20° sectors, and allow sufficient time in each sector for the "seeing" to fully occur. Sometimes referred to as the 20-2 rule (20° sector and 2 seconds in each).
- One other aspect of lookout often overlooked is seating position. Make sure you sit correctly and are comfortable. Do not sit too low, it can reduce the approach view.

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Vision and Lookout (2)

- There is more to lookout than just seeing a distant object. If you see something then it triggers a series of actions – “Did I see it”, “What is it”, “What’s it doing” and “What do I need to do”. The time differential between spotting an object and responding can be around 7 seconds.
- Fast approaching objects can appear small and slow moving, but rapidly increase in speed as they grow nearer. A jet and glider with an approaching speed of 600 kts who see each other at 3 miles will have around ~15 seconds to avoid a collision. Not much time.
- Canopies should be cleaned well before each flight, inside and out, with a non-abrasive cleaning agent which will not scratch a Perspex or glass surface. Raindrops or marks on a dirty canopy can have the effect of drawing the focal point to the canopy and not beyond.
- Beware of visual illusions. Landing areas sloping uphill or downhill can produce illusions for the unwary pilot. A pilot faced with a field landing in a down sloping field may think he is too low and fly a steeper than normal approach. Landing in an up sloping field may have the opposite effect.
- Beware of visual illusions. Runways of a different width than the pilot is used to, can fool the unwary pilot in the same way. A normal approach angle onto a wider runway may appear too low, and that onto a narrower runway may appear too high.
- Have your eyes tested regularly.

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Orientation

- In simple flying terms, orientation is the ability to know which way is up, or where you are positioned in relation to the sky and the ground. You have been taught to use the horizon to establish the flying attitude and providing you fly in Visual Meteorological Conditions (VMC) you should not experience disorientation in normal flight.
- If you loose the visual reference (e.g. flying in cloud) then things can rapidly change. Unless you are trained in instrument flying you may find yourself in trouble trying to fly by the “seat of your pants”. It can only take a few minutes to become disorientated and lose control.
- What we mean by disorientation is spatial disorientation, or the mistaken perception of one’s position and motion relative to the earth. Spatial disorientation is also known as the “leans”.
- The disorientation experienced with the loss of a visual reference is linked to the balance organs in the ear. There are two main organs - the *semicircular canals* and the *Otolith organs.*
- The sensations produced by these organs when the visual reference is lost is a failure to detect angular, or banking, motion and acceleration.
- Even with if your are trained in instrument flying, your senses will suggest one thing and the instruments another. You will be always be tempted to believe your senses. You should not the instruments are correct.

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Respiration - up to 10,000 ft

- Air is inhaled into the lungs where its oxygen combines with haemoglobin in the red cells of the blood and is then circulated to those tissues where energy is needed.
- Air (by volume) is made up of Nitrogen (78%), Oxygen 21% and Others (1%). The 78% of the air that is nitrogen plays no part in the respiration process, which depends entirely on the amount of available oxygen.
- Up to about 10,000 ft altitude, a healthy body has compensatory mechanisms to cope with the associated reduction in oxygen.
- Be aware, if you fly for long periods on or below these limits, the reduction in oxygen can cause lethargy, headaches and result in poor judgement. Ask the regular Nympsfield Alps pilots if you think this is not the case.
- If you are a smoker, overweight, unfit, elderly or have a cardiovascular medical condition then the altitude limits will be significantly less.
- Donating blood will also may also increase sensitivity to altitude, although this is quickly remedied by the body's reserves. However, a pilot should not fly for at least 24 hours after giving blood.
- To avoid decompression sickness do not 'do not fly within 12 hours of swimming using compressed air and avoid flying for 24 hours if a depth of 30 feet has been exceeded'

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Respiration - above 10,000 ft

- As you climb higher:
  - The percentage content of oxygen in the air remains the same
  - The amount of oxygen diffusing across the lungs reduces because of pressure reductions.
  - The amount of oxygen available decreases
- The effects of a reduction in oxygen become more serious with increasing altitude. The effects are insidious, serious and often unnoticed. No-one is immune.
  - Above 18,000 ft without oxygen loss of consciousness can occur within 10-15 minutes.
  - Above 25,000 feet without oxygen loss of consciousness can occur within 2-4 minutes.
  - Above 30,000 feet without oxygen loss of consciousness can occur in under a minute
- The BGA Laws and Rules state that “Pilots must take all reasonable steps to ensure that oxygen is used during any period when the glider is flying above Flight Level 100”.
- The Bronze test, refers to carrying oxygen for flights above 12,000 ft and use above 10,000 ft. This is likely to change with the introduction of EASA.

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Respiration - Hypoxia

- The shortage of oxygen in the human body results in a condition called hypoxia, which simply means oxygen starvation. Hypoxia is dangerous and ultimately, lethal
- At high altitudes, there isn't enough oxygen pressure to force adequate amounts of oxygen through the lungs into the blood stream. The function of various organs, including the brain, is then impaired.
- Oxygen starvation gets worse the longer you remain at a given altitude or if you climb higher.
- The first symptoms are similar to mild alcohol intoxication and induce a feeling of well being. Your normal self-critical ability is out of order. Your mind no longer functions properly; your hands and feet become clumsy without being aware of it; you may feel drowsy, languid, and nonchalant; you have a false sense of security; and, the last thing in the world you think you need is oxygen.
- The extent of the symptoms depend on the altitude, but even short flights above 10,000 ft are likely to produce effects. In the Event of Suspecting Hypoxia
    - Go on to oxygen and select high flow
    - Check integrity of system; connections, lines for kinks, contents, mask fitting
    - Extend brakes and trim glider in max rate descent & descend to below 10,000 ft
    - Tell someone what happening, return and land.

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Respiration - Hyperventilation

- Hyperventilation is a condition where an abnormal increase in the rate of breathing results in an a decrease in carbon dioxide and an excess of oxygen.
- Increasing the rate and depth of breathing doesn't help hyperventilation, because it speeds up the removal of carbon dioxide. The body is more sensitive to changes in carbon dioxide than oxygen.
- The symptoms of Hyperventilation can appear similar to hypoxia, but can occur at a lower altitude where hypoxia would not be a consideration. The symptoms are typically: *rapid breathing, but can also include a rapid pulse, a feeling of unreality and anxiety.*
- The most common causes of hyperventilation are stress and anxiety, but this can usually be controlled by consciously returning to a normal rate of respiration and relaxing.
- Hyperventilation can also be relieved by breathing into a bag.

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Respiration - Carbon Monoxide

- Gilders don't have engines, but motor gliders and turbo gliders do. If you fly or operate a motor glider you should be aware of carbon monoxide (CO) poisoning.
- CO is colourless, tasteless and lethal. Exposure of pilots to it has been the cause of many fatal accidents. It can usually only be recognised in an aircraft by associated engine exhaust smells.
- Symptoms are subtle, similar to hypoxia but perhaps with a more obvious headache and it doesn't respond so promptly to oxygen – although using an oxygen mask is likely to restrict further exposure.
- The best way to deal with CO poisoning is to prevent exposure in the first place, but if you do suspect its presence when in flight, increase ventilation, land and try to get an engineer to trace any sources.

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High Temperatures

- High temperatures can lead to Heatstroke and Dehydration. Heatstroke occurs when the body's internal temperature control system gets overloaded. Dehydration is related to heat stress and results from a severe imbalance of water content.
- Symptoms can include: *Air-sickness, a severe headache (or just a general feeling of being unwell), torpor, extreme tiredness and/or irritation, irrationality and poor or non-existent judgment.*
- Always take precautions, even on those non-sunny days.
  - Wear a hat when exposed to the sun (essential for glider pilots)
  - Wear loose fitting clothing which allows air to circulate around the body.
  - Wear clothing which shields the skin from direct exposure to the sun.
  - Keep the body cool as far as possible by proper ventilation or shading.
  - As a general rule always drink more than you feel you need. If cockpit temperatures are very high you can sweat out a litre an hour.
  - Avoid diuretics, such as coffee or tea.
- Make arrangements for relieving yourself. Pilots who desperately need to pee can become obsessed with their discomfort such that they can lose concentration on the critical issues such as lookout or an imminent landing.

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Low Temperatures

- The cold can be debilitating and even though you may be dressed for the airfield conditions it is important not to forget the drop in temperature that occurs with height.
- Extreme cold can result in Hypothermia. Hypothermia can be dangerous, because once the body has dropped below a certain minimum it can be difficult to raise it again.
- One would not normally fly in conditions that would induce hypothermia, but be aware of the effects of extreme cold coupled with low levels physical activity (e.g. a long wave flight) can cause.
- Apart from the obvious symptoms of shivering the cold can also cause: *Tiredness, poor co-ordination and lethargy.*
- The “cure” for cold’s most obvious effects is to dress appropriately.
    - Wear Correct Clothing
    - Protect all the Body
    - Wear a hat (The greatest heat loss occurs through the head)
    - Do not get chilled standing around a cold airfield

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Effects of Pressure and Altitude

- If you take a balloon from sea level to 18,000 ft, its volume will double due to the decrease in pressure (Boyle's Law).
- Gas in the cavities of your body will do exactly the same thing and anywhere where air can expand without escaping can cause pain and discomfort and damage.
- The sinuses, ears, teeth and stomach can all trap air. There isn't much that can be done for teeth, but the ears and sinuses have features for equalising pressure.
- The Eustachian tube, is a tube that links the pharynx to the middle ear. Normally the Eustachian tube is closed, but it can open to let a small amount of air through to equalize the ambient pressure between the middle ear and the atmosphere.
- You should know how to 'clear your ears' using the Valsalva technique. This is normally done by closing your mouth, pinching your nose and breathing out. If you cannot clear your ears before flight, stay on the ground because you may tear an eardrum, or suffer severe pain in your ears or sinuses on descent (climbing is not usually a problem).
- It is also possible for the nitrogen gas which is dissolved in our body fluids to come out of solution and form bubbles if exposed to reduced pressure for a prolonged period. This is known as decompression sickness or 'the bends' and is rarely experienced at an altitude below 18,000 ft.

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Am I Safe to fly?

- **Illness:** Not feeling 100% is less dramatic than a bed-ridden fever, but could be just as dangerous to your safety. A Cold or blocked nose or ears? Then don't fly, apart from the distraction they cause changes in pressure, because of altitude could damage your ears and lead to other infections.
- **Medication:** Some drugs can cause drowsiness, blurred vision, nausea and produce allergic reactions. Examine why you are taking drugs in the first place and are you safe to fly? If in doubt don't fly and seek medical advice.
  - Do not do not fly for 24 hours after a local anaesthetic (dentist)
  - Do not do not fly for 48 hours after general anaesthetic.
  - Do not do not fly for 24 hours after a blood donation.
- **Alcohol**: Any residual alcohol in the system will have an adverse affect, which may not be apparent to anyone, least of all you. A pint at drank at ground level is the equivalent of 2 at 5,000 ft and 4 at 10,000 ft. A single unit of alcohol takes an hour to eliminate from the system, a small amount of alcohol takes 8 hours. Any more than this takes 24 hours. Do not fly with a hangover.

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Am I Safe to fly?

- **Stress:** Anything that prevents you from concentrating on the flying puts you and others at risk. Emotional stress can make you preoccupied and vulnerable to mistakes. Unless you are well aware of your situation not flying is the safest option.
- **Fatigue:** Have you had a good night's sleep? Have you done many launches today? Tiredness is something with which you may be familiar and can allow for. However, boredom, and even long spells of hard concentration are also forms of fatigue and should not be underestimated.
- **Eating:** If you go for several days without eating your blood sugar level falls and can cause lack of concentration. Food poising can also have serious effects too. The first question asked by accident investigators after at least one gliding fatality was "What had the pilot had to eat?" and "where was it prepared"?. Inadequate fluid intake can have potentially serious effects. Dehydration can rapidly incapacitate you (and can kill).
- **Familiarity:** Are you current? When did you last practice stalling or spinning or have a launch failure? When did you last (if ever) fly in these conditions? Are you familiar with the glider and when did you last fly it? As well as your own health is the glider "healthy"? Did you DI it? Have you walked around and checked it yourself before flying? Have you carried out a positive control check? It's easy to be distracted and overlook something, especially if you have been waiting around, are cold or hot, or being pressured into launching.

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Summary

- An understanding of human limitations in gliding is just as important as an understanding of aircraft limitations.
- Human performance is not a glamorous subject or one with definitive absolutes, but after discussing the content of this presentation and the influence Human Performance had on the examples presented in slide 1, you should see that it is a pervasive and all embracing subject, which has a significant influence on all our flying.

Acknowledgements

- CAA (BGA) Safety Sense Pilot Health
- BGA instructors' manual
- Human Factors, Graham Wardell of the Auckland Gliding Club N.Z
- http://www.gliding.co.nz/training/syllabus
- http://www.gliding.co.uk/bgainfo/regulatory.htm#keydocuments
- http://www.pilotfriend.com/index.htm