15a THERMALLING

SPL Syllabus: Exercise 15a Thermalling			
(i)	**Lookout procedures**	**(v)**	**Flying safely in proximity to other sailplanes**
(ii)	**Detection and recognition of a thermal**	**(vi)**	**Centring in thermals**
(iii)	**Use of audio soaring instruments**	**(vii)**	**Leaving thermals**
(iv)	**Joining a thermal and giving way**	**(viii)**	**Considerations of use of oxygen**

INTRODUCTION

Our objective is not simply to train safe, competent pilots, but to produce good soaring pilots. On two-seater training flights good soaring opportunities are sufficiently rare that they should be taken, even if it means dropping previously briefed exercises from the flight.

Using a thermal poses no great risk but joining and sharing a thermal with other gliders certainly does. Some inexperienced pilots who are overconfident and unimaginative (two qualities which often seem to be welded together) will enter thermals in any way they think convenient, which usually means straight in anywhere, regardless. This direct injection method hugely increases the likelihood of a mid-air collision and needs firmly discouraging right from the start. Other trainees and some solo pilots may be understandably nervous about entering already occupied thermals. A discussion of why the rules 'are as they are' is helpful, but they are largely common sense. Even most birds know to thermal in the same direction as each other. Teaching a safe way of entering the thermal will encourage them and help keep all of us safer

Rules of thermalling need to be explained in a ground briefing early on in the training. Make sure trainees know and understand the rules about joining, sharing, and leaving thermals (see box below).

Thermalling Rules

Joining a thermal

(1) Gliders already established in a thermal have the right of way

(2) All pilots shall circle in the same direction as any glider(s) already established in the area of lift

(3) If there are gliders thermalling in opposite directions, the joining gliders shall turn in the same direction as the nearest glider (least vertical separation)

(4) The entry to the turn should be planned so as to keep constant visual contact with all other aircraft at or near the planned entry height

(5) The entry shall be flown at a tangent to the circle such that no aircraft already turning will be required to manoeuvre to avoid the joining aircraft

Sharing a thermal

(6) Pilots shall adhere to the principle of see and be seen

(7) When at a similar level to another aircraft, never turn inside, point at, or ahead of it, unless you intend to overtake and can guarantee safe separation

(8) If, in your judgement, you cannot guarantee adequate separation, leave the thermal

(9) Look out for other aircraft joining or converging in height

Leaving a thermal

(10) Look outside the turn and behind before straightening up

(11) Do not manoeuvre sharply unless clear of all other aircraft.

THERMALLING - THEORY BRIEFING

(i) Lookout

However good a trainee pilot's situational awareness on the ground, in the air it is likely to be poor initially. It is not unusual for the instructor to be aware of a potential collision risk long before the trainee realises there is a problem.

Assuming the trainee can fly reasonably well and keep a good lookout, emphasise any points that give clues to imminent collision For example, there is a high collision risk if another aircraft stays in the same position in your canopy; it is coming directly towards you. If no avoiding action is taken it will suddenly appear much bigger just before impact.

The basics that they learned in the first turning exercises – i.e. looking both outside and inside the turn – are especially important when entering or leaving the thermal or when adjusting the turn radius. The potential for getting into blind spots is significant.

The commonest scenario being when a glider (B) is above and behind another glider (A) – glider A cannot see glider B because it is directly behind. Glider B cannot see glider A because one cannot see through the floor of the cockpit. So, avoid getting into this situation in the first place.

(ii) & (iii) Detecting thermals and use of audio

In the early stages of training, finding a thermal often involves reading the sky and looking under appropriate clouds. As you approach a thermal, the air is often increasingly turbulent or 'bubbling' and there may be increased sink ahead of the thermal. This is followed by a sensation of lift in the 'seat of your pants' and an indication of lift on the vario (ideally an audio indication, as well as a mechanical) which lags a second or so behind actually finding the lift. The side of the thermal air which is rising most strongly will tend to push the glider away from the thermal. The pilot needs to be holding lightly on the stick to feel this movement and then turn towards the rising wing.

On other days, take the opportunity to explain other ways of identifying thermal such as thermal sources on blue days - hotspots/triggers/ridges/birds or other gliders.

An audio vario is highly recommended even in a training glider. It significantly reduces time with the 'head in the cockpit' instead of looking out.

(iv) Joining a thermal and giving way

Thermalling rules dictate the entry should be planned to:

- keep constant visual contact with all other aircraft at or near entry height, and
- the entry should be flown such that no other aircraft will be required to manoeuvre to avoid the joining aircraft.

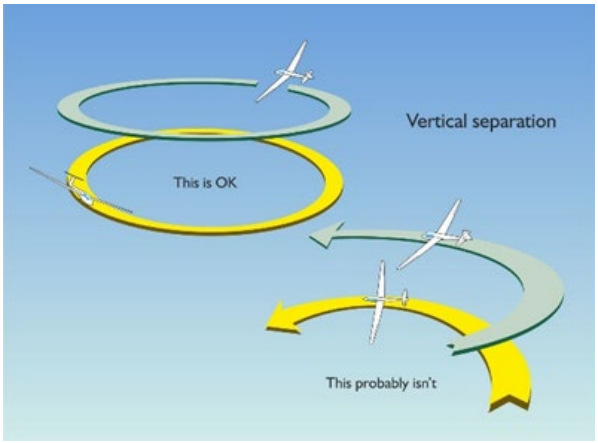
Good lookout is vital. If a pilot is going to share a thermal with other gliders, they must be able to keep the attitude steady at the same time as moving their head to look round. Inexperienced pilots may be very poor at this. Lookout should not be detrimental to the flying. Is there any point in knowing everyone's position, being in exactly the right position, and then spinning down through the whole lot?

A couple of points:

- If you are not sure that what you are about to do is safe, don't do it; better to be saying 'I could have done it', rather than 'I wish I hadn't'.
- Aggressive thermalling in gaggles is nearly always to the detriment of everyone's ability to utilise the thermal and is often dangerous.

How to join an occupied thermal safely

If you enter with sufficient **vertical separation** between you, all that is required is to circle in the same direction as everyone else, and position yourself such that they can maintain visual contact i.e. if possible, on the opposite side if the thermal to any glider at a similar height. See below: **fig 1**



Where relevant, the vertical separation between your glider and the closest should be at least 100'. At that vertical separation, if you are both flying 15m gliders and are steeply banked, one above the other (figure 1), the nominal separation between your nearest wingtips will be just 65 ft, which is close!

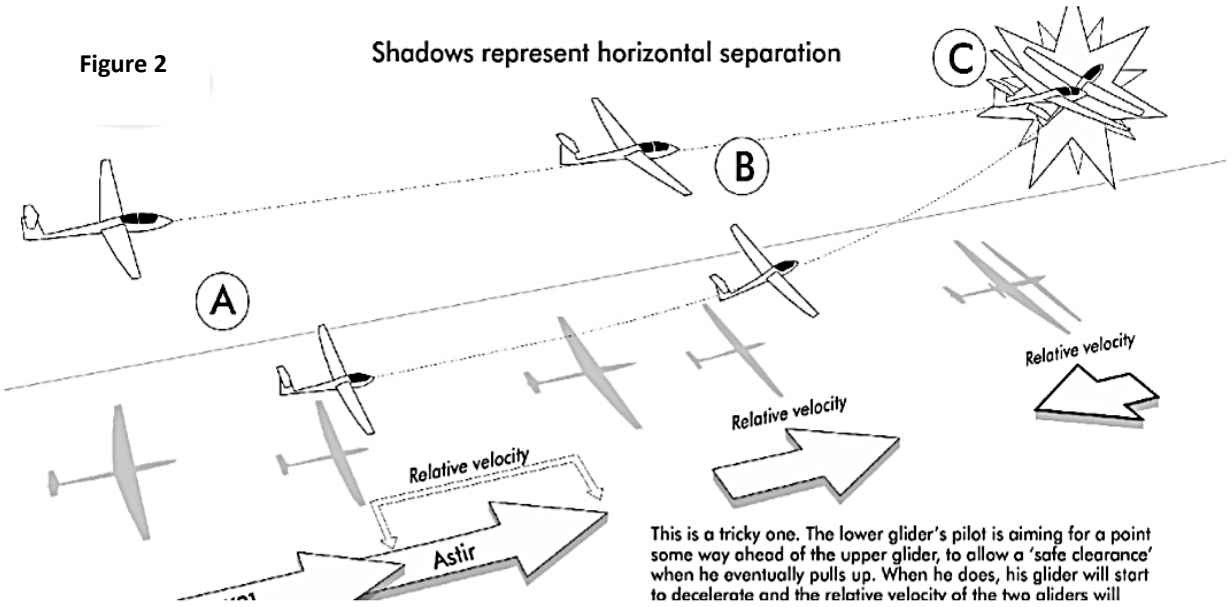
If you join a thermal with two gliders already in it that are circling in opposite directions, you may find yourself forced to join somewhere in between. The thermalling rules require you circle in the same direction as the nearest glider, vertically speaking. In practice, it may be better to continue to the next thermal, if practicable, unless there is plenty of vertical separation.

When you are approaching a thermal, you can only estimate your eventual vertical separation from already established gliders, because you do not know exactly what the air in between is going to be doing.

Low performance gliders are more affected by the ups and downs of the air, so it is harder to guess where you will arrive. With more efficient gliders the problem is not so much the air movements as proper management of the pull-up into lift.

Converting speed into height can be risky in certain situations. See fig 2 next page. As you pull up, your speed will decrease dramatically, but the other pilots speed does not change. Therefore, the gap between you can close very quickly leading to a risk of collision.

Figure 2



Trainees are often nervous about how to join a thermal so taking time to explain it in a proper briefing will add to both their safety and everyone else's.

When joining a thermal the horizontal line which you take is important. The following comments assume there is ONE other glider there already, and that you will be joining at the same height as them. Broadly speaking there are five possible ways to join, three of which ask for trouble (see figure 3 below):

- Approach A creates a risk of meeting the other glider head-on at very high speed. You may both be doing only 50kt, but head-on your closing speed will be double that.
- Heading towards the centre of the other glider's circle, as indicated by approach B, will lead to two overlapping circles and hence a risk of collision.
- entry via C is a subtle variation on B, with the centres of the overlapping circles much closer together. This increases the area of potential risk, and there will also be longer periods where one glider is out of sight of the other. Blind spots are high risk in thermals.
- option D may look reasonable. But it is difficult to arrive at exactly the right moment, in the right position on the opposite side of the other glider's circle. This ideal join can be and is done by many pilots, but not every time, despite their best intentions. In practice, you either arrive too soon, or too late.
- approach E avoids the above problems by allowing the joining glider to follow an adjustable and spiralling path (figure 3, A to C) into the 'correct position'

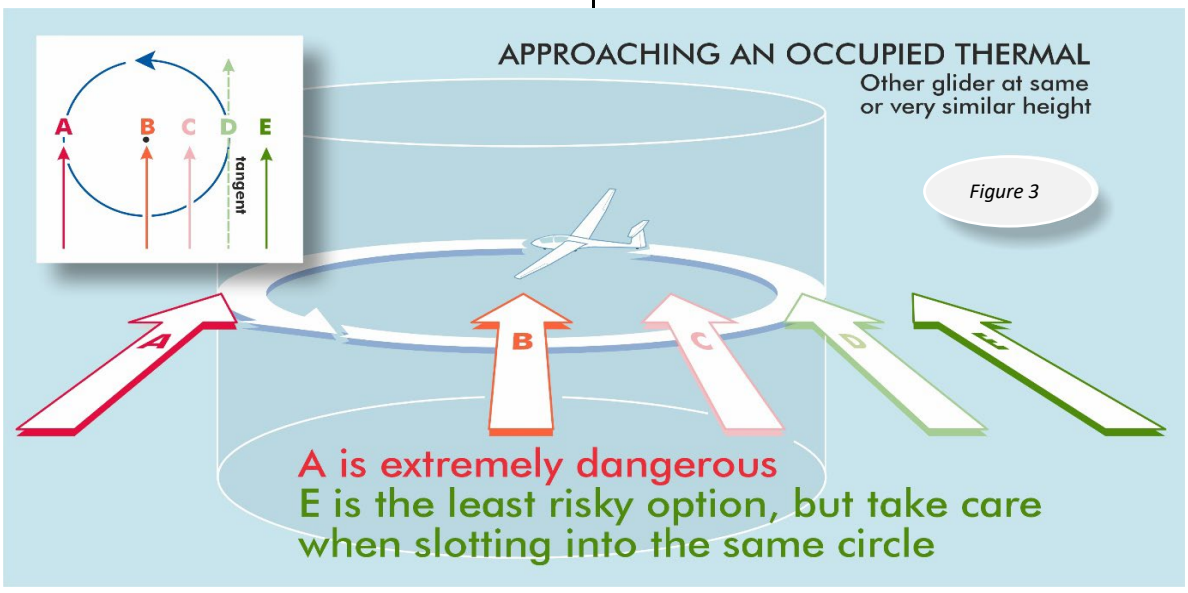


Figure 3

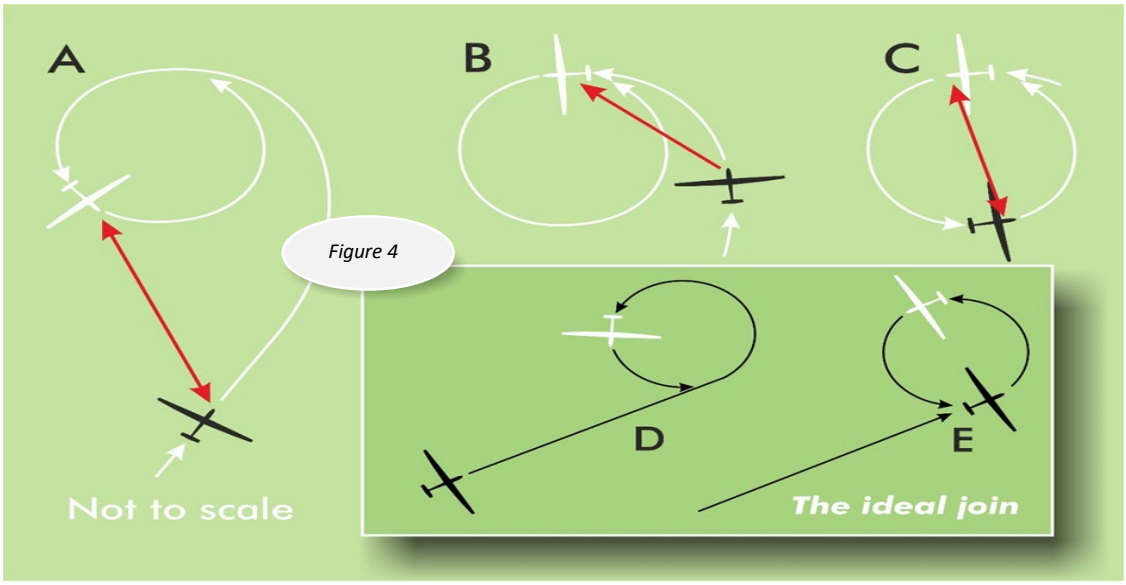


Figure 4 shows how spiralling in ought to work. If you are not in the 'correct' position, you can continue turning outside the other glider's circle until you are. Nevertheless, spiralling in to match circles, speeds, and stay in the correct position, is difficult to do well.

Do not concentrate exclusively on the glider(s) you are trying to avoid as you could easily hit somebody for whom you haven't been looking. If your trainee seems over-anxious about joining other gliders in a thermal, probably best for you to do it initially. Alternatively, if the option is there, go and find an unoccupied thermal.

(v) Flying safely in proximity to other aircraft

Horizontal separation

Assuming you are joining a thermal with one other glider in it at a similar height, the correct position is on the opposite side of the circle to the established glider. If you are both circling at the same rate with the same centre, the two gliders will remain stationary in relation to each other.

Maintaining position.

In order to maintain station on the opposite side of the circle you need to match the angle of bank and approximate speed of the other glider.

If the other glider is catching you up, the natural inclination is to try to accelerate, but this does not work. It can actually have the opposite effect because it increases the radius of your turn. The correct technique is to increase the angle of bank and tighten the turn and the gap will open up again. If you do not do this and the other glider comes up behind you, such that you lose sight of the other glider, check under the upper wing, open the turn and leave the thermal.

If you are more steeply banked than the other glider, **you will catch the other glider up**. This may be frustrating, but getting in the blind spot is dangerous. Overtaking on the inside when you will both get into each other's blind spot is dangerous. So, the correct response is to decrease the angle of bank to open up the turn, to increase the distance between you and the other glider again.

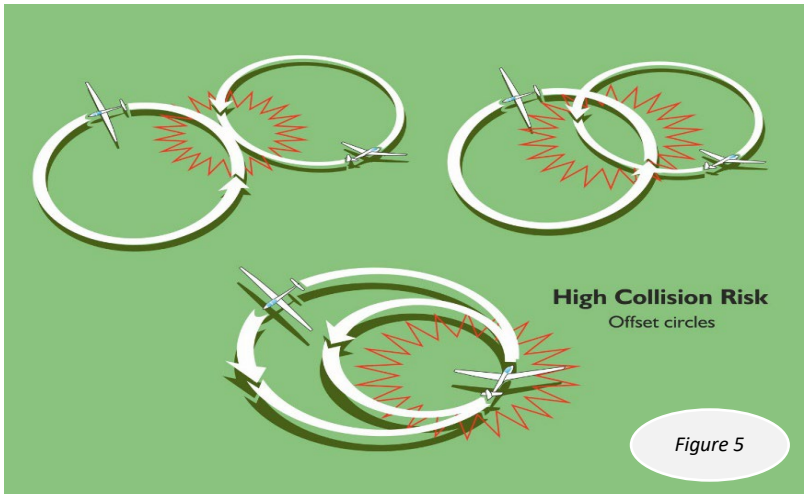


Figure 5

Overlapping turns and offset circles both carry a high collision risk.

If there is not sufficient vertical separation, persisting with this type of thermal pattern is poor airmanship and dangerous.

(vi) Centring in thermals

To be able to centre a thermal, the trainee needs to be able:

- to make co-ordinated turns at a steady angle of bank, **and**
- be able to change that angle,
- all whilst maintaining a steady attitude/speed, **and**
- keeping a good lookout.

This is not an easy task, but in an ideal world we would find a nice large steady thermal to let the pupil practice these skills without worrying overly much about centring the thermal to start with – preferably away from other gliders. Taking control intermittently to re-centre is acceptable, indeed usually inevitable, at this stage.

Once their turns are reasonable, they need to understand how they move the centre of the turn to stay in the best lift.

There are a number of techniques that can be used to centre a thermal.

Using 'landmarks':

This technique requires the pilot to make a mental map in their head of the turning circle. On the turn ask the trainee to make a note of where the strongest lift in the turn is, in relation to a ground feature.

The next time they come round the turn as them to decrease the angle of bank as they come round towards that feature, in order to move the turning circle in that direction. Count to three moderately slowly (about 2 secs) and then tighten the turn again. Spatial awareness of the thermal is a key skill, and using ground features such that they build up a mental picture may help this skill. Be careful to ensure that a good lookout for other gliders is maintained throughout.

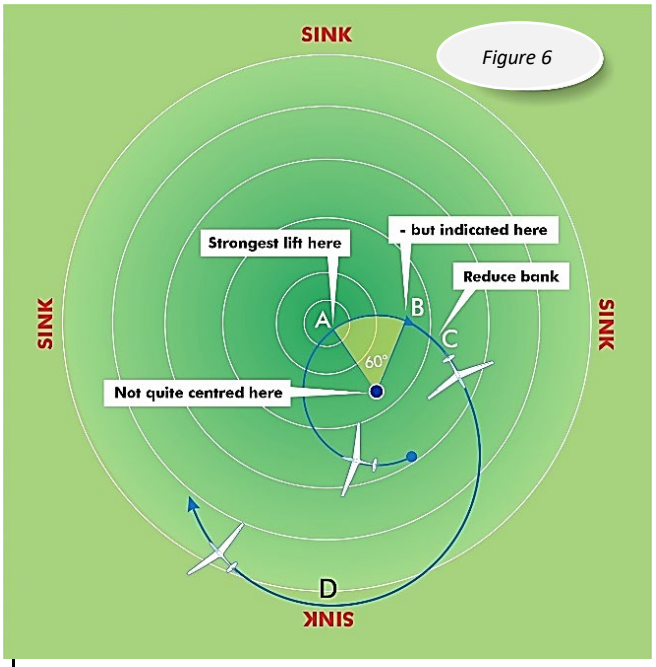
Some instructors prefer the next technique which is basically 'Less lift: reduce the bank and 'increase the bank' as the lift improves. Figures 6 and 7 show how the technique works.

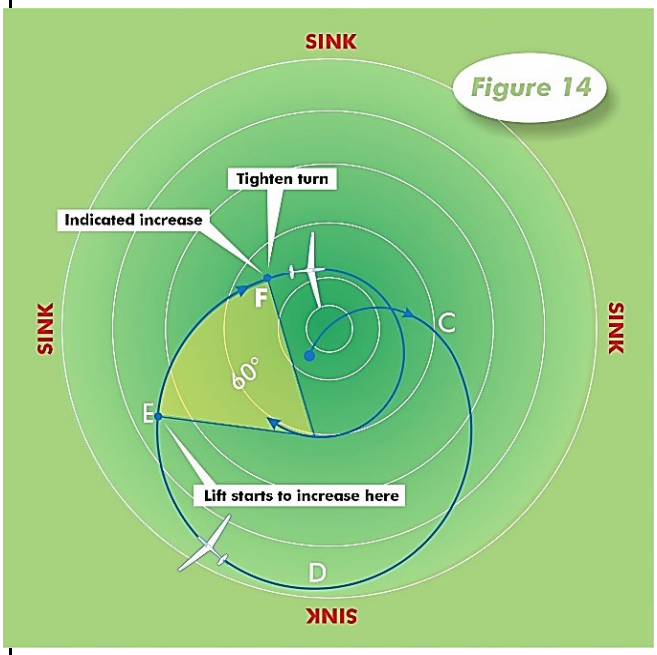
To understand thermal centring using this method we need to know two figures:

- the time taken for a complete 360° turn in a thermal - this is about 25 seconds
- the variometer's 'lag'. Variometers respond to changes in the glider's height, but this does not occur instantly. Variometers themselves also have small lags in their response. As a result, any lift or sink indication is likely to be about 3 seconds out of date. This is unhelpful, particularly when attempting to centre and means that any reading relates to roughly 1/6th of a turn, or 60°.

Therefore, it is important that you do not straighten up when the variometer indicates maximum lift, as by then the glider is already well into the core. Straightening out at this point may well fly you out of the lift (figure 6.)

The recommended method is when the variometer indicates maximum lift continue to fly a properly banked thermal turn (aim for about 40 degrees) Then, when, less lift is indicated reduce the bank and increase the bank again as the lift improves. Figures 6 and 7 show how the technique works.





The lift core is at A. Variometer lag means that the strongest lift is not indicated until point B. If the pilot then straightens up C), the glider will be heading almost directly away from the core. The mistake has already been made, so whatever method of counting the pilot uses to decide when to turn again at, say, D, the situation will be worse than it was before.

Rather than straightening up shortly after the strongest lift has been indicated on the variometer, the pilot should reduce the bank by, say, 15° at C, and continue the turn. As the indicated lift begins to increase at F, the pilot tightens the turn and should now be closer to the centre.

Tightening on the surge

Many experienced cross-country pilots use a third method – tightening in the strongest lift. As you come round the turn again, relax the bank as you feel the lift increasing – a bit like surfing a wave. Once trainee get better at feeling the surge as

they come into increasing lift, they can be encouraged to 'tighten on the surge' and then relax the bank as they feel the lift decreasing again.

Hints and tips

1. Unless they can fly well banked, accurate turns at constant speeds, none of these techniques will work. Concentrate on getting the basics right.

2. Making more than one correction per turn complicates both procedures and rarely works.

3. Maintaining lookout in the early stages is essential. If they get into the bad habit of failing to look out early on, it is difficult to break the habit again.

(vii) Leaving a thermal is usually straightforward. Look under the upper wing, gradually straighten up and fly away. Two points to watch out for:

- As you leave make sure you are not going to conflict with someone who is about to join (i.e. look outside the turn and behind before straightening up and do not manoeuvre sharply.)

- Do not manoeuvre violently when leaving; this includes precipitous dives to gain speed before hitting the sink.

(viii) Considerations for use of oxygen

Supplementary oxygen should be used in gliders above 10,000 ft. This is unlikely to occur in thermal flying in the UK, but relevant when flying in hotter climates such as S Africa or in wave.

The Flying

You need to explain the basic principles of relative movement, and how things will look from your trainee's point of view, by using models, or your hands, or by drawing what happens in various scenarios. The BGA 'Managing Flying Risk' document includes, in its 'Safe Thermal Soaring' section, a link to an excellent 3-minute video on 'thermalling with others'. This is well worth showing to your trainees. If you happen to be very good at joining thermals but have never analysed exactly what it is that you do, then you will need to give it some thought if you want to be of any help to trainees.

Once the trainee has achieved some proficiency at frequently altering the angle of bank whilst maintaining a reasonably constant speed in the turbulent air of a thermal, it is important to give them a good ground briefing on how to centre the thermal using your preferred technique. It can then be demonstrated as an air exercise.

Stage 1

The trainee (who could be at any stage from early pre-solo to advanced solo) flies the glider in the thermal and simply responds to the instructor's prompts to increase or reduce the bank.

Accurate speed control is important and should be kept at around that required for the 40° banked turn used in the centre of the thermal.

Most trainees will allow the speed to reduce as bank is reduced and to increase as bank increases. These speed changes counteract any changes in the radius of turn that the changes in angle of bank are intended to produce. Frequent prompts, and if necessary, re-demonstration, are required to control this tendency.

Early pilots have a tendency to look down the wing when thermalling, which makes attitude control more difficult for them. The airspeed is of course related to the attitude and in general the key point to stress is to maintain the correct attitude, even if the airspeed varies slightly as the glider turns in a gusty thermal. At all times, the co-ordination must be accurate, with no tendency to over-rudder.

The trainee should be encouraged right from the start to keep a very good lookout while thermalling, even when they are not sharing the thermal. The habit has to be learned and practised. The instruments must be glanced at from time to time, but the principal guides are the attitude over the nose and the sound of the vario, neither of which requires 'head in cockpit.'

Stage 2

The instructor begins to withdraw by not prompting to increase/reduce the bank - leaving only the hint that the rate of climb is increasing/reducing. In other words, acting as a sort of audio-variometer. A little later even these prompts can be withdrawn, and the trainee should be able to soar successfully unaided. Prompts should still be made if the trainee is not responding correctly to changes in lift or if lookout or speed control are inadequate.

POST FLIGHT DEBRIEF

Lookout is paramount and allowing the pupil to fail to look out properly, risks this practice becoming embedded. A common early fault is poor speed control and may be due to failure to monitor the attitude of the glider, especially whilst looking out and or due to looking down the wing persistently. Errors in maintaining adequate separation should be addressed by reference to appropriate diagrams

COMMON DIFFICULTIES

Poor lookout It is essential to embed the habit of good lookout from the start of their training: look both ways before entering a thermal, maintaining lookout including above and behind, and lookout before leaving.

Lack of awareness of other gliders – they may see them but do not anticipate their actions.

Poor speed control. If the speed is varying, they will not be able to centre a turn.

Indecisiveness entering a thermal and ending up flying straight through it

