How to Fly Faster

notes from a talk given by Sarah Kelman at BMGC on Saturday 3 December 2006

"How to fly faster"? The two key points are:
- Efficient and confident centring
- Good route planning – keep looking ahead

Thermal centring

There is no substitute for confident centring. The most common complaint among pilots is that they wish to be better at low scrapes and on weak days. The answer is good centring. When you can centre quickly and well, you can now use those weak thermals and also decide whether a thermal is worth staying with.

Vario limitations

Even the best vario systems don't react instantly. As the glider enters rising air, it has inertia and so takes some moments before the glider starts to rise. The vario then takes a few moments before it responds and registers lift. A pilot just using the vario will take some time to react to the readings. Top pilots will feel the initial surge as the glider flies into lift and be ready to react, but they will always make sure their feelings are confirmed with the vario.

Classic technique 'by numbers'

- Tighten in the lift, and open in the 'sink'.
- This works whenever you are unsure as to where the core is and for making small adjustments near the core. However, it is a rather slow method of making large centring adjustments. The bank of the glider should vary directly with the vario needle, so bank is greatest when lift is greatest and vice versa.

Mental model – shifting the circle

- Top pilots can be seen making tiny straightening manoeuvres in thermals. Rather than opening the turn away from the core which would entail spending longer away from the best lift, they pull round the sink and then straighten momentarily about 90^{o} before where they think the core is. This requires a good understanding of where the core is and lots of practice!

Handling

- The aim is to fly in as small a circle as possible. Most pilots do not use enough bank in the thermal. You should use as much bank as you can whilst remaining in control and keeping the speed as low as possible. If you use too much bank you will either stall and lose lift, or start to spiral dive and build up speed and fly a larger circle. Constant speed allows you to map the lift mentally with less confusion as to where the core is. It also minimises total energy errors or 'stick lift' (no glider system is perfect).
- Many gliders thermal best right back near the stall (eg K21, LS8). Some modern gliders climb better if flown a few knots faster than this (eg Discus 2, ASW24).

Practise, practise, practise

- There is no substitute for practise. Poor days are better because inaccurate thermalling means you will not stay airborne – no room for lazy thermalling!
- Try not to fly through the same area of sink twice, especially when searching for a core. When thermalling, don't allow yourself to do more than two turns with lift on one side and sink on the other before re-centring.

Thermal types

- Thermals are four-dimensional things. They vary in the air and with time. You should be constantly centring until you leave the thermal. If you can talk / eat / drink / do anything else whilst thermalling, you are not trying hard enough to centre!
- Often, and especially when low down, a thermal will consists of several gusty cores each too small to centre in well. It is up to you to try flying 'around' the core or half in and half out if it is too small. Remember, you only know a core is too small when you have fallen out of both sides of it!
- Be prepared to move to another core as the thermal develops.
- Sometimes the hardest thermals to centre in well are the very large, smooth ones. Keep searching for the core and never be satisfied – you may well be climbing in 6 kts but there may be 8 kts a little further in.

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<u>Soaring height bands</u>

Thermal structure

- Thermals begin as stationary bubbles of air on the surface. They lift and accelerate as they rise, then slow down and stop again at the top (and subside away from the centre). Low down, a 'single' thermal actually consists of many small gusty cores, most of which will go no higher than a few hundred feet. As the thermal builds, the cores combine and the thermal gains coherence and the climb strengthens. Near the top, the thermal again begins to break up, but not as much as at low level. The gusts still promise good lift but the averages drop rapidly.
- To maximise cross country speed, try to stay in the height band of best lift, typically down to half the cloudbase.

When to stop

- When you get low, workload increases and thoughts stray from making soaring decisions. Worries about outlanding force erratic route planning as the pilot desperately tries to find a climb. When a climb is found, it is often gusty, difficult to centre in and less strong than higher, established lift.
- Staying in your comfort zone allows you to focus on soaring and routing.
- The altitude for thinking of stopping should be around half the depth of convection you are working, but not lower than a safe altitude for field selection (around 1500ft).
- The higher the your 'stop' altitude, the more time you will spend finding thermals, so the lower your overall average climb rate and slower your speed cross country, so don't be too cautious either!
- Try to only stop in the good thermals – in a typical standard class glider, you should be able to dolphin through two or three thermals of acceptable strength before having to take the next one. If you are regularly finding 4kt climbs, then only stop for 4kts or more – simple!

When to leave

- Once you decide to stop, really make the thermal count. Work hard at it!
- You should leave a thermal when the average climb rate drops below what you *expect* to get in the next thermal.
- Look ahead and think what you expect to find – are conditions getting better or is there 'bad patch' ahead?
- If you find the 'thermal of the day', don't be tempted to leave just because the rate is dropping. Only leave when the average drops below what you expect to get next time you stop (eg if finding 4kt climbs, you stumble across a one-off 8kt one, stay with it until it drops below 4kts!)

Selecting a thermal strength for stopping

- This should vary throughout the day, increasing as day improves and vice versa. If you are flying too fast or hoping for too high an average, you will be getting below your comfort height regularly. If you are too conservative, you will not be using the full available depth of convection and your overall speed will suffer. Analyse your barograph trace after flight and see whether you really did go down to half thermal depth each time before stopping.

Running the energy

Run energy so as not to thermal

- Once you've got the hang of quick and confident thermalling, the next trick is to learn how to not have to! It is vital to read the sky ahead. Always know where you will go next, from when you're in a thermal to when you're running the energy lines. You need to be picking a route as far ahead as you can see.
- Treat cumulus as stepping stones, and try to stay under them and avoid gaps. If you are near cloudbase you will have to look at cloud shadows on the ground to pick the best routes – allow for sun slant angle.
- When swapping energy lines, look for the shortest routes. If running streets, look for wispies out from the side of the street.

MacCready theory and real life speed to fly

- MacCready is a theory and works in theoretical air! Remember the system limitations and that you cannot react to every changing air current.
- Generally choose your speed to fly between thermals based on your confidence in conditions.

Speeds and glider polar

- Manuals quote 'best L/D' speed but usually you can fly around 10 kts faster with negligible loss of performance. This is your minimum speed unless pulling up in good lift. The only excuse to fly at best L/D speed is when you have taken the very last thermal in the sky and you are just desperate to trudge it out as far as possible.
- Above this speed, the polar begins to curve downwards but is fairly straight up to a much higher speed when the performance drops off sharply. This higher speed is your maximum running speed between thermals when conditions are really stonking!
- Most pilots use the lower speed when conditions are weak, an intermediate speed on good days, and the higher speed if it is fantastic.

Pull ups

- The faster you fly, the more dramatic any pull-up needs to be to avoid flying through the lift and back into the sink. Remember the vario lag and anticipate any pull-ups.
- Some pilots dolphin quite violently, others take a more average speed. Both techniques seem to work. However, if you think you may want to stop and thermal in upcoming lift, be sure to not slow down below thermal speed plus around 5 to 10kts so you have enough speed to manoeuvre when you choose to turn

<u>Gear changing and planning ahead</u>

Route selection

- Choosing a route up to ±30^{o} off track does not significantly reduce speed to destination. Larger diversions rapidly increase flight kms required and cost valuable time. Try to restrict large track diversions to survival flying, unless conditions are so variable that it is obviously a much quicker route (eg unusual strong convergences).
- If given a choice, try to make track deviations into wind – you will drift back when you thermal.

Watch ground ahead

- Beware of large areas of shadow. Make sure you top up in the sun so you can glide across dead areas without slowing or stopping in weak lift. Work on 100ft per km (1 in 30) for crossing gaps and judge distance across using ground features and your map.

Use of radio

- Listen to other pilots. What climbs are they getting and are they struggling? What weather conditions are they reporting?
- Beware – glider pilots are a very pessimistic bunch, so do not base your decisions solely on reports, use these to be prepared and ready to change gear.
- Glider varios vary hugely and few are accurately calibrated. Your 3kt thermal is another glider's 6kt climb!

Deteriorating conditions

- Do not rely on being able to use the last thermal of the better weather. Stop and top up slightly early.
- Continue to climb and glide as before, but make sure the lower point does not come in the middle of a bad patch.
- When entering worse areas, reduce the thermal strength you are prepared to stop in and cruising speed, but be ready to increase them again in response to actual conditions if you find good thermals still.

Improving conditions

- It is psychologically much harder to speed up when conditions improve. It is natural to feel happy staying higher, but remember to keep pressing on. If you find you're sampling more thermals and not getting as low as you were, you're flying too slowly now.

Final glides and performance

Final glide planning

- Plots of national pilots have shown that on a normal day, pilots actually fly to a performance of 1 in 30. Even the open class final glide to this gradient, only they are gliding at 110kts or more! Most pilots are achieving this performance throughout the flight, only Junior pilots are doing it slower.
- Plan on 100ft required per km (5nm per 1000ft) plus your finish margin.
- Continue to fly as you were until you achieve this gradient. You should not now have to stop but still continue to choose the route, dolphin, and fly between thermals as you have been. The only difference is you're not intending to stop and thermal again.

Margins

- Minimum arrival height must allow for obstacles. Trees can be a couple of hundred feet high.
- Glide computers set on MacCready show the arrival height but at uncomfortably low speeds. If you finish low you will need a fair amount of speed to pull up and manoeuvre for landing unless you are able to safely land ahead with no conflicting traffic.
- Outside a competition environment, you may need to allow for a normal circuit entry.
- In blue, deteriorating or unreliable conditions, be ready to allow extra margins to avoid having to top up late into the glide in weak lift.

Speed to fly

- Initially continue to fly at same inter-thermal speed that you were before. Do not do anything different just because it's final glide!
- Monitor the glide every 5km / 500ft or so. If your margin is improving, speed up by a few knots and continue to monitor.

Contingency planning & undershoots

- If the margin is reducing, you must notice before descending below the 'comfort' altitude. Again, just like you have been doing all day, stop in a suitable thermal before you get low, but only take it high enough to get a safe margin back (maybe increase the margin if it wasn't working before or the sky looks bad).
- Once you get below your comfort altitude, the lift becomes more broken and pull-ups less reliable. If you drop off glider low you must make an early decision to land short or continue. Do not wait for the ground to come up and meet you! Only final glide into a field if you have previously surveyed the field thoroughly from a sensible height, and you know exactly where it is (suggest marking suitable fields in a GPS).

Finish

- In the last kms, start to burn off the margin with increased speed for a high energy finish.

Can I cross that gap?

- Treat gaps the same way as final glides, working on 100ft per km. Use cloud shadows over ground features then refer to the map to judge distance. If radio available, listen for position reports from pilots on other side.
- Once you've estimated the gap, calculate what altitude you'll arrive on the other side at. If it is uncomfortably low, it may be worth flying at or close to best L/D. If the gap is too big to cross you may have to consider a lengthy diversion or even backtrack, unless a glide out and landing seems to be the only option remaining.

Using other gliders

Blue days – club flying

- Beware the circling glider – it may not actually be climbing!
- Compare circling glider's height change to yours. If both are circling, join other as soon as he out-climbs you. If you are running, glance at the vario to see your sink rate – a glider in zero sink will appear to be climbing if you are in 4 down. Learn to judge relative height change when local soaring.
- Not all gliders will be flying the same task – don't get dragged too far off track, lured by visible thermalling gliders.
- Remember all the soaring energy patterns you used on cumulus days. Blue days are actually more straightforward as there is no cloud shadow to inhibit thermals! Despite the comfort it affords, it is rarely worth thermalling right up to the haze caps – leave when the lift decreases (usually several hundred feet below 'top')
- Watch out for gliders doing clearing turns before spinning – they have often just climbed up in a thermal themselves only to spin down through it!

Blue days – comp flying

- Do not start first, even if the day is running out! You are all in the same situation so be patient and start with everyone else. You will soon catch the early starters.
- It is even more important to stay high and near the start line before you start so as not to get left behind either.
- Be aware of the effects of gaggling (see below) as there is even more tendency in the blue.

Cooperation in the glide

- Any time you find yourself in a street or crossing an area of sink with another glider treat them as a visible vario and double the amount of sky you effectively cover. Fly at least three wingspans out to the side so you get to explore the other parts of the street. Watch the other glider and if they gain compared to you, move across or consider swapping to the other side.
- If forced to cross a very large gap to unknown conditions, try to allow others to start across first or with you. Again as a pair you will be able to search twice the area of sky for the next climb, but resist the temptation to just follow in their wake (the downwash from the lead glider makes the air sink for starters!)

Thermal marking and centring

- As in the blue, do not dive in to join another glider unless they are actually climbing. However, in weak conditions, a circling glider is marking an area where there is lift and, with all your thermalling practise, you should be able to find the core for yourself!
- When joining another glider, take the opportunity to sample another likely part of the cloud, or adjoining cell, first on the way in. The established glider may have missed a stronger core.
- Most of the time the glider you join will not be fully centred. If you have sufficient vertical separation you should now effectively ignore their circle and centre as if you were on your own. They should soon move across when they see you outclimbing them.
- If you are at similar altitudes, use the other glider again as a visual vario around the turn – it becomes easy to see on which side of the circle the lift is. Make small recentring manoeuvres so that the other glider has a chance to see you and move across with you avoiding a conflict.

Flying in gaggles

- Unless you are competently team flying, gaggles always serve to slow down cross country speed. A small group will almost always perform better.
- It is much harder to centre effectively in a gaggle due to traffic. It is unsafe to circle much differently to the others, and the more gliders there are the less likely they are to move their circle to match yours. Again, look at the average you are achieving and if it is too low then leave and find another thermal of your own.
- Gaggles also fly slower overall as there is a reticence to be the first to leave. Pilots in gaggles tend to stay too long as the lift decreases, finding a feeling of safety in numbers. Having said that, gaggles do tend to make good routing decisions between thermals, so don’t risk trying to do something drastically different in the run in an attempt to break free.
- In competitions, gaggles are almost like a mobile traffic jam. Gliders behind see the gaggle and dive in to join, just adding to the congestion and slowing down.
- To break free, try to just continue your own techniques. It will take several thermals before you pull ahead properly again so be patient and don’t make any rash decisions.

Rounding turn points

Don't land out!

- Stastically you are more likely to land out near a TP than elsewhere! Minimise your workload and plan ahead so you can continue to concentrate on making soaring decisions.

Planning route out on run in

- **With around 20km to run**, start thinking about track out – use ground features to minimise head-down-on-GPS time on initial turn. Note how clouds and route look on next track – clouds look very different when viewed from the other side.
- **With 10 to 15km to run** start planning energy route out. That cloud may well prove to be just beyond the TP then be prepared for a long run back to the next cloud. Allow for twice normal height loss between thermals to allow for track change effects.
- **At turn** be very aware of other gliders also using TP and those possibly running in from behind you. Keep head outside cockpit – GPS programming can come later. Just concentrate on that initial track and first climb after TP.

Wind effects – turn high or low?

- In theory, faster to round an into wind TP 'low' and vice versa. Remember that good soaring decisions are more important! Think about wind if considering using a thermal close to a TP – may be better to come back to it after the TP if TP is into wind, but will thermal still be there and will you still be high enough to use it?

Tactics

Distance flights using whole soaring day

- If you can local soar GRL you can potter off! Be ready to speed up as conditions improve

Speed flights

- Before flight, decide on a start time window and do not start after your latest start time.
- When approaching first start time, get high, stay high and stay close. Be ready to take any start opportunity when it comes.
- Watch for a good energy run out from start area on first leg.
- If latest start time is approaching and conditions still not perfect, go anyway.

Terrain effects on soaring

Terrain & thermals

- Thermals need a source of hotter air, and a trigger.
- On days with a distinct trigger temperature, hotter ground sources become more important. Think about towns and villages, sun facing slopes, rocks vs forests etc.
- Trigger may be a point heat source, eg fire; a small hill or peak (or steeple!), some disturbance, eg tractor in field, another glider landing, a winch launch; a sharp temperature gradient, eg lake edge or cloud shadow edge.
- The lumpier the terrain , the more pronounced terrain effects.
- In hilly areas, thermals often only trigger off ridges and peaks – make sure you do not fall into valleys and stay above the lowest peaks and ridges. Use lower peaks and ridges to work way up onto main peaks and ridges.

Thermalling near ridges and valleys

- Wind shadow often allows better thermals to form on lea side
- Weak thermals often enhanced as driven up ridge faces by breeze.

Wave interference

- Wave even occurs at Gransden!
- Closer to lumpy area, more influence wave has.
- Wave often not usable in itself but influences thermal strengths and structures.
- Wave rarely forms long ‘bars’, usually just little patches.
- Standing wave in fact shifts around, especially the further away you are from the source hills.
- Always look for the energy lines and don’t discount thermal ‘streets’ that appear to line up across the wind even in East Anglia! If you suspect wave, often the best thermal lift will be on the windward side of the cloud rather than the sunny side.
- If it is possible to get above cloud into ‘pure’ wave, consider the fastest route – thermals beneath cloud or wave on top?