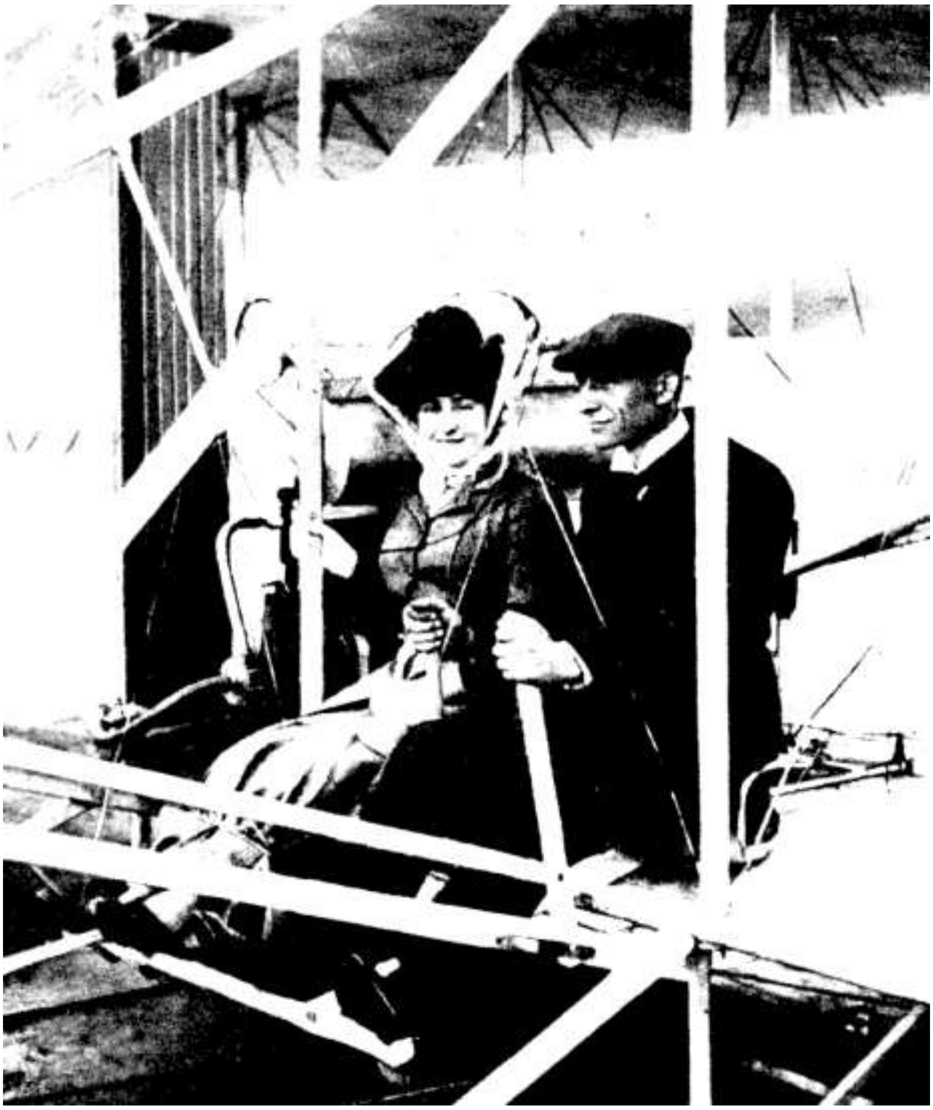
FLY BETTER

(The things you should have been taught as a Flying Instructor.)

Book Four - First Edition

Flight Instructional Technique



Transcripts of lectures about Flight Instructing by

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The mind is not a vessel to be filled, but a fire to be lit.

Plutach

BOOK FOUR CONTENTS

First Edition 2011 *

Preface

In 1916, during the four and a half month ‘Battle of the Somme’, of World War One, the Royal Flying Corps lost 782 aeroplanes, 308 pilots, and 191 observers. It had destroyed only 164 German machines and forced down another 205. This appalling imbalance was due, in part, to the technical superiority of German aeroplanes, but primarily it was due to the superior flying ability of the German aviators. Such legendary flyers as Max Immelman, Werner Voss, Oswald Boelcke, and Manfred von Richthofen, dominated the skies over France with ruthless skill.

The Commanding Officer of Number 60 Squadron, RFC, Lieutenant Colonel Robert Smith-Barry, formed the view that only a completely new approach to flying training would produce the calibre of flyers the ‘Scout’ Squadrons needed to master their German opponents, and whenever he met the Commander of the RFC, Brigadier General Hugh Trenchard or members of his staff he told them so.

Smith-Barry considered that the then current practice of the pupil flying in the passenger’s seat, and leaning over to see what the instructor did with the controls was “lamentable”. Many supposedly ‘trained’ pilots were arriving at the ‘front’ with little more than 5 hours of actual ‘hands on’ experience, and barely able to land an aeroplane!

Smith-Barry put forward the radical notion that all training aeroplanes should be fitted with ‘dual’ controls, and that a method for the instructor and pupil to communicate with each other, other than hand signals, also be fitted. He also proposed that a unit of dedicated instructors be formed and that they be trained in proper instructional methods; as opposed to the then current method of using surviving but exhausted pilots, home from the front for rest, who had little enthusiasm for the job and no guidance in how to do it.

Hugh Trenchard, appalled at the general poor performance of RFC pilots, and tiring of Smith-Barry’s pestering, sent him home to England to try out his ideas. Smith-Barry was given command of No1 (Reserve) Squadron at the Gosport Military Aerodrome near Portsmouth. You may have heard of the instructor/pupil communication device which was developed there: the ‘Gosport Tube’. He was given a free hand to develop his ideas and choose his own instructors (which was very non-standard for the British Army in 1917).

Smith-Barry’s ‘Gosport System’, as it became known, rapidly proved itself, and over the next two years produced flyers of greater calibre than the enemy, who in turn contributed significantly to the gaining and maintaining of air supremacy in the skies over France until the war ended on 11 November 1918.

Years later Lord Trenchard, who became known as the 'father' of the Royal Air Force, wrote that "Robert Smith-Barry was the man who taught the Air Forces of the world how to fly". Smith-Barry's flying school at Gosport was renamed the 'Central Flying School', a name it still carries to this day.

In 1939 a 'Gosport reunion' was held for all of the school's surviving instructors and graduates. Robert Smith-Barry was, of course, the guest of honour, and he gave a speech in response to the many accolades given him. In his speech he said that "one of the many beneficial effects of the Gosport System was to make aviators not only safe in the air, but also near the ground, just as a competent seaman could handle his ship confidently in a gale, near rocks, on a lee shore". He said that *"the ground is always the aviator's lee shore"*. (The italics are mine; I just love the analogy in this phrase.) Smith-Barry went on to remind his audience that in 1914 banked turns and sideslips were regarded as 'stunts' which were not tolerated, and landing cross-wind was cause for being put under arrest! The Gosport System changed all of that. All graduates of the Gosport flying course could loop, roll, sideslip and spin. They could take-off and land with the wind from any quarter, and perform 'Immelman turns', 'Luffberries' and 'Wifferdils'. All of this before learning gunnery, air fighting, and upgrading to the latest single-seat scouting aeroplanes.

After World War One, the Gosport system of basic flying training remained in use in both military and civilian flying schools throughout the world, and for the next 30 years, except for the inclusion of the technological advances of twin engines, retractable undercarriages and constant speed propellers, remained virtually unaltered. Then, after World War Two, a steady and constant erosion of these standards, in civilian flying schools, began. Certainly, today, the provision of dual controls (although not always the throttle), and a good reliable instructor/student intercommunication system in all basic training aircraft has become axiomatic. But the skills taught have declined to the extent that today I despair for the bright eyed, eager, young student pilots I meet who have been taught that sideslipping is dangerous and spinning will kill them; who have been taught that basic aerobatics is for crazy people, and that learning the laws of the CAA is more important than learning the laws of Newton.

For 22 years, in my little corner of the sky, at the Sydney Aerobatic School, I fought against this decline. The private and commercial pilot graduates of my flying school could all loop, roll, sideslip and spin, and were able recover from any mishandled manoeuvre. I think Robert Smith-Barry would have approved.

I hope that this little book will help some of you to keep his legacy alive.

Introduction

I came into the role of a basic flying instructor a little differently to most aviators. In a manner of speaking, I came into it in reverse. As a result, I never came under the direct influence of a ‘standard’ chief flying instructor, military or civilian, and I never worked for a civilian flying school other than my own. So I was not forced into the standard flying instructor ‘mould’ and was able to bring my own perspective to the task of teaching someone how to fly.

In 1969, after serving six years as an operational fighter pilot with the Royal Australian Air Force, I was trained as a Fighter Combat Instructor (FCI). The job of an FCI was (and still is) to take chosen graduates from the RAAF’s advanced flight training course (‘boggies’ with shiny new wings) and/or more experienced aviators from other roles (like bomber or maritime) and teach them how to be fighter pilots.

The initial training in weapons delivery techniques and air combat manoeuvring was done, in those days; in the two seat de Havilland Vampire jet trainer. All candidates for fighter pilot training were already qualified on this aeroplane so we FCIs could get straight to work teaching the new techniques required. It was an easy job as all candidates were pre-screened, capable and highly motivated young men, and the lessons were extreme fun.

The next and longest part of the student fighter pilot’s training was done on the aeroplane they would be flying operationally, the Sabre. Now the Sabre was only a single seat aeroplane, with a huge performance increase over the Vampire, so this led to many challenges for both student and FCI. The FCI flew in another Sabre in close formation with the student during his first few training flights, and loose formation during more advanced training. As well as flying his own aeroplane the FCI had to put himself mentally ‘in the cockpit’ of the student’s aeroplane and communicate with him via the radio, so all directions and critiques had to be done with succinct phrases, especially since ‘things’ happened quickly at 450+ knots.

Judging the student’s progress through the course of training was done purely on his observed performance and his ability to attain the objectives set. This is where I learned about behavioral objectives in their purest form, and about clear concise communication of directions.

I remember when I was an undergraduate student flying the Vampire, I had developed an approach and landing technique of which I was particularly proud, and which got me high scores on my day and night ‘wings tests’. After graduation and posting to undergo fighter pilot training, I decided that when I did my first flight in a Vampire at the fighter training unit I would 'knock their socks off' with my landing prowess.

On day one, my FCI said, "Forget all that, I am going to teach you an approach technique which simulates the steeper approach angle of a Sabre, from 1500ft with the speed brakes out and full flap all the way down!" My first attempt at this approach almost did knock our socks off…..for real!

Years later, when I was the FCI, I was saying the same thing to my students and teaching them this simulated Sabre approach in the Vampire (I had figured out how to do it by then). But about half way through my tour of duty at the fighter training unit the RAAF decided to replace the aging Vampire with the Macchi MB326H, a neat and modern little two seat jet, which was a delight to fly but which had no weapons capability at that time, rendering it unsuitable for use as an introductory fighter trainer. So new Macchi-trained 'wings' graduates coming to our course with no Vampire experience at all, had to be taught how to fly this geriatric jet before fighter pilot training could commence.

The air force hierarchy decided that we FCIs should not do this Macchi-to-Vampire conversion training, and sent a couple of Vampire-qualified flying instructors from the advanced flying school to check the new students 'out' on the aeroplane. My boss thought this presented an opportunity to introduce the new students to the simulated Sabre approach technique from the outset, and bypass the 'normal' Vampire circuit, so these two instructors were asked to teach this type of approach as part of the student's Vampire 'check out'. The two instructors, who had a helicopter and transport background, refused to do it because "that was not the way a Vampire should be flown". This was my first encounter with flying instructors since my own graduation, and I was surprised at the inflexible mindset they had. Six years of operational flying and 12 months as an FCI had already started to give me a different perspective on how flying could be taught.

In the meantime the poor students had to fly the Vampire one way to get certified, and change that one week later as part of their introductory fighter training. As a result, my boss convinced the hierarchy that this was a counter productive solution to the 'no guns, no bombs' problem of the Macchi, so we FCI's were permitted to be flying instructors for a while, until the Macchi grew some 'teeth'. I enjoyed this brief role as a Vampire flying instructor and thought it was much less challenging than the work we had to do with the Sabre, but the seeds of one day becoming a fully qualified basic flying instructor and doing it my way were sown.

Many years later, having been 'recycled' as a tactical transport pilot, I attained the exalted title of 'Check and Training Captain'. The primary role of a Check and Training Captain was to upgrade 'line' pilots and co-pilots within the squadron. Initial checkouts and refresher training was done by type-qualified flying instructors at the beginning of a pilot's tour of duty. 'Line' training and upgrade training were operationally oriented and involved little 'pure' flying, except for the approach and landing techniques involved in operating in the mountain airfields of Papua New Guinea and Indonesia. It was mostly cognitive training to make better aircraft captains. It was interesting to see and discuss the various decisions and actions that these capable pilots made in the variety of challenging circumstances which regularly confronted them.

At one stage in my air force career I was relegated to a 'ground job' at a technical training school. My job was to be part of a group of instructors who taught experienced tradesmen how to pass on their skills and knowledge to less experienced personal. This was called an 'Instructional Technique Course', and each course lasted four weeks. I taught the students how to teach 'motor skills', and how to apply these teaching techniques to their specialist field. I learned, in turn, such things as how to light a welding torch (without blowing up) and how to break into a motor car! I also gained a lot of experience in the employment of a very effective fundamental 'motor skill' teaching technique, which I taught to my own flying instructors years later, and which forms the basis of this book.

Still later in my air force career, having been posted to a particularly boring desk job, I took up the sport of competitive aerobatics in order to save my sanity. Within a few months I was 'unofficially' teaching advanced aerobatic manoeuvres to private pilots. The aerobatic club nominated me to the Australian CAA for approval to be their 'official' aerobatics 'coach', and this was approved, but, because I wasn't a rated flying instructor, I was not approved to do initial basic aerobatic training, only advanced manoeuvre training to "already qualified" aerobatic pilots. (A bit like an FCI, but without the guns.)

Quite often, during the club's regular practice days I was approached by licenced pilots who asked me to teach them aerobatics from 'scratch'. "No", I would tell them, "I am not permitted to do that", and I would direct them to one of the local flying schools to be trained in basic aerobatics first. Many of those aspiring aerobatic pilots never came back, and those who did come back were very poorly trained by instructors who quite obviously did not know how to teach aerobatics. I would then have to tell them that, despite the fact that they had just spent thousands of dollars, we would have to do it all again before we could start on advanced manoeuvres. This was a most frustrating situation for them and me, and I felt quite guilty as it was I who sent them away to do this inadequate training in the first place. (A few of them reminded me of that quite forcefully.) I was also quite bewildered and a little angry that such poor standards could be allowed by the Australian CAA.

It was in the area of basic and advanced aerobatic training that I recognized a 'niche' market. I had already been introduced to an aeroplane that made this type of specialist flying school economically viable, the Robin 2160, and the final catalyst for my next 'career move' came from a lady from the USA named Betty Stewart. Betty was the first person to take out the title of 'World Aerobatic Champion' twice, and during a couple of visits to Australia, Betty flew with a few of my aerobatic club trainees in a Robin, and then convinced me that "the world needed my style of aerobatic training".

So it was done; I resigned my commission in the RAAF and underwent a one month 'crash course' to qualify as a civilian flying instructor. A month later I was a grade 3 civilian flying instructor at the age of 40, with a wife, two kids, no job and a head full of bright ideas…was I crazy? (Many of my air force buddies who went on to drive Boeings for Qantas thought so.)

One thing that being a military staff officer had taught me was to read all regulations thoroughly, because many are poorly written and therefore open to 'interpretation'. So it was with the Australian civil aviation regulations at the time, particularly in regard to flying schools and flying instructors. I had found a beautiful 'loophole' which enabled me to set up my aerobatic school immediately, which I did. This sent ripples of consternation through the CAA and those neighboring flying schools which also 'taught' aerobatics, and over the next few years they each had a go at shutting me down, but they never did. It took the CAA seven years to close the loophole, which was fine by me, because by then I had become 'legitimate', so they stopped anyone else doing what I had done and competing with me.

I suppose I have digressed a little, but I simply want to point out that I was never pre-conditioned by either the RAAF or any civilian flying schools in how to teach people to fly, before going it alone. So I was able to implement those ideas in my head and, "do it my way". My business would 'sink or swim' depending upon how new students valued my teaching techniques. It 'swam', and is still 'swimming' 26 years later, whilst all of those early very vocal competitors are long gone.

This book is a distillation of the fundamental things that I have learned about how to teach someone how to fly an aeroplane....properly. I have tried to keep it short and simple so that it can be used as a quick reference book by junior flying instructors who are still learning the art (and maybe a few not so junior).

Before putting 'pen to paper' to create this book, I conducted a review of the standard publications available to trainee flying instructors to see if they had changed much in the last 30 years….they haven't. They are all very 'thick' with information on how to give a theory lesson on a white board, but very 'thin' on a useable airborne instructional technique. One book that I reviewed quite recently was a beautifully presented book of about 350 pages, utilizing the latest full colour computer graphics. It contained 3 ½ pages just explaining how to build up a vector diagram of the forces acting on an aeroplane in a climb, on a white board, but only 2 ½ pages addressing the subject of airborne instructional technique; that is, the technique an instructor uses to get his message across to a student in the confined and dynamic environment of an aeroplane cockpit in flight.

The 'standard' CAA exams on the subject of 'learning' that a trainee flying instructor is required to pass before graduation, are also very 'thin' on airborne instructional technique.

In some ways this book can be regarded as a supplement to these other books, because they have the techniques that should be used to present a long-brief/theory lesson 'nailed', so I am not going to address that topic at all. I am, however, going to address the topic of airborne instructional technique, because, it seems, no one else has.

Also, I am not going to revise the subject of how to fly an aeroplane. You should already know how to do that and be able to do it well. If you can't, do the world a favor, discontinue your instructor training right now and go out and get a few hundred hours of operational flying experience before continuing, because the first rule of teaching anything is: **Know your subject.**

As a 'work up' to the 'fundamentals of airborne instructional technique' that I detail in Section Four, I discuss, in Section One, how the student learns 'motor skills' and introduce a simple 'model' of how the brain does this. Fear not, I am not a psychologist and will not bore you for too long on the subject. In Section Two, I talk about how a proper syllabus of training should be produced to guide flying instructors in their task, and I touch on the responsibilities of flight schools and Chief Flying Instructors in this regard. Section Three covers one-on-one briefing technique, and Section Five contains a mental practice technique which I am sure you and your students will find interesting and helpful.

Finally, I apologize to all of my female readers, because I have used the masculine gender throughout this book. The modern usage of 'he/she' and 'his/her' is just too clumsy. No adverse discrimination intended; indeed many of my most accomplished students were women.

So, let's get into it……

Section One - Learning

All of the flying instructor manuals that I have consulted over the years contain a definition of learning similar to the following: "learning is a change of behavior which results from *experience*". So I will start with that definition too. You will note that I have emphasized the word *experience;* being able to recall and recite a bunch of facts, numbers or rules is not learning, it is just memorizing. Only those things that are experienced are truly learned. Experience is defined as: "To have first hand knowledge of states, (the way something is with respect to its main attributes), situations, sensations or emotions". So an experience is not necessarily just something physical, like bungee jumping; it can also be something mental, like listening to music or reading a book.

Learning can be short term or long term, depending upon the ongoing need for it and how well it took root' in the first place. Learning also comes in two different forms, 'Motor Learning', that is, learning a physical skill like landing an aeroplane, and 'Cognitive Learning', which is learning a mental skill like navigating the aeroplane.

Learning to fly involves long-term learning of both motor skills and cognitive skills. There is much written about teaching cognitive skills in a class room, but the art of teaching motor skills in an aeroplane cockpit is not so well published. It is motor skill learning that I have focused on in this book, but I have also addressed the application of cognitive learning 'in the cockpit'. I have also 'touched on' how the brain learns a motor skill, but fear not, I am not about to launch into a mountain of psycho-babble illustrated by a maze of little labeled boxes linked by more arrows than seen at Custer's last stand. Throughout this book I have attempted to utilize one of the first principles of teaching anything, the KISS principle…..Keep It Simple Stupid!

Motor learning happens in three phases, the 'beginning', the 'intermediate' and the 'advanced' phases. The flying instructor is primarily involved with the first two of these three phases; the third develops with post graduate experience - provided the flying instructor has done his job properly in the first two. Of course there is no clear line of demarcation between the three phases; they tend to 'blur' into each other at the 'edges'.

During the 'beginning phase' the student is focused on how the skill is performed, that is, what has to be achieved, where to look, and what are the control inputs to reproduce what the flying instructor has just demonstrated and directed him through (more details on this instructional process in Section 3). The flying instructor should take care not to overload the student with too complex a manoeuvre during this phase; it should be broken down, where possible, into more easily reproduced components. Any cognitive instruction, like how to talk on the radio, should be layered on top of the motor skill only after the motor skill is no longer absorbing 100% of the student's attention, and, if its introduction causes the motor skill to be degraded at all, it should be removed for a while. Introducing the cognitive elements of learning to fly too early only serves as a distraction to the motor learning, and both are degraded.

In the early lessons of any flying course, motor skill learning must have priority. However, within a short time the student will remember what comes next, and the motor skills will be starting to become automatic, so the student can spare some attention to cognitive learning. But whenever new motor skills are introduced the instructor should ease the cognitive 'load' for a while until the student is ready to handle it again. A good example of this would be the first, and possibly the second session of circuits. The student will be fully absorbed in focusing on the spacing and timing of his manoeuvres, so the instructor should take responsibility for radio procedures and traffic awareness. Any decisions or actions required, which arise from traffic separation or ATC requirements, should be simply conveyed to the student as directions; the reasons can be explained later on the ground during the post-flight debrief.

Next comes the intermediate phase. This phase is usually the longest of the three phases. It is during this phase that the memory of what comes next and the motor skills to achieve it are starting to 'take root', and are practiced in order to 'fine tune' them and remove small errors. The instructor's job during this phase is to critique the student's performance and offer guidance on how to improve. Ultimately the student will be able to detect his own errors and be able to correct them unassisted. The student is now said to be gaining a 'feel' for the aeroplane and the manoeuvres. The instructor's job is very challenging at this point in the student's training, because each flight will probably involve introducing 'new' skills and critiquing the 'old', so the instructor is continually switching back and forth between the roles of 'teacher' and 'critiquer'.

Finally comes the advanced phase, where, if the flying instructor has done his job properly during the first two phases, the post graduate pilot starts to perform the motor skills with little or no conscious thought. He decides upon a goal and the aeroplane just seems to go there automatically. The aeroplane is now becoming an extension of him, just like his arms and legs, or a pair of wings.

How does the inflow of sensory information and the instructor's 'instructions' get turned into automatic motor skills within the brain? Well, I am not a psychologist or expert on the brain but I am going to give you my 'take' on how it does it. First a couple of definitions:

> 'Cybernetics': The science of systems of control and communication used by animals and automatic machines. (From the Greek 'Kybernetes' meaning, 'Steersman'.)
>
> 'Servo': A means of automatic control of a larger system.

A cybernetic device is a servo-mechanism that responds to outside stimulus and in turn affects its external environment to achieve a pre-set or pre-programmed goal. A constant speed propeller governor is a servo-mechanism. A cybernetic servo- mechanism operates by a process which involves what is called 'negative feedback loops'; that is, it compares what is happening at every instant with stored information and images of what should be happening to get to the goal, and takes corrective action to make it happen; and it does it automatically. The early model 'Sidewinder' air to air missiles that I used to fire were a good example of this 'negative feedback' process. Once fired toward a target, the missile would sense the direction to the target from its heat signature, compare it to its own flight path and correct for the difference. Initially it would over-correct this error and so have to correct again, thus the missile would be seen 'snaking' its way toward the target - hence its name. As the Sidewinder drew closer to its target the amplitude of its over-corrections diminished until ultimately it reached its goal and destroyed it. The Sidewinder missile reached its goal by moving forward and correcting its errors along the way. It was of course, a 'one shot' operation. The human brain is, in part, a cybernetic servo-mechanism, and it controls the body to reach a goal the same way. However, it can take as many 'shots' as it likes, and it usually makes fewer errors with each 'shot', which we call learning, until ultimately it can move smoothly and efficiently to the goal without error. Of course, it has to be given a goal to aim for in the first place. If you haven't a clue what you want to do, the body is apt to meander aimlessly, sometimes completely out of control.

All motor skill learning is accomplished by this 'trial and error' process, that is, by making a trial, missing the mark, remembering the degree of error, and making corrections on the next trial - until finally, a 'hit'. The successful 'moves' are then remembered, and recalled and repeated on future trials. This process is true for learning to throw darts, ride a horse or fly an aeroplane. Thus all cybernetic servo-mechanisms, by their very nature, contain 'memories' of past errors and negative experiences. These negative experiences do not inhibit, but rather contribute to, the learning process, provided they are properly recognized as 'negative feedback data' and used to improve the next trial. Of course once a more successful retrial has been achieved the memory of these 'old' errors should be discarded (sounds like a formula for life, doesn't it?).

We each have two brains. These two brains are crammed inside our skull side by side and are usually just referred to as 'the brain', but they are two physically distinct entities. There is the 'Left Brain', which is responsible for rational and logical thought, and which gives us our sense of consciousness; and there is the 'Right Brain', which contains the data store and the cybernetic control centre which controls the machine we call the 'human body'. The right brain is the 'seat' of all our motor skills, and it uses them to move the body toward any goal set for it by the left brain. These two brains communicate with each other via a huge bundle of nerve fibers called the 'Corpus Callosum', and they live together, inside your skull, in a 'symbiotic relationship'. Now many people, with interests and expertise ranging from psychoanalyst to raging feminist, have their own ideas of the different attributes of these two brains. Here are mine.

The left brain is the brain with which we carry out cognitive skills. Also, during the 'beginning phase' of learning any motor skill, the left brain records all of the sensory images associated with what is happening, and 'writes' the motor skills program about how to perform the skill. It then transmits this program, and the associated sensory images, via the Corpus Callosum, to the right brain. The right brain receives and 'files' these programs and images and uses them to control and co-ordinate the muscles to perform the motor skill in the future. Obviously the right brain contains a vast number of programs, some of which are 'called up' as required; for example, tying your shoe laces, walking, and driving a car, and many of which run continuously, like the program that keeps your heart beating and lungs breathing. Some of these programs are 'written' from experience (learned), like flying, and some we are born with; again, like the one that keeps your heart working.

A student pilot's initial motor skill experience in the air causes the left brain to start creating the 'base program' for the future performance of this skill. This occurs during the 'beginning phase' of the learning process. During the early 'intermediate' phase this program is transmitted to, and 'filed' by, the right brain along with the sensory images associated with it. On future attempts at this motor skill, the right brain tries to reproduce these recorded images in the 'real world' whilst the left brain adds more detail to the images and corrects any initial programming errors. This two-way process between the left and right brain is what is going on during the 'intermediate phase' of learning any new motor skill. However, if the base program, created during the 'beginning phase' is flawed, subsequent correcting messages sent to the right brain have a more difficult job correcting the errors, and, if there are no correcting messages by way of constructive critiquing from the student's flying instructor, the flaws will become 'set in concrete'.

Whilst this initial 'programming' function is being carried out by the left brain, the process is easily corrupted by distractions and confusing information inputs. These two corrupting inputs often come from the very person who is attempting to teach the student the skill in the first place…..the flying instructor. It is the flying instructor's responsibility to ensure that the programming process is not corrupted by, as I said previously, his attempts to layer cognitive learning 'on top' too soon and, most importantly, he should not send confusing and/or contradictory information signals to the student. Confusing information often comes from an instructor who does not know his subject, whilst contradictory information comes from conflicting signals the instructor sends to the student via non-verbal means. For example; the instructor tells his student that the 'wing drop stall' he is about to demonstrate is safe and easy to control, but the student notices that the instructor becomes very tense and the tone of his voice rises as the airspeed reduces, suggesting that this manoeuvre may not be as safe as he said. Students get their programming information through all of their senses, so to avoid sending confusing and contradictory signals a flying instructor must be comfortable in the sky and must know his subject thoroughly.

Once the right brain has been programmed it is still possible for the left brain to interfere with the smooth running of the program by 'thinking about it'. Even some of our 'inbuilt' programs can be over-ridden in this way; holding one's breath is an obvious example and, to a limited extent, the heart rate can be controlled by the conscious thought of the left brain. Learned programs are particularly susceptible to being over-ridden by conscious thought. In the introduction to Book One I mentioned that I was once told that the best way to destroy a golfer's 'T' shot was to ask him how he held his club. What happens here is that the left brain starts to analyze what the right brain is doing with the hands, interrupting its function; I called it "analysis paralysis". This comes about because, once programmed, the right brain is 'thinking' a little into the future and is anticipating the bodily movements required to match the images it has of what it should be doing to achieve the goal, whilst the left brain is continuing to perceive the present moment, so is a little out of 'sync' with the right brain. The end result is like watching a movie with the sound track running about one second behind the lip movements. These out of 'sync' signals from the left brain distort the signal being sent to the muscles from the right brain, resulting in un-coordinated movement. Instructors must resist continuing to direct a student's control inputs after the student has demonstrated the correct change of behavior during the 'intermediate phase', or he will slow the student's progress. The instructor must now only emphasize the goal to be achieved and sit back and let the student 'use the force' (with apologies to Obi Wan Kenobi).

Once the program and the associated sensory images have been 'filed' (taken root) in the right brain during the 'intermediate phase', they can be taken out and 'dusted off' by practicing the particular skill, but, as I have already said, any correcting messages sent to the right brain will have a more difficult job correcting programming errors during this phase if the initial program is flawed. Making radical changes to it will be much more difficult. Psychologists call this the 'Rule of Primacy', which simply means that whatever is learned first 'sticks', and is hard to correct later. Also, whatever is learned first influences how we perceive what comes after. Present the same three experiences to three different people, but present them in a different order, and the total learning effect will be different for each person. The first experience will 'set up' the mind to perceive the second experience differently than if that second experience was perceived first, and each of them will 'colour' the perception of the third experience. In the end each of the three people will walk away from the experiment with different behavioral changes. The logical extension of this is that all of life's experiences influence our perception of what comes next, including learning to fly. This is why good instruction during a student's 'beginning phase' is vital. However, many bad habits that pilots have acquired through 'primacy' are systemic, and not the fault of an individual flying instructor. Let me give you my favorite example of this systemic problem.

In the standard lesson format used by the majority of flying schools, lesson one 'effects of controls', contains a demonstration of the effect of the rudder. Now virtually all students come to their first flying lesson knowing what a rudder does, be it from their experience in the bath tub when small children playing with toy boats, or later with real boats. The rudder turns the ship…right? So when they take their first flying lesson, they are shown how the nose of the aeroplane can be turned from side to side by the use of the rudder, so their initial (mis)understanding of the use of the aeroplane rudder is immediately reinforced. Their instructor tells them that this action is called 'yawing', but that is only a word, the student saw it turning. (By the way, one of the dictionary definitions of yawing is 'turning'!) At no stage during the rest of the 'standard' course does the student experience the result of the misuse of the rudder.

On subsequent lessons it is explained and demonstrated that the correct way an aeroplane turns is by being banked, and that the rudder is used as a sort of trimming device to balance unwanted residual yaw, which is correct, but, it comes too late, the damage has been done, primacy 'rules'. 150 flying hours later, whilst turning onto final approach to land, our post-graduate student applies a bit of extra rudder to decrease the turn radius without using more bank and the aeroplane autorotates into the ground. The accident investigators call it pilot error, and no one asks why.

When I gave initial flying lessons I would have my students fly with both feet flat on the floor whilst they experimented with elevators and ailerons, and whilst they flew climbs descents and turns, to emphasize that a modern aeroplane can be flown through most modes of flight without significant use of the rudder, (I worked the rudder when required on this flight without mentioning it). Only after they had been shown the unwanted yaw resulting from propeller slipstream and aileron drag on lesson two, would I allow them to operate the rudder to counter this unwanted yaw and keep the 'ball' in the middle. Later when learning stalls and side slipping I would introduce the further uses of the rudder, culminating in its use and abuse in autorotation, spinning and stalling in skidding turns.

Once, all primary training aeroplanes required the gross use of rudder to 'balance' manoeuvres, so the rudder was introduced on lesson one. Modern aeroplanes hardly need any rudder input for most manoeuvres but training syllabuses have not been updated to reflect this change. In the 21st century, flight schools continue to use training syllabuses developed before 1945!

Have I digressed? No! Primacy is important, both from the point of view of the sequence of when new things are introduced, and the quality of the initial instruction. It is the flying instructor's job to ensure that the program written by the left brain during the 'beginning phase' is written correctly, before it is 'set in stone' in the right brain.

Earlier in this section I emphasized the problem of 'layering' cognitive skill learning on top of motor skill learning too early in the flight training program and thereby degrading the motor skill. There is a 'flip side' to this, and that is an inadequate motor skill program degrading the application of the pilot's cognitive skills. Note that I said "the application" of the cognitive skill. A large percentage of the cognitive skills associated with learning to fly can be pre-programmed 'outside the cockpit'. Most of the navigation skills that I detailed in book three can be pre-programmed by studying the book and practicing the simple arithmetic involved at home. Regularly playing the navigation game described in the book (2nd Edition) can make learning to navigate the real aeroplane much easier.

However, the application of this cognitive skill in flight can be seriously degraded if the pilot's motor skills are deficient. You may recall from Book One that I mentioned the problem that one private pilot, who came to me for help, had in navigating his aeroplane in turbulence. The continual bouncing around of the aeroplane took him to the limit of his 'comfort zone' and caused him considerable stress. Now stress reduces the left brain's ability to perform cognitive skills, which then causes more stress. So this increasing stress level caused a degradation of his motor skill responses because he started to 'think about' the control of the aeroplane (how to grip the golf club), and the application of the cognitive skill stopped, causing even more stress. A 'stress' feedback loop was set up, resulting in him being unable to navigate, and often becoming lost, in rough weather.

I worked on expanding his comfort zone by teaching him basic aerobatics and how to escape from mishandled manoeuvres, and reinstalled a better motor skill program into his right brain. Because of the 'primacy' of his earlier instruction, it took a while, but eventually he became much more relaxed in the cockpit and not 'fazed' by turbulence. As a result he could apply his navigation skills, which were always 'in there', without any further problem.

"Anyone can steer a sailboat when the wind is light and the water smooth; it is when the conditions become rough that true seamanship is needed." This is a quote from my sailing instructor a number of years ago. It applies equally to aviation. The motor skills involved in flying an aeroplane must be of sufficient quality and be correctly installed in the right brain that they continue to function automatically when conditions become 'rough'. The ability to do an instrument approach in a basic (no motion) flight simulator will not translate into the cockpit if the pilot cannot fly in the turbulence and the real lack of visibility that will prevail inside a cloud.

When I was undergoing initial instrument flight training as a RAAF cadet, wearing a plastic hood in VFR conditions, there was a joke floating around which said "one peek is worth a thousand cross references", and we all peeked from time to time. But then we began flying in real clouds, so peeking outside didn't work; it just reminded us that this was real, and elevated the stress level somewhat. Fortunately we all had a good grounding in 'flying' the aeroplane first. Over the succeeding years I often found myself flying in very rough conditions and recall continually mumbling to myself, "fly the jet Noel, just fly the jet".

So skipping proper motor skill learning may not manifest itself as a problem when the weather is smooth, but it is a latent problem waiting to 'bite' your student when the weather gets 'rough'. This is why I believe that basic aerobatics should be an integral part of all initial pilot training. I am aware, however, that most flying schools do not have the equipment or the instructors capable of this level of motor skill training, so it behooves them to at least teach the student how to fly at the limit of their aeroplane's manoeuvre envelope with skill and confidence, before layering complex cognitive skills on top.

A big ask? Yes it is. But the first 50 hours of initial pilot training is the most important 50 hours a pilot will ever fly. Teaching him how to fly properly during this first 50 hours is a task that requires competent flight instruction, and should not be relegated to an inexperienced junior flying instructor.

A further word on instrument flying. Instrument flying presents a unique challenge to the interaction of our twin brains. I have often heard flying instructors say that instrument flying is just like visual flying except that the 'real' world has been replaced by the attitude indicator, but this is just not so.

In annex C to the lesson on landing in Book Two, I devoted some discussion to the dual function of the human eyeball. In that annex I said that the 2º cone of view in the middle of our 150º field of view is our focal vision, and the remainder is our peripheral vision. The focal vision is channeled to the left brain so that the information can be used to make decisions and set goals like: "I will go there", whilst the information from the peripheral vision is channeled to the right brain to provide orientation data to the appropriate motor skill program, so that it can move the muscles, etc, to “go there”.

When instrument flying; information about the aircraft’s attitude comes to the right brain via the left brain, because the focal vision (which we use to look at the attitude indicator) is routed to the left brain. The right brain has no orientation data from the peripheral vision and must rely on its other sensory inputs (vestibular and muscular) and this ‘pre-digested’ information from the left brain. These two data streams are often in conflict, resulting in the ‘leans’, or worse, ‘spatial disorientation’. As we know, the left brain data must dominate this process because the other senses are easily ‘tricked’ by the motion of the aeroplane. Herein lies a serious problem, because believing the left brain input and discounting the other inputs is an unnatural process and requires an unnatural effort of ‘will’. At best it is like thinking about how to hold the golf club throughout the entire game. Being able to pass the aircraft attitude information through the left brain and translate it into orientation data, without suffering ‘analysis paralysis’ is why becoming even moderately competent at instrument flying takes longer than getting to first solo. Instrument flying instruction must be done by flight instructors who are themselves competent instrument pilots and who understand how ‘unnatural’ this learning process is. I will discuss instrument flying a little more in Section Five - Practice.

Section Two - Syllabuses

Since we have defined learning as a ‘change of behavior’, we can tell if learning has taken place only by observing this new behavior. No change, no learning. Asking a student “Have you got that?” doesn’t cut it. He must *show* you he has 'got it’. By comparing this change to his previous behavior it is possible to determine the degree of change which has taken place. To determine if the new behavior is of a standard which satisfies certain criteria, these criteria must be clearly defined.

To enable a flying instructor to do his job effectively, there must be available to him detailed information about the individual behavioral skills required (goals), and the standard the student must ultimately demonstrate in these skills to ‘graduate’. Also, a method of gauging the degree of accuracy an individual student has achieved toward these standards and goals, at each stage of the flying course, must be part of this information.

The document which should provide this information and set these goals and standards is called a ‘Flight Training Syllabus’. Now all flying schools have what they call a flight training syllabus, for each type of licence training, but sadly most are just a course outline containing non-specific statements like:

> Lesson Three: Teach the student to turn the aeroplane, or;
>
> Lesson Twelve: Conduct forced landing training.

This type of syllabus is not specific enough to guide a flying instructor and enable him to do his job properly.

A syllabus should divide each lesson into individual components, and express them as specific behavioral objectives, that is, detail the specific behavior that the student should exhibit by the end of the lesson. For example:

> Lesson Three Objectives: At the conclusion of this lesson the student should be able to:
>
> 1. Maintain straight and level balanced flight +/- 10º heading, and +/- 150ft altitude. **( )**
>
> 2. Turn aircraft at 30º bank angle +/-5º, and +/- 200ft altitude. **( )**
>
> 3. Climb aircraft, +/ 5kts airspeed, and +/- 10º heading. **( )**

Copies of this detailed syllabus should be made and used as training records for each individual student, not hidden away in the bottom of the Chief Flying Instructor's desk drawer.

The syllabus should also contain a grading system which can be applied to each of the behavioral objectives at the conclusion of the lesson. For example, a score should be written, during the post-flight debrief, in the space enclosed by the **( )** at the end of each objective in the previous example. This records the instructor's assessment of the observed standard of the student's performance of this objective. This score should be based upon a grading system similar to the following example and which should be detailed in the introductory section of the syllabus.

Score	Meaning	Amplification
1.	Poor.	Sub-standard. More training required.
2.	Below Average.	Barely acceptable standard.
3.	Average	Acceptable standard.
4.	Above Average.	Very good standard.
5.	Exceptional.	Very high standard.

Space for amplifying comments should be provided for each lesson too.

As the student gains experience, the tolerances for each objective should be adjusted toward those of the graduating standard. For example, by the time lesson 10 is reached the tolerances for straight and level flight could be +/- 5º heading and +/- 100ft altitude, and finally approaching graduation, +/- 2º heading and +/- 50ft altitude. A student who continues to score (3) for this objective on each successive flight is improving at an average rate, whilst a student whose scores slip lower may need remedial training.

The production of such a document is a lengthy and detailed process. Its creation is the responsibility of the Chief Flying Instructor of the flight school. It is a vital document which not only guides individual flying instructors in their task, but also ensures that all instructors are working to a common standard. It is equally vital if, for any reason, a change of the student's instructor becomes necessary, because, since the student's progress and standard is accurately recorded in the document for each objective attained so far, the transition should be 'seamless'.

Finally, this syllabus should be available to the student to read so that he can be aware of standard he has achieved so far, and the standard required of him on future lessons as he progresses through the flying course.

Once armed with these detailed behavioral objectives for each element of each lesson, the flying instructor is ready to conduct the flying lesson using the instructional techniques detailed in Section Three and Four.

Section Three – Briefings

In the introduction I said that much of the literature used by trainee flying instructors has ‘nailed’ the techniques required to present a theory lesson on a white board. Many of these books refer to these lessons as ‘long briefings’, which is a somewhat self-contradictory phrase. Unfortunately many of the techniques and methods taught for the presentation of these lessons do not translate efficiently into the presentation of an adequate pre-flight briefing.

A theory lesson usually runs for about one hour, covers a substantial amount of material on one subject, and is best presented to a number students simultaneously. However, the majority of student pilots train individually, and undergo theory training at a time prior to their flying lesson, and often at a location remote from their flying school. Many learn the required theory by studying books similar to Book One of this series. So a flying instructor has little opportunity to use his theory lesson presentation skills during his normal day-to-day activities.

A pre-flight briefing is shorter, can cover a number of subjects, and is usually presented to only one student at a time. Its purpose is to link the theory to the techniques to be experienced in the immediately forthcoming flight and to mentally prepare the student for this flight. This is what a flying instructor is called upon to do regularly.

I have watched many trainee flying instructors agonize over the presentation of a particular theory lesson on a white board, trying multiple layouts and using more colours than a rainbow, but still not getting the ‘message’ across properly. One of the problems is usually that the student is distracted from what the instructor is saying because he is reading ahead and looking at all of the diagrams to come. I have seen some instructors cover sections of the white board with large sheets of paper to prevent this pre-emptive reading, only unveiling the information at the appropriate point in the lesson. It worked, but was an unwieldy process. The flying instructor who can write and draw neatly on a white board as he goes, thus avoiding this problem, is a rarity. I could never do this. Presenting the material via an overhead projector, using multiple slides and appropriate masking is a more efficient way of doing it, but the most modern method is to use a ‘power point’ presentation utilizing a computer and big-screen projector.

Each of these methods consumes a lot of time both in the preparation and the presentation of the lesson, and requires the right equipment to be available.

Often this equipment is not compatible with the environment in which the pre-flight briefing takes place.

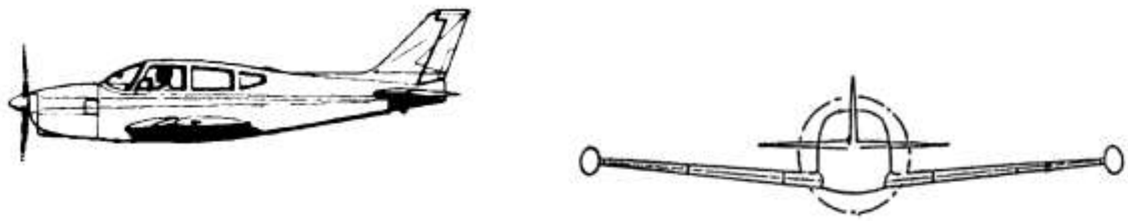
Regardless of which presentation method is used for giving a theory lesson, none of them fit into a working flying instructor's average day. A day in which he may fly with four or five different students, each at a different stage of their training, with little more than a 30 minute interval between flights in which to brief the next student. Often, in these circumstances, the briefing is completely bypassed or is given in a very scratchy and disjointed way.

So how can a flying instructor present to his student an adequate pre-flight briefing of the specifics of the flight to come, within the time frame available, and in any location?

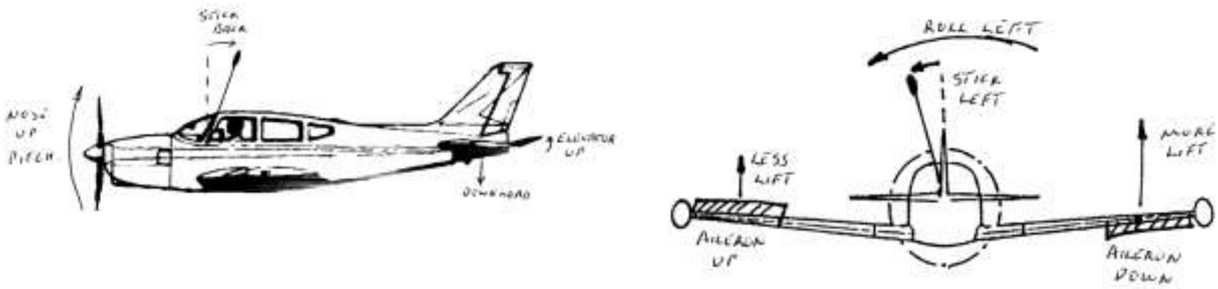
I would now like to share with you a method that my flying instructors and I used at the Sydney Aerobatic School. This method is very portable and requires few training aids. Being an aerobatic school we were often involved in aerobatic training camps at undeveloped airfields remote from our main training base, and I have often given briefings on the wing of an aeroplane, and on one rainy day, sitting in the cockpit with the canopy closed. All that is needed are pre-prepared 'briefing sheets', some blank paper, a pen and a small model aeroplane. (Make it a robust model. Many of our plastic models suffered major structural failures during particularly exuberant briefings.)

Of course at home base we had better facilities. The instructor and student sat side by side at a desk or table, so the briefings were like a friendly chat at the kitchen table, complete with coffee mugs. The primary ingredient in this method is the pre-prepared 'briefing sheets'. These briefing sheets are unfinished outlines of the points to be raised in the briefing, and they are finished off during the briefing, by hand, as the briefing develops. For example, you may be giving a briefing of the primary effects of the aeroplane's controls, so the briefing sheet would just contain diagrams of the side view and the rear view of the aeroplane. During the briefing - after a demonstration using the model and some hand waving - the control stick movement, elevators/aileron deflection, and the pitching/rolling motion are drawn onto the diagrams. The following are 'before' and 'after' illustrations of this example:

Before:



After:



The briefing will usually require certain data to be recorded, so a sentence containing a half-finished statement would be included requiring the student to fill in the blank space, i.e.

As airspeed increases, lift…….

Which when completed would be;

As airspeed increases, lift increases as the square of the speed increase.

Or;

As angle of attack is reduced, induced drag reduces as the square of the A/A reduction.

Obviously this data is extracted from the student by questioning, which immediately verifies that he is keeping his theory lessons ahead of his flying lessons.

To prevent the student reading ahead, as he can with a white board presentation, the briefing sheet is masked with a blank sheet of paper, which is moved down to reveal the next item for discussion when the briefing has reached that point.

This blank piece of paper can also be used to sketch amplifying diagrams if required. The briefing sheet itself should be laid out with double spacing between each line and with substantial margins to allow for additional notes if required (because of this more than one briefing sheet may be needed to cover the whole briefing).

After the flight, during the ‘post flight de-briefing’, these briefing sheets can be referred to again to highlight points experienced and/or add further notes. (There is more to come on debriefing technique in section four.)

The student is not distracted by taking notes during these briefings because he is participating in the creation of his notes on the briefing sheet, so he remains focused on what you are saying. At the end of the flying lesson he keeps the completed briefing sheets (and the cover sheet, too, if it contains related sketches). The student should keep all of these briefing sheets in a ‘ring binder’ of some sort (so that the sheets can be easily removed for future use) and bring them to each flying lesson. As the course of training develops the instructor can refer back to earlier briefing sheets to reinforce a point or to add more data. (This is particularly useful if remedial lessons are required.)

Where do these briefing sheets come from? Well, you have to create them. You need to sit down with a copy of the training syllabus, and create individual briefing sheets based upon the content of each lesson therein. Draft them by hand, first in their finished form, then go back and eliminate all of the things you want to write in during the briefing. Finally, convert them into a presentable format and print off a few copies of each. When I first created these it was done with a type writer and the diagrams were cut and pasted in (with real scissors and glue) from copies taken from books and modified with paint-on error correcting fluid. The end product was then photocopied for use. This process is much easier now with a modern computer.

Do not print out too many at a time, because once you start using them you may find that they need adjusting to better suit your presentation style and sequence of delivery as you gain experience, and they may need expanding to cover regular questions posed by students. After a while, when you feel you have ‘all bases covered’, print off as many as you like. Keep them in dedicated folders labelled with the appropriate lesson number, and keep the folders in a convenient carry bag for maximum portability and instant availability. (One of those broad ‘pilot navigation bags’ is ideal for this purpose.)

Creating your own briefing sheets like this is an excellent way for you to consolidate your knowledge, and order it in a way that is meaningful for your students. These sheets also act as an excellent ‘aid memoir’ for you, both prior to, and during the briefing, so that nothing is missed.

Once created and printed, take one example of each briefing sheet and complete it yourself (use a different colour to the print colour for easy reference), and file these sheets in your own private archives. These become very handy for lessons that you haven’t instructed for a while. Not only will they refresh you on the form and content of the briefing, but also on what you expect the student to contribute.

Now remember, a pre-flight briefing is not the place to be introducing new aerodynamic (or other) theory; that is the job of the theory lessons or study books mentioned previously. So the preparation of your briefing sheets should be predicated on the basis that the student understands the theory, and the purpose of this briefing is to test this knowledge and show him how it relates to the job of actually flying the aeroplane.

Finally, before sitting down with your student to commence the pre-flight briefing, review his progress report and decide if you need to refresh or review anything from a previous lesson. If there is something, have him find the corresponding briefing sheet in his ring binder and have it ready for you to refer to at the appropriate point in the current briefing.

I have attached at Annex A, a couple of completed briefing sheets from my archives, to give you a better idea of their preparation and presentation.

Annex A. Sample briefing sheets.

Annex A.

Sample briefing sheets

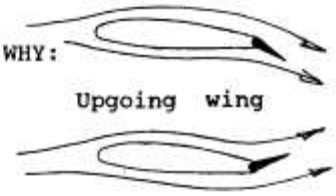
1

CONTROL AND MOVEMENT - TWO

FURTHER EFFECTS OF AILERON

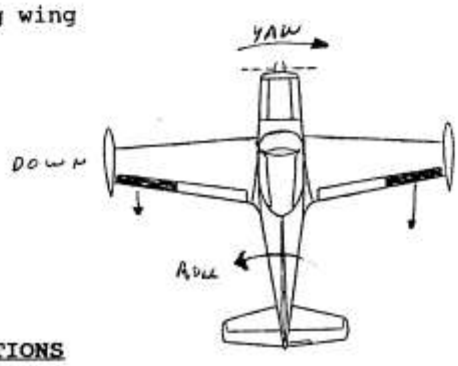
A further effect of aileron is to cause the aircraft to "YAW" in the opposite direction to the roll.

WHY:



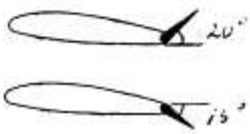
Upgoing wing — A/A increase, ↗ lift, ↗ DRAG

Downgoing wing — A/A decrease, ↘ lift, ↘ DRAG.



∴ ROLL LEFT
YAW RIGHT!

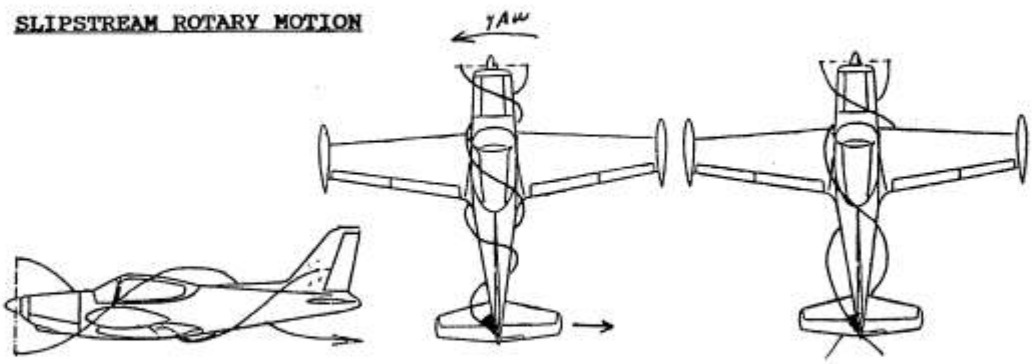
DESIGN CORRECTIONS



Differential Ailerons

Frize Ailerons

SLIPSTREAM ROTARY MOTION



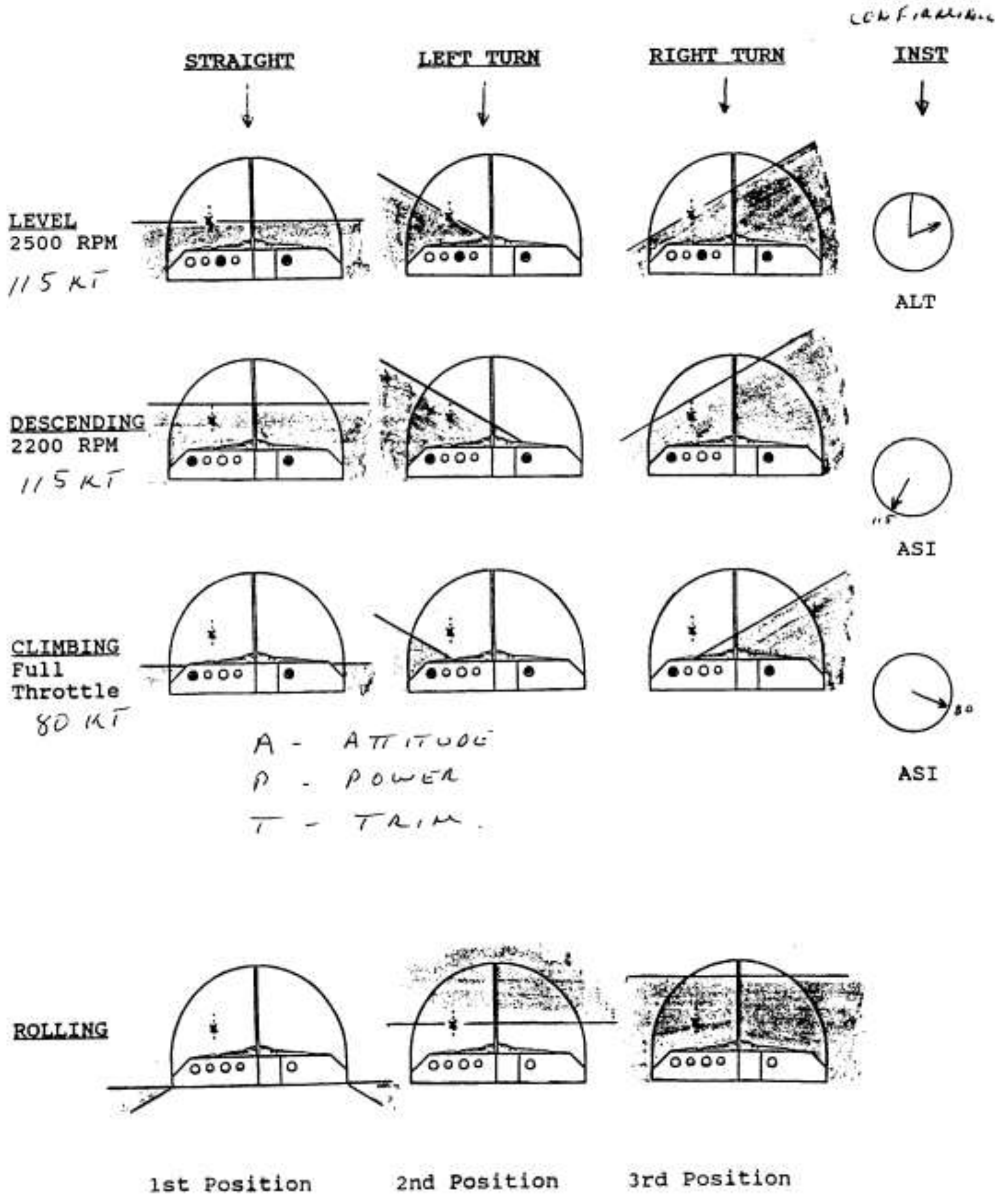
Low Speed
Hi Power

High Speed
Hi Power

SYDNEY AEROBATIC SCHOOL

ATTITUDE FLIGHT - ONE

POWER PLUS ATTITUDE EQUALS PERFORMANCE



SYDNEY AEROBATIC SCHOOL

Section Four

The Fundamentals of Airborne Instructional Technique

1. To aid quick reference to each key point in this section, I have made extensive use of side headings and sub-headings, as well as numbering each paragraph. I suggest that a separate copy be made of this section, and that it be kept handy for at least the first twelve months of your new career as a flying instructor. I have suggested a few places where you should highlight specific points too (its better that you do it as it will help you remember these points). I have also introduced the quintessential flying student, "Bloggs", into some of the examples of how to present certain things. Bloggs has been a permanent student pilot in air force flying training manuals (from which much of this section is derived) since World War Two, and we have all been a Bloggs at some stage in our flying career. Obviously you will refer to your student by his or her name and not as "Bloggs".

Personal qualities

2. In order to function as an effective flying instructor, you should aspire to the following personal qualities:

a. Aviator. You should operate your aeroplane in a professional, competent and confident manner at all times, being capable of taking it to the limits of its flight envelope without qualms (be comfortable in your aeroplane and in the sky).

b. Teacher. You should understand the fundamental 'motor skills' learning process detailed earlier in this book and become familiar with the method of airborne instructional technique detailed in this section, adjusting your presentation to suit the temperament and ability of the student involved.

c. Psychologist. You should be constantly aware of the student's emotional situation, varying your presentation or criticism accordingly. You should have 'empathy', that is, you should be able to anticipate the student's reactions, and avoid or prevent situations developing which might disturb the student, rendering him less able to learn.

Fundamentals

3. Besides aspiring to the foregoing necessary qualities, you will need to employ a method of airborne instruction which will ensure a successful outcome. In order to achieve the ‘un-corrupted programming’ necessary during a student’s ‘beginning’ and ‘intermediate’ phases of learning to fly, flying sequences must be presented in a logical manner. The most successful method is for the airborne instructional sequence to be delivered in three fundamental steps; these steps are headed:

a. Demonstrate.

b. Direct.

c. Monitor.

This demonstrate, direct, monitor (DDM) method of instructing motor skills, when used by an instructor who knows his subject, has proven to be most effective when teaching flying skills. The ‘demonstrate’ and ‘direct’ steps are used during the student’s ‘beginning’ phase of learning, whilst the ‘monitor’ step is used during the student’s ‘intermediate’ phase of learning. There can be considerable ‘overlap’ of these instructional steps and the students learning phases depending upon such factors as manoeuvre complexity, flying rate, and student ability. Also, as the student progresses through the flying course, each flight will contain a number of manoeuvres, some old, some new, and each at a different stage of learning. This can be a challenge for a flying instructor to remember which DDM step applies to which manoeuvre. Complete familiarity with the DDM method will ensure that a flight instructor can navigate this learning ‘maze’ successfully. To that end, I have amplified each of these fundamental steps in the following paragraphs.

Demonstrate

4. Definition. To ‘demonstrate’ is defined as: “to describe and explain by means of specimen or experiment”. An airborne demonstration presents the student with the required aircraft reaction (the specimen) to a particular control input (the experiment). The way in which this is achieved should be presented via the following sequence of events:

a. Introductory demonstration;

b. Pre-brief;

c. Subdividing;

d. Follow-me-through;

e. Actual demonstration; and

f. Post-demo de-brief.

5. Introductory Demonstration. The introductory demonstration is a presentation of the manoeuvre with only a minor amount of talking. This provides the student with an opportunity to gain a general idea of the nature of the sequence in a relaxed environment. To this end the 'patter' should be very general, such as; *"Now Bloggs, as we approach the stall, you can feel a light buffet becoming evident. Now there's the stall, which is causing the nose to drop a little. It's reasonably gentle and nothing to be concerned about, and now I'm recovering the aircraft."* The following points also apply to this introductory demonstration:

a. It allows you an opportunity to quickly refresh your mind on certain points about which you may have become a bit 'hazy', and to test the local effects on the aircraft e.g. an introductory demonstration of a circuit will enable assessment of wind, organization of circuit spacing etc.

b. It need only be preceded by a simple introduction such as, *"Okay Bloggs, just sit back, relax and watch me fly a normal circuit".*

An introductory demonstration is not always necessary or advisable. For example, an introductory demonstration of spinning may lead to student airsickness by virtue of the extra spin encountered, as well as being time consuming. It also may be of little value to an advanced student or one who has experienced similar types of manoeuvres in earlier flights. If you do not intend to give an introductory demonstration then you must give a thorough pre-brief (see Paragraph 6).

6. Pre-brief. The pre-brief allows you to describe to the student the event that he is about to experience and the particular points that you want the student to note. In lieu of describing the event, you may choose, if time permits, to pre-brief by questioning the student on the pertinent points involved, (assuming that a thorough 'pre-flight' briefing has been given). A pre-brief is particularly important for a sequence in which the rate at which the various events occur is too fast to allow a full explanation at the time. Thus, the more involved, and the more rapid the sequence, the more detailed the pre-brief should be. An understanding of these requirements can be established from a comparison of a simple pre-brief with an involved one, as in the following examples:

a. Straight and Level. Straight and level can be presented over an extended period, so the simple pre-brief need only be an introduction such as *"Bloggs, we are now going to look at straight and level".* This sequence is so basic that it negates the necessity of even performing the introductory demonstration described in paragraph 5.

b. Fully Developed Spin. A fully developed spin, by its very nature, occurs in a short period of time. No opportunity exists to freeze a certain section of it for detailed analysis, or to control that period, except with the time consuming and inapt method of climbing higher. A detailed pre-brief is therefore necessary such as: *"Bloggs, we'll now look at a fully developed spin. We'll be entering it through the incipient stage that we've just seen, and I'll be pointing out the moment at which it changes from incipient to fully developed. I want you to look out the front during the first rotation, then I will direct your eyes to the ASI and we'll be looking for the moment at which the airspeed stabilizes. I'll say 'stable' at that instant to indicate the start of the fully developed spin. After that, I will direct your eyes to the turn indicator to confirm the direction of rotation, and then to the altimeter to determine the recovery height. I'll then recover (introductory demonstration) and we'll climb back for another one. Any questions? Right, here we go".*

Do not provide too many details in a pre-brief. If more than about four specific items are likely to be detailed, then the sequence should be subdivided as described in paragraph 7.

7. Subdividing. A complex manoeuvre or sequence should be divided into smaller portions to enable it to be presented in two or more parts. This affords you a better opportunity to describe the various aspects of each section of the manoeuvre without being forced into a fast, non stop description that it would otherwise require. This will enhance the student's learning ability by virtue of its simplification. Subdividing will allow certain aspects of a manoeuvre to be held for an extended period to enable a more detailed analysis e.g. during an asymmetric stall recovery, hold the bank attitude after stopping the yaw to enable emphasis of the visual aspects of the attitude, and the control column position, before rolling 'wings level'. A spin demonstration may be segmented by presenting a certain number of facts during the first spin then the remainder during a second or third e.g. detail the entry recognition items during the first spin, then use the second spin to detail the recovery together with some consolidation of the spin features. A slow roll may be sub-divided as follows:

a. demonstrate the inverted level attitude, detailing the horizon position and the amount of forward stick required to hold it;

b. allow the student to experience the amount of force required to apply full rudder deflection in level flight at entry airspeed. (He may need to adjust his seat and pedal positions to enable him to achieve the required deflection);

c. demonstrate the attitude for the 90^0 and 270^0 position. (This part may be deleted as it is difficult to achieve and hold in some aeroplanes);

d. demonstrate a complete slow roll, showing how the various aspects presented in the previous sub-divisions are combined to present the full sequence of events; and

e. demonstrate a second slow roll, detailing the control movements.

8 Follow-Me-Through. "Follow-me-through" refers to the terminology used by instructors to direct the student to place his hands and feet on the controls immediately prior to the initiation of the actual demonstration or section of the demonstration. This enables the student to experience the control movements necessary to achieve the required result. You should not fall into the habit of automatically saying "follow-me-through" before every demonstration. It should only be utilized when the intention is to point out the control movements that are required. Therefore in any demonstration involving a follow-me through, you should describe the actual control movements in the pre-brief, emphasize them during the demonstration and again in the post-demonstration brief (Para 16). Unnecessary use of follow-me-through will reduce the student's ability to concentrate on other matters being presented. The meaning of the terminology "Follow-me-through" should be explained to the student before his very first flight as should the meaning of "Handing over" to indicate that he is flying the aeroplane, and "Taking over" to indicate that he should now release the controls (See paragraph 22).

9. Actual Demonstration. Demonstration of the actual sequence involved should now occur, if it has not already been presented completely by the subdividing process described in paragraphs 7 and 8. Further points to consider for the demonstration, and which also apply to subdivided demonstrations, are detailed in the following paragraphs.

10. Key Words. Use key words to aid in a more rapid description of the events, rather than extended phrases that absorb time and often cause the verbal description to lag behind the actual event. A slow roll, for example, could be explained in key words thus:

> *"Select slightly nose high attitude, right aileron, top rudder, more aileron, forward stick, inverted attitude, neutral rudder, top rudder, less aileron, constant roll rate, stop roll".*

11. Description of Event. The key words or description of the event should occur at the same time as the event. To this end, you must anticipate the required description/key words before the event occurs rather than relying on the event to inspire your 'patter'. This is not meant to imply that the description precedes the event but rather that the instructor's thought processes must do so. Such anticipation should ensure simultaneous occurrence of description and event, rather than succumbing to the trap of describing what has just occurred.

12. Kiss. Kiss is an anagram for 'Keep It Simple Stupid'. You should remember that you are involved in presenting experiences in an environment that is totally foreign to the student. A student will often have problems just grasping the concept of what is being demonstrated, never mind the refined details. Therefore you must avoid introducing excessive detail before the basics are presented and understood. This requires that demonstrations should be short and to the point.

13. Ad-Lib. A demonstration will often not proceed exactly as planned or expected. Small variations will invariably occur due to a number of influences such as turbulence, flying accuracy etc. If you simply 'patter' your presentation by rote, and/or present facts assuming that the evidence will occur, rather than ensuring that it does, you will frequently be unsuccessful. Success is achieved by improvisation i.e. 'pattering' to the flying situation rather than vice-versa. This does not negate the requirements of anticipating the event as detailed in paragraph 11. Rather, it requires the instructor to be constantly aware of the aircraft's flying situation and to be one step ahead of it.

14. Flying Accuracy/Errors. A demonstration should be presented as accurately as possible. However, the student must at some stage, be instructed on how to detect and correct errors which he will undoubtedly make. Therefore, you should take advantage of your own errors to demonstrate how best to correct them i.e. ad-lib for the error. Should you present a perfect example of a sequence, you should, nonetheless, demonstrate errors and their correction at some later stage. Errors that exist should be acknowledged not only for their value in the student learning process, but also for their psychological value. A student will more readily relate to an instructor who is obviously human because of his failings, than one who is faultless and sanctimonious. An instructor who is 'never wrong' will eventually gain little but disdain and contempt from his student.

15. What and How. Instructing initially consists of demonstrating what we wish to achieve (e.g. *"This is the straight and level attitude Bloggs. Note the position of the horizon in relation to a specific point on the windscreen"* etc), then how we achieve it (i.e. *"...note the amount of stick movement required, to maintain the straight and level attitude. Note that if we need to make a correction, we only need a small amount of control movement...."* etc). Frequently an inexperienced instructor will present the WHAT without the HOW. A manoeuvre, or sequence of manoeuvres, has not been, fully demonstrated until the means of achieving the result has been detailed. (Highlight that last sentence.)

16. Post Demonstration Brief. After each demonstration or each sub-divided section, you should summarize the points that you have established in that presentation in a post demonstration brief. Often this will be very similar to the pre- brief in the points raised, but it should also include the actual details that were noted during the sequence. Any items that were missed from the demonstration or inadvertent errors that marred the presentation may be discussed at this point. The post demonstration brief allows the student the opportunity to consolidate the details presented and to clear up any doubts. This brief is therefore concluded with the statement *"Are there any questions?"* You may also choose, if time permits, to question the student on the points which he should have observed.

17. Aircraft Attitude. Flying, at its most basic level, consists of selecting and maintaining certain attitudes. Therefore, aircraft attitudes are all important, in both visual and instrument flight. You should ensure that the relevant attitudes are specifically promoted in all demonstrations. The student's height/seating position may cause his impression of the attitude to be different to yours, so you should be wary of detailing your own images; rather, you should promote the correct attitude by having the student describe his own impressions with relation to specific items in the front windscreen, (this is where an Attitude Reference Point is very useful).

18. Use of Student's Instruments. To ensure the student is able to see the correct performance indications on his instruments, you must perform your demonstrations by reference to the student's instruments. Some purpose-built training aircraft have dual instrument panels; however, you must develop the habit of flying and referring to the performance instruments on the student's panel. On tandem-seat training aircraft you must develop the habit of asking the student, before a demonstration, for the indications on the pertinent instruments on their panel. You should then align your instruments with the student's (e.g. altimeter and DI), or note the variation between the instruments if they are not adjustable (e.g. ASI and skid ball).

19. Speech. Speech should be clear and deliberate. Take care not to mumble or talk in a monotonous voice. Keep the voice pitched up and ensure that the student is able to understand both the words and intent. A confident and determined voice, (without being 'gruff') will influence the student into being likewise.

20. Radio Interruptions. Verbal presentations in the aircraft will frequently be interrupted by radio transmissions, many of which will be of no concern to you. You should become adept at listening to the first few words of the transmission, determining if it involves your aircraft and, if not, mute out the rest of the transmission to allow the presentation to continue. Use of the radio volume control can prove effective in this situation. The volume should be reduced to a level that will at least allow you to recognize your call sign when transmitted, but not cause difficulty for the student in understanding what you are saying.

21. Purpose of a Sequence. All the flying sequences have been developed for one or more specific purposes. Some sequences are taught to develop the student's proficiency in handling the aircraft at different attitudes and airspeeds (e.g. aerobatics). Many others exist to enable an obvious result to be achieved (e.g. circuits, instrument approaches). Others exist with a purpose that is often obscure, especially to a new student. Unless the intention of the exercise is explained to the student, he will fly it as an exercise only. His ability to associate that exercise with an actual situation will be severely limited, thereby reducing the effectiveness of that sequence. Examples of such exercises with potentially obscure intentions are stalls, spins, unusual attitudes, maximum rate descents, etc. Note that these exercises generally fall into some form of loss-of-control (either minor or major), or are associated with an emergency situation of some sort. Each of the quoted examples (and many others), are designed to show the student:

a. the features of the adverse situation so that he can learn to recognize them when they do occur inadvertently;

b. the flying environments that may lead to the development of such situations so that he may either avoid operating in these environments, or be better able to anticipate the onset of the associated adverse situations if he is obliged to continue operating in that environment; and,

c. the best recovery actions to enable him to regain control of the aeroplane safely in the shortest time, and with a minimum of height loss.

You should continually promote the association of such exercises with the actual situations in order to gain the maximum training value for the student.

This is best done in flight by developing - either verbally or by flying an apparently un-associated sequence - a scenario which eventually leads to the loss of control situation. An example of this would be to have the student fly a maximum rate steep turn which develops into an incipient spin. You should then point out that the student should always be prepared for an incipient spin recovery when flying such a manoeuvre. Another example involves low speed stalling. A low speed stall in the most dangerous situation, close to the ground, is most likely to occur during a final approach to land, or during a missed approach (going around). You should promote these facts to the student, both during stall sequences and circuit sequences so the two become naturally associated in the student's mind. Of course, to preclude the possibility of such situations developing, incipient stalls and recoveries should be taught, and regularly practiced, in the approach configuration, and the similarity between the incipient approach configuration stall recovery and the missed approach stall recovery should also be demonstrated. The recognition and recovery from incipient stalls in the approach configuration is as important as full stall recoveries, as it ensures greater situational awareness. Therefore you should also promote and practice incipient stall recoveries in the approach configuration as frequently as full stall recoveries.

22. Handover - Takeover. ‘Handover-takeover’ involves the transfer of the control of the aircraft from one pilot to the other during flight. It will normally occur, in the first instance, following the ‘pre-direction’, and immediately prior to the ‘direction’ step. (See paragraphs 24 and 25.) The handover-takeover ‘drill’ must be well regimented as any laxity in its application can lead to an extremely dangerous situation developing in which neither pilot is in control of the aircraft. This is especially applicable to tandem seat aircraft. You must fully detail the handover-takeover drill to the student in the student’s first pre-flight briefing. Phrases other than “Handing Over” and “Taking Over” are often used by flying instructors. The actual phrase is not too important as long as its intention is clear and it is used consistently and religiously. Whatever phrases are used, they should be used throughout the flying school to avoid confusion by the student in the event of an instructor change.

Direct

23. Definition. To direct is defined as:

a. To order a person to carry out an action (pre-direction); and

b. To control or govern the movement of….. (direction).

24. Pre-direction. As suggested by the definition, there are two forms of directing which you will need to use, depending upon the circumstances. The first form, 'pre-direction', provides the means by which you advise the student of the actions that you require him to complete when you hand over control of the aircraft to him. An example of this would be *"Okay Bloggs, when I hand over to you, I want you to climb the aircraft straight ahead maintaining 80kts, and then level off at 4000 feet".* Note that the performance details have been stated in order that the student is not confused by doubt about your requirements. You need not, however, go to extremes in this regard by stating all the performance parameters and variables, as most of them are understood to apply, e.g. balanced flight, aircraft trimmed, maintaining lookout etc. Indeed, it is possibly superfluous to state "80kts" in the requirements for a climb. However, if it is the first time that the student is to fly the aircraft in a climb following a demonstration, then detailing the IAS has merit. In this instance, it reinforces the key performance requirement that he should strive for during his attempt. Pre-direction should occur every time the instructor hands-over control of the aircraft to the student, regardless of whether it precedes a direction phase. (Highlight that last sentence.) It can be as simple as, *"Now you have a go at that Bloggs - handing over".*

25. Direction. The second form of 'direction' should generally occur after a demonstration, or segment of such, has been completed. It is the means by which you control the student's control inputs during his first attempt at the manoeuvre that he has just observed. It should be preceded by a statement such as *"Okay, now I will talk you through the manoeuvre Bloggs".* This prepares the student to anticipate the requirement to respond to the instructor's directions. Thus, 'directing' is the process of connecting the instructor's brain to the student's hands, feet and eyes, using the medium of the instructor's mouth. (Highlight that last sentence.)

26. Directing Eyes. As mentioned in paragraph 17, flying any sequence generally requires the pilot/student to select certain attitudes, and then confirm that the attitude is correct by reference to certain instruments. Besides the actions required of the hands and feet to attain that attitude, the eyes need to be directed outside to the horizon so the pilot can see when he has selected the nominated attitude. The eyes must then be directed inside the cockpit to one or more instruments for confirmation of that attitude. This sequence of eye movement does not exist naturally in the student pilot. Therefore you must generate it by directing the student to look outside at the horizon or to look inside at the required instrument(s). Because of this, it will also be necessary for you to direct the student's eyes during the initial demonstration. For example, during a demonstration of flying the 'downwind' leg of a circuit, the 'patter' should include the following eye direction:

> *"Now look outside to the left Bloggs, and confirm that the wing tip is tracking down the runway centre line. Now look out the front and confirm we still have the correct attitude. Now look inside and check the altimeter. Outside again to the attitude and back inside to the compass and heading ...etc."*

Eye direction also applies to lookout directing e.g.

> *"The lookout for other aircraft comes next, so move your head to the right and scan the area between the wing and nose out to the horizon. When that's done we call 'Clear Right'. Now scan the area out to the front and call 'Clear Ahead' ... etc".*

Eye directing and the sequence of eye movements is also important in events which require spatial orientation and/or visual reference to a number of items in a short period of time e.g. entry and maintenance of an aerobatic manoeuvre such as a loop.

> *"Look out the front and select the dive attitude, maintain wings level. Cross referring between attitude and airspeed, approaching correct airspeed, raising nose to horizon, clear above, look at G meter, pull to 4G. Now hold the head position, but cast your eyes up looking for the horizon (spatial orientation) ...etc".*

As student experience increases, the instrument may be alluded to by statements such as *"check airspeed, heading, altitude, etc"*.

27. <u>How to Direct.</u> If the 'directing' step is considered the equivalent of a demonstration with the instructor talking but the student flying, then it can be understood that some of the points detailed under the 'Actual Demonstration' heading, will also apply to 'directing'. The following paragraphs describe these and other items.

28. <u>Key Words;</u> Key words apply as detailed in paragraph 10.

29. <u>Description of Event.</u> Details apply as for paragraph 11 except that now the 'patter' and anticipatory thought processes should occur simultaneously. This 'pre-description' of the event is usually necessary for directing to allow for the time-lapse between the student hearing the direction command and his responding to it.

30. Aircraft Attitude. The various relevant attitudes should be as strongly promoted in the direction as they were in the demonstration, (see paragraph 17).

31. Use of Student's Instruments. The instructor, during the direction phase, should utilize the student's instruments as detailed in paragraph 18.

32. Speech and Radio Interruptions. The requirements for the direct phase regarding speech and radio interruptions are as described in paragraphs 19 & 20.

33. Instructor Follow - Through. Your ability to direct a student may be enhanced if you follow-through on the controls whilst the student is flying. This will provide you with more indications than just visual, which will better enable you to perceive the students actions and therefore, to satisfy the requirement to pre-describe the next segment (see paragraph 29). However, you should take care not to impart any force or inputs to the controls during this process. To this end, you should follow-through with only the tips of your fingers on the controls. As the control of the rudder is not as sensitive as that of the other controls, resting your feet on the rudder pedals is acceptable. This follow-through situation provides you with the additional benefit of being instantly able to take over should the necessity arise. However, when instructing in side-by-side seating aircraft, you should take care that your follow-through is not visually obvious to the student, as it may give him the impression that you are preparing to take-over at any instant. This could demoralize him or cause him some fear of the manoeuvre he is about to perform.

34. Student Errors. You should anticipate that difficult sections of a manoeuvre may be the subject of errors in student technique. Therefore you should place emphasis on them in the ‘pre-direction’ and again during the ‘direction’. Short statements during the ‘direction’ such as *“more forward stick”* or *“nose higher”* or *“pull harder”*, etc will normally serve the purpose.

35. What Actions to Direct. Generally, during the ‘beginning phase’ of learning a new manoeuvre, you should direct all sections of the manoeuvre that require action (movement or pressure application) of the hands and feet, or observation by the eyes. Take care not to develop the bad habit of ‘directing’, in the first instance, by only correcting errors. Not only is it contrary to the basic premise of directing, but it can confuse the student who is awaiting the next command on how to accomplish the manoeuvre, rather than how to correct it.

36. Directing by Error Correcting. Although paragraph 35 warns against merely correcting errors as a means of directing, this limitation generally only applies when a completely new manoeuvre is directed for the first time. If a manoeuvre is similar in its flying technique requirements to one experienced previously by the student, then you may successfully utilize a limited error correction/directing technique without fully directing the manoeuvre first,

provided that a thorough 'pre-direction' is given first. The student's ability at handling the initial similar manoeuvre may dictate whether full directing, or this modified form of directing is appropriate.

37. How often to Direct. Generally, fully detailed 'directing' will only occur once following the demonstration. This may be increased for more complex manoeuvres or where the student has displayed poor ability at completing the originally directed manoeuvre. Subsequent attempts by the student at the manoeuvre will fall into the monitor phase (paragraph 43). However, you may choose to utilize limited amounts of directing whilst monitoring, if consistent errors are noted. Limited directing may also be employed to correct errors that, if allowed to progress any further, may result in the eventual demise of the manoeuvre. It is generally preferable to direct a student out of a poor situation rather than wait until it is necessary for you to take-over. (Highlight that last sentence.)

38. Limited Directing. The limited directing noted in paragraphs 36 and 37, should take a certain form when it is utilized to correct an error in a sequence with which the student has some experience. In this situation, the Instructor should point out the error only e.g. *"Bloggs, check your altitude".* The student's experience should now provide him with the ability to know how to correct the error. If this prompting subsequently proves unsuccessful, then the Instructor may continue the directing with, for example *"...look out the front; raise the nose to a new attitude, trim etc."* The situations described in paragraphs 37, 38 and this paragraph are examples of the 'blurring' of the 'line' between the 'Beginning' and 'Intermediate' phases of the student's learning process. Also it is quite common for the various manoeuvres performed within one training flight to be at different stages of development, requiring you to deal with each one differently.

39. Directing Cognitive Skill. The foregoing details apply mainly to the manner in which to direct the movement of the hands, feet, and eyes, that is, the motor skills. A flying instructor must also be capable of developing student's cognitive skills, that is, the student's ability to perceive a situation and then apply a logical sequence of mental skills to arrive at the required solution/action. Such cognitive skills can, in part, be termed 'airmanship' in their application to the day-to-day general flying environment. As such the method of acquiring these particular skills does not fall into the directing situation that is being addressed here. Nevertheless, many other cognitive skills can be taught using the same general techniques detailed herein. Navigation and flying instrument approaches, for example, require the initial development of cognitive skills by directing these skills during a student's first encounter with the sequences. Motor skill directing involves the procedure of commanding an action, which requires little or no process of reasoning by the student. Cognitive skill directing involves 'inducing' the student to determine the next course of action; that is, reasoning, by

judicious questioning. To ensure that the student gains the maximum benefit from having to deduce the complete answer to a problem himself, such questions should be cryptic, but not too cryptic. Conversely, they should not be so full of clues that little mental effort is required by the student to deduce the solution. A means of overcoming this problem is to start with a reasonably general question, then add clues if the student is unable to provide the answer. An example of such cognitive skill directing in navigation could be, *“What are you going to do next Bloggs?”* No answer or incorrect answer may be followed successively by, *“well, what time is it now and what time is our next checkpoint due?”* and/or *“Do we have anything else to do before the checkpoint?”* etc.

40. Timing of Cognitive Skill Directing. Cognitive skill directing is time consuming. Therefore, you must initiate such questioning some time before the event to which it refers. If the required answer has not been solicited from the student by the starting time of the event, then you should switch to ‘command’ directing for that event, that is, tell him what to do. You must also take care not to question the student during or immediately prior to a high workload situation, where the student's attention will be diverted from the action in hand, causing a reduction in the standard of the present situation plus an inability to cope with the questions being proffered. This is particularly important during the early lessons of the flying course when the basic flying motor skills are being learned.

41. Student Flying - Instructor Talking. In general, if the student is flying the aeroplane, you should only be talking to him as part of the actual direction phase of the sequence (motor or cognitive). For any other discussion with the student, such as critiquing his just-completed attempt at a manoeuvre, you should take over control of the aircraft. This enables the student to concentrate on your comments rather than be distracted by his involvement in aircraft control. This requirement is particularly important when you are critiquing complex cognitive skills like navigation. However, with more experienced students receiving only a short, uninvolved critique, the requirement to take-over is not as important.

42. Student Ability. The student's first attempt at a particular manoeuvre will occur during the directing step. You should not, therefore, expect too much of the student in this situation. You should remember that the student, during direction, is responding to your commands, so a poorly executed manoeuvre may be due to poor or untimely direction. You should, therefore, check your technique before criticizing the student. However, assuming your technique is okay, if the student is incapable of performing a manoeuvre to even a very basic level under your direction within the time frame available, and if this lack of ability is becoming consistent despite remedial lessons being flown, he may be unsuitable to continue the flying course.

Monitor

43. Definition. To monitor is defined as: 'to maintain regular surveillance' (over the student), and falls within the 'Intermediate Phase' of the student's learning process. This requires you to watch the student's attempts to complete a nominated manoeuvre or sequence of manoeuvres with the intention of:

a. assessing the student's ability and detecting his errors for later appraisal or remedial instruction;

b. providing limited direction if required (see paragraph 38); and

c. taking over control of the aircraft if the demise of the manoeuvre is imminent, or if a dangerous situation is developing.

44. General Points. Generally the monitor phase should follow immediately after a successful direction phase, or when the student is flying a sequence with which he is familiar. It should be preceded by a pre-direction (paragraph 24) then a handover-takeover (paragraph 22). The pre-direction before a monitor phase should be concluded with a phrase such as *"Handing over Bloggs, I'll just watch you fly this time".* This alerts the student to the fact that he is now fully responsible for the manoeuvre. The monitor phase will generally involve no commentary at all by you (except perhaps short words of praise), unless you considers it necessary to provide limited direction. Once the monitored sequence is completed, you should take over control of the aircraft, and appraise the student's techniques, detailing any errors and providing guidance on how to correct these errors (see paragraph 50). You should then have the student fly a monitored repeat of the sequence to confirm that he has overcome the problems just discussed. If the errors are persistent and have not responded to limited direction, or if the student is unable to comprehend the correction guidance, then you may need to provide remedial instruction by re-demonstrating and/or redirecting all or part of the sequence.

45. Transition from Direct to Monitor. The rate at which you choose to transition your instructional technique from the 'direct' step to the 'monitor' step will depend upon the student's ability (paragraph 42) and manoeuvre difficulty. The monitoring phase should be delayed in preference to more directing if the student's ability or progress is poor, or if the manoeuvre is complex or difficult. (Highlight that last sentence.)

46. Error Analysis. You should take care not to critique every error that you detect. Rather, you should detail only two or three of the major errors, leaving

the minor faults or refinements for later rectification when the student is more competent at handling the basics of the manoeuvre. In the first instance of error analysis, you should remember that the monitoring phase is not a test, but a means of ensuring that you have imparted the necessary knowledge and techniques to the student. If the student demonstrates a lack of this ability, then it well may be that it is you, and not the student, who has failed in this 'transfer of information' process. Re-demonstrating, subdividing or further subdivision, or using a different approach may be necessary before you may reasonably assume that the fault is now the student's and not yours. Once this is established, you should now seek out the root cause of the error. Errors which exist late in a sequence may have a root cause well back in the early stages. An example of this may occur when flying circuits, where a high airspeed on final approach may not be simply due to excessive power. It may be traced back through the following thought process:

> 'High airspeed on finals, because lined up high on finals, because too close on base leg, because too close on down-wind leg, because insufficient allowance for cross wind into circuit while tracking the down-wind leg, and/or too much bank on the turn from cross-wind leg to down-wind leg, which did not allow for known cross-wind towards the runway'.

Note that the error analysis consists of determining the cause, not just the effect. Once this has been done, the student should be advised of both the error and the fault that created it. As his experience increases, the student should be induced to analyze his own errors by using judicious questioning as describe in paragraph 40.

50. The Critique. First, always give positive feedback on those manoeuvres performed correctly. It is too easy to fall into the trap of only mentioning the errors made. Second, remember that the 'feedback loop' used by a cybernetic mechanism, operates on negative feedback; that is, it is constantly sampling the current 'situation', comparing it to its 'perfect image' of what should be happening, and correcting the errors it detects, in order to achieve the goal. During the early 'Intermediate' phase of the student's learning process, the flying instructor's job is to critique the student's performance and provide much of this negative feedback. But it must be done correctly; human beings are easily demoralized if just 'hit over the head' with their mistakes. Negative feedback can be 'constructive' or 'destructive', and it is important that you know the difference. Destructive and/or abusive statements like:

> *"You dopey bugger! How many times have I told you to maintain climb power after leveling off until the aeroplane has accelerated to cruise speed? Don't pull the power back*

> *straight away because we will never bloody get there. Are you trying to waste my time or are you just stupid?"*

….are not going to improve the student's performance, or make for harmony in the cockpit. Negative feedback, in order to be 'constructive', should be 'sandwiched' between two layers of positive feedback, and should contain the method of correcting the error, like this;

> *"Not bad Bloggs, I like the way you continually adjusted attitude to maintain level flight whilst the aeroplane accelerated. Did you notice how long it took, and how long you had to focus on changing attitude? Remember I mentioned on a previous flight that if you maintain climb power till the aeroplane reaches cruise speed before reducing it, the aeroplane will accelerate quicker and you will be able to stabilize level flight sooner? Let's try it again with that adjustment to your technique, I am sure that you will notice how much easier it is".*

This simple 'feedback sandwich' approach to giving constructive feedback should always be used for longer de-briefs in the air (like that above) and can even be applied to the 'quick critique' situation during a manoeuvre e.g. *"Good, now pull harder"* or at the end of an individual manoeuvre e.g. *"That was good Bloggs, but next time pull harder and it will be even better".*

'Sandwiching', should also be used when de-briefing your student in the class-room, after the flight.

51. Footnote. Many students bring to the cockpit, memories of the student/teacher relationship they experienced at school, and this was not always good. You may find it advantageous to give your students a basic outline of this DDM method at the beginning of the flying course, so that they are aware of the teaching process that you use. This will help them to help you when the 'going gets tough'. Your student may surprise you at some stage by saying "demonstrate that to me again" or "talk (direct) me through that again", when he feels he hasn't quite 'got it' yet. In this way you will be working together as a team to achieve his goal of learning to fly. This will build a great camaraderie in the cockpit and make the whole process more enjoyable for both of you.

Section Five - Practice

It is in the ‘Advanced’ phase of learning that an aviator’s skills are ‘honed’ to perfection by proper practice. However, the right brain does not know if the program it is running during practice sessions is good or bad, so it can just as effectively practice the wrong way to fly as it can the right way. It is the flying instructor’s job, during the ‘beginning’ and ‘intermediate’ phases of learning, to ensure that the program the right brain is practicing is the right way to fly.

Once the ‘how to fly’ program has been correctly installed in the right brain it needs repeated use to maintain it, otherwise it fades away. ‘Use it or lose it’ is an applicable slogan in this case. You may recall from book one that I disagreed with the old adage that ‘practice makes perfect’; my version is “good instruction makes perfect and practice makes permanent”. The right brain, unlike your computer’s ‘hard drive’, will slowly lose the motor skill program if it is not used regularly, that is, practice, practice and more practice. In the early stages of learning, the whole process is like climbing a greasy pole; the longer the pause between practice sessions the more you slip back. The good news is that the higher you climb the dryer the grease gets, so you don’t slip back as far - but you do slip back.

In my corner of the world, the civil aviation regulatory authority’s minimum currency requirement is one flight every 90 days including 3 take-offs and landings. This requirement is applicable to all licenced pilots regardless of how high up the ‘greasy pole’ they have climbed. It may be okay for a few ‘old hands’ but for recently graduated pilots it is a dangerous joke. For these ‘new’ pilots I believe that one hour of concentrated practice at least once every month should be the absolute minimum. Of course each and every flying school has the ability to set more stringent currency standards than those required by their regulatory authority; it all depends upon how much they value their reputation and their aeroplanes.

The lure of flying is, for many people, very powerful, but the cost of flying is, for most of these same people, prohibitive. This is a world wide problem, and the gap between people’s desire to fly and their ability to pay for it is widening. Modern airlines and air forces around the world invest millions of dollars in sophisticated flight simulators which reproduce all of the sensations of flight; the sight, the sound and the feel of flight are faithfully reproduced in these machines. They are brilliant pieces of modern technology which aid pilot training and currency practice, but unfortunately these too are beyond the financial ‘reach’ of general aviation pilots. Flight simulator programs that run on your laptop computer are just games, and are of no use in the practice of flying because they only appeal to the left brain via the focal vision and do not exercise any other senses; indeed they can be detrimental to ‘real’ flight training.

I would now like to share with you, so that you can pass it on to all of your students, the following, little known characteristic of your twin brains, which can be a very effective 'flight simulator' (and save them lots of money). It is simply this. The cybernetic goal seeking 'servo-mechanism' in the right brain cannot differentiate between the sensory inputs it receives from external reality or those it receives from a 'virtual reality' made up of sensory images generated internally from memory by the left brain. Now this enables us to perform a neat trick: the left brain can access the sensory images of the goal (manoeuvre) held in the right brain, and then feed them back to the right brain as if they were actually happening, and the right brain's cybernetic control centre responds to these imagined sensations in the same way it would if the manoeuvre was actually happening. The applicable motor skill program is practiced by this 'virtual reality' almost as well as it would be if it were actually in flight.

Assuming that the initial program for flying a particular manoeuvre or sequence of manoeuvres, such as flying a circuit and landing, or flying aerobatic or non-aerobatic routines similar to those suggested at Annex A, has been installed in the right brain correctly, that is, without corruption or distortion, its cybernetic function can be exercised by vivid visualization of the sequence from memory, that is, by consciously recalling the sensory images associated with the particular manoeuvre or sequence of manoeuvres. But I must emphasize that this visualization must be vivid, and must include all sensory inputs. You must <u>see</u> the nose attitude and the earth and the sky moving by it, and you must <u>see</u> the appropriate instrument display. You must <u>feel</u> the angle of attack and the airspeed (Book Two-lesson seven), and you must <u>feel</u> the 'G', the vibration and the turbulence. You must <u>hear</u> the engine note as it changes with speed and power, and you must <u>hear</u> the radio communications. In short, you must <u>be in the aeroplane in your mind</u> and 're-live' the <u>experience</u> of flying the manoeuvre.

I do <u>not</u> mean that the detailed control movements should be imagined, because this will over-ride the automatic program and corrupt the practice, (like thinking about the golf club grip). I mean visualize, from a pilot's perspective, the 'flow' of the flight. See, feel and hear the aircraft's nose moving across the ground during the turn to final approach, or the earth rotating in the windscreen and the negative 'G' coming and going during a roll. See, feel and hear the take-off and the landing. See, feel and hear the 'G' and the sky and clouds moving past the nose during a loop. This 'reliving' process could be likened to watching a 3D movie taken with a camera looking through your eyes, but with the added inputs of the other senses. The right brain will receive these images and act upon them as if they are real, and run the motor skill program associated with them. As a result of this vivid mental imagery, the images and the program will become more deeply embedded, and more automatic with each 'virtual flight'. It will also slow the rate of slippage down that greasy pole.

Another interesting thing about the right brain is that it has a flexible sense of time. It will run its programs at any pace the left brain requires. This means that the virtual reality inputs it receives from your vivid imagery can be in slow motion or even ‘freeze-framed’ without affecting the practice. Complex and rapid manoeuvres can be ‘flown’ in slow motion so that more accuracy and detail can be added, or the flight can be frozen while you ‘fine tune’ the picture before continuing.

So is this just a way of accelerating the transition to the ‘advanced phase’ of motor learning? Well, whilst this accelerated transition certainly happens, something else happens. This mental practice can also improve and polish your flying skills. Now this might sound like I am contradicting myself as I just said that “practice (only) makes permanent”, but I was talking about ‘normal’ practice, the sort of practice done in an aeroplane with all your flaws and mistakes going along for the ‘ride’ too.

Mental practice can be different, because it can be what I call “perfect practice”, that is, whilst you may not yet be able to fly the perfect flight, you can certainly use your ‘creative’ imagination to visualize the perfect flight, and these ‘perfect images’ will update the current ‘imperfect’ images. Then, when flying the real aeroplane, the motor skill program will attempt to recreate these perfect images in the ‘real’ world. Eventually it will, and it will do it automatically. Ultimately the quality of your flying will improve, and your aeroplane will become an extension of you, and, provided you maintain your focus on the goal, you will fly perfectly, without conscious thought. This is what I meant in the first paragraph by honing your skills through ‘proper’ practice. I guess another version of that old adage could be, ‘Perfect (proper) practice makes perfect’.

Of course even this mental practice technique does, itself, require practice. The human brain is easily distracted by random thoughts intruding into our consciousness. When practicing flying in your head these random thoughts will return again and again, and must be let go. Find a quiet place to sit where you will not be interrupted, and start by focusing on one manoeuvre at a time. Repeat this manoeuvre a few times, relax for a moment and then focus on the next manoeuvre. Initially each session need only be about ten minutes long; then as you become more adept at focusing your mind, the sessions can be progressively extended to about half an hour. Talking yourself through each manoeuvre, out loud, mumbled, or just in your head, in the same manner that your instructor initially directed you through the manoeuvre, can be of great assistance in maintaining your focus.

You may be surprised to learn that that the results of these ‘perfect mental flights’ will ultimately enable you to fly better than if all of the practice time was done in the real aeroplane! This is a most important point, so read it again.

How can this be? Well, during actual practice, especially early in the learning process, mistakes will be made and, if not detected and corrected, you could end up just practicing your mistakes, but in perfect mental practice there are no mistakes.

Does this mean we can abandon real flying practice completely using this virtual reality visualization technique? Of course not. The muscles also need to be exercised regularly, but modern sport psychologists have determined that when training athletic motor skills, a training schedule of 25% actual training and 75% mental training is more effective than 100% actual training! World class athletes, those people who are the very best at the motor skill they have chosen, believe that winning is 75% mental. Since flying is a motor skill requiring a lot of sensory input, it is much more mental than it is physical, so it is not unreasonable to apply these percentages to practicing flying too. So, if for every one hour of practice in the air, you practice for a total of three hours in your head (in those short sessions mentioned earlier), using this vivid mental imagery technique, then your performance in the air will be better than if you had practiced for the whole four hours in the air!

Buy one, get three free! What a great way to attract customers to your style of flight training. But how do you, the flying instructor, teach this technique to your students? Simple, give them a copy of this section of this book.

In Section One - Learning, I mentioned that instrument flying is an ‘unnatural’ skill requiring a lot of training and practice. This vivid imaging technique can be used to great advantage when ‘practicing’ instrument flying, not just by visualizing the instruments and the ‘scanning’ technique, but by superimposing upon these images, images of the ‘outside world’ too. This is like seeing in your ‘mind’s eye’ a double exposure of both the attitude indicator and the ground, sky and horizon in the same attitude. Indeed this visualization technique can be used whilst practicing in an instrument flight simulator by visualizing what the attitude indicator is telling you with your eyes wide open. In this way you are training the left brain to not only determine the goal, but use the instrument information coming through your focal vision to ‘trigger’ a recollection of corresponding images of the outside world too. Ultimately, this technique can be translated to the cockpit of a real aeroplane in flight.

I have spoken to a number of very experienced instrument pilots, who have told me that when they look at the instrument panel in flight it becomes ‘translucent’ in their mind and they ‘see’ the world outside in the same attitude, and they react to that mental image to fly the aeroplane. This is the complete ‘fusing’ of instrument information and mental visualization, and is a very advanced state of ‘being one’ with the aeroplane.

Is it possible that this 'double exposure' technique can be used when flying visually, with eyes wide open? Yes it is.

In 1917, Baron Manfred Von Richthofen wrote:

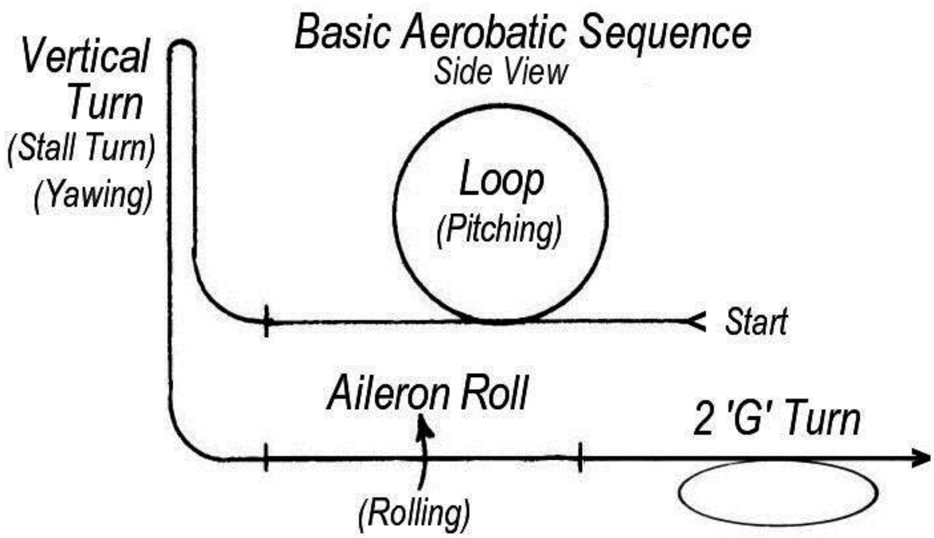
> *When I wish to bring an aeroplane down, I get behind him and see with my mind's eye the clearest possible picture of him falling to destruction. Then I say, "Now you are going down, down, down. You* ***must*** *go down." Then I press the trigger and down he most assuredly goes.*

I first read about this vivid mental imagery technique way back in the 1960s, and started applying it to great effect as a fighter pilot when engaged in both air combat manoeuvring and air to ground weapons delivery, and later, when practicing and teaching competitive aerobatics. It worked for me then, and continues to work for me.

Annex A.

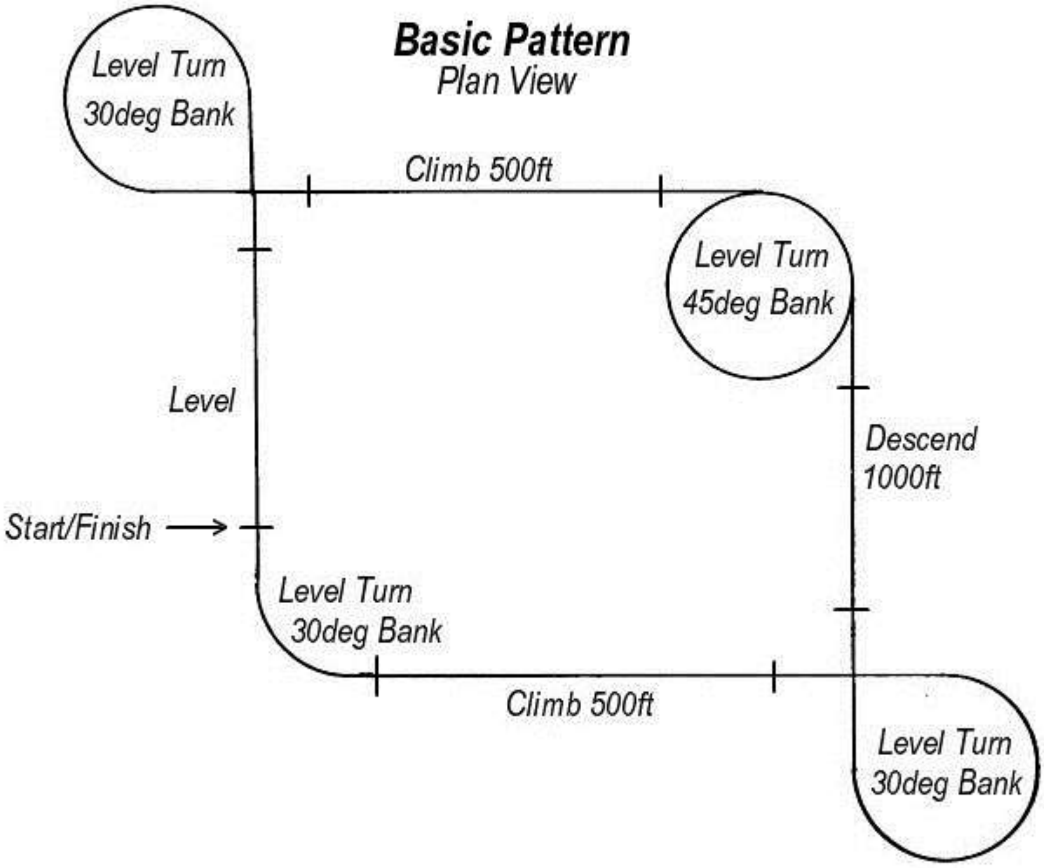
Practice Sequences

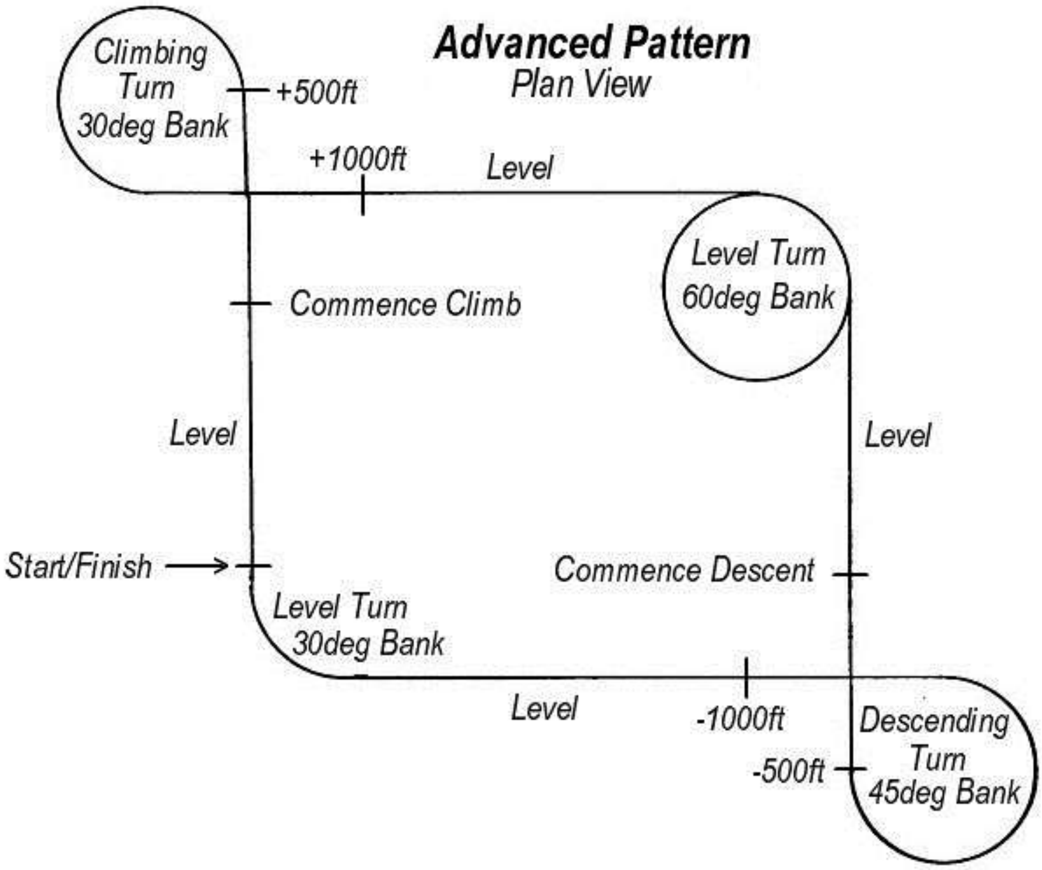
In order for the student to effectively practice flying an aeroplane the instructor should set him a series of flying exercises comprising a sequence of manoeuvres of increasing complexity. Flying a take-off, circuit and landing is one such sequence and is extremely good value, but the distraction of fitting in with other traffic and complying with ATC instructions can often decrease its value as a pure flying exercise. When teaching aerobatics I would have my students fly a simple sequence comprising the manoeuvres they had learned thus far, and would add each new manoeuvre to this sequence as the course progressed. This also gave the student something substantial to practice in his head between flights. The following is a diagram of such a sequence of aerobatic manoeuvres:



Student pilots who are undertaking non-aerobatic training need something similar so that they, too, have something substantial to practice when flying solo and 'flying' in their head. Randomly flying around the sky without specific goals is not conducive to effective practice either in the air or in their head. A sequence of manoeuvres comprising climbing, descending and turning, and combinations of all three should be created. Initially, it can be a simple sequence but its complexity can be increased throughout the training course. In this way, even though the instructor is not present in the cockpit during solo flights he is guiding the student by giving him clear goals to achieve.

On the following page are two such flying sequences, one simple and one more complex. These sequence (or something similar that you have designed) and their mirror images should be flown regularly, both when flying dual, so that you can critique their performance, and during solo practice. Of course they should also be practiced 'at home' by the student, using this vivid mental imagery technique, regularly.


Basic Pattern
Plan View
Level Turn
30deg Bank
Climb 500ft
Level Turn
45deg Bank
Level
Descend
1000ft
Start/Finish
Level Turn
30deg Bank
Climb 500ft
Level Turn
30deg Bank


Advanced Pattern
Plan View
Climbing
Turn
30deg Bank
+500ft
+1000ft
Level
Level Turn
60deg Bank
Commence Climb
Level
Level
Start/Finish
Commence Descent
Level Turn
30deg Bank
Level
-1000ft
Descending
Turn
-500ft
45deg Bank