know your

In his second article, **Martin Axon** discusses how we learn to make decisions and cope w

Automatic Pilot

Understanding how our thought processes control our actions can help us to understand issues such as how we learn to fly, what our limitations are when flying and why we need to prepare and plan our flights.

We all know that the mind is a wonderful thing. Having a better understanding of the way it functions and its limitations can help us to use it to its best ability. We sometimes joke that we can only do one thing at a time but this is essentially true with respect to conscious actions. We are only able to process one action, thought or decision at a time. To do two things at the same time we have to split our attention. We are able to manage two conscious actions at once such as flying a balloon and map reading. We do this by focusing our attention on flying and then map reading alternately. When our attention is split in this way, trying to do anything more complicated than maintaining altitude while map reading will be difficult. However we are able to do some things in tandem; for example, we are able to walk and read at the same time. This is because these two operations are controlled at two different levels and we are able to combine a conscious operation with a non-conscious operation that is at the skill based level.

Skill Based Level of Operation

When we are operating at the skill based level, we really are on automatic pilot. We are using acquired skills which are programmed into our motor memory. We use these programmes all the time, they are sophisticated and designed for specific tasks. Once selected they allow us for example to walk, drive a car or ride a bike. The motor memory programmes that we "record" into the brain allow complex actions to be undertaken. There is even some recent evidence suggesting that acquiring a complex motor skill (learning to juggle) actually changes the structure of the brain. Learning to perform in this way isn't easy, though, it requires many hours of practice to "record" the programme. During much of this learning phase we are operating at the conscious, rule-based level. It is not until the juggling becomes second nature that we have successfully transferred our performance into an unconscious skill. For most balloon pilots, flying a balloon isn't an automatic task; most pilots are operating at the conscious rule-based level.

Rule Based Level of Operation

We truly are creatures of habit; we use familiar sets of rules all the time to help us to make decisions about issues that affect us. Most of these rules aren't written down, we internalise them in a structured way to allow us to access the correct rule for a particular situation. Most of what we do when flying a balloon is governed by rules that we have acquired during our training and through experience. We apply these internalised rules to make our decisions: whether to fly, how to control a descent, how to decide on a good landing site, how to decide on when to initiate a descent. Experienced pilots have internalised a whole battery of rules and so are able to deal with a wide range of different situations. Every time each of us flies and encounters something new we add to our arsenal of rules, allowing us to cope should we encounter similar situations in the future. When a PuT is learning to fly they have an experienced pilot with them who helps them by passing on some of their own rules. The more experienced the instructing pilot the more the student is likely to learn.

To supplement our internalised rules there are some simple external rules. An example of an external rule which an instructing pilot might pass on is "lead with liquid". More extensive lists of rules may also be remembered or written down as a checklist. The obvious examples are the burner test, pre-launch checks and pilot light failure. You can often hear novice pilots reciting the burner test as they work their way through it. As they become more proficient this becomes second nature until, like juggling, it is automatic. While doing the burner test may become automatic, the decision to test the burner is always conscious and rule based. The strength of this rule (how religiously it is followed) will depend on a number of factors. On occasions weak rules will be overridden for convenience or because the pilot thinks it isn't necessary.

External rules are important because they have been thought through carefully by others, allowing us to just follow them without needing to think too hard. Together with the internalised rules they provide an arsenal of "if this, then that" rules to apply, so that we can deal with a whole range of situations.

Our rule database isn't infallible, however. It may need adapting to cope with a new situation such as flying with a new type of burner or using a fast deflation system. Everyone will eventually encounter a situation where they run out of rules. They are then forced to operate at the knowledge-based level of operation.

Knowledge Based Level

If it wasn't for the knowledge-based level of operation the Montgolfier balloon would never have flown and the Wright brothers wouldn't have progressed past making bicycles. When we are operating at the knowledge-based level we are dealing with problems that we don't have rules for, so we need to go back to first principles and, using all the information we have to hand, work out what to do. Operating at the knowledge-based level can solve problems. But unlike the rules-base level there are no ready made solutions in our database, so it is a slow and thought-intensive process which often involves trial and error. An example of such a situation could be a newly qualified pilot who is trying to find somewhere to land when there is crop everywhere. The winds are light and variable and there are set-aside fields off to one side of the flight path. Training hasn't prepared the pilot for this, it isn't a

own limits

vith new situations, and argues that we can improve our abilities by recognising our limitations

situation he has previously encountered, or even thought about. The only rule that the novice has available is "don't land in crop", and this is unlikely to be useful here. By contrast, the more experienced pilot will have a range of rules he can use such as, "try and land on a track" or "land at the edge of the field" or "gain height and see if you can get a change in direction". The less experienced pilot may or may not work out these solutions. Those who have more experience might have already noticed that there was a change in wind direction when they were at flying 1500 feet or may have noticed those wispy clouds 500 feet above them moving across their direction of travel. Meanwhile, the newly qualified pilot doesn't have access to this knowledge and so will try to use his existing knowledge to deal with the situation. The solution which is chosen may not be the best given the circumstances.

In aviation circles there is a clear recognition that operating at the knowledge-based level whilst in control of an aircraft will significantly increase the chances of an error occurring. The aviation industry counters this by providing training and exhaustive lists of procedures. These allow pilots to deal with a range of emergency situations. Occasionally though, the pilot encounters a situation which isn't covered by the procedures and is forced to operate at the knowledge based level. The Kegworth plane crash was the result of such a situation.

Workload

When we are operating at the rule-based level, we can carry out tasks and make decisions relatively quickly. However, if we need to resort to the knowledge-based level of operation then things slow down. We are concentrating on solving the problem but still need to fly the balloon, so our cognitive workload has increased. Workloads increase at predictable points during any flight. If we can predict these and prepare for them then we are more likely to be able to take them in our stride. The landing has the highest potential for high levels of workload, especially if we land in a tight space or if the landing is fast. Concentration is focused on controlling the balloon. A typical scenario where the pilot hasn't thought about workload during landing might go as follows. The passengers are briefed during the approach then a check for nearby sensitive areas is made, a call from the retrieve is answered during the final descent and finally the pilot waves to the locals as the basket skims over the rooftops. However the pilot fails to notice the high tension cable which cuts across the flight path just before the playing field he has decided to land in.

High workload can to lead to mistakes where we don't have enough time to properly evaluate a situation or are distracted by too many other things going on. This can be countered by preparation, planning and delegation so that workload is spread out and reduced to a minimum during critical periods. This allows attention to be given to the important issues.

Summary

When we learn to fly a balloon we gradually and steadily build up our database of rules, and these rules may be internal or external. Most of the time we use these rules to enable us to make appropriate decisions to control the balloon. If we don't have a rule to deal with a new situation then we have to work out what to do; we are then operating at the knowledge-based level. The trial and error type approach at this level means that we won't always make the right decision. Working at the knowledge-based level increases our workload; our workload will also increase if we try to do too many things at the same time. The two main conclusions have been recognised in aviation circles for some considerable time. Avoid high levels of workload at critical points. Plan and prepare for likely situations, so reducing the possibility of operating at the knowledge-based level when flying.

Learning the Aviation Lessons

Balloonists are part of the aviation community and yet often see themselves as different from other pilots. The reasons for this are not difficult to understand. However, the fact that we are often isolated when flying and are without the support mechanisms provided by a club and aerodrome means that we should be paying more attention to the lessons learnt by the aviation community. Maintaining and improving flying skills involves tackling a particular paradox. That is, in order to be a good pilot, we need to be self sufficient and self reliant. Unfortunately, this is a quality that is likely to inhibit further learning, as self reliant people often don't like being told what to do. So perhaps the solution is not to provide books of instructions to cover situations that balloon pilots might encounter, rather it is to offer structures and training that allow balloonists to work out the solutions for themselves, thereby increasing their available arsenal of internal rules. They are then more likely to be able to have solutions available when they next encounter that difficult situation.

Martin Axon will be running a ground school for balloonists on the 18th May in Essex. See www.axon.to where you will also find a selection of rules that have been passed on by experienced pilots, past and present. The ground school aims to provide a structured learning environment where balloonists are able to improve both their understanding of balloon flying and their ability to cope with a range of situations.