

# Sub-Gravity Sensations and Gliding Accidents

Derek Piggott, C.F.I. Lasham Gliding Centre.  
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## Introduction

Over the past twenty years or so there has been a surprising number of fatal accidents in which the glider has gone into an ever steepening dive until it hit the ground. Unless the pilots survive it is impossible to be sure of the cause of these accidents and it is difficult to believe that any fully trained pilot would hold the stick hard forward when to pull back would save his life.

The first such accident I know about occurred in 1952. After releasing the winch cable the Cadet Mk 2 went into a vertical dive hitting the ground past the vertical. There was absolutely no sign of technical failure and at the inquest the medical authorities suggested either a panic state or a first epileptic fit as possible causes. However any form of fainting or loss of consciousness would apparently result in a relaxation rather than a push forward on the stick and the glider being stable would have started to recover.

Another accident for which no definite cause could be found occurred to a two seater making a normal approach in rather turbulent conditions. In this case the glider was seen to dive suddenly into a railway embankment just short of the airfield. Probably a reduction in loading was caused by the nose being lowered quickly or by turbulence and apparently the student pushed hard forward on the stick. In this case the student was reported to be very sensitive to low "g" and there was evidence that the instructor had shouted out just before the crash.

A personal experience not long afterwards convinced me of the cause of this accident. I was fully aware that my student was very sensitive to low "g" and was working on the problem. At about 50 feet on a normal approach we hit some rough air so that momentarily we almost left our seats. The student's immediate and instinctive reaction was to push forward on the stick. I was just quick enough to close the air brakes and to pull back and we hit the ground hard but on an even keel. Had I been a second later we would have crashed and probably been badly injured. In this case the student had reacted to what he thought was a stall.

Several dive-in accidents following cable breaks on winch launches drew attention to the dangers of teaching "stick forward" as the pater for the initial reaction to a cable break or stall recovery.

In an emergency the student is likely to push *hard* forward pitching the glider violently. Unless he is watching the change of attitude by looking ahead, this will result in a very intense sensation. Close to the ground there may not be time to recover from this incapacitating sensation and the glider may fly into the ground. Students should be taught to lower the nose into the normal or the approach attitude and to watch the change of attitude over the nose. This allows the visual sense to suppress most of the unpleasant sensation and renders an exaggerated recovery action less likely.

There are several different causes of these dive-in accidents. Some are due to the pilot thinking that his aircraft is stalled whereas others are due to panic or visual dis-orientation. However in every case it is probable that the unpleasant sensations involved with nose down pitching motions resulted in some degree of panic or disorientation which prevented the pilot from realising exactly what was happening and reacting normally.

Unfortunately the usual reaction to sub-gravity sensations seems to be to push forward on the stick. This accentuates the sensation and the pilot freezes in a state of panic, perhaps for only a few seconds, but long enough to cause an accident. Instructors who have seen their students in this state need very little convincing that it is the most likely cause of these unexplained accidents. However, other instructors and some accident investigators and medical authorities are still sceptical. By far the majority of experienced pilots and instructors are completely unaware of any unpleasant sensations and it is difficult to convince them that there are other people who feel completely differently.

## Degrees of Sensitivity

Almost every beginner experiences bad sensations during his first few flights, until he has learned to interpret visually

what the aircraft is doing. Poor visibility and turbulent conditions will accentuate these sensations and at this stage the student should be taught to watch ahead rather than attempt to use the instruments. Looking ahead, the visual sense reduces the sensations produced by the inner ear and other balance mechanisms and without a visual reference these sensations are much stronger and can be very frightening. Later in his training during stalling and cable break exercises the student should be taught to look ahead and to avoid watching the instruments while the nose is being lowered.

People who are very sensitive to low "g" may be totally incapacitated by the sensations during even gentle stalls and recoveries. Usually they appear to lose consciousness for a few seconds and look as though they are having spasms or an epileptic fit. During this time they may throw their heads and shoulders back and push the stick hard forward and hold it there. Fortunately most of these hyper-sensitive people give up flying but some persist and these present a real problem to the instructor. About 2-5% of beginners at my own gliding site at Lasham require special care and some extra training to overcome low "g" problems and about 1/4-1/2% are hyper-sensitive. Even experienced pilots may also have problems flying in broken cloud or poor visibility where there is no proper visual reference.

## First flights on unfamiliar types of glider

Accidents often occur on the first few flights when converting onto a new type of glider. The very light elevator and aileron forces on many modern machines result in a feel and response quite unlike the average training machine and it is easy to overcontrol and start a pilot induced oscillation. Once again the disturbing sensation helps to induce a state of panic.

This, I believe, was the most likely cause of an accident at Lasham in which the pilot on a first flight in a Swallow went into a series of violent pitching motions before diving into the ground in a steep attitude. The pilot in a similar incident was able to confirm that, after releasing the winch cable half way up the launch because of the excessive launching speed, she found that although she moved the stick back to reduce the speed, it did not seem to respond. This alarmed her and she became unable to control the glider and stop it pitching up and down. The sensations at this

time were so frightening that she was unable to do anything. The glider flew into the ground and was badly damaged but fortunately without serious injury to the pilot. In this particular case there were various causes.

The glider was being flown with the C of G on the aft limit so that there was a minimum of stability and the stick forces were therefore abnormally low. The pilot was underconfident and had probably been sent off solo prematurely by an over enthusiastic instructor who had hoped that sending her solo would have the effect of increasing her confidence. Subsequent changes of instructor had resulted in her being converted to the new type of glider while still in an underconfident state and possibly still sensitive to low "g". This accident involved an Olympia 2b (Meise) but there is a much greater hazard flying some of the modern machines which have very low stick force. A pilot converting from a training machine could run into serious problems in poor visibility or at times when there is no definite horizon for reference. Already there have been several unexplained structural failures at height involving relatively inexperienced pilots on their first flights in such an aircraft and these may well be caused by the pilot becoming unnerved during pitching oscillations. The pilot who has been allowed to overconcentrate on the A.S.I. readings is particularly vulnerable on a new machine and in looking at the instruments instead of the attitude he exposes himself to the extra mental stress of vivid sensations of low "g".

#### **Instinctive reactions to low "g" sensations**

It seems most likely that we all associate the sensation of reduced "g" with falling. As babies we soon learn that it hurts to fall down and the sensation makes us react quickly to try to save ourselves. Unfortunately instinctively putting out our hands to take the shock results in pushing the stick forward accentuating the pitching movement and the sensation. In the case of glider flying, the stick forces are low and the rate of pitch is rapid and this seems to be the reason that the problem is more common with gliders than with powered aircraft where the stick forces are much higher.

It might be expected that a beginner who moves the stick forward and experiences an unpleasant sensation would respond by moving the stick back. But even on a first flight before any real learning has been done a beginner will

invariably respond by a further pushing motion. This refutes the theory that the cause is always the belief that the aircraft is stalling and that the student is making the forward movement as a recovery action.

#### **Low "g" sensations and stalling**

Unfortunately many beginners do learn to associate low "g" sensations with the stall and this is particularly dangerous. It is safest to explain and demonstrate the sensation of reduced "g" during the introductory lesson on stalling before the student has had a chance to associate the sensation with stalls. The instructor should show the student that any nose down pitching movement produces it. During this demonstration the reaction of the student should be carefully observed.

Any sign of panic or uncontrolled reaction is a warning that special care and extra training may be needed. In these cases, immediately after landing the student should be given a careful explanation of the causes of the sensation and of what happens and why an aircraft stalls. He should also be told frankly that this is one of the sensations which every pilot has to learn to live with. His log book and progress sheet should be endorsed "rather sensitive to low 'g'" or a similar warning so that other instructors will be aware of the problem. In some cases it may take months of patient tuition to affect a complete cure and until then the student may be a danger to himself and his instructors.

Most "sensitive" beginners tend to over react and overdo the forward movement on the stick during stall recoveries in spite of clear instructions at the time to relax the backward pressure or to ease forward. This over reaction is usually a warning sign that extra caution and instruction will be needed. The best cure seems to be plenty of practice at stalling, a little at a time, together with a complete understanding of stalling and the reasons for the unpleasant sensations.

#### **The importance of routine testing of all student pilots**

It may be difficult to believe that many people reach solo standard still in a state where they are seriously disturbed by these sensations and dislike them so much that they would be unable to bring themselves to practice even gentle stalls when they were flying solo. The above-average student is particu-

larly likely to slip through unnoticed and the accident records seem to show rather a preponderance of younger people and girls involved. Probably these students do exactly as instructed during stalling exercises with the result that the recoveries are made with little or no reduced "g". Their performance pleases the instructor so that he is satisfied they are safe although perhaps they express their dislike for the feeling of stalling. Often their progress is so rapid that they are off solo with only a fraction of the normal amount of training and, of course, their post-solo dual is also likely to be less than average.

Experience has shown that the affected students have an uncanny knack of getting through to solo standard without their problem becoming apparent. It is almost as though the instructors are unconsciously persuaded into accepting the student's competence at stalling and spinning. If a student is told that he will be practicing stalls on a particular flight he will usually have a rather poor winch launch so that very little stalling can be carried out. He will often avoid making the glider stall completely and will recover prematurely, or else he will suggest that his turns need more practice or divert the instructors attention to some other aspect of his training. In every other respect his flying may be above the average and it is only too easy for another instructor who is unaware of the problem to send him off solo. Even when the student has only one instructor there is a tendency for him to become convinced that he has solved the problem forgetting that the student must be proof against a sudden and unexpected low "g" situation, a very different matter from being able to control his emotions during a practice stall at a safe height. Unless each student is given a specific exercise involving low "g" it is likely that some will still reach solo without having experienced the feeling and being able to recognise it for what it is.

#### **Testing for sensitivity**

A suitable exercise to add to the introduction to stalling and later for the routine test before solo is as follows: With the student following through on the controls the instructor demonstrates a *gentle* pitching movement from normal flight into a 20° to 30° dive pointing out the sensation. From this position a further *gentle* movement is made into a 45° dive. Finally the glider is pulled up into a steep climb and is

pitched back into normal flight. From this series of manoeuvres it is quite obvious that the sensation is not a symptom of stalling although it may occasionally occur during a stall and recovery and always if the recovery action is over done.

Just pre-solo *every* student should be tested by making him carry out these manoeuvres *himself*. A pilot who is still seriously disturbed by the sensations will be reluctant to do this exercise and will not be able to conceal his nervousness. In addition students who have apparently overcome a problem of this nature should be given a series of unusual attitudes to deal with. After a suitable warning the instructor upsets the aircraft suddenly and puts it into an unexpected position. A very rapid spin entry, a very steep stall, a low "g" manoeuvre and a steeply banked sideslip presented suddenly will test the student's reaction under stress. This exercise will also help his confidence by showing him that he can handle the most expected and extreme situations without assistance.

### Conclusions

The sensations of low "g" seem to be the main cause of panic and freezing on the controls with inexperienced pilots. Insufficient or inadequate training and a lack of understanding of stalling and of pitching sensations leave a pilot exposed to the risk of panic when this sensation occurs unexpectedly. Most beginners dislike or are frightened by the sensation of reduced "g" but quickly overcome this with experience. Some are more sensitive and react instinctively by pushing forward on the stick while throwing their head back. In gliders this can result in a violent nose down pitching movement which accentuates the sensation and increases the risk of the pilot panicking and freezing the stick in the forward position. This can be very dangerous to both the instructor and the student. Low "g" manoeuvres should be avoided during the initial training flights while the student is still learning to recognise changes in attitude. Student pilots

should be taught to watch ahead and to make any pitching movements in relation to the horizon or the ground ahead and not to watch the airspeed indicator. Without a visual reference the sensations are bound to be much more intensive and disturbing.

During the introduction to stalling, it is vital to demonstrate that the feeling of low "g" is not a symptom of the stall but merely of pitching nose down or of the aircraft sinking. Students who are disturbed by these sensations will avoid further instruction and practice at stalling whenever they can. Unless there is a routine test incorporated into the pre-solo checks for every student there is a serious risk that some students will reach an otherwise satisfactory standard and be sent solo without the instructor being aware of the true situations. The same students may be at risk at a later date unless they are given additional refresher training.

All pilots however experienced are liable to visual disorientation flying in conditions of broken cloud or poor visibility and the dangers of launching into low cloud and hill soaring in these conditions should be stressed during training.

It seems probable that there are hundreds of glider and power pilots flying regularly who are susceptible to the effects of low "g" sensations. However the much higher stick forces in most powered aircraft probably reduce the risk of the pilot inadvertently pitching the aircraft further so that the sensations become intensified. A pilot who actively dislikes the sensations involved in stall recoveries and who does not practice stalling regularly should realise that he is a serious risk to himself and his passengers. To many flying instructors are prepared to disregard the signs that their students are frightened by stalling and the sensations of reduced "g".

Only a careful flying check will reveal those pilots who are at risk. Perhaps it is time that every pilot however experienced was given a test in order to reduce the risk of further unexplained dive in accidents in the future.

### List of some of the suspect accidents and incidents reported to the author

Glider Type	Circumstances	Injuries
1. Cadet	Normal launch to about 700 feet. Glider dived vertically into ground. Early solo.	Fatal
2. T21b	Undershot airfield and dived into railway embankment at high speed. Dual.	Fatal
3. Primary	Dived steeply into the ground after a cable break. Early solo.	Fatal
4. Oly 2b	Dived in steeply following cable break. Pilot believed he was still stalled because of low "g" sensation (10 hours solo).	None
5. Oly 2b	Released during fast winch launch and failed to regain control during pitching oscillations. (1st solo on type).	Minor
6. Swallow	Similar accident to 5. but medical evidence suggested possible seizure. (1st solo on type).	Fatal
7. T21b	Student pushed forward on stick during approach through turbulence. Dual.	None
8. T21b	Girl solo pilot over-reacted in practice stall and dived vertically 200-300 feet on dual check flight.	None
9. K13	Glider dived steeply into ground on base leg of circuit in turbulent conditions. Ballast insecure. Early solo.	Fatal
10. K13	Glider dived steeply into ground following cable break. Ballast insecure and suspected of movement. Dual.	Fatal
11. K13	Glider dived steeply into ground on final approach. Canopy found unlocked. Early solo.	Fatal
12. T21b	Glider dived vertically into the ground on final approach from 300-400 feet in hazy conditions.	Fatal
13. Swallow	After low launch glider stalled and spun, recovered, then dived steeply. Pilot known to be sensitive to low "g". Early solo.	Fatal
14. Falke Motor Glider	Dived into the ground from several hundred feet. Experienced pilot.	Fatal
15. Bocian	Launched into low cloud and drizzle. Glider spiralled into the ground. Experienced pilot.	Fatal
16. Libelle	Complete structural failure at height. Pilot inexperienced on the type.	Fatal
17. Swallow	Glider flown onto the ground at speed with stick held hard forward throughout a series of bounces. First solos on the type.	None
18. Swallow	Glider dived steeply into the ground during the final approach.	Fatal
19. Schweizer	Glider dived steeply into the ground during the final approach.	Fatal