



Spatial disorientation



Flying into poor weather without the right training and experience can rapidly lead to spatial disorientation which is a potentially dangerous anatomical reaction to an unnatural situation.

A total of 101 occurrences of visual flight rules (VFR) pilots flying into instrument meteorological conditions (IMC) in Australian airspace were reported to the Australian Transport Safety Bureau (ATSB) in the decade from July 2009 to June 2019. Of those, 9 were accidents resulting in 21 deaths.

Physiologically, there are two types of spatial disorientation:

- » **somatogyral** – involving the semi-circular canals of the inner ear
- » **somatogravic** – involving the otolithic organs of the inner ear

TYPES OF SOMATOGYRAL ILLUSIONS

The graveyard spiral

This can happen when an aircraft begins to bank in cloud or dark night conditions. A constant rate of bank will be undetectable by the vestibular apparatus in a pilot's head, and unless the pilot is scanning the attitude indicator continuously there will be no visual clue. Rushing slipstream will indicate the increasing airspeed of a dive in what otherwise appears to be straight-and-level flight. Attempts to pull out of the dive often only tighten the unrecognised turn and can cause overstressing and failure of the aircraft structure.



The graveyard spin

This happens when a pilot recovers from a spin or mild bank in Instrument Flight Rules (IFR) conditions or marginal IFR conditions but, because of the somatogyral illusion of turning the other way, re-enters the bank or spin.

The coriolis illusion

This is a sudden and intensely unpleasant tumbling sensation caused by looking down when turning – for example, to pick up a pen, read a chart or glance at instruments or controls. This action causes cross-coupled stimulation of the semi-circular canals. The head movement means the canal that signalled yaw now sends a pitch message to the brain, which is at odds with the message the eyes are sending. The result is confusing and debilitating.

A pilot may dive, bank or roll an aircraft under the influence of this illusion, or they may be unable to correctly interpret the state of flight for up to a minute.

The G-excess illusion

This is a complex illusion that can occur even in VFR conditions. If an aircraft is making a tight turn that puts more than 1G load on it, and the pilot looks back into the turn, the pilot can perceive that the angle of bank and G-load are decreasing. The instinctive reaction to apply more bank can overstress or, more likely, stall the aircraft.

TYPES OF SOMATOGRAVIC ILLUSIONS

The 'leans'

This common illusion is a false sensation of rolling. To counteract the sensation, pilots lean their bodies to one side.

Leaning your body is the right way to counter the leans. Rolling your aircraft is the wrong response.

The leans often happen when a pilot looks down at a map, radio or instruments, and the aircraft goes into a gentle, banked turn that is too slow for the vestibular system to detect. When the pilot looks up and corrects the bank, and when this correction is fast enough to be felt by the inner ear, visual and vestibular information get out of sync and the leans occur.

This illusion can occur in both good visual flight conditions and at night.

The pitch-up illusion

This illusion happens in IMC or dark night conditions on take-off, or during a go-around when an aircraft is accelerating.

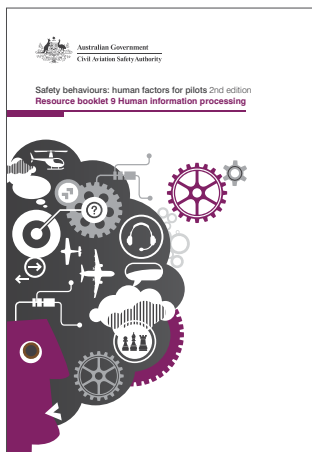
The otolithic organs in the inner ear interpret the acceleration as a pitch-up. As a result, the pilot feels a strong compulsion to push the column forward to avoid a stall. This causes further acceleration and exacerbates the illusion.

The pitch-down illusion

This less-common illusion happens when an aircraft slows suddenly, perhaps from engine failure or windshear. In poor visual conditions, a pilot might feel a compulsion to pitch upwards, risking a stall.

AVOIDING SPATIAL DISORIENTATION

- » Trust your instruments
- » Avoid flying in poor or deteriorating weather
- » Only fly in conditions for which you are trained, experienced and current.



For more information on spatial disorientation and human information processing, refer to the Safety Behaviours: Human Factors for Pilots Kit (booklet 9) available at www.casa.gov.au/safety-management/human-factors or at shop.casa.gov.au.