Not Built to Fly

Humans and all mammals have evolved in a 1 G environment. Although the brain is the central processing unit (CPU) in our physiological system, it receives input from several sense organs. The interaction of numerous sensors in our muscles, tendons, joints and skin feed information to the brain under the category of proprioception. This is how you know where your feet and hands are without looking at them. Your eyes feed data to you occipital lobes (back) of the brain. Visual association areas of the brain then process this data to give rise to the sensation of sight-"seeing" where you are on the planet and "seeing" targets of interest. Part of the inner ear is a sensor of changes of acceleration both angular (turning) and acceleration (translation). The normal brain processes and correlates all this continuous input in order to maintain orientation in space, stabilize the sight (gaze) and keep up balanced-on land! However, this complex system of interrelated sense organs only works correctly in a 1 G, illuminated environment. Change this environment to one of poor visibility and/or G loading other than 1G, you will get a system error. In the aviation environment, many accidents and incidents occurred due to a combination of false sensations. These false sensations are known as sensory illusions.

These illusions can be characterized as vestibular "feeling" or visual "seeing". However, things are more complicated that just one sense being erroneous. For now, I would just like to focus on illusions that are caused by G forces. We'll discuss visual illusions at another time.

To keep it simple, the inner ear's vestibular (balance) component consists of three semicircular canals oriented in the three planes of motion-pitch/bank/yaw. Additionally, there are two chambers called the utricle and saccule that detect linear acceleration. When the fluid in the canals or chambers moves, hair cells projecting into the fluid filled organs are stimulated and the signals from stimulated hair cells are sent to the vestibular centers in the brainstem and the sensation of motion or head/body position is determined. This determination is valid only in the 1 G environment.

Vestibular illusions occur under conditions of poor reference to a clear horizon. Even with proper use and scan of the attitude indicator and other flight instruments, the vestibular illusion will still develop. It is up to you to understand the erroneous illusion and ignore it. Not ignoring this illusion will likely create the potentially deadly situation of special disorientation.

The more common vestibular illusions are:

- Somatogyral: Caused by angular acceleration/decelerations (turning). Examples are the "leans", "Graveyard spiral", and the Coriolis illusion.
- Somatogravic: Caused by linear acceleration/decelerations. Examples are the inversion illusion, the head-up and head-down illusions.

The take home message is that the pilot must give visual information the highest priority and discount vestibular information. In other words, visual information from the flight instruments is much more reliable that sensations from the vestibular and proprioception senses. Be prepared to recognize and acknowledge vestibular illusions, it is a normal physiological effect of flying.

This is a complex subject and this short article is intended to spark your interest and awareness. Furthermore, I have not touched the category of visual illusions, another topic that can create disorientations in space and situation. Therefore, plan on attending my seminar on Advanced Flight Physiology-Illusions at Oshkosh Airventure 2014 and at a DVPA dinner meeting next year.

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