

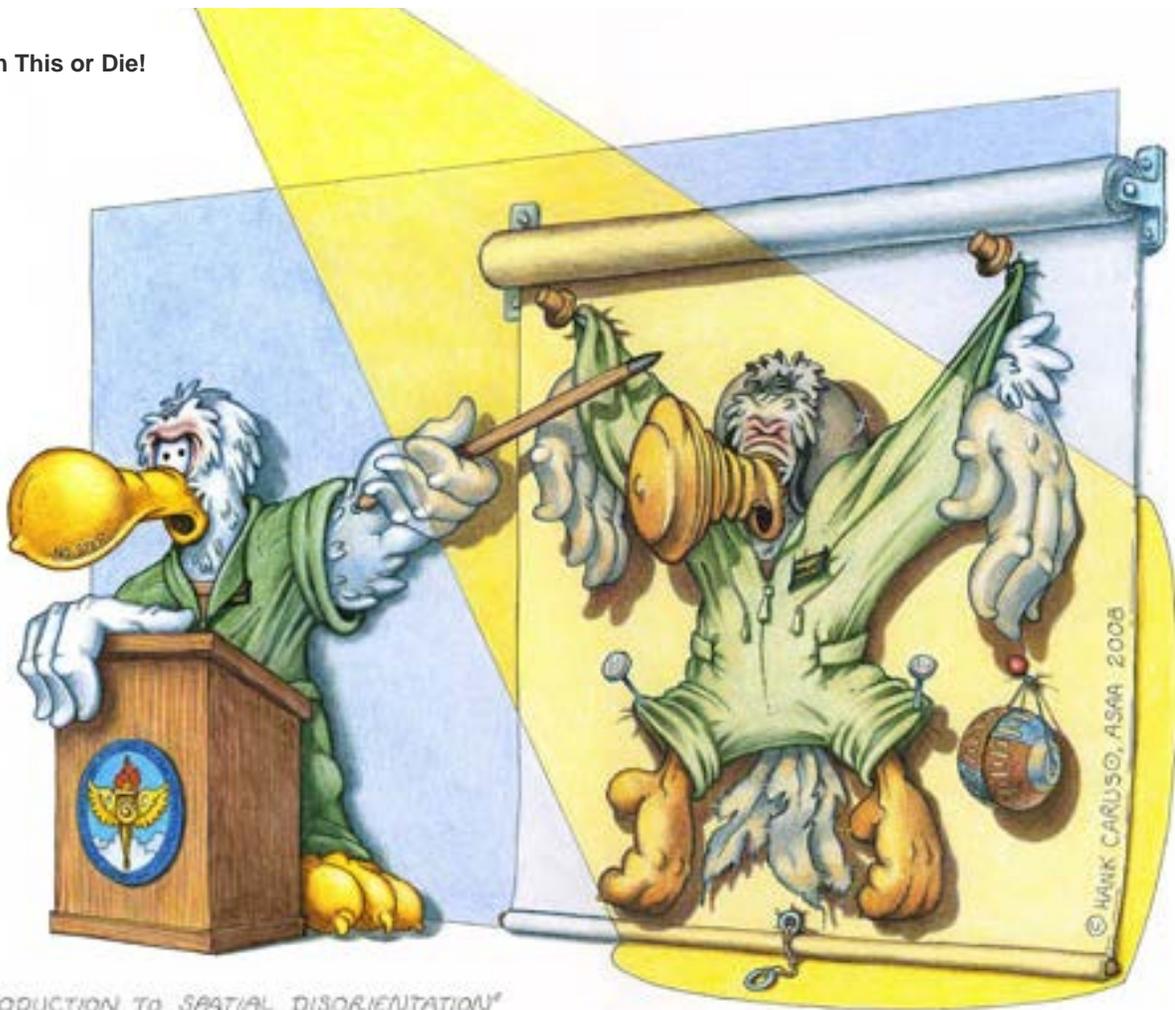
Spatial Disorientation – OCTOBER 30, 2012

Lies My Cilia Told Me: A Spatial Disorientation Primer *Art and text© by Hank Caruso*

<http://navalaviationnews.navylive.dodlive.mil/2012/10/30/spatial-disorientation/>

The genesis of this series of Aerocatures™ was an encounter with Navy Capt. Angus Rupert at a Society of Experimental Test Pilots symposium. He headed a project for the Naval Aerospace Medical Research Laboratory (NAMRL, now the Naval Medical Research Unit-Dayton) to develop a series of enhanced spatial disorientation training modules for safety school. I was recruited to create attention-getting art in a caricature style that was already familiar to the Navy and Marine Corps aviator community. Not only did these illustrations need to be visually novel to break through the “I’ve heard this before” barrier, they also needed to be technically correct to establish their value as legitimate learning tools. The Aerocatures™ on these pages are the culmination of this effort.

Learn This or Die!



*INTRODUCTION TO SPATIAL DISORIENTATION**

Spatial disorientation (SD) is an ever present demon that lurks just around the next cloud for every aviator. Because of the unique environment in which they operate, naval aviators are more at risk than the average aviator. An aviator unable to recognize and properly react to SD situations stands a good chance of becoming an unfortunate object lesson for his or her peers.

Wonderful Ways to Crater



WONDERFUL WAYS TO CRATER

Controlled flight into terrain is too often the epitaph for aviators unlucky enough to lose the battle against SD. Although there are many possible causes, a leading contender is pilot confusion over sensory inputs. If an aviator lacks the tools to resolve this confusion, the consequences can be dire.

Hard-Wired for Deception



BIOLOGICAL BASIS OF ORIENTATION

The human body is hard-wired with sophisticated biological sensors to provide a constant stream of information about its position and orientation in space. These sensors provide visual, attitude, gravitational, wind, and proprioceptor (relative positions of body parts) cues. Because this integrated sensor system is so carefully balanced, however, it can be deceived by conflicting combinations of inputs or depriving it of critical bits of information.

SD Is in the Eye of the Beholder



It was a dark and stormy night—just the right conditions for a severe bout of SD. All of the normal visual cues we rely on are missing. These conditions are usually so obvious that savvy aviators know their instruments are more truthful than their biological sensors. But there are SD situations that are far more insidious because all of the normal sensory cues seem to be present, but have been corrupted in some important way. And because motion is always involved, the consequences may be dire.

Beyond the Blue Horizon

The human sensory system inherently seeks to establish horizontal and vertical reference planes. As a result, visual perception and stark reality can diverge rapidly when horizontal references are obscured, even if only in part, as in the “False Horizon Illusion.” Consider a pilot flying near the slanted edge of a cloud bank. If the horizon is obscured, the pilot’s internal sensor system may unwittingly designate the slanted cloud bank edge as the horizontal reference plane. This, in turn, could lead to the unconscious belief that the aircraft is flying straight and level when it is actually banking. Failure to give the instruments a vote could have serious consequences.



Visual SD: The Leans



Contrary to the False Horizon Illusion, a pilot experiencing the “Leans” is actually flying wings level, but senses the airplane is banking. As a result, the pilot moves the joystick incorrectly to counteract the imagined bank. The “correction” could cause the aircraft to collide with an obstacle hidden by clouds or haze. Here, our Leans gremlin is feeding the pilot false—and potentially lethal—information, while that small inner voice of reason is desperately trying to alert the pilot to the real peril.

Somatogravic Illusion



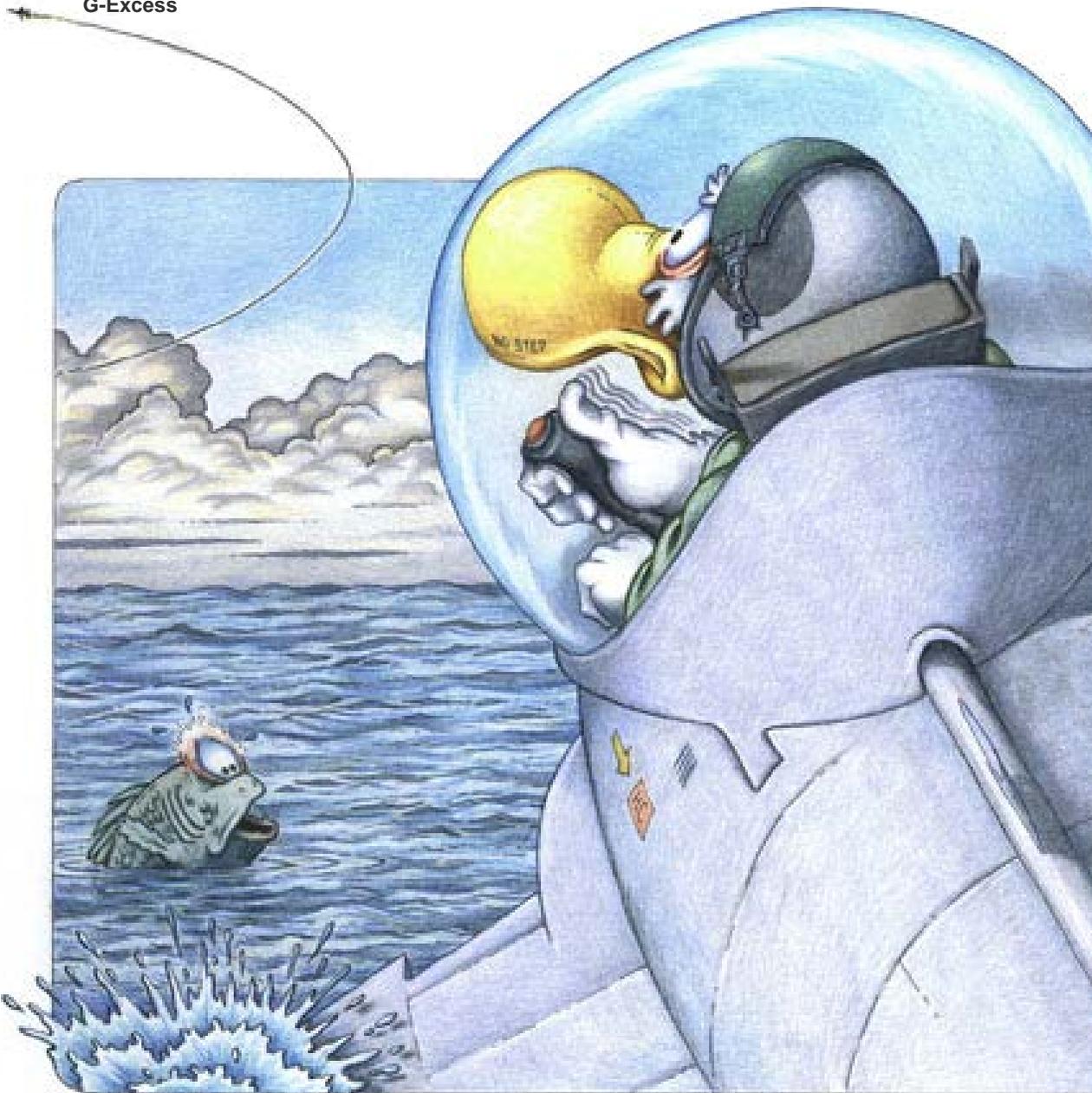
In this SD illusion, obscured vision, acceleration, and the orientation of the pilot’s head (looking upward) conspire to tell the pilot’s inner ear the airplane is climbing when it is actually flying level. To correct the situation, the pilot pushes the stick forward and begins to dive into the ground (as shown by the glimpse of horizon through the clouds). Again, an SD gremlin confounds the pilot’s sensory system, in spite of the pilot’s small inner voice of reason.

Visual SD: Vection



C3DT - VECTION

Helicopter pilots are those most at risk for seduction by the "Vection Illusion." With vection, reduced visibility keeps a pilot focused on local motion cues and obscures the bigger picture of impending danger. In this example, a pilot is attempting to hover over a fixed spot with reduced visibility. External cues (such as receding waves or blowing grass) present the illusion that it is the aircraft that is actually moving—and in the opposite direction! A plumb bob shows the pilot's hovering target, but since the waves from the rotor wash are moving away from the hover point, the pilot moves the helicopter forward to "catch up" with the waves, which the pilot's sensory system interprets as being stationary.



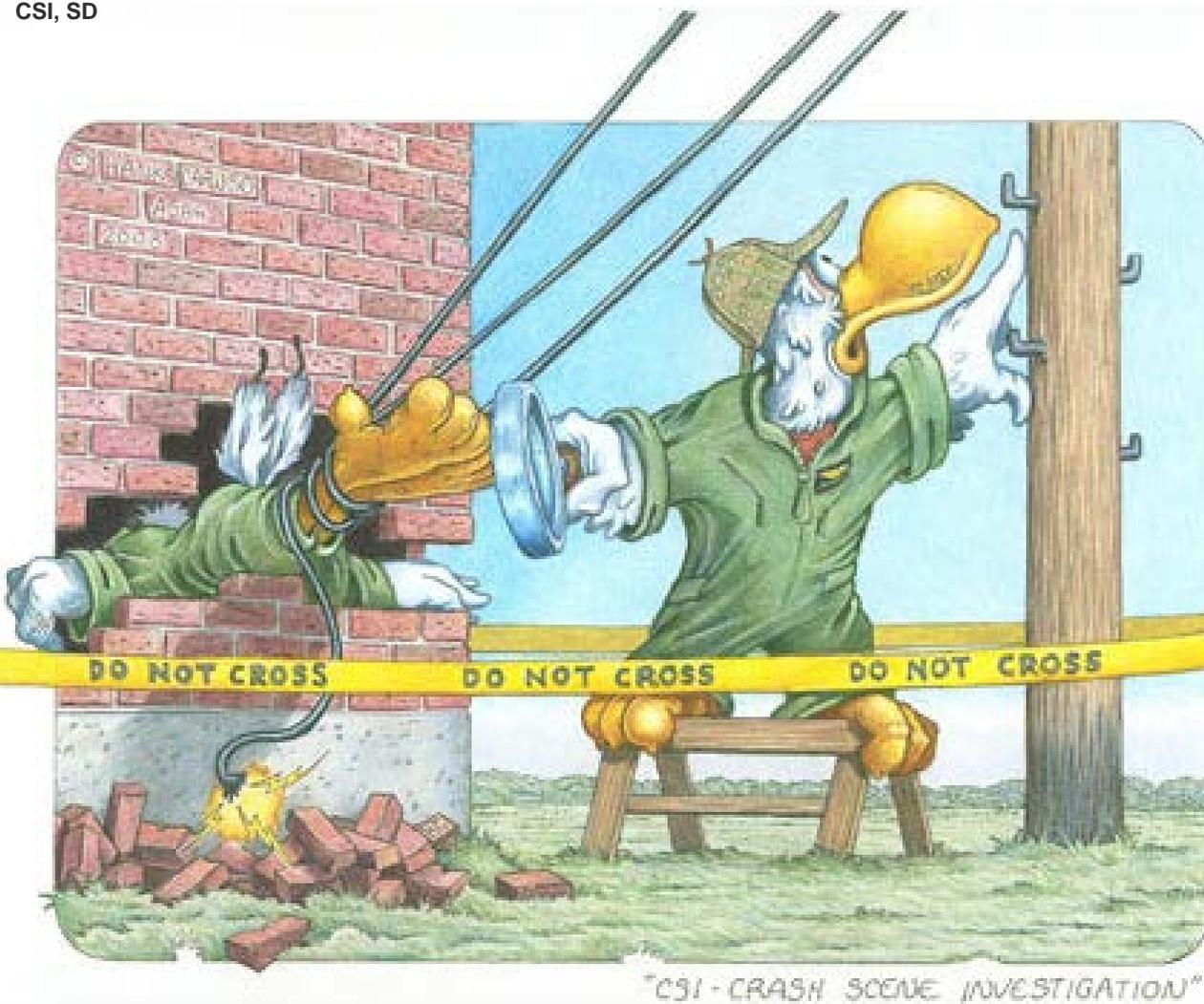
"ESDT - G-excess"

In fast-moving aircraft, the “G-Excess Illusion” can result when a moderated amount of G-force is pulled during a turn. If the pilot simultaneously turns his or her head up, down, or to the side, the pilot’s inner ear could interpret these input forces as an exaggerated head or body tilt. As a result, the pilot might feel the aircraft is underbanked and “compensates” with even more bank angle—and descends without realizing it. Here, the pilot is banking left while tracking an object moving up and left in visual flight rules conditions. The pilot feels less banked than the aircraft actually is, and so moves the joystick even more to the left, causing the aircraft to impact the ground or another obstacle.



Physiological factors can contribute to and amplify an aviator's susceptibility to SD. The first illustration highlights potential contributory factors such as motion sickness, gastro-intestinal ailments, and improperly fitted flight gear. The illustration below focuses on fatigue by showing an exhausted aviator barely awake in the cockpit on "0-dark thirty" alert. Caffeine and meds are on hand to stimulate "awakeness."

CSI, SD



A crash scene investigation is the grim aftermath of many situations in which SD was either underappreciated or misunderstood. Many Class A mishaps are ultimately determined—or strongly suspected—to be attributable to some form of spatial disorientation.

Faster than a Speeding Misconception! More Powerful than a False Illusion!

Because of their subtle onset and pervasive presence, special SD countermeasures education is an essential element for training safe and confident aviators. Aviators must rely on their SD countermeasures knowledge to remain self-assured and effective, even when facing a potential onslaught of SD events.



"ESDT - SD COUNTERMEASURES"

Will It Be on the Test?

Our "student" aviator begins to realize how much there is to understand about SD and how many different forms SD might take in the cockpit. Pencil and panic handle in hand, the aviator may focus too heavily on the details and miss the bigger picture completely. Ultimately, however, the real exam is what actually happens to aviators in flight under the "right" conditions. Gravity and rocks will grade their answers

