
flying
SAFETY
JULY 1998
U.S. AIR

UNITED STATES AIR FORCE

AIR FORCE RECURRING PUBLICATION 91-1

Flying SAFETY

JULY 1998, VOL 54, NO 7

Page 6

Page 15

Page 25

IN THIS ISSUE:

Cover: USAF Photo from '94 Rodeo. Photographer unknown

GENERAL MICHAEL E. RYAN
Chief of Staff, USAF

MAJ GEN FRANCIS C. GIDEON, JR.
Chief of Safety, USAF

GERALD C. STRATTON
Acting Chief, Safety Education and Media Division
DSN 246-0936

PEGGY E. HODGE
Managing Editor
DSN 246-0950

CMSGT MIKE BAKER
Technical Editor
DSN 246-0972

DOROTHY SCHUL
Editorial Assistant
DSN 246-1983

DAVE RIDER
Electronic Design Director
DSN 246-0932

MSGT PERRY J. HEIMER
Photojournalist
DSN 246-0986

Web page address for the Air Force Safety Center:
http://www-afsc.saia.af.mil
Then click on Safety Magazines.

Commercial Prefix (505) 846-XXXX
E-Mail — hodgep@kafb.saia.af.mil

24 hour fax: DSN 246-0931
Commercial: 505-846-0931

DEPARTMENT OF THE AIR FORCE — THE CHIEF OF SAFETY, USAF

PURPOSE — *Flying Safety* is published monthly to promote aircraft mishap prevention. Facts, testimony, and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. The contents of this magazine are not directive and should not be construed as instructions, technical orders, or directives unless so stated. **SUBSCRIPTIONS** — For sale by the Superintendent of Documents, PO Box 371954, Pittsburgh PA 15250-7954; $25 CONUS, $31.25 foreign per year. **REPRINTS** — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments.
DISTRIBUTION — One copy for each three aircrew members and one copy for each six direct aircrew support and maintenance personnel.

POSTAL INFORMATION — *Flying Safety* (ISSN 00279-9308) is published monthly by HQ AFSC/SEMM, 9700 "G" Avenue, S.E., Kirtland AFB NM 87117-5670. Periodicals postage paid at Albuquerque NM and additional mailing offices. **POSTMASTER:** Send address changes to *Flying Safety,* 9700 "G" Avenue, S.E., Kirtland AFB NM 87117-5670.

CONTRIBUTIONS — Contributions are welcome as are comments and criticism. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning.

FSFSFSM notams

"Did You Say What I Heard?"

MANDATORY readback of certain parts of clearances provides a mechanism to reduce misunderstandings between ATC and flightcrews. One civilian ATC supervisor reports on a readback error that slipped by both him and an ATC trainee, with a potentially hazardous result.

"Aircraft A was given a descent from 8,000 feet to only 7,000 feet (6,000 feet would be the norm on this route). The pilot read back 6,000 feet, which was not caught by either of us. We tried to get him back to 7,000 feet, but he went to 6,500 feet before he climbed back. Aircraft B was 1 mile in trail at 6,000 feet, same speed.

"A contributing factor was my overreliance on the trainee, who was fairly well along in training. I was assuming he would catch the problem, so I was not listening as intently. Also, the (typical) descent from 8,000 to 6,000 feet probably had the pilot expecting to hear 6,000. Only goes to prove the importance of readbacks being heard and understood."

Another controller reports that even when the readback of the clearance is correct, sometimes it's the wrong aircraft doing the reading back.

"ATC was holding about five aircraft. All were within 5 minutes of EFC (Expect Further Clearance) times. Air carrier flight ABC checked in on the frequency approaching the holding fix. ATC cleared [same company] flight BCD via the STAR. The readback sounded correct. Flight BCD then asked if that clearance was for him. ATC stated affirmative. Flight ABC was approaching EFC time and mistakenly took BCD's clearance. Flight ABC was given a safe altitude to maintain and reissued holding instructions. Flight BCD did the 'heads up,' requested clarification, and kept ATC from having a very serious situation develop very quickly.

"We all get hurried on occasion. Kudos to the pilots out there for whom safety, not time, is the No. 1 priority."

Careful readbacks—and additional clarification, if necessary—are especially important for both pilots and controllers when aircraft with similar-sounding call signs are on the frequency. ✈

Courtesy NASA Aviation Safety Reporting System (ASRS) *CALLBACK* and *Flying Safety SPOTLIGHT 1/98*

Devil 500 Meets the Mot

CDR E. M. STORRS
Courtesy *Approach*, Jan 98

It was as good an A-6 hop as you could hope for without being a Southern Watch mission—a day launch mining-and-SSC mission in the North Arabian Gulf, then a moonlit recovery.

As we turned up for launch, the weather looked a little hazier than normal. The haze must have been caused by dust, since our weather brief had not warned of anything worse than low visibility in haze—a typical Gulf spring day. Besides, it never rains in the Gulf.

After we launched and headed north to our bombing area, we noticed some large buildups and encountered some heavy rain during our mining runs. Nothing an all-weather aircraft and crew couldn't handle, though. After a few SSC identifications, we headed back toward marshal. During our mission, the weather had deteriorated. We had to pick our way through a wall of embedded thunderstorms. We got a lovely light show from the refueling probe, now a lightning rod. We made it through to VMC and breathed a sigh of relief, figuring we had passed through the worst of the weather.

We had to pick our way through a wall of embedded thunderstorms. We got a lovely light show from the refueling probe, now a lightning rod.

Our mighty carrier, equipped with the latest and greatest radar gadgetry, would surely steer toward a clear area to ease our recovery. Someone must have angered the gods, however, because not only was the ship not headed toward a clear area, it was right in the middle of the mother of all thunderstorms. The XO was kind enough to pull off the radar hood to give me a lesson in interpreting a radar scope. It looked like a scene from the Kirk Douglas movie, *"The Final Countdown."*

We decided it was a good idea to fly at max conserve to give us a little cushion if needed. The XO also dialed up both approach frequencies so we could get a feel for the excitement of tonight's festivities. All of the rest of the night events were canceled, and our approach time was delayed as our pointy-nosed brethren filled up the bolter-wave-off pattern.

As we descended from marshal, we were treated to all the splendors of thunderstorms at night. Night vision was the first casualty of the frequent nearby lightning strikes. Our CV-1 approach was immediately modified to random radar vectors because nobody was having much luck at getting aboard despite the best efforts of our talented paddles.

As we settled down in the 1,200-foot GCA box-pattern with the rest of the air wing, we noticed through the turbulence that we were picking up airspeed rapidly without any change in throttle position from me. As we wondered out loud about how odd this situation was, I remembered a story I had read about microbursts and

ther of All Thunderstorms

then watched in amazement as the airspeed indicator rapidly went from 190 KIAS to 130 KIAS and was still decaying! I applied MRT (Military Rated Thrust) and held the aircraft at the AOA for climbing flight. We watched and waited for our elevator ride to stop. We bottomed out at 400 feet MSL and started climbing.

With a new-found appreciation for microbursts, and with the ship now circling to find a steady headwind, we asked for the bingo field and fuel. It seemed like a good option because nobody had trapped after 15 minutes, and our turn hadn't even come yet. The reply came that we were blue water ops, even though two great diverts were within 100 NM. This was starting to turn into a nightmare.

We figured our own bingo fuel and heading and set up for the approach. The ship was steady on final bearing, but the winds were not in line with the program. We encountered severe wind shifts and shear on the approach, and the best I could do was to be really high at the ramp as paddles advised a bolter. We again asked for bingo information as we set up for another attempt. Approach came back with their plan.

"Devil 500, we want you to parallel the ship's course until we find steady winds, then we'll try again. Let us know when you reach a fuel state of 3.2."

After we encountered another microburst, our state was 3.2. We set course for a nearby field and penetrated some more intense weather, but our chances for a safe recovery were better.

As the XO tried to raise any controlling agency, I remembered flying into this field in the past and how impressed I was with all the anti-aircraft defenses there. It struck me that they probably would not think an unidentified object arcing down from 30,000 feet from the north would be conducive to national security, so I became increasingly interested in the communications aspect of our divert expedition.

Finally, with the help of one of our air-wing compatriots, who was UHF- and VHF-capable, we contacted approach control, and they were willing to help us. The approach and landing were uneventful as the weather over the beach was clear. We shut down with 1,500 pounds of fuel and significant airframe damage from the rough weather we had penetrated.

I learned several lessons that day. I also made commitments to always leave myself an out (a divert option) and to never underestimate the power of microbursts. We learned later that afterburner-equipped aircraft had been tapping burner routinely that night.

After five deployments, I had figured that I was immune from my night in the box. I won't be that smug again. ✈

Does Smoking Affect Flying Performance? Yes, But Not in Ways You Might Think

Editor's Note: Since Dr. Malmstrom wrote this article, smoking on Air Force and contract aircraft has been banned. Ref: AFI 11-202V3 (formerly AFI 11-206), *General Flight Rules.*

FREDERICK V. MALMSTROM, Ph.D.
Certified Professional Ergonomist

I'll admit I'm a nonsmoker of the *worst kind*—an ex-smoker. I puffed for 7 years and enjoyed every minute of it tremendously. I frankly didn't know how I'd live without the things, so I'd like to think I understand the problems of smoking addiction.

Why Is Smoking Addictive?

Good question. For one, we humans are prewired to become nicotine addicts. The brain has its own nicotinic receptors. Ingesting nicotine creates more nicotinic brain receptors, so nicotine creates its own demand. But unlike heroin, alcohol, and cocaine addiction, nicotine is a different kind of receptor addiction. I've never found a crazed smoker who blacked out and robbed a bank under the influence of nicotine. For the long-term smokers, ingesting nicotine doesn't make you feel all that good—taking it keeps you from feeling *bad.*

Evolution seems to have created nicotine as a plant insecticide. Therefore, it stands that nicotine *is* a poison. It's also a powerful alkaloid stimulant. Those feelings of lightheadedness, nausea, and blurred vision a novice smoker gets from the first drag are actually symptoms of nicotine poisoning. There's enough raw nicotine in two packs of cigarettes (60 milligrams) to kill a man outright if he swallowed all the cigarettes in a bunch. There are also a kazillion other hydrocarbons and carcinogens which are present in cigarette smoke—none of them good for you. Nicotine is just the most widely researched tobacco ingredient, so let's concentrate on that one.

Nicotine isn't necessarily "bad," as Richard Restak, M.D. points out in his best-selling book, *Receptors.* For example, it seems to alleviate some of the symptoms of both Parkinson's and Alzheimer's, both of them crippling nervous system diseases. Results from numerous laboratory studies and my reviews of the literature from 1981 to the present are quite consistent, so I've summarized them in the table. As you can see from the table, the short-term effects of nicotine administration are actually quite favorable! That is, nicotine lowers the effects of stress, increases your ability to concentrate, and actually improves our ability to solve problems. Nicotine also appears to speed up correct decision times for both simple and complex tasks.

On the other side of the coin, withdrawal from nicotine decreases your ability to concentrate, increases your decision time, increases mental confusion, increases depression, interrupts sleep patterns, and, finally, increases your aggressiveness. Ouch!

You may have asked yourself, after looking at the table, "Holy smoke (pun intended)! Does nicotine *really* boost IQ?" Curiously, most of the literature does indeed seem to point that way, if only in the short run. Nicotine does have a kind of alerting, mental concentration effect, and this effect is measurable in performance both on IQ tests and simple tasks. However, please don't count on this toxic substance to help you pass your law school admission test. The exact effects are unknown, and I am unaware that anybody has ever done a serious study on the long-term effects of nicotine on mental prowess. Besides, no physician in his right Hippocratic, ethical mind would prescribe smoking as health cure for anything. They've seen too many of their own friends and patients die from the long-term effects of smoking.

Why Isn't Cockpit Smoking Against Regulations?

We have some real problems when trying to extrapolate effects of smoking and human performance and then applying them directly to aviation. Several articles have tried to force comparisons, but there are very few real-life examples.

In 1976, on the assumption that smoking was just no darned good, some public-spirited citizen-action groups actually tried to get the FAA to prohibit smoking by commercial aircrews 8 hours prior to flight. There are lots of reasons why I believe this well-intentioned piece of proposed legislation wasn't such a hot idea, and the table seems to sum up why. J. R. Dille's 1981 monster review of 2,660 fatal general aviation accidents in *Aviation, Space, and Environmental Medicine* looked at the interac-

tion of aircraft safety, accidents, and smoking, and then he asked some serious questions about that proposed smoking ban. Dille found that smoking was not identified as a causal factor in accidents, but may have been a contributory factor. The evidence wasn't all that clear. The review predicted a ban on cockpit smoking would cause some real problems in tradeoffs with the short-term "beneficial" and "deleterious" effects of nicotine. Since that time, HQ USAF has many times considered and kicked around similar cockpit smoking ban proposals and wisely determined that further research is needed.

Smokers Have a Tiger by the Tail

How effective is nicotine chewing gum and the patch? Are they really substitutes for smoking? The short answer is that gum and patches may help some people—but they are not by any means cures. Smokers and nonsmokers alike who receive nicotine from either gum or patches experience most of the same "boost" symptoms in Part A of the table. Furthermore, the systems of persons who smoke denicotinized cigarettes have the same withdrawal symptoms shown in Part B of the table. It's obvious that the effects of smoking aren't only psychological.

It should be obvious that once you start smoking, you have a tiger by the tail. Smokers can't live with cigarettes, and they can't live without them. For those of you who really want to quit, be prepared for some rocky days and nights. I fully agree with the argument that there is really no such thing as the "typical" smoker any more than the "typical" quitter. Some smokers can quit cold turkey, and some do it better if they go in stages. Makers of nicotine patches and gum (wrongly) assume we are all of the step-down variety. Both smoking and nonsmoking is *big business*, as smokers who attempt to quit subsequently relapse at a rate of about 70 to 80 percent. Drs. Teresa Sommese and John Patterson's *Aviation, Space, and Environmental Medicine* (1994) insightful literature review of the adverse short-term effects of quitting smoking indicates the "cure" may be worse than the addiction. That is, *nobody* wants a pilot exhibiting the full-blown symptoms of nicotine withdrawal as shown in Part B of the table. And, for those smokers who don't have enough to worry about, "nicotine withdrawal" is actually defined as a (minor) "mental disorder," according to the psychiatrist's bible, the *Diagnostic and Statistical Manual, DSM-IV.* So…

TABLE

A. Symptoms of Nicotine Administration:

Heart rate (up)
Vigilance (up)
Concentration (up)
Physical energy (up)
Reaction time (down)
Stress (down)
Measures of IQ (up)

B. Symptoms of Nicotine Withdrawal:

Short-term memory (down)
Blood pressure (up)
Food consumption (up)
Aggressiveness (up)
Sleep (down)
Depression (up)
Absenteeism (up)
Confusion (up)
Impulsivity (up)
Job satisfaction (down)

The short-term effects of nicotine actually seem to be quite favorable!

Do You Really Want to Quit?

Simply stated, nicotine withdrawal effects get more intense the longer you are withdrawn and the more your mental performance is degraded. Effects can be easily found in as little as 1 hour after the last cigarette. This is why the aerospace medical literature offers caution about problems associated with quitting smoking, at least in the short term. **My advice is, if you really want to quit, *and* you are concerned about the effects quitting may have on your flying performance, then go cold turkey over a 14-day leave period when you're *not* flying.** By that time, you ought to be over the most serious parts of your physical addiction (see the table, part B) and should then be able to keep your attentiveness and judgment powers more fully on flying.

And…Do You Want to Help Others Quit?

We humans are social animals, and we seek out the company, praise, and encouragement of others (even when we don't deserve it). This step is often overlooked by nonsmokers who are quick to pass judgment on smokers. I've found that supporting those who are trying to quit is a very important first step in breaking the habit. **Regardless of whether you are a smoker or nonsmoker, if you are interested in helping *others* quit, then praise the dickens out of those who are trying to quit, and support their decision enthusiastically.** It's much more helpful to praise the quitter than snarl at the smoker. And, of course, do quitters a favor—don't offer them cigarettes. ✈

Which Way *Is* Up?

A Primer on Spatial Disorientation

CMSGT MIKE BAKER
Technical Editor

It was a partially moonlit night, and there was no discernible horizon—favorable conditions for inducing disorientation. As the four-ship F-15 mission entered its assigned working area, Lead cleared Nos. 3 and 4 to break formation for their pre-briefed point and then cleared No. 2 to move from route to trail position. As No. 2 moved to trail, Lead observed No. 2's aircraft pitch up and roll left rapidly. Lead told No. 2 to recover. Two then rolled inverted, and the nose of his aircraft started falling through the horizon. Certain that No. 2 was unaware of his aircraft's actual attitude, Lead made a hard descending turn to follow and used radar to maintain awareness of No. 2's position and his own aircraft's altitude. As No. 2's aircraft was beginning a second barrel roll, Lead directed him to get on instruments and recover. When queried by Lead about attitude, altitude, and airspeed, No. 2 stated he was severely disoriented and had stagnated one engine—spatial disorientation had struck again.

A Hazard to All Aviators

Spatial Disorientation (SD) occurs when a pilot incorrectly perceives his aircraft's true motion, altitude, or attitude relative to the earth's surface. "Which way is up?" is a question that the aviator may no longer be able to answer with absolute certainty. And beware! In one of the most common—and dangerous—varieties of SD, the pilot *doesn't know* that he doesn't know which way is up. It is said there are two types of pilots: Those who have experienced SD and those who don't know they've experienced SD.

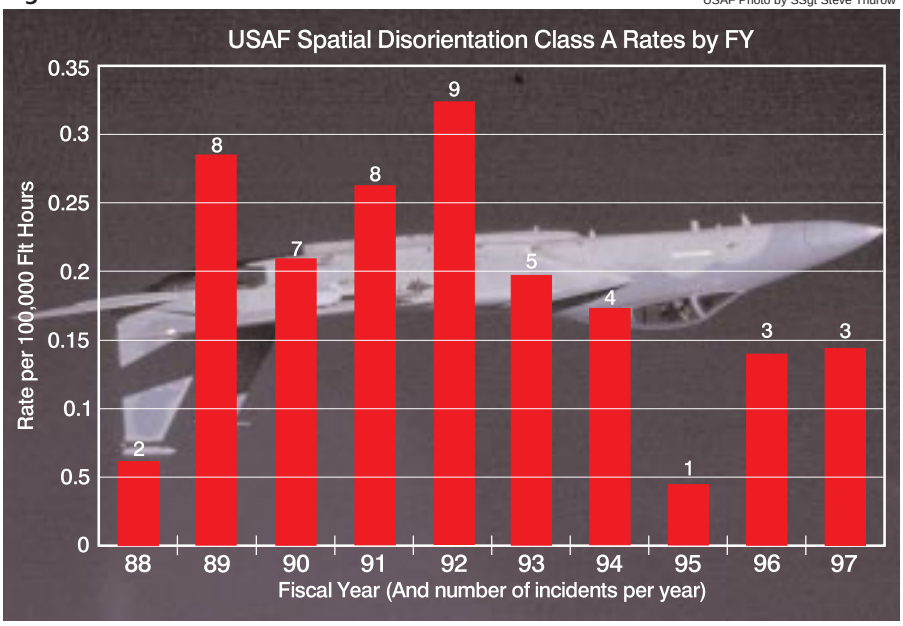
Contrary to some popularly held notions, it isn't just the operator of high-performance aircraft, or the inexperienced flier, who is susceptible to the deadly effects of SD. SD is a phenomenon that transcends aircraft flight characteristics (high-performance or not), experience levels, affiliation (military or civil aviation), and aircraft type (large or small aircraft, fixed- or rotary-wing). And while a seasoned aviator's greater level of experience produces heightened awareness—one of the most effective tools for preventing spatial disorientation—more cockpit time won't provide him with any special immunity.

According to Mr. Bill Ercoline, an engineer and retired USAF pilot assigned to AFMC's Armstrong Laboratory, Spatial Disorientation Countermeasures (SDCM) Task Group, SD is a phenomenon that was observed "almost from the beginning of manned heavier-than-air powered flight." Since SD was discovered to be a factor in dozens of Air Force Class A mishaps, research into its causes, techniques for precluding its onset, and learning how to recover from SD have been studied intensively. As shown in figure 1, between 1988 and 1997 alone, the USAF had 50 Class A mishaps directly attributable to SD.

The Air Force is not alone in recognizing the lives and airpower assets that could be saved by helping prevent SD. Through its Naval Aerospace Medical Research Laboratory, Spatial Orientation Systems Department, the US Navy is actively involved in developing a man-machine interface system to provide pilots with continuous *tactile* information about aircraft attitude and motion. Stay

Figure 1

USAF Photo by SSgt Steve Thurow



tuned for further developments on this.

The Spatial Disorientation Phenomenon

Simply stated, if our senses tell us the aircraft is doing one thing, and the aircraft is actually doing something different, then spatial disorientation has occurred. Although SD often manifests itself in the absence of a visible horizon—flying at night, through heavy cloud formations, in bad weather, in obscured visibility—or when transitioning from VMC to IMC, this insidious killer will also occur in pure VMC.

As ground-dwelling people, our vision, vestibular system (balance mechanisms in our inner ear), and somatosensory system ("seat of the pants" awareness) have all evolved to function reliably on the earth's surface. These internal systems enable us to walk, run, jump, and maintain an awareness of balance and orientation with little conscious thought. On the other hand, once in the flight environment, these internal systems, which work so well on the ground, can be rendered unreliable fairly easily. In flight, we depend heavily on vision—our view of the earth's horizon and aircraft flight instruments—to maintain control and orientation. In the absence of a real (or perceived) horizon, our vestibular and somatosensory systems will provide orientation sensations to the brain, and therein lies the danger. Because our balance and orientation systems evolved in a 1-G environment, even moderate aircraft maneuvering can stimulate them to provide false impressions of orientation.

And keep this thought in mind: Due to another phenomenon known as vestibular suppression, the visual image will generally override the vestibular input. What does this mean to the aviator? A false visual horizon will "bite" much harder than a vestibular input and is much harder to correct. On the other hand, a true visual horizion will almost instantly overcome conflicting vestibular and somatosensory sensations. Since we rely so heavily on vision and the vestibular and somatosensory systems in day-to-day living, it's easy to understand why SD occurs. Knowing these primary senses can provide incorrect perceptions is one of the first steps in preventing SD.

The Three Basic Types of Spatial Disorientation

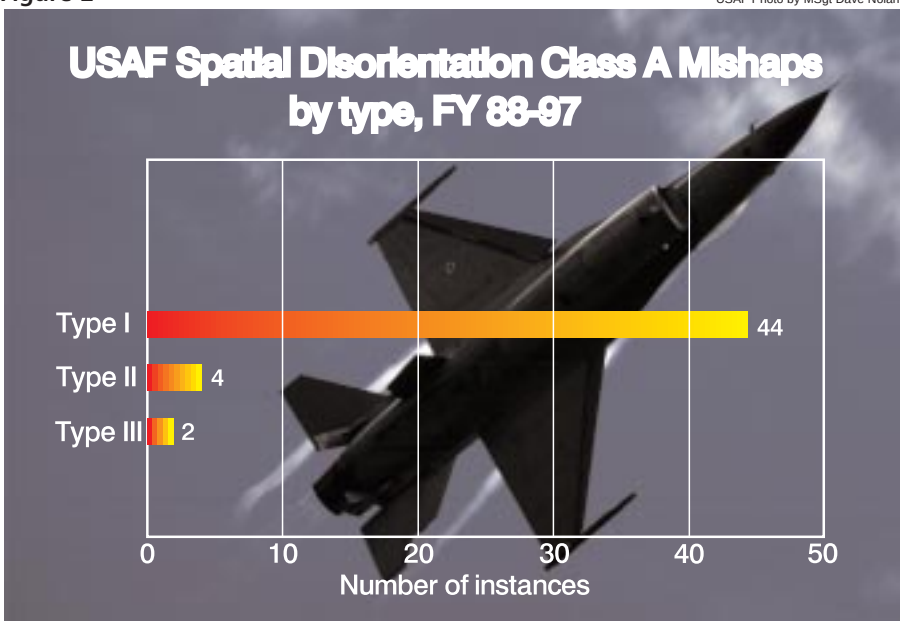
The late Dr. K. K. Gillingham, also a key member of Armstrong Laboratory's SDCM Task Group, described SD as falling into one of three basic categories: Type I, or Unrecognized SD; Type II, or Recognized SD; and Type III, or Incapacitating/Uncontrollable SD.

Type I, Unrecognized SD. Since the pilot has no awareness of being spatially disoriented, Dr. Gillingham describes Type I SD as the most insidious. That Type I SD is the most dangerous variety of disorientation is borne out by taking a look at figure 2 and comparing instances of Type I, II, and III SD. Be careful! While many cases of Type I SD occur during unsuccessful transitions from VMC to IMC, Type I SD may occur under almost any conditions, including IMC, night VFR, or over large bodies of water. Some of the more familiar types of Type I SD are the "Leans," the "Graveyard Spin" (or Spiral), and the "False Climb" illusion. The following mishap typifies an encounter with the Type I SD False Climb illusion.

The mishap pilot—a highly trained, disciplined, exhibition aviator—manned his aircraft with weather reported as 300 overcast, tops at 4,500 feet, and visibility at 6 miles. On takeoff, he built up 300 knots of airspeed under the dense cloud layer, pulled the stick into his lap, and blasted into the clouds 45 degrees nose-high. Once in the overcast—and sensing incorrectly that he was still climbing—he pushed the nose over, maintaining a near-zero-G trajectory until the aircraft crashed 30 degrees nose-low, wings-level at 540 knots.

Figure 2

USAF Photo by MSgt Dave Nolan



Type II, Recognized SD. Dr. Gillingham summarizes Type II SD this way: The pilot "…may experience a conflict between what he feels the aircraft is doing and what he determines from the flight instruments that it is doing. Or he may not experience a genuine conflict, but merely conclude that the flight instruments are lying to him. He may also feel that the aircraft is attempting to assume a pitch or bank attitude other than the one that he is trying to establish. Although Type II SD is labeled 'Recognized,' the pilot may

continued on next page

not actually realize he has SD; he may only realize he has a problem ascertaining or controlling the performance of his aircraft, without the slightest idea as to why."

When a pilot makes reference to "…getting a bad case of vertigo on final approach," this is a Type II SD. Type II SD may also manifest itself through the "Giant Hand" phenomenon. When experiencing this illusion, the pilot feels as though his flight control inputs are being actively countered by external forces, hence the name, "Giant Hand." As with all types of SD, an absence of visual cues, or a conflict between the senses of vision and equilibrium, often give rise to disorientation.

The student pilot—under the hood—was executing a practice missed approach climbout, which included a 4,000-foot climb with a 90-degree right-hand turn. Once at the specified altitude, he had difficulty leveling the aircraft and needed both hands to push the stick forward to arrest the climb. As soon as he removed his left hand from the stick to put it back on the throttles, the aircraft resumed its climb and he again had to fight with both hands to stop the ascent. After this went on for a few seconds, the student pilot asked if the IP in front had his hands on the controls. The IP replied "No," and asked if the student was okay. Realizing he was experiencing SD, the student communicated this to the IP, who allowed him to pull the hood back and look outside. Once the student had his bearings, the Giant Hand disappeared, and he went back under the hood.

Type III, Incapacitating/Uncontrollable SD. Finally, with Type III SD, the pilot is disoriented and knows it, *but is unable to do anything about it.* Under the right conditions, confusion or nystagmus (involuntary oscillation of the eyeballs caused by dizziness) may be so overwhelming that the pilot finds it impossible to interpret the flight instruments. Or the pilot may be convinced that the aircraft is not responding to—and perhaps even counteracting—control inputs, as would happen in an extreme case of the Giant Hand phenomenon. In rare instances, the pilot may even be paralyzed and unable to make a rational decision. Fortunately, Type III SD is relatively uncommon.

Preventing Spatial Disorientation

There are two major categories of factors that influence susceptibility to SD: environmental and physiological. Although the aviator has little or no control over most items in the environmental category, such as weather, type of mission, time of day, mission duration, cockpit layout, and the like, he does have control over many of the physiological factors. Physical and mental fatigue, dehydration, self-medication, and use of alcohol—even if not used within the time limits specified by regulation—will all increase susceptibility to SD. Illness or use of alcohol will also compound fatigue and dehydration, further increasing vulnerability. Conversely, a healthy lifestyle, flying only when physically and mentally prepared, and abstaining from use of alcohol are positive steps that will reduce vulnerability. Other physiological factors, like good crew coordination and thorough mission planning, can enhance prevention of, or quick recovery from, SD, just as poor crew coordination and inadequate mission planning can delay recognition of, and degrade recovery from, an SD encounter.

The most important weapons for combating SD are knowledge and vigilance. Know the causes of spatial disorientation, understand the limitations of your vision and equilibrium systems, be prepared to react when conditions are favorable for SD, and stay alert!

Overcoming Spatial Disorientation

The two most important factors in overcoming spatial disorientation are *recognizing that spatial disorientation has occurred,* and then *"making the instruments read right."* If you don't realize you're disoriented, there's no imperative to correct a dangerous condition. The results can be chilling. As depicted in figure 2, 88 percent of the Class A SD mishaps were due to Type I, "Unrecognized" SD. It is absolutely crucial that you *maintain an adequate instrument cross-check!*

Failing to transition to instruments—the ADI, altimeter, turn-and-slip indicator—when conditions warrant, or making an unsuccessful transition, jeopardizes the safety of you, your wingman, your crew and passengers. "Making the instruments read right" simply means making the aircraft do what you want it to do by flying your instruments. This is more than just "Believe your instruments." Returning the aircraft to a wings-level attitude may require that you suppress an illusion of the horizon, or that you overcome the vestibular sensation that says you aren't wings-level. But believing your instruments, and having a wingman (or another crewmember) back you up in reading them correctly, will enable you to overcome SD. Also, minimizing head movements and scanning with your eyes will prevent an already confused vestibular system from providing further confusing sensory impressions to the brain.

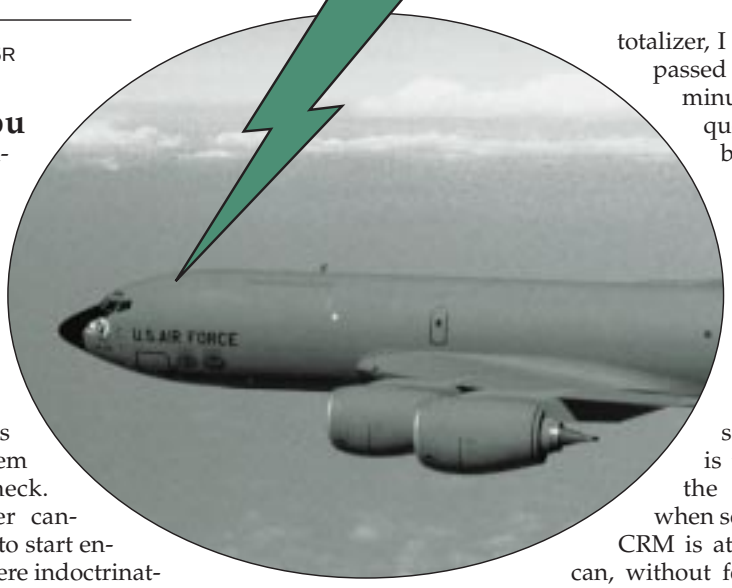
Flying isn't a natural act for human beings, and we must accept that our internal sensory systems may lie to us during any stage of the flight regime. Turning, diving, banking, accelerating, and decelerating can all easily fool the most acute sense of equilibrium, and when the visual component of orientation is lost, SD can take over. Once your "onboard" systems become unreliable, the only thing you can count on is your instruments. Trust them, and always make sure you are controlling them!

Now, back to No. 2. When we left him, the situation was grim: A featureless night, he was severely disoriented, an engine had gone south, and his aircraft was out of control. Thanks to Lead's airmanship and situational awareness, he stayed with No. 2 and talked him through his disorientation by directing a focus on cockpit instruments. Two regained control, successfully restarted his engine, and subsequently made a successful recovery at home field. Lead's appreciation that prevailing conditions were ripe for inducing SD, and knowing how to prevent falling victim to its effects, are what, for No. 2, made this event a frightening tale worthy of publication in a "There I Was" article, rather than a Class A mishap. ✈

Special thanks to Maj Clark Davenport, HQ AFSC/SEFL, for assistance in researching this article.

Don't Just Say Something—Say What You Mean!

CAPT DAN LYKINS
CCTS Instructor Pilot, KC-135R
Altus AFB, Oklahoma



…Say what you mean. It sounds simple. Common sense. But it's not. I had that point driven home recently.

I was instructing my first pair of student copilots during their KC-135 pre-check ride sortie. Confident of their abilities, I was ready to recommend them for their stan/eval check. Our scheduled receiver canceled as we were about to start engines, so my students were indoctrinated in flexibility, "the key to airpower." The hours of planning the day prior went to waste as ops radioed our new refueling track, rendezvous time, and receiver data. Not a problem.

We took off, and before long, our new receiver, a C-17, was closing for his onload. Due to the marginal capability of the tanker autopilot, the big-nosed C-17 must close slowly from 50 feet to allow the tanker's trim to keep up with the aerodynamic forces of flying in close vertical proximity.

As I flew and my students prepared to offload 30,000 pounds of fuel, the cautions and warnings from the refueling manual drifted through my mind: "Large out of trim forces"… "Be prepared to disconnect the autopilot"… "Keep one hand on the yoke and the other hand available for immediate throttle application." Meanwhile, the C-17 student-pilot was saving the vertical portion of his closure to contact until the last second. This is the proper technique for catching the tanker autopilot off guard. I was ready. Thankfully, the autopilot held on.

"Contact."

"Contact."

"Pumping gas."

"Roger."

As my students monitored the offload, I wondered if they were aware of even half of the thoughts going through my mind concerning aerodynamic forces, procedures, and warnings. I maintained my vigilance throughout this first contact.

"How's the offload coming?" asked the boom operator. My students didn't seem to comprehend that the question was directed to them. Glancing at the offload totalizer, I responded that we had passed 24,800 pounds. A few minutes later, the C-17 requested a disconnect and backed out. Then I really looked at the fuel gauges. To my dismay, we had given away 40,000 pounds—10,000 more than we had wanted!

My CRM (cockpit resource management) instructor once said, "The goal of CRM is to empower anyone in the aircraft to speak up when something seems wrong. CRM is at its best when an *A1C* can, without fear of reprisal, tell the *colonel pilot* that he's off altitude. The problem is to get that A1C to say something—anything! ANYTHING!

Well, I got what I asked for. My boom operator had spoken, but I didn't get his message. We missed the single most important thought in communicating—understanding.

I am reminded of an L-1011 that crashed into the Florida Everglades due to a burned-out nose gear light bulb. Only the air traffic controller noticed they were descending to their death after the autopilot inadvertently disengaged.

"Is everything okay up there?" the controller asked.

"Yeah," answered the L-1011.

Yeah, 24,800. But the tanker offload totalizer was inoperative. When I'm running offloads, I normally use the individual tank readings.

"It seemed like it was taking a long time to pass 30,000 pounds," said my boom operator afterwards. That's what he *meant* when he asked how the offload was coming. Busy with aircraft control, I missed his hinting that the offload should be complete.

We were lucky. The receiver change had left us with extra fuel, so the error didn't impact our mission. Actually, it was a good lesson for the entire crew. Had we been over the pond, however, that hour's worth of fuel would have meant much more to us!

Do you include CRM in your mission briefings? How about this: *"If anyone sees anything different, unusual, wrong, or thinks the pilot is unaware of what's going on,* ***SAY WHAT YOU MEAN! NO HINTING! THAT'S YOUR JOB!*** *"* ✈

"Yankin' the Invisible Chain"

USAF Photo by MSgt Perry J. Heimer

MAJ MARCUS JANNITTO
143 AW
Quonset Point, Rhode Island

It was a nice night to fly TAC (tactical flight). Weather was clear with a scattered deck at 10,000 feet, three-quarter moon, and winds out of the west at 20 to 30 knots at altitude. Our mission was a two-ship ESKE (Enhanced Station Keeping Equipment) training flight to a local drop zone. Being a C-130 Guard unit, the majority of the crewmembers on the mission were traditional guardsmen, including the night Supervisor of Flying (SOF).

Having recently picked up the ESKE mission, the majority of us were newly checked out in ESKE IFR formation procedures which we used for most of the flight. However, due to the small size of the drop zone, lead had to make the drop using visual procedures. To maximize ESKE training, our SOP called for us to cancel IFR just prior to the slowdown, then fly the drop VFR while following the ESKE formation procedures. It was a bastardized system at best, but one that allowed us to become proficient with ESKE in our local area.

Several weeks prior, our unit decided to establish the ESKE slowdown points at each of our three local drop zones at 12 NM out of the DZ, as opposed to our usual 6.5 miles for visual drops. This was fine with us—it gave us more time on the run-in to get used to these new procedures.

Prior to flight planning, we got the setup sheet from the SOF, which specified the drop zone, the route, type drop (on this night, each airplane would drop a TBH, or "training bundle, heavy," essentially a 15-pound bag of sand), AGL drop altitude, subsequent routes, and en route threats. As the nav in the No. 2 aircraft, I got the en route winds and temps and plugged them into the computer flight planning program. While the printer was spitting out the flight plans, I did the ballistics on the CARP (Computed Air Release Point) program, inputting winds, altimeter setting, temp, and the 600-foot AGL drop altitude from the setup sheet. We briefed, "what-iffed" a few things, did a quick route study, and went out to the airplanes.

Taxi and takeoff were normal, and by the middle of the route, we were feeling pretty comfortable with this ESKE thing. The moon was out, vis was good. It was a great night to fly.

Inbound to the IP, we descended from our en route altitude of 4,000 feet to 2,500 feet, then cancelled IFR. Since we had an east-west run-in to the DZ and were slowing down at 12 miles out instead of our usual 6.5, the lead nav and I decided we wanted to be early at the slow-

down point due to the run-in headwinds. Our time control showed we were a little too early, so lead slowed the formation from 210 IAS to 190 IAS. We called slowdown at 12 miles, slowed to 140 IAS, and began our descent to our MSL drop altitude of 840 feet. We had the drop zone in sight at the slowdown and, with the 20-knot headwind, had plenty of time to stabilize the formation prior to the drop.

Being No. 2 in a two-ship formation is nice because some of the pressure is off. And though the drop zone perspective looked a little funny, I figured it was because I hadn't flown at night in a while. Positioned in the window next to the copilot, I started a mental cross-check (DZ area in sight, altitude passing through 1,200 feet for 840, airspeed 140, course looks good, lead's a little high, nice wood floors in the house down there, the low altitude light's on (?), radar altimeter 360! 340! 320!!!).

"Whoa! Level off! Level off!"

About that time a bunch of things happened almost at once. The engineer called "Altitude." The AC saw the low altitude and climbed up to 800 AGL. And the copilot called for lead to climb (lead was already climbing). We did manage to get the drops off (I won't mention the scores), finish the mission, and return for an extensive debrief.

What happened? We ended up yanking the proverbial chain of events, with each link being fairly minor, but having the cumulative result of almost putting us into the moonlit dirt.

For starters, our 55-130, Chapter 10, has a night altitude restriction for a TBH at this drop zone of 650 AGL (what's 50 feet, right?). This was a recent change, and it slipped by the night SOF (and the rest of us). Next was the 12 NM slowdown. This was a familiar run-in for all of us. All they did was move the slowdown back (somebody looked at the terrain, right?). On closer inspection, the fairly flat terrain elevation at 9 NM is around 1,000 feet, descending to the DZ elevation of 240 feet. This was never a factor with a 6.5 NM slowdown. Combine this with a 20-knot headwind and 190 IAS, and you're descending quickly into familiar "unstudied" terrain. The other insidious links included complacency, concentration on new procedures, and the lack of the usual "attention getters" (unfamiliar routes, weather, dark night).

Seldom are the links in a mishap chain clearly visible. Hindsight is fine, but it will never take the place of foresight, vigilance, and good communication. Seeing the links and breaking the chain will keep us all where we want to be—above the ground rather than under it. ✈

Flying Blind

Courtesy *Callback*, Apr 98
NASA's Aviation Safety Reporting System (ASRS)

A General Aviation pilot sensitive to sun exposure took the precaution of applying a sunscreen lotion before flying over a desert area. But as the cockpit became warm, he started to perspire. Then began a horrific experience…

At 7,500 feet on a heading to the East…my eyes started reacting in a very violent way to the sun lotion that I had applied to my face prior to takeoff. The allergic reaction resulted in at least 5-8 minutes of total blindness. I just managed to set the autopilot on a heading away from the high terrain to the East. On partial recovery of sight, I found that I had intruded into a [Restricted Area].

During a callback conversation with an ASRS analyst, the reporter stated that when the sunscreen lotion ran into his eyes, he experienced sharp pains and loss of vision in both eyes. Fortunately, he was able to put the aircraft on autopilot. The reporter recalled that he had placed a can of soda in the cockpit. He managed to find the soda and pour it on one eye, while wiping the eye with a tissue until it became usable. He ran out of soda, but then saw a container of water, which he used to clean the other eye. After he had recovered his sight, he checked his position and discovered that he had overflown a turn point and was now inside a Restricted Area. He called the Center controller, who vectored him clear and on course.

According to the reporter, on the back of the sunscreen container—in fine print—was a warning to avoid eye contact with the contents. He told ASRS that he remembered reading the warning before the flight, but never considered the possibility of perspiration causing eye contact with the sunscreen lotion ingredients. The reporter felt that there should be a stronger and more complete warning on the container. He knew of another pilot who had a similar experience, using the same sunscreen lotion. ✈

Helmet Fires

MAJ NED LINCH
309 FS/SEF
Luke AFB, Arizona

Sometimes "helmet fires" get the best of us and result in a mishap. Single-seat fighter pilots face some of the most challenging environments. We have to organize our own resources plus work as a team to accomplish the mission while preparing for immediate contingencies such as weather, threats, IFEs, and alternate missions.

Putting out the fires involves staying ahead of the jet through preparation and anticipation—preparing for the "worst case" and anticipating the next event in the chain. How to maintain this state of situational awareness (SA) varies from pilot to pilot. Here are some proven concepts.

Preparation

• **Mission planning.** Plan together as a team with one central focus led by the flight lead and the mission will flow smoothly even if faced with contingencies (weather, fallout, jet and airspace problems).

• **Know the capabilities of your flight.** Are you flying with a new wingman? What are the currencies for everyone in your flight? The flight commander should be the key person to find the answer to any questions regarding personal problems.

• **Briefing.** The "on time" brief should be the melding of mission planning information, tailored to the least experienced pilot, and not an introduction to the plan. A poor briefing usually equates to a flight filled with multiple "helmet fires."

• **Preflight.** Slip your times to accommodate last-minute changes. Disruptions to pacing and habit patterns increase task saturation.

• **Ground operations.** Review your game plan for a takeoff emergency where critical actions must be accomplished quickly with little time for analysis. Thinking through your game plans, reviewing your shot/kill criteria, and memorizing the attack parameters can increase your chances of killing the bandit/target.

• **Proficiency.** When was the last time you accomplished an emergency procedures simulator or cracked open the Dash One? Did you really accomplish a SEPT last month? You are responsible for your proficiency and knowledge.

• **Personal life.** Are you fit to pull high Gs? You should have a personal fitness program including proper nutrition. Are you getting enough crew rest to maintain a high degree of alertness and beat fatigue? If not, make some lifestyle changes.

Anticipation

• **Wingman anticipation.** Anticipate and lead turn the next event. Use any idle time to accomplish checks (ops, fence, descent) or avionics setup (radar, navigation, IFF) prior to the flight lead's call. This includes anticipating formation changes plus being ready to back the flight lead during an emergency—reading the checklist or calling out critical altitudes. Misprioritization of tasks, such as spending too much time in the "tube" and not monitoring the flight lead, may cause a flight path conflict and degrade the tactic.

• **Flight lead/IP anticipation.** Know your flight's position and fuel state. Put yourself in their cockpits and anticipate what they are doing before directing a task. For example, don't give an ops check during the last stage of a rejoin, during a turn at low altitude, or as the attack/engagement is executed. Have a game plan ready for IFEs, blind wingmen, rejoins, obtaining ATC clearances, weather, and backup missions.

• **Communications.** Check-ins usually indicate the SA of the flight—the initial check-in sets the tone for the entire mission. Anticipating radio changes and using clear, concise 3-1 comm will assist in missing critical information. A formation should work as a team in accordance with the briefing. Don't hesitate to call out a dangerous situation or conflict—traffic, terrain, towers, noncompliance with training rules or AFIs. Knowing the correct radio to use is crucial to mission success and safety. Think before transmitting, and avoid "zipper" comm.

• **Cross-checks.** At low altitude, check near rocks and far rocks prior to accomplishing any other task. Using the autopilot, the HUD, and HOTAS (Hands On Stick And Throttle) can reduce "helmet fires" associated with flying in poor weather or at night. Passing critical flight information to a wingman may reduce spatial disorientation.

Cockpit Resource Management (CRM) is one of those "buzz words" many fighter pilots "blow off." It is what we do every day—staying ahead of the jet by being prepared and anticipating. I, too, have been guilty of disregarding the CRM revolution, but take a look at CRM in a different way and see if it can apply to your cockpit. CRM issues are not new! Every time we strap on a jet we practice some form of CRM learned from experiences—sorties, simulators, the briefing room, and previous mishaps. It takes only one breakdown in SA to teach a lesson. Some examples of learned CRM are forgetting to set up for an approach prior to entering the weather or soaking up a missile due to not arming the flares. Some lessons are not forgiving and result in mishaps. *Prepare and anticipate.* This is CRM in the single-seat world. ✈

Holiday Memory

CAPT JOEL T. ERSKIN
127 BS Flying Safety Officer
Kansas Air National Guard

On 8 December 1997, my friend was reported missing in his light aircraft after not returning home following an Air National Guard exercise. On 15 December, I watched as he was lowered into the earth, and I said goodbye to a true hero.

Dan was simply one of the best people and physicians I ever knew. He loved his family, he served his country, he healed the sick, and he helped the poor. He was no saint, and he made mistakes—one of which killed him—but I never met a man so universally liked and respected. Dan was down-home and easygoing, with a tremendous sense of humor. He treated everyone fairly and with respect, he was truly religious, and he could drink beer with the best of us. He died doing what he loved, and I will truly miss him. But this monologue is not about him. It's about me—and in a very real way, it's about some of you.

I am an Air National Guard bomber pilot and a cardiovascular surgery physician's assistant. I deal in death every day, either by cheating it in the operating room or dealing it from the weapons bay of a B1-B—on some days, both. My call sign is Kevorkian. It seems appropriate.

I received the news about Dan's disappearance early on the morning of 9 December. Being the squadron flying safety officer, I immediately telephoned all the FAA and Air Force safety agencies in the area and the Air Force Safety Center to help in the search. Dan was a traditional guardsman who lived in, and had a private practice in, a small rural town in another state. He'd been in town for drill weekend and an exercise. He had taken off with his brother-in-law in his private plane, in poor weather, the previous afternoon and never arrived home. The search had been hampered by bad weather and darkness the night prior and had resumed that morning in poor weather.

I was in the middle of a conversation with an Army Guard unit coordinating for more search personnel when I received word the aircraft was found and both occupants were dead. I'd talked with his wife about an hour earlier, and we were both in high hopes Dan had been forced down in a field and was using his USAF survival skills (Dan was an F-4 Weapons System Officer prior to attending medical school) and his medical knowledge to keep himself and her brother alive.

The telephone call to inform her of her husband's death was unbelievably agonizing. In 10 years, I had walked out of the operating room, the emergency room, and the intensive care unit dozens of times to inform families of the death of a loved one. I once escorted a husband to the morgue at 3 a.m. to see his wife. I'd felt tremendous pain in my chest every time, but nothing had prepared me for death this close to home. I had, on occasion, cheated death myself in my aircraft. And I'd stared death directly in the face when I "first assisted" on my father's coronary artery bypass surgery (and his subsequent emergency return to surgery in the middle of the night when one of his bypasses began to bleed). But I had won on those occasions. I ultimately didn't take losing well.

That afternoon I learned the details of the accident. The airplane had struck a guy wire on a radio tower, tearing off part of the right wing, and had impacted the ground approximately 300 yards from the tower. Dan was about 30 minutes into his planned 1-hour-and-30-minute flight and approximately 4 miles from the nearest airport when the accident happened. The local sheriff had discovered the wreckage.

The bodies were transported back to our local area as we had the closest aviation medical examiner for FAA needs. The local coroner's office had called the ANG clinic requesting the fingerprints, footprints, and DNA records the military keeps on file for all fliers to use for identification. I'd requested to be the officer responsible for securing Dan's personal effects in his office and for gathering his identification material. I methodically made an inventory of his personal possessions and neatly boxed them to send home. I stuck one pair of his dog tags in my pocket but was later overcome with guilt. His

continued on next page

I was angry with Dan for doing something behind a 3-year-old, a 2-year-old, a 10-mo cursed at him for his negligence and for all force him into a bad decision.

wife and children deserved to have them, and I returned them to the box. It was the right thing to do.

Later that afternoon, I went to the coroner's officer to help identify the body. I didn't recognize my friend of 6 years. The fingerprints matched.

I asked to leave work early that day and headed home. Apparently, I wasn't as stoic as I'd assumed, because later that day, two close friends were dispatched from the squadron to make sure I was okay. It seemed silly to answer the door and assure them I was fine. I even felt a bit resentful. Of course I was okay. Warriors and surgeons are men of steel, and it takes a lot more than death to shake them. After about an hour of reminiscing, I was ever so glad to have these friends.

The next day there was the usual bureaucratic thrash about benefits, authorizations, and whatnot, all of which angered and upset me. I was now the official military escort for Dan's remains. I'd talked with Debbie and assured her I would get Dan home as soon as the remains were released. For 3 days we hashed out details and argued the nonsense. The details were boring and the headaches enormous. Thank goodness for our Mortuary Affairs Officer. She was also a close friend of Dan, and together we suffered through the difficult task of arranging and executing a military escort and funeral. Without her sense of humor and salient performance, a great injustice would have occurred. I am indebted.

The local authorities weren't sure there was enough of the remains to embalm, and we had to discuss with Debbie the possibility of cremation. I was most displeased with this proposition as I would have to transport the remains as a carry-on item. We did, in true medical/military dark humor, laugh at the prospect of me ordering a Scotch from the flight attendant for my friend in the seat next to me and pouring it into the ashes. It was the first time I'd smiled in 4 days, and I know Dan appreciated the humor.

I was angry with Dan for doing something dumb and getting himself killed. He left behind a 3-year-old, a 2-year-old, a 10-month-old, and two teenage stepchildren. I cursed at him for his negligence and for allowing the pressures of work and home to force him into a bad decision. I knew in my heart exactly how he had made the decision to press the weather, and I felt a little sheepish at casting a stone. I was angry with him for putting all of us through this ordeal. I was angry at him for what he had done to his family. I was angry at him for having it all and so carelessly throwing it away. Anger was easy. Grief was unbearable.

Finally the decision came that cremation wouldn't be necessary. Debbie decided she wanted to view Dan's remains as soon as I arrived. I was stunned, and as delicately as possible, I tried to persuade her this wasn't a good idea. But she was adamant. She ultimately needed closure, and this later proved to be best for her.

My family was incredible. They never questioned my duty. We were uncertain whether I would have to miss my 5-year-old's kindergarten Christmas program, depending on when the remains were released. When I explained this to her, she assured me there would be another program next year, and she would have her class say a prayer for my friend Dan and for me. She was ab-

g dumb and getting himself killed. He left onth-old, and two teenage stepchildren. I lowing the pressures of work and home to

solutely beautiful in her program—I left the next morning.

On the morning of 12 December, I arrived at the local mortuary which was handling Dan's remains. As was required by regulation, I examined and approved the preparation of the body and wrappings. I remember looking into the casket at the squared-off olive drab wool blanket and thinking how uncomfortable it would be to take into the afterlife. I joked with the mortician that my friend Dan would be most displeased with our choice of wrappings. It suddenly and forever struck me that Dan looked very short in the casket, and I remembered his legs were crushed to nothingness from the knee down. The image of the short wrappings haunts me.

I assisted in packaging Dan and loading him into the van for transport to the airport. I followed him to the air cargo terminal and supervised the unloading. It broke my heart to leave him alone in the cold, industrial freight terminal, and as soon as I checked in, I returned and draped the American flag over him. I waited 2 hours for our flight there with Dan in the freight terminal. Although I knew the remains were inanimate, this man was my friend, and emotions do play with the mind. I still think it was the right thing to do.

The airline took all day and two stops to get us close to Dan's home. I remember the intense feeling of relief I felt when the airliner took off, at finally being able to take Dan home. I closed my eyes and thought of my wife and children.

We arrived after dark, and I had to chase down Dan's body in the freight terminal again. I had called ahead and specifically stated he was not to be moved until I was physically present. Somehow this didn't get passed on. I ran the gamut of panic and intense anger, alternating between each as I searched. The ticket agent sent me to the freight agent, who sent me to another freight agent, who sent me back to the gate agent, who sent me to the ticket agent. Where Dan went during all this seems to be anyone's guess.

At one point, I laughed out loud as a flashback from *Weekend at Bernie's* popped into my head, and I expected Dan to roll by wearing sunglasses and holding a drink. I don't know if that was medical or flier humor, but it helped. All I could think about was how would I explain that I lost him, and what the hell do I do now!

Thirty minutes after landing, I found Dan in the care of a third-party freight contractor on the far side of the airport. It seems this small airport doesn't handle a lot of "special freight," and the agent was new. That was one of the longest half hours of my life. I placed the flag over my friend and waited for the funeral home to retrieve us. I followed the driver for a little more than an hour and arrived in Dan's rural town around 8:45 p.m.

Debbie waited until the next morning to view Dan's remains. I didn't sleep well, but she handled the viewing extremely well. Her trauma nurse training had somewhat prepared her. I gave her Dan's personal belongings, and she immediately placed his dog tags around her neck and kissed them. She held his flight suit to her face and breathed the life from it. She'd brought a glow-in-the-dark rosary (it seemed fitting for Dan's sense of humor) and a snapshot of Dan's three babies, all soapy

continued on next page

and wet in the tub. She asked if she could place these on Dan's chest against the skin, concerned about disrupting the official military wrappings. We both agreed that what the Air Force didn't know wouldn't hurt, or some expletive to that effect. After Debbie left, we made sure the wrappings looked intact (as if anyone would notice in a sealed casket), draped Dan's flight suit over him per her request, and sealed the remains in the casket. It seemed very final.

I spent the next 2 days making arrangements for Dan's military funeral. The funeral director was excellent and handled the details with ease. She was young, attractive, and vibrant, which struck me as sort of a strange contrast to her chosen profession. But, then again, that may make her amply suited to her job. I still haven't worked that one out in my mind. The priest was cantankerous, forgetful, opinionated, and a really neat guy. I enjoyed working with or for him. I haven't worked that one out either.

Dan lived in a nice little town full of people of good heart. But like in any little town, a stranger promotes gossip. It was difficult to be inconspicuous in uniform, and the looks and whispers as I went about making arrangements made me feel eerily out of place. Everyone I spoke with was pleasant and genuinely bereaved at the loss of Dan, but I think the uniform had an effect. At one point, I was at the cemetery obtaining GPS (global positioning system) coordinates for a flyover, pacing from the grave, looking at approach angles, and scribbling on a pad. I noticed Dan's mother had pulled in her car behind me. I felt like I was somehow desecrating this site. I briefly said hello and quickly left.

It was nice to be busy, for when Sunday came and there was no work left to be done, I experienced a loneliness quite profound and inescapable. This little town, like any other, retreats into itself on the Sabbath, and an occupant of a hotel room has little to do. I attended Mass and went in search of a pub. Dan lived in a dry county, and I'm sure he had a good laugh at my expense while I looked for a brew and a big screen. I settled for a cola and the TV in my hotel room.

At 7 p.m., I attended the rosary for Dan at the mortuary. The scene was resplendent. At the end of a long chapel was the polished metal casket draped with a crisp Stars and Stripes. Flowers and plants surrounded the scene. A large picture of Dan in front of an F-4 and another of him wearing a lab coat and stethoscope flanked to the right. And very small, on a tiny pedestal right in front, was a snapshot of Dan's babies in the tub, a copy of the one Debbie placed on Dan's chest.

I discretely positioned myself in the far corner of the chapel, near the casket, and held a relaxed parade rest. I was doing a good job with maintaining the stiff upper lip and all that despite numerous emotional family members and friends speaking with me about Dan. The previous 6 days had numbed me (or so I thought), and I was approaching this with the same disposition as I had when discussing a CABG (coronary artery bypass graft) gone bad or an ICU death. I was, of course, genuinely concerned but not emotional, and I liked that feeling of self-control.

All went well until right at the end. Dan's niece was the last to leave, and as she was passing she hugged me and said, "I am so glad you were here to protect him." I hugged her firmly and gave her my best reassuring smile. I'm very happy she was the last one in the chapel. I walked with rather weak limbs and slightly blurred vision through the empty chapel to the side of Dan's casket and knelt. I whispered "You're welcome. Goodbye, my friend."

Monday, 15 December, was a blur of activity. The military did an outstanding job with the funeral. There were salutes and a promotion and a medal. Debbie was thrilled. We took Dan from the church to the cemetery, and the Color Guard marched him to the graveside. The priest gave a eulogy, and the Honor Guard presented the flag to Debbie. A rifle volley was loosed and taps played. Debbie stepped from under the tent, clutched the flag, and looked up into the sun, her face radiant and beautiful. She watched as one of our bombers passed quietly, low overhead, pulled off loud, and climbed into the distance. She hugged me, smiled, and simply said, "Thank you." I smiled at her and said, "It was my honor and privilege to bring Dan home to you," and I asked her permission to go home.

I drove the hour and a half back to the airport and boarded the plane. The moment we started to climb away from the runway, I slept and did so alone in the

dark of the back cabin until we landed. I drove from the airport to my home. I kissed my sleeping children and held my wife closely. I think I wept.

Postscript

From 25 to 35 aircrew members lose their lives in aircraft mishaps in a given year. The effects of these deaths often create a great deal of turmoil and grab the attention of the aviator, to the exclusion of flying.

The hours and days immediately following a loss are filled with anxiety and questioning which can affect performance. The doubts and fears of these military members can be so severe they spend their time thinking about the mishap rather than concentrating on the job at hand. Consequently, mistakes can be made, and another mishap could be in the making.

It is important, when faced with a loss, aircrew members understand the grieving process. The grieving process is present whether the crew survives or is lost. (See the sidebar "What Do We Do Now?") ✈

"WHAT DO WE DO NOW?"*

LT COL (DR.) JOYCE TETERS
Chief Aviation Psychologist
Alaska ANG

Anger. The primary feeling expressed in public by aviators following a mishap is anger toward the incident and, at times, the aviators involved. Crewmembers are able to express this feeling more readily than hurt or disbelief.

Spouses and outsiders usually do not understand this anger and are often taken aback when they try to discuss the loss or express their condolences to crewmembers. Sometimes the aviator seems to be angry about everything and everybody. In the aftermath, it will seem to spouses and coworkers they can do nothing right.

Inappropriate Comments. In the squadron environment, crewmembers make jokes about the crash or the situation, which is disturbing to outsiders. It is as if aviators cannot allow feelings of hurt which accompany the loss of someone close to them. Rather, they hide these feelings from others by smart remarks and insensitive comments.

Rationalization. The loss of a crewmember is often the fliers' first confrontation with their own mortality, and it can be frightening. Rather than acknowledge this fear, aviators disavow it by stating "they could just as easily get killed crossing the street." This allows aviators to rationalize the possibility of their own death as they attempt to explain the mishap to their families.

Uncertainty. Young fliers who have never been through the loss of a fellow squadron member do not know how to deal with their feelings or how to interact with the grieving spouse. Often young aviators are not married and, therefore, have no one to talk to about the tragedy. Consequently, they tend to talk to other inexperienced fliers who also have little to offer. Many times this uncertainty leads to excessive use of alcohol and inappropriate behavior. Squadrons have been torn apart by young, inexperienced aviators who confront their own mortality alone.

Sorrow. Spouses also grieve for the lost aviator as friends. However, more immediate is the realization of the lost friendships when the family moves away from the flying and military communities.

If the military member was stationed overseas, the family departs the area quickly to attend funeral services in the CONUS. Often the family remains in the States or returns to the overseas location for only a short period while preparing household goods for shipment or to wrap up personal business. Even if the family is in CONUS, they will need to make some decisions about their future plans. Usually these plans don't include staying in the immediate area.

Relief. Following the initial shock and disbelief, families then experience a sense of relief because one of their own was not involved. This is followed almost immediately by feelings of guilt. Individuals often feel it inappropriate to have happy feelings during a time of tragedy. They believe others will not approve of them if they mention they are glad *their* loved one was not involved.

Anxiety/Fear. Following the feelings of guilt, however, the spouse begins to experience anxiety. Maybe next time they won't be so lucky. This anxiety isn't usually talked about. Spouses hope it will simply go away. Sometimes this is the case, but often it is not. If not adequately dealt with, anxiety becomes fear and can result in the spouse saying to the flying member, "I do not want you to fly anymore!"

If everyone can confront the emotional turmoil following the tragedy of an aircraft loss and find appropriate methods of coping, they can then "get on with the business of flying airplanes." ✈

***This sidebar extracted from "What Do We Do Now?" published in its entirety in *Flying Safety* magazine, August 1992.**

How Safe Is Your Anger?

CHAPLAIN (MAJ) THOMAS AZAR
USAFA

Scenario

Mike had never in his life been so angry. He couldn't even focus on his job when he first heard the news. When he deployed for 120 days, the person he replaced had hinted Mike needed to "watch his back." Mike didn't pay much attention until his supervisor from home station called and said there were some serious allegations Mike needed to answer. Mike hung the phone up feeling like someone had punched him—hard—in the stomach. Then, one of Mike's best friends at home station told him several coworkers had approached the commander saying Mike had been handling on- and off-duty matters unprofessionally and improperly.

As bewildered as he was, Mike's first concern was his family. He immediately called his wife, told her about the conversations with his supervisor and friend, and assured her the rumors weren't true. But Mike's wife was very upset. She said, "The rumors are everywhere. I'm even ashamed and embarrassed to go out. You must have done something wrong!"

Mike felt trapped and angry. The persons whom he trusted most refused to believe him and had closed the door in his face. Unable to vent his frustrations and find support, he let his anger get the best of him, lost focus on what he was doing, and drove into an aircraft ground power unit on the flightline.

As a result of the mishap and the ensuing investigation, Mike made sworn statements to his commander through the OSI and legal office. He was exonerated of the allegations at home station, but the damage had been done. Mike's challenge now was to unload all his anger so he could forgive his wife and coworkers and safely perform his job.

Impact on the Mission

Mike was upset, frustrated, exhausted, and depressed all at once. He found it impossible to forget his anger and concentrate on the job. Thousands of miles from home and despondent, cut off from the ones he loved and trusted, he was drowning in a world of pain. Mike told me "it all felt like a fast-spreading wildfire that consumed everything in its path." And it very nearly consumed him.

Anger is one of our strongest emotions. Bottling it up inside makes concentration difficult and often leads to poor decision-making. Anger alienates you from everyone—including those closest to you—and adversely impacts squadron unity. And anger solves *nothing*. The longer it goes unresolved, the more it festers and the greater the emotional turmoil.

Replacing Anger With Forgiveness

The role of chaplains and other caring professionals is to help people express the pain within and replace it with the message of hope. In counseling, I observe a key recurring issue: An unforgiving person freezes himself in the unfortunate past event. Anger creates pain within you and separates you from wholeness. A new dawn will never rise in the heart of an angry person—just resentment and revenge. A desire for "payback" only diminishes your own self-respect and integrity and puts you on the same level as the perpetrator. Carrying destructive feelings like a ball and chain for the rest of your life will take its greatest toll on you and those you love.

Don't blame others for your response. Anger is a choice only you can make. Every religion emphasizes mercy and forgiveness. That's why the Biblical story of the prodigal son is timeless. When repentance is followed by genuine reconciliation, healing replaces anger, and family and friendships are restored.

Our nature and nurture seek justice. Often we learn to deal with conflict from our early life primary caretakers early—parents, relatives, friends, teachers, and various authority figures. We should sustain and further develop a healthy attitude of reconciliation and forgive those who intentionally (or unintentionally) hurt us. As the timeless proverb states, "To err is human, but to forgive is divine."

A good first step in forgiveness is learning to see without prejudice or resentment. Separate the issue from the individual, the sin from the sinner. When someone says or does something that hurts, try to objectively understand "who" did "what" and "why." You can even learn to respect individuals you disagree with by agreeing to disagree.

Remember: Many things can make us angry, and how we deal with this anger can affect unit morale, job safety, and our productivity. The Air Force is full of people with vast differences, and meaningful interaction with them requires great amounts of patience, skill, and forgiveness. Learning how to deal with them and yourself in positive ways benefits everyone—them, you, your family, and the Air Force.

There are many people who care about you and depend on you. If you ever need help resolving conflicting or destructive emotions, please contact your installation chapel staff, family support center, or hospital. We offer a variety of helpful seminars and have resources to help you through troubling times. ✈

Near Blowout at 20K

LT ERIK FRANZEN*
NAS Miramar
San Diego, California

As a student naval aviator going through aviation preflight indoctrination and then the primary stage, I remember constantly being told that if you are not feeling 100 percent, then do not go flying. In fact, I know a few people who took that advice pretty liberally and went med down quite often. I am sure everyone remembers classmates using the old "tac-med down" ploy to avoid flying with a particular instructor or to gain a few extra days to study.

Now that I am in the fleet, I discovered several more ramifications of going med down. Your squadron mates have to pick up the slack, you lose valuable flight time, and you might even get a seat at the "healing desk" (read squadron duty officer) for a couple of days. For those reasons, I used to avoid flight surgeons like the plague. My disdain for flight surgeons (I do not really dislike them—I just hate going med down, and they always seem willing and eager to give out those red chits) has disappeared in light of a recent flight.

We were on a 2-week detachment in support of All-Services Combat Identification Evaluation Team (ASCIET) exercise in Gulfport, Mississippi. Our squadron sent two airplanes, five pilots, seven NFOs, and a small maintenance group. We had been flying for a week and had four aircrew already go med down. I was trying to avoid being the fifth and had been drinking a lot of fluids and getting as much sleep as I could.

I woke up early in the morning to prepare for my flight. I wasn't feeling too well, and I definitely wasn't at 100 percent. Every person in a flight status knows the first question the flight surgeon will ask is "Can you valsalva?" I could still valsalva (barely) and told my Ops O that I was borderline med down. He and I agreed I should have no problems because our plane pressurizes to 5,000 feet. Also, the Ops O told me if my condition worsened I should let him know and he would take the flight. "Yeah, right," I thought. Just one more chance for a "hinge" to steal flight time from a "JO." No way. I knew I could take the flight.

Without another thought of going med down, I preflighted and manned up. The launch and climb to altitude were uneventful, and my body was handling the pressure just fine. Then about an hour into the flight we received a call from the back-end concerning fumes in the forward equipment compartment. We all immediately donned our oxygen masks. I then called Houston Center and asked for clearance to RTB as well as for a descent. Upon hearing of our distress, Center was more than accommodating, and we were soon in a rapid descent and heading back to Gulfport.

The fumes began to dissipate when we isolated and turned off the affected equipment. Continuing through our NATOPS procedures for Smoke and Fume Elimination, we got to the step CABIN PRESSURIZATION DUMP SWITCH—DUMP, and a little voice went off inside my head, "This is gonna hurt!"

I reached up and put the switch to dump. The pressure in the cabin began to climb up through 10,000 feet. I felt some pain as my ear managed to equalize without blowing out my eardrum. Continuing to valsalva throughout the descent to Gulfport, I was able to keep my ears equalized. We landed at Gulfport, and an inspection revealed one of the radar boxes had fried itself causing the smoke and fumes.

After contemplating the series of events, I thought about how much worse the situation could have become. In an emergency situation, there is little time to level off and let your ears equalize. I could have potentially blown out my eardrums and been med down for up to 6 weeks. A sinus injury would have forced my squadronmates to pick up the slack for me, and I would have had plenty of time at the "healing desk."

Moral of the story: Make sure you are 100 percent before climbing into the cockpit. ✈

**Lt Erik Franzen is a carrier aircraft plane commander with the VAW-117 Wallbangers.*

Sunlight Exposure and Preventing Skin Cancer

Aircrew and groundcrew personnel should take precautions against exposure to the ultraviolet rays in sunlight while on flightline areas and during outdoor recreational activity.

Adapted from an article written by Dr. Stanley Mohler*
Courtesy *Flying Safety Spotlight, 1/97*

Annually, personnel at most Australian ADF airfields enjoy a considerable number of sunny days, particularly in the summer months. However, during this time, aircraft crewmembers and ground support staff are at risk of developing skin cancer as a result of time spent on airfield line areas and while outdoors during layovers (outdoor recreational activity, etc.), both of which can expose personnel to excessive amounts of ultraviolet (UV) rays.

The major cause of skin cancer is excessive exposure to UV light rays. Sunlight is the major day-to-day source of UV light, and a certain amount is beneficial. (The body produces vitamin D in response to exposure to sunlight.) But overexposure to sunlight, and particularly a severe sunburn, can significantly increase skin cancer risk. Excessive exposure in suntanning parlors should be avoided.

The extent of exposure to UV rays in sunlight is influenced by elevation, latitude, and cloud cover. UV-ray penetration is greater at higher elevations because the thinner atmosphere offers less filtering. The sun's rays are stronger and more direct closer to the equator. Crews flying to destinations with a combination of tropical or desert climate and high altitude should be especially cautious. Cloud cover blocks some UV rays, however, and areas with frequent cloud cover may have a UV-ray level that's 50 percent lower than areas that are generally sunny.

The portion of the electromagnetic energy light spectrum that is visible to humans is between the wavelengths of 380 nanometers (nm) to 760 nm (a nanometer is 1 millionth of a millimeter). At the end of the low-frequency portion of the light spectrum is the UV range (400 nm to 180 nm). The human retina does not detect light rays in this range, and it is defined, therefore, as invisible light. Nevertheless, UV rays are absorbed by human tissues and produce damage to cell genetic structures.

The beginning of the UV spectrum is arbitrarily divided into the UVA range (320 nm to 400 nm) and the UVB range (290 nm to 320 nm), with subsequent wavelengths becoming shorter and shorter. At the extreme low end of the electromagnetic spectrum are X-rays, which are so short that some of them can pass through human-body

tissues without being absorbed.

Skin cancer should not be feared excessively, but symptoms of a developing skin cancer must not be disregarded. Any unusual skin change, especially on the face, neck, shoulders, and arms, should be examined by a medical officer.

The growth of cancer cells in the body leads to the death of normal tissue. Each cell of the body contains a genetic code that tells the cell when to divide and when not to divide. A cancer cell is a formerly normal cell that has lost its genetic code. The marauding cancer cells produce their own death when they bring down the host within whom the cells originated. All types of skin cancer are serious, but the least serious (though not to be ignored) is basal-cell carcinoma, the most common of all types of cancers. The next most serious type of skin cancer is squamous-cell carcinoma, and the most deadly is the type known as melanoma, or malignant melanoma.

No one knows exactly how many skin cancers occur each year. In the United States, the American Academy of Dermatology (AAD) estimates that about 750,000 persons will develop basal-cell carcinoma. Few of these will die of the cancer because of its very slow growth rate and often successful treatment. The AAD estimates that squamous-cell skin cancers claim about 2,300 lives each year and that 6,800 lives are claimed by melanoma.

Risk Higher Than Ever

The risk of melanoma has increased dramatically in recent decades. In the United States, there is a 1-in-87 chance of developing melanoma during one's life, an increase of 1,800 percent since 1930. Melanoma is the most frequent type of cancer among U.S. women aged 25 to 29 and the second most frequent among women aged 30 to 34.

Many other countries, including Australia, Austria, Canada, Germany, Italy, and Scotland have also experienced a rising rate of melanoma, according to the AAD. It has been suggested that depletion of the ozone in the stratosphere, which is a natural filter against UV rays, is responsible for the rise in the incidence of melanoma.

The top layer of the skin, called the epidermis, is thinnest in non-weight-bearing areas, thicker on the soles of the feet, and thickest where repeated pressure causes calluses, e.g., on the palms. Squamous cells are cells close to the surface. Basal cells are deeper beneath the surface.

Pigment is produced near the basal cells, and pigment production increases as the skin absorbs UV rays. As squamous cells multiply, they are pushed toward the skin surface, flattening as they move outward. These cells ultimately die and become the dense, toughened outer skin layer.

The basal layer of the skin contains column-shaped cells that form the supporting foundation for the epidermis. The basal cells in fair-skinned persons are especially susceptible to genetic damage as a result of UV-ray exposure. When a cell's genetic material is changed, the cell may begin to divide in an ungoverned way.

Randomly and rapidly dividing cells are the beginning of basal-cell carcinoma, the most common form of skin cancer. They form a growing cluster that presses on nearby normal cells, disrupts the distribution of nutrients to the normal cells, and leads ultimately to their death. As the basal cells continue to multiply, they outgrow their blood supply, and some begin to die.

Basal-cell carcinoma usually starts as a small growth of cells about 1 millimeter to 2 millimeters across on the surface of the skin that may have a tiny cluster of capillaries at the center. Gradually, the cells in the center die and slough away, and the ring of growing cancer cells slowly becomes larger. The tissue may take on a slight pink color. Various types of superficial (skin-surface) treatment can eradicate the cancerous growth at this stage.

Squamous-cell carcinoma is a slow-growing type of cancer that can spread to other parts of the body if cancerous cells enter the bloodstream. This type of cancer is very dangerous, and it can appear initially as a small cluster of cells that forms a lesion, or sore, that does not heal.

The amount of pigment in an individual's skin is determined by heredity. The pigment protects against solar UV rays, and, accordingly, populations that have lived for many generations near the equator tend to have darker skins than those with a polar ancestry.

Melanoma cells contain melanin, a dark brown-to-black pigment. Melanoma cells can stimulate growth in nearby capillaries, thereby bringing nourishment to the cancer cells. This ability to obtain nourishment, along with other attributes involving immunologic factors, leads to very rapidly spreading melanoma cancers.

Avoidance of excessive UV-ray exposure, especially by those who are at higher risk for developing skin cancer, is a primary preventive measure. Individuals with a genetically higher risk include those with very fair skin; those with blond or red hair; those with blue, hazel, or other light-colored eyes; and those whose fathers and mothers have shown a susceptibility to skin cancer.

Protective measures include wearing a broad-brimmed hat during daylight and using a solar-protective cream that has a sun-protection factor (SPF) rating of 15 or higher. The AAD and the U.S.-based Skin Cancer Foundation recommend that sunscreen be reapplied

continued on next page

every 2 hours, even on cloudy days, and after swimming or perspiring. It's particularly important to avoid unprotected exposure to sunlight during the most intense period of sunshine, between 10 a.m. and 3 p.m.

Suntan Will Not Prevent Cancer

Tanning is the skin's natural response to exposure to UVA rays, but it doesn't prevent skin cancer. UVA rays are used in suntanning parlors because they trigger the deposition of melanin, but a tan produced by exposure to UVA rays offers skin protection only at the SPF-3 level.

UVA-ray exposure produces direct skin damage, and there is an underlying connective-tissue response to this injury that produces a thickening of the collagen in the skin. Collagen is the fibrous "mat" that gives toughness and resilience to the skin.

Fair-skinned people who spend a lot of unprotected time in the sun, such as farmers, sunbathers, and those who frequent tanning parlors, tend to have tough, wrinkled, parchment-like skin by the time they reach middle-age. This thickened skin is a product of the body's attempt to repair its repeated injuries. Exposure to UVA rays can also promote the conversion of normal cells into cancer cells.

UVB rays penetrate the skin more deeply than UVA rays and destroy bonds in the genetic makeup of underlying skin cells. This type of cell damage can trigger the conversion of a normal cell into a cancer cell. Exposure to UVB rays causes sunburn, "actinic keratoses" (the overgrowth of thickened, dead skin cells that form small "blotches" a few millimeters in diameter that fail to heal), and skin cancer. Sunscreens provide protection from both UVA rays and UVB rays.

Other Risk Factors

There is epidemiological evidence that exposure to certain petroleum products, coal tar distillation products, and/or arsenic dust can facilitate or cause skin cancer. Workers in industries where exposures to these substances can occur are at risk of developing skin cancer.

Repairing the Damage

When signs of skin damage appear—for example, a small actinic keratosis—steps can be taken to stop further growth. Dermatologists can apply liquid nitrogen as a spray or as a tiny "dab" to the actinic keratosis. In addition, if there are multiple such lesions, 5-fluoro-uracil (5-F-U) can be applied in a schedule guided by a dermatologist. This eliminates all overt lesions and early lesions that are not yet visible. This procedure causes the affected area to turn bright red and develop an itching sensation, but the procedure is successful in almost every case to eliminate the lesions and prevent the skin cancer from spreading.

Suspicious-looking lesions should be surgically removed before they have time to become more advanced forms of skin cancer. All moles, especially those that are blue-black and slightly raised, should be removed. A newly discovered, localized basal-cell carcinoma, squamous-cell carcinoma, or melanoma should be promptly removed.

Surgical removal of skin cancer often involves a procedure in which the edges of the area surrounding the newly removed cancer are sampled and sent to a laboratory for immediate evaluation and report to the surgeon. If cancer cells remain in these unclosed edges, the process is repeated, and more skin is removed until the edges are found to be free of cancer cells. The skin edges are then pulled together and sewn with material that is absorbed by the body during the following weeks, leaving very little scarring or other evidence of the surgery.

Followup Treatment May Be Necessary

If squamous-cell carcinoma or melanoma has spread to nearby tissues or to lymph tissues, more complicated followup treatment is necessary.

If recurrence develops after primary treatment of cancer, followup treatment can consist of further surgery at the margins of the original surgery. This may involve dissection and removal of tissues or lymph nodes into which cancer has spread. (Lymph nodes are part of the lymphatic system, a network of fluid containing white blood cells that drains blood vessels of waste products.)

Further measures can be applied if, after primary and secondary treatment, there is evidence that cancer still exists in the cells. These measures include radiation therapy (X-rays) and administration of anti-cancer drugs and/or advanced immunologic techniques, some of which are still under development.

Usually, skin cancer is readily visible on the skin, and almost all skin cancer can be successfully treated before it begins to spread. Medical examination should be sought at the first sign of skin changes that are consistent with early forms of skin cancer. Early treatment (removal by surgery or other means) of skin cancer can almost always bring about a complete cure. ✈

**About the author: Stanley Mohler, M.D., is a professor and vice chairman at Wright State University School of Medicine in Dayton, Ohio. He is director of aerospace medicine at the university.*

Mohler, an airline transport pilot and certified flight instructor, was director of the U.S. Federal Aviation Agency's Civil Aviation Medicine Research Institute (now the Civil Aeromedical Institute) for 5 years and chief of the Aeromedical Applications Division for 13 years.

Article courtesy U.S. Flight Safety Foundation
Human Factors and Aviation Medicine.

Fatigue in Air Operations

(Guantanamo Bay, Cuba, 1993) The DC-8 freighter collided with terrain approximately one-quarter mile from the approach end of the runway after the captain lost control of the airplane. The flightcrew had experienced a disruption of circadian rhythms and sleep loss. They had been on duty about 18 hours and had flown approximately 9 hours…[the] captain initiated a turn from base leg to final at airspeed below calculated Vref of 147 knots…he allowed bank angles in excess of 50 degrees to develop. There was no evidence to indicate that the captain attempted to take proper corrective action at the onset of stick shaker. Probable cause: The impaired judgment, decision-making, and flying abilities of the captain and flightcrew were due to the effects of fatigue.

MAJ C. R. SHELLEY
Department of Military Psychology and Leadership
Royal Military College of Canada

Official USAF Photo

Introduction

The insidious effects of fatigue almost killed the three-man crew of that DC-8 freighter; they survived, albeit with serious injuries. Fatigue can be a problem in any high-tempo air operation, whether in war or peace, and can set us up for a fatigue-related accident. Long duty days, operational pressures, irregular hours, flying across time zones, and poor quality sleep all contribute to [excessive] levels of individual fatigue which can compromise flight safety and operational effectiveness.

In Part 1, this article will look at fatigue—what it is and how it affects the human being in air operations. Part 2 will look at how to fight fatigue—how fatigue interacts with sleep and circadian rhythms and what this all means for performance and safety.

Part 1—Fatigue

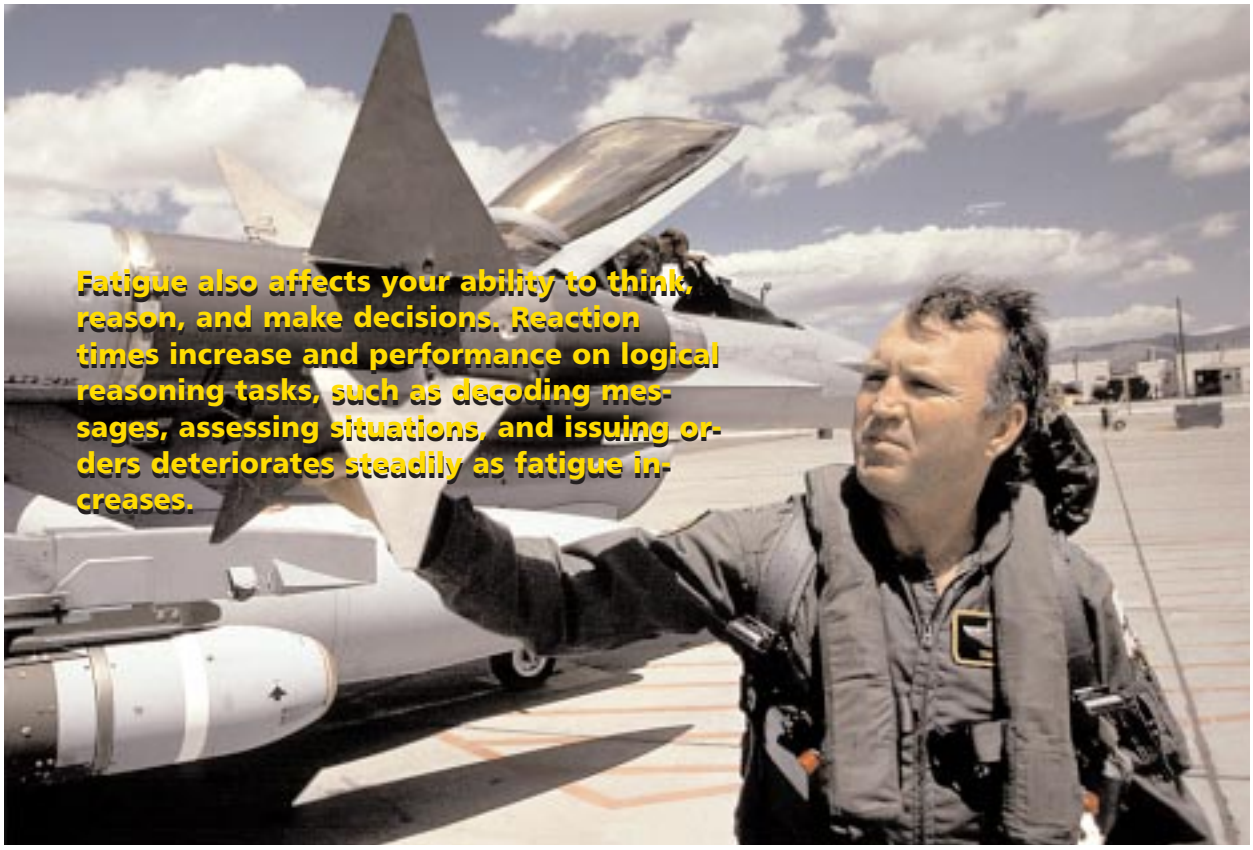
Fatigue has many faces. Everyone is familiar with tired and aching muscles, exhaustion, and the difficulty of completing that fiftieth pushup! That is **physical fatigue**, a sense of muscular tiredness caused by exertion which results in a decrease in physical performance. It is related to an accumulated oxygen debt and the buildup of lactic acid in the muscles.

General fatigue is that sense of weariness or boredom that develops after the repeated performance of monotonous tasks. Monotony can bring on feelings of drowsiness and sleepiness within minutes. Monotonous activities, such as flying on autopilot on a long overwater leg, are likely to bring on general fatigue. The good news is that general fatigue can be shaken off when a demand is made on the individual. For example, when an engine quits, you suddenly become wide awake! (Too bad you missed the dropping oil pressure for the previous 15 minutes.)

Lastly, there is **phasic fatigue**—a short-term fatigue felt as a result of prolonged vigilant activity such as flying on instruments, monitoring a radar screen, or installing a particularly finicky part on an aircraft. Why do you feel so drained after a 2-hour instrument checkride? Why is an instructor "beat" after a trip with a student? The instructor may have touched the stick only once or twice the whole trip, yet the requirement to monitor everything that went on and be ready to jump in and take control extracts a mental toll which results in fatigue.

The total fatigue felt by an individual is a combination

continued on next page



of physical, general, and phasic fatigue. The way people perceive their fatigue differs widely from one individual to another and, indeed, from one situation to another. Psychological factors such as motivation, mood, the novelty of the situation, and your attitude toward the task can all affect how "tired" you feel. This is a benefit because we can sometimes "wake up" and respond to an unforeseen demand when required, but it can also be dangerous because individuals are often poor judges of just how fatigued they really are.

Consequences of Fatigue

Several things happen when you become fatigued. The perception of exertion increases. If you are loading boxes onto a truck, the fiftieth box seems to be a lot heavier than the first. This is not only because your muscles are getting exhausted, but also because the task is boring and repetitive. Willingness to exert effort also diminishes. Given a choice, fatigued people will do less than others. They tend to accept greater risk in return for savings in time or effort. Tired technicians may not follow the [technical orders]…for a repair in favor of a "shortcut" perceived to hasten a repair and lessen their workload.

Cockpit studies have shown several fatigue effects. As pilots become more fatigued, they allow larger deviations to occur before making a correction, and their corrections are larger. Tired pilots tend to concentrate more on primary flight instruments and pay less attention to others on the periphery of their visual scan. Checks may be abbreviated—or skipped altogether. Errors of omission occur more frequently, and nonflying crewmembers may fall asleep due to lack of stimulation.

Fatigue also affects your ability to think, reason, and make decisions. Reaction times increase and performance on logical reasoning tasks, such as decoding messages, assessing situations, and issuing orders deteriorates steadily as fatigue increases. Those most affected will be those whose jobs require a high degree of alertness and swift reaction (i.e., those who have demanding mental requirements for making decisions and organizing activities…such as supervisors and commanders at all levels). Simple, well-learned tasks (such as firing a weapon) are least affected by fatigue. The insidious thing about fatigue is that self-assessment of abilities in a fatigued state can be very unreliable. Although you may feel fine and capable of handling the mission, in reality, fatigue has made you much less capable.

Part 2—Fighting Fatigue

You have probably heard the old saying, "A change is as good as a rest." For certain types of fatigue, this is true. General fatigue—and to some extent phasic fatigue—can be alleviated by taking a break, engaging in some light physical activity, or simply by doing something different for a while. [For example,] duties can be scheduled during long flights to break periods of monotony.

There is only one proven antidote for fatigue: sleep. Young adults require 7 to 9 hours of sleep per night; older ones 6 to 8. Failure to get this amount results in a "sleep debt" that accumulates to where it is the same as if you had missed a night's sleep. The only way to repay this debt is to get your head down and get a good night's sleep. Failing that, getting almost any sleep is good and

helps restore you. If we were half as smart as cats, we too would sleep whenever the opportunity presented itself. But naps alone will not return your normal level of performance; rather, they will only arrest your decline for a while. It takes a minimum of 4 to 5 hours of sleep to restore minimum performance. Eight hours is ideal.

Yet, sleep is a funny thing. Although you can have a sleep debt, you cannot "bank" extra sleep (i.e., 12 hours sleep one night won't let you get away with 4 hours the next). Also, "when" you sleep is almost as important as "how much" sleep you get. That is due to the body's circadian rhythm. This is the natural daily cycle of increasing and decreasing alertness which mirrors the body's increasing and decreasing core temperature.

The body's temperature rises from about 0800 hours until 1700 hours and then decreases until about 0200 hours. Generally, our mental performance mirrors the circadian rhythm; that is to say, our performance increases during the day (rapidly in the morning) as our body temperature increases and then falls off during the evening. A period called the "circadian trough" occurs from 0230 hours until 0600 hours, when the body's temperature is at its lowest and our mental performance is at its worst. We naturally want to sleep during the period of falling body temperature, and this is also when sleep does us the most good. A 2-hour nap taken from 0200 to 0400 hours is much more restorative than a nap taken from 1000 to 1200 hours.

Significant problems happen when we run counter to our body's circadian rhythm by working at night or by flying across time zones (jet lag). Both activities can affect the quality and quantity of sleep, and both contribute to fatigue. The body adjusts to a new time zone at the rate of 1 to 1.5 hours per day, and it will take three nights to restore normal sleep after a westbound flight and up to 7 days after an eastbound flight crossing several time zones. Until adjustment occurs, it is difficult to get full value from sleep.

Changing from day to night operations also presents a problem, as it takes up to 12 days to adjust circadian rhythms to a night shift. As it usually is not practical to make a full adjustment, more often a rapidly rotating shift schedule is used; and the effects of being "out of phase" are simply accepted. Daytime sleep presents problems for some people no matter how good the sleeping accommodations are, and most day sleepers average 2 hours less sleep per day than night sleepers. In a field location, when 24-hour flying operations are in progress, quality and quantity of day sleep is probably pretty low, and fatigue levels increase.

Safety

How do we manage the fatigue risk? Everyone in air operations has a responsibility to ensure they and their buddies are alert and fit for duty. Each air group has orders detailing the length of crew days, daily flying times, and accumulated duty and flying times over specified periods for different types of aircraft and missions. Observe them! Authority to exceed these limits is retained at high levels to ensure that the increased risk is justified by the operational necessity.

On an individual level, getting a sufficient quantity of good quality sleep is a must. Without it, you can expect your performance to drop; so get someone to doublecheck your work. Remember that you are a poor judge of your own abilities when you are fatigued, so watch your buddies for signs of fatigue; and get them to watch you. If your lack of sleep presents a hazard to the mission, admit it or at least accept it if someone else points it out to you. Don't make matters worse by going to excess with alcohol, coffee, or drugs of any description.

For supervisors, the old adage of knowing your people was never more true. Watch your people for deviations in performance that might indicate fatigue. Be aware of their schedules and what is going on in their lives that might be causing a fatigue-related problem. Represent your people to higher authority when necessary to ensure that sufficient rest is provided during continuous operations. Last, know when to take a break yourself! Studies show consistently that leaders are the ones who need sleep the most but are the least likely to get it.

For units, review establishments, orders, and operating procedures to ensure that they provide for sufficient people to do the job and that scheduling permits adequate rest even in periods of high-tempo operations. Think about how things are done: Is everyone awakened at 0600 hours in the field, regardless of whether they are needed or not? Can crews eat when it is convenient for flying operations, or do they have to choose between sleep or food? If so, it is time to rethink the situation.

Conclusion

Fatigue is a problem that must be managed effectively for safe air operations. Fatigue is insidious in that personnel may not realize that their performance has fallen off. While some fatigue can be countered by a change of activity or some mild stimulation, serious fatigue can only be solved by getting good quality sleep. Countering fatigue-related problems is everyone's business, from the individual to the highest headquarters. Sound sleep management practices can make air operations safer. So know them and practice them in your unit, because failure to stay on top of fatigue can bring you that much closer to an accident that nobody wants. ✈

Editor's Note: Although the author focuses primarily on how fatigue may adversely impact personnel in the operations community, commanders and supervisors of personnel in all career fields—logistics, support, medical, and communications—must ensure a balance between work and rest requirements. Fatigue in wrench-benders, security forces, or emergency room personnel can be just as harmful to the mission.

Courtesy *The Combat Edge,* Mar 98

—from the files of the United States National Transportation Safety Board

Reprinted with permission from *Flight Comment,* No. 1, 1997

Maintenan

With a Na

That Rundown Feeling

ADCS (AW/SW) VAL CALDERON
Courtesy *Mech*, Jan-Mar 98

It was one of those pleasant Southern California evenings in mid-April: 52 degrees, a slight breeze, and a moonlit sky. A perfect night to spend under a warm blanket, dreaming about the past weekend.

Suddenly, the dream was shattered by the noise of jet engines, and reality stepped in. "Just one more aircraft to recover and I'll be done. Where is that last bird anyway? I think I'll just lie down until it gets on deck. I can't wait to get back to the shop and take a nap. Mmmmm, this feels good… ZZZZZZZZZZZZZZZ…Huh, what? What the…?!? Ouch! Ouch!!!" The dream had become a nightmare. A tired plane captain, assigned to check for hot brakes, had fallen asleep on the taxiway waiting for an airplane.

He hadn't told anyone he was too tired to work. Instead, he lay down on the centerline of the taxiway and was asleep within 5 minutes.

As the pilot taxied to the hot brake area, his attention was diverted from the taxiway because he didn't see the usual illuminated taxi wands where the brake checker normally stands. He scanned the hangar, fuel pits, and each side of the taxiway looking for the brake checker.

As he got closer to the fuel pits, another squadron aircraft that was refueling further distracted the pilot's attention. He expected the brake checker to emerge from the pits; consequently, he never saw the brake checker lying in the taxiway, even though his taxi light was on.

The brake checker didn't wake up until the nose wheels hit him and dragged him down the taxiway. The nose tires didn't roll over him, but they pushed him along the taxiway and destroyed his left knee. Finally, after being dragged 30 feet, he freed himself from the nose tires…Twenty minutes passed before he could get someone's attention in the fuel pits because of the noise of turning aircraft and the darkness. When the pit crew finally found him, they told maintenance control, who called an ambulance.

The plane captain will probably be partially disabled, but at least he's alive.

Pilots describe flying as "hours of sheer boredom punctuated by moments of stark terror"; that also describes working on the line.

You owe it to yourself to be alert and use good judgment.

Maintenance Marathon

AT1(AW) STEVEN M. WHITTEN
Courtesy *Mech*, Jul-Sep 97

Our detachment's SH-2F Seasprite had a combining-gearbox chip light on startup. We cleaned the chip detectors and gave the aircrew a green light to try again. After several additional attempts with the same results, we decided to change the gearbox, which, on this helicopter, is a major maintenance effort.

We got all the required parts and hardware within 4 hours. The MO (maintenance officer) asked us to estimate how long the job would take and we replied 8 hours if all went well. The MO then told the ship's CO (commanding officer) that the bird would be up in 8 hours. Unfortunately, everything that could go wrong did go wrong.

ce Matters

wal slant

Four sleepless days and nights later, the crew leader told the MO that the gearbox had been installed and was being serviced. The MO wanted a preflight in 1 hour. The exhausted crew rushed the final QA inspection, daily, and turn-around. They moved the aircraft on deck, re-stowed maintenance gear, and prepared it for the FCF.

The aircrew had gotten their rest, but we maintainers were fried. We'd had little sleep in 96 hours and had to do a fast series of inspections and hurried maintenance. What were the odds of an overtired inspector missing a critical torque or a plane captain missing FOD on the transmission deck? Would you bet on those odds? This MO did.

After-the-fact observation: Our long, tiring race to finish this job could have hurt someone. The fact we lived to tell about it is not a testament to skill. The pressure in this scenario should never have happened. We weren't involved in a shoot-or-die situation.

Lesson learned: Maintenance crew rest is *just as important* as aircrew rest.

Attitude for Injury

Ltjg KEVIN M. QUARDERER
Courtesy *Mech*, Jan-Mar 98

We are sometimes tasked to do unfamiliar jobs, and we don't always take the time to get familiar with them. Many people get hurt because of it. This was the case around 2200 one night when maintenance control told an AOAN (Aviation Ordnance, Airman (E-3)) to help hang an air-refueling store (ARS) on an S-3B Viking for the next day's tanking mission.

The AOAN went to the aircraft and started cranking on the ARS cradle handle, which is used to hang the ARS. Halfway up, the handle had slipped and nailed him just above the left eyebrow. He immediately reported to the SDO, who had someone take the AOAN to Acute Care at sick bay where he got two stitches on his left eyebrow.

Post-mishap investigation of the ARS cradle handle revealed that the setscrew, which is supposed to prevent the crank handle from slipping, was missing. We learned that the setscrew had broken off long ago and had never been replaced. We also discovered seven of eight setscrews on three other ARS cradle handles in the squadron were either missing or stripped.

A supervisor knew that these were accidents waiting to happen, yet shop personnel had been using the cranks without the setscrews. To keep the handle from slipping out, people kept one hand pressed against the side of the crank and turned it with the other hand.

The investigation also identified a FOD hazard. ARS cradles are used on the flight deck during operations. Setscrews are small enough to be missed during FOD walkdown, but big enough to damage aircraft engines if ingested.

We learned two lessons: First, better tool control could have prevented this injury. If a tool or a piece of equipment is missing setscrews, treat it as a broken tool. And second, a this-is-the-way-we've-been-doing-it attitude can cause accidents. ✈

The Return of the Hot Ice Picks

Next, I was treated to the uncomfortable feeling of needles pushing on my sinuses from the inside out.

LT CHRIS BERGEN
Courtesy *Approach*, Mar 98

When I first started flying in VT-10, I read an *Approach* article about the "hot ice picks" that were described by veteran fliers who suffered the dreaded sinus block or sinus blowout. Of course, that wouldn't happen to me. I had always been careful to recognize when I wasn't medically fit to fly. If I developed any sort of congestion, I would see the flight doc, get some medication if needed, rest up, and ride out the cold. Somewhere between VT-10 and the fleet my decision process broke down in a big way.

The boat headed out for a 6-week adventure that promised lots of flying. I wasn't slated to fly aboard because I was recovering from a bad head cold. I was feeling better a day or two before cyclic operations were to start, so I figured I would see the doc on the first fly day for an up chit. I was itching to get back into the jet.

After being med down with a cold for more than a week and preparing for the detachment, it had been almost 2 weeks since my last flight, and I didn't want to lose any more traps.

The doc did the usual poking, prodding, and asked, "Can you valsalva?" then he gave me the up chit.

"If I can valsalva, and the doc says I'm good to go, who am I to question a medical expert?" I figured.

Our crew briefed, preflighted, and manned up. It was a little chilly on the flight deck, and my nose was running.

"Just the cold air," I told myself.

We climbed to FL 180 and proceeded with the mission. Approximately 30 minutes before we had to return overhead the ship, ECMO 3 noticed a ship to our left. Not wanting to waste a training opportunity, we decided to descend and investigate.

On the descent, the pilot pulled the power back to idle while we were at about 15,000 feet. For some reason, the cockpit depressurized, going from the normal 8,000 feet to 15,000 feet (our present altitude). With a slight application of power, the cockpit repressurized to the normal 8,000 feet. However, my sinuses decided enough was enough. In the time it took to repressurize the cockpit (it felt like forever), my head felt like a balloon was inflating behind my eyes. Next, I was treated to the uncomfortable feeling of needles pushing on my sinuses from the inside out. I immediately called over the ICS to level off, but the problem was the repressurizing cockpit, not our descent. After the cockpit repressurized to 8,000 feet, no amount of rubbing my eyes and nose or squirting Afrin® (which I kept in my SV-2) seemed to relieve the dull pain and throbbing inside my head.

The return overhead was normal. The pilot began a shallow descent through 8,000 feet to our holding altitude of 4,000 feet. The rest of the flight was uneventful. The mission commander (also the ops officer) noted that I probably shouldn't fly that night since I had taken Afrin®. The pain in my head told me that it might be a little longer than he thought.

The flight surgeon was a little surprised to see me again, and after explaining the situation, he ordered X-rays taken. I'm not a doctor and the X-ray technician wasn't either, but it didn't take a rocket scientist to see the clots of blood that littered my sinus cavities. The real shock came when the flight surgeon told me to come back in 2 weeks for more X-rays. I was med down again.

Two weeks dragged by as I stood duty after duty, watching my squadronmates bag traps. More X-rays showed the clots clearing. "Come back next week, and we'll see how they look then," said the flight surgeon.

Nearly a month later, my sinuses had cleared, and I could fly again. Believe it or not, I was lucky. I had suffered a sinus block, not a sinus tear or what is more commonly known as a blowout. My sinus-cavity lining filled with blood like a balloon but didn't burst. A blowout means a 6-month down chit. I was lucky because our crew could stop our descent without any trouble. If we had just begun any sort of nose-low maneuver, or had been at a higher altitude when we lost pressurization and then repressurized, the results could have been much worse.

Was I really okay to fly that day? No, I should have waited until I knew myself that I was good to go. No amount of medical training gives a doctor the ability to know how you are feeling. He has to rely on what you tell him. Just because you can valsalva doesn't mean your sinuses are clear. Your ears may be, but not your sinuses. If your nose is running, it's congestion, not a weather indicator. ✈

☆ U.S. GOVERNMENT PRINTING OFFICE 1998-673-366/43039

1LT JAMES E. "JEB" BUCK
26 OSF
Vogelweh, Germany
Courtesy Air Scoop, Dec 95

I left common sense at home one day during the latter part of winter 1994. I was living near Dayton, Ohio, and was looking forward to a trip home to Florida for several weeks. In addition, I was eager to put some more miles on my new instrument rating.

I called the weather station early in the morning and discovered marginal weather conditions prevailed. A fast-moving cold front, preceded by a squall line, was about 80 miles away. Hail, the size of golf balls, was reported 100 miles away with lightning activity around the squall lines. There was no reported icing, but light icing conditions were forecast.

I debated whether or not to proceed, but **excitement and aggressiveness** from my inexperience **prevailed.** The weather was calm and dry when I took off in my Piper, but in the distance I could see localized showers accompanied by lightning. There was a cloud deck at about 3,000 feet. Reaching my initial altitude, I requested vectoring around the nearby storm cells since I had no weather radar. The controller obliged with clearance to 6,000 feet, so I ascended into the mush.

As I neared Cincinnati, the turbulence became worse, but I told myself it would get better. After attempting to get the controller's attention several times, it became apparent he didn't have much time for me. Rather, he was busy vectoring airliners well clear of the airspace I was in.

Things got worse fast. The turbulence was making me wonder how well my airplane was constructed. The single-engine aircraft was icing up, and I couldn't simply turn around because I didn't know where the weather cells were.

Then several strange events occurred—all in a matter of about 10 seconds. My radios began to crackle and fade. My skin began to tingle from static electricity. All of my hair stood on end. My muscles began to twitch uncontrollably and ache like when I went through physical therapy treatment with electrical stimulation. I knew then that I was an airborne lightning rod. That's when the fireworks began.

As I peered out of my window (the windscreen was iced over), it appeared as though I was flying into a spider web of lightning bolts. This lasted for 1 or 2 seconds, then—whack! Two forks of lightning contacted the left wingtip, sending a discharge through the cabin and providing me with a "finger in the socket" jolt.

I quickly initiated a high rate of descent and told the controller I had been struck by lightning. This immediately got his attention. I began to feel the charging sensation once more, but it stopped as I broke out of the clouds.

After landing safely, I had the plane checked out thoroughly. It was down for several days and, thankfully, only minor repairs were needed.

I, on the other hand, needed **major repairs to my attitude and concept of safe flying.** I had abided by the regulations yet **ignored a crucial element—common sense.**

Aircraft accidents don't usually happen after one mistake. They occur after multiple mistakes and factors that combine to make a deadly situation. My lack of common sense, bad weather, and the lack of ATC support were several strikes against me. Thank God I didn't strike out! ✈

The Ten Commandments of Preventing Heat Injury

1. Thirst is not an adequate indicator of dehydration, so provide adequate water and ensure water breaks are taken every 15 to 20 minutes. Drink to maintain clear urine. Alcohol, coffee, soft drinks, and sports drinks are not good substitutes for water. Do not use salt tablets!

2. Ensure a gradual adjustment to working in the heat. Acclimatization is essential for preventing heat injuries.

3. Schedule work and rest periods each hour. Schedule heavy work for the cooler part of the day (morning or late afternoon) if possible. The body generates more heat when heavy work is being performed.

4. Avoid overexertion. Use mechanical aids whenever possible. Assign tasks between several people to reduce the stress on individuals.

5. Use shaded areas. Temperature in the shade may be 8° to 20°F cooler.

6. Encourage use of sun screens to protect exposed skin.

7. Wear loose-fitting, light-weight, light-colored clothing. Do not layer clothing; more clothing increases the risk of heat injury. Consider the effects of protective equipment when planning and scheduling activities.

8. Know the WBGT (Wet Bulb Globe Temperature) so the heat-stress index (both available through the bioenvironmental engineer) may be monitored. Environmental conditions, such as temperatures above 70°F (80°F at night), direct sunlight, humidity, and exposure to any toxic agents add to heat stress. The wind reduces the risk of heat stress by increasing the evaporation of sweat.

9. Train all personnel to recognize and treat heat injuries, and encourage them to monitor each other for signs of heat stress.

10. Conduct safety meetings to emphasize special heat-spell procedures. Be prepared to provide medical assistance.